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

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Cities are complex

Adapted from Waddell, 2005
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

Data Preparation 50%

Real World
R
Observations

Model World
M
Algorithms

Evaluation 20%

15% Scenarios

Iterative

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
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
OpenTripPlanner

OpenStreetMap

GTFS

Configuration parameters

Graph Builder

Graph/network
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)
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

Lowest-cost trips between OD pairs

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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