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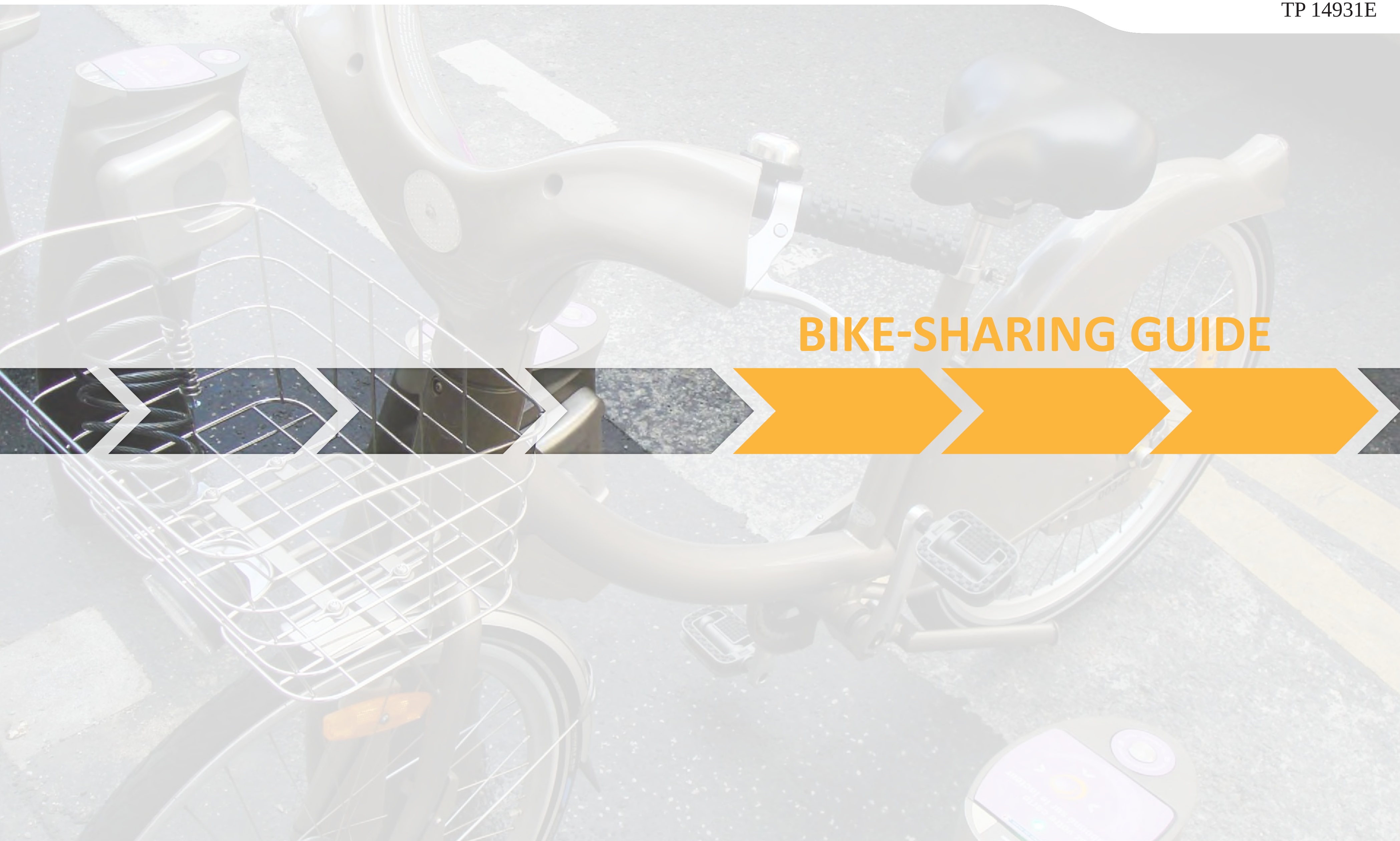

BIKE-SHARING GUIDE

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1 Introduction

1.1 Purpose

This guide is intended to help planners and decision makers determine whether public bicycle sharing is viable in their community and, if so, how to design, implement, and operate a successful system. The material presented in this guide is drawn primarily from recent European experiences, given the absence of relevant North American experience. Canadian communities are generally quite different in terms of land use and transportation patterns from their European counterparts, information from Europe is assessed in terms of relevance to the Canadian context, where appropriate.

The introductory chapter of the guide provides a general overview of bicycle sharing and public bicycle systems. It includes definitions, a brief history of the concept, a summary of the general benefits of increased bicycle use, as well as the specific benefits of public bicycle sharing systems.

The second chapter, Assessing the Potential, provides information to help planners and decision makers determine whether a public bicycle sharing system would be viable in their community. The chapter examines several factors that are believed to influence the demand for public bicycles, such as city size, density, climate, and the bicycle friendliness of the road network, the quality and extent of bicycle facilities, and current levels of bicycle use. The chapter also suggests how to devise a feasibility study to better assess local demand for shared public bicycles.

The third chapter, Hardware and Operations, explains in detail how public bicycle sharing systems work and what kinds of resources they require. Topics covered include the mode of operation (manual or automated), the mode of distribution of bicycles (fixed-station or flexible), station hardware and bicycle design, and required human and capital resources.

The fourth chapter, Financing Your System, examines the startup and ongoing costs and the approaches to financing public bicycle sharing systems. In particular, the public-private partnership model used by most public bicycle systems is examined in detail, a few alternative approaches are also mentioned.

The fifth chapter, Implementing Your System, outlines the steps that can be taken to implement a public bicycle sharing system. Information provided covers the planning and implementation stages, as well as the follow-up and monitoring stages once the system is up and running. Key considerations such as sizing the system, choosing the service area, and determining the distribution of stations, and marketing are also covered.

The final section of the guide contains a set of five illustrative case studies of existing and soon-to-be launched public bicycle systems. The case studies include two existing European systems, including Paris's *Vélib*, illustrating a large fixed-station system; and the *Call-a-Bike* system in Munich, Germany, illustrating a large flexible system. The remaining three case studies look at systems in North America, including Washington DC's modestly sized *SmartBike DC* system, launched in the summer of 2008; Montreal's *BIXI*, launched in the spring of 2009; and Minneapolis's planned *NiceRide* system, to be launched in 2010.

1.2 What is bicycle sharing?

The distinction between bicycle sharing programs and bicycle rentals is similar to that between car sharing programs and car rentals. Shared bicycles are intended for shorter periods of use and a larger number of daily users per bicycle than rentals. Moreover, fees for use are generally very low or use is free. But beyond these basic features, bicycle sharing schemes vary widely in nature.

Bicycle sharing initiatives are divided in two broad categories: private and public systems. Private systems are those operated by a particular institution (public or private), such as a corporation, a university or a park, and are available only to the employees or the clients of that institution. For example, a number of universities have bicycle sharing programs open only to students, faculty, and other staff of the university. Similarly, some large urban parks make bicycles available to visitors for short-term use exclusively within the park's territory. Public systems, in contrast, are those operated by a municipal or local governmental authority (or by a private entity on behalf of a government authority) and, like other forms of public transportation, are open to the public at large. This guide focuses on public bicycle systems, although much of the information presented here can be useful for planning a private bicycle sharing system as well.

1.3 What is a public bicycle system?

A public bicycle system is a bank of bicycles that can be picked up and dropped off at numerous points across an urban area. The bicycles are available to the general public for short-term use for free or for a small fee. The concept has been widely embraced in Europe over the last decade and is generating considerable interest in North America. Recent European experiences suggest that public bicycle systems can act as a door opener for increased bicycle use. Not only are there new bicycle trips made with the public bicycles, but it has also been observed that the use of private bicycles can increase considerably after the introduction of a public bicycle system.

1.4 Why develop public bicycle systems?

Public bicycles offer rapid and flexible mobility for short distance trips. As such, they can be an attractive alternative to public transit and the automobile. For longer distance trips, they can complement rather than replace public transit, creating opportunities for transit-bicycle intermodality. In this regard, they can be especially useful for commuters who can use them to travel between their workplaces or schools and the nearest rapid transit node. Public bicycles can even be attractive to people who are already bicycle commuters. Private bicycles can only be used for return trips; public bicycles can be used for one-way trips.

Given that public bicycle trips can help convert motorized trips to non-motorized trips and, ultimately, increase the mode share of cycling, they can be regarded as a strategy for reducing fossil fuel consumption and emissions of noxious pollutants and greenhouse gases. They can also be regarded as a means for encouraging physical activity among the local population and are therefore consistent with efforts to combat obesity and improve the cardiovascular health of the population.

Public bicycles are worth adding to the mix of transportation options in some but perhaps not all Canadian communities. In Europe, systems have successfully been implemented in communities varying widely in size, urban form, topography, and climate. Some systems have been implemented in cities in which cycling was already a well-established mode of urban transportation, while others have been set up in cities in which cycling was at best a marginal mode. This suggests that public bicycles are a widely applicable urban transportation concept. Still, caution is necessary when drawing on European experiences. European and Canadian cities and towns differ significantly in terms of urban form, land use, transportation infrastructure, climate and so on, all of which have ramifications on bicycle use.

These differences must be considered in the design of public bicycle systems for Canadian communities.

1.5 History of Public Bicycle Systems

The world's first public bicycle initiative is believed to be *Witte Fietsen*, or White Bikes, launched in Amsterdam in 1964. Regular bicycles were painted white and distributed across the city, unlocked and free for anyone to use (DeMaio and Gifford, 2004). The program was created as a measure to reduce bicycle theft. It was believed that wide availability of free, public bicycles would discourage theft of privately owned bicycles. The program failed as virtually all of the bicycles were stolen (or, more accurately, appropriated for private use) not long after the program was launched.

Nearly three decades later, in the early 1990s, the small Danish cities of Farsø, Grenå, and Nakskov pioneered a new approach to managing public bicycles, in attempt to avoid the fate of the White Bikes (DeMaio, 2008). Unlike the bikes used in Amsterdam, these would be custom made and would include many parts that were not interchangeable with regular bicycle parts and would require special tools for installation or removal. Furthermore, rather than being merely spread about town unlocked, free for anyone to use, these bicycles were docked at special bicycle racks, or essentially public bicycle stations. A coin deposit was required to release the bicycle from the station. The deposit would be refunded upon returning the bicycle to a station – either the station from which it was taken initially or any other public bicycle station with available slots. A very large coin-operated public bicycle system of this type was launched in the Danish capital, Copenhagen, in 1995. The system, called *Bycyklen*, currently has about 2,000 bicycles distributed across 110 stations. A deposit of 20 Danish Krones (C$25) is required to take out a bicycle (Bycyklen København, 2008). Despite the use of custom parts and the coin deposit, rampant theft and vandalism are an ongoing problem for *Bycyklen*. As users of the system are anonymous, there is no way to hold them responsible for theft or damage of the bicycles.

In the late 1990s, a new generation of fully automated, self-service public bicycle systems with sophisticated, electronically controlled locking mechanisms emerged. Unlike their Danish precursors, these so-called 'smart bike' systems would require user identification – thought to be a major theft deterrent. To unlock a smart bike, some form of personal identification is required – e.g., an electronic key card, a credit card, a transit pass, etc. The pioneering smart bike system, called *Vélo à la Carte*, was launched in Rennes, France in 1998.

Despite the major technological advance represented by *Vélo à la Carte*, bicycle sharing generated relatively little interest elsewhere in France and Europe. The number of cities establishing public bicycle systems grew slowly in the years after Rennes launched its system. This changed in 2005 when Lyon, France's second largest city, launched a fairly large smart bike system called *Vélo'v* (pronounced vay-love) and caught the attention of other large European cities, including none other than Paris. *Vélo'v* has by all measures been a resounding success. Prior to the system's debut, bicycles were all but a marginal mode of transportation, taking a mode share of about 1.5% of all trips – comparable to the current mode share for bicycles in most Canadian cities. The volume of bicycle trips in Lyon has since increased by 500%. Interestingly, only one quarter of the increased traffic is attributed to public bicycles; the remainder of new trips are attributed to privately owned bicycles. This suggests that *Vélo'v* has been an effective door opener for the use of private bicycles. Over the month of June 2008 alone, 1.5 million kilometers had been travelled with *Vélo'v* bikes. Since the system's inception, it is estimated that customers have travelled over 36 million kilometers. The same distance travelled by car would have resulted in 7,260 metric tonnes of CO_2 emissions (DeMaio, 2008 b).

Figure 1 - A *Bycyklen* bicycle in Copenhagen

Photo: Ingrid Luquet-Gad

Vélo à la carte introduced another major innovation: unlike *Bycyklen* and its sister systems in Denmark, which are publicly owned and operated, the Rennes system would be developed and operated by the advertiser Adshel (later acquired by Clear Channel) in exchange for advertising space on billboards across the city. The public-private partnership model, with an advertiser providing public bicycles as part of an advertizing contract with the municipality, would later be copied by other cities in France and across Europe. The vast majority of systems operating today use a similar ownership and financing model.

1.5.1 Public Bicycles in Canada

A Toronto community group, the Community Bicycle Network (CBN), operated a small bicycle sharing system between 2001 and 2006. The system had 150 used bikes that had been refurbished, painted yellow, and distributed across 15 stations around downtown Toronto. Most stations were located outside cafés or other businesses, with staff from these business providing bicycle loan services. The system required an annual membership ($25 or four hours of volunteer service) and there was no charge for uses up to 3 hours. The system relied primary on public subsidies and private sponsorships to cover its cost, as user fees generated only minimal revenues. Though the system operated at its capacity of 450 registered users, it was shut down in 2006 due to a funding shortfall after a key subsidy expired.

A prototype station and set of bicycles belonging to what is set to be the first smart bike system in Canada was demonstrated in Montreal in the fall of 2008. The system, dubbed *BIXI* (contraction of BIcycle and taXI), is to be fully deployed in the spring of 2009. The only other smart bike system in North America was launched in the summer of 2008 in Washington, DC.

Figure 2 - Montreal's new *BIXI* bicycle sharing system being demonstrated in October 2008

Source: Stationnement de Montréal

1.6 Benefits of Increased Bicycle Use

Public bicycle systems are ultimately intended to encourage bicycle use. Thus, many of the benefits of public bicycle systems are the same as those of any initiative designed to increase bicycle use. Nonetheless, public bicycle systems also offer a number of distinctive benefits. Both types of benefits are discussed in the present section.

1.6.1 Mobility Benefits

Bicycles offer fast and flexible mobility on short distances. For distances up to 5 km, bicycles can compete with public transit in terms of speed and time. In dense urban environments, they can even be faster than automobiles by avoiding traffic congestion and by obviating the need to find parking.

1.6.2 Health Benefits

The physical and mental health benefits of bicycle use are well established (Pucher and Dijkstra, 2003). Regular bicycle use has been shown to counteract many of the health risks associated with sedentary lifestyles, including obesity and cardiovascular diseases. Somewhat counter intuitively, research has also shown that cyclists may be less exposed to traffic-related pollutants than motorists, given that these pollutants concentrate inside automobiles (Table 1).

Table 1 - Comparison of motorists' and cyclists' exposure to traffic-related pollutants

pollutant	cyclists' exposure ($\mu g/m^3$)	motorists' exposure ($\mu g/m^3$)
carbon monoxide (CO)	2,670	6,730
nitrogen dioxide (NO_2)	156	277
benzene	23	138
toluene	72	373
xylene	46	193

Source: Van Wijnen et al. (1995)

1.6.3 Environmental Benefits

The bicycle is the most energy efficient mode of urban transportation.[1] A shift in mode share from motorized modes to the bicycle entails lower use of fossil fuels and a reduction of toxic

[1] Cycling is in fact even more efficient than walking: a cyclist typically expends from one quarter to one third as much energy as a pedestrian over the same distance (IDEA, 2007).

pollutant and greenhouse gases emissions (Table 2). It also entails a reduction of noise pollution related to motorized transportation.

The only significant life cycle energy costs of bicycles are those associated with production and disposal. These too are relatively small; the energy cost for manufacturing one car is equivalent to that for 70 to 100 bicycles. Very little residual waste is generated over a bicycle's life cycle.

Table 2 - Comparison of key environmental indicators for various modes of transportation with the private automobile for the same number of people/km

	auto - catalytic converter	auto + catalytic converter	bus	train	airplane	bicycle
space consumption	100%	100%	10%	6%	1%	8%
primary energy consumption	100%	100%	30%	34%	405%	0
CO_2	100%	100%	29%	30%	420%	0
NO_X	100%	15%	9%	4%	290%	0
hydrocarbons	100%	15%	8%	2%	140%	0
CO	100%	15%	2%	1%	93%	0
total atmospheric pollution	100%	15%	9%	3%	250%	0
accident risk	100%	100%	9%	3%	12%	2%

Source: European Communities (1999)
Note: A catalytic converter only works when the engine has warmed; on short distance trips, the pollution mitigating benefit is negligible.

