
A Conceptual Proposal for an Agent-based Commodity Transport Model using the MATSim framework

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Agenda:

1. Motivation
2. Passenger versus Freight Transport
3. Decision Framework in Freight Modelling
4. Freight Modelling with MATSim
5. Discussion

Motivation: *Why do we need an agent based freight model?*

Policy Assessment

- *Evaluation* of transport policies (e.g. taxes, fees and regulations)
- *Impact assessment* of new technologies like new transport vehicles

⇒ Policy sensitive freight model

⇒ Representation of individual decision-makers and their reactions on transport policies (fundamental relationships of freight transport)

Why do we examine the use of **MATSim**? Passenger Model?

1. Agent-based transport simulation
 - Keeping individual level in time and space throughout the whole simulation run (⇒ very strong representation of individuals)
 - Learning framework for agents
2. Flexible and extendable tool
3. Open source

⇒ 1. Scientific Benchmark for a multi-agent transport simulation

⇒ 2. Passenger and Freight Vehicles share the same infrastructure, thus integrated model

Comparison: *A few differences of passenger versus freight tp-modelling*

1. Freight is much more heterogenous

- Volume and Weight,
- Solid or Liquid bulk
- Containerizable goods
- Perishable,

=> a number of different transport units, logistic facilities to handle freight, etc.

2. Transport cost are not transparent (subject to negotiations, confidential data)

3. Activity patterns are heterogenous (e.g. urban express carrier vs. long haul)

4. Asymmetric commodity flows

5. Freight is passive, does not have activities and cannot decide anything

⇒ Thus, its transport is influenced by various decision makers

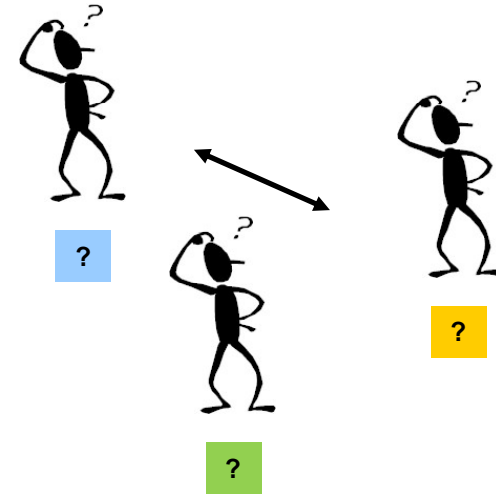
⇒ **Freight Transport System is much more complex**

Decision Framework: *Desicion Makers and Decisions?*

Modelling freight needs answers on following questions:

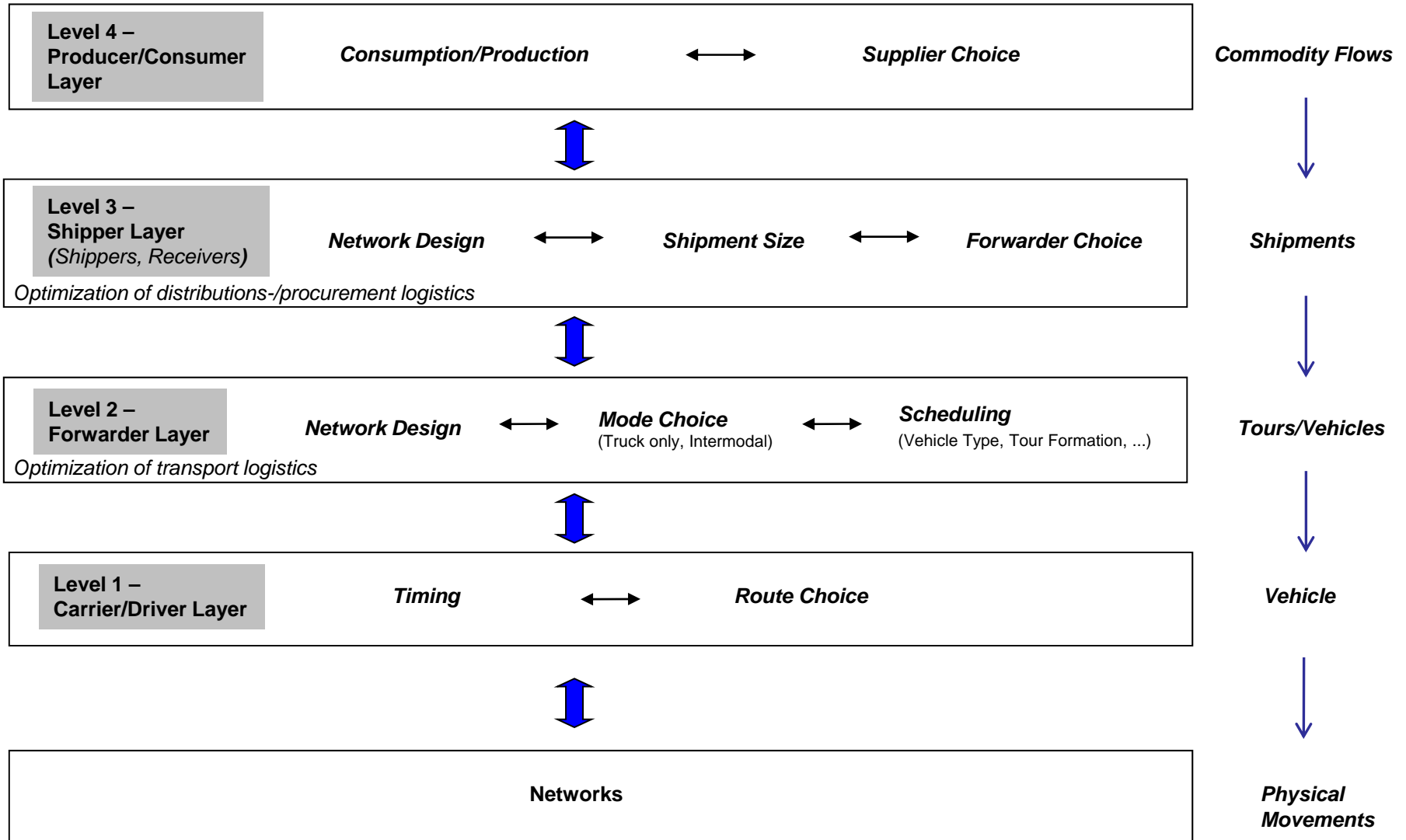
Who are the decision makers?

Which are the relevant decision?
- *relevant?*



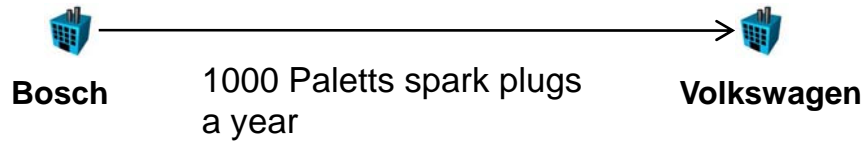
Decision Framework: *Synthesis from practical experiences & literature*

- Frameworks in lit. differ according to time horizon and decision makers



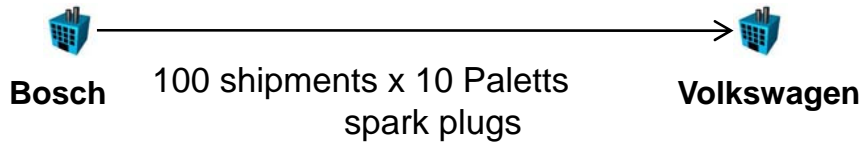
Methodology: *Decision Framework for freight modelling*

Commodity Flows



Would Bosch send 1000 paletts at once?

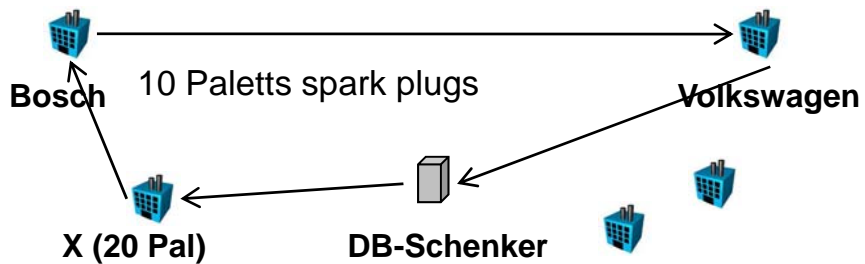
Shipments



-Transport costs
-Inventory costs

How do shipments become tours? Would Bosch transport these spark plugs by its own?

