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EUROPEAN COMMISSION
European Research Area
SEVENTH FRAMEWORK PROGRAMME
Funded under Socio-economic Sciences & Humanities

Advancing land use transport interaction models

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May 2011

SustainCity

EUROPEAN COMMISSION
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SEVENTH FRAMEWORK PROGRAMME
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IVT Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

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Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Outline

The SustainCity project

Data aquisition

Data organisation and processing

Create base year

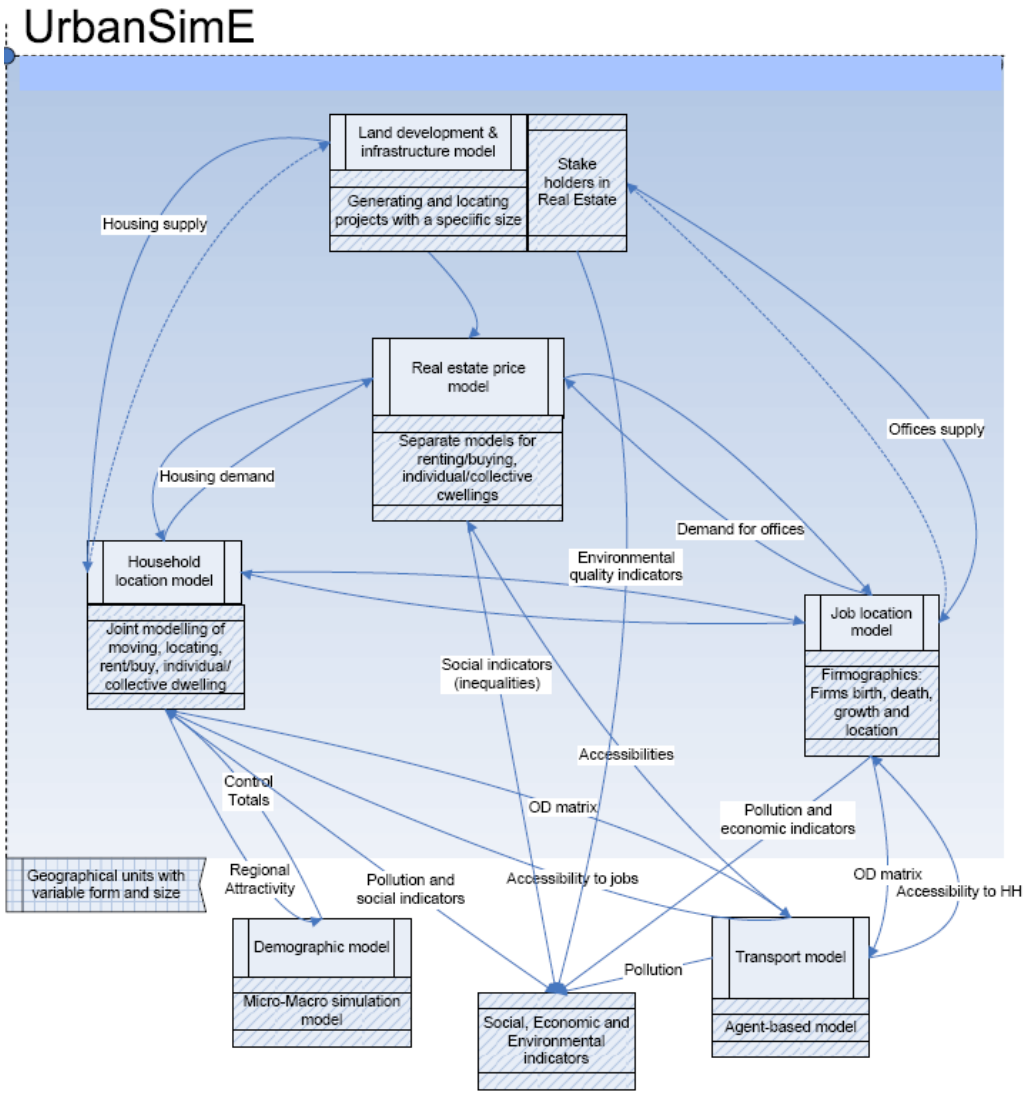
Base year data

Set up the UrbanSim project

Lessons learned

Outlook

The SustainCity project



Case study Zurich

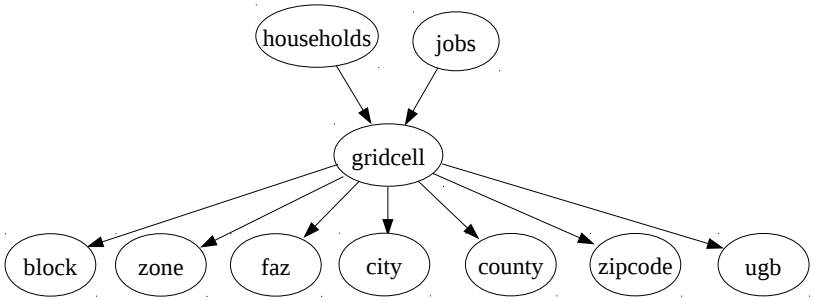
Existing girdcell operationalisation (project ZUK)

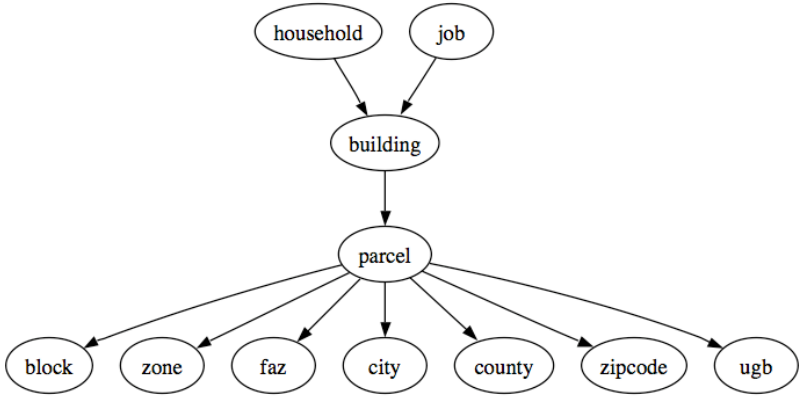
Changing from gridcell to parcel version

