

The science of bike-sharing

January 31 2011



The new environmentally-friendly concept of municipal "bike-sharing" is taking over European cities like Paris, and American cities like New York are also looking into the idea. It allows a subscriber to "borrow" a bike from one of hundreds of locations in the city, use it, and return it to another location at the end of the journey. It's good for commuters and for running short errands.

While the idea is gaining speed and subscribers at the 400 locations around the world where it has been implemented, there have been growing pains — partly because the projects have been so successful. About seven percent of the time, users aren't able to return a bike because the station at their journey's destination is full. And sometimes

stations experience bike shortages, causing frustration with the system.

To solve the problem, Dr. Tal Raviv and Prof. Michal Tzur of Tel Aviv University's Department of Industrial Engineering are developing a mathematical model to lead to a software solution. "These stations are managed imperfectly, based on what the station managers see. They use their best guesses to move bikes to different locations around the city using trucks," explains Dr. Raviv. "There is no system for more scientifically managing the availability of [bikes](#), creating dissatisfaction among users in popular parts of the city."

Their research was presented in November 2010 at the INFORMS 2010 annual meeting in Austin, Texas.

Biking with computers

An environmentalist, Dr. Raviv wants to see more cities in America adopt the bike-sharing system. In Paris alone, there are 1,700 pick-up and drop-off stations. In New York, there soon might be double or triple that amount, making the management of bike availability an extremely daunting task.

Dr. Raviv, Prof. Tzur and their students have created a mathematical model to predict which bike stations should be refilled or emptied — and when that needs to happen. In small towns with 100 stations, mere manpower can suffice, they say. But anything more and it's really just a guessing game. A computer program will be more effective.

The researchers are the first to tackle bike-sharing system management using mathematical models and are currently developing a practical algorithmic solution. "Our research involves devising methods and algorithms to solve the routing and scheduling problems of the trucks that move fleets, as well as other operational and design challenges

within this system," says Dr. Raviv.

For the built environment

The benefits of bike-sharing programs in any city are plentiful. They cut down traffic congestion and alleviate parking shortages; reduce air pollution and health effects such as asthma and bronchitis; promote fitness; and enable good complementary public transportation by allowing commuters to ride from and to train or bus stations.

Because of the low cost of implementing bike-sharing programs, cities can benefit without significant financial outlay. And in some cities today, bicycles are also the fastest form of transport during rush hour.

The city of Tel Aviv is now in the process of deploying a bike sharing system to ease transport around the city, and improve the quality of life for its residents. Tel Aviv University research is contributing to this plan, and the results will be used in a pilot site in Israel.

Provided by Tel Aviv University

Citation: The science of bike-sharing (2011, January 31) retrieved 24 April 2024 from <https://phys.org/news/2011-01-science-bike-sharing.html>

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