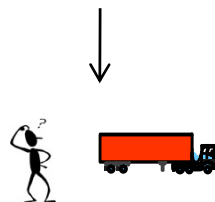
Tours/Vehicles



Vehicles

Tour: DB-Schenker (Depot) → X (Pick-up: 20) → Bosch (Pick-up: 10) → Volkswagen (Deliver: 30) → DB-Schenker (Depot)

Physical Movements

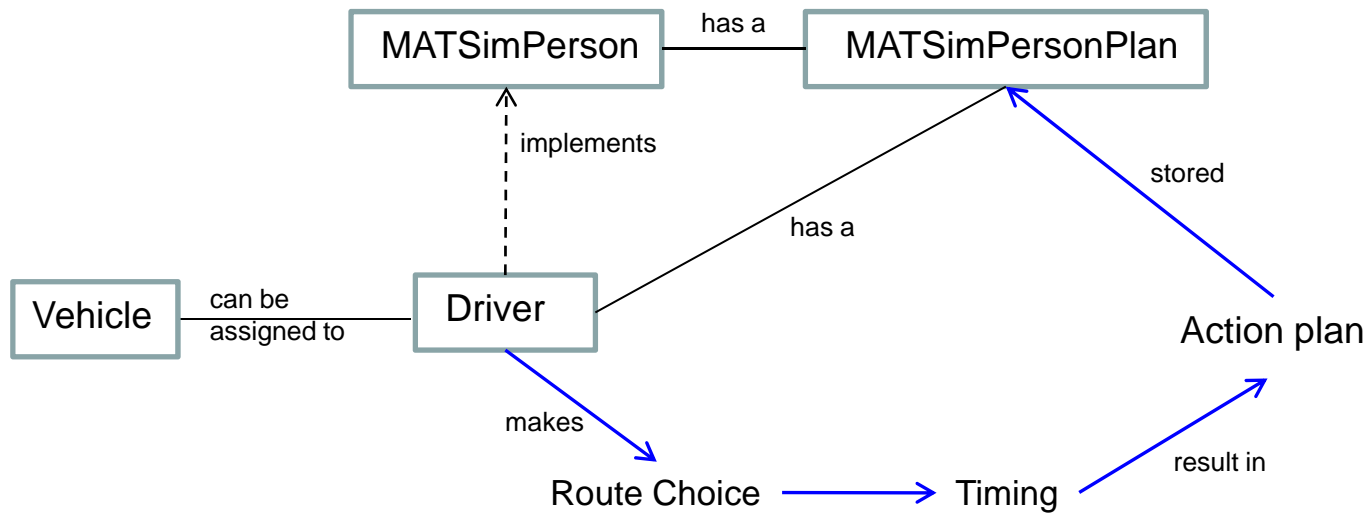


=> Idea of freight transport system

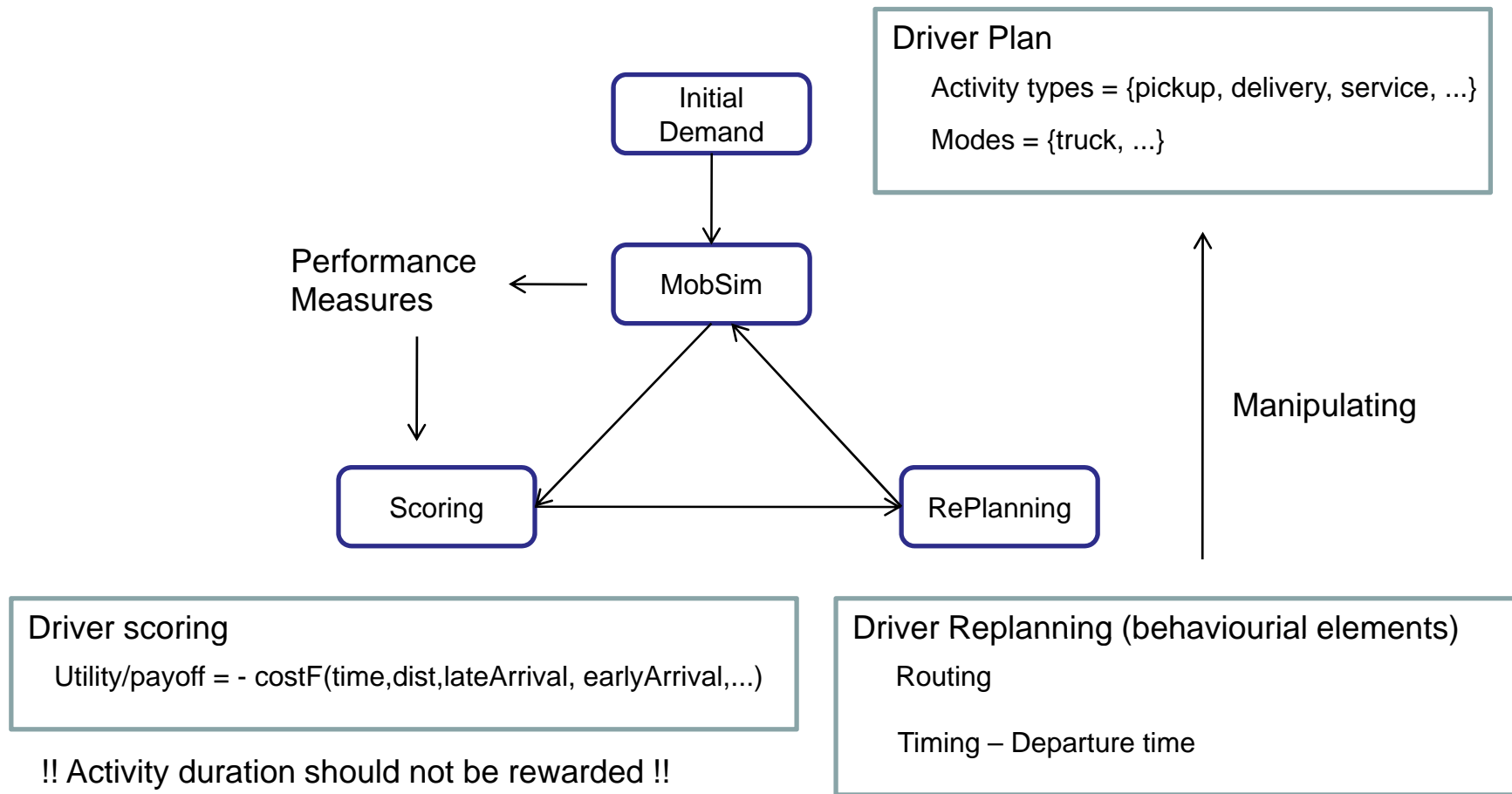
MATSim Extension: *How could MATSim be extended?*

- Point of departure: MobSim simulation physical movements
- Starting from the lowest decision level according to our decision framework
 - Driver-Level (1) – closest to physical infrastructure
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 - Producer/Consumer-Level (4)
- Each level: Analysis of whether and how we could integrate decision-makers

