DOWNTOWN BOISE

Parking Strategic Plan

APPENDIX A3

The Bike-share Planning Guide

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Expect More. Experience Better.

THE BIKE-SHARE PLANNING GUIDE

ITDP

THE BIKE-SHARE PLANNING GUIDE

The Bike-share Planning Guide
Cover Photo: Mexico City's Ecobici has helped to increase
cycling mode share in Mexico City.
Cover Photo By: Udayalaksmanakartiyasa Halim

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INTRODUCTION

Former Mayor Adrian Fenty takes part in the launch of the Washington, D.C., Capital Bikeshare system. Photo by DDOT DC.

Bike-share has taken many forms over the course of its development, from free bikes left for a community to use at will to more technologically advanced and secure systems. In every iteration, the essence of bike-share remains simple: anyone can pick up a bike in one place and return it to another, making point-to-point, human-powered transportation feasible.

Today, more than 600 cities around the globe have their own bike-share systems, and more programs are starting every year. The largest systems are in China, in cities such as Hangzhou and Shanghai. In Paris, London, and Washington, D.C., highly successful systems have helped to promote cycling as a viable and valued transport option.

Each city has made bike-share its own, adapting it to the local context, including the city's density, topography, weather, infrastructure, and culture. Although other cities' examples can serve as useful guides, there is no single model of bike-share.

Vélib', in Paris, France, is one of the largest and most successful public bike-share systems in the world.
LUC NADAL

However, many of the most successful systems share certain common features:

- A dense network of stations across the coverage area, with an average spacing of 300 meters between stations

- Comfortable, commuter-style bicycles with specially designed parts and sizes that discourage theft and resale

- A fully automated locking system that allows users to check bicycles easily in or out of bike-share stations

- A wireless tracking system, such as radio-frequency identification devices (RFIDs), that locates where a bicycle is picked up and returned and identifies the user

- Real-time monitoring of station occupancy rates through wireless communications, such as general packet radio service (GPRS)

- Real-time user information through various platforms, including the web, mobile phones and/or on-site terminals

- Pricing structures that incentivize short trips helping to maximize the number of trips per bicycle per day

Fig. 1: Growth of Bike-share Worldwide (January 2000–July 2013)

When the first bike-share opened in the 1960s, bike-share growth worldwide was relatively modest. It wasn't until after the turn of the century and the launch of Velo'v in Lyon, France, in 2005 and Vélib' in Paris in 2007 that growth in bike-share exploded.

CASA BIKE SHARE MAP BY OLIVER O'BRIEN, SYSTEM WEBSITES, PUBLICBIKE.NET
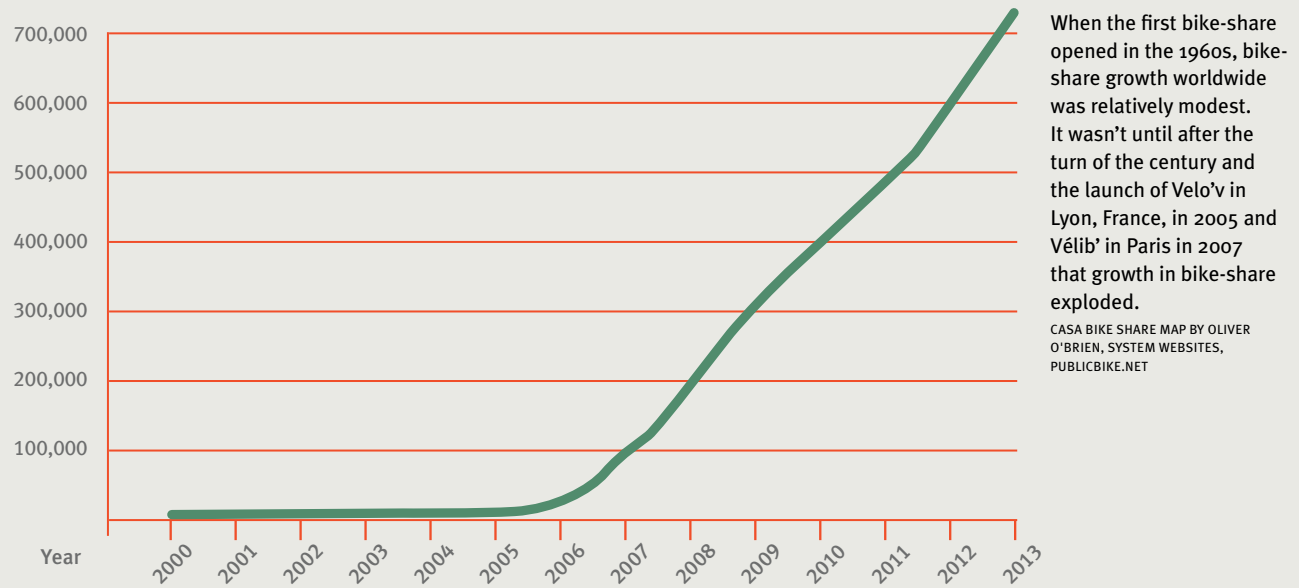
This guide is meant to bridge the divide between developing and developed countries' experiences with bike-share. It should be useful in helping to plan and implement a bike-share system regardless of the location, size, or density of your city.

1.1 The Benefits of Bike-share

The reasons for implementing a bike-share program are often centered on goals of increasing cycling, reducing congestion, improving air quality, and offering residents an active mobility option. Bike-share has two key advantages when compared to other transportation projects: implementation costs are comparatively low and the timeline is short. It is possible to plan and implement a system in one mayoral term (i.e., two to four years), which means that benefits to the public accrue more immediately than in most transportation projects.

Bike-share has become a significant trend worldwide, including in Seville, Spain.
CARLOSFELIPE PARDO

Bike-share systems can benefit a city in a number of ways:

- **Reduce congestion and improve air quality**
  Bike-share offers an alternative means of transport for short trips that might otherwise have been made by car. As of November 2011, Washington, D.C.'s 22,000 bike-share members had reduced the number of miles driven per year by nearly 4.4 million (LDA Consulting 2012).

- **Increase accessibility**
  Implementing a bike-share system gives local users greater access to places that are beyond their reach on foot.

- **Increase the reach of transit**
  Bike-share fills that critical gap between the station or stop and the final destination for the passenger. Since cycling is more efficient than walking, bike-share enhances mobility and is much less expensive to the city than extending public transport service.

- **Improve the image of cycling**
  Bike-share systems project a hip, modern image and can help transform the cycling culture in a city.

- **Provide complementary services to public transport**
  Bike-share offers an alternative for short trips that people would have otherwise made on transit.

- **Improve the health of the residents**
  Bike-share offers an active transport choice, providing both physical and mental health benefits. Studies have shown that spending twenty minutes every day on a bike has a significant positive impact on mental health (Obis 2011, p. 41).

TOP
Washington, D.C. designed its Capital Bikeshare system to be easily used by tourists seeing the sites as well as everyday use by residents.
KEVIN KOVALESKI, DDOT DC (CREATIVE COMMONS)

BOTTOM LEFT
Lyon's Velo'v provides easy transportation within the city for students, residents and tourists.
KARL FJELLSTROM

BOTTOM RIGHT
Buenos Aires, Argentina, has implemented a bike-share system that has stations near mass transit lines, increasing the coverage of both systems.
CARLOSFELIPE PARDO

- **Attract new cyclists**
  Bike-share offers an easy way into cycling for people who may have been prevented from cycling by a lack of access to a bike or bike parking. Lyon, France, saw a 44 percent increase in cycling within the first year of opening Velo'v, its bike-share system. In a survey of members of Capital Bikeshare—Washington, D.C.'s bike-share system—80 percent of respondents said that they cycle more often now than they did before joining the program, and 70 percent said that Capital Bikeshare had been important in helping or encouraging them to ride more often (LDA Consulting 2012).

- **Improve a city's image and branding**
  Cycling is a sustainable transportation option, and a city that implements a bike-share system may strengthen its image as a "green" or innovative city. In 2007, Paris' Vélib' won the British Guild of Travel Writers' Best Worldwide Tourism project.

- **Generate investment in local industry**
  Bike-share has the potential to spur development of new products and services through demand for hardware and software, as well as provision of the operations.

Bike-share can also attract existing riders through its convenience and practicality. ITDP China conducted a survey of bike-share users in Guangzhou, China, that found that sixteen percent of the users were previously private bicycle users. By broadening the bicycle user base and raising the profile of cycling in a city, bike-share can build a constituency for improved bicycle infrastructure, which benefits all cyclists, rich and poor alike. Cities that have implemented bike-share systems have found that the benefits are felt by a wide variety of users—spanning generations, classes, ethnicities, and genders—in a variety of seasons (New York City Department of City Planning 2009).

Bike-share systems like
the one in Guangzhou,
China are very popular,
even among international
visitors.
KARL FJELLSTROM

How Vélib' Came to Be

In 2001, newly-elected mayor Bertrand Delanoë set out to transform Paris into more sustainable city. Under his low-carbon transport plan, his administration added 271 kilometers of bike lanes. However, the lanes were not well used, and the city determined that the biggest deterrent was the lack of bicycle parking—most apartments were too small to store a bicycle, and people did not feel safe parking their bikes on the street overnight. Parking was also a problem once cyclists reached their destinations, where, again, there were often no safe or legal ways to park their bikes. In response, the city implemented a bike-share system, which addressed the need for bike parking and increased cycling (Spitz 2008).

1.2 History of Bike-Share

Bike-share has evolved significantly since its inception in 1965, when Amsterdam city councilman Luud Schimmelpennink proposed the world's first public bike-share system as a way to reduce automobile traffic in the city center. He proposed that 20,000 bicycles be painted white and distributed for pick-up and drop-off anywhere in the city center, free of charge. When the city council rejected the proposal, Schimmelpennink's supporters distributed fifty donated white bikes for free use around the town. The police, however, impounded the bikes, claiming that unlocked bikes incited theft (Schimmelpennink 2012). Though a large-scale free bike program such as the one Schimmelpennink originally imagined has never been implemented, smaller-scale free bike systems in Madison, Wisconsin, and Portland, Oregon, have been implemented.

   The next attempt at a bike-share system occurred in La Rochelle, France, in 1993, which offered a free, but more regulated, program that allowed the public to check out bicycles for two hours. Cambridge, England, implemented a similar system in 1993. This type of free bicycle rental system, also known as a "bicycle library," reduced problems with theft and vandalism, since users were required to show identification and leave a deposit in order to use the bicycles. However, these bicycle libraries also required the user to return the bike to same place from which it had been checked out, limiting the usefulness of the system as a point-to-point transit option.

The Bike-Share Lexicon

Bike-share systems go by a variety of names around the world: "bicycle sharing" or simply "bike-share" in North America, "cycle hire" in the United Kingdom, "cycle sharing" in South Asia and "public bike" in China. In this report, we will use the term "bike-share." Other key bike-share definitions used throughout the guide include:

- **Docking spaces** are the places at the station where bikes are parked and locked.

- **Stations** are composed of docking spaces, terminals, and bicycles. Bikes are parked there for users to check out, and spaces should be available for users to return the bikes. Users can get information and pay for using the system. Stations can be manual or automated, or some variation in between. They can also be modular in design or fixed and permanent (i.e. built into the street).

- **Terminals** are places where users can get information about the system and check in and out bicycles. They can be self-service dynamic interfaces for the customer or static information systems that tell users how to check in or out a bike. They can serve as the nexus of communication between the bikes, the docking spaces, and the control center, as well as be the place for payment. Terminals usually serve the function of helping users locate a station on the street — a visual totem that is consistently branded. Terminals are also known as kiosks, but in this guide we refer to them as terminals.

Luud Schimmelpennink helped to introduce the 'white bike' in the Netherlands in 1968.

To address these issues, Copenhagen introduced a second generation of bike-share, called ByCylken, in 1991. To prevent theft and vandalism, custom-built, heavy-duty bikes were kept chained to special bicycle parking racks with coin-operated locks. Although more secure than their predecessors, these systems remained vulnerable because users were not registered, and thus could not be held accountable for vandalized or stolen bikes.

The third generation of bike-share sought to improve security, accountability, monitoring capacity, and billing. These systems have a more extensive method for registering users, and they monitor use as part of a complete technology-enhanced operating plan. The bike-share system in Rennes, France, was the first to use smart-card technology in 1998. In 2001, Lyon's Velo'v system opened, and it was the basis for the Vélib' system in Paris. Velo'v and Vélib' have become the prototypes for third-generation systems.

The critical attributes of the third generation of "smart" bike-share networks are the technological advances that have increased accountability through identification devices and allowed for real-time monitoring of station capacity and bicycle users. All users are required to provide proof of identity, either when registering or when checking bikes out at the station kiosk. Most systems in Europe and North America rely primarily on credit cards for payment and as a security mechanism, while Asian systems rely on national identification documents. If the user fails to return a bicycle, a fee can be charged to the user's credit card, or the user's account may be blocked to prevent him or her from checking out other bicycles.

Users of Rio de Janeiro's bike-share system, BikeRio, must pre-register online or through a mobile phone application. To borrow a bicycle, the registered user accesses BikeRio through the application or via phone, and the bicycle is released from the docking station. In Washington, D.C., and Mexico City, users preregister and are mailed a key fob that contains a radio-frequency ID card that allows the user to unlock a bike at a station simply by inserting the fob into the docking station. In countries where credit systems are not as established, there are other ways to ensure financial accountability. For example, very few public bike-share systems in China use credit-card registration. In most Chinese systems,

users must either put down a deposit on a smart card or provide a local identification card in order to check out a bike. If the bike is not returned, the user loses the deposit, or he or she can be found and fined through the ID card. In Hangzhou, users are required to keep deposits on their smart-card accounts, and if they fail to return a bicycle, they forfeit the deposit.

The Vélib' system in Paris is the prototypical example of a third-generation bike-share system.
KARL FJELLSTRO

1.3 New Developments and Trends

Many new systems incorporate innovative characteristics that some believe represent a fourth generation of bike-share, including:

- **Universal cards:**
  Bikes can be integrated into other public transport systems through the use of a rechargeable smart card that can cover a range of payments and trips. Many cities in China already have this kind of integration. In Hangzhou and Guangzhou, for example, the card used for the local bike-share system can also be used on the bus, bus rapid transit (BRT), and metro systems. The use of these universal cards is now spreading to other countries and cities.

- **Modular, movable stations:**
  These stations do not require excavation and trenching, which reduces implementation time and costs. Also, because the stations are easily movable, the system can be optimized once demand patterns reveal themselves through usage. They can also be removed during winter months.

- **Solar cells:**
  Solar cells can power stations and wireless communications. Solar cells make modular stations feasible, as they eliminate the need for excavation to connect the station to underground power lines. The systems in Boston, Washington, D.C., London, Montreal, and Rio de Janeiro have stations that are powered entirely by solar energy and are completely wireless.

The future of bike-share will probably include offering cargo bikes for large purchases, electric-assist bikes, and bikes for children.

1.4 Building Political Will

Successful implementation of a bike-share system requires strong political support to ensure funding, land use rights, and coordination between various city agencies. Involving more than one political party is critical to ensuring support for bike-share over several years and multiple election cycles.

Building political will begins with educating political leaders on the benefits of bike-share. This can include presentations on and site visits to successful projects. Persuading decision-makers to travel to other cities to actually see and use successful bike-share programs, and to speak to other implementers, builds the necessary political will to make bike-share a reality. These decision-makers become champions for the new system in their own cities.

London Mayor Boris Johnson's strong support for the city's bike-share system earned that system the nickname "Boris Bikes." His determination to increase the use of bikes in London by improving infrastructure and setting bike-share as a top priority created the context for a successful and innovative system in one of the world's most famous cities. While the London system is overseen by the city's transport department, Transport for London, and operated by Serco under a six-year contract, the support of the mayor's office was the key to the system's success. Johnson personally promoted the bike-share system to residents of the boroughs, whose support and cooperation was necessary to the success of the project (Mulholland 2008).

New York City Department of Transportation Commissioner Janette Sadik-Khan and other city officials test bicycles in for New York City's bike-share program.
NYC DOT (CREATIVE COMMONS)

1.5 Elements of Bike-share

Prior to entering the planning phase, the agency implementing the bike-share system must have a basic knowledge of the essential elements of bike-share so that it can space stations appropriately and create a business model and a financial model. These elements include bikes, stations, software and other technology needs, as well as personnel/staffing objectives. These elements will impact both the business and financial models.

Many bike-share systems are found in areas with lots of activity, making it convenient for people to pick up and drop off a bike, like in Paris' city center.
LUC NADAL

section two

THE PLANNING PROCESS AND FEASIBILITY STUDY

Mexico City introduced
segregated bike lanes
along Reforma Avenue,
which are frequently used
by Ecobici users.
BERNARDO BARANDA

2.1 Overview of Planning Process

The process of planning a bike-share system can be broken down into three steps:

1. Conducting a feasibility study
A high level analysis of the possibilty of bike-share, defining key parameters for planning and developing an initial institutional and financial analysis, the foundation needed to take the next steps (see the rest of chapter 2)

2. Detailed planning and design
This step defines the exact locations of the stations, the size of the stations, and the type of hardware and software needed (see chapter 3)

3. Creating business and financial plans
This step defines the institutional and revenue models, including contracting (see chapters 4 and 5)

The time frame for each step is based on the political will and resources behind the project. Completing the feasibility study and detailed planning and design phases could take three months to a year. Tendering and contracting operations, which are dictated by the city's procurement rules, could take as little as a year in the most organized and efficient of city governments, but it is likely that more time will be required. Regardless, the time frame for planning and implementation is still far shorter than that of most transportation projects and can be realized within a couple of years or within a mayoral term. For example, Mexico City's first phase took one year to plan and six months to implement.

New York City first considered the feasibility of bike-share in 2007 but decided that the Vélib' model's requirement for permanent stations would be impractical in the city's environment. When Bixi, the bike-share system in Montreal, developed modular stations that do not require excavation and trenching, New York City reassessed, releasing its feasibility report in 2009. It released the tender in 2010 and decided on an operator in 2011, awarding the contract in September of that year (New York City Department of City Planning 2009). New York's bike-share system, Citi Bike, opened in May 2013.

The rest of this guide looks at the planning process, with a brief conclusion on implementation.

New York City installed
its modular bike-share
stations fairly quickly—
over the course of
one month.
LUC NADAL

2.2 Feasibility Study

The feasibility study establishes the critical parameters that will guide the planning and design process—specifically the coverage area and size of the system—and then analyzes whether the proposal will be financially feasible and under what conditions. The feasibility study should recommend investment and revenue sources, a contracting model, and an organizational structure, as the agency or department conducting the feasibility study may or may not be the implementing agency. Finally, the feasibility study will also need to review the local context and identify any specific local obstacles to implementation, including weather, cycling infrastructure, culture, and political and legal realities. Much of the feasibility study can be done by drawing on other systems' experiences and adapting them to the local context.

The first step is to outline the city's objectives for a bike-share system. Bike-share systems are often implemented as part of a general sustainable transport initiative to reduce pollution and improve mobility options. Strategic objectives for bike-share may include solving the "last mile" problem for transit passengers who still need to travel from the station to their destination (as in the San Francisco Bay Area in California), avoiding capital investments in order to increase the capacity of overcrowded mass transit (as in Guangzhou, China), meeting targeted city modal splits or pollution targets (as in Paris), developing tourism (as in Hangzhou, China, and Paris), and even generating employment (as in Hangzhou). These locally defined objectives will inform the rest of the feasibility study.

Guangzhou, China's, bike-share stations are near BRT stations, benefitting users of both systems.
KARL FJELLSTROM

After defining the objectives of the bike-share system, the feasibility study should include the following three main components:

1. Demand analysis

The demand analysis identifies the potential number of system users and forms the basis for all other analysis. It requires the following steps.

- Define the proposed coverage area. Usually, cities choose as a first phase the areas where there will be the most demand for bike-share. Residential population density is often used as a proxy to identify those places where there will be greater demand. (See section 2.3.3 for more detail about the coverage area.)

- Define targets for key performance metrics. This should include both the two key performance metrics discussed in section 2.3.1 and the indicators for evaluating how well the system is meeting its objectives in section 2.3.2.

- Create a demand profile. Review existing demand and conditions for cycling, taking into account the population of the coverage area, the number of commuters, current modal split, existing transit, bicycle and pedestrian networks, and existing major attractions that will draw people to the area. Sometimes it is useful to create profiles of potential bike-share users to get a sense of who will use it and at what scale, but it has generally been found that people of all incomes and backgrounds use bike-share.

- Create estimations of demand. One way to do this is to create a Price-Elasticity of Demand (PED) analysis according to various customer types. Another, less rigorous, way is to create an estimation of demand based on a percentage of the population, known as the uptake rate. After Vélib' opened, Paris saw a 6 percent uptake, meaning that 6 percent of the population used the system (Nadal 2007). New York City ran three scenarios: a 3 percent uptake by the existing population, a 6 percent uptake and a 9 percent uptake. The city ultimately used 6 percent for financial estimations (New York City Department of City Planning 2009).

- Size the system by defining station density, bike density, and bikes per station. These basic planning parameters are discussed further in section 2.3.4.

2. High-level financial feasibility analysis

Based on the demand analysis and size of the system, preliminary numbers can be used to estimate how much the system will cost, including both capital costs and operational costs. This is a high-level estimation used to guide decisions, not a detailed budget, which should be done later. This analysis includes the following steps:

- Propose options for station type, bicycles, and technology to create a capital cost estimate.

- Estimate operational costs based on the size of the system. This should include maintenance and redistribution, as well as replacement costs for bikes.

- Propose financing options to identify the most appropriate combination of user-generated revenues (per-use and membership fees), government funds, corporate sponsorship, street advertising contracts, etc.

- Analyze estimated costs against financing options to ensure that the proposal is financially feasible.

- Recommend a business model that establishes an organizational structure and contracting model.

3. Analysis of risks and barriers

Identifying possible barriers and risks will help planners mitigate those challenges as they go into detailed planning and design. This analysis includes the following steps:

- Review possible barriers to implementation and propose mitigation measures. Such barriers may include access to credit cards by the users, advertisement regulations and existing advertising contracts, helmet requirements, traffic laws, safety concerns, institutional constraints, etc.

- Identify risks to project implementation and propose mitigation measures. These risks may include institutional infighting and lack of cooperation, NIMBY-ism and protest by the community, and the absence of a political champion for the system.

These three components are an iterative process whereby decisions about the coverage area and system size may change based on the financial feasibility. This study becomes the basis for the next steps: detailed planning and design, the creation of business and financial models, and tendering and contracting. With the guidelines determined in the feasibility study, the government organizing team can move into the planning phase.

New York City's Feasibility Study

New York City's feasibility study determined that the first phase would focus on the city's medium- to high-density areas, like Herald Square, Midtown, lower Manhattan and parts of Brooklyn. The recommended business model was to contract operations to a private company, with the assets owned by the city and operational costs covered by membership fees and sponsorship.

