# Development of prototype UrbanSim models

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# Outline

- Introduction
- Literature review
- Brief UrbanSim description
- Brussels case study
- Lausanne case study
- Developing a Prototype UrbanSim model
  - Familiarization
  - Data preparation
  - Sub-model estimation
  - Simulation and analysis
  - Evaluation
- Conclusions

# Introduction

- Importance of integrated modeling
- UrbanSim: appealing platform
- Most implementations done by UrbanSim's developers
- Effort required to develop an operational model? (very high, probably)
- Prototype models help to evaluate the application of a fully implemented UrbanSim model

# Literature review

- Descriptions of UrbanSim
- Computer science (software and user interface)
- Discrete choice innovations related to location choice (UrbanSim as a tool to test hypotheses)
- UrbanSim applications (by developers)
- Independent UrbanSim applications

Little information on how to evaluate UrbanSim as an integrated model

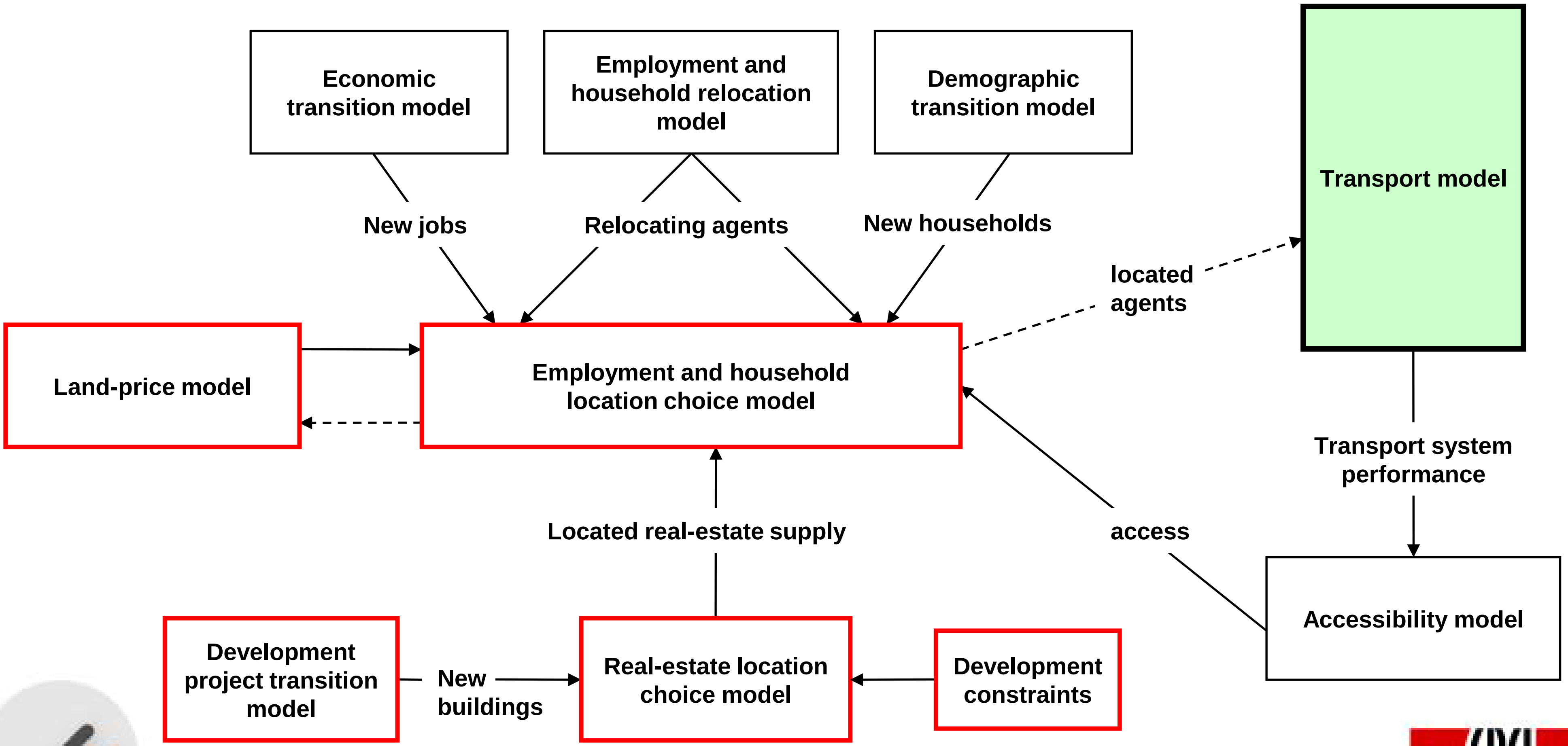
# UrbanSim

- Why UrbanSim?
  - Open source
  - Very disaggregate
  - Dynamic disequilibrium approach

- Disadvantages:
  - High data requirements (because of disaggregation)
  - Learning costs
  - Complexity of model preparation, estimation and calibration

# UrbanSim

- How UrbanSim works?