1.6.4 Economic Benefits

Compared to automobiles and public transit, the cost of building and maintaining infrastructure for bicycles is minimal. The spatial footprint of bicycle infrastructure is considerably smaller than that of automobile or public transit infrastructure. A standard unidirectional bicycle lane is 1.2 m to 1.5 m wide while automobile lanes are generally at least 4 m wide. The difference is even more striking where parking infrastructure is concerned; numerous bicycles can be parked in a space the size of a standard automobile parking space (Figure 3). Furthermore, because of their low weight, bicycles have a low impact on road infrastructure. A shift in mode share from motorized modes to bicycles could obviate large capital investments for new road and public transit infrastructure and expenditures on the maintenance of existing infrastructure.

Figure 3 - Bicycles parking replaces an on-street automobile parking space in Montreal

Source: www.bta4bikes.org

1.7 Specific Benefits of Public Bicycle Systems

The most important specific benefit of public bicycle schemes is they can be a strong catalyst for increased bicycle use. They can help increase the acceptance of bicycles as a utilitarian rather than recreational mode of transportation. New bicycle trips generated by a public bicycle system are not only taken on public bicycles; experience in several European cities shows that more trips are also taken on private bicycles after public bicycles are introduced.

Public bicycles systems' capacity to generate increased bicycle use can perhaps be attributed to a "safety in numbers" effect, as documented by Jacobsen (2003). Jacobsen found that the probability that a motorist would collide with a cyclist decreased as the number of cyclists increased. This relationship held across communities of different sizes and at different scales of analysis – from a single intersection to a whole city. According to Jacobsen, in the presence of a greater number of cyclists on the road, motorists changed their behaviour. It seems that they become more aware of the presence of cyclists, and therefore less likely to collide with them.

Altering motorists' behaviour and making cycling safer mitigates one of the most important barriers to cycling. The perception that cycling is unsafe has been found to be a key factor inhibiting people from using bicycles, both in Europe (e.g., Beck & Immers, 1994) and in North America (e.g., Badgett et al. 1994 ; City of Vancouver, 1999 ; Baromètre, 2005). Considering this fact together with Jacobsen's (2003) main finding, it can be suggested that public bicycles could create a virtuous cycle: by increasing the number of cyclists, which increases bicycle safety, which further increases the number of cyclists, and so on.

Not only can public bicycles help augment the number of single mode bicycle trips, but it can also increase the number of multimodal trips that include bicycle use. Specifically, public bicycles can allow access by bicycle from public transit facilities. Public bicycles can be particularly useful to transit commuters, who can use the public bicycle to travel between the commuter transit facility and their workplace or school. Commuters can also use public bicycles during the day to run errands from their workplace or school.

It should be noted that even people who are already cyclists stand to benefit from a public bicycle scheme. Using a private bicycle has one crucial limitation: the owner is generally required to make return trips with the bicycle. Public bicycles free cyclists from this requirement, allowing them to make one-way bicycle trips. For example, due to inclement weather, a bicycle commuter may decide to take transit to work or school, leaving his bicycle at home. If the weather improves during the day, the same commuter may decide to return home by public bicycle, picking one up at a station near work or school and dropping it off at one near home.

If public bicycle systems are considered as an alternative form of public transit, they are then the least expensive form of public transit available. Capital and operating costs for public bicycle systems are a small fraction of those for any motorized form of public transit. They are cheap in part because they consume very little space. In the French city of Lyon, for example, it has been observed that a car parking spot has on average six users per day while a *Vélo'v* station with five bicycle berths, which takes up an equivalent amount of space, has on average 15 users per day (NICHES, 2007).

Finally, public bicycle systems can have a variety of economic spinoffs. They can be beneficial for the image of the host town or city, demonstrating a progressive attitude towards transportation and, more generally, an inclination towards sustainable development. A public bicycle system can become a tourist attraction – especially here in North America, where at the time of writing, there is only one very small system functioning and only two others planned. A public bicycle system can also provide a considerable amount of ongoing employment – for station and bicycle construction, for maintenance and repairs, as well as system operations.

Section Summary

Purpose

- to help planners and decision makers assess the viability of a a public bicycle sharing system in their community
- to provide information to help plan and implement a successful public bicycle system

Definition

- bicycle sharing entails lending bicycles for short-term use at little or no cost to multiple daily users
- public bicycle systems are a form of bike sharing that is open to the general public

History

- 1964 - *Witte Fietsen*, the world's first public bicycle scheme, is deployed in Amsterdam
- 1995 – *Bycyklen*, the first public bicycle scheme with special locking stations is launched in Copenhagen
- 1998 - *Vélo à la carte*, the first public bicycle system to use electronic key cards to unlock bicycles, allowing users' identities to be tracked, is launched in Rennes, France – considered the first "smart bike" system
- 2005 – *Vélo'v* a large smart bike system is launched in Lyon, France and leads to a 500% increase in bicycle use
- 2007 – *Vélib*, the world's largest system is launched in Paris; by late 2008, the system has 20,600 bicycles and 1,451 stations
- 2008 – *SmartBike DC*, the first automated public bicycle system in North America is launched in Washington DC
- 2009 – *BIXI*, the first automated bicycle system in Canada is to be launched in the spring in Montreal

Benefits of Increased Bicycle Use

- mobility benefits – bicycles are faster and more flexible than public transit distances under 5 km
- health benefits – increased cardiovascular health, lower risk of obesity, fewer diseases related to air pollution
- environmental benefits – lower energy use, GHG and toxic pollutant emissions than motorized vehicles
- economic benefits – smaller spatial footprint, cheaper infrastructure than motorized vehicles

Specific Benefits of Public Bicycles

- "door opener" to increased bicycle use
- can help change public perception of the bicycle from a form of recreation to a form of urban transportation
- "safety in numbers" effect – the more cyclists there are on the road, the safer they are

2 Assessing the Potential

2.1 General Considerations

2.1.1 Size

There is no clear lower bound for a City's population to sustain a public bicycle sharing scheme of some nature. European experiences suggest however that automated public bike systems are unwarranted in communities below a certain minimum population size; manually operated systems may be more cost effective in smaller cities. Automated systems have been implemented in cities as small as Drammen, Norway, with a 2008 population of about 60,000, and as large as Paris, with a 2008 population of about 2.2 million in the city itself and a metropolitan population of about 12 million. Drammen and a few other small cities notwithstanding, a European urban transportation think-tank (NICHES, 2007) suggests that a minimum population of 200,000 is required to support an automatic bicycle sharing system. A Spanish policy guide on public bicycle systems (IDEA, 2007) makes a similar recommendation, albeit with a caveat. It also recommends that automatic public bicycle systems be used in municipalities with a population exceeding 200,000. However, it proposes that automatic systems may be warranted in smaller municipalities if the population density is sufficient.

European cities are generally denser and have more mixed land uses than Canadian cities. The share of the population living in areas sufficiently dense and diverse in terms of land use to support high levels of bicycle use is likely to be larger in a European city than in a Canadian city with a comparable population. It is possible that a population larger than 200,000 would be required for an automated public bicycle system to be cost effective in a Canadian city.

2.1.2 Density

In Europe, public bicycle systems are invariably implemented in dense, core areas of towns and cities. The service area of *Vélib*, for example, which corresponds roughly to the boundaries of the City of Paris, has an overall population density around 24,000/km². The initial (Phase I) service area for Montreal's *BIXI* includes some of the city's densest boroughs, namely Plateau–Mont-Royal with over 13,000/km² and Rosemont–Petite-Patrie with over 9,000/km². The planned expansion (Phase II) will include parts of the adjacent boroughs of Outremont, Villeray–Parc-Extension–St-Michel and Sud-Ouest, all of which are also relatively very dense (Figure 4).

City centres or 'downtowns' can be an exception to the population density rule. In most Canadian cities, downtowns do not have the highest population densities; these usually occur in adjacent residential areas. Nevertheless, downtowns have several other attributes that can generate a large number of bicycle trips. In particular, Central Business Districts (CBDs) tend to have very high employment densities and tend to be rich in retail and entertainment services as well as in public facilities. Furthermore, in a number of Canadian cities, there are large educational institutions in or adjacent to the downtown core. This is well illustrated by the Montreal case. *BIXI* will be deployed in the central Ville-Marie borough, which contains the metropolitan CBD and has a population density that is significantly lower than the other boroughs in which *BIXI* will operate –around 5,000/km². Nonetheless, it has an extremely high employment density, with an average of 22,400 jobs/km² compared to the metropolitan average of 786 jobs/km² (van Susteren, 2005); has several large shopping centres and a few retail intensive streets, such as St-Catherine

Street; has a number of museums, including the Montreal Museum of Fine Arts, Contemporary Art Museum of Montreal, the McCord museum, the Canadian Centre for Architecture, to name only a few; and has an extremely high student density, with three university campuses (Concordia, McGill, and UQAM) and two college campuses (Dawson and Vieux-Montréal) within its boundaries. These factors combined undoubtedly make the Ville-Marie borough a major generator of bicycle trips.

2.1.3 Roads and bicycle facilities

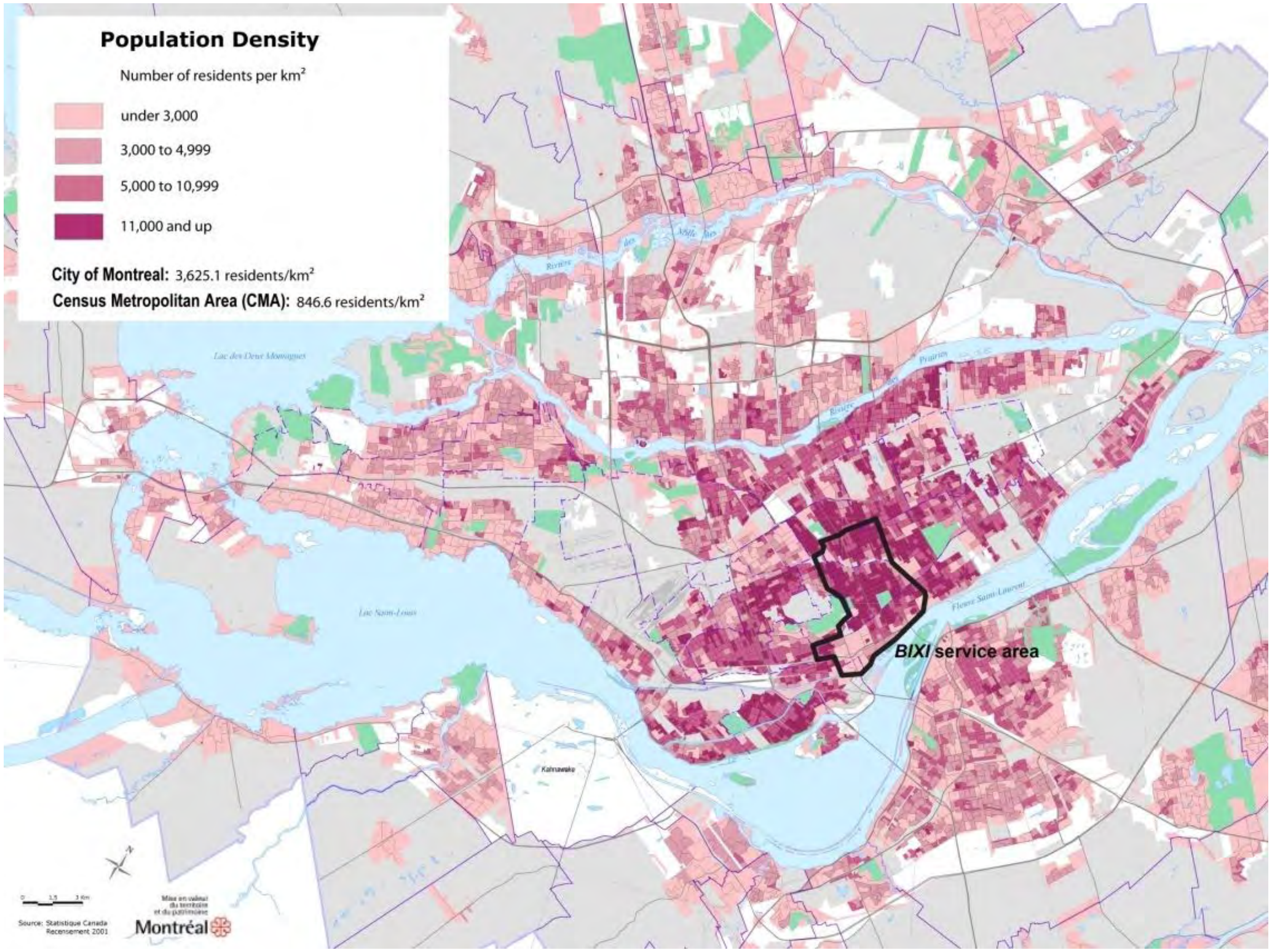
For a public bicycle system to succeed, cycling must be perceived as a safe activity. A number of researchers have identified the perception of danger as one of the key barriers to bicycle use. The extent and the quality of specialized bicycle facilities, such as dedicated bicycle paths and lanes, are likely to affect the perception of safety (FHWA 1995; Landis 1998). Traffic calming and measures for limiting automobile use can also have a positive impact on cyclists' perception of safety. In many of the European cities in which public bicycle systems have been implemented there have been widespread commitments to expanding bicycle facilities while simultaneously putting limitations on automobile use.

Table 3 - Recommended system type and distribution with respect to city size, density, and land use

municipal population	density	system type	distribution
P < 50,000	high	automatic	transit stations and main activity areas (commercial centres, employment nodes)
	low	manual	transit stations and public facilities (community centres, sports facilities, libraries, etc.)
50,000 < P < 200,000	high	automatic	citywide
	low	manual	at transit stations and public facilities (community centres, sports facilities, libraries, etc.)
P > 200,000	high	automatic	citywide
	low	automatic	in the city centre and other dense areas

Source: IDAE (2007)

Figure 4 - *BIXI*'s initial service area and the distribution of population densities in the Montreal Metropolitan Area



Source: Ville de Montréal

Aside from merely being perceived as safe, the network of on- and off-road bicycle routes must also be interconnected and have a layout that affords direct trajectories, given that the practical range of cycling trips is limited to about 5 km. A layout that forces cyclists to take circuitous routes is likely to discourage cycling. Adaptations to the road network that provide cyclists with short cuts and direct routes are likely to have a positive impact on bicycle use. Such adaptations can include, for example, mid block links between streets, or contra flow bicycle lanes on one-way streets (Figure 5), which allow cyclists to travel against the direction of traffic.

The absence or limited availability of bicycle facilities, the lack of traffic calming and measures limiting automobile use, as well as the poorly interconnected, car-oriented road networks found in many Canadian cities are barriers to bicycle use in general and are a factor that could potentially limit the success of a public bicycle system. Canadian municipalities should consider undertaking both bicycle facility improvements as well as extensive neighbourhood traffic calming before delving into public bicycle systems. Other measures that curtail automobile use, such as road and parking pricing, can help induce higher levels of bicycle use and can favour the success of a public bicycle system.

Figure 5 – Contra-flow bicycle lane in Montreal provides a safe shortcut for cyclists

Photo: Christopher DeWolf / Spacing.ca

2.1.4 Potential for Transit Intermodality

A strong synergy can develop between metropolitan rapid transit systems and public bicycle systems. In principle, public bicycles can become a means for accessing transit facilities from home or for getting to work or school from transit facilities. The utility of public bicycles for the former is likely to be low; transit stations can be accessed from home by private bicycles. However, the utility of public bicycles for travel between transit stations and work or school is likely to be high given that few people are likely to take their own bicycle with them on public transit[2] or to keep a second bicycle at the destination station.

There are several examples of public bicycle systems that have a strong focus on intermodality with public transit. These include the *Call a Bike* schemes operated by Deutsche Bahn (DB), the national passenger rail company, which runs most urban commuter rail services. There are *Call a Bike* hubs at commuter rail stations in the central parts of several larger German cities, including Berlin, Frankfurt, Munich and Hamburg. Aside from physically locating the bicycles at rail stations, DB also offers rail customers strong financial incentives to use the system. Customers with DB monthly train passes enjoy discounts on *Call a Bike* membership and usage fees. Another notable initiative is *OV Fiets*, short for *openbaar vervoer fiets* or 'public transit bike', available at centrally located rail stations in towns and cities across the Netherlands. The service, which lends bicycles at a flat rate of €2.75 per 20 hour block or an annual flat rate of €7.50, was designed explicitly to encourage train commuters to use bicycles to access work or school from the train station, thereby lowering the strain on conventional local public transit services.