NYCSTREETS (CREATIVE COMMONS)

Most bike-share stations are rolled out in phases, with the most successful systems, like Paris, Lyon, and Hangzhou, beginning with a robust citywide network of bike-share stations. The feasibility study can help determine a phased implementation plan. This can be especially useful if the eventual goal is to create a system on a large regional scale that might be challenging to implement all at once. Initial phases should focus on covering as much of the city as possible, focusing on areas that are the densest in terms of demand, have strong bicycle infrastructure, and would have good public support for bike-share. Areas that are financially more difficult or constrained by infrastructure challenges should be prioritized for future phases.

Generally, the first phase needs to be both large enough to connect meaningful origins and destinations and dense enough to ensure convenience and reliability for the user. Smaller pilots are not ideal for bike-share, as that scale can limit the usability of the system due to poor coverage or bike availability, which ultimately damages the public perception of bike-share as a viable mode of transport. Smaller pilots have often not been successful, as was the case with

Washington, D.C.'s original Smartbike system and Rio de Janeiro's original Samba bike-share. Both cities went on to relaunch their bike-shares based on lessons learned from those experiences.

Paris launched Vélib' in 2007 with 7,000 bikes at 750 stations across the city. The system immediately began attracting tens of thousands of riders each day and averaged 75,000 trips per day in its first year, with peak days exceeding well over 100,000 riders (New York City Department of City Planning 2009). The successful launch also generated public support for the system and brought the city international acclaim. The following year, Vélib' grew to 16,000 bicycles in 1,200 stations in the city, and it is now planning to have more than 20,000 bicycles at over 1,450 stations both within Paris and within twenty-nine other communities on the periphery of the city.

Paris rolled-out Vélib' to high demand areas, like above in Les Halles, where there were more people to use the system, as evidenced by this empty station.
KARL FJELLSTROM

Why Did Washington, D.C. Relaunch Its Bike-share?

The Smartbike system, launched in August 2008, was the country's first fully automated bike-share system. In this public-private partnership between Clear Channel Outdoor and the District of Columbia Department of Transport, Clear Channel received outdoor advertising rights to the city's bus shelters, while the District received all user subscriptions fees to operate the system. The city defined the system as a pilot project, with ten stations and 120 bikes. Due to the small number of bikes and stations, as well as the great distances between stations and limited operating hours, the program was poorly utilized and thus largely unsuccessful (Silverman 2008 and DePillis 2010). The District of Columbia chose to finish the bike-share portion of its contract with Clear Channel and then totally revamp the system.

In September 2010, Smartbike was replaced by Capital Bikeshare, a fully automated system with 1,100 bicycles and 116 stations, but now available twenty-four hours a day, seven days a week. The new system is operated by Alta Bicycle Share, a company that specializes in operating bike-share systems and has experience in other leading cities around the world.

Washington, D.C.'s first bike-share system, called Smartbike (above), and its current system, called Capital Bikeshare (left).
CARLOSFELIPE PARDO

Bike-Share Essentials

In order for a bike-share system to be well-used and efficient, it must be properly planned and designed. Based on the performance of existing systems across the globe, ITDP has developed the following planning and design guidelines that are characteristic of the best-used and most efficient systems. More detail about each recommendation can be found in the guide.

PLANNING GUIDELINES

- Minimum System Coverage Area: 10 km^2

- Station Density: 10–16 stations per km^2

- Bikes/Resident: 10–30 bikes for every 1,000 residents (within coverage area)

- Docks per Bike Ratio: 2–2.5 docking spaces for every bike

BIKE GUIDELINES

- Durable

- Attractive

- Utilitarian

STATION GUIDELINES

- Theft-proof locking mechanisms or security system

- Clear signage and use instructions

- Quick and easy electronic bicycle check-in/check-out system

PERFORMANCE METRICS

- System Efficiency: Average number of daily uses: Four to eight daily uses per bike

- Market Penetration: Average daily trips per resident: one daily trip per 20 to 40 residents

2.3 Bike-Share Metrics

The planning of a bike-share system is based on a simple analysis of readily available data. This allows planners to design a system that is the right size and scale to meet their performance and financial goals for the system.

2.3.1 Basic Context Data and System Metrics

In order to complete a feasibility study, a range of local data must be collected and analyzed. This data will help to determine the appropriate size and scale of the bike-share system to best meet the goals for the system. The following two data sets are critical to establishing the basic framework for the feasibility study—defining the physical size of the area and the the potential size of the users:

- **System Coverage Area:**
  Defined as the contiguous area, in square kilometers, in which bike-share stations are located. The coverage area includes a 500 meter radius around each station located on the edge of the area.

- **Population in System Coverage Area:**
  Defined as the number of people that live in the system coverage area. This figure can be quickly obtained by multiplying the system coverage area by the population density (i.e., the number of residents per kilometer in that area). The more specific the data is to the coverage area, the more accurate the planning will be.

For comparisons in this guide, the average population density of the entire city was applied to the system coverage area to find the population in the system coverage area. This likely underestimates the population in many coverage areas because bike-share systems are generally implemented in areas with higher-than-average population density and high concentrations of workers commuting in.

At its most basic level, a bike-share system is comprised of a certain number of bikes, docks, and stations, which will serve a given market. These basic data points are described below:

- **Number of bikes**
  Defined as the number of bikes in active circulation in a system (in a dock or in use). This is not the total number of bikes owned by a system (which may include bikes that are being repaired or are part of the contingency fleet), which is less relevant to measuring the performance of the system.

- **Number of docks**
  Defined as the number of functional parking locations where a single bike can be checked in or out. Some systems allow bikes to be checked in and out without the use of docks, which may skew comparisons.

- **Number of stations**
  Defined as the number of specific locations where a bike can be checked in or out. Each station consists of multiple docks.

For planning purposes, two basic types of users are defined. This distinction is used to understand usage and define fees. These are:

- **Casual users**
  Defined as users who pay for subscriptions of seven days or less. Casual members typically can purchase these short-term subscriptions the day of use.

- **Long-term users**
  Defined as users who subscribe for a month or longer. The registration process for annual members typically takes a day or more and often includes a registration token, such as a key fob or a membership card, to provide access to the system.

Fig. 2: Bike-Share System Performance: Trips per Bike vs Trips per 1,000 Residents
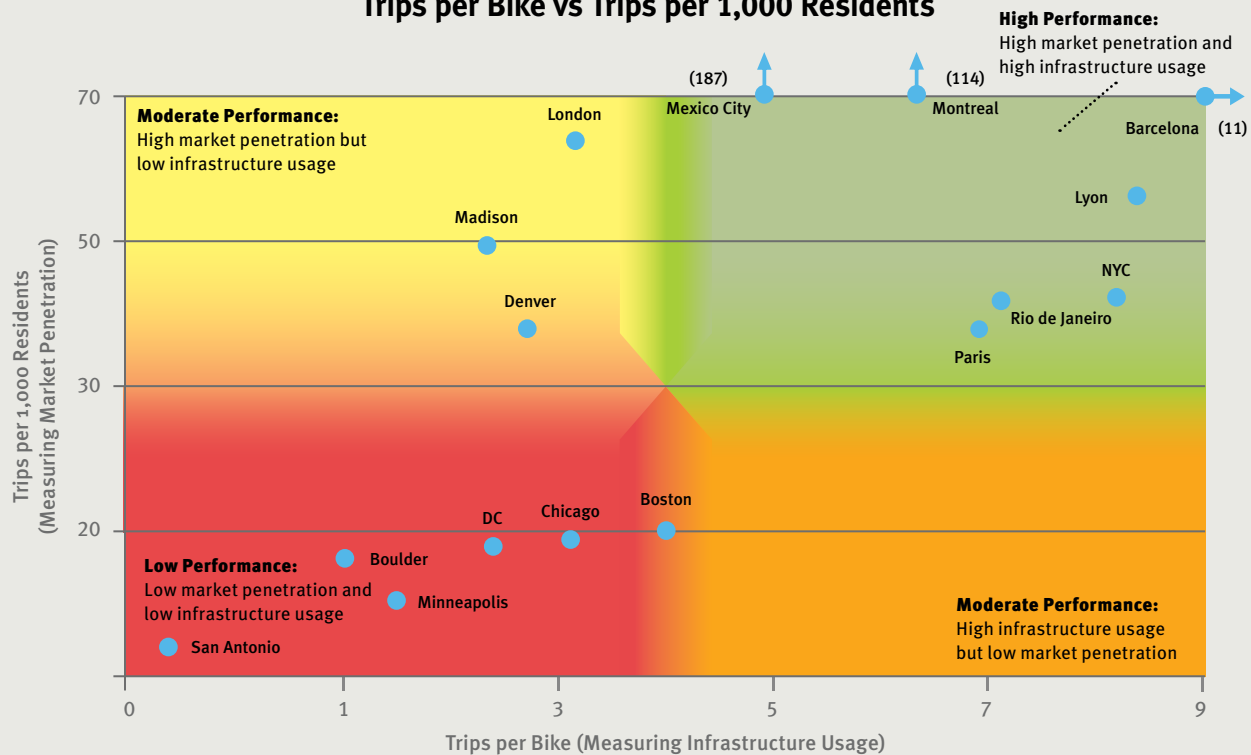
2.3.2 Performance Metrics

An efficient, reliable and cost-effective system will maximize two critical performance metrics:

- **Average number of daily uses per public bike**
Ideally, four to eight daily uses per bike. Turnover is critical to a successful bike-share system, and this is a measure of the efficiency of the system. Fewer than four daily uses per bike can result in a very low cost-benefit ratio, while more than eight daily uses can begin to limit bike availability, especially during peak hours. In 2010, Paris averaged more than four daily uses per bike for the whole year, including winter, when the usage is lower.

- **Average daily trips per resident**
Ideally one daily trip per twenty to forty residents. This is a metric of market penetration. High quantity of uses among the population of the coverage area is key to achieving the primary objectives of a bike-share system, including increased bicycle mode share, decreased congestion of vehicle and transit networks, and promotion of safe, clean, healthy modes of transport. Lyon, for example, has one daily trip per twenty-five residents.

These two metrics have an inverse relationship. Many systems have a high average daily use per bike because they actually have too few bicycles in circulation, and this means that market penetration (expressed here as average daily trips per resident) will be very low. Other systems may have high market penetration, but very few uses per bike, indicating inefficient usage of infrastructure and low cost-benefit, likely due to a surplus of bikes. The planning of a bike-share system must be carefully calibrated to ensure performance is within the optimum range for both metrics.

A system that has a very high number of daily uses per bike may have too few bikes to meet demand. This results in low market penetration, and a smaller impact on the city's objectives. The early years of the Barcelona system serve as a prime example, as there were, on average, nearly ten daily uses per bike, but the number of people using the system relative to the city's population was very low. According to Sertel, the operator of Rio de Janeiro's bike-share system, BikeRio has about ten to twelve daily uses per bike in 2013. This may be due in part because of the limited numbers of bikes available. If bikes are not readily available, the system will not be viewed as a reliable mode that could replace or compete with other options, such as transit or private cars.

Conversely, a system with too many bikes and a relatively low number of users could result in the perception that bike-share is an investment with a low return. An indicator of such a situation is the average number of trips per bike. Bike-share systems should strive to maintain an average of four daily uses per bike to maximize the public cost-benefit of the system.

The figure on the previous page shows how sixteen bike-share systems perform based on these two critical performance measures. The systems in the green area of the chart have the highest overall performance, as they are achieving optimum levels of both market penetration (expressed as daily trips per resident) and efficiency of the system (as expressed by daily uses per bike). Systems that fall in the orange zone are achieving high usage per bike, which reflects good cost-benefit of the system; however, they are not achieving a high market penetration, which indicates that these systems may warrant expansion. Systems in the yellow zone are achieving high market penetration and usage among residents, but have low usage per bike, which indicates that that they may have a surplus of bicycles. Bike-share systems in the red zone are not achieving good usage levels on a per capita or per bike basis, meaning they most likely need to expand their size and adjust other factors such as station placement or pricing.

What to Do if a System Is Too Popular?

Barcelona's Bicing was more popular than anticipated. Within its first two months, 30,000 people signed up for memberships—number that had been forecast for the entire year. While the city originally wanted to include tourists as part of the membership base, that option was removed to address the high demand and to avoid competition with the existing bike-rental companies that cater to tourists. However, short-term memberships, which tourists typically buy, can be a significant revenue generator, since cities usually give discounts for annual memberships. Now, with Barcelona facing a financial crisis, city services are being cut across the board. As a result, the city is proposing to increase Bicing fees by 116 percent, which has sparked a public outcry (Baquero 2012).

MICHAEL KODRANSKY

Paris · London · Montreal · Barcelona · Minneapolis

Ottawa · Brussels · New York · Zhongshan · Brisbane

Mexico City · Seville · Kaohsiung · Boston · Sao Paulo

Rio · Washington DC · Taipei · Tel Aviv

Every docking station in 19 of the world's bike sharing programs; each city mapped at the same scale.

2.4 Coverage Area

When beginning to plan a system, identifying a coverage area (the physical area that the bike-share system will cover) and saturating it with the appropriate number of stations are the most critical factors in creating a successful system with high ridership. The coverage area must be large enough to contain a significant set of users' origins and destinations. If it is too small to connect meaningfully to other places, the system will have a lower chance of success because its convenience will be compromised. While many people attribute Melbourne's low ridership to the city's mandatory helmet law (Preiss 2011), the city's bike-share operator, Alta, attributes it to the small coverage area, which was the smallest of the three options recommended in the feasibility study (Alta Planning 2012).

Dense, mixed-use areas with a high trip-generation capacity (generally city centers) are likely to see the most demand for bike-share, as they will be both the origin and destination points of many trips and are usually the best places to start. When defining the coverage area, the city will have to balance demand with costs. The identification of the appropriate coverage area is best carried out by qualified planning institutions through surveying and statistical data analysis.The coverage area must be determined in tandem with the system size to ensure that the system is both large and dense enough to encourage high ridership due to its convenience, reliability and ubiquity.

2.5 System Sizing: Three Basic Planning Parameters

The system size is determined by the number of bikes and number of stations the proposed system should have. From a user perspective, density of stations and availability both of bikes and of spaces to park the bikes will be the main considerations. A good station density within the coverage area ensures that no matter where a user is, there will be a station within a convenient walking distance to both the origin and destination of his or her trip. A large area of dense stations creates a network that users can learn to count on for all their trips in the city. The farther apart the stations, the less convenient the system is for the user. Lack of bikes or docking spaces for bikes results in frustrated users.

The following three parameters will help guide planning to ensure that the designed system will create a network that users can rely on and trust. They are meant to be guidelines, or averages, for planning; a more nuanced look at station spacing and location is described in the detailed planning and design section.

### 1. Station Density Ratio: the average number of stations within a given area

To create a reliable network, cities should pursue a more or less uniform station density throughout the coverage area to ensure users can bike and park anywhere in that area easily and conveniently. This parameter ideally scales the spacing of stations so they are within a reasonable walking distance within the coverage area. An ideal station density is approximately ten to sixteen stations per square kilometer. As the figure on the next page shows, increasing station density will yield increased market penetration (defined as trips per resident). Paris used one station every 300 meters as a guideline for the first phase of its bike-share system, as did London and New York. Phase one in Mexico City used one station every 250 meters. While this serves as a planning guideline for the detailed design, it also gives the number of stations for the proposed system to be used for costing estimates.

2. Bicycles-to-population Ratio: the average number of bikes per person in the coverage area

This parameter scales the number of bicycles to the number of potential users in the area in order to ensure that there are enough bicycles to meet demand. Large, dense cities or areas with high numbers of commuters and/or tourists will likely require a bicycle-to-population ratio of a minimum of ten to thirty bikes per 1,000 residents to meet demand. Cities that have a large influx of commuters during the day will need a higher ratio of bikes-to-residents to serve commuters as well. This ratio should be large enough to meet demand, but not so large as to have fewer than four daily uses per bike. While this serves as a planning guideline for the detailed design, this also gives the number of bikes for the system to be used for costing estimates.

3. Docks-per-bike Ratio: the average number of docking spaces per bike

Having more docking spaces than there are bikes is critical to ensure that there will be a parking space for a bike at multiple locations. Once the number of bikes needed for the system has been determined, the number of docks required should be considered as a function of the number of docks available per bike in service. Most successful medium and large systems have 2-2.5 docking stations for each bike in service. Montreal, London, and Washington, D.C., each have two docking stations for each bike in service, while New York has 2.5, Mexico City has 2.2, and Paris has 2.4. An analysis of the performance of the systems based on the ratio of docks to bikes was inconclusive. However, it is likely that cities with less mixed uses and highly directional peak flows of bicycles (generally toward the center in the morning and toward the periphery in the evening) will need a ratio that is closer to 2.5-to-1, while more mixed-use cities that do not have such defined peak directional flows can have a ratio that is closer to 2-to-1. Systems with lower docks-per-bike ratios may need to invest more in redistribution efforts in order to avoid station saturation, especially at peak destinations. While this framework serves as a planning guideline for the detailed design, this also gives the number of docking spaces for the system to be used for costing estimates.

Fig. 3: Station Density and Performance

Bike-share Market Penetration:
Trips per 1,000 Residents vs Station Density
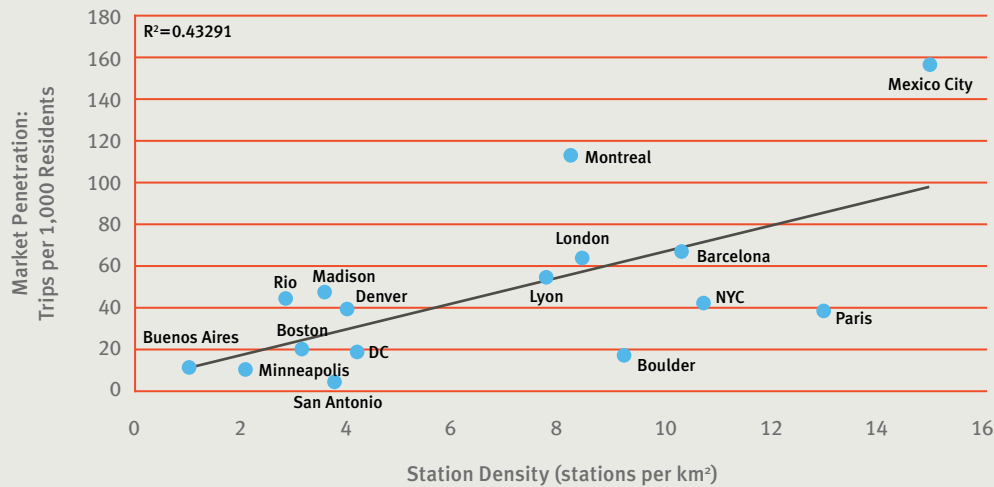
A direct correlation exists between a higher station density and a higher market penetration. A correlation, albeit weaker, also exists between a higher station density and a higher system efficiency.

SOURCE: ITDP DATA

Bike-share Usage:
Trips per Bike vs Station Density
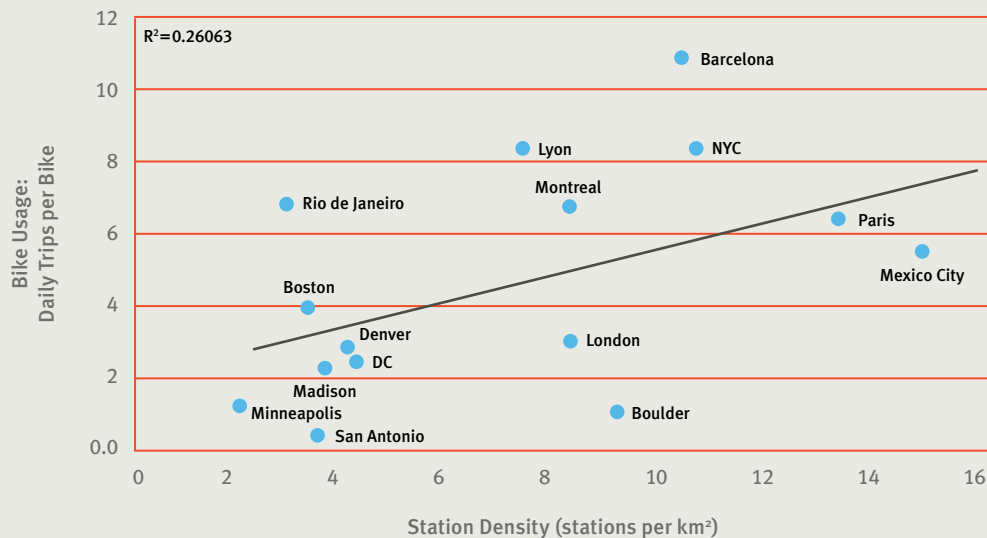
Bikes Per Population

Ideal ratio of bikes per population is between 10 to 30 bikes per 1,000 residents.

