CHAPTER 2

ELEMENTS OF BIKE SHARE

Photo Credit: San Antonio B-cycle

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For the purposes of this report, the only U.S. bike share programs being considered are automated and do not require on-site staff. To provide easy access and security, these systems utilize credit cards and radio frequency identification (RFID) technology in the stations and bicycles. Some new systems are starting to use Near Field Communications (NFC) technology.

There are currently two major types of bike share technologies utilized in existing U.S. bike share systems: "smart dock" (or station based) systems, and "smart bike" systems. Both technologies utilize RFID, credit card and GPS technologies to track customer transactions and location of bicycles. They do however differ in where the technology is housed.

In smart dock systems, users interact at a separate terminal or kiosk and the locking mechanism for the bicycle is located at the dock. With "smart-bikes," all of the technology is housed on the bicycle itself including the lock and payment system. See **Figure 4** for more information about the components of smart bike and smart dock systems.

Smart bike systems typically have lower capital costs as the technology is all housed in the bicycle and therefore do not require docking stations. However, the majority of existing bike share programs in the U.S. have used smart dock technologies due to their branding flexibility and recognizable stations.

SMART DOCK

Most smart dock systems use wireless technology to communicate as well as solar technology to charge the station. Most systems are modular, allowing various sizes and arrangements. The elements of a smart dock system include:

- **Station**: Includes the following components
  - **Kiosk**: Electronic unit where rental transactions are made.
  - **Informational Panel**: Display panel which is regularly used to provide system maps information about the system, and where advertising is regularly placed.
  - **Dock**: Mechanism that holds the bicycles. Each dock is individually controlled and has a mechanized system that locks and releases the bicycles.
  - **Platform**: Structure that holds the kiosk, information panel, and docks together.

