Preferred citation style for this presentation

Ciari, F. and M. Löchl (2008) Location choice of retailers – an agent-based approach, presented at the *15th International Conference on Recent Advances in Retailing and Services Science*, Zagreb, July 2008.

Location decisions of retailers: an agent-based approach

Francesco Ciari
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IVT
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July 2008

Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

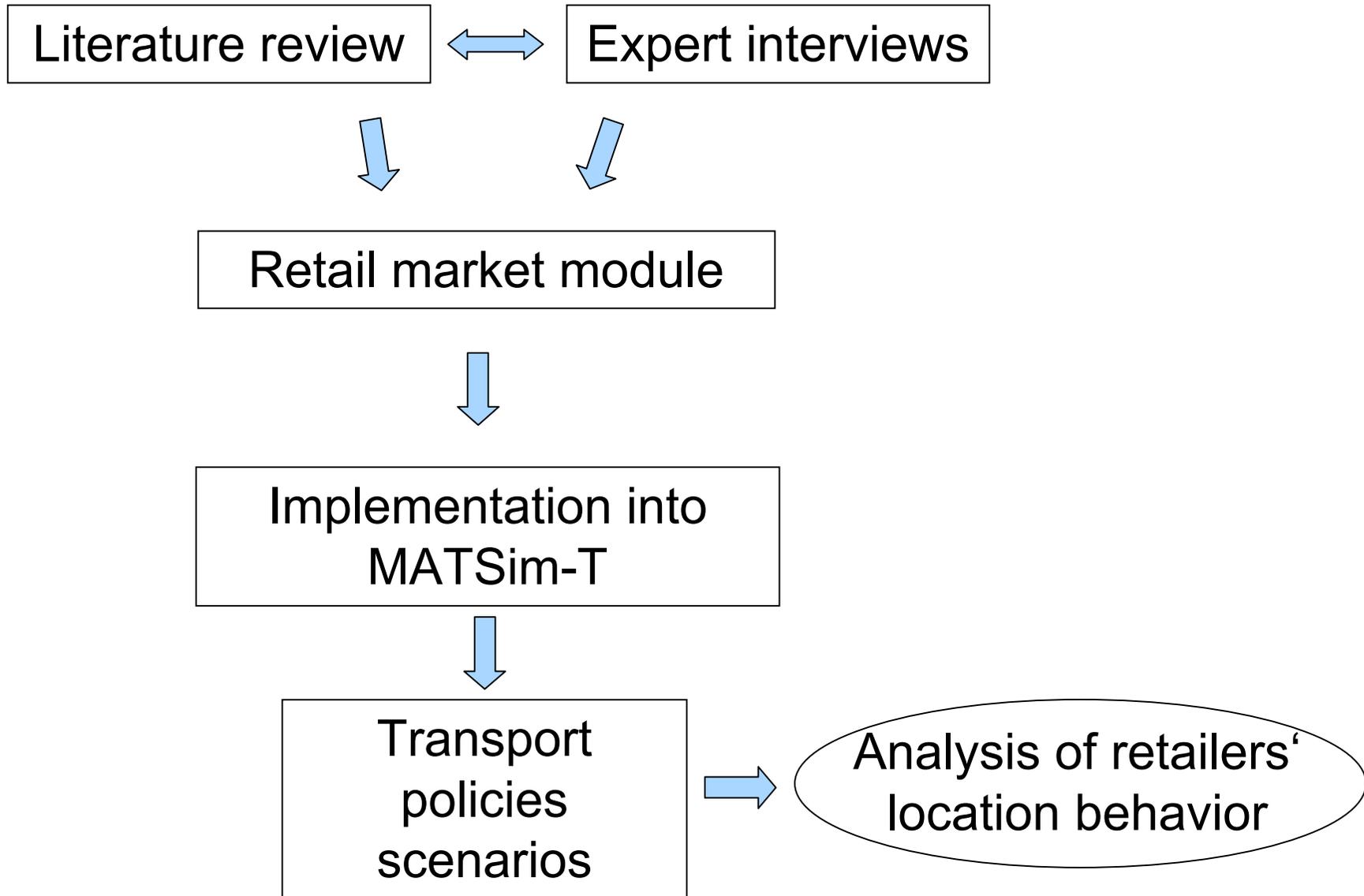# Project team

Team ETH Zurich:

    Prof. Kay W. Axhausen

    Francesco Ciari

    Michael Löchl

External expert:

    Prof. Rainer P. Lademann (Lademann & Associates, Hamburg)
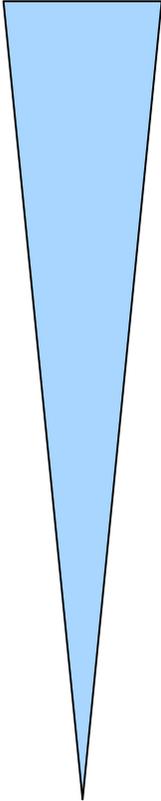
Project outline and objectives

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┌─────────────────────┐         ┌─────────────────────┐
│  Literature review  │ <────>  │  Expert interviews  │
└─────────────────────┘         └─────────────────────┘
            │                              │
            ▼                              ▼
        ┌───────────────────────────────────┐
        │        Retail market module        │
        └───────────────────────────────────┘
                          │
                          ▼
        ┌───────────────────────────────────┐
        │      Implementation into           │
        │      MATSim-T                      │
        └───────────────────────────────────┘
                          │
                          ▼
        ┌───────────────────┐        ⬭─────────────────────────⬭
        │    Transport      │   ──>  │  Analysis of retailers'   │
        │    policies       │        │     location behavior     │
        │    scenarios      │        ⬭─────────────────────────⬭
        └───────────────────┘
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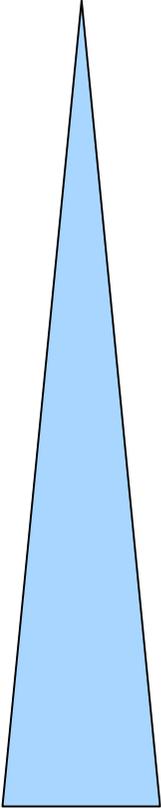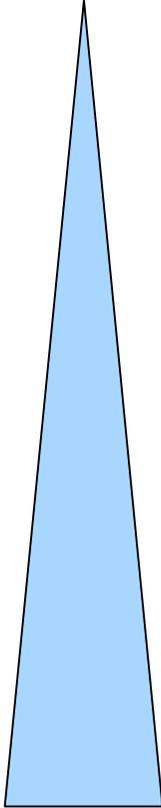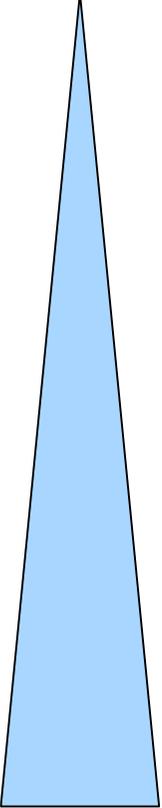
Overview

- Retailers location choices

- Agent-based modeling

- MATSim overview

- Retail market module in MATSim

- Conclusions

Importance of location for retailers

Common methods and tools in retail location planning

Technique/s	Subjectivity	Cost	Technical experience required	Computing and data needs
rules of thumb, checklists, ratio and analogue methods				
multiple regression discriminant analysis, cluster analysis, gravity models				
Expert systems, neural networks				

Adapted from Hernandez and Benninson, 2000

Practice in location choices

- Extensive literature research

- 11 explorative interviews accomplished in Germany and Switzerland in 2008

Results:

- Location strategies vary both between and within different retail sectors
- Location choices are still heavily based on experience and intuition, particularly those decisions at the micro scale
- Site availability and legislation constraints in Switzerland explain low level of methodological sophistication compared to Germany

Agent-based modellig

Agent

Attributes

Behavioral rules

Decision making power

Knowledge

Agent-based modeling

Environment
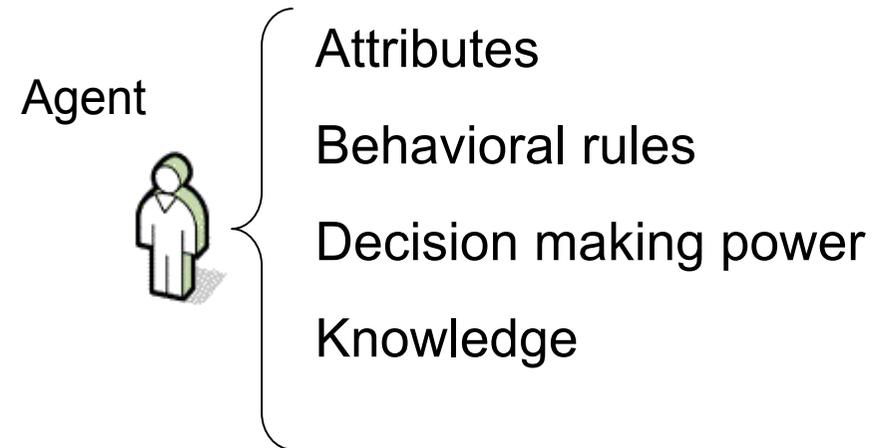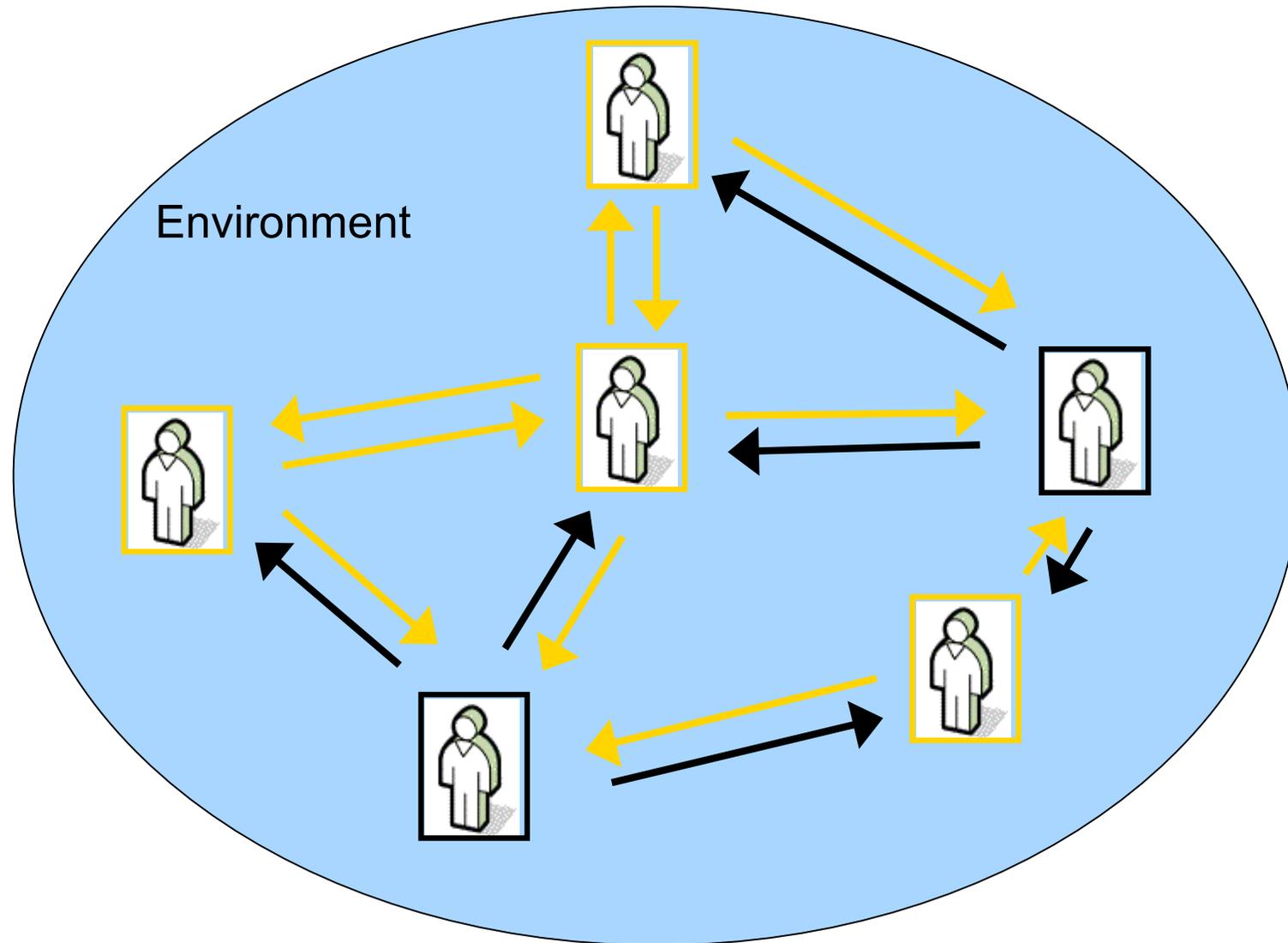
Agent-based modeling