Station Density

Ideal station density is between 10 and 16 stations per square kilometer.
  Fourteen stations per square kilometer is equivalent to:
• One station every 300 meters
• Thirty-six stations per square mile

Fig. 4:

Bike-share Market Penetration:
Trips per 1,000 Residents vs Bikes per 1,000 Residents

$R^2 = 0.43291$

Market Penetration: Trips per 1,000 Residents (y-axis)
Bikes per 1,000 Residents (x-axis)

Data points: Shanghai, Mexico City, Montreal, Lyon, Barcelona, London, Rio, NYC, Paris, Denver, Madison, Boston, DC, Buenos Aires, Minneapolis, San Antonio, Boulder
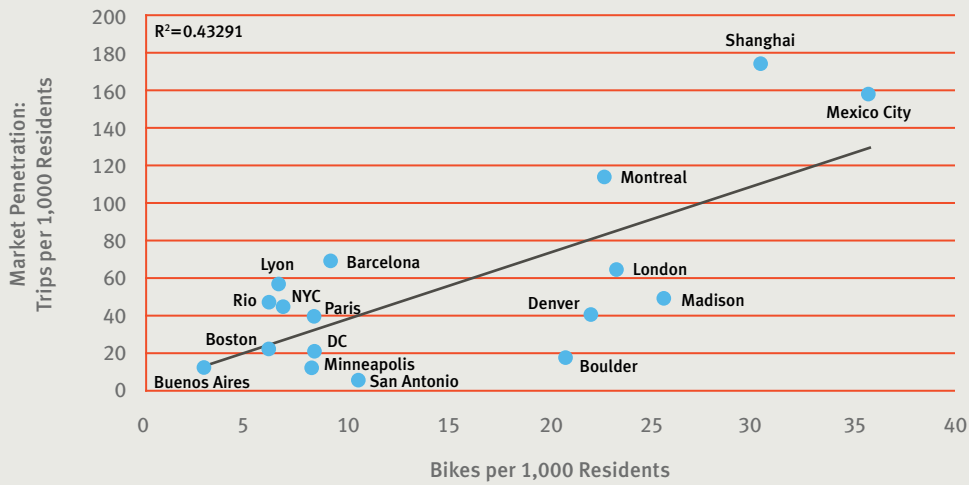
Bike-share Usage:
Trips per Bike vs Bikes per 1,000 Residents

$R^2 = 0.10766$

Bike Usage: Daily Trips per Bike (y-axis)
Bikes per 1,000 Residents (x-axis)

Data points: Barcelona, Lyon, NYC, Rio, Paris, Montreal, Mexico City, Boston, Denver, London, DC, Madison, Minneapolis, Boulder
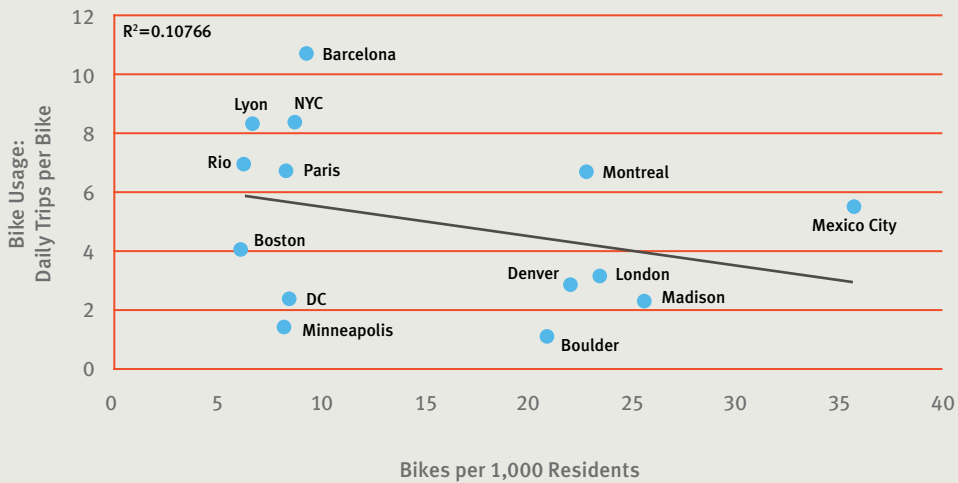
A higher number of bicycles per resident will increase market penetration. Providing more than thirty bicycles per resident, however, may lead to too few daily uses per bike. While the data show that the number of daily uses per bike tends to decrease as the number of bikes per resident increases, the statisical relationship is too weak to accurately predict values here. These graphs illustrate the inverse relationship between the metrics.

SOURCE: ITDP DATA

After the system opens, another parameter that will be useful in evaluating performance is the number of annual members per bike in service. This metric is another way to measure the amount of use that can be regularly expected. Many practitioners in the field recommend a 10-to-1 ratio of annual members to bikes to create a well-functioning system (Cohen 2013). Systems below this ratio will need to recruit more members through better promotions, better bicycle facilities, better system service, etc. Systems above the 10-to-1 ratio will likely need to expand to accommodate demand. For example, New York City surpassed a 16-to-1 ratio in its first two months of operation and is experiencing difficulty meeting demand at many locations. This signals that the system needs to expand to meet ever-growing demand.

The parameters used for the feasibility study and as the framework for planning do not address specific station locations or the exact number of bikes and docking spaces at each station, as that is determined in the planning and detailed design phase.

Hangzhou has stations with attendants who monitor bike check-in and check-out.
KARL FJELLSTROM

2.6 Financial Analysis

Once the system size has been decided, an initial financial analysis can be undertaken. This analysis usually considers the estimated capital outlay, projected revenue, and estimated operational cost. It should also consider the advantages and disadvantages of different financing mechanisms.

An estimation of capital costs and operating costs can be calculated by multiplying the number of bikes, docks, and stations against an average cost. The capital and operating costs are a function of system technology and are straightforward to determine, but the revenue depends on usage levels and can only be fully estimated in the detailed planning stage. Usually the revenue scenarios are based on expectations of demand using both a conservative estimate (in which demand, and therefore revenue, is low) and an optimistic scenario in which demand projections are higher, resulting in higher projected revenue.

Capital costs are often expressed in terms of the "cost per bike," defined as the total cost of the system—including stations, bikes, redistribution equipment, the control center, and other equipment—divided by the total number of bikes in the system.

Operating costs vary widely from system to system and from city to city due to many factors, such as the cost of labor, accounting practices, and, of course, system planning and infrastructure. Common operating costs are expressed in an annual-per-bike amount and can range drastically depending on redistribution mechanisms and needs, labor costs and service level delivery. In Zhuzhou, China, for example, annual operating costs are ¥1,200 (US$191) per bike but similar 3rd generation systems in the West can have operating costs of upward of US$1,970 -4,200 per bike (Midgley 2011).

Using cost-per-bike may be useful in the planning stage to size the system financially, but in analyzing system performance after it opens, a per-bike analysis is not recommended, because bike fleets vary from day to day (Cohen 2013). Some have used the per-dock basis for analyzing annual operating costs as a more stable, and therefore, more comparable basis

(Cohen 2013). However, this guide recommends evaluating the cost efficiency of a system after it opens by looking at operating costs per trip. For example, Mexico City and Washington,D.C. have similar operating costs per trip ($468 and $556 respectively), while operating costs per bicycle are very different ($2,594 and $1,255 respectively). Mexico City's per bike costs are about double that of Washington, D.C.'s but its per trip costs are lower. Like other transit systems, the goal of bike-share systems is to attract and move as many people as efficiently as possible, and a system's operating expenditure should be based on the number of people, as expressed in the number of trips, using it. Most transit systems express their costs in a similar way.

To estimate revenue, multiply the demand estimations for usage against the proposed revenue structure. Demand is often estimated using what is called an uptake rate, which is an assumption of the likely usage as a percentage of the residential population of the coverage area. As previously discussed, London used an uptake rate of nine percent, based on market

Bike-share systems can range from very simple (such as EnCicla in Medellín, top) to more complex (such as Citi Bike in New York City). The level of complexity will have a direct impact on the financial model.
CARLOSFELIPE PARDO

studies. In Paris, after Vélib' opened, the system saw a six percent uptake rate. New York City looked at three scenarios: a conservative estimate based on a three percent uptake rate, a middle estimate using a six percent uptake rate, and an optimistic scenario of a nine percent. Ultimately, the city decided to use the six percent rate for projections (New York City Department of City Planning 2009).

Another measure of the financial health of a system is the percentage of operating costs that are covered by membership and user fees. This metric, known as farebox recovery, measures the degree to which a bike-share system is self-sustaining. Most systems do not meet their operating costs through membership and user fees alone, although some do come close. This metric can be used to determine the degree to which other revenue sources, such as advertising revenue, government subsidies, and system sponsorship, will be needed to cover operating costs.

A financial analysis of a bike-share system should consider what percentage of total trips will be taken by long-term members, and what percentage by casual members. This metric can reveal which of the two user groups will generate the majority of the system's revenue. In most systems, casual users are charged a higher price per day than annual users, and casual users are the source of more revenue, even if in numbers they are not the largest user group. Casual users are less familiar with the bike-share system in a city and are therefore more likely to be charged fees for exceeding time limits. However, systems with high percentages of casual users are more susceptible to changes in tourism and subsequent fluctuations in revenue. Systems with a high percentage of casual users may rely on overtime fees for revenue, leading to unhappy customers, who had inadvertantly accrued these fees. Typically, as a system grows, the percentage of casual users declines, as some casual users purchase annual memberships.

Many Chinese systems, including in Zhuzhou, opt for simpler, cheaper bikes.
LI SHANSHAN

Fig. 5: Bike-share Economic Performance:

Operating Cost per Trip vs. Station Density
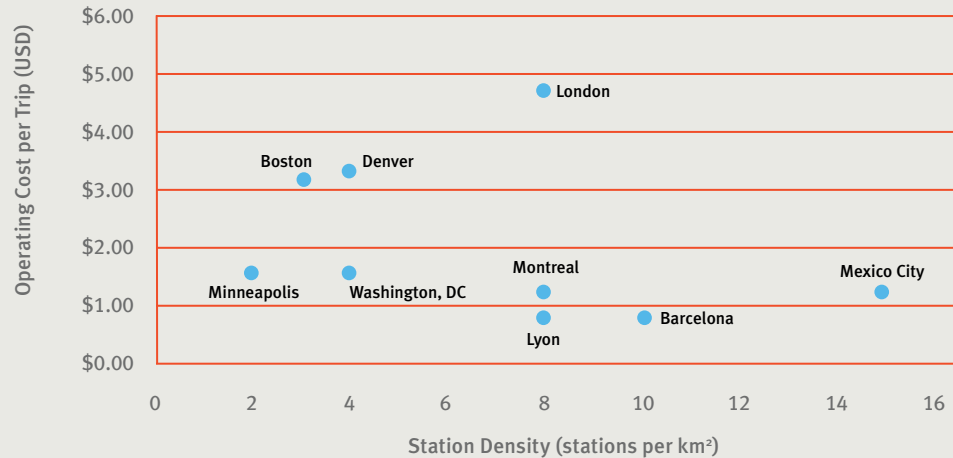
Operating Cost per Trip vs. Bikes per 1,000 Residents
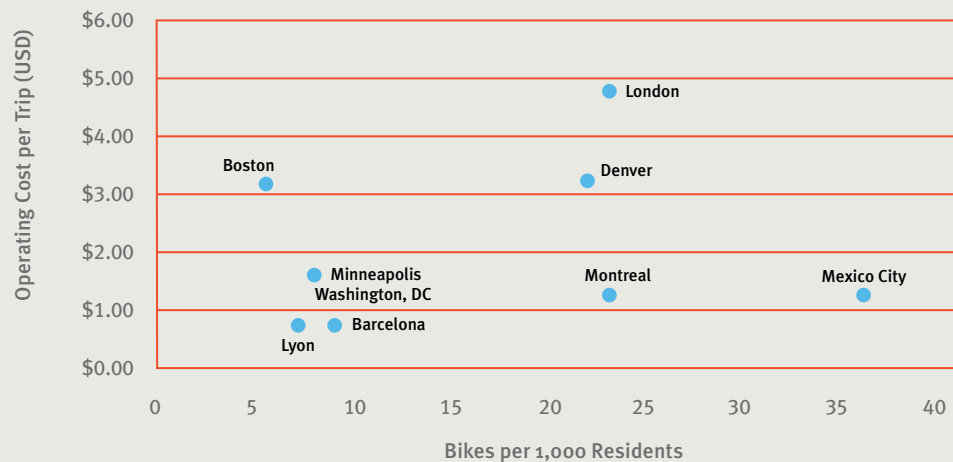
SOURCE: ITDP DATA

The different systems show a degree of variation in cost per trip, with no definite correlation. Logically, larger, denser systems should benefit from economies of scale, and each additional trip should cost less money. However, the limited amount of data available does not yet confirm this notion.

SOURCE: ITDP DATA

An analysis of US systems illustrates this shift from casual users to annual. Washington, D.C.'sCapital Bikeshare annual members account for 80 percent of the system's trips, whereas in Boston, the first year saw only 56 percent of rides by annual members (the remaining by casual) and that number grew to 69 percent in the second year. Most of the other systems have a split, such that approximately 60 percent of the rides are from annual members and 40 percent of the rides are from casual members. Madison B-Cycle system saw 57 percent of its first year trips taken by casual users, but only 34 percent of rides were by casuals in the second year (Cohen 2013).

When projecting usage, London officials considered density and location of stations.

KARL FJELLSTROM

High demand on
Shanghai's system
necessitated building
many large stations with
over a hundred spaces.
LI SHANSHAN

section three

DETAILED PLANNING AND DESIGN

Detailed system design and planning applies the parameters discussed previously to determine the exact locations and sizes of stations. During this phase, the city should also decide on the hardware and software of the system, including vehicle type, station design, and IT systems. Finally, during the planning stages, the city needs to develop a communications plan and marketing strategy, including the brand for the system.

Stations should be roughly uniform distance from one another. The size of the station will be a function of the anticipated demand and the attractions of a particular area, and station's location will depend on the actual environment. The station density that was decided in the feasibility stage should be more or less adhered to, although some factors may influence that. For example, areas that are more densely populated may require more stations than the stated parameter, while other areas, due to land use and existing conditions such as large parks or industrial areas, may require less.

However, consistent coverage through uniform station density, or at least a minimum station density everywhere, is critical to creating a system that users can truly rely on to go anywhere in the city. Demand in a particular area is best addressed by adjusting the size of the station.

Many bike-share systems concentrate stations in high-demand "destination" areas, while neglecting station coverage in lower-demand, residential areas. However, a significant portion of trips in most cities occur in low-density areas of a city. For instance, many morning commutes begin in lower-density residential areas, and many evening commutes end there.

The size of the stations, meaning the number of bikes that can park at a station, will be the most variable aspect of the system design. Every system has many station sizes that differ because of demand. Stations can vary from having ten docks per station in low-density areas to as many as hundreds

of docks per station in very high-density areas with high peak-hour flows. Vélib' ranges from twelve docks per station in lower-traffic areas to seventy docks per station in central tourist areas, while stations in Hangzhou and Shanghai can accommodate hundreds of bikes at a single central location.

Existing trip patterns can be researched to help determine demand and station locations. Because most transport models use zone structures that are too large to be of much use in deciding on the size and location of bike-share stations, most cities use local knowledge to determine these elements. To get an idea of popular destinations in the area, origin-destination (OD) surveys can be conducted at major local public transport terminals and stations, focusing on passengers who transfer to taxis or buses to complete their journeys. This can help to determine where the system is most likely to succeed and to anticipate demand.

3.1 Station Location

Choosing good station locations is critical to ensuring that the system will have high usage and turnover. Stations should be situated such that that they can be found at regular and convenient intervals throughout the area and are in desirable locations that generate usage throughout the day. General guidelines for locating stations are as follows:

The bike-share system in Brussels has many stations in key activity areas around the city.
KARL FJELLSTROM

- The station-density parameter, such as 1 station every 300 meters, that was defined in the feasibility study (see section 2.3.4) should be the basis to ensure mostly uniform coverage.

- Stations should be adjacent to mass transit stops and stations, as bike-share is complementary, helping passengers connect more easily and quickly to their destinations.

- Whenever possible, stations should be located along existing bike lanes or on streets that are safe and accessible for bikes.

- Stations are best situated on or near corners, so that users can access and egress from multiple directions.

- Stations are ideally located between multiple uses that generate activity at different times of the day. This ensures that bikes will be used from morning to night. For example, a station that is situated between an office complex and bars/restaurants means that the bikes are used by commuters during the morning and evening and by the restaurant and bar customers during the middle of the day and night. Proximity to places that attract lots of different types of activity over the course of the day increases safety for the users.

- Stations should not be placed next to barriers like train tracks, or single-use areas such as a large gated park or factory. Barriers reduce the area that the bikes can reach, reducing their effectiveness. Stations in single-use areas have lower usage because there are fewer activities to attract a variety of users. Underused areas, like underpasses, while interesting in terms of having space to place the station, should be carefully considered for potential safety concerns.

The city should specify which guidelines it wants to follow as a framework for the next step of determining the exact location of each station. Determining ideal station location is a two-step process:

1. Create a first draft of all station locations

2. Finalize the positions through site visits and stakeholder engagement

Creating a first draft of station locations can be done in one of two ways: The first draft can be mapped out remotely using a grid approach and then verified by a site visit, or it can be done in the field and then analyzed remotely and adjusted where there is too much coverage or too little. Either way, the idea is to have roughly even distribution of stations while working within the constraints of the environment.

To map locations remotely, draw a 1 x 1 km grid over the map of the coverage area using a computer program such as Google Maps or GIS, or simply using a paper map, marker, and ruler. The grid provides a simple foundation for rational and even distribution of stations. The map should show transit stations and bicycle lanes, as well as any other important demand generators or facilities. Then, applying the station density parameter and station location guidelines, calculate the number of locations per grid square. This ensures that stations are spaced evenly throughout the coverage area. If the desired station density is fourteen stations per square kilometer, fourteen stations should be placed more or less evenly in each box on the map's grid. The grid can be altered, subdivided or zoned into high-station-density zones and low-station-density zones if desired, though a uniformly high-density approach is recommended for most situations.

If you start in the field, you will need to analyze the results to ensure continuous coverage by drawing coverage areas of each station (using a radius of 150 or 200 meters). The areas left without coverage will, then, need to be analyzed to see if a station should be added, and, if so, where. While the goal is to use the station-density parameter to ensure uniform coverage, rarely is this achieved 100 percent in practical terms. This is because existing infrastructure and space often dictate how many and what size of stations are needed.

Exact positioning of the station will require a site visit. Using a bicycle to conduct the site visit is recommended because it will give the planners a sense of the coverage area from the perspective of a cyclist and will be more efficient for siting many stations. A tape measure and a GPS or smart phone will also be needed. If using a map, visit each general location marked on the map grid and examine the area to determine the specific site to best accommodate the bike-share station and see if there is sufficient space for the station. The space needed per station will depend on how many bikes are at that station. Depending on the bike docking design, each bike will need a space that is approximately 2 meters long and 0.7–1.5 meters wide.

Once this draft has been finalized, it needs to be vetted by stakeholders. Engaging stakeholders in the station location process is a good way to build support for the project and gain an understanding of the demand for particular stations. Community workshops to present these plans provide an opportunity

New York City's Station Location Guidelines

The following are the general guidelines for the location of New York City's bike-share stations:

- On wide sidewalks or in the roadbed. Bike stations should not impede pedestrian or vehicular traffic

- With enough frequency to ensure program visibility and use (approximately 28–30 stations per square mile)

- Along existing or proposed bike lanes whenever possible

- Near subway stations, major bus stops, the Staten Island Ferry Terminal and other ferry landings

- Near major cultural and tourist attractions

- Adjacent to major public spaces and parks

(NEW YORK CITY DEPARTMENT OF CITY PLANNING 2009)

No stations are located here because of a variety of reasons: a dense urban village, private land (universities) and a park where it is prohibited to ride a bicycle

Proposed Station Placement for Guangzhou, China's, Bike-share

The station-density parameter is a guideline that, on the ground, may need to be adjusted, as is seen with the first phase of the bike-share system in Guangzhou. The bike-share system was implemented in conjunction with the BRT corridor. Bike-share stations are needed on both sides of the corridor because the only way for users to cross the corridor is through pedestrian bridges, which would require carrying the bicycle up flights of stairs to get to the other side. Therefore, the density of stations along the corridor is much higher than the recommended ratio. Conversely, in areas where bicycling is forbidden, such as a large park, there are no stations.

to disseminate information about bike-share to people living in neighborhoods where the system will be introduced, and can be valuable in choosing where to place docking stations and understanding demand. Before holding public meetings, the government should establish criteria for approving or denying station requests. Another, increasingly popular method is to crowdsource the station locations through websites. This can also serve to identify high demand areas. This, however, will not identify the exact location of the station, just proximate areas that need to be served by the system. Exact locations for stations need to be done through analysis and selection by the planning team.

New York City crowdsourced station location ideas by organizing an website where people could request a bike-share station or vote for one that had already been identified. The city received more than 10,000 station location ideas and 55,000 votes for

suggested stations. This helped show public support for this initiative. The city also held 159 workshops with the community to refine station locations. For each possible station, the Department of Transport identified up to five potential locations that were then brought to the community to finalize the location. Crowdsourcing and community workshops also can help provide some political cover when the system is being implemented if a backlash occurs when the stations show up on the streets, as happened in New York City (Miller 2013).

Once the specific location for a bike-share station is established, it should be placemarked using a GPS system (or bookmarked on a smart phone), a photo should be taken and precise details noted about the station positioning. These coordinates, notes, and photos should then be given to the station installation contractor to safeguard against location/positioning errors, which are common.

Care must be used in matching station location to the cityscape. Stations are better located in sunny spaces when possible, rather than under trees, so that the bikes dry off more quickly after it rains. This is also important if the system is solar-powered. Locations will need to balance visibility of the system with integration into the street environment. Often, larger stations in prominent areas are designed to stand out against their landscape, while stations in residential areas are meant to blend in to the streetscape. Stations should not be placed on footpaths unless there is sufficient clear space for walking beside the station. In general, a width of two meters of clear space for walking is recommended in all locations, and more space should be provided where there is higher pedestrian traffic. At intersections, space is often more readily available on the minor street than on the main thoroughfare.

A variety of options for station locations should be considered:

- On-street parking spaces: Car parking locations are an ideal location for bicycle parking stations. In Paris, more than 1,450 on-street parking spaces were removed to create space for 4,000 bicycles in the Vélib' system (Kodransky 2011). Similarly, Barcelona converted nearly 1,200 parking spaces for use by the city's Bicing bike-share system.

- Space between landscaped areas or adjacent to other infrastructure: Space that is not used often by pedestrians such as in between trees or planter boxes or next to other infrastructure such as pedestrian bridges or utility installations can be used for bike-sharing stations without impeding pedestrian flow.

- Dead spaces: Areas beneath flyovers and bridges, which are often not utilized, can be good locations. These spaces may raise some safety concerns, but those concerns can be resolved by proper lighting and good station design. A bike-share station can transform a previously desolate space into something more lively.

Some systems include applications for smart phones that show station locations.
CARLOSFELIPE PARDO
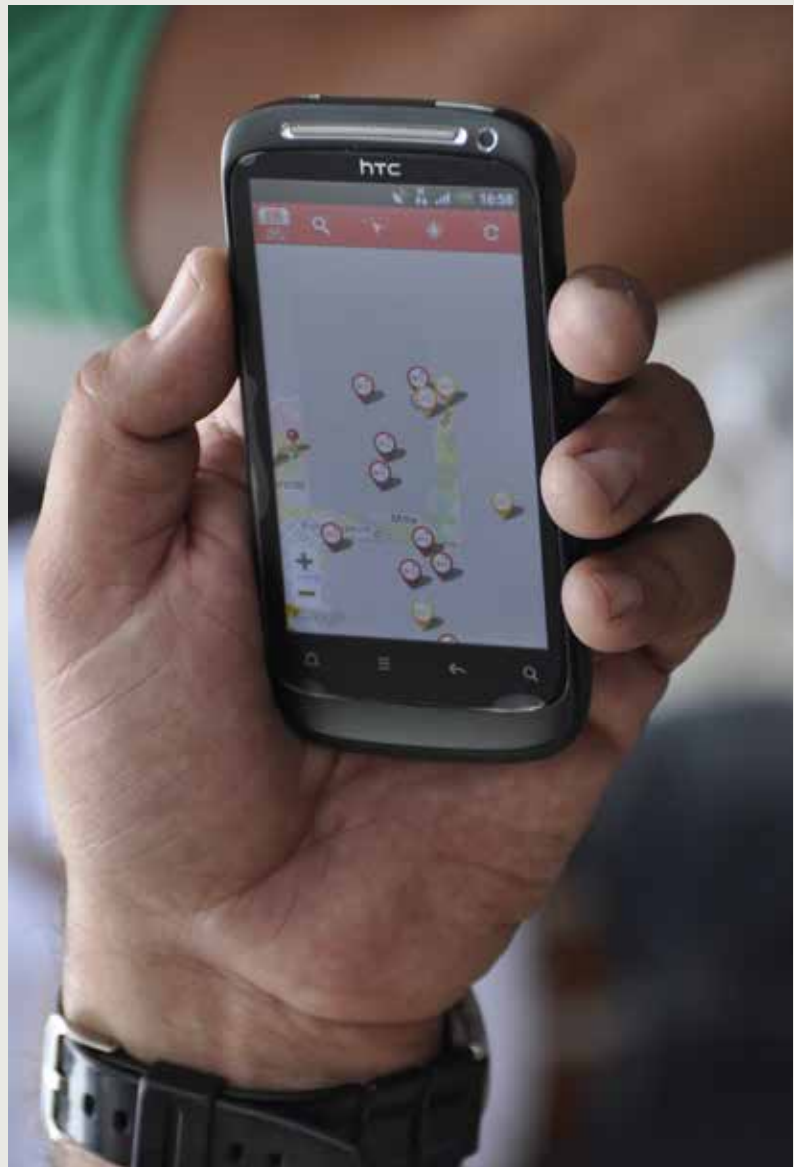
- Private property near large commercial and housing developments: Bike-sharing stations create destinations, so private property owners can be convinced to give up private land in exchange for the benefits of having a station near their premises.