Figure 6 - A *Vélo'v* station in Lyon facing a tram station

Source: www.velov.grandlyon.com

The potential for synergy between public bicycles and public transit in Canadian cities is likely to be highest in the few larger cities that have metropolitan rapid transit systems. Such systems include dedicated bus rapid transit (BRT), light rail transit (LRT), subways, and commuter trains (Figure 6). Stations in core areas at which a large volume of commuters arrive on their way to work or school are likely to be the best sites for achieving synergy with public bicycles. Using the 'hub and spoke' analogy, under this scenario the rapid transit station acts as the hub and public bicycles act as the spokes. In the absence of a true rapid transit system, synergy with public bicycles could occur along a major transit corridor – i.e., an arterial road with a high volume of transit traffic, even if it is not 'rapid transit' per se.

[2] Some public transit systems in Canada allow users to transport their private bicycles, but usually with many restrictions regarding the time of day and number of bicycles per transit vehicle. Given such restrictions, and given the cumbersomeness of carrying a bicycle by transit, it is not a practical solution for most users.

2.1.5 Topography

Cyclists generally dislike going up inclines of more than 4% and avoid inclines greater than 8%. In an area in which streets mostly have slopes under 4%, topography is not a factor limiting the success of a public bicycle system. In an area where many streets are sloped between 4% and 8%, topography does become a significant constraint. Cyclists will go down the slope but will refuse to go up. Public bicycle stations at higher elevations will tend to empty, while those at lower elevations will tend to fill up. This problem occurs in Barcelona, whose centre lies at the bottom of a bowl-shaped valley. Users happily take *Bicing* bicycles downhill into town but take other modes of transportation to go back uphill, leaving the bicycles behind. In Barcelona's case, the problem is overcome through redistribution: a larger-than-usual fleet of redistribution vehicles continuously takes bicycles from low-lying stations to uphill stations.

Rather than relying on redistribution, a more expensive alternative would be to have a fleet of electric public bicycles. The advantage would be that users would be more likely to ride the bicycles two ways, rather than riding one way and using another mode of transportation for the return trip (or vice versa). In areas where the slopes of most streets exceed 8%, a public bicycle system is unlikely to succeed, redistribution and electric bicycles notwithstanding (IDAE, 2007).

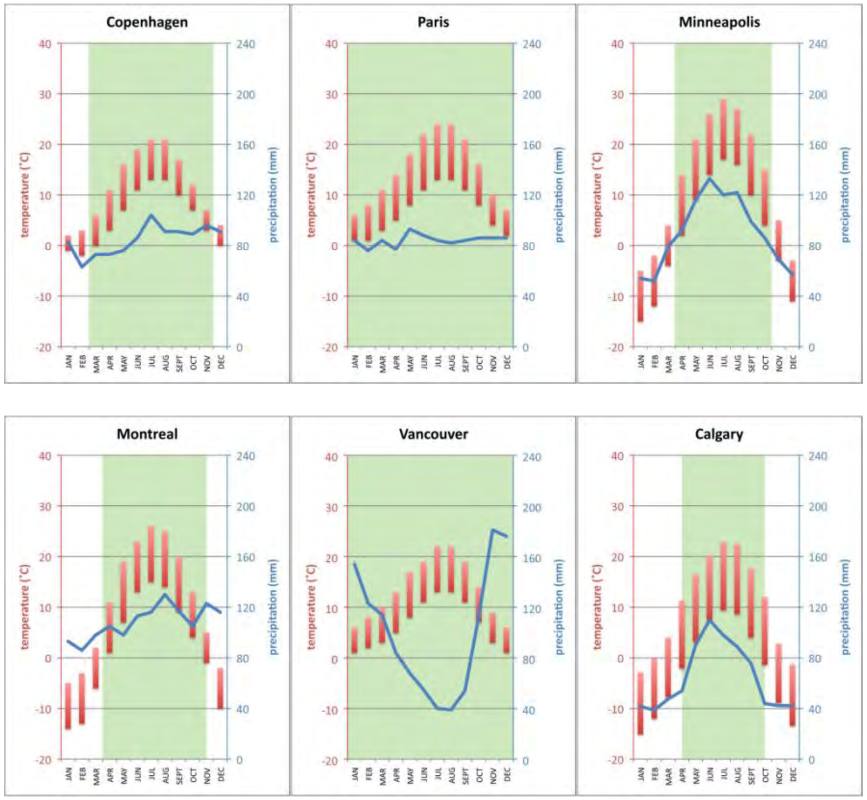
2.1.6 Climate

In Europe, public bicycle systems have been successfully implemented in cities with very different climates – from Nordic climates in the Scandinavian countries to warm, dry climates in France and Spain. Systems in Northern Europe tend to be shut down during the colder months while others remain open year-round. In Copenhagen, Denmark, for example, the *Bycyklen* system shuts down between early December and early April while *Vélib* in Paris remains open year round.

In most Canadian cities, however, the winter is generally longer, colder, and snowier than anywhere in Northern Europe. In Copenhagen, for example, average high and low temperatures in January are 2˚C and -2˚C respectively whereas in Montreal they are -6˚C and -15˚C (Figure 7). A long, severe winter could limit the number of months during which the public bicycle system can operate and generate revenues. Montreal's *BIXI* public bicycle system will operate only in the Months that temperatures are above zero – April to mid-November.

An important exception are Pacific coastal communities, in which winters are comparable to or even milder than in northern Europe. In Vancouver, for example, average January temperatures range from high 6˚C to low 1˚C, while in Victoria they range from high 7˚C to low 3˚C. In this case, the public bicycle system could operate over a longer period or even remain open year-round.

Figure 7 - Comparison of average temperature range, precipitation, and cycling season



Sources: weather.msn.com, Environment Canada

2.1.7 Levels of Bicycle Use

European experiences suggest that public bicycle systems need not be implemented only in places that already have high levels of bicycle use. Some public bicycle systems have been developed in countries that tend to have a very high mode share for cycling in urban areas, such as The Netherlands (27%) and Denmark (20%) but also in countries with low levels of urban bicycle use, such as France (4%) (deMaio and Gifford, 2004). In effect, European experience suggests that public bicycles can be a “door opener” for increased bicycle use (NICHES, 2007). *Vélib*, for instance, is expected to eventually double or triple total bicycle use in Paris – i.e., the use of public and private bicycles taken together (Nadal, 2007).

Canadian metropolitan areas have even lower levels of bicycle use than the average in France. Most mid-sized and large cities have a bicycle mode share for trips to work under 2% (e.g., 0.8% in Toronto, 1.3% in Montreal, 1.9% in Vancouver and Ottawa-Gatineau). A notable exception is Victoria, BC, where the bicycle mode share for trips to work is 5.6% (2006 Canadian Census). Although on a metropolitan scale the mode shares are generally low, there are nonetheless urban areas in which bicycle use is relatively high. For example, while only 1.3% of trips to work are made by bicycle in City of Montreal as a whole, in the Plateau–Mont-Royal borough, one of the three that will be served by *BIXI* as of next spring, 7% of trips to work are made by bicycle (Ville de Montréal, 2004). An estimate by the cycling advocacy group Vélo Québec (2001) suggest that as much as 12% of all trips in the Plateau–Mont-Royal borough are made by bicycle during the warmer months. The dense, mixed-use central areas of other larger Canadian cities also tend have levels of bicycle use higher than average levels of bicycle use.

Table 4 - Bicycle commuting rates in Canadian Census Metropolitan Areas (CMAs)

	cycling to work (%)		
	1996	2001	2006
Calgary AB	1.1	1.5	1.3
Edmonton AB	1.1	1.2	1.1
Gatineau QC	1.4	1.6	1.7
Guelph ON	2.1	1.8	2.3
Halifax NS	1.0	0.9	1.0
Hamilton ON	0.7	0.9	0.9
Kelowna BC	2.0	2.1	2.1
Kingston ON	2.1	2.2	2.4
Kitchener ON	1.1	1.1	1.6
London ON	1.5	1.4	1.6
Moncton NB	0.7	0.6	1.0
Montréal QC	1.0	1.3	1.6
Ottawa ON	2.3	2.0	2.2
Québec QC	0.9	1.3	1.4
Regina SK	1.1	1.4	1.4
Saskatoon SK	2	2.5	2.4
Sherbrooke QC	0.7	0.9	0.9
St. John's NL	0.3	0.1	0.3
Toronto ON	0.8	0.8	1.0
Trois-Rivières QC	1.2	1.5	1.4
Vancouver BC	1.7	1.9	1.7
Victoria BC	4.9	4.8	5.6
Windsor ON	1.1	1.1	1.3
Winnipeg MB	1.4	1.4	1.6
Total CMA population	**1.2**	**1.3**	**1.4**

Source: Statistics Canada

The experience of some European cities suggests that high levels of bicycle use are not a prerequisite for successfully implementing a public bicycle system. Paris's *Vélib*, Lyon's *Vélo'v,* and Barcelona's *Bicing* are all proof that public bicycle systems can thrive in cities that did not previously have high levels of bicycle use. For example, even though less than 2% of trips made by Parisians were by bicycle at the time that it was launched, *Vélib* quickly became one of the most intensively used public bicycle systems in the world, with 8 to 10 daily users per bicycle (JCDecaux, 2009). A user survey in early 2008 (Mairie de Paris, 2008) found that there were 190,000 registered users and 70,000 average daily users. *Vélib* is expected to eventually double or triple total bicycle use in Paris (Nadal, 2007).

Indeed, it would seem that the introduction of public bicycles can trigger the development of a non-recreational cycling culture, compelling local residents to see the bicycle in a new light as a viable mode of urban transportation. In this sense, public bicycle systems can be "door openers" for increased bicycle use (NICHES, 2007).

2.2 Feasibility Study

Market research can be useful for ascertaining whether there is latent demand for a public bicycle system. A survey of local residents, conducted by telephone, by Internet, in the field (on streets and in other public places), or a combination thereof can be useful for gauging the general public's interest in and support for a public bicycle system, and to investigate the potential users' willingness to pay for this type of service. A market study would generally probe the following:

- incidence of short trips and the mode of transportation used
- awareness of the public bicycle concept

- interest in using public bicycles, if they were available
- willingness to pay for using public bicycles, if they were available
- support for dedicating existing road and parking space for public bicycles
- support for increased outdoor advertising to help fund public bicycles

A survey with these types of questions was conducted in the Greater Vancouver area in 2008 (Translink, 2008).

Beyond helping to determine the overall feasibility of a public bicycle system in a given community, the willingness to pay data from the market survey can help determine the nature of the business model that could be used if the system were implemented. The data on general interest and willingness to pay can also help determine the shape of the service area and the target audience for the public bicycle system.

Figure 8 - Cyclists in Paris using both *Vélib* and private bicycles

Photo: Luc Nadal / ITDP Sustainable Transport

Section Summary

Size

- automated (self-service) public bicycle systems are suited for cities with a population of 200,000 and more manual systems are recommended for smaller cities
- Density - systems should only be set up in areas with a high population density
- an exception are downtown cores – even if population density is low, high employment density and concentration of services and amenities should drive bicycle use
- Montreal's system will be launched in the downtown core and neighbourhoods with density over 8,000/km^2

Roads and Bicycle Facilities

- a network of bicycle routes made up of traffic calmed streets and dedicated bicycle facilities (bicycle lanes, tracks, and greenways) will favour the success of a public bicycle system
- the network of bicycle routes must offer have good coverage of the city and offer direct trajectories

Potential for Transit Intermodality

- high capacity rapid transit systems (BRT, LRT, subway, and commuter train) can feed and be fed by public bicycles
- in the absence of such systems, public bicycles might still be able to thrive in major transit corridors that are not "rapid transit" per se

Topography

- slopes under 4% are no obstacle to cyclists
- cyclists are reluctant to scale slopes between 4% and 8%; additional redistribution vehicles needed to keep public bicycle system operating
- cyclists avoid slopes above 8%; public bicycle systems not recommended in such areas

Climate

- cold and snowy winters restrict the number of months a public bicycle system can operate and generate revenues
- in Canada, only Pacific coastal cities could run year-round public bicycle systems; most other cities would have to close for the winter months

Levels Bicycle Use

- existing high levels bicycle use are likely to favour the success of public bicycle system
- however, high levels of bicycles are not a prerequisite as shown by cities such as Lyon, Paris, and Barcelona

3 Hardware and Operations

3.1 System Operation Type

3.1.1 Manual

A manual bicycle sharing system is one where transactions related to taking out and returning a bicycle are supervised. Supervision can be provided by a dedicated employee or by non-dedicated staff who have other primary responsibilities. For example, some bicycle sharing systems collaborate with local businesses for the provision of loan services. Manual systems can but do not necessarily involve information technology for keeping track of the use of bicycles and monetary transactions. Generally speaking, a computerized tracking system is required when there are multiple pick up and drop off points for the bicycles.

3.1.2 Automated

In an automated bicycle sharing system, transactions related to taking out and returning bicycles are unsupervised – the systems rely on self-service. Bicycles are either locked to special electronically controlled racks or are equipped with an electronically controlled lock of their own. In the former case, the racks are either coin-, credit card-, or electronic key card-operated. In the latter case, the locks on the bicycles have a combination pad; users must call or send a cell phone text message to the bicycle sharing operator to obtain a combination to unlock the bicycle. By definition, automated systems rely heavily on information technology for user interface, system control and monitoring.

Figure 9 - The coupling system on *Vélo à la carte* bicycle in Rennes

Source: ClearChannel SmartBikes

The fundamental difference between coin-operated credit card-, key card-, or cell phone-operated systems: in the latter case, the identity of bicycle users is known. In case of theft or damage to bicycles, the users can be held responsible. Coin-operated systems such as Copenhagen's *Bycyklen* do not keep track of user identities

Table 5 - Comparison of manual and automatic bicycle sharing systems

factor	manual	automatic
city size	small to medium	medium to large
loan duration	medium (>1 hr)	very short (<30 min)
daily users per bicycle	low (<5)	high (5-20)
capital cost (per bicycle)	low	high
operating cost (per bicycle)	medium to high	low to medium

3.2 Automated System Types

3.2.1 Fixed-permanent

A fixed public bicycle system is one in which bicycles are locked to designated racks when not in service. In most cases, bicycles are attached to the rack via a specialized coupling system (Figure 9). The racks therefore act in essence as "stations". The vast majority of urban public bicycle systems feature fixed stations.

Figure 10 *Vélib* bicycles have an auxiliary cable lock, seen here inside the basket, that allows users to lock the bicycle temporarily between stations

Source: austinevan

Figure 10 - A *Vélib* station in Paris being refilled

Source: JCDecaux (2008)

A bicycle can be taken out from any station and returned to the same or any other station, provided that there is an available locking berth. Some systems allow users to temporarily lock bicycles at other locations using a built-in cable lock (Figure). Making stopovers and otherwise keeping bicycles between stations is discouraged by the pricing scheme of most systems. In most cases, only the first half hour of use is free and afterwards the usage charges are applied, encouraging users to return bicycles to a station.

Fixed systems require constant monitoring to ensure bicycles are available for pick up and vacant berths available for bicycle drop off at every station. The stations are networked to a central computerized control system, allowing the balance of bicycles at each station to be monitored electronically. The control system dispatches motorized redistribution vehicles to rebalance bicycles between stations that are emptying out and those that are filling up (Figure 10). Most fixed bicycle systems have significantly more locking berths at stations than bicycles. *Vélib*, for example, has 70% more support racks than bicycles.

The stations of most fixed systems are installed permanently. The installation of a station usually requires significant construction work to anchor the station and connect it to underground power mains and network cables, and usually entails the prior excavation of the road or sidewalk surface where the station will be installed (Figure 11). Station installation is therefore relatively time, labour, and cost intensive. This type of system demands careful planning of the size and location of stations, as errors are liable to be expensive to correct (see Section 5.3.3).

Figure 11 - Construction of a *Vélib* station in Paris

Source: JCDecaux (2008)

3.2.2 Fixed-portable

Montreal's *BIXI* has introduced a significant innovation to the fixed system concept – portable modular stations. Service terminals and the bicycle stands are mounted onto sets of rectangular platforms to form two types of modules: main modules having a service terminal and three bicycle docks and secondary modules having only bicycle docks. Each station requires one main module; the number of secondary modules can vary, depending on the required number of bicycle docks at the given location. As the stations are solar powered and wirelessly networked, they are completely self-contained - no wiring is required for installation. As a result, station installation consists merely of placing the modules in the desired location; there is no need for anchoring them to the ground (Figure 12). It is therefore time, labour, and cost efficient.

