

The Role of Smart Bike-sharing Systems in Urban Mobility

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Abstract

Following the success of the smart bike-sharing system in Paris, these systems are rapidly being introduced in European cities for daily mobility. The basic premise of the smart bike-sharing concept is sustainable transportation. Such systems often operate as part of the city's public transport system. They provide fast and easy access, have diverse business models and make use of applied technology (smart cards and/or mobile phones). Bike-sharing systems are currently operating in 78 cities in 16 countries using around 70,000 bikes. This paper reviews the state of the art of bike-sharing systems, drawing on experiences in selected European cities.

Introduction

The basic premise of the bike-sharing concept is sustainable transportation. They differ from traditional, mostly leisure-oriented bicycle rental services, in the following ways:

- They can be “rented” at one location and either returned there or at another location;
- They provide fast and easy access;
- They have diverse business models;
- They make use of applied technology (smart cards and/or mobile phones); and
- They are often designed as part of the public transport system.

Rental charges are time-based pay-per-ride fees, and in most systems, the first half hour is free of charge. Bike “pick up” and “return” stations operate 24 hours per day, 7 days a week. They are strategically placed at regular intervals throughout the city,

making them easily accessible from public transport stations as well as office and shopping areas. The latest systems operate with smart technologies and provide users with real-time bike availability information on the internet. These “smart” bike-sharing systems provide the missing link between existing points of public transportation and desired destinations, offering a new form of mobility that complements the existing public transport systems.

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in Australia, Canada, China and the recently introduced system in Washington D.C. (USA), all systems are in Europe and most are in France (Table 1).

Table 1: Distribution of bike-sharing schemes by country

Country	Systems	Bike Fleet	Bike Stations
Australia	1	n/a	n/a
Austria	1	1,540	58
Belgium	1	250	23
Canada	1	2,400	300
China	2	200	2
Denmark	2	2,400	167
France	26	39,798	2643
Germany	6	5,800	n/a
Italy	19	2,563	246
Luxembourg	1	250	25
Norway	3	1,575	153
Portugal	1	350	33
Spain	6	9,689	720
Sweden	2	2,125	191
UK	5	198	59
USA	1	100	10
Total	78	69,238	4,630

The Vélib system in Paris is by far the largest with 20,600 bikes available in 2008. The systems in Caen, Copenhagen, Dijon, Lyon and Paris have the highest densities, with an average of one bike per 200 persons.

Objectives

In general, bike-sharing systems are introduced to increase mobility choices, improve air quality and reduce congestion. Table 2 lists the objectives as articulated by some cities for their respective systems (Curran 2008).

Examples of Smart Bike-sharing Schemes

The largest and most famous smart bike-sharing system is in Paris, France. Called “Vélib”, which stands for “vélo libre” (“free bicycle”) or “vélo liberté” (“bicycle freedom”), it was launched on 15 July 2007 with 10,000

Table 2: Objectives of selected bike-sharing schemes

System	Objectives
Barcelona, Spain	<ul style="list-style-type: none">• Improve interchange between different modes of transport, and promote sustainable travel.• Create a new individual public transport system for citizens’ habitual travel needs.• Implement a sustainable, health inducing service fully integrated with the city’s public transport system.• Promote the bike as a common means of transport.• Improve quality of life, reduce air and noise pollution.
Göteborg, Sweden	<ul style="list-style-type: none">• Raise the status of cycling.• Promote using bicycles for short distance trips.
Lyon, France	<ul style="list-style-type: none">• Help create a more sustainable transportation system in the region by launching a public bicycle system that provides a new mobility option for short trips.• Help achieve transport and land use planning objectives including pollution emission reductions, reduced traffic congestion, road and parking cost savings, consumer cost savings, energy conservation, reduced crash risks, improved public health, and support for smart growth land use development.
Montreal, Canada	<ul style="list-style-type: none">• Encourage the use of public bicycles instead of cars for short, inner-city trips.
Paris, France	<ul style="list-style-type: none">• Act on air quality and public health.• Improve mobility for all.• Render the city a more beautiful and agreeable place to live in.• Encourage economic vitality.• Reinforce regional solidarity.
Washington, D.C.	<ul style="list-style-type: none">• Provide as many transportation options as possible and reduce the level of congestion, especially downtown.

bicycles and 750 automated rental stations, each with 15 or more bike spaces. In less than 2 years, Vélib has become a high performance service with 20,600 bikes and 1,451 stations (Figure 1), available 24/7. Mayor Bertrand Delanoë's re-election six months after the launch of Vélib was even credited in part to the success of the system.