TOP
Barcelona replaced parking spaces with bike-share stations.
DUAN XIAOMEI

BOTTOM
Stations located on sidewalks are fine, as long as there is also plenty of space for pedestrians, such as at the station on Avenue Paseo de Reforma in Mexico City.
AIMEE GAUTHIER

Bicycle Lanes and Bike-share

While bike-share can be implemented even if there is little existing cycling infrastructure, pairing the construction of new bicycle tracks with the opening of a bike-share system can add to public acceptance and improve safety for users of the new system. Several cities around the world have pursued this approach.

In other cases, the success of the bike-sharing program is high, even if there are not a lot of cycle lanes. In Mexico City, there is not a lot of cycling infrastructure, and many of the streets in the coverage area are small streets that do not need separated space for bicycles. Given that and in preparation for the opening of the system, the city conducted a safety campaign to teach motorists and cyclists how to share the street with each other. Since Mexico City's bike-share system opened in 2012, there have been five million trips, with few accidents and no fatal collisions (Godoy 2013). That said, cycle lanes do help, and where good cycle lanes have been built in Mexico City, annual bicycle flow has increased over 40 percent.

Bogotá's pilot bike-share program was explicitly developed along bikeways to increase user safety.
CARLOSFELIPE PARDO

Fig. 6: Cycling Infrastructure Implemented Alongside Bike-share Systems	
City	**Bike Infrastructure With Bike-Share System**
Guangzhou, China	46 kilometers of segregated bike lanes
Paris, France	68 kilometers of segregated bike lanes, in addition to 371 existing kilometers
London, United Kingdom	37.8 kilometers of 4 cycle superhighways
Barcelona, Spain	150 kilometers of segregated bike lanes
Boston, United States	80 kilometers of segregated bike lanes (Kaiser 2012)
Rio de Janeiro, Brazil	300 kilometers of physically segregated (ciclovias), painted lanes (ciclofaixas) and signalized shared routes (either with traffic or pedestrians)

3.2 Station Sizing

Once the station locations have been chosen, the next decision will be how big those stations should be, including the number of bikes and the number of docking stations. This will depend on the demand of the area, which can be determined by several different methods:

- Conduct surveys at the transit stations to see where people are going and if they would use a bike to get there if the option were available.

- Look at existing mode splits and major attractions or points of interest that may create a higher demand.

- Crowdsource station locations to get an idea of the demand for a particular area. This can be done online by asking people where they would like to see a station. It can also be done in public areas in an installation where people can mark on a map where they would like to see a station.

- Hold community workshops to test station location and get a sense from the community of the local demand.

To simplify the planning process, stations can be defined into few key sizes, such as small, medium and large, so that each station size is not overly deterministic. Once demand is determined, the station size will then be the number of bikes per station multiplied by the docking-space-per-bike ratio to determine the number of docking spaces at each station. For example, if the docking-spaces-per-bike ratio is 1.7 docking spaces per bike, a station that needs ten bikes will need seventeen docking spaces.

Using modular stations mitigates some of the risk of wrongly sizing stations, as it is easier to add or remove docking spaces once the system opens. See the next section for more information.

3.3 Station Type and Design

There are three key considerations for choosing a station type:

- Manual versus automated

- Modular versus permanent

- Docking style

Station design is a function of the level of demand, the amount of space available, the cityscape, and the desired visual impact on the urban environment. The choice of station type will need to take into account the IT requirements for each option.

Stations are composed of bicycles, docking spaces, and terminals, also known as kiosks. Docking spaces are where the bikes are parked and locked when not in use. In some systems, users can check out bikes at the docking space. Docking spaces represent the single largest capital cost in many systems, but a greater number of docking spaces helps cut operating costs by reducing the need for redistribution of the bikes. This guide uses terminals as the term to cover the places where users can get information about the system, but these can also be called kiosks and totems. Stations can also include advertising boards that can be rented as a source of revenue for the system.

London's Barclays Cycle Hire chose to install stations that are fixed into the ground. The terminals have excellent signage explaining the system and how it relates to other aspects of the city.
KARL FJELLSTROM

3.3.1 Manual vs. Automated

Systems can be either manual or automated. In a manual system, an attendant records the user's information and helps with checking in or out the bike, including payment. This information can be recorded on paper or electronically. Automated systems are where the user checks in or out the bikes and makes payments electronically either at the terminal or kiosk or directly at the docking station. These types of systems often use specialized key cards for the users. The key difference is having an attendant at the station who checks in and checks out the bikes for the user. Some systems have a mix, where larger or higher demand stations have an attendant.

Manual systems entail reduced initial capital costs compared to automated systems, but long-term operating costs are higher, and system reliability suffers. Proponents of manual systems argue that having staff at stations generates better service, reduces theft and vandalism, and requires less technological complexity at stations. Manual stations are used in systems of various sizes in places like Buenos Aires (although the city is moving to an automated system, keeping some larger stations as manual), Santiago, and Medellín. These are very basic types of stations that need only a simple locking mechanism for the bicycle (if the bikes are locked at all) and depend exclusively on an attendant. Their designs can be simple: some, such as the system in Buenos Aires, use specially designed freight containers; others, like Santiago's system, have no significant infrastructure other than a large horizontal pole to hang the bicycles. These basic stations are obviously the easiest to maintain and least expensive.

Automated stations are more complex in design, installation, and maintenance than manual stations. The capital costs will be higher than those of manual stations, but the operating costs over time will be lower. Automated stations are more secure and do not need staff at stations. Their design is more sophisticated in that it must include specifically designed docking infrastructure to lock the bicycles and technology that allows wireless information to transfer from the docking spaces and terminals in order to facilitate the checking in and out of bikes. Instead of attendants, the stations have a terminal that gives users information, accepts payment, and allows for checking bikes in or out. At least initially, however, automated terminals can be confusing, and can thus deter people from using the system. London addressed this problem by employing staff for an initial inaugural period to instruct people on how to use the system. However, terminals are not necessary, as the docks alone can allow for bike check-in or return.

While manual systems require an attendant at all stations, automated systems may also want to have a staff person at certain large stations for customer-service reasons. Though manned stations are cost-prohibitive in some economies, manned stations are desirable in many developing economies because of the job creation, security and added customer service that accompany them.

Bike-share stations should provide customers with information about how to use the system. In Rio, a placard offers instructions, as well as a map of the system.
AIMEE GAUTHIER

TOP
Capital Bikeshare
allows users to sign up,
check in and check out
automatically.
AIMEE GAUTHIER

BOTTOM
The bike-share system
in Medellín is manually
operated, and every
station is manned by one
or two people. However,
the stations also have
GPS-tracking software and
GPRS ID software.
CARLOSFELIPE PARDO

Buenos Aires:
Moving from Manual to Automated

Buenos Aires opened its bike-share in 2010 with 100 bikes, and by 2013 had expanded to thirty stations and 1,200 bikes. The system is a manual system using specially designed containers as stations. In first half of 2014, the system will expand again, reaching 200 stations and 3,000 bikes, and it will transition to a mixed system, with both manual stations and automated stations. The city decided to make this change because larger systems are more easily managed through automated stations. However, the stations with the highest demand will remain manual for the time being. Automated stations will be open 24 hours a day, while the manual ones will close at night. (City of Buenos Aires 2013)

In the first phase of Buenos Aires's bike-share system, users checked out bikes from an attendant.
ITDP ARGETNINA

3.3.2 Modular vs. Permanent

Two main types of stations are modular and permanent. Modular stations are easily moved, usually constructed on a base that is then bolted into the concrete or asphalt. Those stations require solar power. Permanent stations require excavation and trenching to reach the power source. This requires a longer time frame to implement and may entail a more onerous approval process.

The most flexible type of automated station is the one that was introduced in Montreal's Bixi system and is now used in other cities such as Washington, D.C., and Melbourne. It consists of a heavy base with docking locations and a terminal for information/registration/ payment, but it can also be relocated. The station is bolted into asphalt or concrete, but uses solar power and thus does not need to be connected to an underground power source. Once a station is built, if its location is found to be inadequate—as is sometimes discovered after some weeks of operation—the station can easily be relocated to a place with better demand. Stations like this are also more easily scaled up or down, adding or removing docking spaces as real usage is determined after opening.

New York City chose modular stations that were quicker and easier to install — both the docks and terminals are on platforms that connect to each other.
NYCSTREETS (CREATIVE COMMONS)

3.3.3 Docking Styles

In automated stations, there are two basic types of station design that accommodate check-in and check-out: docking spaces and cycle parking areas. Which type works best depends on the needs and location of the station:

- **Docking spaces:**
  Each space docks one bicycle. The number of spaces determines the size of the station's footprint, which means there is a great deal of flexibility in adjusting the station size to fit the existing urban landscape. This style takes up more space per bike than cycle parking areas, but blends in better with the urban environment. Bicycles are checked out by customers either at the terminal or at the actual docking space.

- **Bike parking areas:**
  Bicycles are stored together in a secured area, on racks. Cycle parking areas are a good option for larger stations—i.e., more than 50 bicycles—because cycle parking racks can hold more bikes per square meter than docking spaces. At stations with cycle parking areas, bicycles are checked in and out through a turnstile or manually. Because these stations require a secure area that is fenced or walled off, they can be more intrusive in the urban landscape.

A station can use individual, stand-alone docking spaces, as in Paris, or it can use a docking bar that joins the different spaces together, as in Mexico City and Washington, D.C. Individual docking spaces are perceived to integrate better into the urban environment and are more porous—unlike docking bars, individual docking spaces do not create an obstruction that pedestrians must walk around.

Other considerations for docking spaces include whether the user rolls the bike into the docking space to lock it into the dock, or whether the bike must be lifted up.

A system may incorporate both station types, depending on demand levels, desired street views and availability of space at a particular station. While docking stations are popular for roadside stations, bicycle parking areas are best utilized in underused spaces, such as those beneath overpasses or in suburban areas, where land space is not as precious as it is in cities. Whether a system uses docks or parking areas, stations should always have more docking positions or storage space than bikes in order to accommodate peak demand. This should be reflected in the station's docking-space-per-bike ratio.

TOP
New York City chose to install some docks where the road was very narrow to save space.
AIMEE GAUTHIER

BOTTOM
Lyon, France, uses individual docking stations where the locking mechanism is on the side of the frame of the bicycle.
LUC NADAL

TOP
In Rio de Janeiro's system, bikes lock into the side of the docking bar, rather than the top.
AIMEE GAUTHIER

BOTTOM
The docking system for Ecobici requires the user to line up the bike so it can be properly inserted into the docking bar.
AIMEE GAUTHIER

3.4 Information Technology Systems and Payment Mechanisms

Information technology (IT) forms the nervous system for the bike-share system, connecting the individual stations, users and control center using software and data-transmission mechanisms. Decisions that must be made relating to IT include deciding how customers register and pay for the system, how bikes are checked in and out from the docking spaces, and how information is transmitted both internally for management and externally for the customers.

The software needs to support the front end, or the public side, of the system, including registration of new users, payment and subscriptions, general information about the system, and customer data management. The front end of the IT system can include website portals and apps for smart phones. On the back end, where the implementing agency and operator receive the information required to run and manage the system, the software needs to support station monitoring, redistribution of bikes, defect and maintenance issues, billing, and customer data.

Most systems use card technology (smart cards, magnetic cards, or credit cards) to check bikes in or out. The second most popular technology is locks that use codes to release the bikes. Some systems are manual and do not require any technology to release or return the bikes. A few systems use keys.

IT will need to serve two types of users: long-term users—who are usually registered members and use the system with some frequency— and casual users, such as tourists, who use the system infrequently or even just once. Long-term members can be given access cards and can place deposits to use the system. Casual users will not be able to use the system if a special access card is needed or if there is no way to guarantee the return of the bicycle (which is usually accomplished through a financial mechanism, like a hold on a credit card).

In most systems, members check out cycles using RFID smart cards or keys. The smart card is registered in the user's name and carries a balance from which user fees are deducted. For short-term users who have not registered, such as tourists, many systems accept credit cards, placing a hold on the card that acts as a guarantee in case the bicycle is not returned.

Nearly all existing systems require a guarantee before use to ensure that users will return bikes. Sometimes this guarantee is in the form of either a hold on the credit card while the bike is in use or a deposit that is held by the operator until the user cancels the membership. If the bike is not returned, the prepaid deposit is retained or the user's credit card is charged for the guarantee amount. However, both credit cards and deposits present barriers for low-income users.

In Guangzhou, China, users must have a minimum balance of ¥300 (about US$48) on their smart cards (called a Yongchengtong card), about 67 percent of the cost of a bike (the bikes cost ¥450). The company is not allowed to touch this money, and it is held in escrow.

In some Chinese cities, citizens can use the local ID (called a hukou card) to register in the system and do not need to put down a deposit at all. This is the case in Shanghai, Shenzhen, and Yantian. Bangalore requires a deposit of 1,500 (US$28) for members and 2,500 (US$46) for non-members. Buenos Aires and Rio de Janeiro do not require a deposit, but do require registration, which can help locate users in the event of theft or damages. Mexico City requires a deposit of US$416. Bixi, in Montreal, requires a deposit only for non-members.

Payment systems are very specific to the laws and payment options available in the country in which the bike-share operates. Different countries have different privacy regulations and laws regarding payment, as well as different requirements for keeping the customers' information secure. Most countries have very established payment mechanisms, and it is best to work within those existing systems. Integrating bike-share payment mechanisms into the payment systems used by other local modes of transport should be a high priority.

Fig. 7:
Communications Systems and User-Interface Schematic
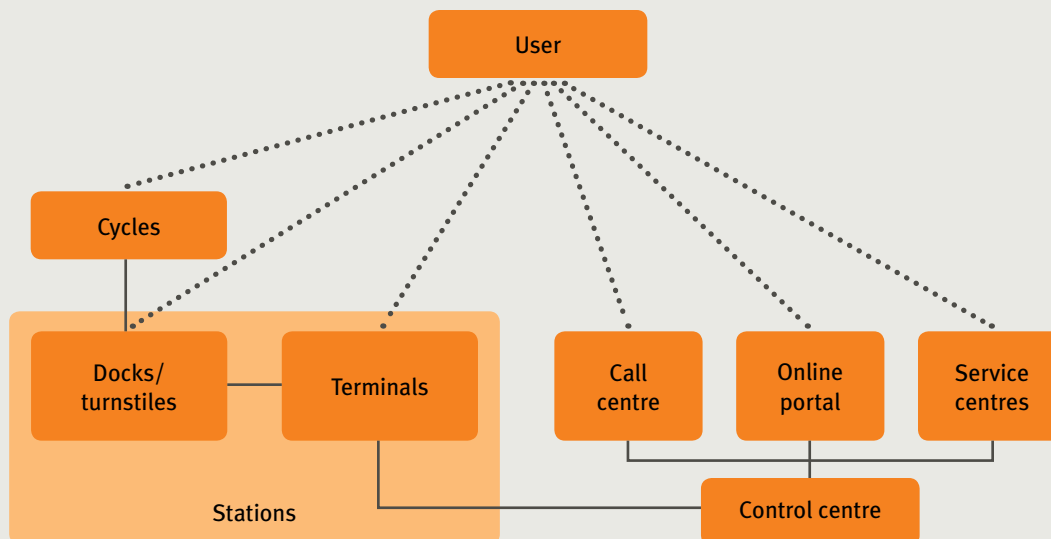
3.5 Bikes

Modern bike-share systems are typically based on a standardized bicycle with specially designed or proprietary components built solely for the system for added durability and security so that the parts cannot easily be stolen and resold. The appearance of the bicycle is a key element in the overall branding of a bike-share system and the bike should project a sleek, modern image. The design can differentiate the bike-share fleet from regular bicycles in the city through distinctive colors, frame style, molding, and graphics. The bikes must be robust since they will be used much more frequently daily than normal bicycles that are designed for less intensive use. Because of this, bike-share bikes have an average lifespan of three to five years.

System planners need to define the guidelines for the bicycle that be the most important part of the system branding and experience. The following are some desirable characteristics:

- **One-size-fits-all**
  A bike-share system usually offers only one size of bike. The bicycle should be comfortable for the user, but since there is only one size, it will not be for all users, but hopefully most. A city can determine the average user height and make a recommendation based on that. A step-through frame with long seat post can easily accommodate a wide variety of heights.

- **Robust**
  A bike-share bike has a much higher frequency of use than normal bikes. Conservatively plan for six to nine uses a day.

- **Low-maintenance**
  Bicycle designs that require less maintenance, including tire inflation, chain lubrication and adjustment, and brake adjustment, will have lower operating costs.

- **Secure**
  To deter theft, the bike must securely and easily lock into the docking space, and it must have components with proprietary tooling that make it difficult to remove and to resell the components.

- **Safe**
  The color of the bike, appropriate reflectors, bells, and lights for night riding all must be considered, and must meet the local laws concerning bike safety. Many bikes have lights powered by dynamos (through pedaling) that turn on automatically.

- **Include storage**
  A front basket is usually preferred to a rear rack to help users carry their belongings. Many systems avoid rear racks to discourage a second person riding on the back or carrying excessively heavy loads, both of which can lead to extra wear and tear.

Generally, these bikes are proprietary designs and tend to be heavy due to their robust, comfort- and style-oriented design. In Europe, bikes range from 14.5 kg (32 lbs.) in Barcelona, Spain, to 22 kg (48.5 lbs.) in Paris, France. Bikes in both New York and Washington, D.C. weigh 20 kg (44.1 lbs). In Guangzhou and Hangzhou, China, bikes weigh 14.3 kg (31.5 lbs) and 15 kg (33.1 lbs) respectively. In Buenos Aires, the bikes weigh 18 kg (39.7 lbs), in Rio de Janeiro 17.2 kg (37.9 lbs), and in Mexico City 14.5 kg (32 lbs). These bikes also usually have mudguards and chain covers to protect the user from dirt and oil.

Bikes require ongoing maintenance, both in terms of prevention and new parts. The three major points of maintenance on bicycles are tires, which will need tube changes and regular inflation; brake pads, which will need to be replaced; and drivetrains, which will need lubrication and adjustment due to chain stretch. However, new technologies have been developed to address these problems: Shanghai's Forever Bicycle Company has developed bicycles for the Shanghai bike-share that employ lightweight, solid foam-rubber tires that never need to be inflated, belt-driven drivetrains that need no lubrication or adjustment, and drum brakes that are more durable, are unaffected by rain, and need to be replaced much less frequently than regular brakepads.

London's bike-share bikes have mud guards and chain protectors.
LUC NADAL

TOP
Ecobici has mud guards and chain protectors to protect the user from dirt.
AIMEE GAUTHIER

MIDDLE LEFT
Capital Bikeshare, in Washington, D.C., uses bikes that completely enclose the chain, gear, and brake systems in order to protect the customer from dirt and grease, and the bikes from dirt and tampering.
CARLOSFELIPE PARDO

BOTTOM LEFT
The system in Medellín, Colombia, offers two types of bicycles, depending on station location: a road bike and an off-road bike (pictured).
JORGE IVAN BALLESTEROS

BOTTOM RIGHT
Shangai's tires are special-made to fit the terrain in the city.
LI SHANSHAN

Are Helmets Necessary?

Helmet use can pose a problem for system operation, especially if it is required by law, as in Bogotá, Colombia, and Melbourne, Australia. Helmet requirements represent an additional system cost and a significant potential barrier to use, for the following reasons:

- If each bicycle needs a helmet, there must be a system to distribute the helmets, as well as to prevent loss or theft

- Users may be reluctant to use a helmet worn by someone else

- Users will not necessarily use a helmet, and if they do, they may not return it, since there's no way of attaching it securely

- Users will not necessarily carry their own helmets, since the whole trip will not be made by bike and they are unlikely to carry around a helmet "just in case"

The operator of Washington, D.C.'s SmartBike system argued that helmets could not be provided for hygiene reasons (i.e., that helmet use by different people involved a risk that was not compatible with local health regulations) and thereby freed itself from the helmet requirement. There have also been concerns regarding leaving helmets exposed to the elements at stations. For Ecobici, in Mexico City, helmets were initially mandatory, but the law was repealed for reasons of social equity, on the grounds that not everyone could afford a helmet and disposable helmets were an environmental hazard (Penalosa 2010).

The mandatory helmet law in Melbourne has generated some negative effects with regard to system ridership, finances, and an overall perception of cycling as "dangerous." However, the operator feels that the system's insufficient coverage area has a greater negative effect on ridership than the helmet law (Alta 2012).

In Melbourne, Australia, cyclists are required to wear helmets.
ALASTAIR SMITH (CREATIVE COMMONS)

The Cycle

The cycle should be attractive and durable. The overall appearance of the cycle is a key element in the overall branding of a cycle sharing system and should project a sleek, modern image. The design can differentiate the cycle sharing fleet from regular cycles in the city through distinctive design, colours, and graphics.

Front basket
The cycle should be designed with a porous front basket for carrying personal items. Rear racks are not advisable as they can be overloaded, causing damage to the cycle. Front baskets are ideal for carrying purses and valuables, which would be subject to theft if carried in a rear rack. The design should prevent the use of the basket for carrying a second passenger.

Docking mechanism with RFID tag
The RFID device carries the cycle's unique identification number and is read when the cycle is docked at a station. The cycle should be held in a fixed position when docked.

Sturdy tires
Solid or puncture resistant tires with a wide profile are recommended to reduce the frequency of punctures and increase life expectancy.

