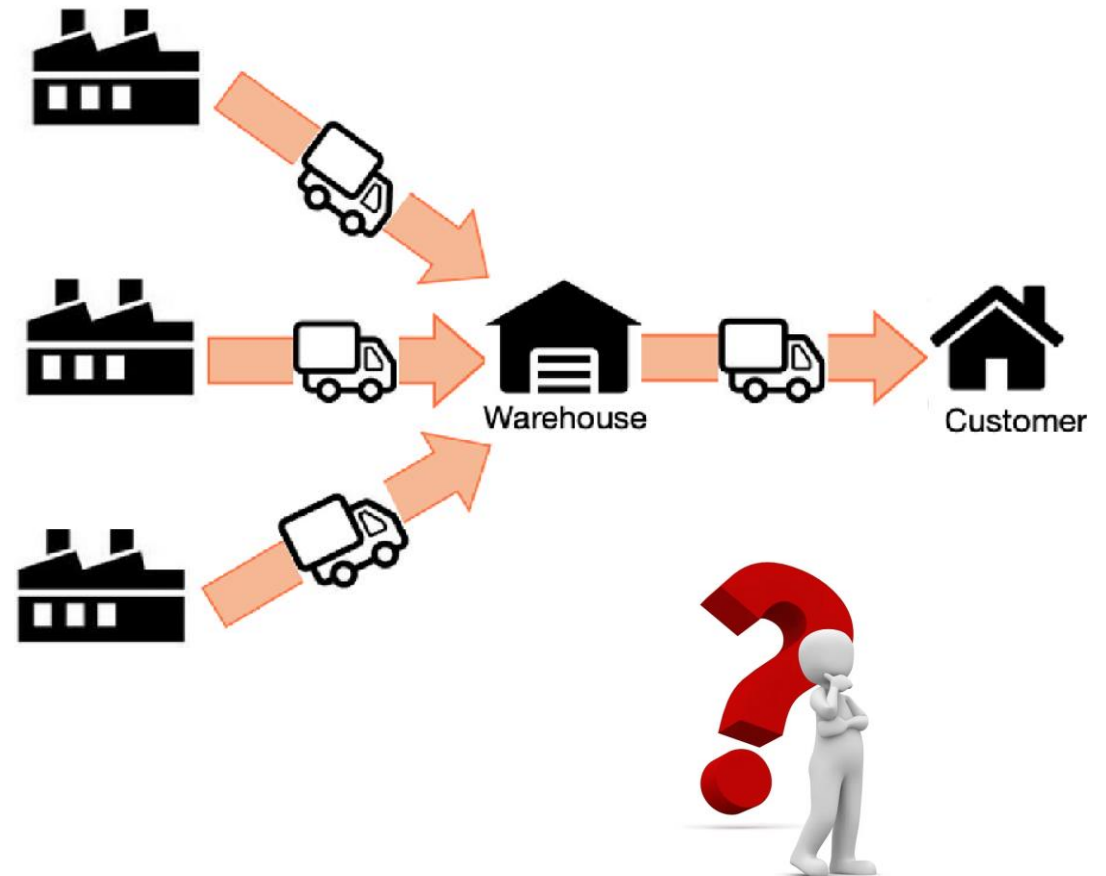




# Freight Distribution Travel Demand Assessment - Arenastaden Study Case

# Introduction:

- Growing city centers can lead to increase of activity system, including private car demand, public transportation and goods distribution;
- Different stakeholders (e.g. producers and consumers) can present big heterogeneity in distribution desires;
- Multi-agent models can be useful to estimate urban freight distribution considering daily trip and logistic choices.



# Introduction:

- In this sense:

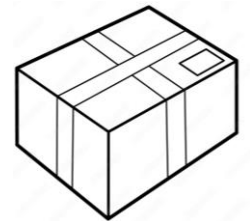
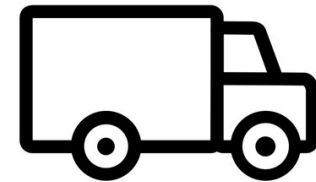
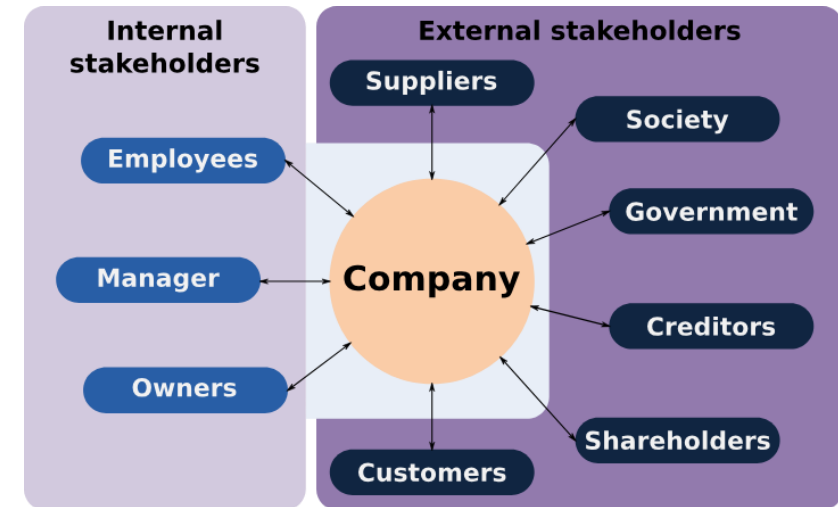


**Freight Transportation  
Assessment**

- 
- Online purchases
  - Congestion charge
  - Accessibility
  - Efficient Land Use
  - Air pollutant reductions
  - Technology improvement
  - Logistic optimizations

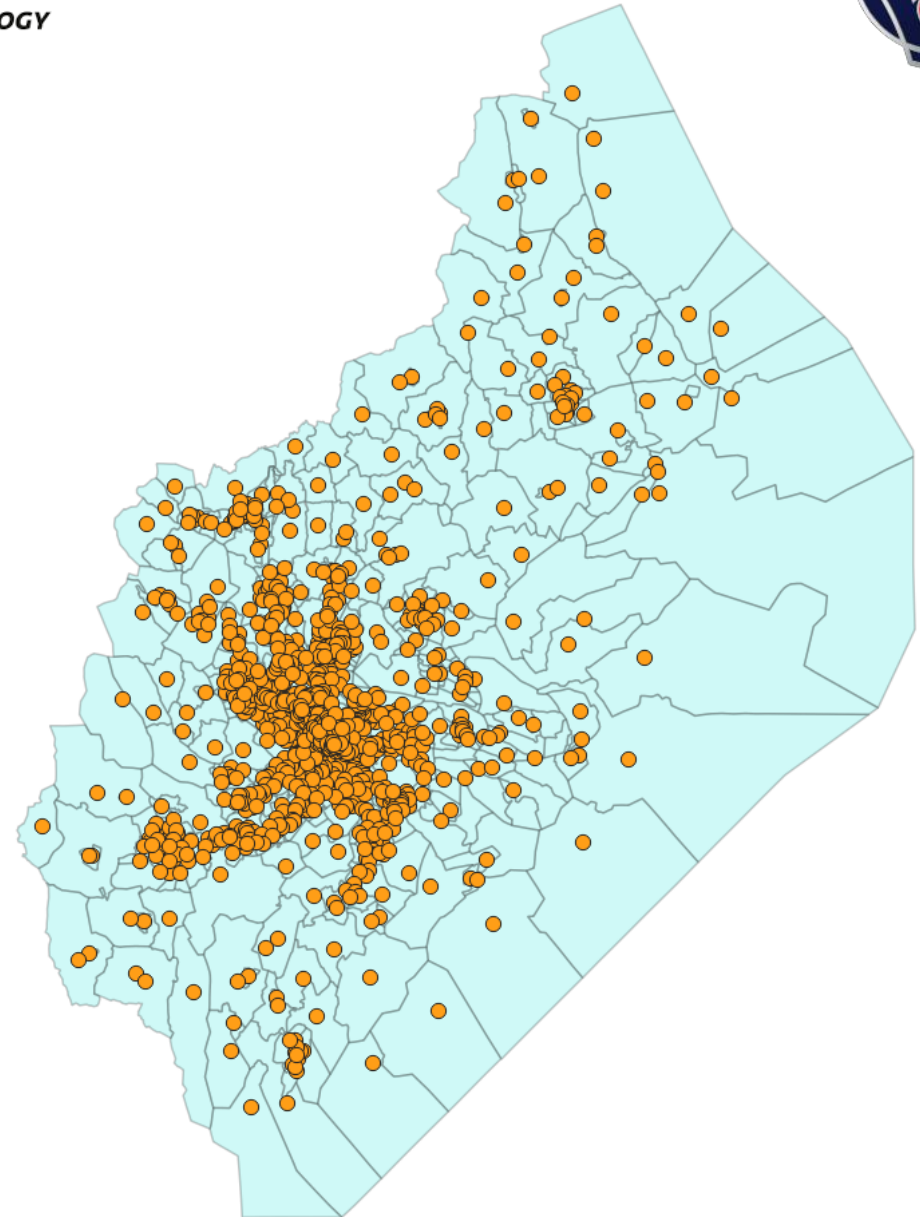
## Research Questions:

- How may stakeholders be affected by goods distribution generated in Arenastaden (time, operation efficiency, air pollutant emissions)?
- How can Cost of Sourcing, Carrying Capacity and Vehicle Technology affect travel demand?
- Can fuel consumption and mobile air pollutant emissions be accurately estimated in Arenastaden freight operations?
- Can demand estimation based in shipment units (instead of vehicles) present accurate results in Stockholm region?



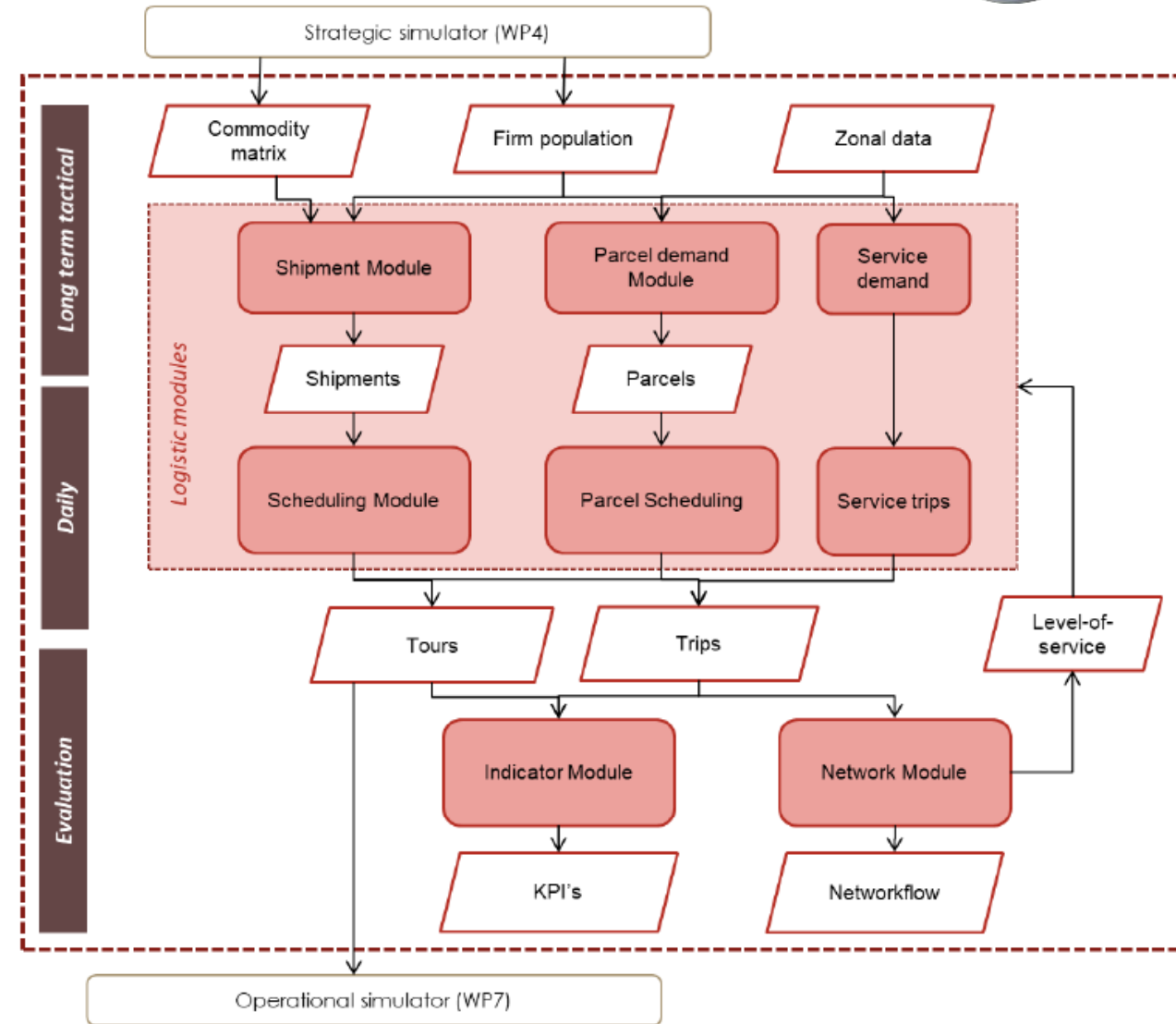
# MASS-GT Stockholm:

- Multi-Agent Simulation System for Goods Transport;
- Capable to address multiple stakeholders involved in urban freight distribution;
- Freight demand modelled considering the number of shipments instead of number of vehicles;
- Distribution centers and shipment terminals represented as logistic nodes.



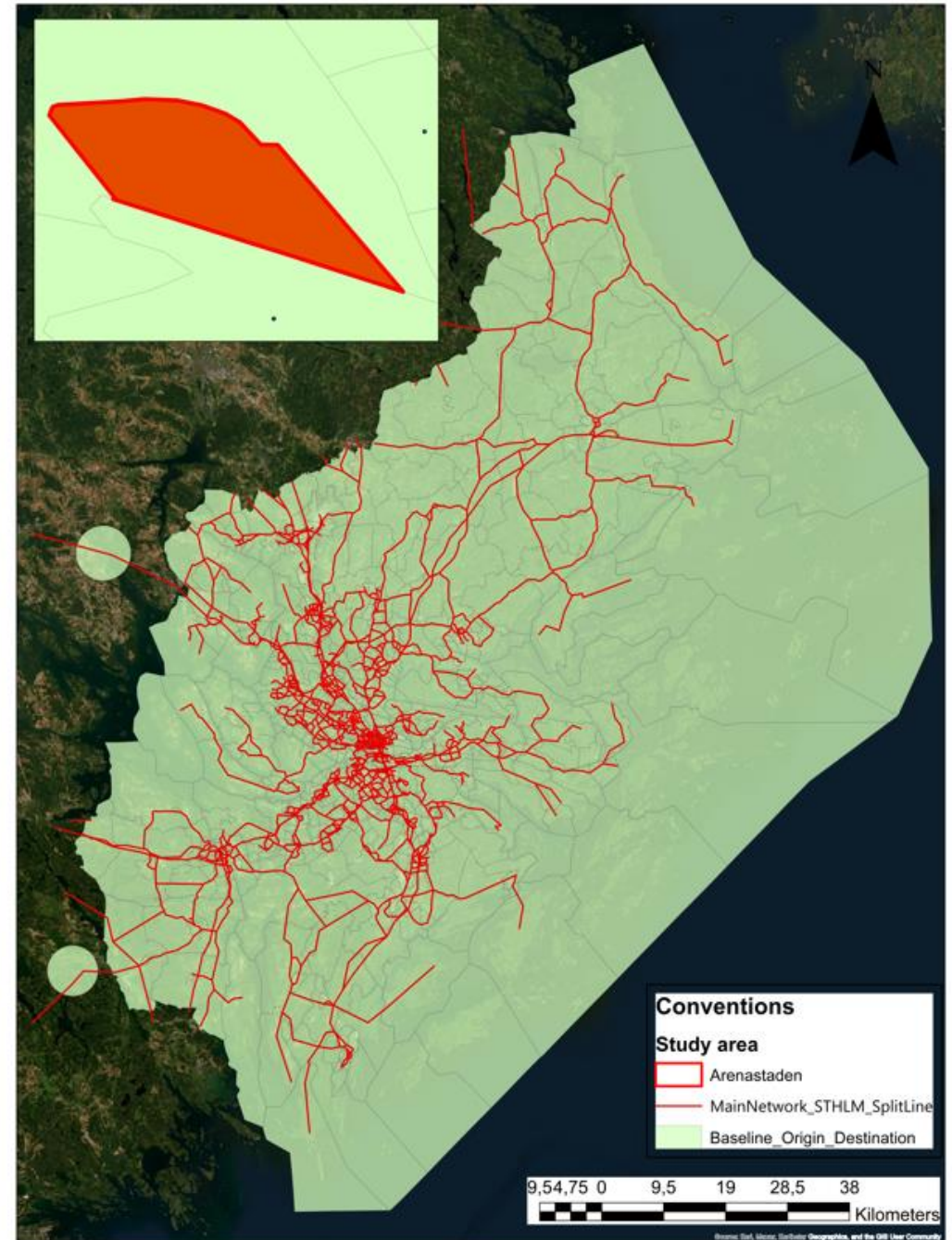
# TFS Concept:

- **Long-Term Decisions:** Sourcing/Producer choice; Distribution channel choice; Shipment size & Vehicle type;
- **Daily Decisions:** Tour formation; Time of the day;
- Separate module for service trips (Vans, in this case);
- Network module, route choice and air pollutant emissions.