MATSim Extension: *Can we include the DRIVER/CARRIER in MATSim?*



MATSim Extension: *Level 1 - Simulation Triangle*

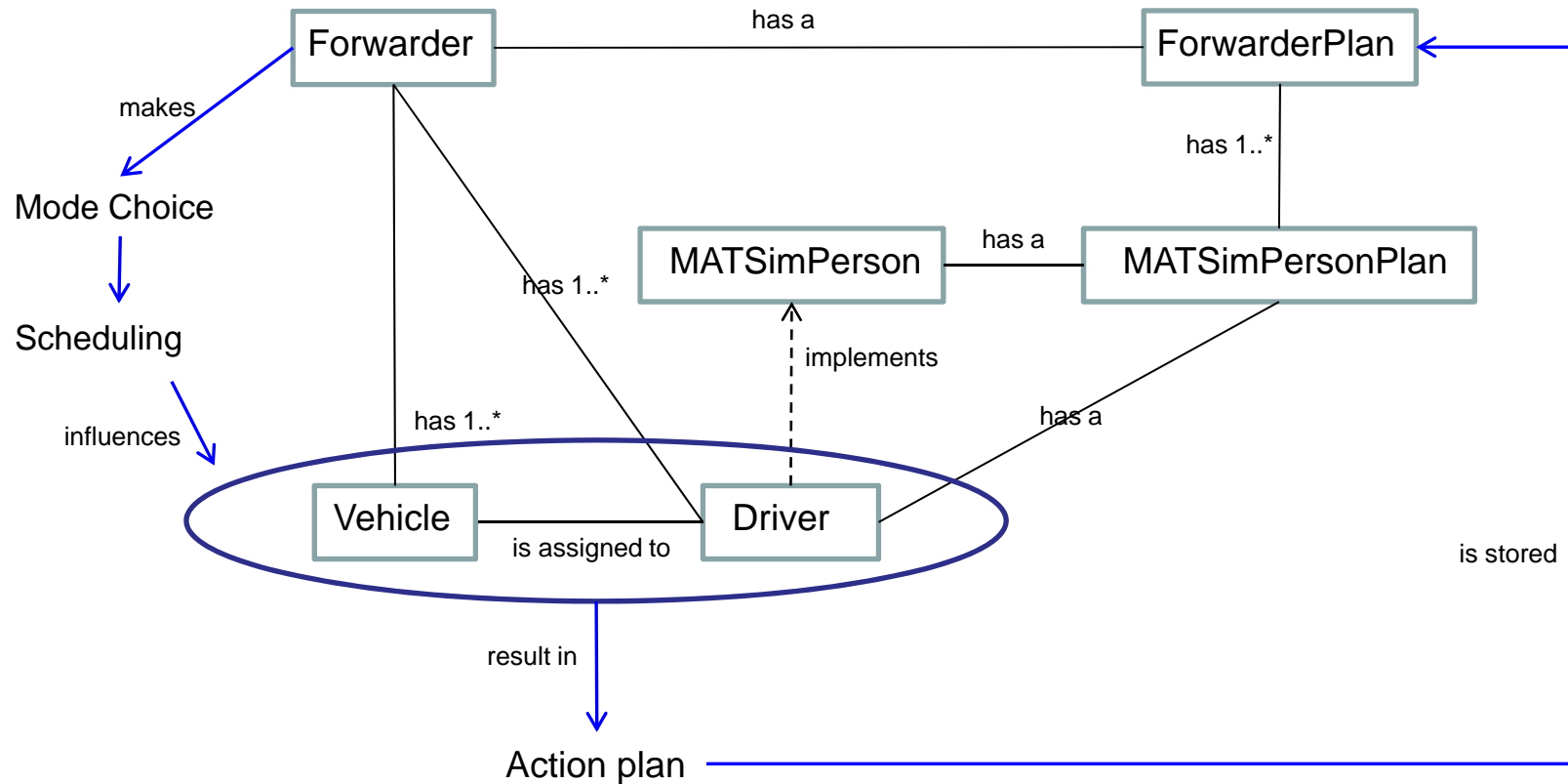


⇒ Implementing the MATSim Persons/Plan API enables us to incorporate Freight transport into the MATSim **given VEHICLE-TOURS**

VEHICLE-TOURS are made by the FORWARDER (Level 2)