Drum brakes
Front and rear drum brakes with internal wires are preferred. Disk, cantilever, and V-brakes should be avoided because they are difficult to maintain.

Protection against theft & vandalism
The cycle should be made from unique parts and sizes to deter theft. Nuts and screws should be designed so that they can only be opened with proprietary tools. Similarly, the standard 26-inch tire size should be avoided. (The tire diameter should not be too small because small tires are prone to getting stuck in potholes.)

Step-through frame
A step-through frame design is required to ensure that the cycle is compatible with all types of clothing. The frame should allow for a comfortable upright riding position.
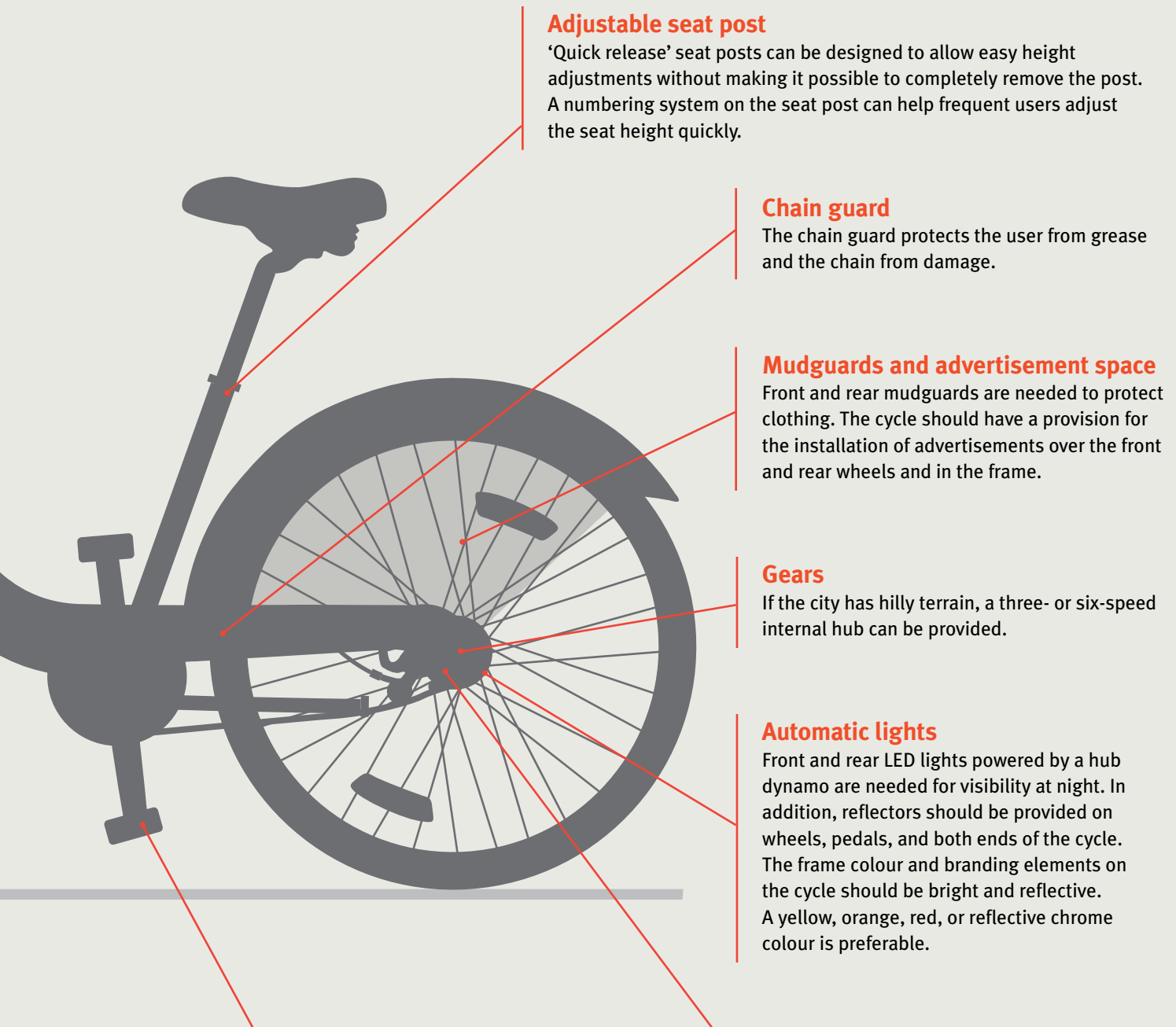
Adjustable seat post

'Quick release' seat posts can be designed to allow easy height adjustments without making it possible to completely remove the post. A numbering system on the seat post can help frequent users adjust the seat height quickly.

Chain guard

The chain guard protects the user from grease and the chain from damage.

Mudguards and advertisement space

Front and rear mudguards are needed to protect clothing. The cycle should have a provision for the installation of advertisements over the front and rear wheels and in the frame.

Gears

If the city has hilly terrain, a three- or six-speed internal hub can be provided.

Automatic lights

Front and rear LED lights powered by a hub dynamo are needed for visibility at night. In addition, reflectors should be provided on wheels, pedals, and both ends of the cycle. The frame colour and branding elements on the cycle should be bright and reflective. A yellow, orange, red, or reflective chrome colour is preferable.

Safe pedals

Large, flat pedals can help inexperienced riders keep their feet securely on the pedals. Avoid selecting a pedal with sharp barbs, as they can injure the foot and leg of an inexperienced rider.

Protected components

If the cycle has multiple speeds, these must be provided through an internal hub. External derailleurs are to be avoided, as they are fragile and difficult to maintain. Wiring for brakes and gears should be hidden.

3.6 Marketing

Bike-share is a new type of transport solution for cities, and a well-thought-out public participation and marketing campaign is essential for gaining acceptance of the system. A broader marketing campaign can follow, making use of print media, the Internet, and other media.

3.6.1 System Identity

A bike-share system needs a clear, consistent identity — a strong brand — that presents a professional, modern image and distinguishes it from other urban transport options. There are several elements of the identity, including the system's name, logo, and tagline. Consistent use of the core identity elements can improve customer identification with and pride in the system. The system's brand should all be easily used in different types of media. Choosing an effective name is critical to the identity of the system (Wright 2011).

The name of the system should usually be one short word, should carry a positive and ideally local connotation, and should roll nicely off the tongue in the local language. The name can either reflect some aspect of the system, or

Marketing can be done in various ways. Above, Minneapolis residents call attention to the new Nice Ride bike-share by wearing banana suits.
MASSDISTRACTION (CREATIVE COMMONS)

the system can take a positive connotation from the name it is using. A well-thought-out name can be a way for users to identify with a system.

   The system should have a logo that is meaningful in the local context. The logo can help create a vibrant, progressive image for the system. The tagline can link the name to the function of the system. It can ground a name in what the system does for the individual or the community. In New York City, Citi Bike's tagline is "Unlock a bike, Unlock New York." In Washington, D.C., Capital Bikeshare's tagline is "Take one & go." These taglines help create a vision for the system or for the person using the system. They further communicate what bike-share can do for the user and the community.

3.6.2 Internal Marketing

Internal marketing focuses on educating staff and officials from the city, departments within the city (such as the the departments of parks and recreation, environment, and transport), and other transport operators about the service the system will provide, and its costs and benefits. The internal campaign is more than a presentation to each body. Most important is a focus on integrating the bike-share system into the city's overall transport framework. True success in integration can be seen by the creation of complementary external marketing plans, combined signage, and pricing and operational coordination.

3.6.3 External Marketing

The goal of the external campaign is to inform the public about the merits of bike-share, how the system works, and the benefits to the individual citizen and to the city as a whole. The external marketing campaign should make use of new media, such as blogs and social-media sites, to reach different audiences. The marketing campaign must work proactively with media houses to define the public narrative about the system, rather than simply responding to external queries. Before and after implementation, it is important to have a communications push around safe cycling aimed at new cyclists and car drivers.

TOP
Advertisements raise awareness and excitement for a program, as above in Brussels, Belgium.
KARL FJELLSTROM

BOTTOM
In a successful bike-share system, city officials like Janette Sadik-Khan of New York City embrace the program.
NYC DOT (CREATIVE COMMONS)
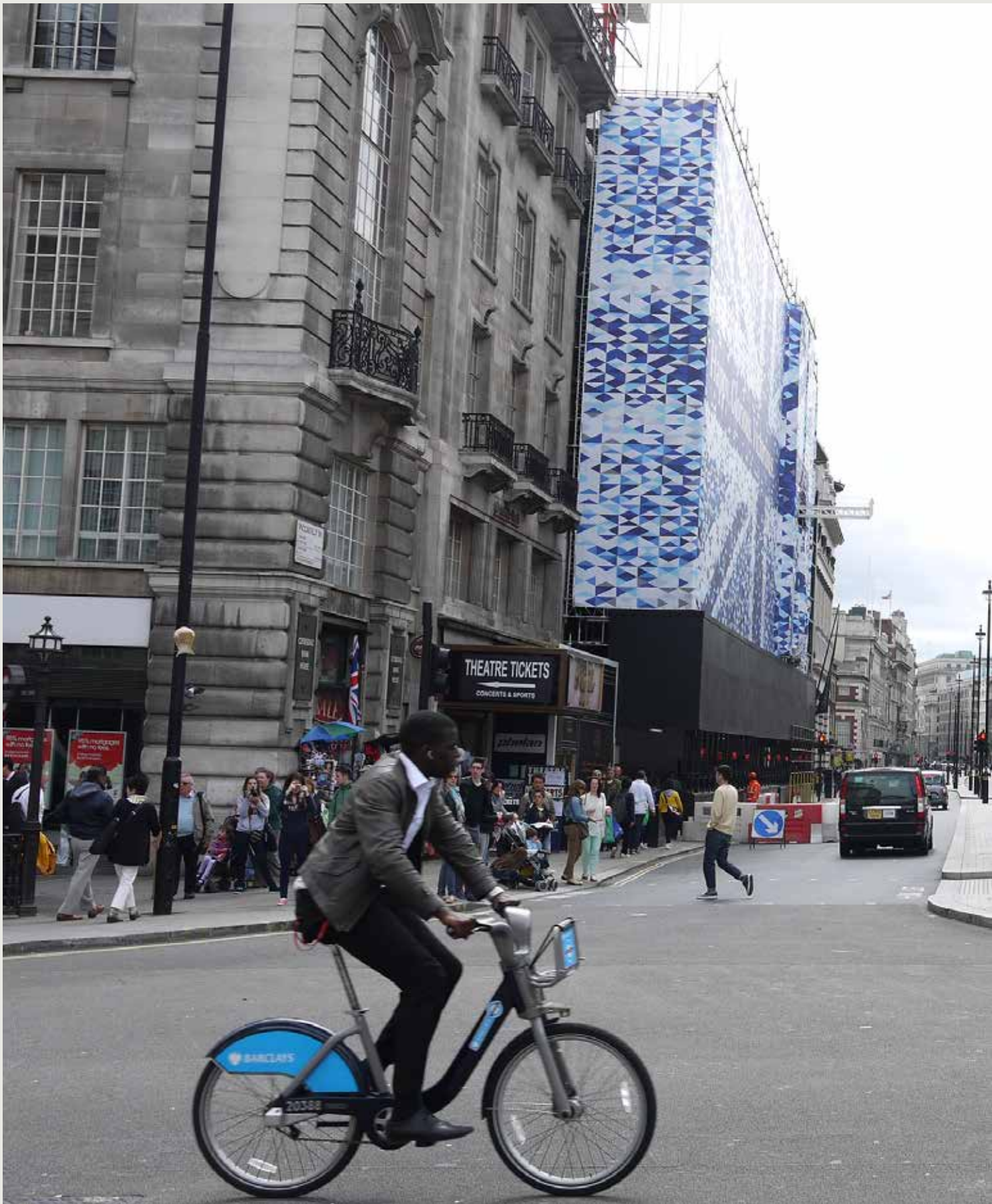
Fig. 8: Table of Names of Bike-share Systems		
City	Country	System Name
London	U.K.	Barclays Cycle Hire
Paris	France	Vélib'
Barcelona	Spain	Bicing
Lyon	France	Vélo'v
Montreal	Canada	Bixi
Washington, D.C.	USA	Capital Bikeshare
Guangzhou	China	Guangzhou Public Bicycle
Hangzhou	China	Hangzhou Public Bicycle
Mexico City	Mexico	Ecobici
Rio de Janeiro	Brazil	Bike Rio
Dublin	Ireland	Dublinbikes
New York City	USA	Citi Bike
Denver	USA	Denver B-Cycle
Minneapolis	USA	Nice Ride
Chattanooga	USA	Bike Chattanooga
Madison	USA	Madison B-Cycle
Taipei	Taiwan	YouBike
Brussels	Belgium	Villo!
Tel Aviv	Israel	Tel-o-Fun
Boulder	USA	Boulder B-cycle
Boston	USA	Hubway
San Antonio	USA	San Antonio B-cycle
Toronto	Canada	Bixi Toronto

Barclays bike-share in London—known around the city as 'Boris bikes'—has a clear, recognizable identity.
KARL FJELLSTROM
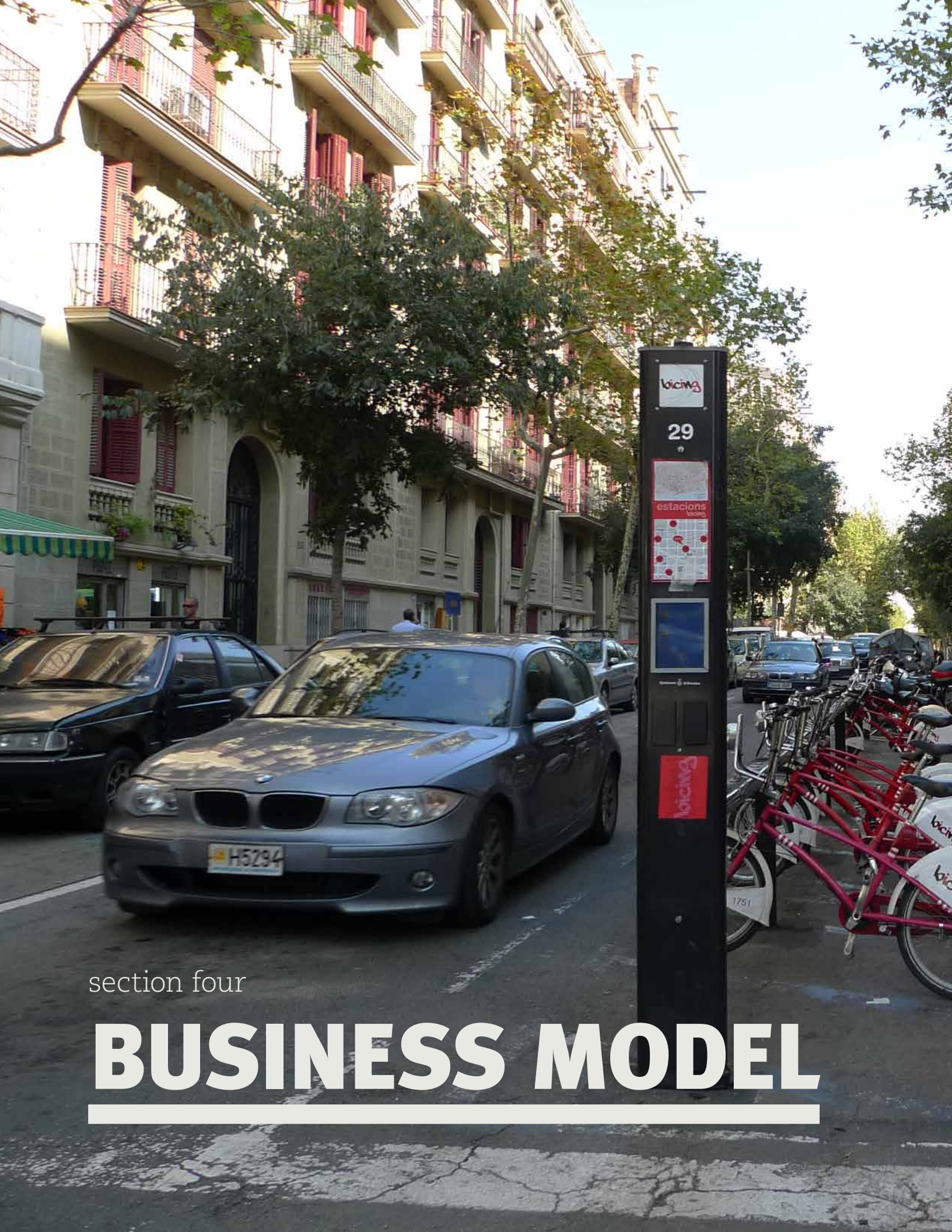
BUSINESS MODEL

Barcelona's Bicing system uses its stations to protect segregated bike lanes.
LUC NADAL

The business model defines the asset ownership and revenue flow between the government and the operator. The goal is to balance service provision with resource allocation. To do that, the government will need to consider three things:

- Organizational structure

- Asset ownership

- Contracting structure, including service levels

As a public transport system, bike-share should be situated similarly to other public transportation systems. Because bike-share systems are not large profit centers, the business model more closely resembles that of public transport than the models used for toll roads and parking management, which can often be unsuccessful when applied to bicycle sharing because of the difficulty of obtaining a return on investment.
In the planning phases, the government agency leading the project will need to set up a project-management unit to

oversee the implementation of the bike-share system. This implementing agency will manage the detailed system design, tendering and contracting, and the launch of the bike-share. Often, this agency also becomes the administrator that manages the system for the government after implementation. In this guide, the implementing agency will also be assumed to be the administrator post-implementation, and those terms will be used interchangeably.

A bike-share system can be completely public or completely private, but most successful systems are a combination of the two. The decision regarding which aspects should be public or private depends on the environment in which the system operates. Different cities need different structures to meet their specific needs, and this should be analysed in the feasibility stage. In selecting a business model, the government must weigh the desired utility that bike-share will provide to a user against the necessary resources.

4.1 Organizational Structure

The organizational structure establishes the relationship between the implementing agency, other key departments and officials in the government, and contractors or partners involved in the ownership, oversight, financing, operation, and management of the bike-share system.

City-wide
Bike Strategy Director

ECOBICI
Manager (clear channel)

SEDEMA-ECOBICI
Director

Operations

Customer Service

Information
Technology

SEDEMA-ECOBICI
Manager
and Team

Finance Coordinator

Institutional Relations
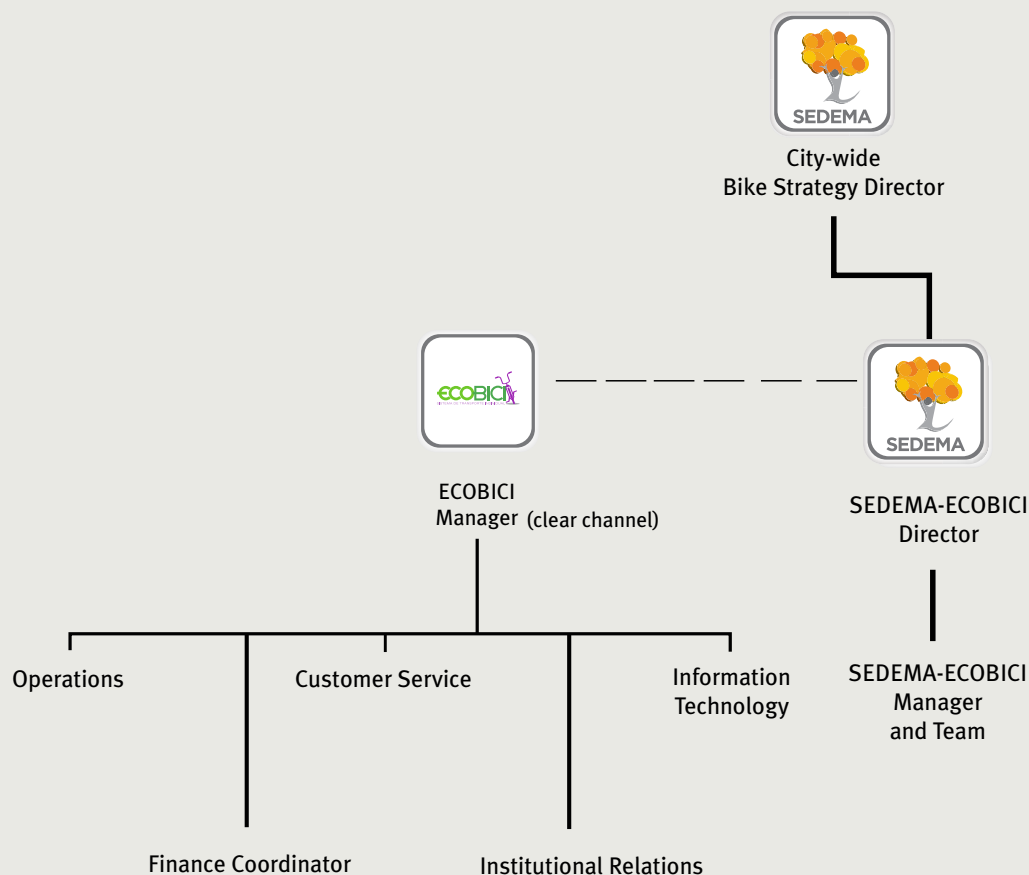
SEDEMA, the city's Environment Ministry, is the implementing agency for Ecobici. SEDEMA contracts Clear Channel to operate the system.
ECOBICI

4.1.1 Implementing Agency

The implementing agency is the government entity that oversees the planning, implementation, and operations of the bike-share system. Ideally, this entity will be located within the agency that has the authority to build out the stations—i.e., the authority that has control over the roadbeds and sidewalks. As the system grows across political boundaries and integrates with other transport systems, however, this structure could hinder expansion. It is best to consider what a system might look like in five or ten years, and place the agency accordingly. This will streamline decision-making, growth, and general administrative processes.

Outside of the transport department, other departments that can house the implementing agency include the departments of urban development, environment, and parks and recreation, as well as public transport agencies and regional planning authorities. The implementing agency should be staffed with people familiar with implementing urban transportation projects, as well as those who specialize in bike-share. In Mexico City, Ecobici is administrated by the city's Environment Ministry.

The implementing agency will be responsible for detailed system design, tendering and contracting, developing the financial model, and infrastructure implementation. For tendering

and developing the contract, the agency will need to include performance criteria and service- level expectations for the contracted entities. This agency will also make decisions about the fees to be charged and the revenue model, and it will take the lead on community outreach and promotion.

Once the system has been launched, the implementing agency will need to manage it and evaluate the operator's performance according to the defined service levels. Service levels are the benchmarks for operation that a system should meet. The list of service levels embedded in the contract governs the expectations the government has of the operator and will affect compensation to the operator, with penalties for noncompliance or rewards for meeting or exceeding expectations. The proper setting of service levels requires a balance to make sure that the service levels are set high enough that operations meet expectations but are not so stringent as to excessively penalize the contractor. If service levels are too lax, the operator will not have any incentive to meet the government's expectations. If service levels are set too high, potential operators may be discouraged from bidding.