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# Fundamental Data

- Gridcells
- Households
- Jobs
- Buildings
- Development event history
- Development Constraints

**“The Six Tables”**

# Two case studies

**Brussels, Belgium**

**Lausanne, Switzerland**

# Brussels case study

- Data from an already implemented TRANUS model:
  - Households by zone and socio-economic cluster for 1991 and 2001
  - Employment by zone and economic sector (13) for 1991 and 2001
  - Land-value (3 land-uses) by zone for 2001
  - Interzonal travel time and logsums for 2001
  - GIS layer of road infrastructure
  - GIS layer of zoning

# Brussels case study

- **Data preparation**
  - Standard gridcell of 150 x 150 meters
  - Households and jobs were disaggregated into gridcells
  - One building of each required type were created in each gridcell
  - Number of residential units and non-residential surface was adjusted to account for vacancy rates
  - Employment and population change between 1991 and 2001 was used to create a synthetic development event history
  - Development constraints were derived from "observed" development in the city

# Brussels case study

- Results (Household Location Choice Model)

| | Variable | Coefficient | Std. Error | t-value |
|---|---|---|---|---|
| 1 | Cos t: Income | -0.0661 | 0.0307 | -2.2 |
| 2 | % High Inc. If High Inc. | 0.0334 | 0.00150 | 22.3 |
| 3 | % Low Inc. If High Inc. | 0.00400 | 0.00138 | 2.9 |
| 4 | % Low Inc. If Low Inc. | 0.0603 | 0.00109 | 55.4 |
| 5 | Travel Time to CBD | -0.000622 | 0.000148 | -4.2 |
| 6 | In Flanders | -0.0267 | 0.00856 | -3.1 |
| | Null Log-likelihood is: | -440982.247 | | |
| | Log-likelihood is: | -439242.311 | | |
| | LR Test: | 3479.871 | | |
| | Number of observations: | 129655 | | |
| | Convergence statistic is: | 7.617E-05 | | |

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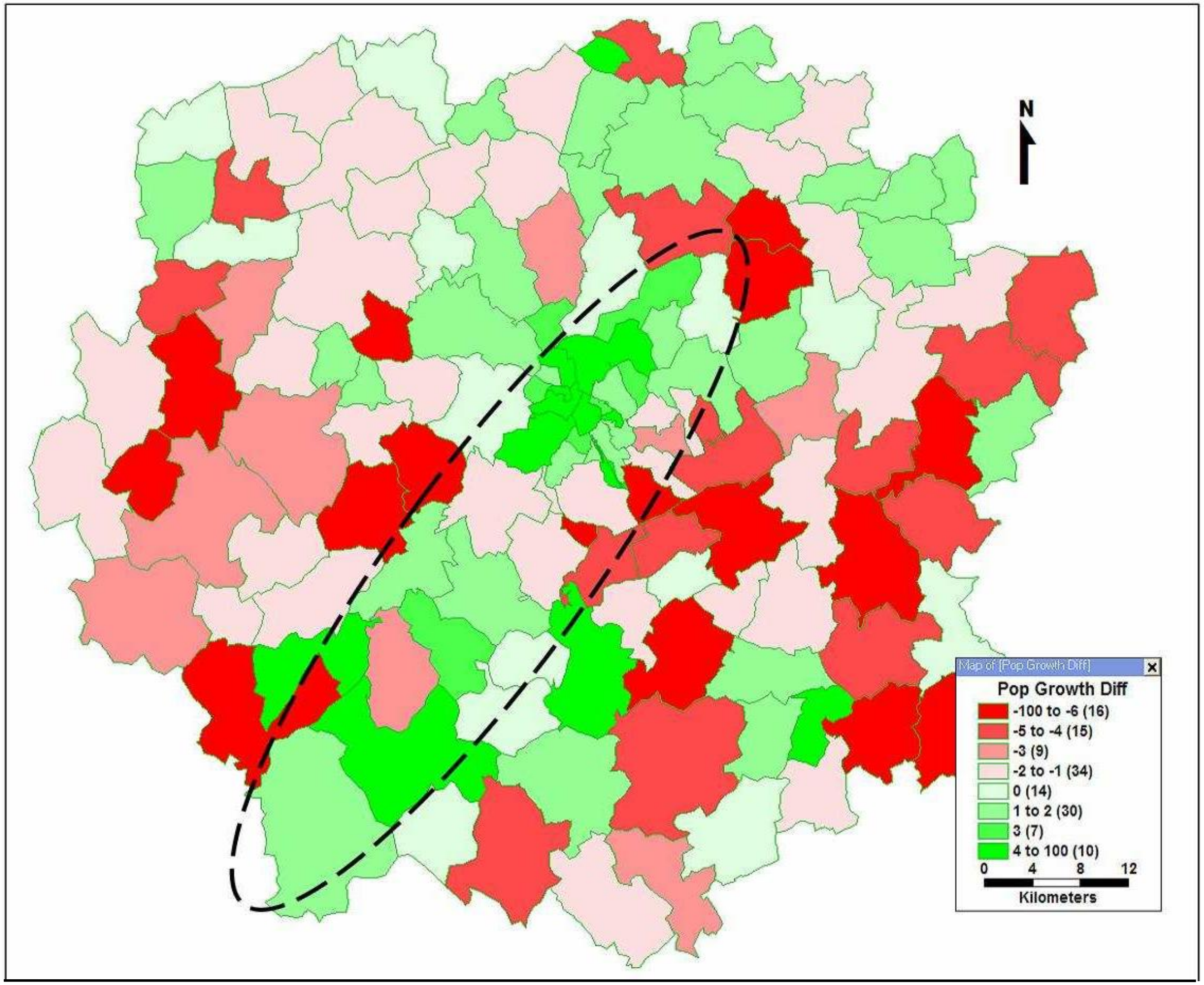
# Brussels case study