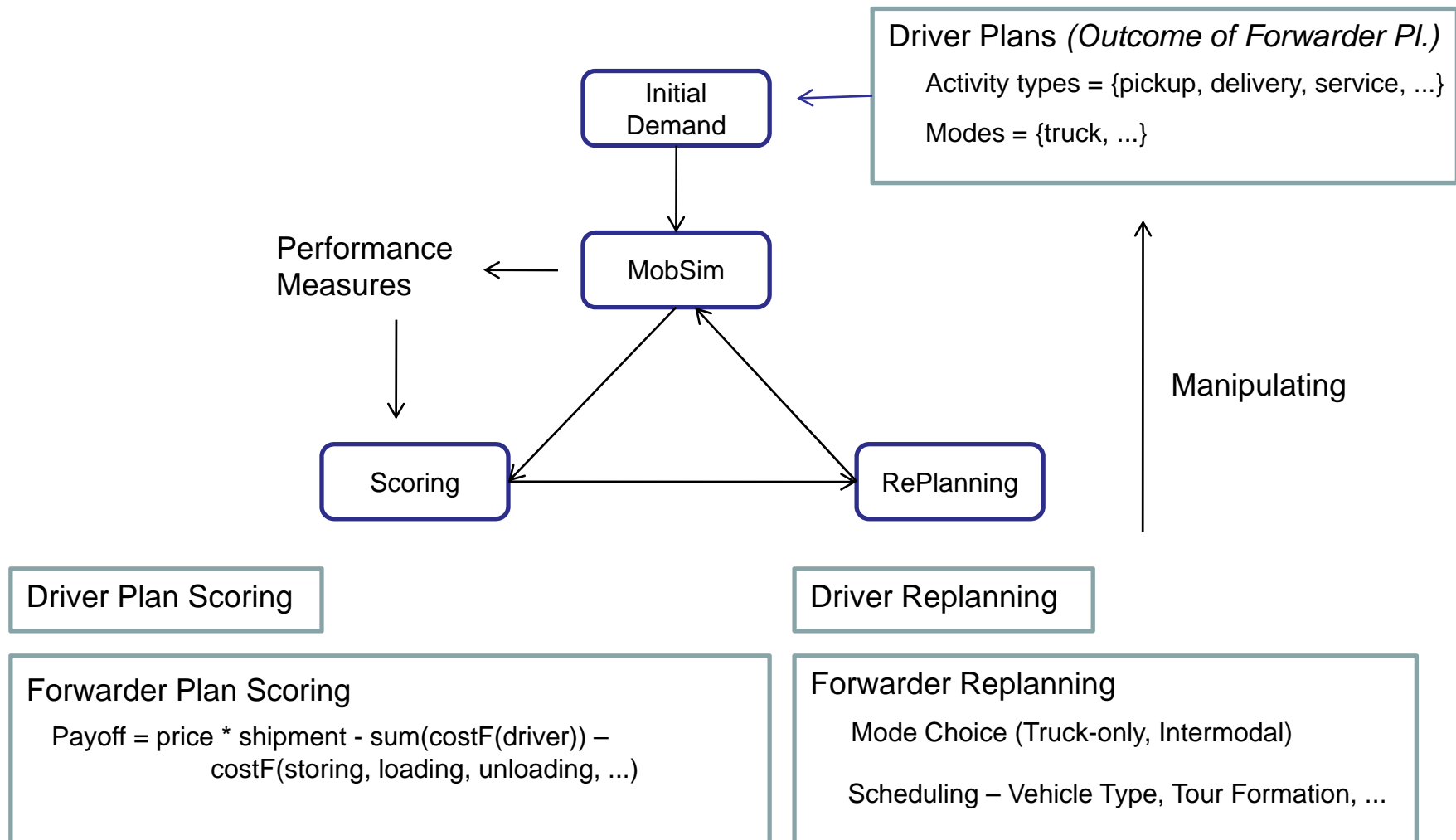
MATSim Extension: *Can we include the FORWARDER in MATSim?*

- Forwarder has customer contact, manage the tp-chain and schedules resources



- Forwarder seeks for an optimal plan

MATSim Extension: *Level 2 (Forwarder) – Simulation Triangle*



⇒ Introducing the Forwarder-Concept enables us to incorporate Freight transport into the MATSim ***given the Shipments of the Forwarder***
Shipments/[Transport Contracts] are planning outcome of the Shipper