Changing from Windows to Ubuntu

New base year (2000), more detailed data structure (schema pw)

- Considering new and detailed data, new contracts
- Adapting and improving ZUK models





Scheduling of work

Data acquisition

Data organisation and processing

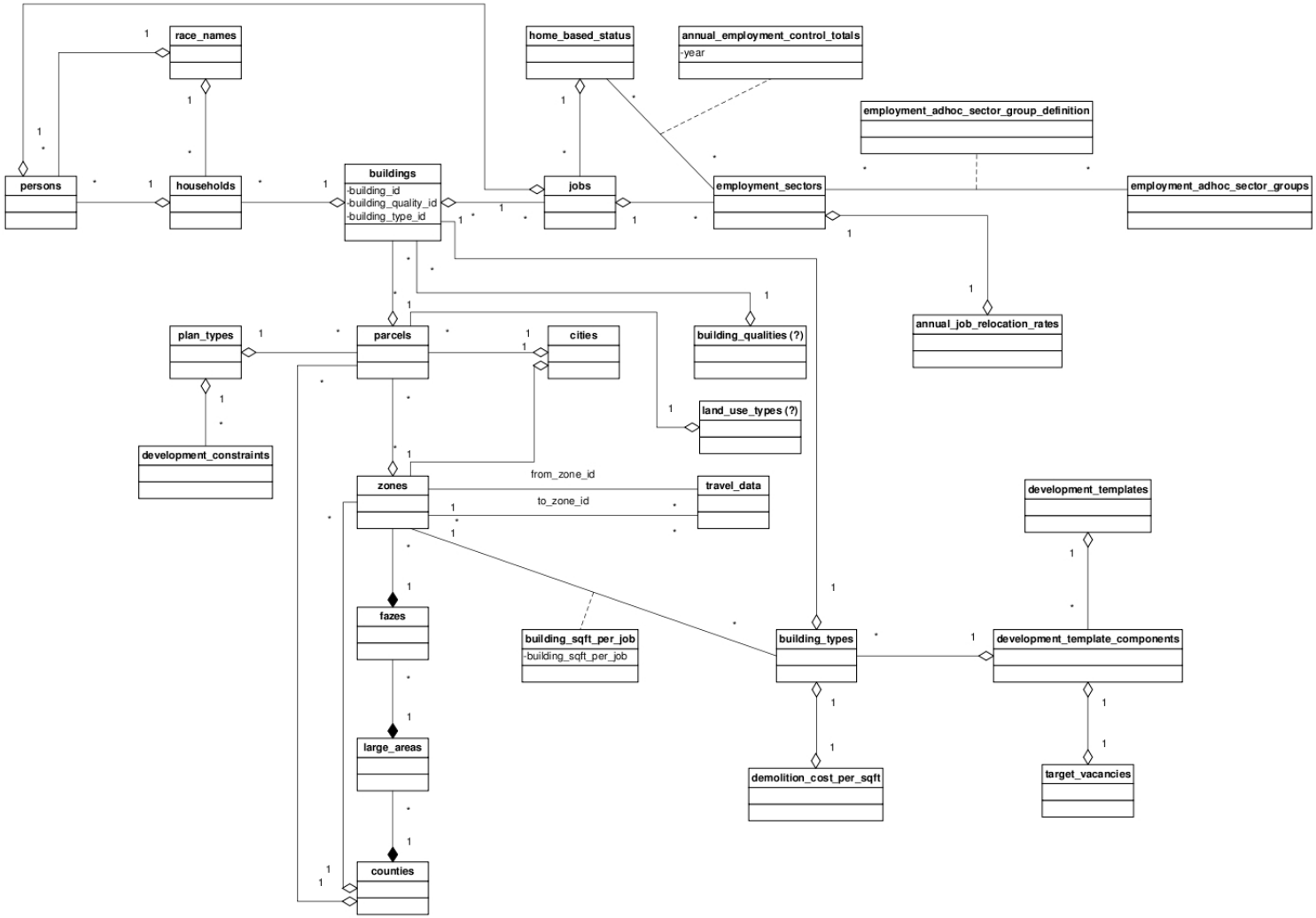
Create base year

Initial first run with dummy models and Zurich data

First run with reimplemented ZUK models and Zurich data

Second run with new data structures

Data needs - US parcel entity relationship model



Data acquisition

Data for:

- Base year
- Model estimation
- Control totals
- Geographies
- Scenarios

Basic sources:

- Data providers
- Survey (Household location choice)
- Synthesise (Population synthesis)

Data acquisition – data providers

Hierachy of dataowner	Data owner	Data
National	Swisstopo, the Federal Geo-Information center	Topographical maps (pixel)
		Digital hight model
		Topographical maps (vector)
		Municipal boundaries
	BfS, Federal Statistical Office	Population census
		Enterprise census (3 sectors)
		Micorcensus of travel behaviour
		Building- and dwelling register
Cantonal	Cantonal building insurance	Building data
	Cantonal office of spatial development	Building- and dwelling register
		Vacancy rates for dwelling sizes
		Zoning and building status
		Cadastre
		Cantonale Richtpläne
		Orthophotos
	Cantonal civil engineering department	Cantonal travel model
		Public transport stations
		Noise maps (Transport and shooting)
	Cantonal statistical office	Population growth
		Land prices per zone and region
Municipal	Statistical office of the city of Zurich	Building- and dwelling register
Private institution	DOCUMEDIA (Baublatt)	Building projects

