Using MATSim as a travel model plugin to SILO: Why this time we will get it right

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Models and projects

SILO (Rolf Moeckel et al.)

Explicit representation of…
- … households with their respective income and household members
- … household members with their individual workplace
- ... monetary and time constraints

Year-by-year:
- Household relocation
- Demography
- Real estate development

Figures removed because of possible copyright issues. See http://silo.zone

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MATSim (= Multi-Agent Transport Simulation)

- TUB, ETHZ, senozon, others

- persons, veh's, links, nodes, signals individually represented

- iterate into schedule equilibrium

- typical choice dimensions: route, **mode, dp time (, loc ch)**

- car, pt, **walk/bike, taxi, AV**

- noise, particulate emissions, accessibility, benefits

- **schedules automatically consistent**
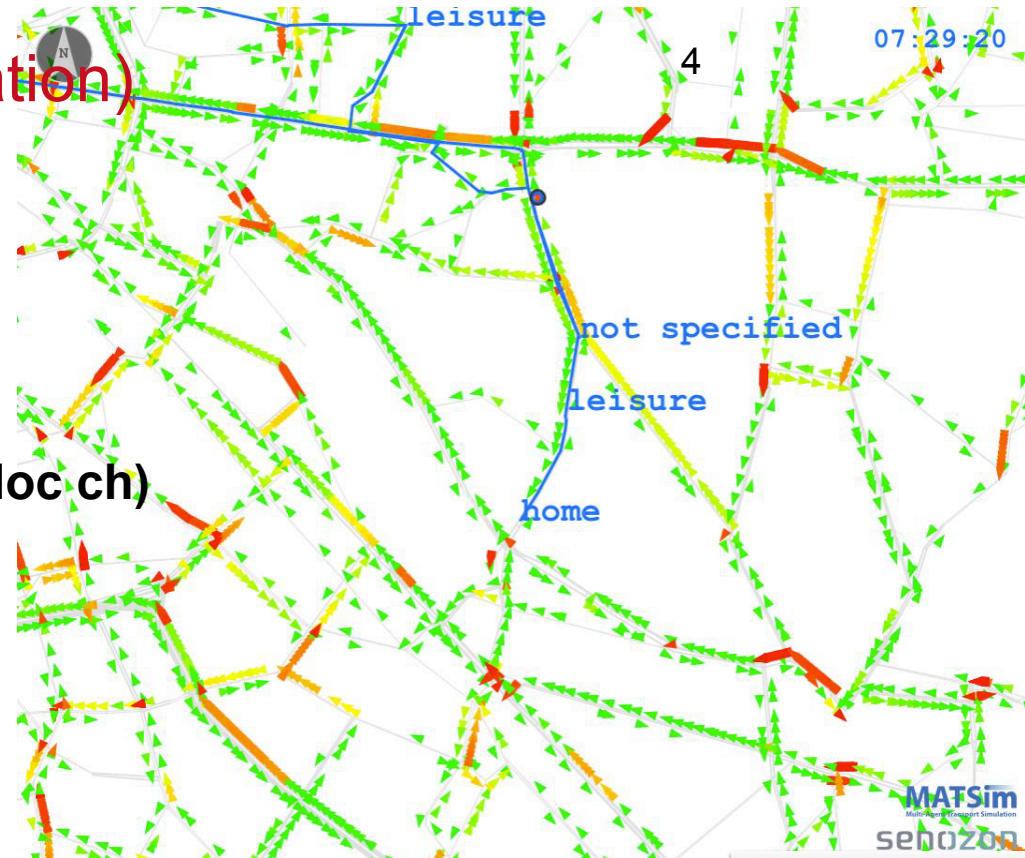
Source: own
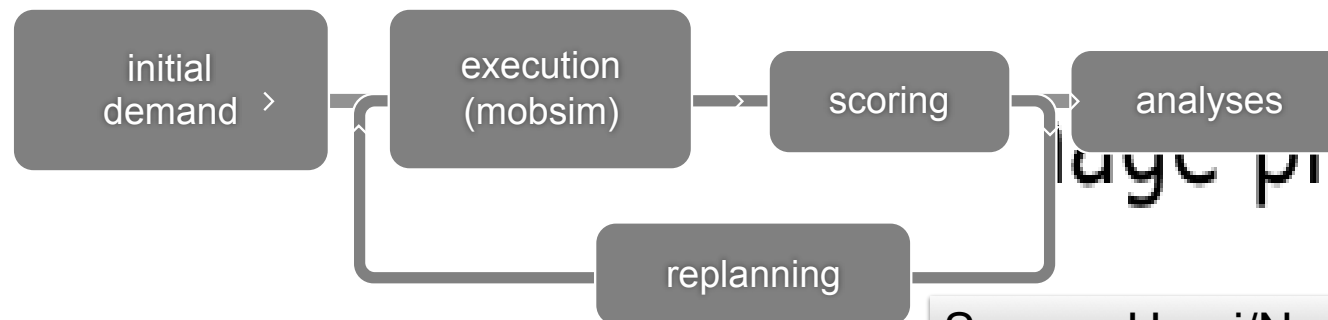
Source: Horni/Nagel/Axhausen