Figure 1: Vélib bike station in Paris



Source: Luc Nadal, ITDP

Paris, France

(City population 2.15 million)

The Vélib system is highly accessible with bike stations every 300 metres and more than 230 miles of cycling lanes. The first half hour of usage is free of charge (as a result, in the first two months of operation, 92 percent of trips lasted less than 30 minutes). After the first half-hour, time is charged by 30-minute increments¹. The aim is to encourage the turnover of bikes, but the rates are also designed to avoid competing with private bike rental companies. Users need to take out a subscription², which allows for an unlimited number of rentals during the subscription period.

Two-thirds of users say their Vélib trips are usually part of a longer journey. Among the 212,000 long-term subscribers (Faye 2008), a majority of them use Vélib daily to go to work

or school, and about 20 percent reported driving less. After one year in operation, Vélib has clocked 27.5 million trips, representing an average of 8 to 10 users per bicycle per day (Nadal 2008). Since it was launched, the system has averaged 75,000 trips per day and each Vélib bicycle has covered a total of 10,000 km.

The entire network is operated by JCDecaux at its own expense. JCDecaux paid start-up costs of about \$115 million. It employs the equivalent of about 285 people full time to operate the system and repair the bikes. The city receives all the subscription and usage fees from the scheme (estimated to be about €20 million) and a fee of about €4.3 million a year from JCDecaux. In return, JCDecaux receives exclusive rights to advertise on 1,628 city-owned billboards for 10 years, while the city retains the right to use about half of that billboard space at no charge for public-interest advertising (Anderson 2007).

Figure 2: Bicing bike station in Barcelona



Source: Clear Channel Outdoor

Barcelona, Spain

(City population 1.5 million)

Called "Bicing", the system was launched in May 2007 with 750 bikes and 50 stations (Figure 2) located near Metro stations and major parking areas. By the end of 2008,

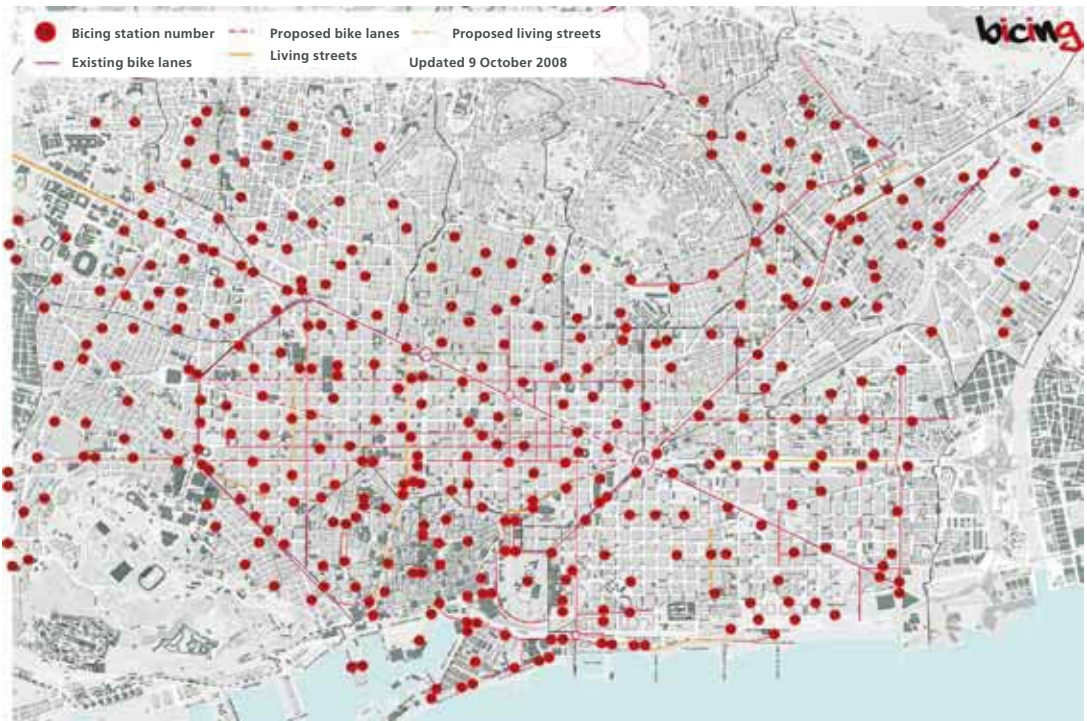
it had expanded to 6,000 bikes and 400 stations. The system is highly accessible with bike stations every 300 m. Some 22 km of new bike lanes have been implemented to link the bike stations with the city's strategic 128 km cycling network. *Figure 3* shows the distribution of Bicing stations and bike lanes in Barcelona.