Advantages:

- Fine representation of all actors

- Heterogeneity of agents

- The model is flexible

- Macroscopic behavior emerges from microscopic one

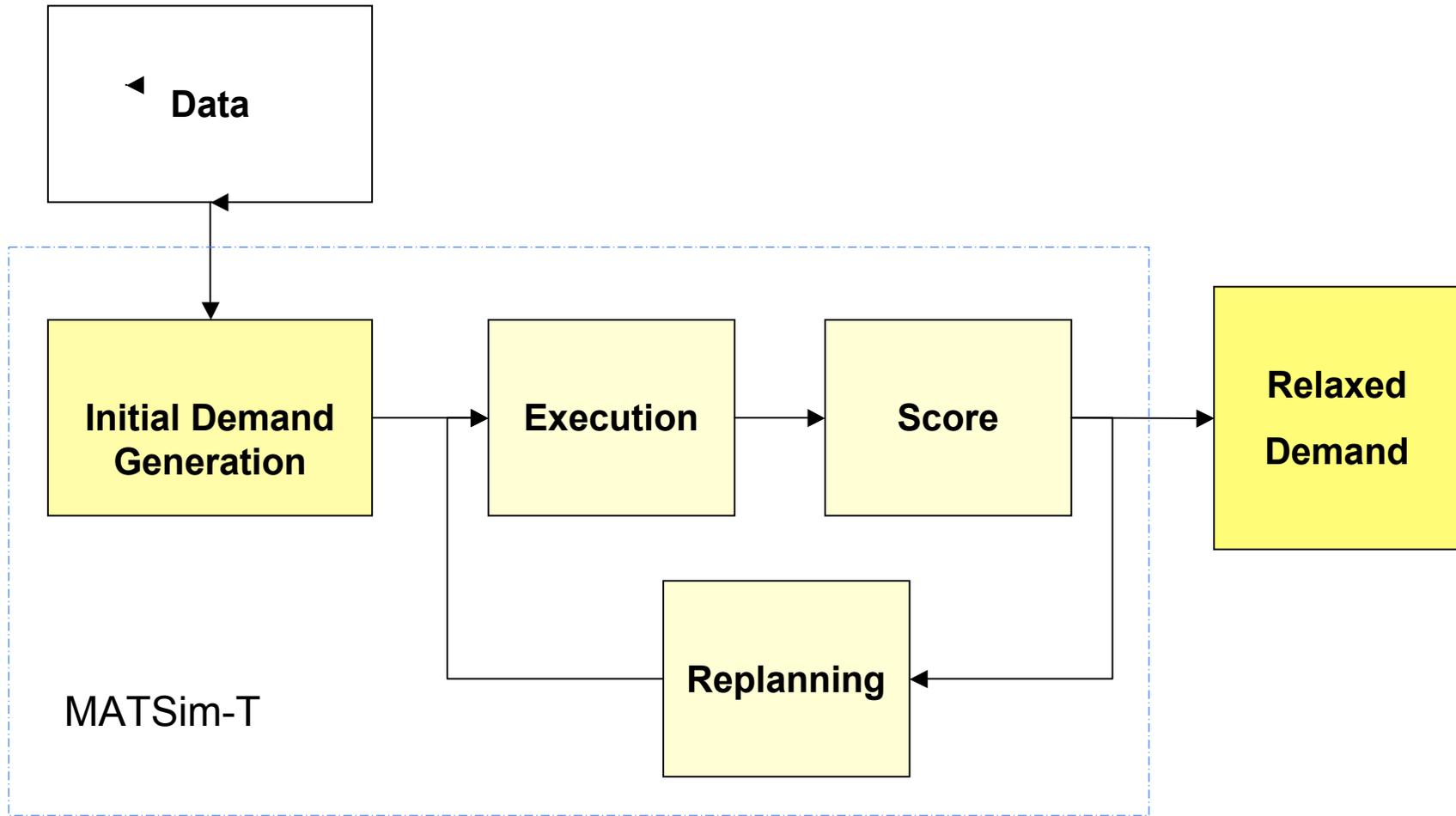# Agent-based modeling: Applications for retail markets