Model integration

IMO:

Division of labour: Need to learn how to use other teams' models.

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OD matrix, skims → true person-centric coupling

Traditional coupling

"Traditional" coupling:

- LU model → OD matrix → T model
- LU model ← Skims (zone2zone impedances) ← T model

Works ok because

- OD matrix, skims established/stable interfaces
- Travel model interpreted as "stable" library (no joint dev't).

Not way into the future!

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Way out: true person-centric coupling

LU → T

- facilities

- persons, home locations, work locations
  ("persons" & "locations" as the fundamental objects (cf. Donnelly)
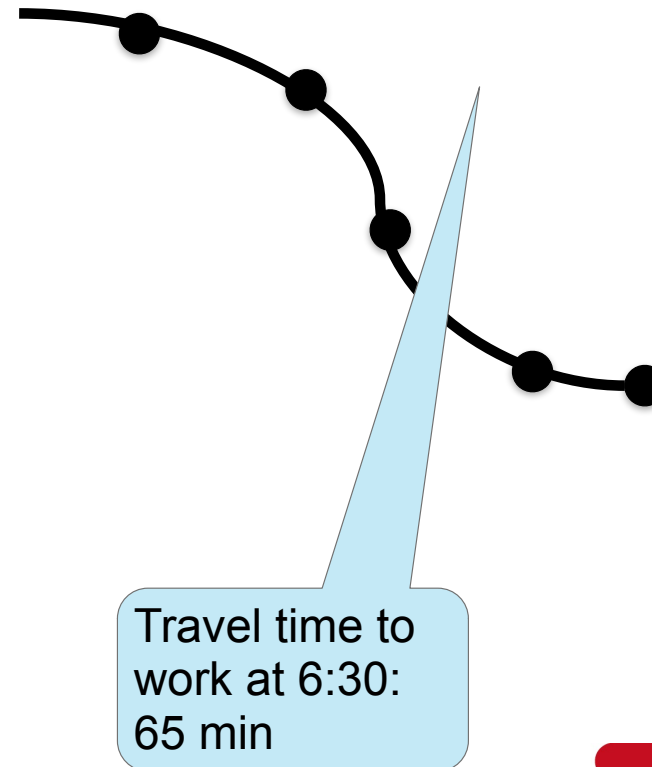
T → LU

Synthetic persons/firms in LU model should

→ query T model ←

as needed.

(Cf. Rosella Picado: What will be the next gen. stable interface?)

MATSim ➔ SILO: Query Architecture

Idea: Allow the land-use model to query the transport model for required information for a specific decision

