Performance Evaluation for Bike-Sharing Systems: a Benchmarking among 50 Cities

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Agenda

- Introduction
- Objectives
- Methodology
- Results
- Conclusions
Context

• Today, **54% of the world’s population** lives in urban areas, a proportion that is expected to increase to **66% by 2050** ¹

• Cities all over the world struggling to maintain **cost effective and sustainable transport systems**

• Growing concerns with the **impact of greenhouse emissions** from the transport sector

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*Bike Sharing emerges as a solution*

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Source: ¹ UN (2014)
New form of sustainable transport capable of meeting the increasing mobility demand

“A bike-sharing system or bicycle-sharing system offers a self-service, short-term, one-way urban bicycle rental in public spaces, for several target groups and with network characteristics.”

Source: ¹ OBIS (2014) - Optimising Bike-Sharing in European Cities
From left to right: [TO]Bike in Turin, Italy; Municipal Public Bicycle System in Beijing, China; Bike Rio in Rio de Janeiro, Brazil.
Bike sharing plays an important role in the niche of short and low-cost trips

Distance x cost for urban displacements

Source: Midgley (2011)
Bike sharing is a growing global trend

Today there are more than 600 bike-sharing schemes spread across 5 continents

Notes: systems in green are currently operating; blue question marks are schemes in planning or under construction; red triangles reflect bike-sharing schemes that are no longer operating. Retrieved from The Bike-sharing World Map - 2015
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The study sought to **evaluate the performance** of bike-sharing systems around the world

**Objective:**

To evaluate the performance of bike-sharing systems through KPIs and customer satisfaction

**Secondary goals:**

- To determine the **influence of business model and city size** on the performance of bike-sharing schemes
- To build a **bike-sharing database** that permits a benchmarking comparison and serves as **reference for future research in the subject**
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Extensive research was made to collect information on bike-sharing schemes around the world.

1. Sample definition and data collection
2. Definition of key performance indicators
3. Data analysis design for benchmarking
4. Customer satisfaction analysis to test defined KPIs

Criteria for sample selection:

- Cities with a population **greater than 200,000 inhabitants**
- **Third and fourth-generation** bike-sharing schemes
- Bike-sharing schemes that had available data

50 cities
Key performance indicators were based on existing metrics and parameters gathered through:

1. Sample definition and data collection
2. Definition of key performance indicators
3. Data analysis design for benchmarking
4. Customer satisfaction analysis to test defined KPIs

- Existing bike-sharing performance metrics
- Parameters gathered in the research phase

**Definition of KPIs**
The performance evaluation was made in two different settings

1. Sample definition and data collection
2. Definition of key performance indicators
3. Data analysis design for benchmarking
4. Customer satisfaction analysis to test defined KPIs

### BY CITY SIZE

<table>
<thead>
<tr>
<th>City class</th>
<th>Population range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>200K to 1M inhabitants</td>
</tr>
<tr>
<td>Large</td>
<td>1M to 5M inhabitants</td>
</tr>
<tr>
<td>Very large</td>
<td>5M to 10M inhabitants</td>
</tr>
<tr>
<td>Mega-city</td>
<td>More than 10M inhabitants</td>
</tr>
</tbody>
</table>

### BY BUSINESS MODEL

<table>
<thead>
<tr>
<th>Management</th>
<th>Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>Public</td>
</tr>
<tr>
<td>Public-Private</td>
<td>Public</td>
</tr>
<tr>
<td>Private</td>
<td>Private</td>
</tr>
</tbody>
</table>

Source: Population ranges – adapted from UN (2014); Business models: adapted from Midgley (2011); Shaheen, Guzman and Zang (2010)
Customer satisfaction was used to test the key performance indicators.

1. Sample definition and data collection
2. Definition of key performance indicators
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4. Customer satisfaction analysis to test defined KPIs

Case studies:
- **Turin, Italy**
  [TO]Bike: Public business model

- **Washington, USA**
  Capital Bikeshare: Public-private partnership

- **São Paulo, Brazil**
  Bike Sampa: Private business model
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1. A **large bike-sharing database** was created, serving as starting point for **future research** in the subject...