The easy installation and removal of stations entails a number of advantages: the distribution of stations can be adapted to match actual demand, allowing the system to be rapidly optimized at little cost; stations can be placed at temporary locations for special events, such as festivals; and stations can removed for the winter. The last advantage is especially significant in the Canadian context. The removal of stations in the winter would prevent them from being damaged by snow and ice as well as by snow clearing equipment. The only significant disadvantage of fixed-portable stations with respect to fixed-permanent stations is an aesthetic one: the modular, platform-mounted stations are liable to be less visually integrated with the streetscape.

Figure 12 - A *BIXI* station module being installed during a demonstration in Toronto

Photo: Yvonne Bambrick

3.2.3 Flexible

A flexible bicycle sharing system is one in which bicycles do not need to be locked to designated racks or stations. In this case, the bicycles have a general purpose locking device, such as a chain or a cable, which allows to be locked to any stationary object when not in use – e.g., a standard bicycle rack, a traffic sign, a parking meter, etc. In addition to the built-in chain or cable lock, there may also be locks that block the bicycle's drive train and steering.

Flexible systems entail a key advantage for the operator of a public bicycle system: the operator does not need to provide a network of stations. The logistics of managing the system can however be much more complex than a fixed system. In the latter, bicycles are picked up and dropped off at a limited number of points – i.e., at the stations – making it easier to keep track of the location of individual bicycles. It is easier to retrieve bicycles at fixed locations for maintenance, repairs, or redistribution. In a flexible system, individual bicycles can get scattered across a large territory. It is necessary to develop a system for keeping track of the locations of individual bicycles. Deutsche Bahn, the operator of *Call a Bike* flexible public bicycle systems in several German cities, considered using GPS to keep track of bicycle locations but the found the technology too expensive (DB Rent, 2005). Instead, the system relies on users to report the locations at which they drop off bicycles (see Section 6.2). Even when their locations are known, the scattering of individual bicycles across countless locations is liable to make retrieval for maintenance, repairs, or redistribution much more onerous.

Figure 13 - A *Call a Bike* repository at a train station in Munich

Photo: Kostas Pagiamtzis

From the user's point of view, a flexible system is also a mixed blessing. On one hand, the flexible system makes leaving the bicycle after use much more convenient. The bicycle can be left virtually anywhere within the authorized service area. It also avoids a common inconvenience associated with fixed systems – a full station, with no berths available for locking the bicycle. The user of the fixed system who encounters a full station is forced to seek out another station that has empty berths, consuming time and potentially taking the user further from his final destination. On the flipside, while a flexible system can make dropping off a bicycle after use more convenient, picking up a bicycle in the first place can be much less convenient. Without fixed pick up points, there is no guarantee that there will be an available bicycle within walking distance. Some systems partly overcome this problem by having some fixed stations that hold a reserve of bicycles. In German cities with *Call a Bike* flexible systems, there are bicycle repositories at multiple intercity and commuter train stations (Figure 13).

3.3 Station Design & Technology

As mentioned already, fixed system stations, both of the permanent and the portable variety, are composed of two basic components: a service terminal and a set of bicycle locking stands. The difference is permanent stations have terminal and stands anchored directly to the ground, while portable systems have the some components mounted onto a moveable platform. Another difference is that permanent stations are hard wired to electricity mains and IT cables, whereas portable stations are solar powered and wirelessly networked.

Figure 14 - The *Vélib* membership card or a NaviGO public transit card are used as a key to take out bicycles

Sources: Mairie de Paris and Syndicat des transport d'Île-de-France (STIF)

The service terminal provides a user interface for performing basic financial transactions related to the purchase of user memberships, provides information about how to use the system, and about the availability of bicycles and docking spaces at other stations. The *Vélib* service terminal illustrated in Figure 15 is representative of most smart bike systems put into service after 2000. The terminal includes:

A. **Advertizing space.** For supplemental revenue generation.

B. **Touch sensitive screen.** For user interface.

- purchase of day, week, or annual passes, in conjunction with financial card terminal (D).
- information on how to use the system
- information on bicycle and parking space availability at other stations in the network
- several languages available

C. **Key card reader.** For users with annual memberships or users using NaviGO public transit cards. Allows users to check account information, such as usage charges.

D. **Financial card terminal.** Accepts credit and debit cards. Used in conjunction with touch sensitive screen to purchase day, week, or annual passes.

E. **Card dispenser.** Dispenses temporary (one-day and one-week) passes purchased at the terminal

Figure 15 - A *Vélib* station service terminal

Photo: austinevan

The Vélib locking stand depicted below is representative of JCDecaux Cyclocity system; the main competitor, the ClearChannel SmartBike system, uses a slightly different locking system. The Vélib stand (Figure 16) includes:

A. **Dock number.** Users with daily and weekly passes must check bicycles out at the service terminal; they can select the number of the dock from which they will take a bicycle.

B. **Status indicator light.** Flashes when the bicycle is ready to be taken out after the card reader on the stand. Confirms that the bicycle has been correctly locked upon return.

C. **Key card reader.** For users with annual memberships or users using NaviGO public transit cards. Allows users to check out bicycles directly from the stand, with using the service terminal.

D. **Unlocking button.** After the user's membership has been read, the button must be pressed to release the bicycle from the stand.

E. **Coupling device.** Mates with a hook other protrusion on the bicycle to lock the bicycle to the stand.

Figure 16 - A *Vélib* locking stand

Photo: austinevan

The ClearChannel SmartBike system features a service terminal much like those found in Paris but the bicycle stands and coupling devices used are somewhat different. Rather than individual posts, there are long rails with evenly spaced bicycle docks. There is no card reader at the individual docks; instead, the user must check in at the service terminal. The terminal assigns a dock number from which the user must then retrieve the bicycle (Figure 17).

Figure 17 - A *Bicing* bicycle stand in Barcelona

Photo: Ani Kalemkerian

3.4 Bicycle Design & Technology

The design considerations for public bicycles are:

- ease of use
- adaptability to users of different sizes
- mechanical reliability
- resistance to vandalism
- theft prevention
- distinctive visual appearance

The most recent, so-called "fourth generation" of public bicycles, which includes systems such as *Vélib* and *BIXI*, have the following features, illustrated on a *BIXI* bicycle in Figure 18:

A. **Handlebar-mounted bag rack.** Some systems provide a basket instead of a rack.

B. **Highly adjustable seat.** To accommodate users of a wide range of sizes.

C. **Robust down tube / no top tube.** Allows easy mounting and dismounting and also prevents a second person from sitting on the bike.

D. **Wide tires.** For comfort and stability.

E. **Internal hub gears.** More reliable than external derailleur gears: less risk of chain dropping, less torsion on the chain affords longer chain life. Also, less prone to theft and vandalism.

F. **Front and rear lights.** Battery powered LED lights operated whenever the bicycle is undocked. The battery recharges while the bicycle is docked at a station.

G. **Enclosed chain.** Protects users' clothes from dirt on the chain.

H. **Internal hub brakes.** Less prone to theft and tampering than regular rim brakes.

Figure 18 - Anatomy of a *BIXI* bicycle

Source: Stationnement de Montréal

There are a number of other less visible features included to maximize reliability and prevent theft and vandalism. In particular, all public bicycles developed since Copenhagen's *Bycyklen* have used non-standard components – wheels, tires, seat post, screws, bolts, and so on. As a result, the components are not interchangeable with regular, commercial bicycle parts. This is supposed to deter theft of the components themselves as well as theft of the bicycles; without access to custom components and special tools, it would be impossible to maintain the stolen public bicycle. The drawback using of custom components is that they are likely to be considerably more expensive than standard components, meaning that the initial cost of the bicycles and ongoing maintenance costs are higher. Other special features are intended less to deter theft but rather to make the bicycle as tamper proof and reliable as possible. For example, as mentioned above, gears and braking mechanisms are enclosed within the wheel hubs. On Cyclocity (e.g., *Vélib* and *Vélo'v*) bicycles as well as on *BIXI* bicycles, brake and gear cables are hidden within the bicycle frame's tubes. On SmartBike (e.g., *Bicing* and *SmartBike DC*) and *Call a Bike* bicycles, however, the cables are exposed on the handlebars.

3.5 Required Resources

3.5.1 Human Resources

Smart bike systems eliminate the need for staff to handle bicycle pick up and drop off and monetary transactions related to membership and usage fees. Nonetheless, significant human resources are still needed to keep the system running. Staff is required for the following general functions:

- **fieldwork:** redistribution of bicycles, station maintenance and minor bicycle repairs
- **workshop:** major bicycle repairs
- **warehouse:** storage of spare parts, spare bicycles, and other equipment
- **call centre:** subscription management and customer assistance

Table 6 below compares the human resources of three French public bicycle systems: Paris's *Vélib* behemoth, Lyon's large *Vélo'v*, and Rennes's small *Vélo à la carte*. Despite a difference of two orders of magnitude in the number of bicycles, Paris's and Rennes's systems have roughly the same number of bicycles per staff member – approximately 50. Lyon appears more efficient in this regard, with about 100 bicycles per staff member. On the other hand, Lyon and Rennes both have about 6 stations per staff member, whereas Paris has fewer.

Table 6 - Human resources with respect to the number of bicycles, stations, and daily users for three French smart bike systems

system	staff	bicycles		stations		daily users	
		total	per staff	total	per staff	average	per staff
Vélib (Paris)	400	20,600	52	1,451	3.6	70,000	175
Vélo'v (Lyon)	40	4,000	100	250	6.3	15,000	375
Vélo à la carte (Rennes)	4	200	50	25	6.3	320	80

Sources: Mairie de Paris (2007), IDAE (2007), and Vélo à la Carte (2008).

3.5.2 Capital Resources

A public bicycle system requires more than just bicycles and stations; a variety of other equipment is needed to keep the bicycles and stations functioning at an adequate level of service. This includes:

- a fleet of vehicles for redistribution of bicycles between stations, station maintenance, and light bicycle maintenance
- warehouse facilities for heavy bicycle maintenance, for storage of spare parts and spare bicycles and, in colder locations, storage of bicycles and other equipment if the system shuts down in the winter
- IT equipment for monitoring the status of the stations and the locations and status of bicycles
- a logistics centre for coordinating redistribution, maintenance, and repair operations as well as for customer service

For example, to serve its fleet of 20,600 bicycles and 1,451 stations, Paris's *Vélib* has 20 natural gas powered redistribution vehicles (Figure 19), to shuttle bicycles between stations and the repair facility; 130 electrically assisted bicycles with trailers for station maintenance and light on-site bicycle maintenance (Figure 20); and 10 electric powered service vehicles (Figure 21), which carry water and supplies for cleaning stations and bicycles. An unusual feature is *Vélib*'s main repair facility, which floats on a barge on the river Seine (Figure 22). The barge floats between 12 stops along the Seine, where the redistribution vehicle drop off bicycles in need of heavy maintenance and pick up repaired bicycles to be put back into service. Once a day, the barge travels further down the river to *Vélib*'s main logistics and warehouse facility on the outskirts of Paris, where it deposits used parts and broken bicycles and picks up new spare parts and replacement bicycles (Mairie de Paris, 2007; Nadal, 2007). Thanks to the barge and the 12 drop off points, broken bicycles and their replacements do not need to be carried by truck over long distances, saving costs and limiting emissions. Having the logistics and warehouse facility on the outskirts also helps limit costs.

Figure 19 - *Vélib* redistribution vehicle

Source: blog.velib.paris.fr

Figure 20 - A *Vélo'v* maintenance bicycle in Lyon, similar to those used in Paris for on-site maintenance of *Vélib* bicycles

Source: alain.caraco.free.fr

Figure 21 - *Vélib* station service vehicle

Source: www.nainposteur.org

Figure 22 – Outside and inside *Vélib*'s unique floating maintenance facility

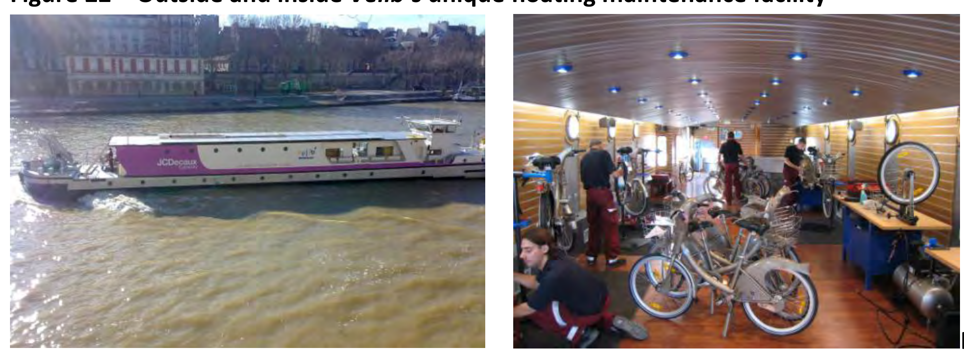


Photo: Tom Taylor

Photo: Ellen Cavanagh

In contrast to Paris, Rennes's modest *Vélo à la carte* system, with 200 bicycles and 25 stations, has a single vehicle used for redistribution of bicycles and system maintenance. The vehicle also doubles occasionally as a mobile customer service centre; once a week, it is parked for a few hours at the *Gares* public bicycle station, near the city's main train station, from where staff distributes key cards to new members and shows them how to operate the bicycle racks. The entire system is managed from a single computer, housed in a warehouse along with spare parts and bicycles. The control computer monitors the number of bicycles at each station; when a station is down to two bicycles or less, the computer automatically dispatches the redistribution van by sending a text message to the van driver's cell phone (Figure 23). The high level of automation means only one employee is needed at all times to run the entire system.

It is unlikely that any Canadian city would have a system as large as *Vélib*, both in terms of shear number of bicycles and stations as well as in terms of geographic coverage. The required number of support vehicles is likely to be much smaller, proportionally to the number of bicycles and stations. It should also be noted that the required number of support vehicles would also depend partly on the intensity of use of the system; systems with a high average number of users per bicycle could require more redistribution and maintenance equipment to provide good quality of service. As noted in Section 2.1.5, topography can have bearing on the number of redistribution vehicles; public bicycle systems operating in a hilly or sloped area can require additional redistribution vehicles to return bicycles from lowering lying stations to the more elevated ones.

Systems using a fixed-portable technology, such as Stationnement de Montréal's *Public Bike System*, will require vehicles able to lift and transport the portable station modules (see Section 3.5.2). These would be necessary for deploying stations in the spring and removing them in the fall, if the system shuts down during the winter. They could also be useful for installing stations at temporary locations for special events, such as festivals or for relocating stations that are underused. Adequately sized warehousing facilities would be required to hold station modules that are not in use; during a winter shutdown, that would mean the system's entire set of station modules.

Figure 23 – Dispatching the redistribution vehicle by text message in Rennes

Source: Vélo à la carte (2008)

Section Summary

System Operation Type

- **manual:** bicycles are taken out from and returned to staffed locations
    - less capital intensive
    - more staff intensive (more expensive to operate)
    - not suitable for high user turnover
- **automated:** bicycles are taken out from and returned to unstaffed locations
    - highly technology and capital intensive
    - staff efficient, less expensive to operate
    - ideal for high user turnover

Automated System Types

- **fixed-permanent:** bicycles taken out from and returned to special stands at fixed locations
    - efficient, easy to keep track of bicycle locations
    - requires excavation and heavy construction work – time, labour, and cost intensive to implement
    - expensive to alter the system after initial construction to correct inefficient station locations
- **fixed-portable:** bicycles taken out from and returned to special stands at fixed but non-permanent locations
    - same advantages as fixed-permanent
    - does not require heavy construction – fast, labour efficient, and inexpensive to deploy
    - can be redeployed rapidly and cheaply to correct inefficencient station locations
    - can easily be removed for the winter – highly recommended for Canadian context
- **flexible:** bicycles can left anywhere within a specified service area
    - obviates provision of stations – an important cost saving
    - trade off for the user: great flexibility as to where bicycles can be left after use but it might be difficult to get a bicycle in the first place
    - scattering of bicycles can complicate retrieval for maintenance and redistribution
    - sometimes hybridized with the fixed-system concept – i.e., some fixed location for pick up and drop off are provided

Capital Resources

- a fleet of vehicles for redistribution of bicycles between stations, station maintenance, and light bicycle maintenance
- warehouse facilities for heavy bicycle maintenance, for storage of spare parts and spare bicycles and, in colder locations, storage of bicycles and other equipment if the system shuts down in the winter
- IT equipment for monitoring the status of the stations and the locations and status of bicycles
- a logistics centre for coordinating redistribution, maintenance, and repair operations as well as for customer service

Human Resources

- **fieldwork:** redistribution of bicycles, station maintenance and minor bicycle repairs
- **workshop:** major bicycle repairs
- **warehouse:** storage of spare parts, spare bicycles, and other equipment
- **call centre:** subscription management and customer assistance

4 Financing Your System

4.1 Costs

An automated public bicycle system will require a significant initial investment for planning, for the procurement of equipment, and for construction costs for stations. It is difficult to obtain data on the capital costs because public bicycle systems are seldom financed directly by the public sector. Rather, most cities give private companies advertizing rights in exchange for providing their public bicycle system (more detail in Section 4.2.2).