Travel time to work at 6:30: 65 min

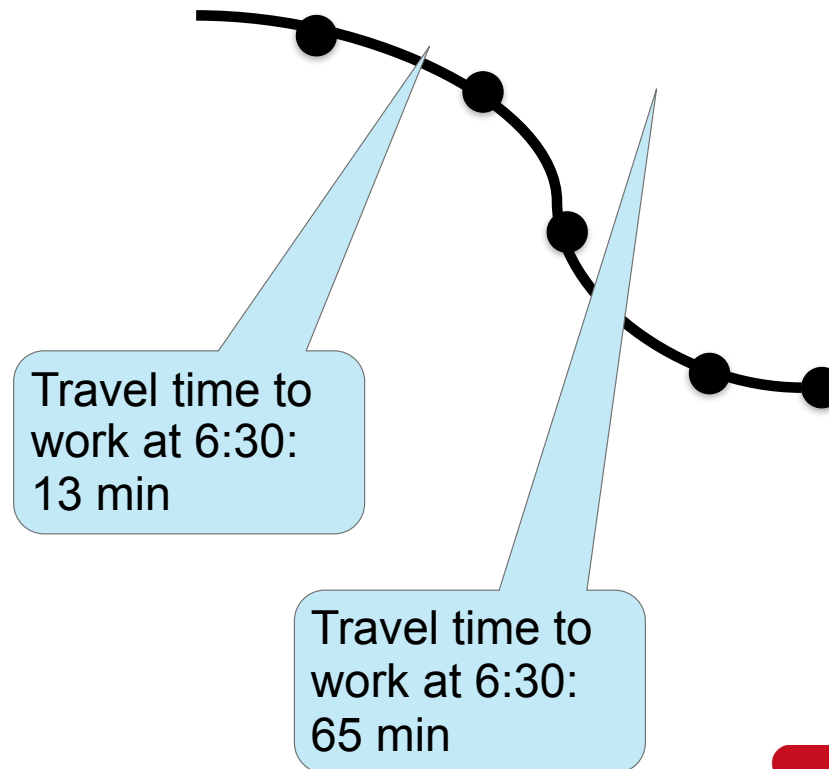# MATSim ➔ SILO: Query Architecture

Idea: Allow the land-use model to query the transport model for required information for a specific decision

Travel time to work at 6:30: 13 min

Travel time to work at 6:30: 65 min

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MATSim ➔ SILO: Query Architecture

Idea: Allow the land-use model to query the transport model for required information for a specific decision
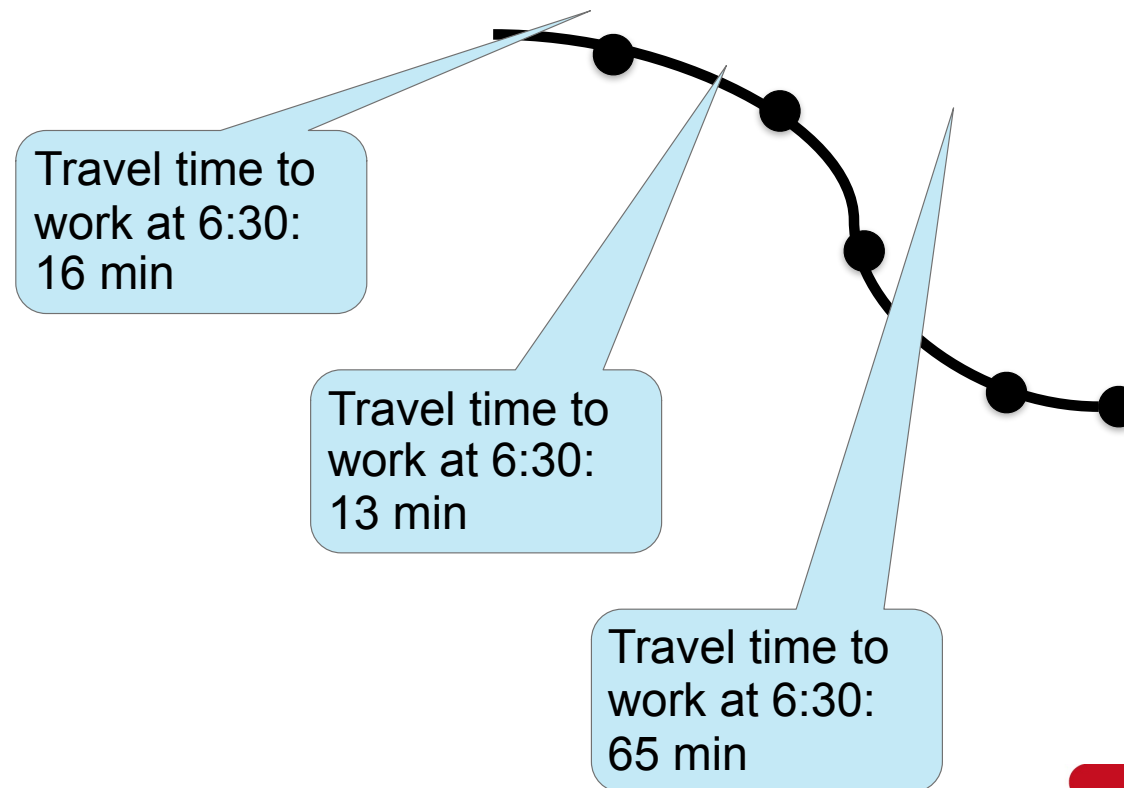
Travel time to work at 6:30: 16 min

Travel time to work at 6:30: 13 min

Travel time to work at 6:30: 65 min

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Joint development

Joint development

Need dev't on both sides for this

$\rightarrow$ cannot treat travel model as stable library.

Computational and computer science tools and methods that are important for integration

SILO, MATSim are on github

Cf. https://github.com/pbsag

https://github.com/matsim-org/matsim/branches

Github *includes* systematic regression tests

Newly committed version of code same results as before

!! Commodity availability via github and travis !!