Survey of household location choice

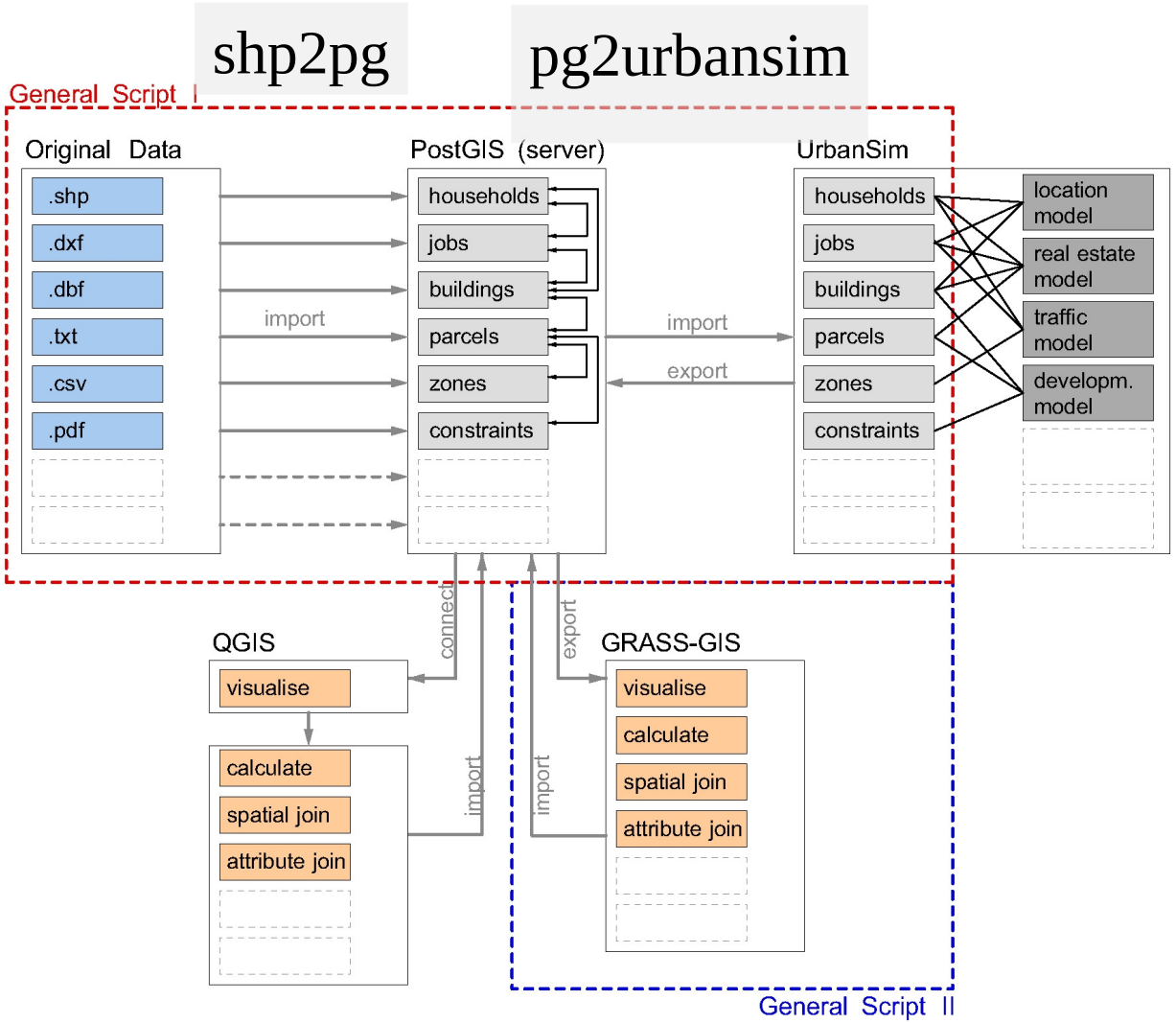
- Recently moved households in canton Zurich (~5000 persons contacted, 1000 answers)
- Addresses from address dealer
- Observed attributes:
  - **socio demographic variables**
    - Workplace, education, place of all household members
    - Social contacts
  - **charecteristics and location**
    - characteristics of house/apartment
    - location of previous residence
    - search mode for residence (internet, newspaper, contacts,...)
  - **lifestyle**
    - lifestyle-typologies of G.Otte (2005)
    - new items / scope of B.Belart (2011)

- Two models estimated (renter, owner)

Population synthesis

- Base year: 2000
- Use national census (2000) for population
- Missing attributes: Income, car ownership and job
- Impute from travel microcensus (2005)
  - Probabilistic selection with replacement, based on the attributes available in both census and microcensus
- Using census data is tied to heavy restrictions
  - Sensitive data, no sharing
  - Using a synthetic population would be preferable
- Next steps: Generate a synthetic population using PopGen
  - Upcoming beta version of PopGen usable for non-US contexts should be available soon

Data organisation and processing



Create base year - GIS

Missing GIS functionality relevant for work with UrbanSim:

- Combine datasets through spatial joins and attribute-joins
- Convert data, e.g. polygon to centroid or intersections
- Queries and visualisation of data
- Interpolations and density-calculation (use of raster procedures)