## Results



# Lausanne case study

- Available data
  - Swiss census of households (2000)
  - Swiss census of enterprises (2001)
  - GIS layers for geographical data
  - Transportation model (EMME)

- No info on land prices
- Imperfect data on household income

# Lausanne case study

- Data preparation
  - Households: directly from census
  - Jobs: a record for each job in each enterprise
  - Buildings: from households and jobs tables
  - Development event history: directly from census
  - Development constraints were derived from observed development in the city

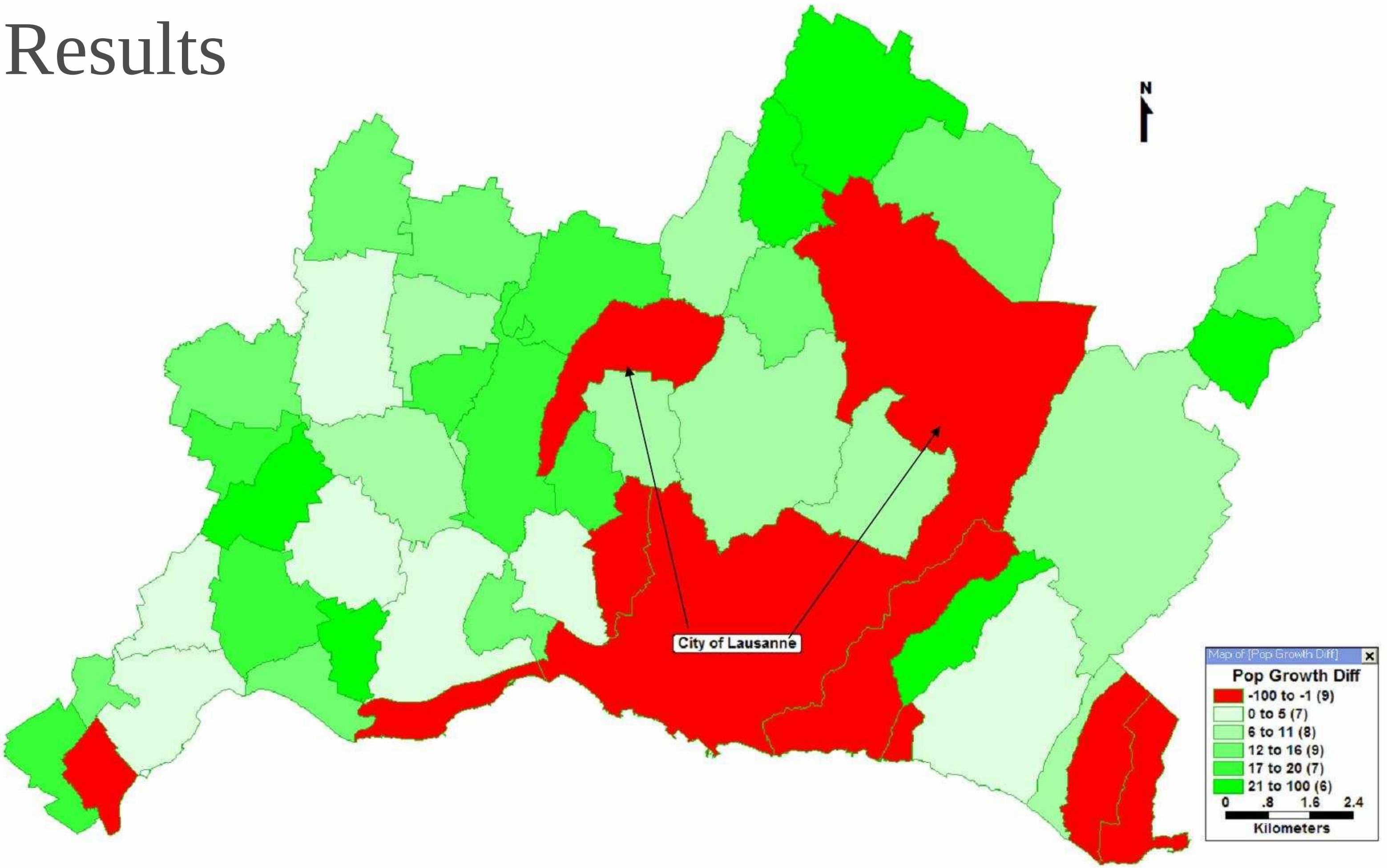
# Lausanne case study

- Results (Household Location Choice Model)

| | Variable | Coefficient | Std. Error | t-value |
|---|---|---|---|---|
| 1 | **Cost: Income** | -5.935 | 0.747 | -7.9 |
| 2 | **Retail Employment WWD** | 0.0298 | 0.00328 | 9.1 |
| 3 | **% High Inc. If High Inc.** | 0.0298 | 0.000616 | 48.4 |
| 4 | **% Low Inc. If Low Inc.** | 0.0236 | 0.00113 | 21.0 |
| 5 | **High Density if Young** | 0.428 | 0.0177 | 24.1 |
| 6 | **Mixed Use if Young** | 0.454 | 0.0217 | 21.0 |
| 7 | **Res. Units with Children** | -0.00472 | 0.000103 | -45.6 |
| 8 | **Accessibility to Population** | 0.400 | 0.0455 | 8.8 |
| 9 | **Travel Time to CBD** | -0.0211 | 0.00259 | -8.1 |
| 10 | **Travel Time to Station** | 0.0320 | 0.00210 | 15.2 |
| | **Log-likelihood is:** | -440830.606 | | |
| | **Null Log-likelihood is:** | -444383.444 | | |
| | **LR Test:** | 7105.676 | | |
| | **Number of observations:** | 130655 | | |
| | **Convergence statistic is:** | 5.398E-04 | | |