Premises:

- Increase in calculation power

- Increased availability of spatial data (i.e. EPOS systems, fidelity cards, etc…)

Application examples for:

- Description of customers behavior
  - Schenk et al. (2006)

- Complex interactions customers vs. retailers
  - Arentze & Timmermans (2007)

MATSim: Framework

Data

Adapted from Balmer, 2008

Initial Demand Generation → Execution → Score → **Relaxed Demand**

Replanning

MATSim-T

Introducing the retail market in MATSim

Motivations:

- Evaluate effects of transport policies on the retail market
- First step to a fully agent-based representation of the system

Goals:

- Correctly predict the shopping location choices of individuals
- Correctly predict the location choices of retailers (retailers react to individuals' choices)
- Recognize in the model system how such choices and shopping location choices of individuals are mutually interdependent

Tasks:

- Enrich individual agents (customer aspect)
- Introduce retailer agents
- Integrate the module in the MATSim framework
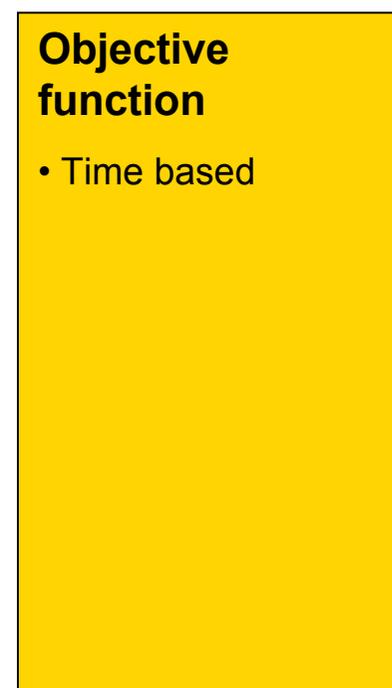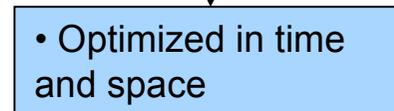
Individual agent framework

Current MATSim

Next Stage

Individual Agent

Personal attributes

• Age

• Gender

• Home location

• Work location

• Driving License

• Car availability

• Transit tickets ownership

Location choice methodology

• Not optimized

Objective function

• Time based

Knowledge

• Memory of previous plans (score)

• Income

• Household

• Optimized in time and space

• Utility based with budget constraints

• Shop Attributes (Price, Quality, Parking, etc.)