=> Geometry and shape essential for dataprocessing

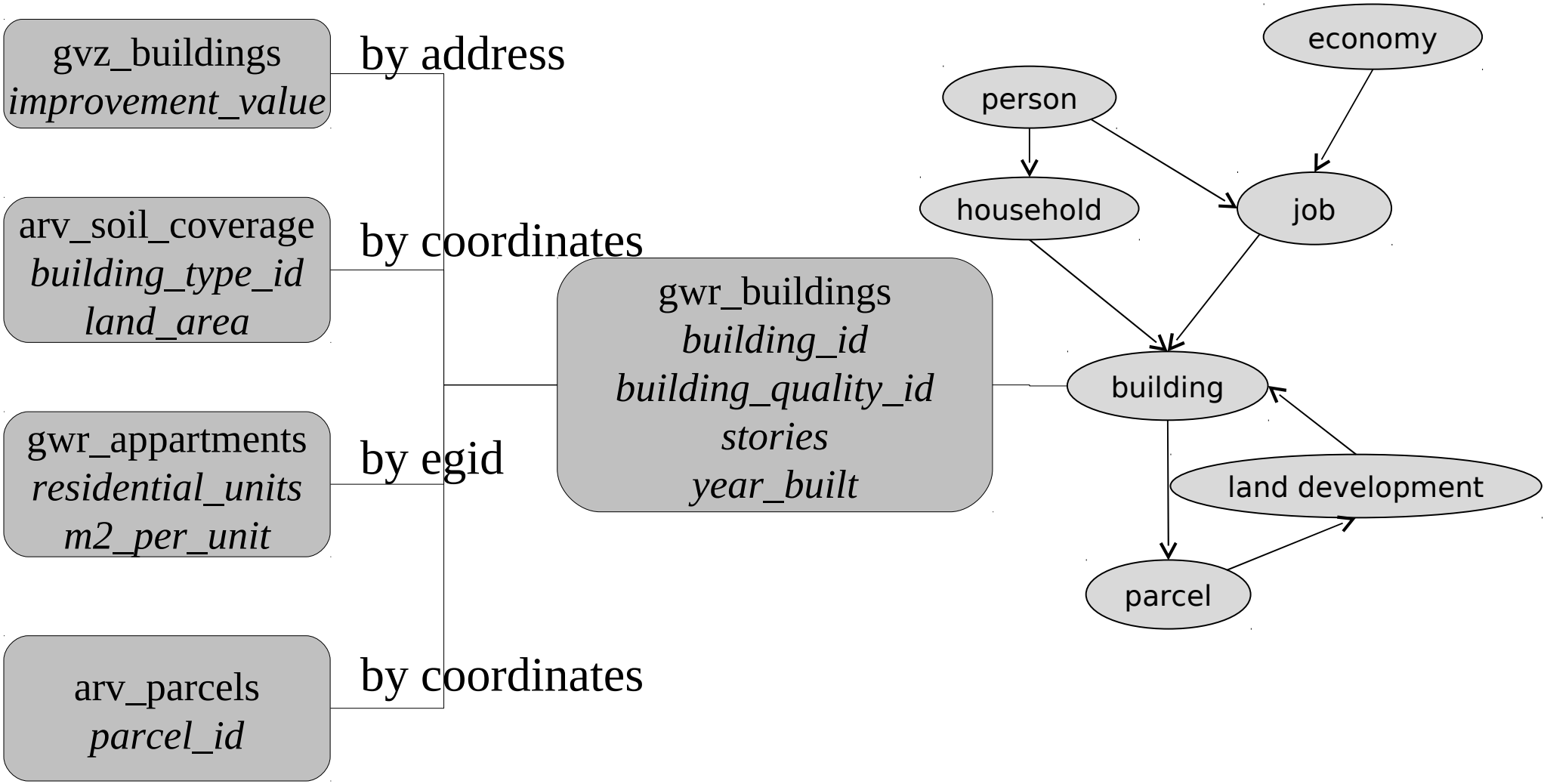
=> As OPUS can not handle geometry, (external) processing is necessary

Creat base year – sample script for assembling building data

```
#!/bin/sh
psql $PSQL_OPTIONS <<- END_SQL
SET search_path TO sc261,public;
-- Create table buildings with SQL queries.
INSERT INTO buildings
(building_id, building_quality_id, building_type_id, improvement_value, land_area, parcel_id, residential_units, sqft_per_unit, stories, year_built)
WITH
gvz AS (SELECT DISTINCT ON (egid) egid AS egid_gvz, wert FROM sc261.gwr_gebaeude10 JOIN sc.gvz_geb2000 ON
    sc.gvz_geb2000.strname=sc261.gwr_gebaeude10.dstrname AND sc.gvz_geb2000.hausnrs=sc261.gwr_gebaeude10.deinr AND
    gvz_geb2000.plz=sc261.gwr_gebaeude10.dplz4),
av_geb_grundrisse AS (SELECT gid AS gid_av_bod, art_code, flaeche_m2, the_geom FROM sc261.av_bodenbed_f WHERE art_code < 8),
geb_whg_infos AS (SELECT egid AS egid_whg, avg(warea) AS avg_whga FROM sc261.gwr_wohnungen10 GROUP BY egid),
parcel AS (SELECT gid AS parz_id, the_geom FROM sc261.av_liegensch)
SELECT
egid AS building_id, gklas AS building_quality_id, art_code AS building_type_id, wert AS improvement_value, flaeche_m2 AS land_area, parz_id AS
    parcel_id,
ganzwhg AS residential_units, avg_whga AS sqft_per_unit, gastw AS stories, gbauj AS year_built
FROM sc261.gwr_gebaeude10
JOIN gvz ON egid=egid_gvz
JOIN av_geb_grundrisse ON ST_Contains(av_geb_grundrisse.the_geom, sc261.gwr_gebaeude10.the_geom)
JOIN parcel ON ST_Contains(parcel.the_geom, sc261.gwr_gebaeude10.the_geom)
JOIN geb_whg_infos ON egid=egid_whg;

UPDATE ONLY buildings SET non_residential_sqft=land_area * stories WHERE building_type_id<>1;
UPDATE ONLY buildings SET non_residential_sqft=0 WHERE building_type_id=1;
END_SQL
```

