***Journal Papers***

1. Paul DeMaio, MetroBike, LLC ; “Bike-sharing: History, Impacts, Models of Provision, and Future” . Journal of Public Transportation, Vol. 12, No. 4, 2009

<http://bike.cofc.edu/bike-share-program/history%20of%20bike%20sharing.pdf>

2. Jia Shu , Mabel C. Chou, Qizhang Liu, Chung-Piaw Teo, I-Lin Wang ; “Models for Effective Deployment and Redistribution of Bicycles within Public Bicycle-Sharing Systems”

Operations Research; manuscript no. OPRE-2011-02-077.R2

<http://bschool.nus.edu/Staff/bizteocp/SMRT2013R2edited2.pdf>

**Literature Review**

Literature available regarding bike renting and redistributions is very large as it provides a wide variety of conceptual and mathematical information of how the bikes were and could be shared/rented. Different sources show the simulation models for sharing and re-distributing bikes.

Paul De Maio (2009) provides good information on history of bike sharing and how the 1st generation, 2nd generation and 3rd generation bike sharing models work. It talks about the benefits and disadvantages of each generation of bike sharing models and how the future generation bike sharing program would look like and operate. It also talks about the capital and operational expenses incurred by the bike sharing programs.

**Literature Review – Paul DeMaio(2009)**

A brief look into the history of bike sharing programs-

1st generation bike sharing program was introduced in Amsterdam. A person took a bike, rode to his/her destination and left it there for the next user. However, the bikes got thrown into the canals and people kept them for personal use.

2nd generation bike sharing program was introduced in Denmark. The bikes could be picked up and returned at specific locations throughout the Central City in Copenhagen with coin deposits. However, the bikes were stolen in this model.

3rd generation bike sharing program called “Bikeabout” was introduced in Portmouth University in England which used more sophisticated methods such as magnetic swipe card to rent a bike, which further emerged into advanced 3rd generation bike sharing programs operated using electronically locking racks/bike locks, telecom systems, smartcards, fobs, mobile phone access and onboard computers.

The cost of the bike sharing program depends upon the system, population density, service area and fleet size. Capital costs include fabrication of the bikes and stations, license or purchase of the back-end system used to operate the equipment, member access cards (if necessary), purchase or rental of maintenance and distribution vehicles, and installation.

For example- estimates for capital costs are $3,600 per bicycle for Clear Channel Outdoor’s SmartBike system, $4,400 per bicycle for JCDecaux’s Cyclocity system and $3,000 per bicycle for Bixi.

Operating Costs of bike sharing program comprises of maintenance costs, distribution, staff, insurance, office space, storage facilities, website hosting and maintenance and electricity.

For example – operating costs for New York city’s several bike sharing programs comes to about $1,600 per bicycle.

Based on the simulation study, the 4th generation program would have improved efficiency, sustainability and usability by way of improving bike distribution, installation, tracking, offering pedal assistance bikes and using new business models.

Improved bike distribution at various stations will be implemented by having “push” and “pull” stations which will either encourage trips to leave or arrive, respectively, at these stations based on the demand for bikes. Incentives will include free time, credit, or cash.

This has been implemented by “Velib” (A bike share program in Paris) which give extra 15 min for example if the rider has to go on a route which has an uphill or upslope ride. Also, giving extra credit to riders for future use or giving them instant discounts motivates for appropriate distribution of bikes at stations.

So basically when customers are given extra credit/incentives for distribution of bikes to stations where there is more need increases distribution efficiency at a much lesser cost than having the bike company staff do the distribution work.

Costs for installation of bike stations will be reduced by utilizing a “technical platform” which is basically a stand-alone platform placed over the ground. This technical platform has in-built system for docking and locking the bikes and has an inbuilt payment system too. So this platform can just be bolted to the ground without having an expensive need of excavating the ground and doing underground wiring and electrical connections which leads to skyrocketing of prices.

Tracking of bikes will be improved by implementing GPS in the bikes which will help understand the favorite routes, pick-up points and destinations based on which stolen bikes could be tracked and also the miles travelled could be tracked.

Pedal assistance provided in the bikes will help ride the bikes in hilly areas or would help people who do not have enough leg strength to pedal the entire distance of their journey. Therefore, electric pedal assistance would be a great help for these people and hence would motivate more people to adopt bike sharing programs.

Powering stations for bikes are expensive since they have to be close to the nearest electrical source and limits the place where bike stations will be located. Therefore, implementing solar panels will be a cheaper and cleaner option to charge/power the bikes and will remove the need for underground wiring. This has been implemented by Bixi.