Retailer agent framework

Retailer Agent

Attributes

- Type
- Facility portfolio
- Price level
- Needed turnover
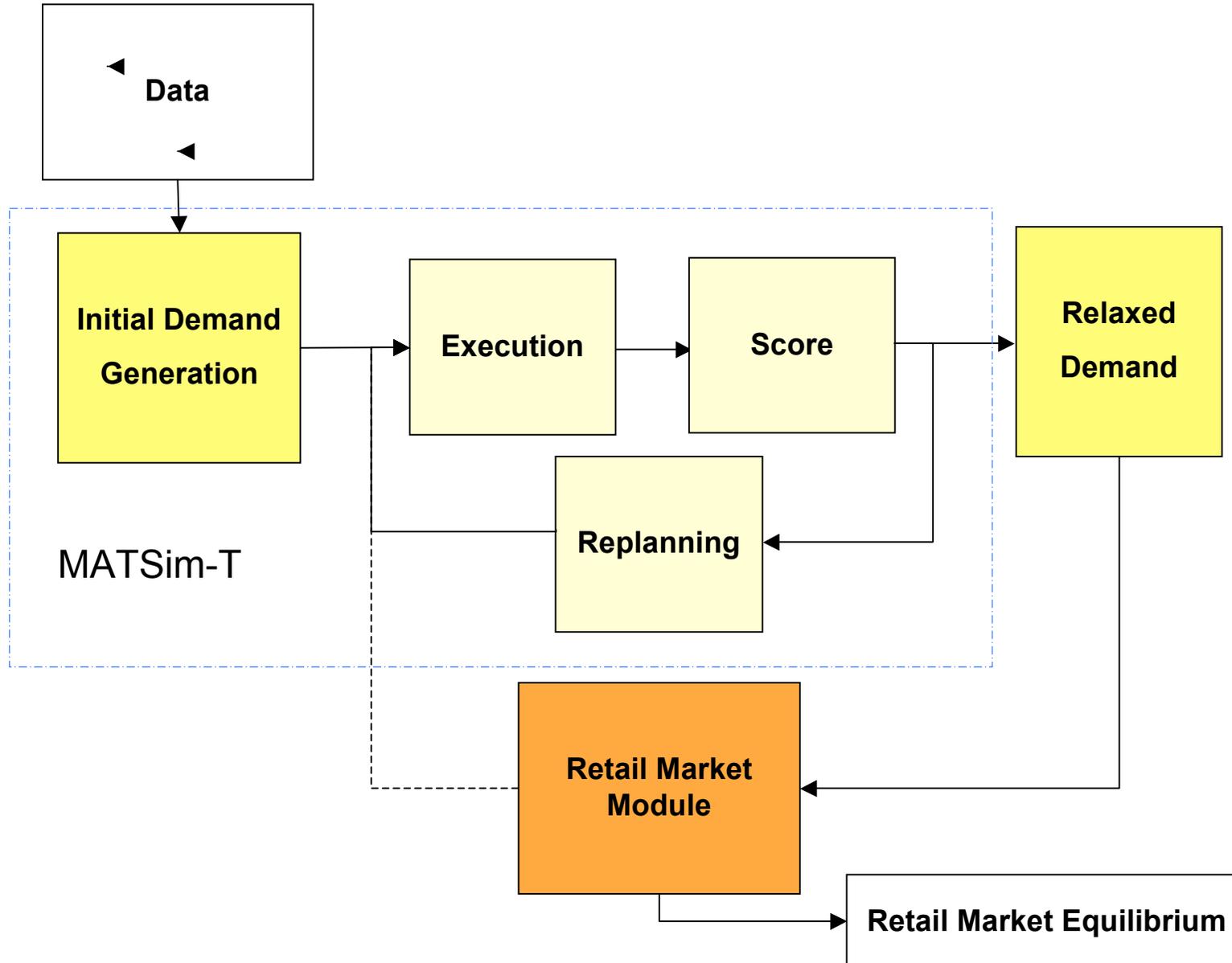
Location choice methodology