# Lausanne case study

Results

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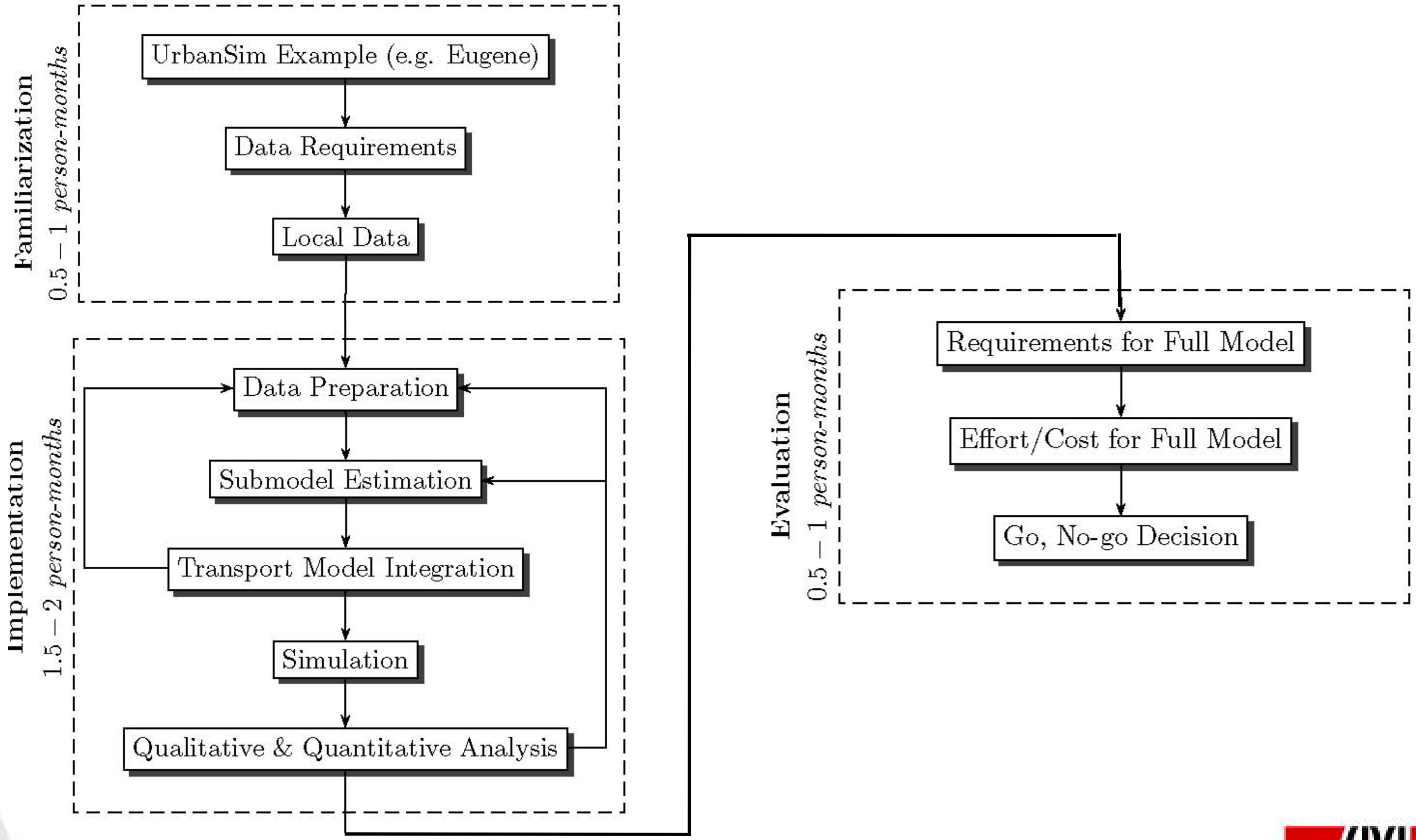
# Developing a Prototype UrbanSim model



# Developing a Prototype UrbanSim model

- **Familiarization**
  - → With UrbanSim
  - → With local data

  - – Run simulations with provided example (Eugene)
  - – Explore data of provided example
  - – Identify required data
  - – Analyze “fit” between required and available data

# Developing a Prototype UrbanSim model

- **Data preparation**
  - Concentrate on the “six tables”
  - Build tables starting from available examples
  - Focus on readily available data
  - Identify missing data
  - If necessary, use simulated data or simplifying assumptions

# Developing a Prototype UrbanSim model

- **Submodel estimation**
  - Quality of models is difficult to evaluate without seeing simulation results
  - ⇨ Estimate quickly in order to be able to run simulations soon (models can be improved later)
- **Transport model integration**
  - Continual interaction is not strictly necessary
  - Clearly identify inputs and outputs of the transport model
  -

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# Developing a Prototype UrbanSim model

- **Simulation**
  - Start to run simulations early, even if data is incomplete (helps to identify possible errors and improvements)
  - Use the latest stable release

- **Analysis**
  - Population growth by area?
  - Simulation results comply with expectations?
  - Problems with data?
  - Problems with submodels?

# Developing a Prototype UrbanSim model

- **Evaluation**
  - Desired characteristics of the operational model
    - Level of disaggregation (Data requirements)
    - Interaction with transport model
  - Effort required to implement a complete model
    - Data gathering
    - Submodel estimation
    - Transport model (Is there an appropriate, available model?)
  - Priority identification
    - Disaggregate projections ➔ UrbanSim
    - Aggregate projections ➔ Other models may be better (easier)

# Conclusions

- Best way to evaluate UrbanSim is developing a prototype model
- Even with incomplete data results can be reasonable
- Developing a prototype model is possible within 3 – 5 months of one person's effort

# Conclusions

- Recommendations:
  - Learn by doing
  - Start with provided examples and available data
  - Concentrate on the “six tables”
  - Continual interaction with transport model is not strictly necessary
  - Run simulation early, even if data is incomplete
  - Concentrate on general results
  - Identify desired characteristics and  data requirements for an operational model

# Questions?