The implementing agency plays the role of referee, keeping the best interests of the government and the customers in mind, while also focusing on the financial interest of the operator. Because of this, the agency ideally should be independent of the contractor operating the system.

This agency will also be in charge of planning future expansion and the promotional activities that are often still needed even after the system has been implemented. Evaluation of the current situation and planning for the future are ideally done in tandem.

4.1.2 Operator

The operator is the entity that handles the day-to-day operations of the public bike-share system. The operator's duties include managing the maintenance and general cleanliness of the fleet of bicycles and stations, as well as the redistribution of the bicycles. Except in special circumstances, the operator also handles the customer service, payment processing, marketing, and general brand management of the system.

The first decision when selecting an operator is determining whether the operator will be part of the government, such as the implementing agency or a similar parastatal entity, or an external operator, such as a for-profit or nonprofit entity.

A quasi-governmental operator, such as a transit agency, that is close to the implementing agency brings with it access to the government and the benefits of a cooperative relationship. The drawback to such a situation is that, historically, public operators bring inefficiencies that the private sector has proven itself able to overcome. Private operators generally bring more cost efficiency, but their primary objective is profitability, not the creation of a great bike-share system. When working with a private operator, a well-written contact and oversight are essential to ensure that the operator meets its obligations to the implementing agency.

Sometimes governments prefer turnkey projects in which the private operator can set up the whole project by itself in one large contract, providing both the assets and the operation. Other times, the government prefers to separate the contracts for the operations and for hardware and software procurement. This mitigates the risk involved with having just one company that the government is wholly dependent upon, but it increases the risk of the different pieces not working well together.

Fig. 9: Bike-share System Implementing Agencies and Operators					
City	Country	System Name	Implementing Agency	Operator Name	Operator Type
Buenos Aires as of June 2013	Argentina	Mejor en Bici	City Government of Buenos Aires	City Government of Buenos Aires	Public
Brussels	Belgium	Villo!	City Government of Brussels	JCDecaux	Private
Rio de Janeiro	Brazil	Bike Rio	Prefeitura da Cidade do Rio de Janeiro	Sertell	Private
Montreal	Canada	Bixi	Stationnement de Montreal	Public Bike System Company (Bixi)	Public
Toronto	Canada	Bixi Toronto	City Government of Toronto	Public Bike System Company (Bixi)	Public
Guangzhou	China	Guangzhou Public Bicycle	Guangzhou Municipal Government	Guangzhou Public Bicycle Operation Management Co.	Public
Hangzhou	China	Hangzhou Public Bicycle	Hangzhou Municipal Government	Hangzhou Public Transport Bicycle Service Development Co.	Public
Shanghai	China	Shanghai Forever Bicycle	By District	Shanghai Forever Bicycle Co.	Public
Zhuzhou	China	Zhuzhou Jinning Public Bicycle	Zhuzhou Municipal People's Government	Zhuzhou Jianning Public Bicycle Development Co.	Public
Lyon	France	Vélo'v	Grand Lyon	JCDecaux	Private
Paris	France	Vélib'	Mairie de Paris	SOMUPI (subsidiary of JC Decaux)	Private
Dublin	Ireland	Dublinbikes	Dublin City Council Planning Department	JCDecaux	Private
Tel Aviv	Israel	Tel-o-Fun	–	FSM Ground Services	Private

City	Country	System Name	Implementing Agency	Operator Name	Operator Type
Mexico City	Mexico	Ecobici	District Federal de Mexico, Ministry of the Environment	Clear Channel	Private
Barcelona	Spain	Bicing	Barcelona Town Council Security and Mobility Department	Clear Channel (sub-contracted to Delfin Group) & City of Barcelona	Private
Taipei	Taiwan	YouBike	Taipei Department of Transportation	Giant Bicycles	Private
London	U.K.	Barclays Cycle Hire	Transport for London	Serco Group	Private
Boulder	USA	Boulder B-cycle	City Government of Boulder	Boulder Bike Share dba Boulder B-cycle	Non-profit
Chattanooga	USA	Bike Chattanooga	Outdoor Chattanooga	Alta Bicycle Share	Private
Denver	USA	Denver B-Cycle	City and County of Denver	Denver Bike Sharing	Non-profit
Madison	USA	Madison B-Cycle	City Government of Madison, Wisconsin	Trek Bicycle Corporation	Private
Minneapolis	USA	Nice Ride	Nice Ride Minnesota	Nice Ride Minnesota	Non-profit
New York City	USA	Citi Bike	NYC Department of Transportation	Alta Bicycle Share	Private
San Antonio	USA	San Antonio B-cycle	San Antonio Office of Sustainability	San Antonio Bike Share	Non-profit
Washington, D.C.	USA	Capital Bikeshare	Metropolitan Washington Council of Governments	Alta Bicycle Share	Private

Fig. 9: Bike-share System Implementing Agencies and Operators, continued

4.2 Asset Ownership

The ownership of the assets—primarily the stations, terminals, docks, bicycles, and IT system—is usually determined by the implementing agency, as well as the permanency of the assets in the streetscape. The different assets of a system can have varying ownership, and the assets may be shared, transferred, or licensed. For example, the government might finance and own the station, docks, and terminals, and license the IT system, while the operator owns the bicycles. Another arrangement is one in which the operator owns, supplies, and operates all of the infrastructure, and the city provides the space for the stations.

Control of the bike-share system is closely bound to asset ownership: the owner determines the investment, and thus the quality of the system. If a governing body does not want to make a significant capital outlay, it risks creating a system in which it does not have much control over the quality (life span) of those assets. However, if the operator invests in the infrastructure, it will have a greater incentive to maintain it.

Decisions about asset ownership and about who should make the initial investment should be guided by the lifetime of the asset, as that typically guides the contracting period. For bike-share systems, the average life span of a bike is three to five years, while the stations typically average between ten and twenty years. The bicycles could also be considered part of the operational costs instead of assets, but this will have consequences for the financial model. Most agencies and companies will choose to consider the bicycles as fixed assets.

In Taipei, Taiwan, bicycles are donated to the city by local company Giant as part of Giant's corporate responsibility program. Giant operates the program under concession.
CARLOSFELIPE PARDO

Initial funding for Chicago's Divvy came from federal grants for projects that promote economic recovery, reduce traffic congestion and improve air quality, as well as additional funds from the city's tax increment financing program.
CHRTISOPHER VAN EYKEN

4.3 Contracting Structure

Decisions about asset ownership will shape the contracting structure. There may be separate contracts with the suppliers of each of the various components of the bike-share, which can include the following:

• Hardware

• Software

• Operations

• Advertising on the bike-share system

• Marketing and public relations

Bundling of the contracts can bring simplicity, with the government having to manage only one contract, thus focusing accountability on a single entity, but in some situations, signing separate contracts can be a better choice. Separate contracts help mitigate the risk that accompanies reliance on a single entity and allow the government to contract with an entity that specializes in the requested service. For

instance, if the smart-card system and payment mechanism are integrated into the city's larger public transport system, that operator will be contracted to expand into bike-share and will be responsible for payment and customer tracking, while another operator will be contracted for operations. In Paris and Mexico City, contracting is essentially a complete concession of the entire system to a single contractor.

The initial provision of infrastructure can be packaged with the operations contract or carried out as a separate contract. Combining infrastructure and operations provides an incentive for the contractor to supply high-quality infrastructure, so as to minimize maintenance costs over the life of the contract. However, given the large variation in the depreciation time of the hardware systems— stations, terminals, and the control center—it often makes sense for the city to procure these systems and issue a separate contract for operations. Creating separate contracts for infrastructure and operations also can reduce implementation time, as was the case in Barcelona (Obis 2011).

JC Decaux operates the Vélib' bike-share, and is compensated by the outdoor advertisements it is able to place, like here, on a bus shelter.
LUC NADAL

The duration of the contracts that require investment into infrastructure are usually tied to the life span of that infrastructure, to allow for depreciation of the asset and a chance to obtain a return on the investment before having to invest in recapitalization. In London, the contract for the bike-share system is six years.

The operations and advertising on the bike-share system contracts coincide well with the lifespan of a bicycle, which in bike-share systems is three to five years. Recapitalization of the fleet occurs after that. This is long enough to create an incentive for the operator to procure high-quality bicycles, but short enough to give the implementing agency the flexibility to find a new operator in the event of lackluster performance. This also creates potential for profitable branding on the bicycles and advertising possibilities. Generally, though, keeping revenue-generating advertising separate from operations is recommended for transparency reasons and to keep the operator focused on the core functions of bike-share.

Since the station and IT infrastructure are expected to last beyond the initial operations contract, the implementing agency should ensure that all the pieces of the bike-share system work together, especially the software

and the hardware. In the case of software, the rights to the use of the software and the data should be retained by the city after the operating contract is over, and ideally the system is designed as "open source," meaning that there is universal access via free license to the product's design or blueprint.

There are three main types of contracting structures, as defined by the ownership of the assets:

- Publicly owned and operated:
  The government owns the assets and provides the services.

- Publicly owned and privately operated:
  The government owns the assets but contracts a private entity to run the services.

- Privately owned and operated:
  The private entity owns the assets and provides the services.

Regardless of the structure, in all cases, the government, through the implementing agency, still oversees the system and is responsible for managing the contracts and monitoring the level of service.

4.3.1 Publicly Owned and Operated

Under this type of contracting structure, the government plans, designs, implements, and operates the bike-share system. The government also owns all the assets of the system, and the financial risk lies entirely with the city. The implementing agency would then most likely become the operator, or operations could be contracted out to a parastatal or another government agency. The greatest advantage to this structure is that one entity is responsible for the planning, procurement, implementation, operations, and future expansion of the system. The downside to this type of business model is the potential inefficiencies that occur when a government-owned entity pursues an endeavor that private industry might do more efficiently.

In Germany, DB Rent (a subsidiary of the national train system, Deutsche Bahn) operates the Call-a-Bike system in cooperation with the city, and the system currently operates in more than sixty cities in the country. In this model, the public authority usually creates an internal entity to manage the entire project, including station siting and details of network development, operational planning, fee structuring, and collection and marketing. The advantage to this type of organizational structure is that the public authority can prioritize the desired goals of the system—ideally, that it supports the larger public transportation system—over other incentives, such as profitability. The disadvantage of this approach is that it requires more public resources, and the public body also assumes operating efficiency and risk.

4.3.2 Publicly Owned and Privately Operated

This type of contracting structure means that the government owns the assets and a private entity provides the services. This can be a simple fee-for-service model, like in Barcelona or in Shanghai, China, where the fee is based on the number of bikes in the system. The procurement of bicycles for the system can be done by the government or it may be the responsibility of the operator. All other assets—software, control center, stations—are owned by the government.

The advantage of the publicly owned, privately operated model is that the private operator manages all logistics, the public owner has some control during key phases of the project, and operating details and system risk are not the responsibility of the public body. If the operator has no investment in the infrastructure, it is easier to do shorter contracts, like in Barcelona, where the contract is negotiated every year. This offers more flexibility for the city, but also requires more work (issuing tenders, negotiating, signing a contract every year).

Hamburg has one of Germany's most successful bike-shares, with 130,000 registered users, 1,650 bikes, and 125 stations. The system is run by DB Rent, a subsidiary of the national train system.
MICHAEL KODRANSKY

4.3.3 Privately Owned and Operated

Under this type of contracting structure, a private entity owns the assets and provides the services, while the government provides the land on which to put the stations. In privately owned and operated system arrangements, the government will set standards for the system and put it out to tender. The government grants the rights, in the form of legislation and street space, for the system, but the capital assets are owned and the operational costs are borne by the operator. This approach avoids taking money from city coffers. Some cities even ask the operator to pay a fixed fee or share revenue with the city.

Privately owned and operated systems do have some risks associated with them, particularly regarding conflicts of interest

and balancing the city's need for widespread distribution against the private operator's desire to optimize revenue. Normally, the private operator is interested in high-revenue-producing areas or neighborhoods, while the city may have a greater interest in making sure the system has a wide coverage that includes low-revenue-producing areas. In the original agreement, high-revenue areas should be complemented with a few lower-revenue areas to create an agreement that serves both parties. Usually, as the system expands, the number of high-revenue areas decreases and the number of low-revenue areas increases, making it harder for an operator to get an attractive return on investment. This can be solved by adjusting the revenue model.

One version of this structure is the "BOT"

Nice Ride, in Minneapolis, USA, is owned and operated by an independent nonprofit of the same name.
TRACKTWENTYNINE (CREATIVE COMMONS)

model: build, operate, and transfer. At the end of the contract, the private company transfers the ownership of the assets to the government. The problem with such arrangements is that most of the entities interested in this type of arrangement are not public transport operators looking to provide a customer-oriented transport solution. The result is subquality infrastructure and a less-than-efficient system for the user. There is no incentive for the operator to construct or innovate any aspect of the system that will last longer than the agreement, because the operator will forfeit the assets when the agreement terminates. It is probable that the operator will write off the assets from the onset and take a greater interest in its return on investment, which comes from advertising revenue.

Bike-share is known for bundling bike-share and outdoor advertising contracts by contracting companies like JCDecaux or Clear Channel. These firms operate public bike-share systems in exchange for exclusive (or near-exclusive) rights to the city's outdoor advertising space. Combined contracts such as these are often less cost-efficient than separate contracts. However, they mitigate the financial risk from the city's perspective (Obis 2011) and enable the city to open a bike-share system without having to create a line item in the budget for it. Nonetheless, the disadvantages to this approach include loss of advertising revenues, the risk of problems with the public due to the increase in outdoor advertising, and the fact that it is hard for the public agency to evaluate levels of service compared to

Flat Fee per Bike Experience in Shanghai

Shanghai Forever Company, which operates the bike-shares in Shanghai and Zhangjiagang, charges the government a flat rate per bike per year to supply and manage the system. The company does not actively use advertising revenue to support the system, although such an option will be available in the future. The advantage of this model is that the city has a fixed contract, making it easier to budget for the system. The disadvantage is that the operator is incentivized to oversupply the system with bicycles to raise its revenues. Additionally, there is very little incentive for the operator to provide an efficient system and to manage redistribution well, since operations are not linked to service levels, but to the size of the system deployed. ITDP CHINA

LI SHANSHAN

investment. Such contracts can be successful, but the advertising revenue should be contractually separated from the service-level agreements to operate the bike-share system.

Paris is the classic case study for this type of bundled contract. JCDecaux, in exchange for outdoor advertising rights including at bus stops, on public announcement infrastructure, and other urban components, operates Vélib', and it made the initial investment in bikes and stations. The company publicly claims it is losing money from Vélib'. However, since JCDecaux is privately held, it does not have to report its profits, and there was no provision in the contract to mandate that that it must. Therefore, there is no real way to verify the company's statements. The city is bound to a considerable extent to JCDecaux's demands if the city wants the company to provide a certain level of service. The income generated by Vélib', estimated at €30 million annually,

or approximately US$40.4 million, goes to the city's general budget, so operating revenues are excluded from the business plan (Nadal 2007). This can also be seen as an advantage, although assigning bike-share revenue to the general budget may not always be the best option, as then that money does not necessarily get reinvested in the system or sustainable transportation more generally.

New York City's Citi Bike system is an example of a privately owned and operated system. The city considered what is called a franchise model, in which the outdoor advertising contract is tied to the bike-share system, but that would have needed legislative action that would require a longer timeline than the city wanted. The city decided to focus on the higher-demand areas (as identified by population density), so that the operating revenues, combined with sponsorship, would cover the operational costs. Citi Bike is operated by NYC

Bike Share, a fully owned subsidiary of Alta Bicycle Share, and all funding for operations comes from sponsorship and user fees. Citibank provided New York City's bike-share with $41 million to sponsor the system over five years, and received exclusive naming and branding rights. MasterCard provided $6.5 million for a five-year sponsorship and was named Citi Bike's Preferred Payment Partner, its logo displayed prominently on the station terminals.

Alta entered into a service-level agreement with New York City's Department of Transportation. Alta must ensure the stations are clean and functional, and bicycles must be properly maintained and fit for use by the public. If this quality is not maintained, the company will be subject to fines. Alta/NYC Bike Share was responsible for finding corporate sponsors to finance operation of the system. While sponsorship revenue goes directly to Alta, the revenue from user fees is split between the City of New York and NYC Bike Share.

Similar to New York, Rio de Janeiro's Bike Rio is privately owned and operated, but is overseen by the city office that defines concessions in the mayor's cabinet and by the secretary of the environment (known as SMAC). Sertell, the system operator, won the tender for a five-year contract, beginning in 2008, that bundles infrastructure and operations. The concession, similar to that of Vélib', is for "mobile advertising rights." SMAC's Technical Working Group on Bikes just finished reviewing the 2008–2013 contract and the system, and has defined the new parameters for the new tender that went public in May 2013.

4.3.4 Types of Operators

As discussed above, operators of bike-share systems can be government agencies, parastatals, or private entities, including both for-profit companies and not-for-profit organizations. Each has its own pros and cons (see table below).

Fig. 10: Comparison of Strengths and Weaknesses of Types of Operators			
	Strengths	Weaknesses	Examples
Government	Maintains control of legislative and public assets necessary to make bike-share successful; Has no ulterior motive other than to operate a high-quality system	Initial lack of expertise in bicycle sharing	Buenos Aires (as of June 2013)
Public Transport Authority	Has experience in managing transport-related services; Facilitates cost sharing with existing assets such as customer service, maintenance personnel and depots	Difficulty in accessing and working with other transport providers because they are seen as competitors; Bike-share system may expand such that it needs its own customer service, maintenance, and depot facilities	DBRent (German systems)
Private Sector	Generally achieves a high level of efficiency	Profit-oriented, which can conflict with maximizing the utility of system for the user; May reduce its efficiency due to financial constraints or suboptimal contractual conditions; Limited ability to push for policy and planning changes in government	Santiago, Paris, London, Washington, D.C., Boston, New York
Not-for-Profit	Prioritizes the utility of the bike-share system to the user	Frequently financially constrained; Normally below-average business focus, leading to financial unsustainability	Denver, Minneapolis

4.4 Managing Contracts Through Service Levels

Service levels should be included for system operations (hardware and software), customer service, maintenance, redistribution, marketing, and reporting. Each service level normally identifies an optimal level, and then a variance within which performance is acceptable. Beyond the variance, the operator is penalized if it negatively affects the system and rewarded if it positively affects the system. Offering rewards as well as penalties allows for flexibility in how an operator can make revenue from the system.

For example, an operator of a recently launched system is having a hard time keeping the system online in accordance with the software service-level agreement due to initial glitches in the system. This causes the operator to fail to meet the service level in this category. The operator does, however, far exceed the service level for membership. Between the service level for software, which the operator does not meet, and for membership, which it exceeds, the operator is able to secure a decent revenue while working on the service levels where there are problems. Service levels should be designed to create incentives for an operator to increase its revenue while doing an outstanding job. They should not bankrupt the company.

While the government sets the quality and service standards when the contract is signed, it should work with the private sector on the best way to achieve the desired service level. It is important to look at the capabilities and limitations of the system and set the service levels realistically. When planning a system, many service levels will be estimates or best guesses, and will need to be re-evaluated as the system goes online. Service levels should be an evolving matrix of give-and-take

between the operator and the authority or governing body. Service levels that prove to be unreasonably high should be lowered to be more realistic, while those that are vastly exceeded should be adjusted, or should have ceilings regarding compensation.

There are two basic principles when monitoring service levels: first, set realistic service levels that can be monitored at little expense to the authority. Setting service levels that cannot be easily monitored leads to difficulty calculating the compensation to the operator, or to non-enforcement. This ambiguity starts off small but will over time create problems in the relationship between the operator and the authority. Second, an open-book policy is best between the authority and the operator. The authority should have access to all data collected and transmitted by the system, and should know how much revenue comes from the different sources. Audited financials should be shared by the operator with the authority so there is a clear picture of excessive profit or loss.

The contractual relationship between the operator and the governing body with the associated service levels creates the performance-management system. The performance-management system is usually based on a weighted points system whereby service levels that are very important, like the system's being online, are weighted more heavily than those that are desirable but not essential, such as marketing efforts. By weighting the service levels, the governing body can create an incentive to the operator to put resources toward meeting service levels that the governing body feels are most important to serve the user.

In the case of Ecobici, Clear Channel's proposal (which was initially accepted) set a minimum level of service of 85 percent with two indicators:

- Docking Level of Service (DLS): the probability that a user will find a free dock in the station.

$$DLS = 1 - \frac{\text{Total time of full stations in a month}}{\text{Total service time in a month in the system}}$$

- Bicycle Level of Service (BLS): the probability that a user will find a bicycle in the station.

$$BLS = 1 - \frac{\text{Total time of empty stations in a month}}{\text{Total service time in a month in the system}}$$

The limitation of this measure is that certain difficult stations (for example, those in hilly locations, like some in Barcelona) can remain perpetually full or empty without exceeding the limits of level of service. Recommended indicators should consider even station or group-of-stations level-of-service indicators to prevent this.

Sample Service-Level Indicators from London's Barclays Cycle Hire System

Below is a sample of the service-level indicators Transport for London uses to manage its bike-share system. This is not a comprehensive list, and is meant to illustrate the types of service-level agreements needed, and how one city chose to measure them. These all come directly from the service level agreement documents for London's bike-share (Transport for London August 2009).