4.1.1 Startup Costs

The two main operators of fixed public bicycle systems, JCDecaux and ClearChannel, are secretive about the capital and operating costs of the systems that they run. All that is known about *Vélib*, for example, is that the startup costs for the initial system launched in the summer of 2007 were around €90 million (C$142 million), based on statements by various City and JCDecaux officials (Nadal, 2007). With 20,600 bicycles, this amounts to an initial investment of about C$6,900 per bicycle.

Minneapolis, Minnesota is in the process of developing a public bicycle system that will be a run by a non-profit organization (see Case Study, Section 6.5). As it is run by a non-profit with public subsidies, details about costs have been released to the public. The business plan for the bicycle sharing system (CoLNSF, 2008) that is to initially have 1,000 bicycles and 75 to 80 stations has pegged start up costs at US$3,387,000 (C$4,200,000) or approximately C$4,200 per bicycle. The startup costs are broken down as follows:

- US$3,200,000 (C$3,970,000) for bicycles and stations
- US$106,000 (C$130,000) for maintenance equipment and promotions
- US$80,000 (C$100,000) for salaries and administration

4.1.2 Ongoing Costs

Information on operating costs of existing public systems is scarce. One source (NICHES, 2007) cites the annual operating costs of Lyon's *Vélo'v* (a JCDecaux system) and Rennes's *Vélo à la carte* (a Clear Channel system) as both being about €1,000 (C$1,600) per bicycle per year. Another source (IDAE, 2007) suggests that the costs could be much higher – anywhere from €1,400 to €3,900 (C$2,200 to C$6,200) per bicycle per year. The Minneapolis bicycle sharing business plan pegs annual operating costs at US$1,574,000 (C$1,952,000) for 1,000 bicycles, or approximately C$2,000 per bicycle.

At an annual cost of C$2,200-6,200 and assuming an average of 10 users per bicycle per day, the operating cost per rider would be C$0.60-$1.70.

4.1.3 Theft and Vandalism

Despite preventive measures, such as the use of custom components and electronic user identification, theft and vandalism of bicycles can be a significant ongoing cost factor. The replacement costs for smart bikes in Europe range from €250 to €1,200 (C$400 to C$1,900) (NICHES, 2007). Unsurprisingly, rates of theft and vandalism vary from city to city. Paris, for example, appears to have the highest rate of theft and vandalism of any city with a public bicycle system (Figure 31). Between the system's spring 2007 launch and early 2009, due to rampant theft and vandalism, the entire initial fleet of 20,600 bicycles has been replaced at a cost of €400 (C$630) apiece (BBC News, 2009). The rate at which bicycles are stolen in Paris is around double the rate in Lyon, which uses the same JCDecaux Cyclocity technology.

JCDecaux has requested that the City of Paris inject public funds to help cover the cost overruns associated with repairs and fleet replacement. The advertiser has argued that since theft and vandalism are questions of public order, which is the City's responsibility, the City is partly liable for the costs. Agreements made with private operators must take into account the risk of the operator pulling out if operations are not profitable.

Table 7 – Initial and ongoing costs for public bicycle systems

cost factor	initial cost	ongoing cost
planning	$	
bicycles	$$	$-$$$*
stations	$$$	
bicycle maintenance and repairs (parts, staff, and facilities)	$$	$$$
bicycle redistribution (vehicles and staff)	$$	$$$
station maintenance		$$
control and management system (software, key cards, and readers)		$$$
marketing		$

Source: based on IDAE (2007)
* for replacement of stolen or damaged bicycles

4.2 Sources of Revenue

Public bicycle systems are generally not profitable. Revenues from membership and usage fees, which are generally kept low to attract and retain large pools of users, are insufficient to recover the capital costs and to cover ongoing operating costs. Most public bicycle initiatives therefore require a continuous stream of external funding. This funding can come either from the public sector or the private sector, or a combination of the two depending on the business model being used.

4.2.1 User Fees

Most public bicycle systems require users to register and pay a membership fee. As most systems aim to have a large pool of registered users, membership fees are generally low. Annual membership fees are typically in a range of $50 to $80 per year. Major European public bicycle systems, including *Vélib* and *Bicing*, charge around €30 (C$50). Montreal's *BIXI*, which is not run by an advertising company and must rely more on revenues from user fees, will charge C$78 for an annual membership.

Users of most systems are also charged time-dependent usage fees each time they take out a bicycle (e.g., *Vélib*, *Call a Bike*, *BIXI*). The usage fees are usually designed to encourage short-term uses, compelling users to promptly return the bicycle to a station (or to terminate their session in the case of a flexible system). Many systems have a grace period, usually half an hour, during which usage is free; afterwards, fees grow exponentially with every additional half-hour of use (e.g., *Vélib*, *BIXI*). Most fixed systems give users an additional grace period if they check in at a station that is full and are forced to proceed to another station to drop off their bicycle.

See the Case Studies in Section 6 for examples of membership and usage fees of existing public bicycle systems.

4.2.2 Public Private Partnership

The overwhelming majority of public bicycle systems in Europe are operated as public-private partnerships (PPPs) with large advertizing companies. In exchange for advertising space in the public realm, the advertising company commits to providing equipment for and overseeing the operations of a public bicycle system. The advertising company allocates part of its revenues to the public bicycle system. If the advertiser's revenues are expected to be larger than the operating cost of the bicycle system, the remainder is shared between the advertiser and the municipality (e.g., *Vélib*). If the expected advertizing revenues are smaller than the cost of operating the bicycle system, the municipality covers the difference (e.g., *Bicing*).

A municipality usually enters this type of PPP by issuing competitive call for tenders for advertizing space in the public realm in which it requires bidders to provide a public bicycle system conforming to certain parameters. The contract between the municipality and the advertiser specifies how responsibilities are to be shared (Table 8).

The advantage for the municipality of using this business model is that little or no direct public funding is required to set up and operate the public bicycle system. Consequently, the system can appear to have little or no cost to the taxpayer. However, although public money need not be spent on the public bicycle system, there is still a cost to public sector in the form of forgone advertizing revenues.

There are currently two large, international advertisers that offer turnkey public bicycle systems: JCDecaux, whose *Cyclocity* systems are operating in France, Austria, Spain, Belgium and Ireland (see Section 6.1); and Clear Channel, whose *SmartBike* systems are operating in France, Norway, Sweden, Spain, and the US (so far only *SmartBike DC* – see Section 6.3). A number of smaller competitors also operate in Europe.

Table 8 – Typical distribution of responsibilities and cost burden in a PPP business model for public bicycles

partner	responsibilities
municipality	roles: ▪ provides space for advertising ▪ designates station locations ▪ provides space for stations costs: ▪ construction costs related to station installation (fixed-permanent system only) ▪ may cover a portion of procurement costs for bicycles, stations, and service vehicles ▪ may cover a portion of operating costs
advertiser	roles: ▪ provides bicycles, stations, and service vehicles ▪ provides IT infrastructure for system control and for financial transactions ▪ operates the system: maintenance, repairs, bicycle redistribution ▪ provides customer service through website and call centre ▪ hires and trains all required staff costs: ▪ equipment: bicycles, stations, service vehicles, IT infrastructure (may be shared with municipality) ▪ operations: staff, maintenance supplies, replacement parts, replacement bicycles (may be shared with municipality)

4.2.3 Alternative Business Models

A public private partnership with an advertiser is not necessarily the only solution for financing a public bicycle system. The alternative is for the municipality or a delegated authority (such as a non-profit organization) to develop its own business model using a combination of user fees, direct public subsidies, corporate sponsorships, and advertizing licenses. The municipality or delegated authority will need to procure the bicycles and other equipment from a vendor and either contract the vendor to operate the system or operate it itself. Examples of systems with alternative business models include *Bycyklen* in Copenhagen, *BIXI* in Montreal, and the *NiceRide* in Minneapolis.

Copenhagen, Denmark

Copenhagen's *Bycyklen*, for example, depends on a combination of public subsidies and multiple sponsorships to fund the system; the system charges no membership or user fees. The sponsorship scheme used by *Bycyklen* is quite unique. Rather than placing ads on the bicycle stations, sponsors' logos are instead painted onto the bicycles themselves. The bicycles' spokes are entirely covered with plates, providing a large surface area for displaying sponsors' logos (Figure 24).

Figure 24 - *Bycyklen* bicycles in Copenhagen display sponsors' logos on their frames and wheels

Source: www.mujermagnolia.com

Montreal, Quebec

Montreal's soon-to-be-launched *BIXI* is to rely on a combination of user fees, corporate sponsorship, and advertizing licenses; the system is supposed to run without any ongoing public funding. The City of Montreal only allocated an initial startup fund of $15 million that was used primarily to develop the *BIXI* technology, to plan the initial implementation of the system, and to begin marketing the system to the public (Ayotte, 2008). The system is not owned and will not be operated by the City per se; rather, Stationnement de Montréal, a city-owned company that oversees on-street parking and municipal parking lots, owns and will operate the system. Ultimately, the City assumes the financial risks, and any profits that system might generate will accrue to the City. In order to make the system financially self-sustaining, Stationnement de Montréal has struck a sponsorship deal with the giant aluminum conglomerate Rio Tinto Alcan. The company has offered to provide aluminum for construction of the bicycles as well as funding for system operations (Rio Tinto Alcan, 2008). Another partnership has been established with Astral Media Outdoor (AMO), a media conglomerate that already provides street advertizing in Montreal. Under the deal with Stationnement de Montréal, AMO will place advertizing on the backside of the service terminals on 200 of the 300 planned *BIXI* stations.

Minneapolis, Minnesota

The City of Minneapolis has decided to pursue a non-profit ownership model for its soon-to-be-launched public bicycle sharing system, dubbed *NiceRide*. The system will thus be owned and operated by a local non-profit organization and will be subsidized by the City, by the US Federal government, and private sponsorships. The City of Minneapolis retained the City of Lakes Nordic Ski Foundation, a local non-profit organization to that promotes skiing and other outdoor sports and organizes Nordic skiing and running events, to draw up a business plan for a non-profit bicycle sharing system for the Twin Cities.

According to the business plan for *NiceRide* released by the City of Lakes Nordic Ski Foundation (2008), the reasons pursuing this business model, rather then the more common PPP with an advertising company include the following:

- A local non-profit corporation is likely to better serve the users' interest. Its primary customers will be the bicycle system's users and its main source of revenue will be membership sales. It will have to satisfy the users needs in order to survive. In contrast, an advertising company's primary customers are advertisers and its main source of revenue is selling advertising space. There is an inherent risk that the bicycle system's users needs would take the back seat to those of advertisers.
- A local non-profit corporation can obtain capital funding needed for initial equipment purchase through a combination of public subsidies and private sponsorship.
- A local non-profit is likely to be well positioned to operate the system at a low cost by using local contractors and employees and by obtaining cash and in-kind sponsorship.
- A local non-profit corporation can leverage the popularity of bicycle sharing to accomplish other goals, including:
    - educating the public about bicycle safety and ways of reducing automobile dependency
    - creating healthy lifestyle and wellness programs with local employers
    - advocating for bicycle-friendly infrastructure and bicycle-supportive policies

Other reasons for avoiding the PPP business model are that some municipalities may wish to limit the proliferation of advertizing in the public realm for various reasons, or may be simply be unable to enter into a new contract with an advertizing company due to existing obligations.

Section Summary

Costs

- onetime startup costs are likely to be between C$4,000 and C$7,000 per bicycle
- operating costs are likely to be between C$2,000 and C$6,000 per bicycle per year
- vandalism can be a major ongoing cost factor
  - cost is likely to vary considerably from city to city
  - replacement costs for bicycles are generally between C$400 and C$1,900 per bicycle

Sources of Revenue

- most systems require users to purchase a membership
  - to have a large pool of registered users, membership fees are set low – typically C$50 to C$80 per year
- most systems also assess usage fees
  - usage is in most cases free for the first half hour of use and then grow exponentially, encouraging high turnover
- the vast majority of bicycle sharing systems operate as public-private partnerships (PPPs) with advertising companies
  - municipality provides company with advertising space in exchange for operating the public bicycle system
  - the municipality does not need to spend public money on starting up and operating the system – the private partner shoulders the costs
  - the cost to the municipality is hidden – the municipality forgoes advertising revenues
  - there are two multinational advertising companies offering complete turnkey bicycle systems: JCDecaux and Clear Channel
- a growing number of systems, including ones currently being launched in North America, are rejecting the PPP business model
  - the municipality or a delegated authority (such as a non-profit organization) operates the system
  - revenues from a combination of user fees, direct public subsidies, corporate sponsorships, and advertizing licenses
  - Examples include Copenhagen's Bycyklen, Montreal's BIXI, and Minneapolis's NiceRide
- advantages of having a local authority or non-profit organization operate the public bicycle system include:
  - better serving the public interest, rather than the interests of advertisers
  - being able to access public subsidies
  - operate the system at minimal cost by using local contractors and employees and by obtaining cash and in-kind sponsorship
  - leverage the popularity of bicycle sharing to educate the public about bicycle safety and car-free living
  - create healthy lifestyle and wellness programs with local employers
  - advocate for bicycle-friendly infrastructure and bicycle-supportive policies
  - avoid proliferation of advertising in the public realm

5 Implementing Your System

5.1 Planning

5.1.1 Assembling a stakeholder group

The implementation of a public bicycle system is likely to involve a variety of stakeholders. Involving them early on in the planning process will help build support for the initiative and will pave the way for a smooth implementation. The key types of stakeholders and their likely roles are listed in Table 9.

5.1.2 Mobility Study

A mobility study can provide valuable information that can help determine the spatial distribution of public bicycles and stations. Some municipalities in Canada already perform studies of this type at regular intervals. The most prominent example is the Greater Montreal's Origin-Destination Survey. The survey is performed every five years, collecting rich travel data from a large sample of citizens from across the metropolitan area. It is recommended that municipalities that do not possess such data perform at least a rudimentary mobility study before planning a public bicycle system.

Table 9 – Key stakeholders and their potential roles

stakeholder	potential roles
politicians	▪ provide required resources ▪ enact regulatory changes, if necessary ▪ ensure cooperation between municipal agencies
planners	▪ ensure integration of the system with bicycle infrastructure ▪ ensure integration of the system with public facilities
transportation authority	▪ operate the system (potentially) ▪ ensure integration of public bicycle infrastructure with public transit infrastructure ▪ promote the use of public bicycles to current transit users ▪ provide financial incentives
parking authority	▪ operate the system (potentially) ▪ provide space public bicycle stations
traffic and roads department	▪ coordinate construction of the stations ▪ make change to road infrastructure, signage and signaling to support increased bicycle traffic volume
police	▪ maintain a safe environment for public bicycles ▪ enforce the safe use of public bicycles ▪ protect the system from theft and vandalism
community groups & NGOs	▪ build support among citizens ▪ provide bicycle safety education ▪ promote the use of public bicycles
merchants associations	▪ build support among merchants ▪ mitigate opposition to removal of parking spaces ▪ find sponsors

A mobility study consists of collecting information about a large number of trips taken within the urban area. At minimum, the information about each trip should include:

- origin and destination

- time of day and day of the week
- the mode chosen (or modes in the case of an intermodal trip)
- age of the trip maker
- trip purpose

This survey should be conducted with a random representative sample of the population – as large a sample as budgetary constraints allow. In spatial terms, the survey should be conducted across the metropolitan area and not merely in the areas in which public bicycles will most likely be implemented. Commuters who live outside the likely service area of the public bicycle system but work or study within that area are potential users and their travel habits need to be known.

5.1.3 Service Area

The mobility study can be used to determine the ideal service area for the public bicycle system. In general terms, this should be an area that surpasses the other parts of the metropolitan area in terms of:

- number of short trips
- levels of transit use
- levels of walking and cycling

In most Canadian cities, core areas that feature a combination of high residential, employment, and student densities and that are rich in services and amenities should be the most appropriate areas for deploying public bicycles systems.

5.1.4 System Size

Once the service area has been determined, it will be necessary to determine what number of bicycles will be appropriate. Based on experience in Europe, most public bicycle system vendors recommend providing one bicycle for every 13 to 20 expected annual subscribers (NiceRide, 2008). The number of subscribers can be estimated based on the residential, employment, and student populations within the service area.