→ any project can implement automatic regression tests

New "snapshots" only after passing tests!

Github *includes* automatic deployment

Make yourself available to others. E.g. bintray, jfrog, jitpack

!! Commodity availability via github and jitpack !!

→ any java/maven project on github makes itself available

Dependency manag't: pull in deployed software

Pull in deployed libraries. E.g. maven, gradle

```
<dependency>
    <groupId>org.matsim.contrib</groupId>
    <artifactId>emissions</artifactId>
    <version>0.9.0-SNAPSHOT</version>
</dependency>
```

- Can use dev snapshots (updated daily).

- Correct version from "cloud".

- "Includes" dependencies from upstream code.

→ adding library / switching version **small number of clicks**.

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SILO, MATSim use same language (Java)

Full integration, e.g.

MATSim side:

```
silo.getAllPersons() ;

silo.getPropertiesOfZone( zoneId ) ;
```

SILO side:

```
matsim.getAccessibilityOfLocation( coord ) ;

matsim.getPropertiesOfTransitConnection( coord1, coord2 );
```

→ !! one executable !! (recall Wegener on Wednesday) ←

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About programming languages

IMO, different programming languages most important impediment to model integration.

Have never seen it stable in the long run.

Cf. the ILUMASS (Wegener) experience!

Waste of scientific time.

Maybe some hope with protocol buffers or similar; otherwise will have to wait.

(Harut had this a bit more balanced. :-))

MATSim4UrbanSim in comparison [[skip]]

Micro-simulation for the prospective of sustainable cities in Europe – **SustainCity**, EU, ~10 partners, 2010–2014.

Dependency (= external library) management

Only for Win → installation about a day on non-Win systems

Deployment

None at that time, neither MATSim nor UrbanSim

Regression tests

yes

Same language

no. → Coupling via files. No person-centric queries.

Overall

Inside Java/Maven/Github:

- build server for regression tests provided for free

- deployment (make available to others) provided automatically

- clean external library management including versioning

Result is "a **single executable**" (Wegener) ...

... nevertheless composed of contributions by many different groups.

Easy to replace underlying T model (cf. Axhausen, Simmonds).

SILO MATSim coupling status

Prototypical work:
- MATSim as a library to SILO
- SILO persons → MATSim home-work-home plans
- assign to network

Now a funded DFG project (DZ):
1. feed back skims to SILO
2. allow SILO to query MATSim
3. addt'l activity types
4. ...

Some MATSim capabilities (that already exist)

NOx (Kickhöfer)

Movie removed because of possible copyright issues.

See http://matsim.org/scenario/munich-germany

Accessibility (here: to workplaces)

Image removed because of possible copyright issues.

See http://geo.vsp.tu-berlin.de .

AVs in Berlin

Replace ~1mio private cars by 100k AVs in Berlin

In MATSim, this is simply a person-centric mode choice: Replace

```
<plan ...>
   <activity ... />
   <leg mode="car" .../>
   ...
```

by

```
<plan ...>
   <activity ... />
   <leg mode="autonomous_vehicle" .../>
   ...
```

and try it out.

(If synthetic person waits a long time, she obtains a low score, and will not try it again soon.)

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AVs for Berlin (Bischoff & Maciejewski)

Movie removed because of possible copyright issues.

Mixed traffic (car, motorbike, bicycle)

Movie removed because of possible copyright issues.

Social network generation

Figure removed because of possible copyright issues.

Title	Maintainer	Description
socnetgen	./.	Code that generates social networks according to certain predefined statistical criteria. Part of dissertation work by Johannes Illenberger. Much less "behavioral" than socnetsim by Thibaut Dubernet.
socnetsim	Thibaut Dubernet	Allows to represent agent coordination, for social travel and activities.

Analysis using VIA

(educational license 1kEu/yr)

kairuns/tampa/output

Make results available!

http://geo.vsp.tu-berlin.de

google earth as "poor persons GIS tool" ?

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Dashboards?

(Many people have talked about sliders ...

... nobody has shown any sliders.)

:-)

Before I finish ...

Summary

Summary

Java/Maven/Github/Travis (open source) tool chain enormously simplifies:

- automatic library management (use other people's code)

- automatic deployment (make own code available)

- automatic regression tests (test code before deployment)

- true person-centric software integration
  (LU model queries T model)

Will be able to combine SILO's and MATSim's (already existing) capabilities with relatively little effort.

Analysis and graphics for "free".

Missing (IMO): translation from "graphs4experts" to "graphs4others"

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