Customer-Service Indicators		
Indicator	Sample Benchmark	Data Source
Registration applications processed	99.5% processed within three days; 90% within one day	Operator records
Customer complaints processed	For post, 99.9% processed within ten days; for e-mail/web, 99.9% within five days; for all complaints, 95% within three days	Operator records
Number of valid customer complaints	Fewer than eleven per month	Operator records
Call-center abandon rate	97% of calls not abandoned	Call center IT system
Call-center queuing time	99.9% of calls answered within 180 seconds; 90% of calls answered within twenty seconds	Call center IT system; spot checks
Percent of the time that the call center is available	99.9%	Call center IT system
Maximum time on a single day that the website is not available	Twenty minutes	Real-time IT feed
Percent of time that the website is available per month	99%	Real-time IT feed
Overall Customer satisfaction	Industry benchmark	Customer interviews

IT System Indicators		
Indicator	Sample Benchmark	Data Source
Time required to check out a bike	95% of transactions executed in less than fifteen seconds	Spot surveys
Number of data protection breaches	Zero	Operator records
Terminal performance	99% of transactions executed in less than ten seconds	Real-time IT feed
Smart-card performance at the terminal	99.5% of transactions executed in less than four seconds	Real-time IT feed
Smart-card performance at the dock	99.5% of transactions executed in less than one second	Real-time IT feed
Payment processing	98.5% of payments processed on the same day	Real-time IT feed

Maintenance Indicators

Indicator	Sample Benchmark	Data Source
Minimum percentage of total cycle fleet available at 6 a.m.	100%	Real-time IT feed
Minimum percentage of total fleet available during the day	95%	Real-time IT feed
Percentage of cycles repaired within four hours of being flagged for repair by a customer	95%	Real-time IT feed, spot checks
Percentage of cycles without major dust accumulation or grease stains	95%	Spot checks
Terminal availability per day	99%	Real-time IT feed

Redistribution Indicators

Indicator	Sample Benchmark	Data Source
Percentage of the time that high-priority stations are empty during peak hours (7–10 a.m. and 4–7 p.m.)	6%	Real-time IT feed
Percentage of the time that high-priority stations are empty during off-peak hours	3%	Real-time IT feed
Percentage of the time that low-priority stations are empty during peak hours (7–10 a.m. and 4–7 p.m.)	23%	Real-time IT feed
Percentage of the time that low-priority stations are empty during off-peak hours	8%	Real-time IT feed
Minimum percentage of total cycle fleet available at 6 a.m.	100%	Real-time IT

Guangzhou uses bike-parking areas in lieu of docks and terminals at larger demand stations.
KARL FJELLSTROM

FINANCIAL
MODEL

The financial model puts dollar amounts on both the responsibilities (expenses) and rights (revenue) of each of the entities in the business model, including the government. The expectations enumerated in the financial model must also be found in the contracts.

Most of the capital costs of China's bike-share systems, including Zhuzhou's, are paid for by the government.
KARL FJELLSTROM

5.1 Capital Costs and Financing

The capital costs include the assets, such as bicycles, stations (including docking spaces and terminals), IT system components, control center, maintenance equipment, and service and redistribution vehicles. Working capital, the costs of running the entity before revenue starts coming in, including pre-launch staffing, installation, marketing, website creation, and launch expenses, can also be capitalized.

   Following is a more in-depth look at the main sources of capital costs.

Fig. 11: Bike-share System Costs				
City	Country	System Name	Capital Cost (Per Bike)	Replacement Cost of Bike
London	U.K.	Barclays Cycle Hire	$4,000	$1,435
Paris	France	Vélib'	n/a	$809
Barcelona	Spain	Bicing	$3,150	n/a
Montreal	Canada	Bixi	$4,000	$1,270
Washington, D.C.	USA	Capital Bikeshare	n/a	$1,000
Guangzhou	China	Guangzhou Public Bicycle	n/a	$69
Hangzhou	China	Hangzhou Public Bicycle	n/a	$74
Zhuzhou	China	Zhuzhou Jianning Public Bicycle	n/a	$261
Mexico City	Mexico	Ecobici	$3,400	n/a
Rio de Janeiro	Brazil	Bike Rio	$1,810	$550
New York City	USA	Citi Bike	$4,750	n/a
Denver	USA	Denver B-Cycle	$4,250	n/a
Minneapolis	USA	Nice Ride	$4,487	$1,000
Madison	USA	Madison B-Cycle	$5,000	n/a
Boston	USA	Hubway	n/a	$950

5.1.1 Bicycles

The bicycles themselves are a small component of capital costs. Bicycle costs vary immensely around the world. Some systems use bicycles that are almost off-the-shelf, with a locking mechanism attached, while others use specialty bicycles with proprietary parts and GPS tracking. The cost of a single bike can range from as little as US$100 in Asian systems to as much as US$2,000 for bikes with GPS and satellite-operated unlocking systems.

5.1.2 Stations

Stations, specifically the docking spaces, often represent the single largest capital cost in many systems. However, a greater number of docking spaces helps reduce operating costs by reducing the need for redistribution. High-tech terminals are not required at every station in most system designs where the customer can directly check out bikes from the docking space, but should be included in medium and large stations. Having a terminal with static information or to identify the station is still recommended. Small stations in residential areas can consist simply of docks, forgoing some of the customer services in favor of decreased costs and a smaller visual impact on the cityscape.

Many of the bikes in Asian systems, such as Hangzhou (above), are cheaper and have fewer features than those of other systems, such as Washington, D.C. (below).
KARL FJELLSTROM

5.1.3 Software

Software can be purchased outright, developed, or licensed, and each option will have a different impact on the the capital costs and the longer-term operational costs. Developing software is the most expensive option, though the intellectual property can often bring medium-term return on investment through the sale or licensing of the software to other systems. Buying off-the-shelf software has become popular at a regional level. Although this is initially more expensive, it is a one-time cost, with perhaps an annual service cost. Many North American systems have bought their software from a single Canadian supplier, 8D, because language and needs are similar throughout the region. Another option is licensing software. Licensing software can be a good solution to help offset capital costs, but can be a cost burden on the system down the line. The Medellín bike-share system used licensed software from the system in Santiago for a year before developing its own software. With licensed software, the software company is responsible for making sure that the software continues to be updated with the latest security and advances in technology. Sometimes the software is bundled into the costs of the hardware, as is often the case in China.

TOP
Terminals in the Vélib' system in Paris accept payments by credit card.
LUC NADAL

BOTTOM
Ecobici stations in Mexico City have touchscreen terminals.
AIMEE GAUTHIER

5.1.4 Control Center, Depot, and Maintenance and Redistribution Units

The control center is where the central management of the bike-share system is housed, the depot is where bikes are held while being serviced or stored, and the mobile maintenance unit is the unit responsible for responding to requests for repairs. Bike-share depots and mobile maintenance units present an opportunity for cost sharing, as most communities have depots for buses or other public goods and services, as well as maintenance staff. Cost sharing can greatly decrease capital investment in such facilities and personnel. Depots and maintenance areas, however, need to be completely secure to prevent loss of inventory, such as bikes, parts, and tools. Guangzhou's bike-share uses the Guangzhou bus company's depot.

Redistribution vehicles—often flatbed trucks or trailers carried behind vans—are a significant investment. The Vélib' system in Paris has what is likely the most creative redistribution vehicle: a barge that carries bicycles up the Seine.

TOP
The control center in Foshan, China.
LI SHANSHAN

MIDDLE
A simple redistribution truck in Shenzen, China.
LI SHANSHAN

BOTTOM
Vélib' in Paris uses a trailer with no rails for easier loading and unloading.
HOTZEPLOTZ (CREATIVE COMMONS)

OPPOSITE
A bike is unloaded from a Nantes bike-share redistribution van.
KARL FJELLSTROM

5.2 Operating Costs

A bike-share system's operating costs reflect the system's size and sophistication. These costs include staffing, replacement parts, fuel for service vehicles, redistribution costs, marketing, website hosting and maintenance, electricity and Internet connectivity for stations, membership cards, warehouse and storage insurance, and administrative costs. Depending on the contracting structure, the operating costs may also include debt service.

How operating costs are reported varies widely, from per-bike to per-station to per-dock to per-trip. As stated before, this guides recommends evaluating the cost efficiency of a system after it opens by looking at operating costs per trip. As with most transit systems, the goal of bike-share is to attract and move as many people as efficiently as possible, and a system's operating expenditure should be based on the number of people, as expressed in the number of trips, using it.

Most often, annual operating costs are reported as cost per bike, but that is not recommended as the number of bikes can vary on a day-to-day basis due to repairs and rebalancing. In an analysis of U.S. bike-share systems, a per-dock basis was used in order to have a more stable basis for comparison. That report found the average operating cost per dock, per month, was between $90 and $120.

The variation in this operating cost is based on intensity of ridership in the system, service levels in the contracts (typically, nonprofit systems do not have contracts mandating service levels or monthly reporting), specific roles covered by the operator (for example, in Washington, D.C., the operator does not undertake marketing, but the operator in Boston does, and nonprofits that manage bike-share systems must undertake sponsorship fundraising themselves), profit margin of operator, and, theoretically, the scale of the system. The operating expense numbers may also be skewed in some cases if systems were under expansion, and there were new station installation costs embedded in the operating costs (Cohen 2013).

In addition to the variation in how operating costs are reported, the expenses included in those numbers are equally varied. As seen in the above examples of U.S. systems, the roles and responsibilities, and therefore the expenses, of the operator vary widely. Reported values may not be reliable, since operators may report inflated figures or may not release them at all. For example, estimates of Vélib's operating costs vary from €30–90 million (US$40–120 million) per year. These costs are far from marginal, so strong financial planning is needed, as with any transportation system,

Fig. 12: Bike-share System Annual Operating Cost Per Trip			
City	Country	System Name	Average Operating Cost Per Trip
London	U.K.	Barclays Cycle Hire	$4.80
Barcelona	Spain	Bicing	$0.86
Montreal	Canada	Bixi	$1.27
Washington, D.C.	USA	Capital Bikeshare	$1.52
Mexico City	Mexico	Ecobici	$1.28
Denver	USA	Denver B-Cycle	$3.22
Minneapolis	USA	Nice Ride	$1.52
Boston	USA	Hubway	$3.09

to ensure the financial success of the system. After conducting the rough estimation, a city or operator will need to do a detailed examination of the real costs, taking into account system design and asset ownership. This model should include the costs described in the following sections.

5.2.1 Staffing

Staffing needs include administration and management, maintenance, redistribution, and customer service. Staffing of a public bicycle system is often heavily dependent on cultural norms and the cost of employment in a country. Most systems in North America, where staffing is expensive, minimize staff through automation. In systems that are not fully automated, staffing costs will increase the operating costs. There is generally an economy of scale in automated systems. However, this is not true of manual systems. For example, every time a new station is added in Santiago's manual system, so is at least one staff position.

TOP
Quick repairs are often done at the station, as seen here in Vélib'.
LUC NADAL

BOTTOM
For preventative maintenance, bikes are brought back to workshops, like here in Medellín, Colombia.
JESUS DAVID ACERO

5.2.2 Redistribution

Redistribution is broadly defined as the rebalancing of bicycles from stations that are near or at capacity to stations that are close to empty. Successful redistribution is critical to the viability of the system from the customer's perspective, and redistribution is one of the greatest challenges of operating a bike-share system, accounting for as much as 30 percent of operating costs in European systems (Obis 2011). If an operator has an adequate IT system, redistribution becomes predictive, and is better thought of as pre-distribution—the movement of bicycles to stations where users will need them and away from stations where users will be dropping them off. While a bike-share system may operate twenty-four hours a day, most of the trips occur between 7 a.m. and 9 p.m. During those periods, redistribution may be necessary, especially for stations that experience high peak-demand. For example, most systems have found that stations at the tops of hills are often empty, as people will check out a bike and ride down the hill, but will rarely ride up the hill to park at that station. Many systems, however, try to do most of the redistribution at night, when there is less traffic and it is more efficient.

A system for redistributing bikes to the points of greatest use is essential, taking into consideration initial data and modeling and expectations of ridership. The operator should not expect to get this perfect from the start, but rather should make the best plan according to available data and refine that plan once the system is implemented. Fortunately, with RFID technology, the data will continually become more accurate as more users enter and exit the system.

A redistribution van in Barcelona is taking bikes to empty stations.
LUC NADAL

5.2.3 Maintenance

Maintenance is another large line item under operational costs. Maintenance includes the stations and bicycles, and covers both preventative and repair activities. Maintenance of the bicycles, terminals, and station can be as simple as wiping them down and sweeping or as complex as lubricating the hubs of the bicycles and fixing the electrical equipment in the terminal. General repairs to the docks and terminal include replacing torn decals or removing graffiti, while bicycle repairs include fixing tire punctures, broken chains, or faulty brakes. Annual maintenance for Vélib' and Velo'v is estimated at about US$1,000 per bike, while the German system operator estimates its annual maintenance costs at US$868 per bike. These figures do not include bike replacement.

Bicycle maintenance and repair are critical to the reliability and image of a bike-share system. For that reason, repair centers must be located strategically, and there must be a strong logistical plan for moving bikes to and from those centers. Mobile maintenance units can also be incorporated into redistribution to increase effectiveness. Paris uses a barge to fix and maintain bicycles while redistributing them from the lower end of the city to the higher end. Montreal has created a social company (Cyclochrome) that maintains the bicycles and, in the process, gives technical training to teens who have dropped out of school.

Maintenance protocols should be spelled out in the service-level agreements in the contract between the implementing agency and the operator, including the penalties for

A member of Santiago's bike-share staff services a bicycle.
CLAUDIO OLIVARES MEDINA

Turning the seat around flags maintenance staff that the bike needs to be serviced.
CARLOSFELIPE PARDO

noncompliance. Generally, the implementing agency will ask the operator to develop a maintenance and repair protocol that both parties find acceptable. This protocol streamlines service to guarantee that users only experience bikes in top form at all distribution points during operations. For example, the contract should stipulate how long a broken bicycle may be left at a station, or how long a terminal or docking space can be out of commission before the operator faces a penalty, as well as ensuring that the contractor provides data on repairs. For bicycles, six to twelve hours is appropriate, depending on other factors. In the case of damaged bicycles, the operator would normally fix minor repairs on-site, while collecting bicycles that need major repairs to be done at the depot. Toward the end of the bike's life span, it may be more cost-effective to buy a new bike than repair it, as the cost of replacing parts on an older bike may be greater than the worth of the now-depreciated bicycle.

Flagging bikes for maintenance can be done in a variety of ways, from high-tech to low. One low-tech method is to ask users to turn the seat around on a bike that needs a repair so that the maintenance or redistribution truck can easily identify it, as is done in Seville, Spain. Another method is to allow for notification through the docking station or terminal. A user presses a button on the terminal or touch screen that alerts the system that there is a problem with the bicycle. Once a user reports a faulty bicycle, that bicycle is taken offline (meaning it cannot be checked out again) and the operations headquarters is notified. The downside to this high-tech solution is it can be a magnet for saboteurs who might report a whole station as damaged, preventing users from checking out bicycles that are in fact perfectly fine.

5.2.4 Control and Customer Service Center

The cost of the control and customer service center depends on the goals of the system and the environment in which it operates. The control center is critical to operations and management, and includes staffing costs and IT costs. The bigger variable in costs will be how the system decides to handle customer service.

Some systems try for full automation, limiting customer service to nothing more than a website and social media. Others choose to have a fully staffed customer service center. The operating cost is completely dependent on the type of service the system desires to provide. Normally, fully automated control and customer service centers are inexpensive to operate, while fully staffed establishments can be a significant operational cost burden but might provide more user-friendly, personalized service and create employment. Regardless of the format, the system will require some outlet for customer concerns and questions.

5.2.5 Marketing and Customer Information

Another important operational cost to consider is promotional material and activities associated with running the system. These can range from simple printed information to elaborate campaigns across various media. This component is particularly important during the first six months (defined as the two months prior to launch and four months after launch) and whenever there are any changes to operation or expansions of the system.

Marketing activities can include an interactive website, social media sites, a blog for users, and a host of other technological elements that can engage people with the system and provide useful information for both the user and the operator.

Membership campaigns are initiatives to increase membership and can involve multiple stakeholders with different objectives. For example, a government might be interested in a safety campaign, while an operator is interested in increasing membership because annual and short-term membership numbers are often tied to service levels. A coordinated safety campaign and membership drive can allow both to achieve their goals while sharing the costs.

In many cases, users first learn about the system through the system website.
SCREENSHOT FROM WWW.BICING.CAT.
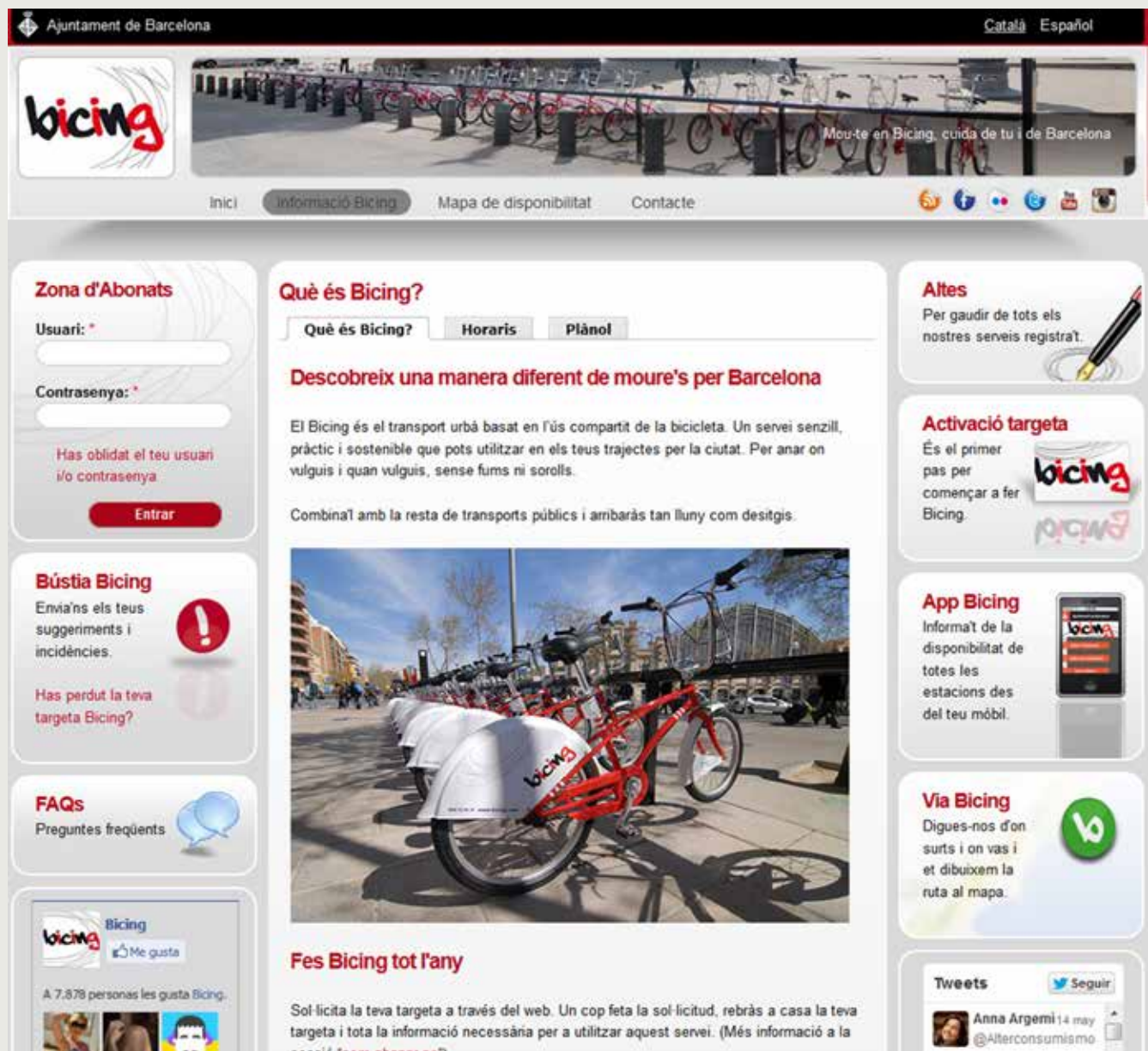
At some Ecobici stations in Mexico City, signs direct the customer to nearby stations, giving the station name and distance. These signs are at a lower height than most street signs.
AIMEE GAUTIER

5.2.6 Insurance (Anti-Theft, Accidents, Vandalism)

Riding a bike presents a level of risk to the rider, and the user of a bike-share system has engaged in an implied contractual relationship with the system (and/or the operator), putting the system/operator at potential risk of legal liability. For that reason, it is strongly advised that a carefully crafted conditions-of-use document be included in the contracting for the system. However, accident insurance is also important, and some sort of anti-theft insurance is also advisable. The cost of this insurance must be part of the operating budget for the system, and system planners should seek advice from trusted legal counsel to decide what coverage and coverage levels are necessary. Some operators estimate that 10 percent of the bicycles in the system will be stolen each year, and integrate the costs of replacement into their financial models. Insurance varies from country to country, and someone with local knowledge on this issue should be contracted.

System planners may also wish to insure against vandalism. Perhaps the best insurance is a strong communications and marketing plan that generates widespread public acceptance of the system and encourages locals to take true ownership of and pride in the system.

Cities in which graffitti is widespread should expect that the bike-share system will be not be immune. Most cities should expect some level of vandalism and have a plan in place to deal with it as soon as possible after it occurs. To prevent widespread graffiti, a quick response plan and a performance measurement—for example, graffiti must be cleaned within twenty-four hours of being reported—are essential.

The potential for bike theft or vandalism should be taken into account when planning a bike-share. Bikes, like the discarded Vélib' bike (below), stations and all other property including signage must be accounted for and maintained.
CARLOSFELIPE PARDO, LUC NADAL

5.3 Revenue Streams

The final component of creating the financial model is determining the revenue streams, including the membership fees and user pricing. Most systems require some combination of advertising, sponsorship, membership fees, or tax revenues to cover their operating costs. The general recommendation is that operators be paid by the government based on service-level agreements, and not directly from revenue streams, as it helps with transparency of the system and gives the government some control over performance.

The utility a public bike-share system provides is often more important than its revenue potential. Government funding for capital costs and operations makes sense in light of the fact that bike-share is part of the larger public transport network, and when all internal and external costs and benefits are considered, it is probable that bike-share will have a lower per person cost than any other public transport option. In Europe and various cities in the developed world, public transport is generally subsidized.

The financial model must be clear on where any revenue generated through the system will go, and this must be clearly defined in the system contracts. In Paris, all municipal revenue from the Vélib' system goes into the general budget, while operator JCDecaux retains advertising-related revenues, estimated at €60 million (US$80 million). In Barcelona, operator Clear Channel receives €11–18 million (US$14.4–23.6 million) in advertising revenues (Nadal 2007), while Lyon's revenue is estimated at €27.8 million (US$36.5 million) annually.

According to an analysis of U.S. systems, while subscription and user fees provide a stable revenue source, rarely do they provide enough revenue to ensure that the system is financially self-sustaining. Capital Bikeshare comes close, with a 97 percent farebox recovery, approximately. However, this does not include the marketing expense that is covered by the city agencies, which could be anywhere from $200,000 to $500,000 per year, moving this farebox recovery down to 80–90 percent. Boston achieves 88 percent farebox recovery, and Toronto about 60 percent. The gap between system revenues and operating costs is covered in different ways. The nonprofit systems are sustained through sponsorships, grants, and advertising. The privately operated systems fill the gap with either public funding or sponsorships and advertising. Several systems that have launched or have announced procurement winners are utilizing no public funding, including the systems in New York City, Tampa, and Phoenix, and it will be informative to see how those business models hold up over time (Cohen 2013).

Users of the Bike Rio
system can pay for daily
or monthly passes.
AIMEE GAUTHIER

5.3.1 Government Funding

Government funding is often used to cover capital costs, in which case the government owns the assets, and it is sometimes used for operating costs. Many bike-share systems cannot cover the operating expenses from membership and usage fees alone, which is not unusual for a public transportation system. Because of this, subsidies may be necessary to cover operational expenses.

