SimMobility Freight: a multi-scale agent-based modelling platform for urban freight distribution

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SimMobility, an agent-based simulation

- **Laboratory** for urban passenger/freight mobility
- **Agent-based** integrated/modular platform (freight-related: shippers, carriers, receivers, drivers)
- **Multiple** spatial-temporal scales
- **Dynamic** plan/action-transaction behavioral models
- **Multimodal** networks
- **Open-source**
Design objectives

- A tool for strategic evaluation of freight transport policies / “what-if” scenarios.
- An agent-based simulation that represents the urban freight multi-stakeholder system using a consistent set of agents.
- Capable of analyzing passenger and freight movement interactions.
- Preliminary application in Singapore context but generalizable to other cities.
SimMobility Freight: Long-term

- Decisions taken sporadically, lasting longer time periods (months, years)
- Contract-based and shipment-based commodity flows including imports/exports and construction flows.
- Suitable to study:
  - Land-use and establishment locations
  - Fleet ownership choices (vehicle type, quantity)
  - Overnight (season) parking choices
Model outputs – Long-term (Singapore case)

- Business establishment locations based on land-use scenarios
- Overnight parking choices based on parking infrastructure and pricing
- Industry to industry flows, aggregating sourcing preferences
- Zone to zone flows, based on establishment mix and sourcing preferences

Shipping zones
Receiver zone
SimMobility Freight: Mid-term

• Decisions taken more often/regularly (resolution >= 1 day)
• Shipment-based and vehicle-based
• Distinguishes carriers with and without fleet (outsource to 3PLs)
• Suitable to study:
  • Carrier selection / vehicle sharing
  • Vehicle routing
  • Vehicle load factors
  • Vehicle parking
Model outputs – Mid-term (Singapore case)

Demand fulfillment, based on fleet availability and demand

Pickup & delivery locations, depending on shipment frequency

Travel speeds, linked to route choices

Vehicle loadings at first pickup location of tour, depending on daily demand & fleet availability
Prototype implementation data sources

**Long-term**

- For synthetic establishments and vehicles (SG)
  - JTC tenant profile
  - ACRA business registry
  - MOM, URA, EDB, and SingStat
  - LTA vehicle registry
  - URA, HDB, LTA parking data
- Tokyo Metropolitan Freight Survey for demand estimation (JP → SG)

**Mid-term**

- Commodity weight to volume (US → SG)
- Link travel times (SG)
- Stop duration data (US, PT → SG)
- Stops per tour distribution (SG)
- Loading bays parking choice observations (SG)
- Vehicle GPS tracking and surveys (US)
# Ongoing data collection and target models

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Application 1 – Forecasting Future Traffic

2012 Freight Vehicle Traffic (veh/day)  

2035 Freight Vehicle Traffic (veh/day)
Application 2 – Overnight parking

Long-term

Supply scenarios → Overnight parking choices → Tours → Travel metrics

Mid-term

- Empty travel distances
- Zone specific traffic flow (speed, delay)

- Location
- Type (private, public, etc.)
- Price
Application 3 – Consolidation policies

- **Impact on goods vehicle activity**: VKT, Vehicle trips, Vehicle load factor
- **Impact on loading/unloading activity**: Loading/unloading bay usage, Time spent in loading/unloading activity
- **Social/environmental impact**: Traffic (flow, speed, density)
Ongoing research

Model developments
• **Long-term**
  • Consolidation initiative participation
  • E-commerce demand
  • Service trips demand

• **Mid-term (Pre-day)**
  • Carrier operations considering multi pickup-up delivery with time-windows

Model applications
• E-commerce growth and urban logistics management policies
Thank you!

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