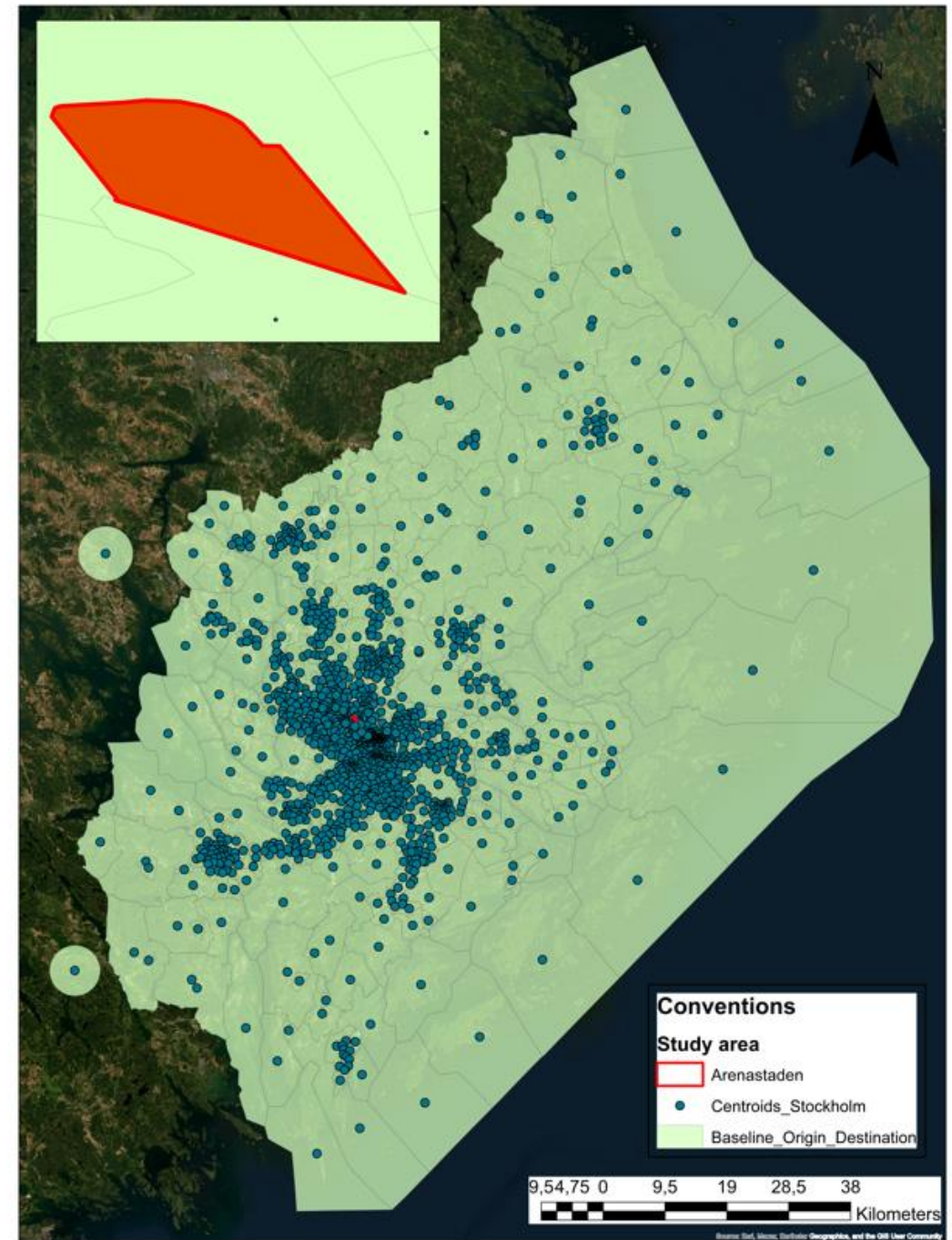
# TFS Necessary Data:

- Usually available data as inputs (tracked shipments, vehicle types, parcel types, etc). Can be calibrated and validated;
- Road network, socioeconomic data (demographic, employment, etc) per zone, location of logistic nodes;
- Can use detailed freight trip diaries, establishment surveys and/or truck counts.
- O/D demand matrix of cars and bikes calculated using EMME and LuTRANS;
- Travel distance (meters) and travel distance (seconds) between each combinations of Zones ;



## Research Area:

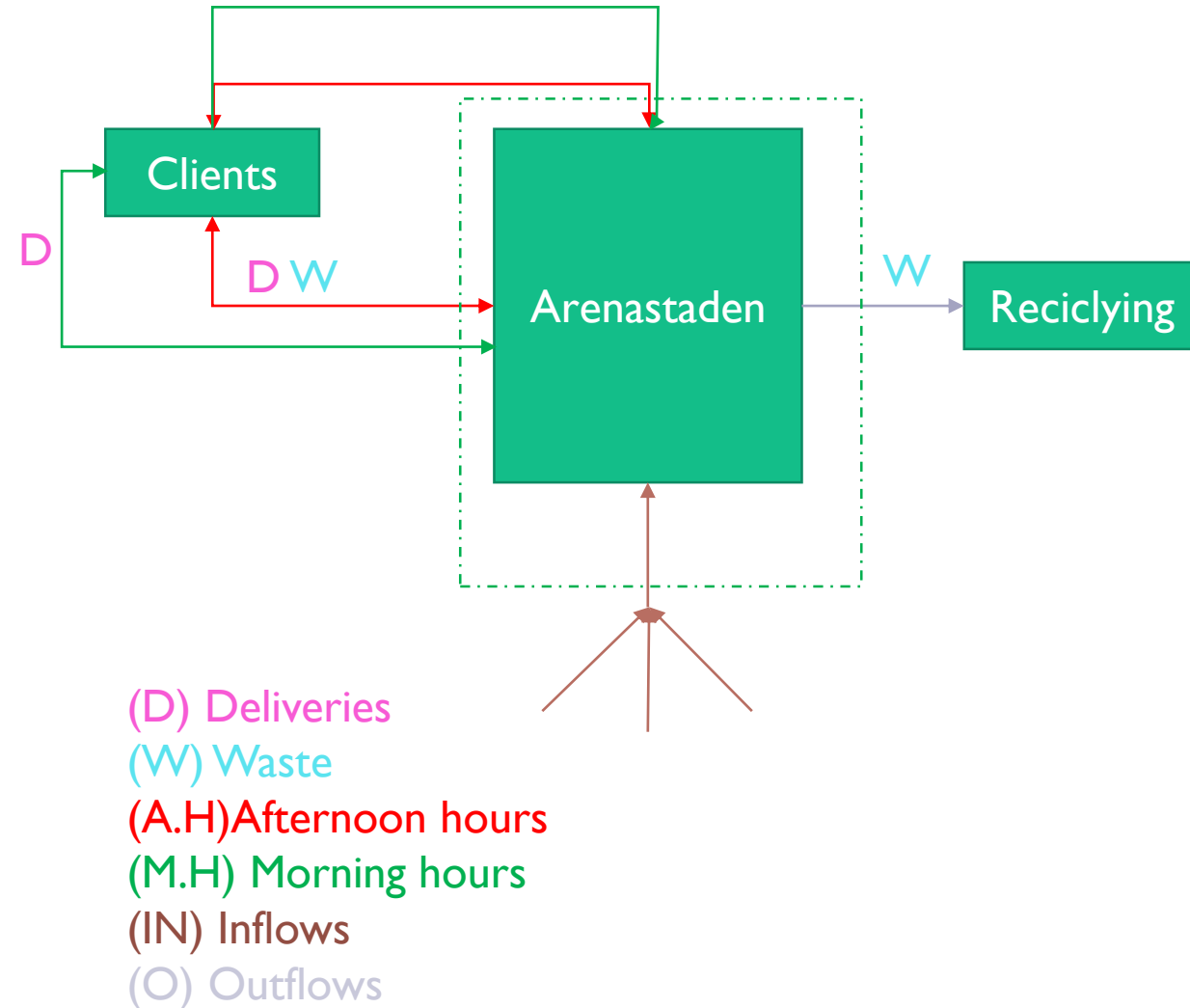
- Arenastaden Area: Approx. 200000 m<sup>2</sup>;  
Population: Aprox. 18000 inhabitants;
- Impacts on whole Stockholm freight distribution region. Approx. Area: 188 km<sup>2</sup>;
- Operation provided by Urban Services shows that Copenhagen and Enköping ships parcels to Arenastaden (Nationalarenan).





