Complex networks approaches to the Urban Transport Master Plan in Kinshasa. Advantages, constraints and perspectives

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Some theory...

Our daily life is embedded in a network-like environment, roads.

Some theory...

Our daily life is embedded in a network-like environment

Roads network of Barcelona

Betweenness centrality $(b)$

Measures how many times a node is transversed by shortest paths connecting all pair of nodes.

\[
b(e) = \frac{1}{(N-1)(N-2)} \sum_{\substack{j, k \in N \atop i \neq j, j \neq k}} \frac{n_{jk}(e)}{n_{jk}}
\]

Centrality in urban road networks

Centrality in urban road networks

Measuring places *in between*

*Betweenness centrality* (b)

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Road structure vs. micro economic activities

Does roads’ structure imply the location of economic activities?

Centrality in Barcelona

Location of shops and services

The Mario's dilemma

Where I open my new pizzeria?

Road structure vs. micro economic activities

Road centrality is correlated with shops’ locations

Finding: a place itself may not attract people or cargo as a major trip destination, but it may take advantage of its unique location as merely a pass-through nexus to generate great business opportunities. Hence a high value of betweenness centrality often implies a high concentration of commercial or service activities.

Processes of evolution in road systems

Centrality remains stable over time

Finding: The backbone structure in road system remains stable over decades, suggesting that:
1: Once a central place emerges is likely to stay there for long time.
2: Creating a new central place must imply a great effort.

Few lessons learnt...

Fostering economic life of cities

Fostering walking and cycling behaviour

Structural stability over time

... but how we can use it in real planning practices?
Kinshasa (RDC)

Estimated pop 2017: 12M
Estimated pop 2040: 26M

Fertility rate 6.1 (RDC)
Fertility rate 5.1 (Kinshasa)

Severe risk exposure (erosion)
Lack of infrastructures
Urban transport master plan to 2040

- **Spatial planning goals:** toward a highly connected African metropoly. Decreasing risk exposure (erosion).
- **Estimated total cost:** 33B
- **Funding schema:** Internal government schema (incremental taxation + land value capture (LVC)). External founds: loans and donations.

Source: RDC, Ministry of Infrastructure and Reconstruction
Urban transport master plan to 2040

Managing the transition from current state to 2040

2040 goal

Current situation
Transport master plan in Kinshasa (RDC)

Implementation schema

- Municipality
- Proposed Interventions
- World Bank
  - Design
  - Evaluation
  - Loans
  - Implementation
  - Taxation
  - Assets

Road network of Kinshasa

Area of interventions
Transport master plan in Kinshasa (RDC)

Example roads upgrading interventions

- Fast tool to measure the impact of road network accessibility given some interventions
Transport master plan in Kinshasa (RDC)

Evaluation (improved version of Betweenness Centrality)
- Analysing the effect of upgrading intervention on overall connectivity.
- Propose further interventions according to the MP and the new connectivity patterns.
Transport master plan in Kinshasa (RDC)

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Conclusions

Advantages of network approach
• Speed of the analysis. In absence of mobility data a traditional transportation model is impossible to calibrate.
• Connection with other urban assets beyond transportation (economic activities, urban form, street layout, urban design)

Constraints
• OSM data can be improved for transportation analyses.
• Absence of data to make validation tests.
Perspectives and future approach

Abidjan mobility maps, frequency of people in 250x250m cell

High frequency mobility data
• Anonimous mobility data coming from multiple mobile application.
• Possibility to calibrate mobility model at street level.
• Monitoring mobility change due to some specific intervention.

THANKS
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