MATSim Extension: *Can we include the SHIPPER in MATSim?*

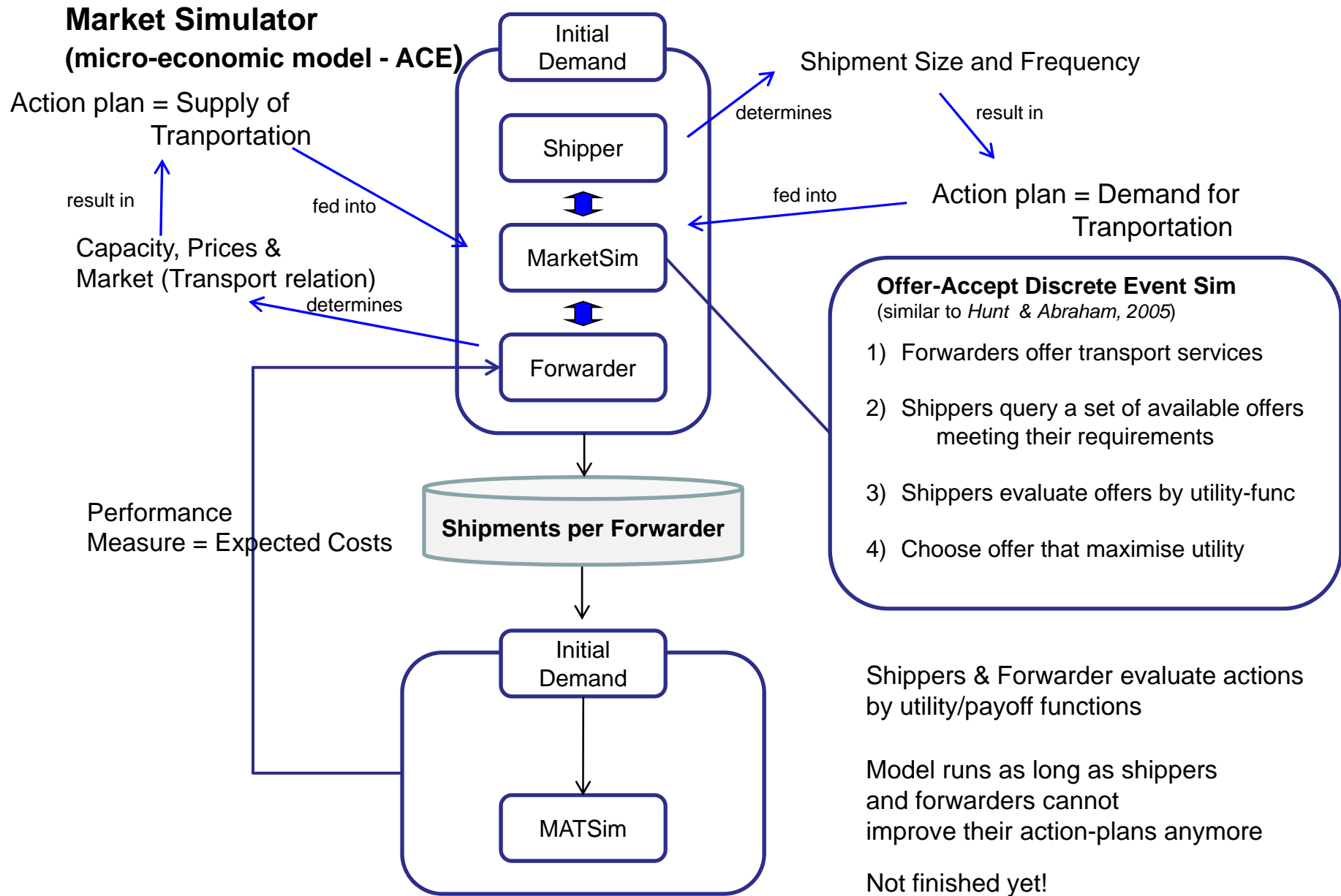
Problem:

- Temporal differences (contracts are mid- and long-term decision)
 - Changing contracts between shippers and forwarder → whole new planning situation
=> Experiences made during sim runs become obsolete
- => Need for steady state