The system has over 170,000 subscribers and an annual subscription cost of €24 (only residents can use the system). The first half hour of usage is free and each additional half hour costs €0.30, up to a maximum of 2 hours. Users that exceed this time limit are penalised. More than 15 million trips have been made (of which 57 percent are work trips) totalling 43.4 million km. The average trip is 3 km and 10 percent of users

reported that their bike trips have replaced car trips. Among the users, there is an equal split between men and women; 51 percent are between 25 and 35 years and all are local residents; 30 percent say they use the system because it is faster than other means of transport; 37 percent value the exercise and 22 percent say they use it because it is environmentally friendly.

Like many of the latest smart bike-sharing programs, Bicing provides real-time information on bike availability on the internet. The system is managed by B:SM (Barcelona de Serveis Municipals), a municipal service company. Clear Channel Outdoor has a contract to operate the system for 10 years. Unlike other systems, Bicing is funded with revenues from on-street parking.

Figure 3: Distribution of Bicing stations and bike lanes



Source: Barcelona de Serveis Municipals

Figure 4: Bike station in La Rochelle

Source: Communauté d'Agglomération de La Rochelle

La Rochelle, France (City population 80,000)

La Rochelle initiated the first successful bike-sharing system in France in 1974 with the introduction of the famous “Vélos Jaunes” (Yellow Bikes). By 2003, there were over 300 bikes in use and the city had built 130 km of exclusive bike lanes. In 2005, La Rochelle launched a second generation bike-sharing system with 120 bikes at 12 stations (*Figure 4*). It was converted to a smart bike system in 2008 and the number of stations increased to 25 while the bike lane network expanded to 150 km. 50 stations with 300 bikes will be available by the end of 2009.

The scheme uses a smart card system which can also be used for electric car sharing, parking and buses. The use of a single smart card enhances the integration of the scheme with the public transport system. Smart card holders can use the system free for the first three hours (compared to two hours for other users).

Major Smart Bike-sharing Systems

Many smart bike-sharing systems are provided

and operated by city administrations or public transport operators. But increasingly, city administrations are contracting private operators to provide these systems. There are currently 3 major operators, each with their own smart bike-sharing system: Bicincittà by Comunicare (Italy), Cyclocity by JCDecaux, (France), and SmartBike by Clear Channel Outdoor (USA).

Bicincittà

First introduced in 2004, the Bicincittà system has been installed in 21 cities, mostly in Italy, but also in Spain (San Sebastian and Pamplona). There are nearly 11,000 registered users and more than 1,700 individual stands (*Figure 5*) in 21 locations. The charging structure varies—in some cities, the service is free; in others, there is an hourly fee; and most cities require pre-registration and an annual subscription. An Italian company, Comunicare s.r.l., provides Bicincittà systems in partnership with City councils (Bicincittà 2008).

Figure 5: Typical Bicincittà bike station

Source: Bicincittà

Cyclocity

JCDecaux, the second largest global outdoor advertising company, is the world leader in

street furniture advertising. In 1999, JCDecaux invented a self-service bike system called "Cyclocity". The first generation was launched in June 2003 in Vienna (Austria), Gijon and Cordoba (Spain). In 2004, a new generation bike (Figure 6) was developed and on 19 May 2005, 1,000 bikes were introduced in Lyon and Villeurbanne. By 2007, the Lyon fleet had increased to 3,000 (currently 4,000 with bikes used 20,000 to 30,000 times a day). The Cyclocity system has attracted a large number of cities, the largest of which is Paris (20,000 bikes). The system is also used in Aix-en-Provence, Besançon, Brussels, Marseilles, Mulhouse and Seville (Cyclocity 2009).

Figure 6: Typical Cyclocity bike



Source: JCDecaux

SmartBike

SmartBike is operated by Clear Channel Outdoor, the world's largest outdoor advertising company. 10 years ago, Clear Channel Outdoor deployed the first smart bike-sharing program in Rennes, France. Nearly 8 million trips totalling over 25 million miles have been made on SmartBike systems by a combination of 260,000 users in 6 countries and 13 cities: France (Caen, Dijon, Perpignan,

Rennes), Italy (Milan), Norway (Drammen, Oslo, Trondheim), Spain (Barcelona, Zaragoza), Sweden (Gothenburg, Stockholm), and the USA (Washington, D.C.) (Smartbike 2009). Figure 7 shows a typical bicycle used for the scheme.

Figure 7: Typical SmartBike



Source: Clear Channel Outdoor

Issues

The major issues with the earlier generation of bike-sharing schemes were people keeping bikes longer than the allowed period, theft and vandalism. The use of smart technology and credit cards has reduced these risks.