For example, the business plan for the Minneapolis *NiceRide* public bicycle system (CoLNSF, 2008) assumes that 7% of the student population of about 50,000, 5% of the residential population of about 100,000, and 3% of the employee population of about 200,000 within the service area will take out annual subscriptions, which adds up to 14,500 anticipated annual subscribers. It was determined that 1,000 bicycles, or 14.5 subscribers per bicycle, would be an appropriate to have for the launch of the system. The business plan claims that a substantially smaller number, such as only 800 bicycles at launch, would most likely subscription sales to be capped early on after the launch.

Table 10 below shows the number of public bicycles per square kilometer of service area and the number of residents per public bicycle in selected cities at the time the public bicycle system was (or will be in the cases of Montreal and Minneapolis) launched. The number of bicycles per square kilometer ranges from a low of 50 in Minneapolis to a high of 167 in Paris. Meanwhile, Paris has the lowest number of residents per bicycle at 135, while Barcelona has the highest at 333. Minneapolis and Montreal are both much closer to Paris in terms of the number of residents per bicycle, with 171 and 148 respectively. Despite having fewer residents per bicycle, these systems are likely to have a high number of non-resident users – i.e., commuters who live elsewhere in the metropolitan area – not unlike like Paris.

Table 10 - Statistics on bicycles, service areas, and residents at the launch of selected public bicycle systems

city (launch year)	bicycles	service area (km^2)	bicycles $/km^2$	residents in service area	residents/bicycle
Paris (2007)	16,000	96.1	167	2,166,200	135
Lyon (2005)	3,000	45.1	67	466,400	155
Barcelona (2007)	3,000	50.0	60	1,000,000	333
Montreal (2009)	2,400	24.1	100	356,200	148
Minneapolis (2010)	1,000	20.2	50	171,090	171

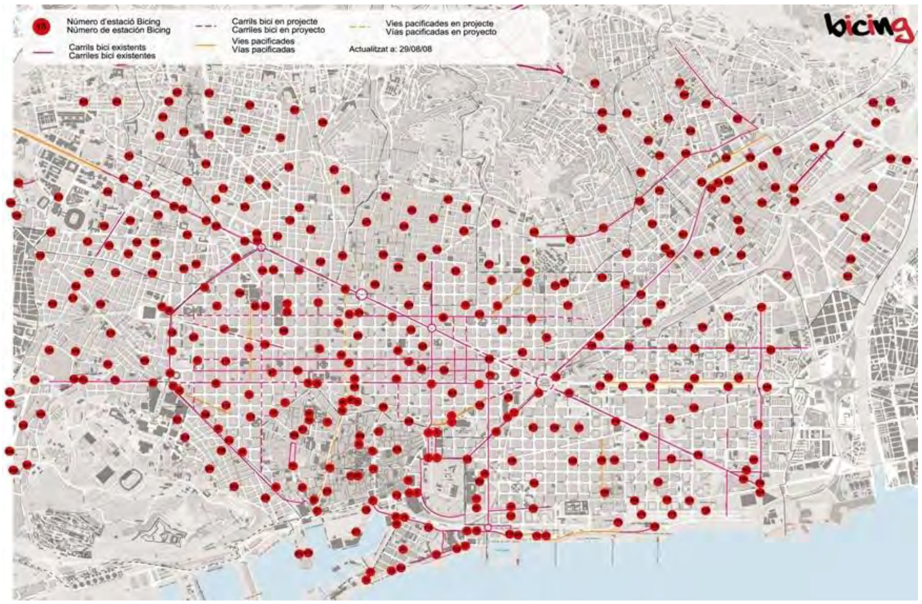
Source: CoLNSF (2008)

For Canadian cities, the ratio of residents to public bicycles at the moment a public bicycle system is launched should probably in the same range as those in Montreal and Minneapolis – i.e. 150-175 bicycles per resident.

5.1.5 Station Distribution Plan

Tailoring the system to match expected demand is especially crucial for a fixed-permanent system because excessive or insufficient station capacities could be expensive to correct. In the case of fixed-portable and flexible systems, the distribution of bicycles and stations can be adjusted to match actual demand at little cost after the system is launched. Nonetheless, this does not obviate careful planning of station distribution. The better the distribution of bicycles and stations matches actual demand at the moment the system is launched, the more efficiently the system will operate. A system that runs smoothly from the beginning is more likely to establish a good reputation and build a pool of loyal users. Conversely, a poorly distributed system, with stations prone to filling up or running out of bicycles, might alienate early adopters and establishing a poor reputation for reliability. Such a reputation could limit the size of the pool of users and might be difficult to shake even after corrective measures have been taken.

Figure 25 - Station distribution map of Barcelona's *Bicing*



Source: ClearChannel Outdoor

As a general rule, stations should be distributed at points or in areas that are strong trip generators – in other words, points or areas in which many trips begin and many trips end. Places that generate a large share of trips with the following properties are likely to be the best locations for public bicycles:

- trips under 5 km – the maximum practical length of a utilitarian bicycle trip
- trips taken by young adults 18 to 35 years old – the age range most likely to use bicycles
- walking and cycling trips

Such places are likely to include the following:

- transit nodes
- educational institutions
- major public facilities: museums, galleries, libraries, parks, etc.

It is also advisable to locate stations along bicycle routes (

Figure 26), especially wherever these routes run close to one of the above types of land uses.

If a mobility study has not been carried out, due to budgetary constraints or other reasons, the general rule is to deploy a public bicycle system in the metropolitan core, where the population and employment densities are the highest and where the land uses are the most diverse. It is suggested that initial service area be chosen conservatively, encompassing only the most dense and mixed use parts of the city. If the system succeeds, the service area can be expanded incrementally outward. Again, stations should be placed near the abovementioned land uses: transit nodes, educational institutions, and various major public facilities.

Figure 26 - A *V'eol* station on a bicycle route in Caen, France

Source: ClearChannel Outdoor

Once the approximate spatial distribution of stations has been determined, finer-grained considerations must be made to determine the precise location of the stations. Generally, stations should be placed in highly visible and accessible locations, where users can easily find them. Preferably, stations should be placed close to street intersections, where they can be seen from a distance in several directions. Stations should be placed where they do not to interfere with other users of the street, especially pedestrians. For this reason, they should not be placed on sidewalks unless they are very wide. For example, on-street parking spots near intersections tend to be the ideal locations for implementing public bicycle stations - they afford good visibility and do not interfere with pedestrian traffic on the sidewalk.

5.2 Implementation

5.2.1 Marketing Strategy

An effective marketing strategy is essential for attracting new users to the public bicycle system, especially when the system is first being launched. According to a business plan for a soon-to-launched public bicycle system (CoLNSF, 2008), most existing public bicycle system have devoted considerable effort towards:

- building a highly recognizable, unique brand and developing a local identity
- a major promotional effort prior to the system's launch, with the objective of creating awareness of the service and driving subscriptions

Figure 27 - Examples of public bicycle system branding

The promotional campaign should be geared towards 18 to 34 year olds, as this demographic segment is highly mobile and most likely to use bicycles. It should stress the benefits of using bicycles in general (listed in Section 1.6) as well as the specific advantages offered by the public bicycle system (listed in Section 1.7). The former is especially important in the North American context, given that the bicycle is far from being a mainstream form of urban transportation in all but a handful of cities. At the same time, the campaign should also address the common perceived barriers to bicycle use, especially that it is unsafe (see Section 1.4).

The promotional strategy for a public bicycle system can also seek to legitimize the bicycle as mode of urban transportation and stress that bicycles do belong on city streets. To this end, the involvement of public officials can be essential. Local politicians in particular can be instrumental in helping to convey the message that bicycles are a legitimate and, moreover, very desirable form of transportation.

In Montreal, for example, a major publicity campaign was held in the fall of 2008, in anticipation of the system launch in the spring of 2009. The campaign included the following elements:

- **Naming contest:** A public contest to find a name of for the public bicycle system, announced on the City of Montreal's website and through the main media outlets, was held. The main prize, awarded to the Montreal residents who proposed the name *BIXI*, was a lifetime subscription to the new service.
- **Demonstration at major public venues:** Over the course of a month, a station and several prototype *BIXI* bicycles along with a team of animators called the *BIXI Squad* were taken on a tour of major public venues in within the planned service area. These included major transit stations, parks and plazas, and public food markets. The animators demonstrated the system to members of the public and allowed them to take test rides (
- Figure 28).
- **Founding members campaign:** To drive early subscriptions, a promotional campaign has been launched to encourage members of the public to become "founding members" of *BIXI*. The first 2,000 people to purchase an annual subscription received a variety of prizes, including a limited electronic key, for unlocking *BIXI* bicycles, a ticket to a museum exhibition on bicycles, and other unspecified "exclusive privileges".

Figure 28 - A team of animators was hired in Montreal to promote *BIXI* and show the public how to use the system

Source: www.bixisystem.com

In terms of driving visibility of *BIXI* and legitimizing bicycle use, municipal politicians in Montreal particularly Gérald Tremblay, the mayor, and André Lavallée, the executive committee member in charge of transport, have both used many media appearances to promote *BIXI* and speak about the role of the bicycle as a mode of transportation. This included the official christening of the system as *BIXI*, a major publicity event held in October 2008, in which the media saw Mayor Tremblay ride in on a prototype *BIXI* bicycle and give a speech expounding the merits of the *BIXI* system and of the bicycle as a important mode of urban transportation for the future.

In addition to general marketing, specific measures for driving subscription sales can be undertaken. These can include pre-sales of discounted long-term subscriptions before the system is launched. Discounts could also be provided during the first few months of operation. To bolster public bicycle and public transit intermodal travel, discounted or free subscriptions could be given to transit pass holders. In cities that have electronic transit passes with user identification, the transit pass itself could serve as the mode for accessing the public bicycle system.

Another way of bolstering subscriptions is through collaboration with various local institutions and businesses. In Montreal, Stationnement de Montréal has reportedly struck agreements with the City of Montreal and the boroughs in which *BIXI* will operate to, under which they have agreed to purchase blocks of annual subscriptions for their employees. In Minneapolis as another example, *NiceRide* intends to drive subscription sales through the following types of collaborative programs:

- **employer-based health and wellness programs:** participating employers provide employees with free or discounted subscriptions
- **tourist programs:** to drive sales of short-term subscriptions (one-day or one-week), subscriptions and promotional packages will be available at hotels and museum information desks
- **subscriber benefits program:** restaurants and other small businesses within *NiceRide*'s service area will be marked on the official service map available online and at each public bicycle station in exchange for providing customers with a small discount (10%) on their purchases

5.2.2 Timing

Production of the bicycles and other hardware is likely to take on the order of several months, depending on the number of bicycles and stations required. For example, Public Bike System, the subsidiary of Stationnement de Montréal that has been created to sell the *BIXI* bicycle system to other cities, has offered to produce 1,000 bicycles and 75 stations for Minneapolis within four months of receiving a firm order (CoLNSF, 2008).

In the case of fixed-permanent system, a considerable amount of time, on the scale of several months, is also required for construction work related to the installation of the bicycle stations. In Paris, for example, the construction of the initial 750 *Vélib* stations for the system launch on July 14th 2007 required 4½ months of work by 150 installation teams working simultaneously under the supervision of the 20 civil engineering contractors (JCDecaux, 2008). In the case of a fixed-portable system, the deployment of the stations will take a much shorter amount of time – the entire system could be deployed in a matter of days.

The production and installation of the system should be timed to allow a launch in the spring or early summer at the latest, when bicycle use resumes after the winter lull. If possible, the launch should be timed to coincide with a major public event – preferably one connected to bicycle use, such as a "bicycle week" or Car Free Day (IDAE, 2007).

5.2.3 User Assistance and Troubleshooting

For a certain period of time after the system has been launched, the operator should temporarily post staff at some or all of the public bicycle stations. The staff would be present to assist new users with purchasing memberships, operating station equipment, adjusting and operating the bicycles, and so on. They could explain the conditions of use of the system and provide general cycling safety advice as well. Moreover, they could help identify any bugs in station hardware and software and, if necessary, provide minor repairs on the bicycles and stations.

5.3 Follow Up

5.3.1 Monitoring Usage

Once the system is launched, usage should be monitored on an ongoing basis. Usage is tracked automatically by most smart bike systems. They generally record information such as who uses which bike, from which station to which station, and at what time. Statistics on usage per bicycle per day, usage per station, user demographics, and so on can easily be calculated. Such statistics will help identify problematic aspects of the system.

5.3.2 Monitoring User Satisfaction

Aside from monitoring usage, it is also advisable to gauge user satisfaction with the system at regular intervals. This information cannot be obtained directly from smart bike hardware but will rather have to be obtained through user surveys. In Paris for example, Taylor Nelson Sofres, a multinational market research firm, conducted a general user satisfaction survey in the spring of 2008, roughly one year after the launch of *Vélib* (Maire de Paris, 2008).

The 878 participants were asked to rate their satisfaction with regards to the following:

- overall satisfaction
- ease of use
- modes of payment available
- cost of using the service
- availability of bicycles at stations
- availability of spots at stations for bicycle returns
- quality of the bicycles and maintenance

The survey also asked long-term membership holders whether they planned to renew their membership and whether they would recommend taking out a membership to a friend. These types of questions will help identify aspects of the service that require improvement.

A periodic user survey can also be an opportunity to investigate what effect the public bicycle has had on people's mobility and their travel behaviour. For example, the first anniversary *Vélib* survey included a number of questions aiming to investigate exactly these issues. Participants were asked whether:

- *Vélib* allowed them to make trips that were previously impossible
- *Vélib* complement the existing offering of transportation options
- they used their car less since starting to use *Vélib*

A few other questions were designed specifically to probe whether users were making intermodal trips using *Vélib*. Participants were asked whether:

- *Vélib* was used at the beginning of intermodal trips
- *Vélib* was used at the beginning of intermodal trips
- *Vélib* was used to link two other modes of transportation during intermodal trips

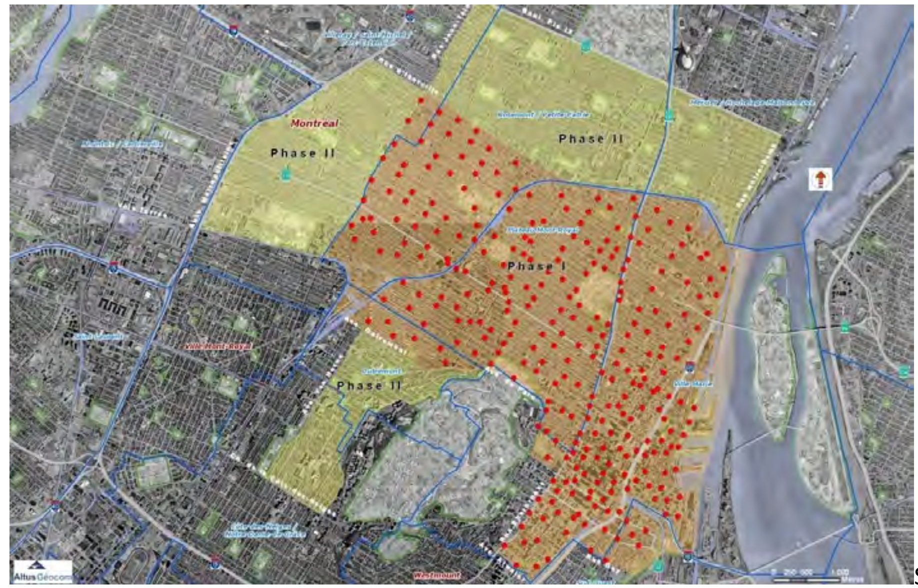
It is recommended that a diagnostic survey of this type be performed within months or a year of the public bicycle system's launch to verify whether the municipalities goals in terms of reducing automobile use, increasing the overall mode share of bicycles, increasing the number of intermodal trips involving bicycles, and so on. This type of information can serve as the basis for implementing corrective measures to improve the quality of the service and increase the number of users (Table 11).

5.3.3 Improving the System

The continuous monitoring of usage facilitates the identification of problems related to station capacity. After a certain period of time, the number of daily users will stabilize and daily patterns of usage of the public bicycles should establish themselves. Certain problematic stations are likely to emerge – i.e., stations that systematically run out bicycles or that fill up with bicycles at a rate with which redistribution operations cannot keep up. The capacity of such stations should be prioritized for expansion. Alternatively, instead of expanding the problem stations, new stations could be added in close proximity. If the system is fixed-portable, it might be possible to relocate underused stations from elsewhere in the service area to the problem spots.

