Developing the bike sharing system to promote urban sustainable mobility: the case of Lyon city

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Outline of presentation

1. Bike sharing development
2. Lyon’s bike sharing system
3. Data and some analysis
4. Perspectives and conclusions
Bike sharing system (BSS) development

**Definition:** service of short term bike location with a system of stations, bikes and docks

**Advantage:** no theft, no maintenance, mobility cost, no bike park, whenever we want

1960s
- Netherland 1st generation

1990s
- Denmark 2nd generation

2005
- Lyon – France 3rd generation

2014
- E-bike sharing 4th generation
  - BiciMad - Spain
  - Bycyklen - Denmark
Bike sharing system (BSS) development

In the world: 49 countries, more than 500 cities, 700,000 bikes

In France: more than 30 systems, important success in Paris and Lyon
Lyon’s BSS – Vélo’v

- One of the first BSS of 3rd generation
- Started in May 2005: 173 stations, 2 000 bikes, 20 000 long-term subscribers
- In 2014: 345 stations and 4 000 bikes
- BSS trips represent 33% bikes trips in Lyon in 2009
Lyon bike sharing system (2014)

- 345 stations
- 4,000 bikes
- Long term subscribers and short term subscribers
- 53,000 yearly subscribers
- 20,000 trips daily ridership
- +6 millions trips / year
- 20% trips by short-term subscribers

Job density Lyon (2009)

Job density at IRIS level in Lyon (2009)

Job density (jobs/km²)

- [0 to 2 500]
- [2 500 to 5 000]
- [5 000 to 10 000]
- More than 10 000

Réalisation : LET
Sources : INSEE 2009
Data – Vélo’v (2011)

Data:

- 341 stations, 4 000 bikes, 50 500 yearly subscribers
- About 6 300 000 trips Vélo’v in the 2011, sources JC Decaux – operator of Lyon’s BSS
- Each trip gives us information about: station out | date and hour out | station in | date and hour in | type of subscriptions (daily, weekly, yearly)
- Socio-economic data of Lyon geo-computed by MOSART platform

This data allows us to analyze Lyon BSS usage by:

- Seasons and month
- Day of week
- Period of day
- Type of subscribers
Lyon BSS monthly and weekly usage analysis

- BSS usage decrease during winter and holiday months
- Same trend for long-term and short-term subscribers

- Yearly subscribers dominate on weekday
- Short-term subscribers usage increases on weekend
Lyon’s BSS daily usage analysis

- 3 peak periods
- yearly subscribers domination
- commuting trips

Weekday ridership of Lyon’s bike sharing system (2011)

- recreational trips
- night trips after public transport stop
- increase of short-term subscribers usage
Typology of BSS station

- **Methodology of classification:** k-means
- **Criteria of classification:** percentage of flows in compared to total flows on weekday 3 peak periods
- **4 groups of stations** (coefficient of determination = 0.80)
- A correlation between the typology of stations and the built environment

### Profile of groups of stations

<table>
<thead>
<tr>
<th>Groupe1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stations</td>
<td>152</td>
<td>102</td>
<td>34</td>
</tr>
<tr>
<td>Daily flow in per station</td>
<td>80</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>Daily flow out per station</td>
<td>78</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>Total flows of group</td>
<td>23986</td>
<td>9151</td>
<td>876</td>
</tr>
</tbody>
</table>
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Typology of Lyon's BSS stations

Daily ridership on weekday (trips)
- 720
- 360
- 180

Group of BSS stations
- Group 1: "mixed station"
- Group 2: "residential station"
- Group 3: "hilly station"
- Group 4: "work/study station"