Topography and climate may not be appropriate in some cities for bike-sharing schemes.

For example, Clear Channel Outdoor bikes have a unique identifier and use a GPS tracking system to reduce theft. The OYBike in London has an anti-theft system that uses an algorithm to generate unique codes to open and lock the bikes (Curran 2008). In most systems, users must provide credit card information so that if they do not return a bike, they will be charged its replacement cost. In addition, smart bikes are designed to require the use of special tools for disassembly, thereby discouraging

unauthorised removal, and most of the components are of uncommon dimensions that would not be usable on other bikes. The bikes also have a unique design so as to stand out from other bikes (DeMaio 2004).

Nevertheless, theft and vandalism have run higher than expected in Paris, where the operator has replaced thousands of bicycles at a cost of 3 to 6 million Euros a year. In some cities, people will borrow a bike for a week or longer and others will not return the bike to a rack. To encourage people to return bikes to underused stations, Paris recently announced a 15-minute credit for returning bicycles to specific stations, particularly those on hills.

Topography and climate may not be appropriate in some cities for bike-sharing schemes. Stuttgart (Germany) is hilly and the city is launching an electric bike scheme called "Pedelec". Although many bike-sharing programs aim to reduce traffic congestion, in some cities, bikes are used instead of walking or public transportation.

Implementing Bike-sharing Schemes

For cities which are considering the introduction of bike-sharing schemes, some key conditions for implementation are:

- A strong commitment to sustainable urban mobility and the promotion of cycling;
- A minimum standard of bicycle infrastructure (bike lanes and bike paths) for safe and convenient cycling;
- Sufficient resources to achieve a real impact; and

- Sufficient space for racks/parking to guarantee access to bicycles.

Most bike-sharing schemes need to be financially backed by a large transport operator or by public resources.

The NICHES (New and Innovative Concepts for Helping European Transport Sustainability) project (Bührmann 2007) 2008 has developed the following checklist to help policy-makers design and plan for a successful bike-sharing scheme.

City size

- Most suitable for medium to large cities (> 200,000 inhabitants).

Implementation time

- Short term (<2 years).

Stakeholders' involvement

- For service implementation and operation: Rail or public transport operators, street furniture companies, advertising companies or local authorities;
- For political and financial support: local authorities, user associations.

Challenges

- Mutual respect between cyclists, pedestrians and car drivers needs to be strengthened (especially in cities with little bicycle use).

Costs

- Principal cost factors include staff needed for operation, service and maintenance; bicycles (costs can range from €250 to more than €1,200 depending on smart bike technology); and racks and service terminals.

- In most cases, financial backing is needed as most of the schemes are not financially self-supporting.

Most bike-sharing schemes need to be financially backed by a large transport operator or by public resources, either through direct funding or indirectly through Public Private Partnerships (PPPs). In most cases, a PPP between a billboard company and a local authority is established. The billboard company receives the right to use specific public spaces for advertisements and in return implements and operates a bike-sharing scheme (e.g. Clear Channel Outdoor and JCDecaux). The Barcelona system operated by Clear Channel Outdoor is financed by revenues from on-street parking.

Conclusion

Bike-sharing programs have expanded rapidly

throughout Europe in recent years as cities search for ways to increase bike usage, meet increasing mobility demands and reduce adverse environmental impacts. The introduction of smart technology has resolved many of the vandalism and theft problems of earlier bike-sharing programs and has made bike sharing popular and trendy, especially among younger users. The city of La Rochelle has shown that bike sharing can be fully integrated with other transport modes by adopting a single smart card ticketing system. In Paris, tens of thousands of Vélib users on the street have boosted a renewal in cycling with resultant sales of bicycles jumping 35 percent. A key ingredient for success in any city is the availability of an extensive and continuous bike lane/path or car free network. Equally important is the combination of a bike friendly topography and climate.

Notes

1. Current rates are €1 for the first additional half hour, €2 for the second additional half hour, and after the third additional half hour, the rate increases steeply to €4 for each additional half hour.
2. Current subscriptions are €1 per day, €5 per week or €29 per year.

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Peter Midgley is the Urban Transport Theme Champion with the global Transport Knowledge Partnership (gTKP), a partnership of global organisations, policy-makers, experts and interested users working to make effective use of international transport knowledge. He is responsible for reviewing, disseminating and publishing examples of best practices in urban transport. Mr Midgley has over 40 years of experience in urban transport. He was a staff member of the World Bank for 25 years. He drafted the Bank's first regional urban transport strategy paper ("Urban Transport in Asia: An Operational

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