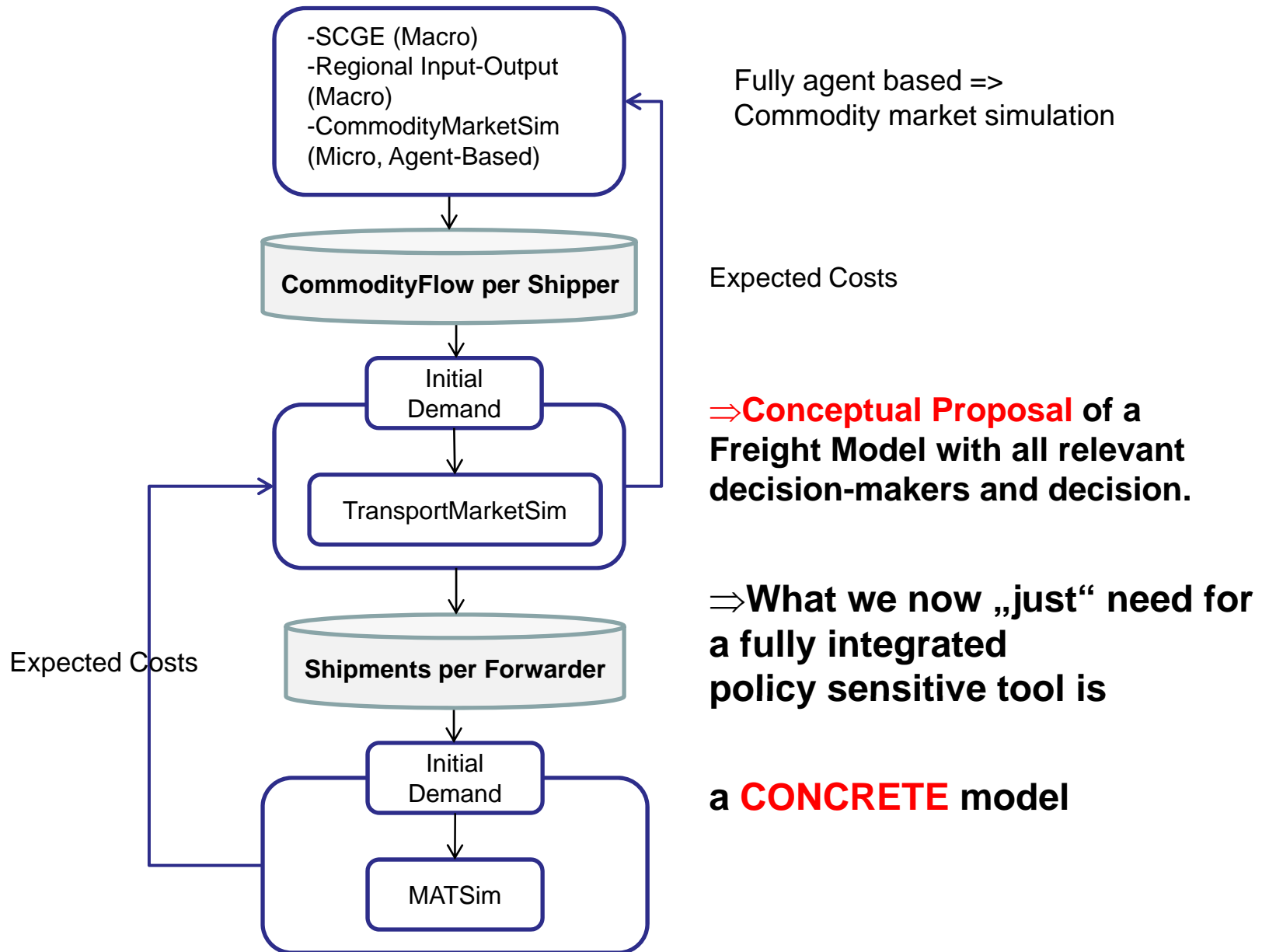
=> Two-model approach

- First-model: shipper and forwarder meet at a market-place;
competition among forwarders
- Second-model: MATSim given shipments (contracts) per forwarder

MATSim Extension: *How does the two-model approach look like?*



Implementation: *Consumer/Producer (level 4)*



Conclusion

-Ambitious plan

-Only an excerpt of the complexity and requirements in freight modelling

-data requirements

-model calibration

-concrete algorithms for combinatorial problems

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-A number of concrete tools already available

-Synthetic population of firms

-Behavioural shipper models, e.g. model of distribution structure in retail market (Friedrich)

-Behavioural forwarder models, e.g. full truckload long distance market (Liedtke)

-Market equilibrium models in hinterland transportation (Carillo & Liedtke)

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-V1 of market simulation by the end of the year

-Someday putting models together

-Evtl. starting cooperation with DFG-Antrag or other scientific work

End

Thank you very much for your attention!

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