Integrated land-use and transport modelling using OTP to determine lowest cost trips

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Cities are complex

Adapted from Waddell, 2005
Overview

Decision makers
Private sector
Public sector
Policies

Modelling
Transport
Urban growth
OpenTripPlanner
UrbanSim
SA circumstances

Results
Accessibility

Households
Developers
Businesses
Government
Household choices

Where to live?
Where to work or study?
Which mode of transport to use?
Infrastructure investment choices

Economic infrastructure
- Transport infrastructure
- Energy systems
- Economic competitiveness

Social infrastructure
- Basic necessities
- Grants/subsidies
- Social well-being
Policy evaluation

- Urban growth boundaries
- Higher density mixed-use zoning
- Transit oriented development
- Corridors of freedom
How do we translate this to the modelling environment?
Modelling

User environment -> Model environment

Encode

Real World (R)
- Observations
- Scenarios 15%
- Evaluation 20%

Iterative

Model World (M)
- Algorithms
- Data Preparation 50%
- UrbanSim 
  & OpenTripPlanner 15%

*Based on Casti, 1994
Modelling paradigms

**Transport models**
- Household forecasts
- Aggregate flows
- Micro/Agent-based
- Steady state/equilibrium
- Policy evaluation

**Urban models**
- Travel time forecasts
- Urban growth forecasts
- Services requirements
- Policy evaluation
Chicken and egg paradox

I just ordered a chicken and an egg on the internet to see which one arrives first...
Modelling paradigms

Transport models
- Household forecasts
- Aggregate flows
- Micro/Agent-based simulation
- Steady state/equilibrium
- Policy evaluation

Urban models
- Travel time forecasts
- Urban growth forecasts
- Services requirements
- Policy evaluation

Land-use Transport Interaction/Integration (LUTI)
Modelling procedure

GIS Data Preparation

OpenTripPlanner → UrbanSim → Analytics
Unique circumstances in SA

"We are all equal, but some are more equal than others…"

*SA has Gini Coefficient of ± 0.59 (0.65 in 2011 – World Bank)
Unique circumstances in SA

85% of households earn less than R9 600 per month with a median income of ~ R3300 per month.

20% walk to work, hence people are more sensitive to monetary cost than travel time.

40% rely on public transport, spending a disproportionate amount of income on transportation.
OpenTripPlanner

Graph
GTFS
Configuration
Parameters
Origins
Destinations

Batch Analyser

Lowest-cost trips between OD pairs
UrbanSim

From a variety of data sources:

**Control Totals**
- Households by income, age, children, cars …
- Employment by Standard Industry Classification

**Synthetic population**
- From 10% sample of enumerator forms from census and control totals for sub places and main places

**Land and buildings**
- Property boundaries (~2 300 000)
- Classify by typology of ~50 classes derived from Knowledge Factory
- Type of building and market value

**Transportation**
- Road network from OpenStreetMap
- Rail, bus & taxi routes/stops

**Other**
- Environmentally sensitive, undermined, dolomitic areas …
- Developments in the pipeline …

**Study area**
- Previously: Metro boundaries.
- Currently: Whole Gauteng.
Results
Private car only

Jobs reached under R40/day
Public transport

Jobs reached under R40/day increased by up to 10 times in certain zones
Putting it into perspective

More sustainable cities

Reduction in urban sprawl

Transit oriented development

Higher population densities

Evidence based decision-making
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