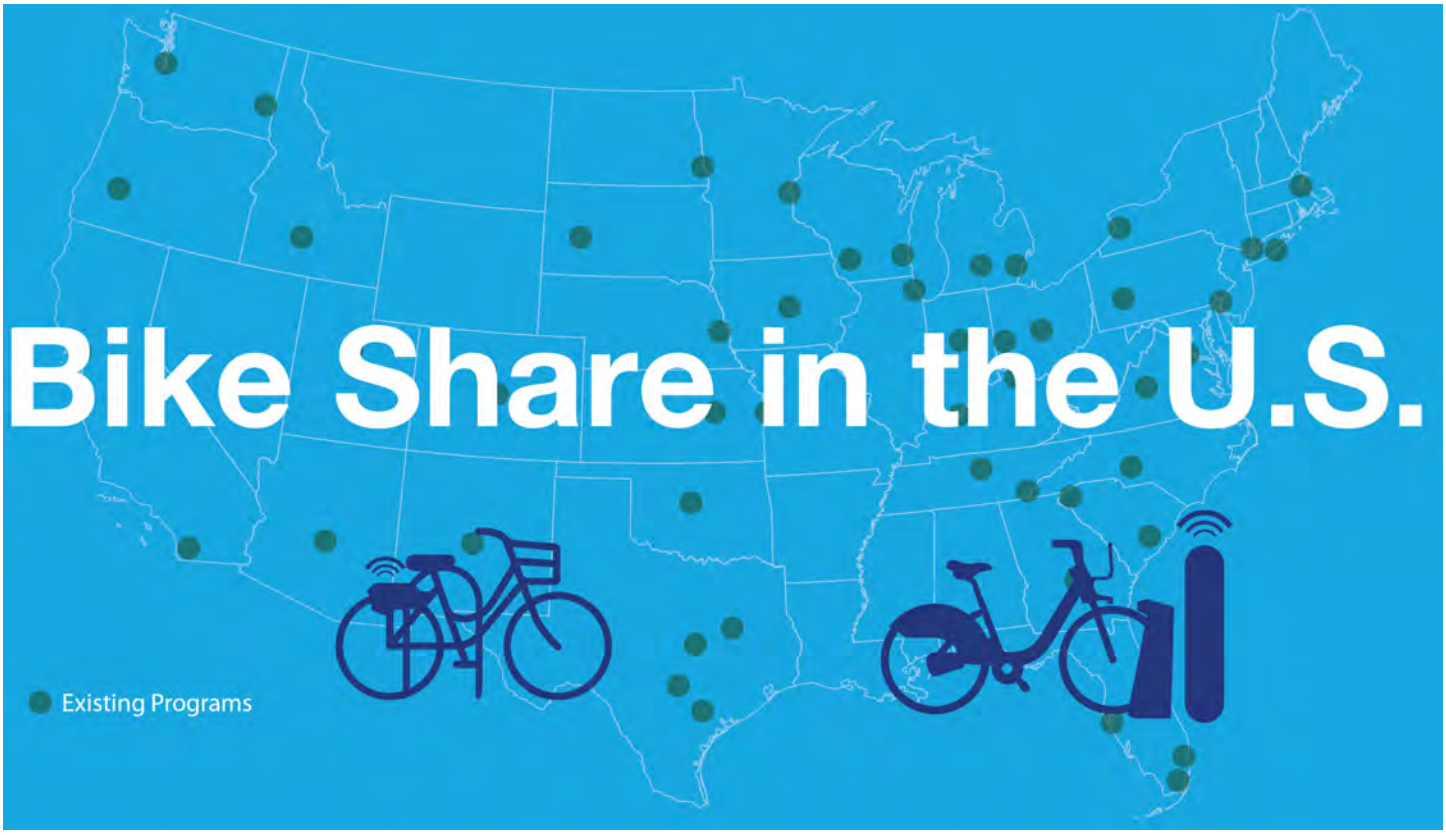

Figure 3: Existing Bike Share Systems in the U.S.