Creat base year – bringing data sources together



Base year data

Main tables

- Parcels
- Buildings
- Households
- Jobs
- Persons

Definition tables

Data for estimation

Travel data

Geographies

Base year data – main tables – parcels

Column name	Type	Required	Status
parcel_id	PrimaryKey	Y	av_liegensch.gid
parcel_id_local	String(20)	N	Dummy 0
land_use_type_id	Integer	Y	N
land_value	Integer	Y	Dummy 1
parcel_sqft	Integer	Y	av_liegensch.flm2
plan_type_id	ForeignKey	Y	Dummy 1001
centroid_x	Integer	Y	sc261.av_liegensch.the_geom
centroid_y	Integer	Y	sc261.av_liegensch.the_geom
tax_exempt_flag	Integer	N	Dummy 0
city_id	ForeignKey	N	av_liegensch.zgde
county_id	ForeignKey	N	1
zone_id	ForeignKey	Y	av_liegensch.zonennr1
census_block_id	string	N	Dummy 0

Base year data – main tables – buildings

Column name	Type	Required	Status
building_id	PrimaryKey	Y	gwr_gebaude10.egid
building_quality_id	Integer	Y	gwr_gebaeude10.gklas
building_type_id	ForeignKey	Y	av_bodenbed_f.art_code
improvement_value	Integer	Y	gvz_geb2000.wert
land_area	Integer	Y	av_bodenbed_f.flaeche_m2
non_residential_sqft	Integer	Y	land_area * stories
parcel_id	ForeignKey	Y	av_liegensch.gid
residential_units	Integer	Y	gwr_gebaeude10.ganzwhg
sqft_per_unit	Integer	Y	avg(gwr_wohnungen10.warea)
stories	Integer	N	gwr_gebaeude10.gastw
tax_exempt_flag	Integer	N	Dummy 0
year_built	Integer	Y	gwr_gebaeude10.gbauj

Base year data – main tables - households

Column name	Type	Required	Status
household_id	PrimaryKey	Y	vz.hhnr
building_id	ForeignKey	Y	buildings.building_id
persons	Integer	Y	COUNT(vz.person_id)
income	Integer	Y	50000 * COUNT(person_id)
age_of_head	Integer	Y	vz.valtj
race_id	Integer	Y	vz.hmat
workers	Integer	Y	COUNT(person_id) when vz.ams BETWEEN 11 AND 14
children	Integer	Y	zkind > 0
cars	Integer	Y	COUNT(person_id) when vz.apkwl = 1

Base year data – main tables - jobs

Column name	Type	Required	Status
job_id	PrimaryKey	Y	Y
building_id	ForeignKey	Y	buildings.building_id
home_based_status	Integer	Y	Default 0
sector_id	Integer	Y	sectors ZUK

Base year data – main tables – persons

Column name	Type	Required	Status
person_id	PrimaryKey	Y	vz.person_od
household_id	ForeignKey	Y	vz.hhnr
member_id	Integer	N	N
relate	Integer	N	N
age	Integer	N	N
sex	Integer	N	N
race_id	Integer	N	N
student	Integer	N	N
worker	Integer	N	N
hours	Integer	N	N
work_at_home	Integer	N	N
edu	Integer	N	N
earning	Integer	N	N
job_id	ForeignKey	N	N

Base year data – definition tables

annual_employment_control_totals → linear extrapolation
annual_household_control_totals → statistics canton Zurich
annual_relocation_rates_for_households → Beige (2008)
annual_job_relocation_rates → ZUK definitions (Löchl et al. 2007, p. 32)
building_types → 7, according to soil coverage information
employment_sectors → ZUK categories (Löchl et al. 2007, p. 32)
target_vacancies → 0.66% (housing), 4.0% (non-housing)
development_constraints → derived from zoning plans
land_use_types → 9 categories
plan_types → reduced to 146 categories

Base year data – plan types, generic land uses, constraints

		SC		GIS_AZ			GIS_AZ via BZ		Densities			Max Fractions (%)					Min Fractions (%)				
azc1	description/comment	PLAN_TYPE (SC)	Generic_Use (SC)	Frequency	Mean_Density	STD_Density	Mean_Density	STD_Density	Max_Total_Density	Developable_for_UrbanSim		Max_Fraction_Residential	Max_Fraction_Commercial	Max_Fraction_Retail	Max_Fraction_Industrial	Max_Fraction_Governmental	Min_Fraction_Residential	Min_Fraction_Commercial	Min_Fraction_Retail	Min_Fraction_Industrial	Min_Fraction_Governmental
Residential	100% Residential	1000	1	Residential						1		100					90				
	Residential district; Fraction residential>90%	1100	1							1		100	10	10			90				
	Residential district; Fraction residential<90%	1200	1							1		90	50	50			70				
Residential & Commercial	Residential with (loud) commercial and industrial	2000	2	Residential+Commercial/industrial						1		100	100		100		90				
	Residential with (loud) commercial and industrial; Fraction residential < 90%	2100	2							1		90	100		100		70				
Center	Central area; Mix of residential, commercial, retail	3000	3	Residential+Commercial+Retail						1		100	100	100		100					
	Urban center: Mix of residential, commercial, retail	3100	3							1		100	100	100		100					
Governmental	Public/GovernmentaL	4000	4	Public Use						0						100					
Industry & Commercial	Industry & Commercial/Industrial	5000	5	Commercial+Industrial						1			100		100						
Industry	Industry	6000	6	Industrial						1			20		100					80	
Open Space	recreation area	7000	7	OpenSpace						0											
	Conservation area	7100	7							0											
	Reserve	7200	7							0											
	Agricultural	7300	7							0											
	Forest	7400	7							0											
	Water	7500	7							0											
Infrastructure	Infrastructure	8000	8	Infrastructure						0											
	Airport	8100	8							0											
Undefined	Unzoned	9000	9	Undefined						0											
	Undefined	9100	9							0											

Base year data – definition tables

urbansim_constants

building_sqft_per_job

demolition_cost_per_sqft

development_constraints

development_event_history/development templates

development_project_proposals

employment_adhoc_sector_groups

home_based_status

household_characteristics_for_ht

race_names

velocity_functions

Further base year data

Data for estimation

- households_for_estimation
- jobs_for_estimation

travel_data

Geographies

- cities
- zones
- counties
- fazes
- large_areas

Set up the UrbanSim project – Approach

Two basic options:

- Start from default (urbansim_parcel)
- Reduce example model

Reasons:

- Target structure of pw-script (some times inconsistent with documentation)
- Example models contain “specials”
- Default project for the European context
- Understanding of model system

Set up the UrbanSim project

Creating new project from template (parent urbansim_parcel)

Import base year data into US cache (sometimes tricky)

Specifying models

- Starting from templates or copied parent models
- Define variables as expressions or python classes

Running estimations or providing model definition tables

Configure scenarios

Running scenarios and checking errors

Lessons learned

Import tool wants database with project name

Not all steps supported in GUI (yet)

- Set scenario as executable (fixed)
- Adding new specification nodes
- Adding datasets to preload

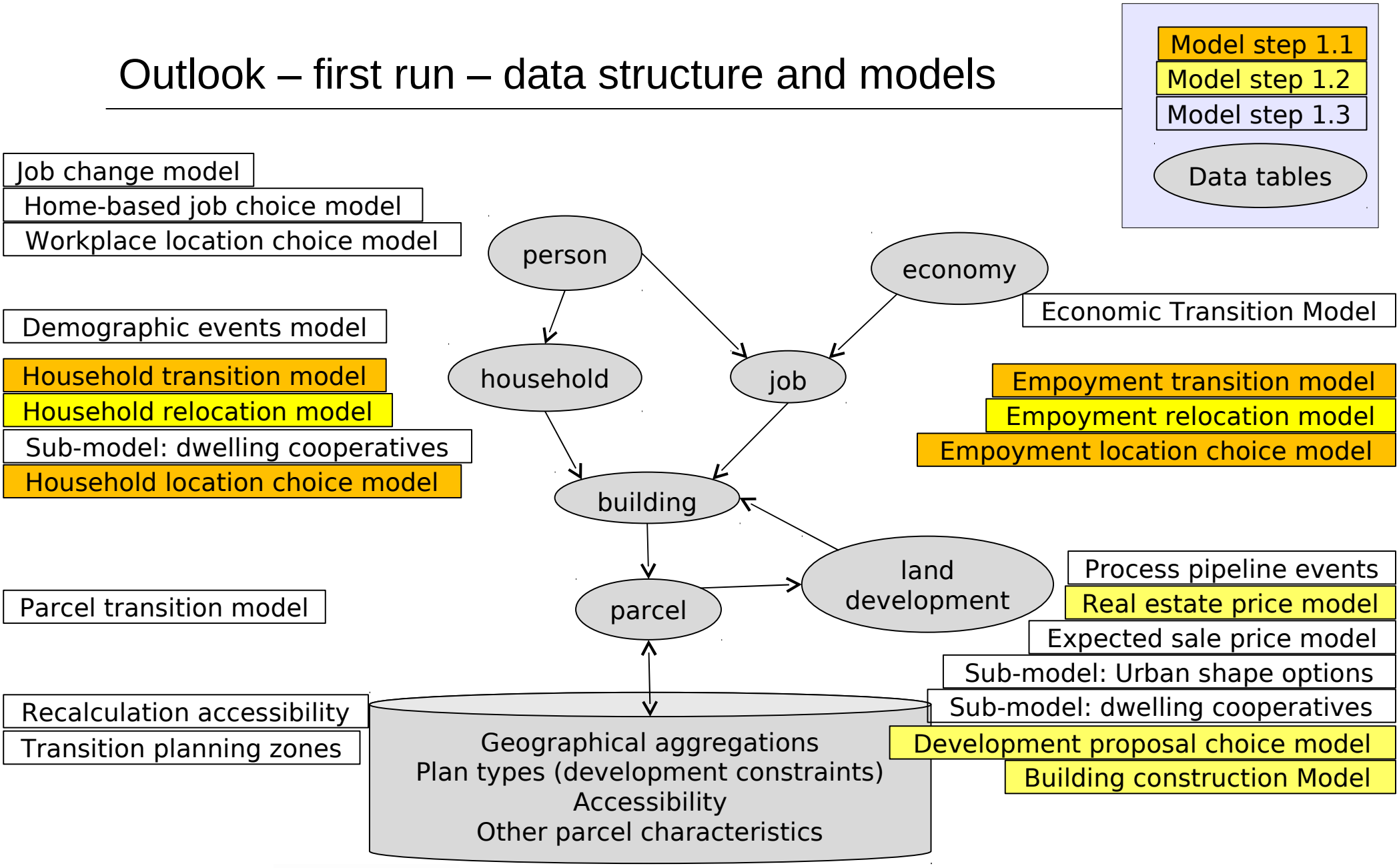
Via editor it is possible

There are no default location choice specifications

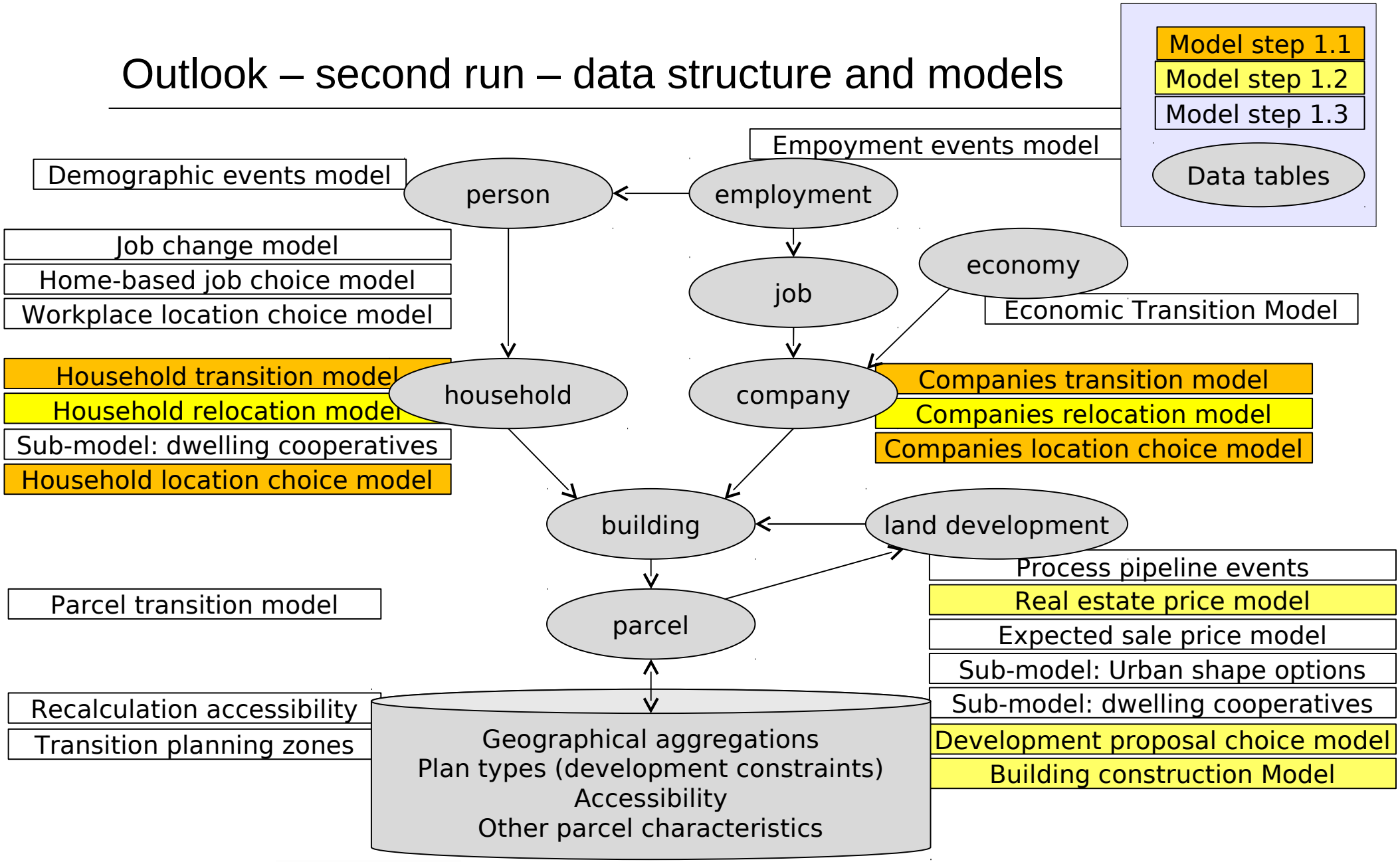
For debugging

- Same process
- All in same thread

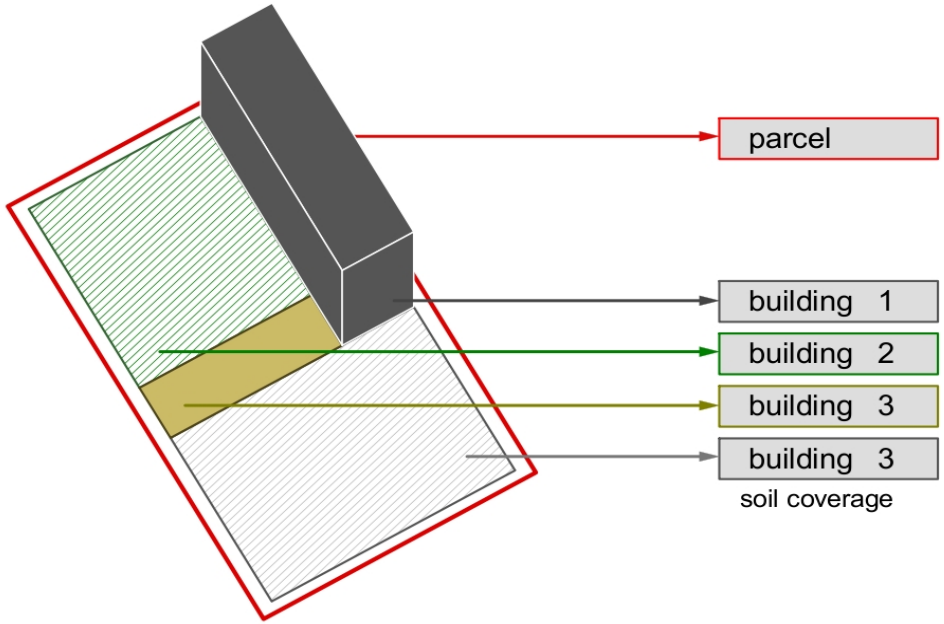
Outlook – first run – data structure and models