Governments often earmark funds for sustainable development, innovative initiatives, or even specifically for bike-share. India is considering developing a framework in which municipal corporations (i.e., city governments) can apply for national funding to implement bike-share projects. Governments can also use the general budget or specific transportation budget to fund the capital investment in bike-share. This was in the case in Mexico City, where 100 percent of the capital investment for bike-share came from the city's general budget. Given the level of political will needed to make this happen, the system gained legitimacy inside the government as a transport system with its own budget.

Earmarked funds from specific revenue sources, such as parking fees or congestion charges, are preferable to general operating budgets of the department managing the program. Parking fees and congestion charges are related to the negative impacts that cars have on the city, from the road space they take up to the air and noise pollution they cause. Redirecting that money to support a sustainable transport option seems logical as a cross-subsidy to the system. Barcelona is notable for being the first city to use 100 percent of the net revenue from on-street parking fees to finance its public bike-share system, Bicing.

General tax revenues may be needed if earmarked funds are not an option. Most Chinese systems are supported completely by government funds, while a private sector company operates the system. Unfortunately, many of the Spanish systems have had to close operations due to government-implemented austerity measures in response to the fiscal crisis. Santiago's system is fully subsidized by the government. Some systems in China, such as those in Shanghai and Beijing, are considering moving to an ad-based revenue model in the future.

Parking revenue in Barcelona, Spain, is used to fund the Bicing bike-share system.
KARL FJELLSTROM

Beijing's bike-share system is funded by the government.
MICHAELVITO (CREATIVE COMMONS)

5.3.2 Loan Financing

Taking out a loan from a bank to cover the investment in the capital costs is one option. If bank loans are a source of financing, then the financial model needs to include debt servicing in the operational costs, and the revenue model will need to be able to cover those expenses. Loan financing is usually reserved for the private sector.

5.3.3 Sponsorship

Sponsorship—sharing the system's image and brand with a sponsoring entity, as with Citi Bike and Barclays Cycle Hire—can help provide funding to cover investment costs. In most cases, sponsorship includes some degree of branding or naming rights, such as with Barclays Cycle Hire in London or having the company's logo placed on the stations and bikes, such as with Bike Rio in Rio de Janeiro. Different parts of the system can be valued separately for sponsorship. In the bike-share systems of Taipei and Kaohsiung in Taiwan, two bicycle companies, Giant and Merida, sponsored the bicycles. Rio Tinto sponsors the Bixi system in Montreal and only has a small logo on the map boards. In London, Barclays Bank made a significant investment to get the naming rights for the system, which was named Barclays Cycle Hire. Even if a sponsor actually pays for the assets, the sponsor does not retain ownership. Usually, the entity responsible for securing the sponsorship will own the assets.

Sponsorship can offset capital costs, operational costs, or both. However, sponsorship can limit the advertising potential of the bike-share system, so the implementing agency should assess which is a more favorable investment. Sponsorship agreements should consider the future expansion of the bike-share system and the long-term vision. New phases could either build on the sponsorship of the first phase or try to package sponsorships in terms of phases. Future deals tend to be less valuable than the initial, or opening, sponsorship. The longer-term viability of sponsorship as a real financing source is up for debate. Finally, with sponsorship comes the risk of affiliation with a private entity. If the sponsoring entity has image problems during the sponsorship period, then the bike-share might suffer from the association. The long-term risks of such an agreement need to be evaluated before entering a sponsorship deal, and a risk mitigation plan should be developed.

5.3.4 Private Investment

Private entities, such as universities or developers, may be willing to contribute to the capital cost of stations on or near their premises, and possibly pay annual operating costs over a set period. This type of investment would probably happen in later phases, after the success of the bike-share has been proven, but it can occur where there is high demand already. Property developers may be enticed to invest in bike-share in order to get stations built in their area first, if they think it will increase the marketability of the development. The implementing agency should either proactively approach developers and other entities in areas it has identified for implementation or expansion—and not let developer interest dictate expansion—or give the authority to the operator to do so.

In Boston, the Hubway bike-share system has at least eighteen corporate sponsors that each paid $50,000 to sponsor a station, which entitles them to to advertise their logos on the system's website, on ten bikes, and on one station kiosk. Arlington, Virginia, has already added station sponsorship for the Capital Bikeshare system to the zoning process. While developers can negotiate with county officials to include full or partial station funding as part of a transit-related improvements package, officials have the right to decline if they think the station won't be used well (MacDonald 2011).

5.3.5 User Fees

There are two types of user fees in most bike-share systems: subscription fees and usage fees. Subscription requires the customer to register and allows them unlimited access for a certain time period—a day, week, month, or year. Usage fees are then charged during the time the bike is in use. Most systems

Rio Tinto, an aluminum company, is a sponsor of the Bixi system in Montreal. The bikes are also made with aluminum provided by Rio Tinto.
AIMEE GAUTHIER

Hubway, in Boston, is partially sponsored by New Balance.
INSECURITY (CREATIVE COMMONS)

offer the first increment of time during use for free — normally 30 or 45 minutes. After that, the fees typically increase exponentially, as a way to encourage short trips, and thus higher bike turnover. Typically, the short-term subscription fees generate the most revenue. In an analysis of U.S. systems, while annual members took a large majority of the trips, the casual members provide roughly 2/3 of the revenue for the system (Cohen 2013).

System planners must consider the service-fee structure carefully, since a post-implementation change to the price structure is likely to cause a public backlash. Some cities have conducted market studies to understand the effect of various price structures on usage and revenue generation, but there has been little research to date into the price elasticity of bike-share. Many cities want to keep the price of bike-share lower than that of mass transit and car use in order to make it competitive with those forms of transportation.

Setting user fees requires knowledge of the habits and average routes that will be used by the target user groups, as well as of the city's own criteria, policies, and objectives for the bike-share system. New York City decided to initially keep the fees for its system lower than the price of transit to attract users. The system in Barcelona is available only to residents, as users are required to register for an annual membership, and the system offers no daily or weekly passes. This decision was made in part so that the bike-share would not compete with the multiple bike-rental operations already in existence in the city.

Pricing models vary widely. Some charge only usage fees, such as pay-by-minute (Germany's Call-a-Bike charges €0.08/minute) and pay-by-day (the Netherlands' OV-Fiets charges €2.85 for twenty hours). Most systems charge both a subscription fee and a usage fee. The subscription fee buys the user a free period of use at first, and then usage fees get charged after that period elaspes and the bike has not been returned. Many Asian systems offer the first hour free. In Rio de Janeiro, users pay US\$5 for a monthly subscription or US\$2.50 for a daily subscription. Both give the user sixty minutes of free use, with at least fifteen-minute intervals between uses. After that period, US\$2.50 per additional hour gets charged to the user.

Long-term subscriptions, usually called memberships, offer a stable revenue stream for the system, and the registration process plays the secondary role of verifying customers' personal and payment information on a regular basis. To make membership more attractive, members get either a discounted usage fee or slightly longer free time periods. Membership can deter theft and track active users more accurately by requiring them to update their user profiles and payment details on a regular basis. It may also be possible to commoditize this information and use it to attract sponsors.

Across all the U.S. systems analyzed in Cohen's report, it is consistent that there is a roughly a 33% / 33% / 33% split of revenues from annual membership, casual membership and usage fees. The vast majority of usage fees come from casual members keeping bikes out for more than 30 minutes. While approximately 2/3 of revenue for U.S. bike-share systems come from casual members, annual members use and create significantly more wear-and-tear on system. Many usage fees are accrued because casual members don't understand the free 30-minute rule. Should casual members a better general understanding of the pricing structure, systems are at risk of losing up to 33% of their revenues (Cohen 2013).

5.3.6 Advertising Revenue

There are two main forms of advertising revenue. One comes from general outdoor advertising placed in public spaces, such as on bus shelters, benches, or billboards. The other is advertising specifically associated with the bike-share system, placed on the bikes, stations, kiosks, etc. Many systems have contracted all or part of the city's outdoor advertising to the company implementing the bike-share system. Estimates indicate that JCDecaux in Paris generates revenues of up to €60 million (US$80 million) annually from advertising.

Linking bike-share operations to the general outdoor advertising revenue means that operational expenses will be subsidized by the advertising revenue, without directly touching city revenue sources. The problem with this arrangement is the lack of clarity between the costs reported and the advertising revenue taken in by the firm. The lesson learned from Vélib' and other systems with outdoor advertising revenue contracts is that there should be separate contracts for outdoor advertising and for operating the bike-share system, even if both contracts are given to the same company. The revenue from all sources should go into a government or escrow account, and the operator should be paid based on service levels. While advertising often comes under criticism, many systems create very good contractual arrangements that utilize outdoor advertising.

Denver's bike-share began as a free service during the 2008 Democratic National Convention, and the success of the program inspired its growth into a full bike-share system.
PAULKIMO90 (CREATIVE COMMONS)

City	Country	System Name	Deposit amount (USD)	Subscription Fees (USD)				Free Usage Period (minutes)	
				Annual	Monthly	Weekly	Daily	Long-term Users (Members)	Casual Users
London	U.K.	Barclays Cycle Hire	n/a	$123	n/a	$13	$3	30	30
Paris	France	Vélib'	$199	$38	n/a	$11	$2	30–45	30
Barcelona	Spain	Bicing	n/a	$62	n/a	n/a	n/a	30	30
Lyon	France	Vélo'v	n/a	$33	n/a	$5	$2	30	30
Montreal	Canada	Bixi	n/a	$80	$30	n/a	$7	45	30
Washington, D.C.	USA	Capital Bikeshare	$202 (Casual members only)	$75	$25	n/a	$7	30	30
Guangzhou	China	Guangzhou Public Bicycle	$49	n/a	n/a	n/a	n/a	60	60
Hangzhou	China	Hangzhou Public Bicycle	$33	n/a	n/a	n/a	n/a	60	60
Shanghai Forever Bicycle	China	Shanghai Forever Bicycle	n/a	n/a	n/a	n/a	n/a	60	60
Zhuzhou Jianning Public Bicycle	China	Zhuzhou Jianning Public Bicycle	$32.68 (Resident) $196.09 (Tourist)	n/a	n/a	n/a	n/a	180	180
Shenzhen Public Bicycle	China	Shenzhen Public Bicycle	n/a	n/a	n/a	n/a	n/a	60	60
Mexico City	Mexico	Ecobici	$393	$31	n/a	$24	$7	45	45
Rio de Janeiro	Brazil	Bike Rio	n/a	n/a	$2	n/a	$1	60	60
Buenos Aires	Argentina	Mejor en Bici (as of June 2013)	n/a	$0	$0	$0	$0	60	60

Fig. 13: Comparison of Subscription Fees

				Subscription Fees (USD)				Free Usage Period (minutes)	
City	Country	System Name	Deposit amount (USD)	Annual	Monthly	Weekly	Daily	Long-term Users (Members)	Casual Users
Dublin	Ireland	Dublinbikes	n/a	$13	n/a	n/a	n/a	30	30
New York City	USA	Citi Bike	$101 (Casual members only)	$95	n/a	$25	$10	45	30
Denver	USA	Denver B-Cycle	n/a	$80	$30	$20	$8	30	30
Minneapolis	USA	Nice Ride	n/a	$65	n/a	n/a	$6	30	30
Chattanooga	USA	Bike Chattanooga	n/a	$75	n/a	$20 (Conferences / Events only)	$6	60	60
Madison	USA	Madison B-Cycle	n/a	$65	n/a	$30	$5	30	30
Taipei	Taiwan	YouBike	n/a	n/a	n/a	n/a	n/a	30	0
Brussels	Belgium	Villo!	n/a	$40	n/a	$9	$2	30	30
Tel Aviv	Israel	Tel-o-Fun	n/a	$78	n/a	$17	$5	30	30
Boulder	USA	Boulder B-cycle	n/a	$65	n/a	$24	$7	60	60
Boston	USA	Hubway	$101 (Casual members only)	$85	$20	n/a	$6	30.	30
San Antonio	USA	San Antonio B-cycle	n/a	$60	n/a	$24	$10	30	30
Toronto	Canada	Bixi Toronto	$250 (Casual members only)	$94	$40	n/a	$5	30	30

Fig. 13: Comparison of Subscription Fees, continued

After over a year of delay, New York City installed stations like this over the course of one month.
AIMEE GAUTHIER

IMPLEMENTATION

Once the contracts are signed, the timeline for implementation will be contingent on procurement and installation of the hardware and the procurement or development of the software. Vélib' and Ecobici took six months to implement. New York City's bike-share took two years, in part due to a contractual problem between the system's operator and the subcontractor developing the software.

Two months prior to the official launch, the city should conduct community outreach and membership drives to help educate customers on how to use the system and to prepare drivers to be aware of these new users. A good communications strategy that builds excitement and support prior to the system's opening will help mitigate any problems during the launch.

A soft launch or demonstration of the actual bike-share system in the city can provide three benefits:

- It allows users to see how the system will work, ask questions, and get a feel for the process of checking a bicycle in and out.

- It lets the operator try out the hardware and software, with informed personnel on hand to answer questions and work out any potential system bugs.

- It provides a positive media event to lead up to the actual launch.

- The actual launch should be a high-profile event with local celebrities and important city officials that is promoted to the press as a victory for the city. This will make potential new customers aware of the program.

Customer service, before and after opening, will be critical to the success of the system. The system will need to have ways for users to register, make payments, and issue complaints or notices of defective equipment, and it must have a point of sales for buying subscriptions and a hotline for user inquiries (Obis 2011).

From the day the bike-share system is launched, it will be evaluated on whether it is meeting, exceeding, or falling below the goals it promised to achieve. Those goals should have been articulated in service-levels agreements between the implementing agency and the operator. The service levels need to be realistic at the outset, and if the operator is not achieving them, it must be determined whether the operator is failing to meet the service levels due to negligence.

Flexibility and communication between the operator and the administrator are essential. While the main operational measures will be established in the tender and contract, service levels may need to be readjusted or refined so the operator has an incentive to innovate and excel in areas where resources can create the greatest change or benefit to the user and the system as a whole. If this doesn't happen, the operator will focus limited resources on service levels that are impossible to achieve, minimizing loss instead of creating potential growth.

This requires give and take, and open communication.

This is a complicated matter to handle contractually, as any leeway in the written agreement could be exploited by either party. One recommendation is to agree to a mediated review of the service levels six months into the operator's contract. This mandates that the two parties sit down and discuss the service levels, while a third party makes sure the outcome is fair.

CONCLUSION

Kids in Zhuzhou, China use the local bike-share.
LI SHANSHAN

The enormous growth in bike-share systems all over the world in the past ten years has done a great deal to legitimize the bicycle as the mode of choice for urban commuting. The transformation of bike-share from the informal, "free bikes for the community" system to its official integration into the city's public transport systems is an important step in creating more equitable and sustainable cities.

While the benefits of introducing bike-share in cities is enormous, adaptations in behavior and enforcement are also necessary to make bike-share work for everyone. Cycling lanes, when protected from cars, encourage riders who may be intimidated by traffic, and the inclusion of signage giving bikes right-of-way helps remind drivers to share the road. In order for this integration to be successful, these spaces and rules should be enforced for drivers and for cyclists. In addition, more cyclists on the road increases the safety of cycling—many cities see a decrease in accidents even though there are more cyclists.

Bike-share, more than any other form of urban transport, has the ability to improve and transform our cities. Bikes allow individual freedom of movement, but without the CO_2 emssions, congestion, and overuse of scarce street space that cars demand. In the more than 400 cities that have implemented bike-share, more people are now experiencing the health benefits, cost savings, flexibility, and enjoyment of the city that comes with cycling. As more cities consider bike-share, cities and streets are once again becoming dynamic places for people and not just cars. We look forward to seeing how bike-share continues to innovate and cities evolve with more and better practices in bike-share.

APPENDIX

Biking along the beach
in Rio de Janeiro.
AIMEE GAUTHIER

Appendix A:
Key Resources and Publications

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Maps

Public Bike Website: photos and data of the main systems in the world, with a special focus on Chinese systems
publicbike.net

Oliver O'Brien's Bike Share Map: http://bikes.oobrien.com/global.php

Global Bike-sharing World Map on Google Maps: https://maps.google.com/maps/ms?ie=UTF8&hl=en&om=1&msa=0&msid=104227318304000014160.00043d8of9456b3416ced&ll=43.580391,-42.890625&spn=143.80149,154.6875&z=1&source=embed&dg=feature

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Key Resources

Some Bike-share System Web Pages

Bici in Città (Chivasso, Italy): www.bicincitta.com

BiciBur (Burgos, Spain): www.bicibur.es

Bicing (Barcelona, Spain): http://www.bicing.com

Bixi (Montreal, Canada): http://www.bixi.com/home

Bycyklen (Copenhagen, Denmark): www.bycyklen.dk

Call-a-Bike (Germany): www.callabike.de

Citybike Wien (Vienna, Austria): www.citybikewien.at

Cycle Hire (London, United Kingdom): http://www.tfl.gov.uk/roadusers/cycling/12444.aspx

Cyclocity (Brussels, Belgium): www.cyclocity.be

Ecobici (Mexico City, Mexico): https://www.ecobici.df.gob.mx/

Fremo (Mumbai, India): http://www.fremo.in/

Oslo Bysykkel (Oslo, Norway): www.oslobysykkel.no

OYBike (London, United Kingdon): www.oybike.com

Vélib' (Paris, France): www.velib.paris.fr

Vélo à la Carte (Rennes, France) : http://veloalacarte.free.fr/rennes.html

Vélo´v (Lyon, France): www.velov.grandlyon.com

Appendix B: Bike-share System General Information

City	Country	System Name	Launch Date (Month/Year)	# of Stations	# of Bikes in Service	# of Docks
London	U.K.	Barclays Cycle Hire	July, 2010	554	7,000	14,000
Paris	France	Vélib'	July, 2007	1,751	16,500	40,421
Barcelona	Spain	Bicing	March, 2007	420	4,100	10,580
Lyon	France	Vélo'v	May, 2005	347	3,000	6,400
Montreal	Canada	Bixi	May, 2009	411	3,800	7,760
Washington, D.C.	USA	Capital Bikeshare	September, 2010	238	1,800	3,750
Guangzhou	China	Guangzhou Public Bicycle	June, 2010	109	5,000	2,298
Hangzhou	China	Hangzhou Public Bicycle	May, 2008	2,700	66,500	n/a
Shanghai	China	Not Available	March, 2009	330	28,000	n/a
Zhuzhou	China	Not Available	May, 2011	502	10,000	n/a
Shenzhen	China	Not Available	December, 2011	1,118	9,500	n/a
Mexico City	Mexico	EcoBici	February, 2010	279	3,200	7,134
Rio de Janeiro	Brazil	Bike Rio	October, 2011	56	600	723
Buenos Aires	Argentina	Mejor en Bici	December, 2010	28	1,122	n/a
Dublin	Ireland	Dublinbikes	March, 2009	44	450	1,105
New York City	USA	Citi Bike	May, 2013	323	4,200	9,980
Denver	USA	Denver B-Cycle	April, 2010	82	450	1,248
Minneapolis	USA	Nice Ride	June, 2010	146	1,380	2,554
Chattanooga	USA	Bike Chattanooga	July, 2012	31	235	517
Madison	USA	Madison B-Cycle	May, 2011	32	230	490
Taipei	Taiwan	YouBike	March, 2009	74	1,000	2,980
Brussels	Belgium	Villo!	May, 2009	180	3,500	7,371
Tel Aviv	Israel	Tel-o-Fun	April, 2011	125	1,100	3,523
Boulder	USA	Boulder B-cycle	May, 2011	22	110	276
Boston	USA	Hubway	July, 2011	113	950	1,931
San Antonio	USA	San Antonio B-cycle	March, 2011	42	330	637
Toronto	Canada	Bixi Toronto	May, 2011	80	660	1,500

Coverage Area (km²) [May 2013]	Overall City Population Density (People/km²)	Population in Coverage Area	Who is operator?	Operator, private, public, non-profit?
66	5,206	343,596	Serco Group	Private
135	21,196	2,861,460	SOMUPI (subsidiary of JC Decaux)	Private
41	15,991	652,433	Clear Channel (sub-contracted to Delfin Group) & City of Barcelona	Private
45	10,101	453,535	JCDecaux	Private
50	4,518	225,448	Public Bike System Company (Bixi)	Public
57	3,977	225,894	Alta Bicycle Share	Private
263	1,708	449,204	Guangzhou Public Bicycle Operation Management Co.	Public
125	4,889	611,125	Hangzhou Public Transport Bicycle Service Development Co.	Public
256	3,600	921,600	Shanghai Forever Bicycle Co.	Public
n/a	n/a	n/a	Zhuzhou Jianning Public Bicycle Development Co.	Public
n/a	n/a	n/a	n/a	n/a
19	6,000	112,200	Clear Channel	Private
20	4,781	94,186	Sertell	Private
28	14,000	385,000	City Government of Buenos Aires	Public
5	4,588	22,940	JCDecaux	Private
30	26,939	813,558	Alta Bicycle Share	Private
21	1,561	32,157	Denver Bike Sharing	Non-profit
70	2,710	190,242	City of Minneapolis	Non-profit
2	473	945	Alta Bicycle Share	Private
9	1,173	10,553	Trek Bicycle Corporation	Private
24	9,600	226,560	Giant Bicycles	Public
73	7,025	509,313	JCDecaux	Private
36	7,956	289,580	FSM Ground Services	Private
2	3,006	7,215	Boulder Bike Share dba Boulder B-cycle	Non-profit
36	4,984	179,904	Alta Bicycle Share	Private
11	2,972	33,281	San Antonio Bike Share	Non-profit
11	4,149	46,054	Public Bike System Company (Bixi)	Public

Appendix C: Bike-share System Performance Metrics					
City	Trips per Bike	Trips per 1,000 Residents	Station Density	Bikes per 1,000 Residents	Operating Cost per Trip
London	3.1	63.9	8.4	23.3	$4.80
Paris	6.7	38.4	13.0	8.4	n/a
Barcelona	10.8	67.9	10.3	9.2	$0.86
Lyon	8.3	55.1	7.7	6.6	$0.86
Montreal	6.8	113.8	8.2	22.7	$1.27
Washington, D.C.	2.4	18.9	4.2	8.4	$1.52
Mexico City	5.5	158.2	14.9	35.7	$1.28
Rio de Janeiro	6.9	44.2	2.8	6.4	n/a
Buenos Aires	3.8	11.2	1.0	2.9	n/a
New York City	8.3	42.7	10.7	6.8	n/a
Denver	2.8	39.1	4.0	22.0	$3.22
Minneapolis	1.4	10.5	2.1	8.1	$1.52
Madison	2.2	48.3	3.6	25.6	n/a
Boulder	1.0	15.9	9.2	20.8	n/a
Boston	4.0	20.9	3.1	6.1	$3.09
San Antonio	0.4	4.0	3.8	10.6	n/a