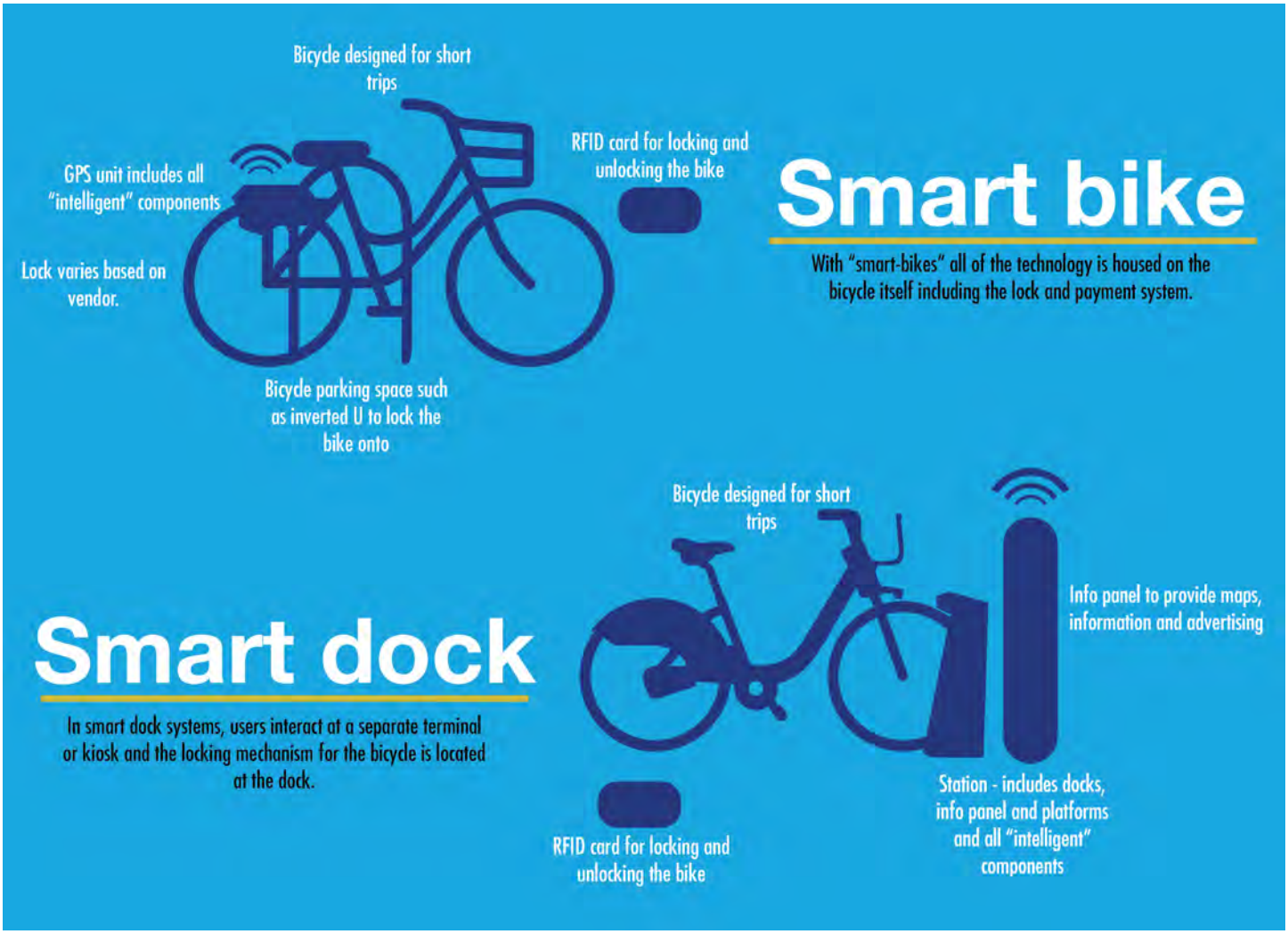

Figure 4: Smart Dock and Smart Bike Components

- **Bicycle**: Specifically designed for short trips and constructed of customized components to limit theft and vandalism.
- **RFID Card or Fob**: Radio Frequency Identification technology, usually in the form of a card or fob, allows users to check out a bicycle.

SMART BIKE

As previously stated, smart bike systems typically offer lower capital costs and house all of the smart technology in the bicycles. Specifically smart bike systems include:

Bicycle: specifically designed for short trips and constructed of customized components to limit their appeal to theft and vandalism.

- **Lock**: Varies based on the vendor. The electronic aspect of the lock is housed on the bicycle.
- **GPS Unit**: Unit with the electronics, fastened to the bicycle. Location on the bicycle varies with the vendor. The unit includes a place to use RFID pass or enter a pin code to lock and unlock the bicycle.
- **RFID Card**: Radio Frequency Identification technology, usually in the form of a card or fob, allows users to check out a bicycle. Some systems do not require RFID card to unlock the bicycle.
- **Dock**: May either be a "dumb dock" with no technology that accepts the locking mechanism, or may be any structure, such as a sign post, depending on the technology.

E-BIKES

In recent years there has been increased interest in bike share systems that integrate both the automation Smart Bike and Smart Dock technologies with electric-assist

Figure 5: BiciMad (Madrid, Spain). Credit: Enbicipormadrid.com

bicycles, also known as pedelec or e-bikes. This integration would allow bike share users to check out bicycles that offer a boost when riding in hilly terrains. Adding this assist, may also help overcome barriers to bicycling for some people with limited mobility, by allowing them to travel longer distances and over hills with less fatigue and sweat. Furthermore, e-bikes may help with redistribution efforts as more users would be more willing to travel uphill using the power assisted pedaling.[1]

According to recent studies on existing e-bike systems, e-bicycles use rechargeable Li-ion batteries to provide that extra boost, primarily because of a relatively low weight and high energy density. To extend battery life, maximize stored energy, and minimize the risk of overcharging and overheating, it is advisable for an e-bike sharing system to adopt a slower battery charging system, which also reduces the availability of batteries. Pedal-assisted e-bikes operate similarly to regular bicycles but have a small electric motor, which supplements the power provided by the user.

E-bikes tend to be heavier and more expensive than conventional bike share bicycles. According to the BiciMad (Madrid's bike share system) website, all bicycles are around 22 Kg (around 48 lbs.).[2] Furthermore, recent studies have calculated the capital price of e-bike bike share systems at around two times the price of conventional bike share systems which may make them a more difficult to implement option due to limited funding availability. [3]

While e-bike systems may provide a good option to help overcome some of the barriers to bicycling, they remain relatively untested in large city-wide applications in the U. S. and as such operating costs and other parameters are still somewhat unknown.

Worldwide, there are approximately 70 cities that have partial or full pedelec systems totaling about 9,400 bicycles in service world-wide. In the U.S., pedelec technology is a nascent one with only one existing system to date, Zyp Bike Share in Birmingham, Alabama. Zyp Bike Share began operating in Fall 2015 and is scheduled to deploy 40 stations and 400 bicycles by Spring 2016. Within this system, only a quarter of the bicycle fleet is pedelec, however early indicators show pedelec bicycles being used four times as much as regular bike share bicycles.[4] Other pedelec systems which are expected to be implemented include those in Baltimore, MD (50 stations and 500 bicycles) and Richmond, VA (20 stations and 200 bicycles) in fall 2016.

1 Accessed from http://www.movilidadelectrica.com/index.php/entrevistas/1173-bicimad-actualidad-del-sistema-de-bicisharing-de-madrid-parte-1-bonopark on August 2015.

2 Accessed from http://www.bicimad.com/index.php?s=preguntas on August 2015.

3 Ji, S., et al., Electric bike sharing: simulation of user demand and system availability, Journal of Cleaner Production (2013), http://dx.doi.org/10.1016/j.jclepro.2013.09.024.

4 Interview with Lindsey West, Director, ZypBikeshare. March 01, 2016.

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