**System investment:**
- Initial capital cost
- Annual operating costs
- Cost of bicycle

**Demographics and economic factors:**
- City name
- Country
- Continent
- Population
- Urban area
- GDP per capita
- Kilometres of cycling lanes

**Basic system information:**
- Programme name
- Beginning of operation
- Operator
- Business model

**System dimensioning:**
- Fleet size
- Number of docking stations
- Average distance between stations
- Number of docks

**System usage statistics:**
- Number of registered users
- Average daily trips
- Average trip time

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**26 parameters in 50 cities**
... and the definition of **KPIs** allowed for the **performance evaluation** of these systems

<table>
<thead>
<tr>
<th>KPI</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>System station density</td>
<td>Average distance between stations</td>
</tr>
<tr>
<td>System fleet sizing</td>
<td>Number of bicycles per 100.000 inhabitants</td>
</tr>
<tr>
<td>System number of stations sizing</td>
<td>Number of stations per 100.000 inhabitants</td>
</tr>
<tr>
<td>System reach related to city infrastructure development</td>
<td>Registered users per kilometre of cycling lane</td>
</tr>
<tr>
<td>System fleet sizing related to city infrastructure development</td>
<td>Number of bicycles per kilometre of cycling lane</td>
</tr>
<tr>
<td>Parking space availability</td>
<td>Number of docks per bicycle</td>
</tr>
<tr>
<td>System network concentration</td>
<td>Average docks per station</td>
</tr>
<tr>
<td>Bicycle availability</td>
<td>Average number of bicycles per station</td>
</tr>
<tr>
<td>Fleet rotation</td>
<td>Average daily uses per bicycle</td>
</tr>
<tr>
<td>System usage</td>
<td>Average daily trips per registered user</td>
</tr>
<tr>
<td>System sizing adequacy</td>
<td>Number of bicycles per 100 registered users</td>
</tr>
<tr>
<td>System reach related to pricing</td>
<td>Registered users times register price</td>
</tr>
<tr>
<td>System pricing adequacy</td>
<td>Register price per GDP per capita</td>
</tr>
<tr>
<td>System market penetration</td>
<td>Registered users per total population</td>
</tr>
</tbody>
</table>

Source: adapted from ITDP - The Institute for Transportation and Development Policy
2. Schemes operating as a **public-private partnership** performed **better** in average...

**Fleet sizing related to city infrastructure**
(number of bicycles per km of cycling lane)

**System reach related to city infrastructure**
(registered users per km of cycling lane)
...and schemes with the **private business model** performed the **worst** in most cases

### Fleet rotation
(average daily uses per bicycle)

### System usage
(average daily trips per registered user)

**Business model**
- Public model
- Public-private partnership
- Private model
3. The size of a city is **not directly correlated** with the **performance** of its bike-sharing system.
4. The **customer satisfaction surveys** reflected the performance measured by the KPIs

**5,06** was the rating out of 10 that the users gave to the bicycle availability in the stations in Turin. [TO]Bike ranked the 6th **worst system** in the KPI measuring bicycle availability.

**8,39** was the customer rating out of 10 for registration and hourly fees in [TO]Bike. Turin had a **very low relative price** as a percentage of city GDP per capita.

**54%** of the respondents complained that the lack of cycling lanes or paths is an issue affecting Capital Bikeshare. Washington presented one of the **shortest cycling networks** in length.

**80%** of the respondents in São Paulo did not regard the initial free time as a problem. Bike Sampa offers **1 hour of free time** instead of the usual 30 minutes.
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Conclusions

• Most of **bike-sharing information** is disperse, unstandardised and difficult to obtain

• The employed **business model** affects the **performance** of a bike-sharing system

• The **city population** is not directly correlated with the **performance** of its bike-sharing system

• The designed **KPIs** successfully evaluated the **performance** of bike-sharing systems
Thank you

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