Realisation: Tien Dung TRAN
Laboratory of Transport Economics (Lyon)
Sources: JC Deceaux 2011
## Typology of BSS stations - results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Groupe 1 «mixed station»</th>
<th>Groupe 2 «residential station»</th>
<th>Groupe 3 «hilly stations»</th>
<th>Groupe 4 «work/study station»</th>
<th>Average of all stations</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>5 124</td>
<td>5 422.00</td>
<td>4 318.00</td>
<td>2 386.00</td>
<td>4 707.00</td>
<td>person</td>
</tr>
<tr>
<td>Job</td>
<td>3 032</td>
<td>1 492.00</td>
<td>922.00</td>
<td>2 846.00</td>
<td>2 332.00</td>
<td>job</td>
</tr>
<tr>
<td>Revenue</td>
<td>29 011</td>
<td>27 796</td>
<td>30 323</td>
<td>27 602</td>
<td>28 559</td>
<td>euros</td>
</tr>
<tr>
<td>Student in campus</td>
<td>919</td>
<td>178</td>
<td>377</td>
<td>1922</td>
<td>800</td>
<td>person</td>
</tr>
<tr>
<td>University restaurant</td>
<td>0.30</td>
<td>0.10</td>
<td>0.10</td>
<td>0.70</td>
<td>0.30</td>
<td>unit</td>
</tr>
<tr>
<td>Gare</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>station</td>
</tr>
<tr>
<td>Metro</td>
<td>0.60</td>
<td>0.20</td>
<td>0.30</td>
<td>0.20</td>
<td>0.40</td>
<td>station</td>
</tr>
<tr>
<td>Tramway</td>
<td>0.40</td>
<td>0.20</td>
<td>0.00</td>
<td>0.50</td>
<td>0.30</td>
<td>station</td>
</tr>
<tr>
<td>Altitude</td>
<td>171.00</td>
<td>176.00</td>
<td>255.00</td>
<td>172.00</td>
<td>181.00</td>
<td>m</td>
</tr>
<tr>
<td>Piste cyclable</td>
<td>1 129.00</td>
<td>985.00</td>
<td>564.00</td>
<td>1 099.00</td>
<td>1 025.00</td>
<td>m</td>
</tr>
<tr>
<td>Retails shop</td>
<td>19.90</td>
<td>8.10</td>
<td>3.90</td>
<td>9.70</td>
<td>13.20</td>
<td>unit</td>
</tr>
<tr>
<td>Restaurant</td>
<td>4.20</td>
<td>2.80</td>
<td>1.50</td>
<td>1.40</td>
<td>3.10</td>
<td>unit</td>
</tr>
</tbody>
</table>
Webmapping- morning flow analysis
Key findings

→ Lyon’s BSS usage:
  - Dominant usage of yearly subscribers during weekday
  - Important usage of daily subscribers during weekend
  - The topography plays an important role to BSS usage
  - The built environment explains the difference between stations usage

→ A segmentation in the modeling and analysis of BSS usage for a better result

→ Take into account the built environment variables for explaining the BSS usage and for the redistribution of bikes
Perspectives

- Build a model of prediction of BSS demand at station level using built environment variables

- Develop the web mapping module to complete the BSS analysis

- Where to put a new BSS station? (using platform MOSART) and how many slots for the new station? (using the model of prediction)
Accessibility by Bike from Jean-Macé square

Time Isochrone:
- <= 5min
- <= 10min
- <= 15min
- <= 20min
- <= 25min
- <= 30min
- <= 40min
- <= 1h

1: Hôtel de Ville
2: Jean Macé
3: Grange Blanche
4: La Part-Dieu - railway station
5: Insa – Einstein (La Doua)

- subway network
- tramway network

Réalisation : MOSART Project. LET N. Ovtracht
Conclusions

- **BSS usage is dependent on:**
  - Day of week, period of day
  - Type of subscribers
  - Important role of built environment

- **To improve the sustainable mobility:**
  - Improve transport policy for soft mode is very important for bike usage: not only development of BSS but also bike infrastructure, etc.
  - Reference car sharing usage analysis

- **The survey 2014 on Lyon BSS users will be helpful for a better understanding of BSS usage**
Acknowledgements

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Thanks for your attention

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