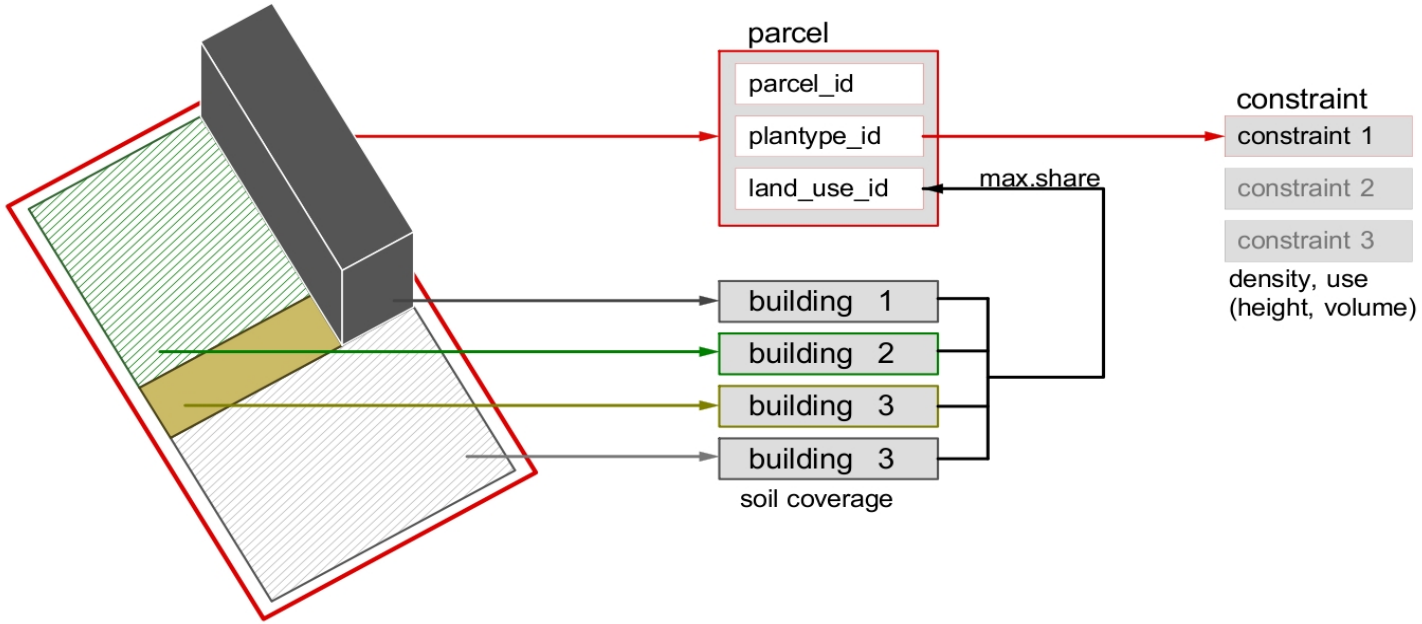
Outlook – second run – data structure and models



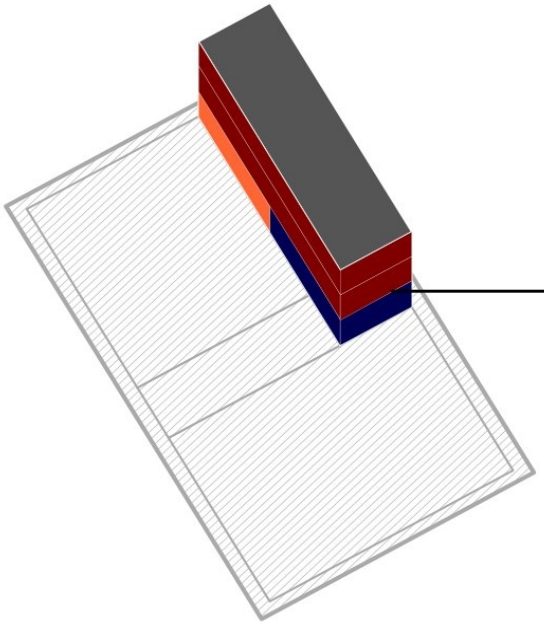
Outlook – Defintions of table-contents and dependency

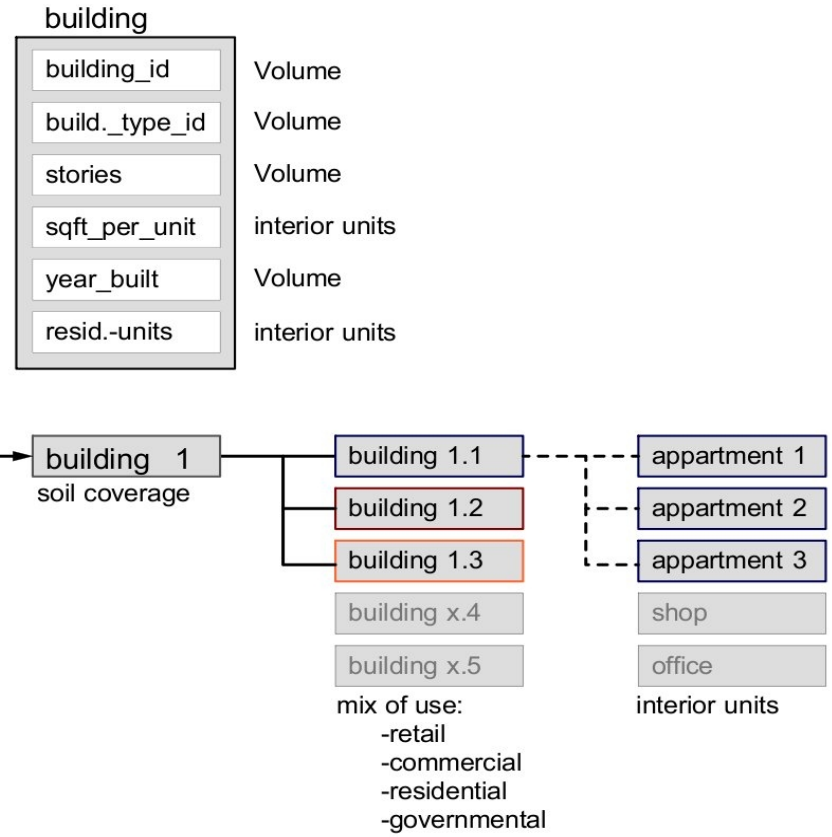


Outlook – Defintions of table-contents and dependency



Outlook – Extension of table-contents and dependency





Outlook – Open questions

First run with MATSim integration (WP6)

First run with demography integration (WP4)

Indicators (WP8)

Usage of vector and raster data

Handling of geometries

UrbanSimE basic default model specifications

- LCM of data sources
- LCM of variables

References

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Otte, G. (2005) Entwicklung und Test einer integrativen Typologie der Lebensführung für die Bundesrepublik Deutschland, *Zeitschrift für Soziologie*, **34** (6) 442-467.