# Arenastaden Logistics:

- Urban Services Data observed, 2022;
- More than 5 million data observed (Number of orders, cargo companies (deliveries), number of stores, number of shipments, etc);
- Yearly data provided. Analysis also performed monthly and seasonally.



# Current U.S. Data Analysis – Arenastaden:

## Basic facts

Total No. Orders	291.970
Total No. Orders (under same ID)	1.963
Cargo companies/deliveries	78
Number of type of vehicles	165
Number of deliveries under same number	37.397
Number of stores	224
Max month	December
No. Shipments	29.294
Min month	February
No. Shipments	18.707

## Major distributors

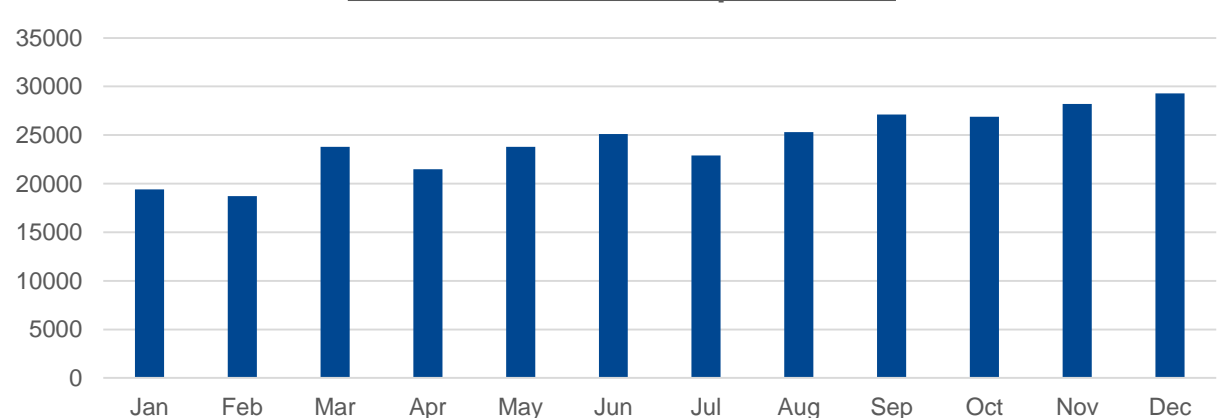
POSTNORD	39,03%
INDITEX	11,16%
US	10,76%
DHL	6,49%
SCHENKER	5,95%
UPS	5,81%
BRING	5,73%
CARRIER	4,81%
M&S	1,83%
Others	8,42%

## Type of delivery

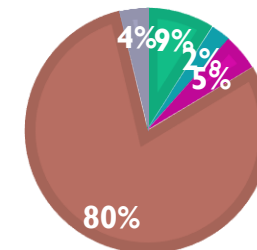
CW (Roll Cages)	24879	9%
H (Hang)	8198	3%
P (Stool)	16667	6%
PE (Packages)	231383	79%
S (Staple)	10841	4%

## Monthly orders

Number of deliveries per month



■ CW ■ H ■ P ■ PE ■ S



# Current U.S. Data Analysis – Arenastaden:

Monthly analysis

December 2022

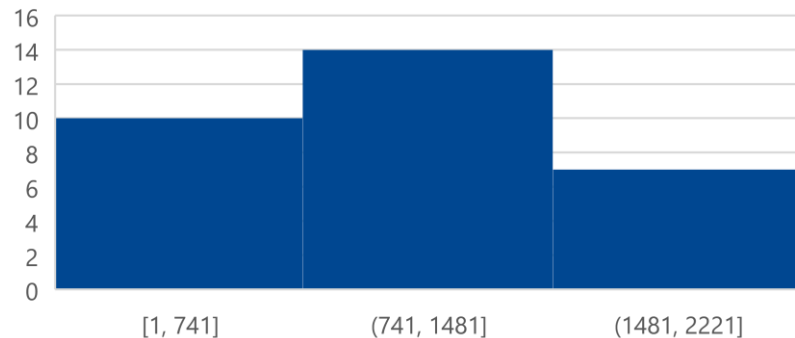
Type of goods	G1	G2	G3
0: Food (general cargo)	1067	414	1209
1: Miscellaneous (general cargo)	7254	3750	7585
2: Temperature controlled	65	32	56
3: Facility logistics	744	244	691
4: Construction logistics	0	0	0
5: Waste	0	0	0
6: Parcel (consolidated flows)	3	0	4
7: Dangerous	573	443	810
8: Parcel (deliveries)	2128	478	1744
Total	11834	5361	12099