Regular monitoring of user satisfaction and travel behaviour through user surveys will help the system operator identify various aspects of the system in need of improvement. Addressing these issues with appropriate corrective measures will help keep current users and may remove barriers that are preventing the user pool from growing. Corrective measures for certain potential problems are proposed in Table 11.

Figure 29 - Phase I and the planned Phase II service areas for Montreal's *BIXI*



Source: Stationnement de Montréal

5.3.4 Expanding the System

If successful, the system can either be expanded in terms of the number of stations and bicycles, or in terms of the size of the service area, or both. If there are widespread problems with capacity, increasing the number of stations and bicycles within the current service area should be considered before expanding the system's coverage. The service area should only be expanded to adjacent areas that are likely to generate bicycle trips.

Given the runaway success of *Vélib*, the supply of stations within the original service area has already been intensified. An expansion of the service areas into some of the neighbouring municipalities is currently under way. Lyon has also added stations to its existing service area but so far has not manifested any ambition to expand *Vélo'v* beyond its current service area, which consists of the two core municipalities of Greater Lyon – the Lyon proper and Villeurbane. Mobility studies have found that there is insufficient demand for public bicycles in the municipalities outside the urban core. As for Montreal's *BIXI*, which has yet to be launched, there is already a planned expansion of the system's service area into the dense neighbourhoods surrounding the initial service area (Figure 29).

Table 11 – Potential problems and suggested corrective measures

problem	possible corrective measures
station is often empty / station is often full	▪ increase station capacity ▪ add more stations nearby ▪ increase redistribution capacity
station is underused	▪ relocate the station to a more visible location ▪ relocate the station to a busier location – i.e., with more pedestrian and vehicular traffic
system as a whole is underused / the user pool is not growing	▪ reduce membership fees ▪ provide temporary financial incentives ▪ intensify marketing ▪ relocate least used stations ▪ improve station visibility ▪ improve bicycle infrastructure and/or calm traffic within the service area
system is not used in combination with transit	▪ advertise on the transit system ▪ provide free or discounted memberships to transit pass holders ▪ improve visibility of public bicycle stations at transit nodes

5.3.5 Maintenance and Repairs

The public bicycle fleet and the network stations require continuous maintenance, performed at regular intervals, as well as special repairs performed when needed. In Lyon, for example, where each bicycle is used daily by 7 to 15 people, the fleet is on an eight-day maintenance cycle – i.e., each bicycle in the fleet undergoes regular maintenance approximately every eight days.

Most smart bike systems are designed to detect problems with individual bicycles. Rennes *Vélo à la carte*, the first true smart bike system, has the simplest fault detection system. The central control system detects whether any given bicycle is systematically being taken out and immediately returned and flags it for inspection by a mechanic (IDAE, 2007). In newer systems, such as *Vélib*, *Vélo'v*, and *Bicing*, a similar logic is used to flag bicycles for inspection, but with the addition of other fault detection features, such as tire pressure sensors. Information from sensors on the bicycle is relayed to the central control system every time a bicycle is docked (Nadal, 2007). When the central control system registers a problem with a docked bicycle, it will dispatch a mechanic to inspect it. The system will not allow the bicycle to be taken out again until it has been cleared by a mechanic. Most public bicycle systems have mobile mechanics that perform small repairs on-site (see Figure 20); for major repairs, bicycles are taken to workshops.

Section Summary

Planning

Assemble a stakeholder group, including:

- politicians
- planners
- transit authority
- parking authority
- traffic and roads department
- police
- community groups & NGOs
- merchants associations

Conduct a mobility study, including:

- trip origins and destinations
- time of day and day of the week
- the mode chosen (or modes in the case of an intermodal trip)
- age of the trip maker
- trip purpose

Determine Service Area

- service area should be an area that surpasses the rest of the metropolitan area in terms of:
  - number of short trips
  - levels of transit use
  - levels of walking and cycling
- in Canadian cities, core areas with a combination of high residential, employment, and student densities and rich in services and amenities should be the best suited for public bicycles

Determine System Size

- estimate the expected number of annual users
- set number of bicycles to have one for every 13 to 20 expected annual subscribers
- if a high number of short-term/occasional users is expected, the system could be sustainable with a lower number of annual subscribers per bicycle

Devise station distribution plan

- the number of stations should be sufficient to cover the service area with stations no more than 300 m apart
- the total number of docks at the stations should be 50-70% greater than the number of bicycles
- station capacities should be highest near:
  - generators of trips under 5 km – the maximum practical length of a utilitarian bicycle trip
  - generators of trips taken by young adults 18 to 35 years old – the age range most likely to use bicycles
  - generators of trips whose mode is walk or bicycle
  - transit nodes
  - educational institutions
  - major public facilities: museums, galleries, libraries, parks, etc.

- select highly visible locations for stations, such as major intersections
- on-street parallel parking spots make ideal locations of public bicycle stations

Implementation

Marketing Strategy

- a marketing strategy should:
    - build a highly recognizable, unique brand and developing a local identity
    - include a major promotional effort prior to the system's launch, with the objective of creating awareness of the service and driving subscriptions
- promotional campaigns should:
    - be aimed at 18 to 34 year olds
    - promote the general benefits of cycling
    - promote the specifc benfits of the public bicycle system
    - address percieved barriers to cycling, such as safety concerns
- local politicians have an important role to play in promoting the public bicycle system and helping to legitimize the use of the bicycle of a mode of urban transportation
- measures should be taken to drive subscription sales, including:
    - discounted subscription prior to system launch or during first few months after launch
    - discounts or free subscriptions for transit pass holders
    - collaborative programs with local institutions and business

Timing

- allow several months for the production of bicycles and station hardware
- if using a fixed-permanent system, allow a few months for station construction
- if using a fixed-portable system, allow a few days to deploy stations, or a week or two if the stations are numerous

User assistance and troubleshooting

- deploy additional staff for the first few weeks after system launch to supervise stations, help new users, and troubleshoot any initial bugs

Follow Up

Monitoring Usage

- smart bike systems continuously collect data on bicycle usage

Monitoring User Satisfaction

- users satisfaction with the system should be periodically gauged with user surveys
- surveys topics should include:
    - overall satisfaction
    - ease of use
    - modes of payment available
    - cost of using the service
    - availability of bicycles at stations

        - availability of spots at stations for bicycle returns
        - quality of the bicycles and maintenance
    - survey can also probe users on the public bicycle system's impact on their travel behaviour
        - is the system allowing them to make trips that were previously impossible
        - does the system complement the existing offering of transportation options
        - do they used their car less since starting to use the system
        - do they use the system at the beginning or at the end of intermodal trips with public transit

Improving the System

- corrective measures for basic problems suggested in Table 11

Expanding the System

- two modes of expansion:
    - increasing the number of stations and bicycles within the existing service area
    - adding new stations outside the current service area – i.e., expanding the servce area
- expanding the service area not recommended until problems ironed out from existing service area

6 Case Studies

6.1 Vélib – Paris, France

City/metro population: 2.2 million/12.0 million
City population density: 24,948/km^2
System type: permanent fixed station
Operator: JCDecaux Cyclocity
Year started: 2007
Bicycles: 20,600 (end of 2007)
Stations: 1,451 (end of 2007)
Other cities using this system: France: Lyon, Aix-en-Provence, Besançon, Marseille, and Mulhouse; Austria: Vienna and Salzburg; Spain: Gijon, Cordoba, and Seville; Belgium: Brussels; Ireland: Dublin.

Source: Mairie de Paris (2008)

6.1.1 Overview

The idea of starting a large public bicycle system in Paris was inspired by the success of the *Vélo'v* smart bike system in Lyon, France's third largest city. The city's mayor, Bertrand Delanoë, championed the idea. Though launched only in June, 2007, *Vélib* is already the largest bicycle sharing system in the world. It is superior to all other systems in terms of the number of bicycles and stations, the size of the service area, the number of registered users, and the volume of daily uses. *Vélib* is operated by the French advertizing company JCDecaux under a 10-year contract with the City of Paris. In exchange for operating the system, JCDecaux is allowed to exploit 1,600 billboards across the city (BBC News, 2009).

Figure 30 - *Vélib* bicycle

Source: JCDecaux (2008)

A user survey conducted in early 2008 (Mairie de Paris, 2008) found that there were 190,000 registered users and 70,000 average daily uses. Two thirds of the system's daily users live in the City of Paris itself whereas most of the remaining third live in the suburbs, beyond *Vélib*'s service area. In terms of age, 39% of users are 26 to 35 years old, 23% are 16 to 25 years old, 21% are 36 to 45 years old and the remaining 17% are 45 and up (children under 16 are not allowed to use the system).

The survey revealed several interesting facts about how *Vélib* is used:

- 61% regularly use *Vélib* for commuting to work or school.
- 19% of users stated that *Vélib* allows them to make trips that would have otherwise been impossible.
- 20% of users stated that used cars less.
- Eighty-four percent of users said they used *Vélib* in combination with other modes of transportation. Among all *Vélib* users:
- 25% use it at the end of a trip taken on the metro (subway) or on suburban commuter trains
- 21% use it at the beginning of a trip, then continue using another mode of transportation (including transit, walking, or cycling on a private bicycle)
- 15% use it to connect between two other modes of transportation

Since the introduction of *Vélib*, bicycles have reportedly become considerably more visible on the streets of Paris – apparently, much to the annoyance of some motorists. However, the system's actual effect on mode shares has yet to be investigated.

Vélib is facing an increasingly severe problem with theft and vandalism of public bicycles (Figure 31). Between the system's spring 2007 launch and early 2009, the entire initial fleet of 20,600 bicycles has been replaced as a result of theft and vandalism, at a cost of €400 (C$630) apiece (BBC, 2009). The severity of theft and vandalism appears to be unique to Paris; Lyon, which uses the same JCDecaux Cyclocity technology as Paris, loses bicycles at less than half the rate that Paris does. JCDecaux, which under the current contract with the City is responsible for replacing lost and damaged bicycles, has stated that it is running the system at a loss. It has demanded that the City of Paris inject public funds to help cover the cost overruns arguing that the City should assume responsibility, because theft and vandalism are issues of public order, for which the City is responsible.

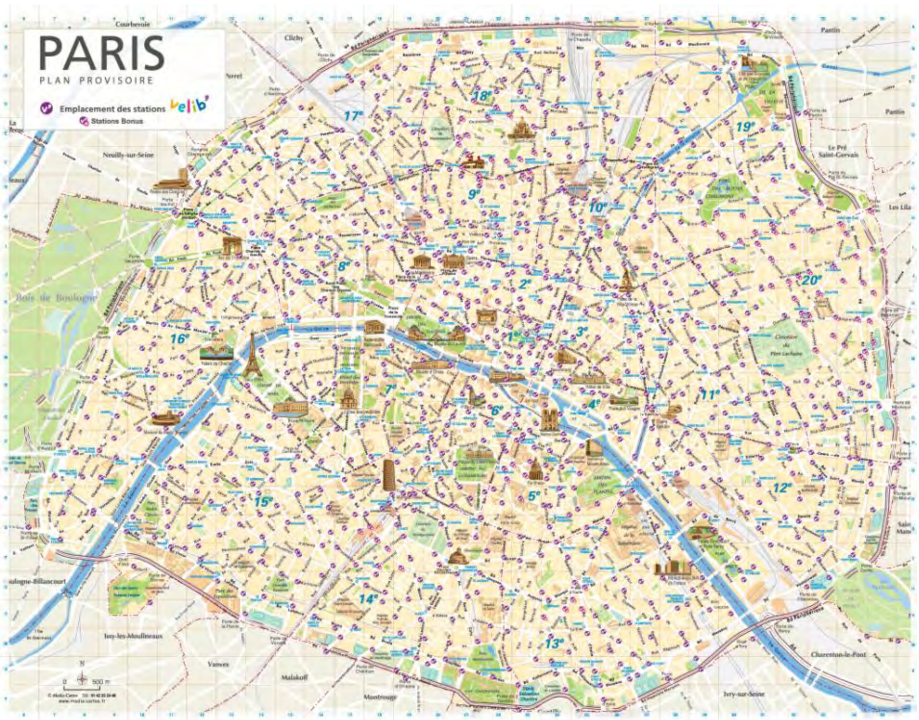
Figure 31 - Vandalized *Vélib* bicycles in Paris

Photo: austinevan

6.1.2 Conditions for Use and Fees

Users are required to purchase as pass to use *Vélib*. An annual pass costs €29 (C$48). Day and week passes are also available at a cost of €1 (C$1.60) and €5 (C$8) respectively. The first half hour of every loan is always free; the second half hour cost €1 (C$1.60); the third half hours an additional €2 (C$3.20); and each half hour afterwards costs an additional €4 (C$6.65). The system operates 24 hours a day, 7 days a week.

Figure 32 - Map of the *Vélib* service area



Source: www.velib.paris.fr

6.2 Call-a-bike – Munich, Germany

City/metro population: 1.4 million/6.0 million
City population density: 4,370/km^2
System type: flexible with some fixed stations
Operator: Deutshe Bahn (DB Rent)
Year started: 2001
Bicycles: 1,350 (2004)
Stations: 55 (2004)
Other cities using this system: Germany: Berlin, Frankfurt, Cologne, and Karlshruhe; France: *Allocyclo* in Orleans, France uses the same bicycle and the same rental procedure.

Source: DeMaio and Gifford, 2004 and IDAE, 2007

6.2.1 Overview

German passenger rail operator Deutsche Bahn (DB) initially developed the *Call a Bike* system to enable rail commuters to cycle from train stations to their destinations. Though the system still emphasizes rail commuters, it is available to the general public. It can be used independently of DB trains, although train pass holders get discounts on membership and usage fees.

The original *Call a Bike* system in Munich, like most DB *Call a Bike* systems in other German cities, have some fixed stations (mostly at railway stations) but do not require that bicycles be dropped off at these stations. Rather, users are allowed to drop bicycles off at most major street intersections within the designated service area by locking them to a bicycle rack or a traffic sign.

The system's bicycles are equipped with a wirelessly controlled combination lock. Users must locate a bicycle at one of the fixed stations or at a major intersection and check whether it is available. A green light on the bicycle's electronic lock indicates availability while a red light indicates it is in use. Registered users can send a text message to obtain a combination to unlock the bicycle. The message includes a serial number that is painted in large characters on the bicycle (Figure 34). They receive a reply containing a combination to open the lock on the bicycle. Unregistered users, including tourists, can call a 24-hour hotline to instantly register using a credit card and obtain the combination to unlock the bicycle.

Figure 33 - *Call a Bike* bicycle

Source: DB Rent

Figure 34 - User unlocking a *Call a Bike* with a combination code received by SMS

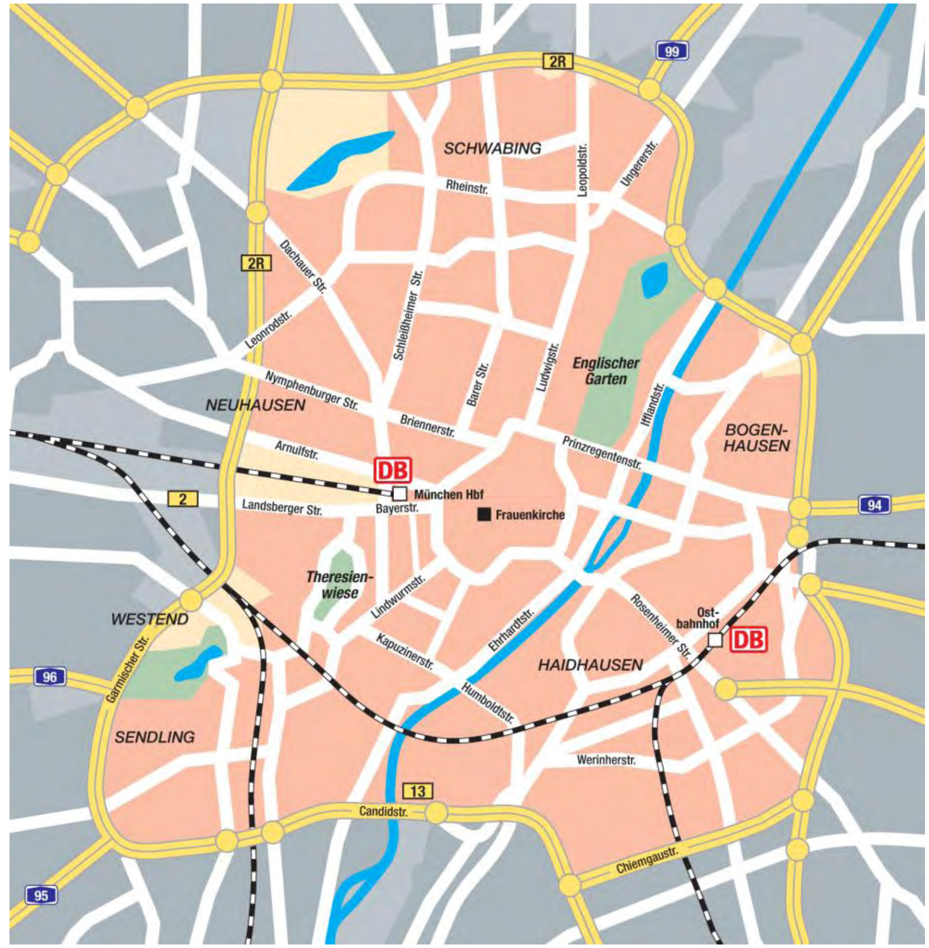
Source: DB Rent

Whenever users relock the bicycle, its onboard computer asks them whether they wish to the keep the bicycle (and resume use later) or end the loan. If they choose to keep the bicycle, the combination they were given earlier remains valid and they continue to be charged for use. If they chose to end the loan, the combination is reset and the timer for usage charges stops.