- Market ratio

Objective function

- Max. Revenue

Knowledge

- Customer
- Competitors
- Land use regulation

New framework

Conclusions

- Retailers are increasingly using sophisticated, computer based, approaches for location choices but simple approaches are still predominant

- The model sketched has rich descriptions of both retailers and customers and is a basis for the implementation of a retail market module in the MATSim framework

- The model sketched is flexible and allows for future enhancement (more complex behaviour, interactions, other actors, etc...)

Summary and Outlook

Summary:

- Theoretical insight in retailer location choices
- Described agent based modeling
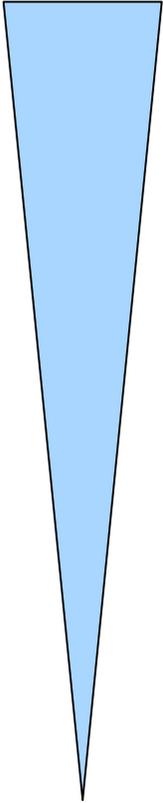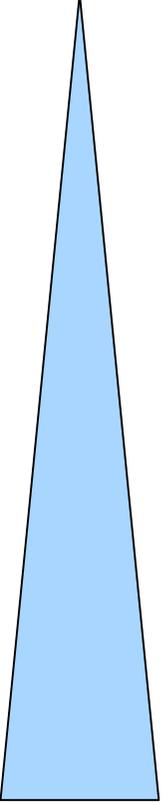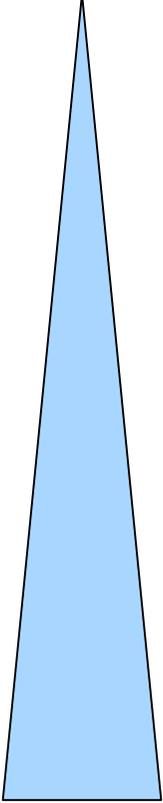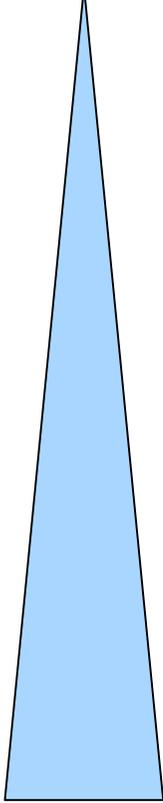- Sketch of the new retail market module in MATSim

Outlook:

- Implementation of the module in MATSim
- Test of concept (small scale scenario)
- Simulation of different scenarios (large scale scenarios, road pricing)
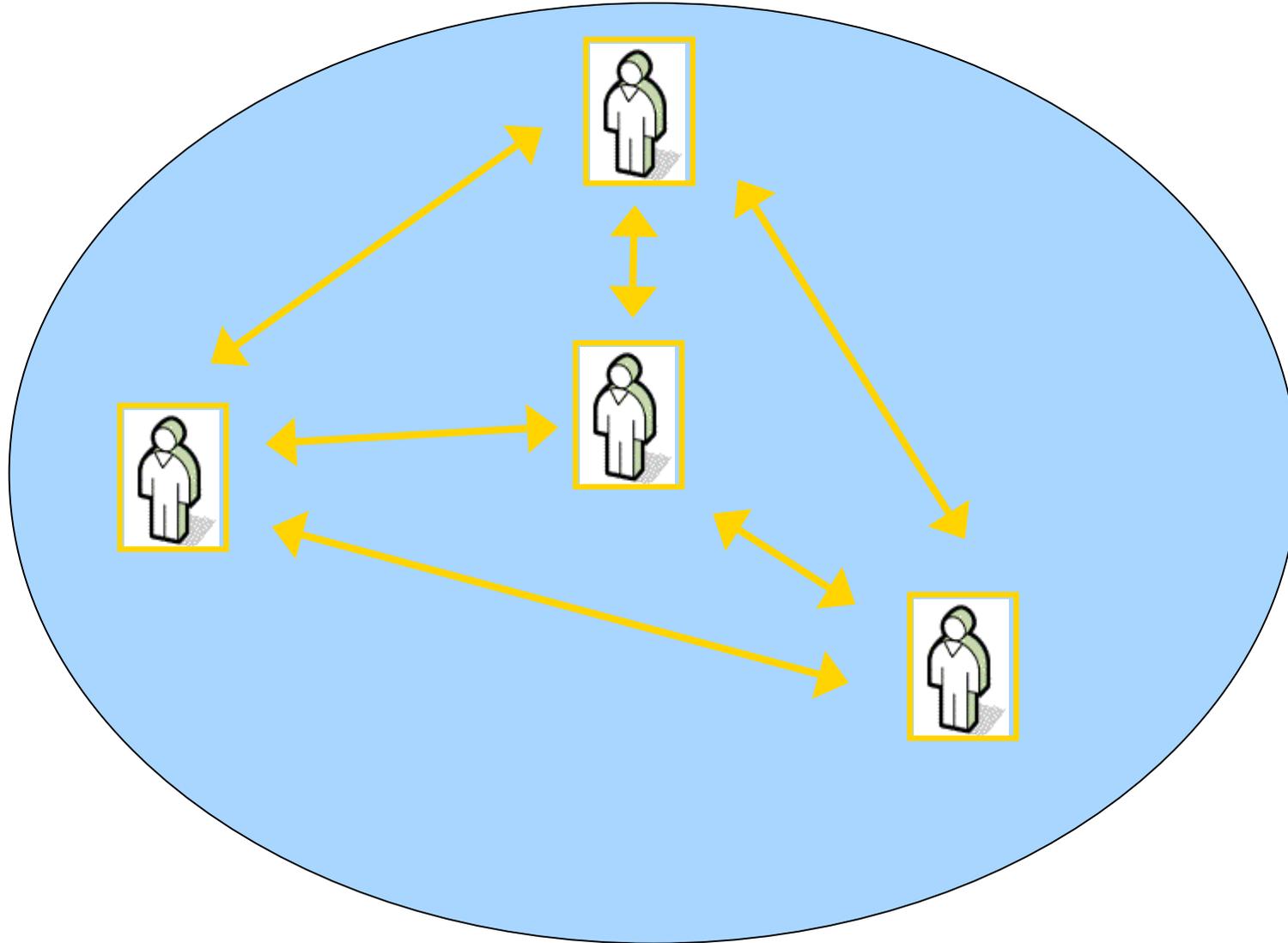
THANK YOU FOR YOUR ATTENTION !

MATSim project page: www.matsim.org
Further publications: http://www.ivt.ethz.ch/vpl/publications/reports

Common methods and tools in retail location planning

Technique/s	Subjectivity	Cost	Technical experience required	Computing and data needs
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Expert systems, neural networks				

Agent-based modeling

Agent-based modeling

MATSim: Overview

Multi-Agent Transport Simulation

- Individual agents have complete daily schedules ("plans") based on activity chains (e.g. home – work – shop – home)

- Transport simulation executes one (selected) plan of each individual agent simultaneously

- Individual agents can create new plans by modifying existing ones (e.g. modifying route or activity durations)

- Individual agents score the executed plan with a utility function

- Perform multiple iterations of modifying, executing and scoring plans