From Individual to Collective Costs of Urban Mobility

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Economic theory of urban accessibility
Hansen 1959, Koenig 1974

\[ A_i = \sum_j D_j \exp(-\beta c_{ij}) \]

« Attractive Masses »

Housing
Jobs
Shops, Leisure

Monetary cost + Travel Time +
parameters

Generalized cost

Sensitivity to Generalised cost

Parameter
Energy and Equity (Ivan Illich and J.P. Dupuy 1973)

• The more you increase speed, the more you reduce equity
• From the generalized cost to the generalized speed or « effective speed »
• Ef. Speed = $1 / [(1/S) + (k/w)]$
Effective Speed and Social Effective Speed

- Average speed = harmonic average
  \[ n/ [(1/V_1)+(1/V_2)] \]

- Effective speed of bike
  \[ 1/ [(1/V)+(k/W)] \]
  \[ 1/ [(1/14)+(0.001/8)] = 13.9 \text{ km/h} \]

- Supersonic effective speed
  \[ 1/ [(1/2000)+(1/6)] = 6 \text{ km/h... not sustainable} \]

- High speed rail (HSR) effective speed
  \[ 1/ [(1/200)+(0.15/8)] = 40 \text{ km/h} \]

- Heavily Subsidized HSR social effective speed
  \[ 1/ [(1/200)+(0.5/8)] = 14.8 \text{ km/h} \]

- Regional train
  \[ 1/ [(1/100)+(0.30/8)] = 21 \text{ km/h} \]
Social effective speed in Lyon urban area

- Car effective speed = \( \frac{1}{\left(\frac{1}{V}\right) + \left(\frac{k}{W}\right)} \)
  
  \( \frac{1}{\left(\frac{1}{20}\right) + \left(\frac{0.25}{10}\right)} = 13.3 \text{ km/h} \)

- PT effective speed = \( \frac{1}{\left(\frac{1}{V}\right) + \left(\frac{k}{W}\right)} \)
  
  \( \frac{1}{\left(\frac{1}{15}\right) + \left(\frac{0.10}{10}\right)} = 13.1 \text{ km/h} \)

- Car “social effective speed” = \( \frac{1}{\left(\frac{1}{V}\right) + \left(\frac{Ks}{W}\right)} \)
  
  \( \frac{1}{\left(\frac{1}{20}\right) + \left(\frac{0.50}{10}\right)} = 10 \text{ km/h} \)

- PT “social effective speed” = \( \frac{1}{\left(\frac{1}{V}\right) + \left(\frac{Ks}{W}\right)} \)
  
  \( \frac{1}{\left(\frac{1}{15}\right) + \left(\frac{0.30}{10}\right)} = 10.3 \text{ km/h} \)
Accessibility for car

Car 0.25 / km

(in thousand)

CBD Lyon, Villeurbanne

Grand Lyon limit

Main highway and road
Differential
PT 0.1 - VP 0.25
(in %)
-25 - 0 [-25 0]
-50 - 25 [-25 -25]
-75 - 50 [-25 -25]
-90 - 75 [-75 -75]
less than -90

CBD Lyon, Villeurbanne
Grand Lyon limit
Main highway and road
Railway line
Multimode railway station
Main railway station

Designed and made by: MOSART project, A. Mercier
Laboratory of Transportation Economics (LET, Lyon)
Accessibility for car

Car 0.25 / km

(in thousand)

CBD Lyon, Villeurbanne
Grand Lyon limit
Main highway and road

Designed and made by: MOSART project, A. Mercier & N. Ovtracht (LET, Lyon)
Accessibility for car

Car 0.5 / km
(in thousand)

more than 225
150 - 225
75 - 150
less than 75

CBD Lyon, Villeurbanne
Grand Lyon limit
Railway line

Designed and made by: MOSART project, A. Mercier
Laboratory of Transportation Economics (LET, Lyon)
Accessibility for PT
PT 0.1 / km
(in thousand)

Designed and made by: MOSART project, A. Mercier
Laboratory of Transportation Economics (LET, Lyon)
Accessibility for PT
PT 0,3 / km
(in thousand)

CBD Lyon, Villeurbanne
Grand Lyon limit
Multimode railway station
Main railway station

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Differential

PT 0.3 - Car 0.5

(in %)

positive value
[ -25 0 ]
[- 50 - 25 ]
[- 75 - 50 ]
[- 90 - 75 ]
less than -90

CBD Lyon, Villeurbanne
Grand Lyon limit
Main highway and road
Railway line
Multimode railway station
Main railway station

0 5 10 20 km
Differential
PT 0.3 - Car 0.25
(in %)

-50 à -25
-75 à -50
-90 à -75
less than -90

CBD Lyon, Villeurbanne
Grand Lyon limit
Main highway and road
Railway line
Multimode railway station
Main railway station

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Conclusion

• Taking into account individual costs of urban mobility is not enough
• Collective costs and “social effective speed” are necessary to avoid some opportunistic behaviors (higher speed whatever the cost!)
• “Social effective speed”, turned into map based tools are very stimulating