6.2.2 Conditions for Use and Fees

A one-time €5 (C$8) registration charge is required to access the system. Usage fees are assessed per minute of use at a rate of €0.08/minute (€0.06/minute for DB pass holders) up to a maximum of €9 (C$15) per 24-hr period. As of recently, users can purchase an annual *Call a Bike* pass for €99 (C$165) (less for DB pass holders) which entitles them to use bikes for free for up to 30 minutes at a time for the entire year; after 30 minutes they are assessed the regular per minute charge. The system operates 24 hours a day, 7 days a week.

Figure 35 - Map of the Munich *Call a Bike* service area



Source: DB Rent

6.3 SmartBike DC – Washington DC, USA

City/metro population: 0.6 million/5.3 million
City population density: 3,700/km^2
System type: permanent fixed station
Operator: Clear Channel SmartBike
Year started: 2008
Bicycles: 120
Stations: 10
Other cities using this system: Norway: Drammen, Oslo, and Trondheim; Sweden: Gothenburg and Stockholm; France: Caen, Dijon, Perpignan, and Rennes; Spain: Barcelona and Zaragoza.

Source: www.smartbike.com

6.3.1 Overview

Inspired by the success of smart bike systems in Europe, planners at the District Department of Transportation (DDOT) became interested in setting up a similar system in the US capital. In 2004, DDOT issued a call for tenders for ads in bus shelters and included a requirement for a small smart bike system. The contract was awarded to Clear Channel, which deployed its SmartBike technology in the District – the same technology that was deployed a year earlier in Barcelona, Spain to create the extensive *Bicing* public bicycle system.

Figure 36 - *SmartBike DC* bicycle

Source: ClearChannel Outdoor

In October 2008, less than three months after *SmartBike DC*'s opening, the system had 930 registered users and an average of 150 average daily users. Registration and daily use were growing steadily, according to a DDOT official. Clear Channel and DDOT are currently planning an expansion of the system but were unable to provide further details.

6.3.2 Conditions for Use and Fees

The system is open only to users who have purchased a US$40 (C$50) annual membership. Bicycles can be taken out for up to 3 hours at no additional charge; after three hours, sanctions, such as suspension of rental privileges, may apply. If not returned within 24-hours, the user will be assessed a bicycle replacement fee of US$550 (C$680). Bicycles can be taken out seven days a week from 6:00 AM to 10:00 PM and returned 24 hours a day.

Figure 37 - Map of the *SmartBike DC* stations

Source: ClearChannel Outdoor

6.4 BIXI – Montréal, QC, Canada

City/metro population: 1.6 million/3.6 million
City population density: 4,439/km^2
System type: portable fixed station
Operator: Stationnement de Montréal
Year started: 2009 (piloted fall 2008)
Bicycles: 2,400
Stations: 300
Other cities using this system: None yet. Minneapolis, MN has selected *BIXI System* for a public bicycle system slated for launch in 2010 (see Case Study)

Source: bixi.ca

6.4.1 Overview

The idea of having a public bicycle system in Montreal came up during the elaboration of the City's recent Transportation Plan (*Plan de transport*) (Ville de Montréal, 2008). Instead of partnering with an advertiser or other private sector partner, the mandate to develop and operate the system was given to Stationnement de Montréal, the City's public parking operator. It was believed that Stationnement de Montréal had existing capital and human resources that could be easily adapted to handle a bicycle sharing system.

Figure 38 - *BIXI* bicycle

Source: www.publicbikesystem.com

A few years prior to obtaining the mandate for *BIXI*, Stationnement de Montréal had developed a wirelessly networked and solar powered parking payment terminals. The new solar powered service terminals that it has developed for *BIXI* stations use them same wireless networking technology and will use the same IT infrastructure as the existing parking payment terminals.

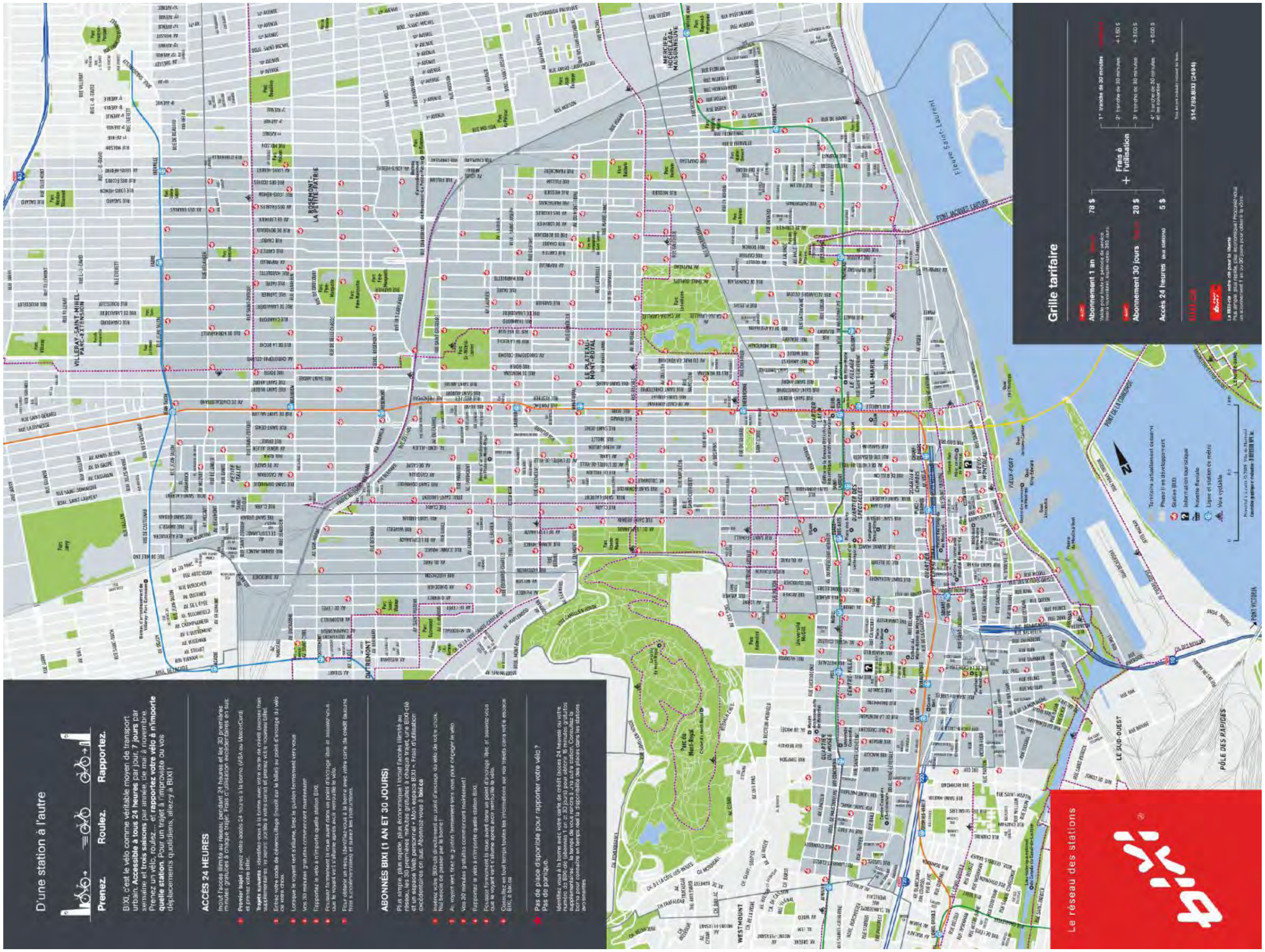
The service terminals along with a set of bicycle locking stands are mounted onto platforms, creating a portable, standalone station modules. On-street installation entails merely anchoring the station module to the pavement. As they are solar powered and wirelessly networked, no wiring is required. As a result, station installation is rapid and inexpensive. As stations are portable, distribution could be rapidly adapted to respond to demand. This will also allow the equipment to be removed during winter (mid-November until mid-April) when it could be damaged by the elements and could obstruct snow removal. Furthermore, it allows additional stations to be temporarily deployed for special events, such as festivals. Stationnement de Montréal intends to begin full operations of the first phase in May 2009, when 2,400 bikes and 300 stations will be deployed across the dense, central boroughs of Ville Marie (which includes the downtown business district and Old Montreal), Plateau–Mont-Royal, and Rosemont–Petite-Patrie. The system's second phase, to be deployed later in 2009, will add several hundred additional bicycles and dozens of new stations. The new stations are to expand the service area to adjacent boroughs.

Stationnement de Montréal has trademarked the *BIXI* technology as *BIXI System* and is marketing it as comprehensive turnkey bicycle sharing system that other municipalities and institutions can purchase. Other cities can purchase a basic package of *BIXI* hardware, including bicycles, station platforms, bicycle stands, service terminals and back room software, or an extended package including services such as ongoing operation, maintenance, customer relations, and training (BIXI System, 2009). The *BIXI System* has been demonstrated in a number of cities in North America, including Toronto, Philadelphia, and Minneapolis.

6.4.2 Conditions for Use and Fees

The system will operate 24/7 between mid-May and mid-November. Users will be required to take out a subscription at C$78 for the whole season, C$28 for a month, or C$5 for a day. The first half hour of every loan will be free; the second half hour will cost C$1.50; the third half hour will cost an additional C$4.50; and each half hour afterwards will cost an additional C$6.00.

Figure 39 - Station Distribution for Phase I of *BIXI*



Source: bixi.ca

6.5 NiceRide – Minneapolis, MN, USA

City/metro population: 377,392 / 3.1 million
City population density: 2,595/km^2
System type: portable fixed station
Operator: City of Lakes Nordic Ski Foundation
Year started: proposed for 2010
Bicycles: 1,000
Stations: 75-80
Other cities using this system: Montreal

Source: CoLNSF (2008)

6.5.1 Overview

After Washington, DC, Minneapolis is set to become the second city in the US to establish a European-style public bicycle system. Minneapolis is a relatively bicycle-friendly city, by North American standards. Of the 50 largest cities in the US, it has the second highest bicycle commuting mode share at 3.8%, topped only by Portland with 3.9% and followed by San Francisco and Seattle with 2.5% and 2.3% respectively (US Census Bureau, 2008). The city itself (excluding the rest of the Minneapolis-St. Paul metropolitan area) has 64 km of dedicated on-street bicycle lanes and 132 km of off-street bicycle paths (City of Minneapolis, 2009).

Unlike the public bicycle system in Washington, DC, which is run as a PPP with the advertiser Clear Channel Outdoor, the City of Minneapolis has decided to give the mandate to run the system to a local, non-profit organization. The organization retained by the City is the City of Lakes Nordic Ski Foundation (CoLNSF), an organization that promotes Nordic skiing and other outdoor sports, including cycling. The CoLNSF has drawn up a detailed business plan (CoLNSF, 2008), which calls for a much more ambitious system than Washington's but a somewhat smaller one than Montreal's, with 1,000 bicycles and 75 stations. The system has been dubbed *NiceRide* and is expected to launch in the spring of 2010. It is to cost $3,386,913 to setup and $1,574,453 per year to operate. Startup costs will largely be covered subsidies from the City and the US federal government. Ongoing costs are to 80% covered by user fees and the remaining 20% by private sponsorships.

Figure 40 - The *BIXI System* bicycle in Minneapolis livery

Source: NiceRide (2008)

As Minneapolis will not be entering a partnership with an advertiser that provides its own bicycle sharing hardware and operations, and as it will not be developing its own hardware as Stationnement de Montreal did, it must purchase a system turnkey bicycle sharing system from one of several existing vendors. Submissions from several vendors were examined during the development of the business plan. The City of Minneapolis and the CoLNSF have expressed a definite preference for Stationnement de Montréal's *Public Bike System*, also known as the *BIXI System* (Figure 40).

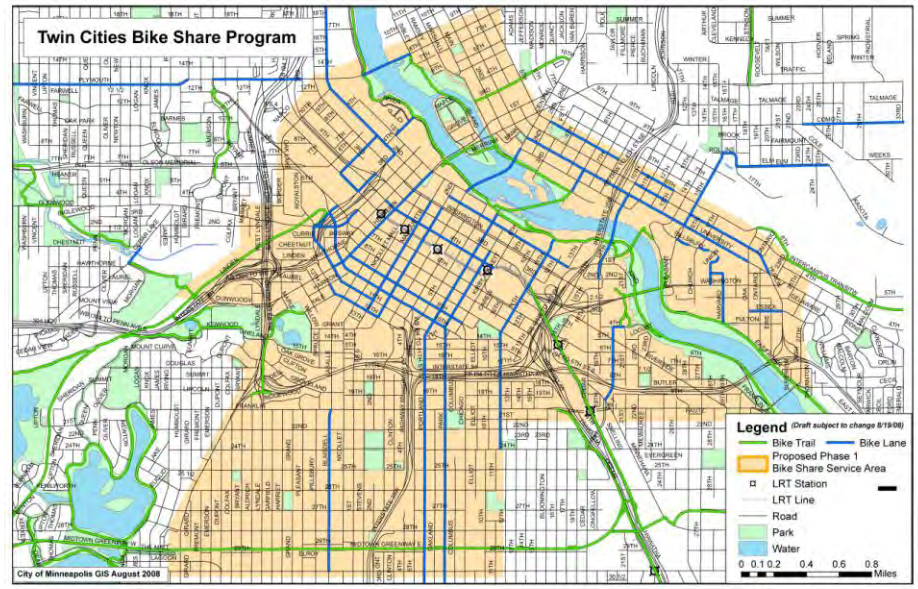
The Proposed Phase I service area includes the Minneapolis CBD, the University of Minnesota Minneapolis campus, and the Uptown neighborhood (Figure 41). The service area will cover 7.75 square miles (20.1 km^2), which contains a residential population of 100,200, an estimated employment population of 200,000, and a student population of 70,890. The business plan suggest that future extensions of the service area should include the St. Paul CBD and the nearby commercial and educational centres as well as high density and mixed-use neighbourhoods along major transit corridors in both Minneapolis and St. Paul.

Two key considerations were made for establishing the appropriate size for system. These include: (1) to be large enough to create the image of a "mainstream" rather than "fringe" mode of transportation; and (2) to have stations large enough to give potential users the confidence that bicycles will always be available to be taken out and free docking spaces will always be available to return bicycles. It is estimated that there will be 14,500 annual subscribers in the Phase I service area and that 1,000 bicycle spread across 75 stations are required to meet this demand.

6.5.2 Conditions for Use and Fees

The system will operate 24/7 between April and November. The system is open only to users 18 and over. Users will be required to take out a subscription for US$50 (C$62) or US$40 (C$50) for students for the whole season, US$15 (C$19) for a month, or US$5 (C$6) for a day. The first half hour of every loan will be free; the second half hour will cost US$1.00 (C$1.25); and each half hour afterwards will cost an additional $2.00 (C$2.50).

Figure 41 - Proposed service area for the Twin Cities public bicycle program



Source: Nice Ride (2008)

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Resources

Research

NICHES
www.niches-transport.org

The Bike-Sharing Blog
bike-sharing.blogspot.com

Public Bicycle Systems

Bicing
Barcelona, Spain
www.bicing.com

BIXI
Montreal, QC
bixi.ca

Bycyklen
Copenhagen, Denmark
www.bycyklen.dk

Call a Bike
Berlin, Cologne, Frankfurt, Karlshruhe, and Munich
www.callabike.de

NiceRide
Minneapolis, MN
www.twincitiesbikeshare.com

SmartBike DC
Washington, DC
www.smartbikedc.com

Vélib
Paris, France
www.velib.paris.fr

Vélo à la carte
Rennes, France
veloalacarte.free.fr

Vélo'v
Lyon, France
www.velov.grandlyon.com