## Major distributors

Delivery company	No. Orders	%	No. Orders (PE)	No. Orders (CW)	No. Orders (H)	No. Orders (P)	No. Orders (S)
POSTNORD	11058	38%	3807	458	79	338	107
US	5861	20%	4609	309	55	276	150
INDITEX	2728	9%	2219	215	37	146	111
DHL	1702	6%	727	56	16	73	54
UPS	1550	5%	937	68	9	50	16

## Order distribution

Average No. Orders by No. days



The peak days are **Tuesdays** and **Fridays**

**M&S uses Electric Vehicles only!**

# Current U.S. Data Analysis – Arenastaden:

## Type of goods

Type of goods	Count
0: Food (general cargo)	30629
1: Miscellaneous (general cargo)	213360
2: Temperature controlled	1718
3: Facility logistics	17171
4: Construction logistics	0
5: Waste	0
6: Parcel (consolidated flows)	89
7: Dangerous	18274
8: Parcel (deliveries)	10729
Total	291970

26 types of stores

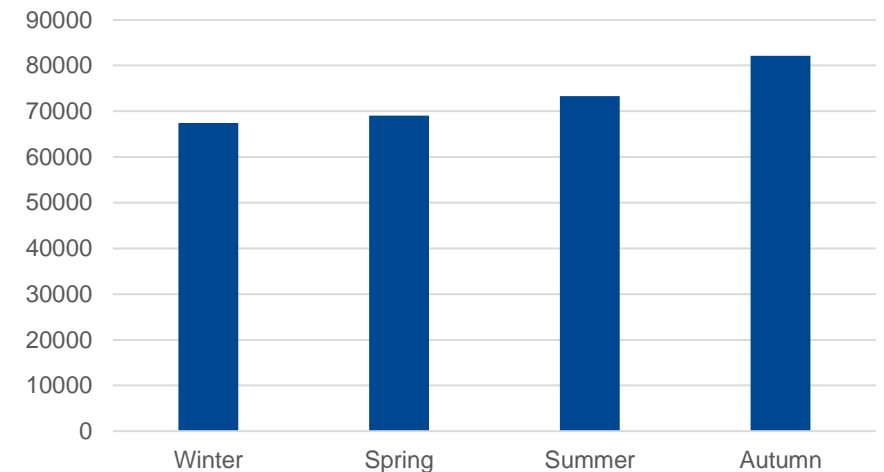
8 categories

## Type of store

Type of store	Count	Classification
Administrative	971	1
Alcohol retail	394	1
Art Gallery	8	8
Automobiles	89	6
Book store	5587	1
Chocolate store	226	1
Clothing & Miscellaneous	173404	1
Coffee store	0	0
Cosmetics & personal care	5836	1
Coworking	260	1
Department store	6638	3
Electronics	1778	1
Entertainment	2271	8
Financial & Consulting services	2827	1
Florist	109	2
Grocery store	0	0
Health relate	5421	7
Homeware	10533	3
Miscellaneous	15991	1
Mobile & Communications	5611	1
Pets	1	1
Pharmacy	12853	7
Restaurant	30629	0
Restaurant (Cold relate)	1609	2
Shipping & Mailing services	8450	8
Tobacco retail	474	1
Total	291970	26

## Seasonal behaviour

Number of deliveries per season



The period of the year with the highest flow is the **Autumn**, when orders increase by **18%, 16% and 11%** compared to winter, spring and summer.

# Current U.S. Data Analysis – Arenastaden:

## By type of goods

Type of goods	G1	G2	G3
0: Food (general cargo)	13309	5390	11930
1: Miscellaneous (general cargo)	85966	46719	80675
2: Temperature controlled	761	246	711
3: Facility logistics	7802	2965	6404
4: Construction logistics	0	0	0
5: Waste	0	0	0
6: Parcel (consolidated flows)	33	7	49
7: Dangerous	7116	3671	7487
8: Parcel (deliveries)	4503	1306	4920
Total	119490	60304	112176

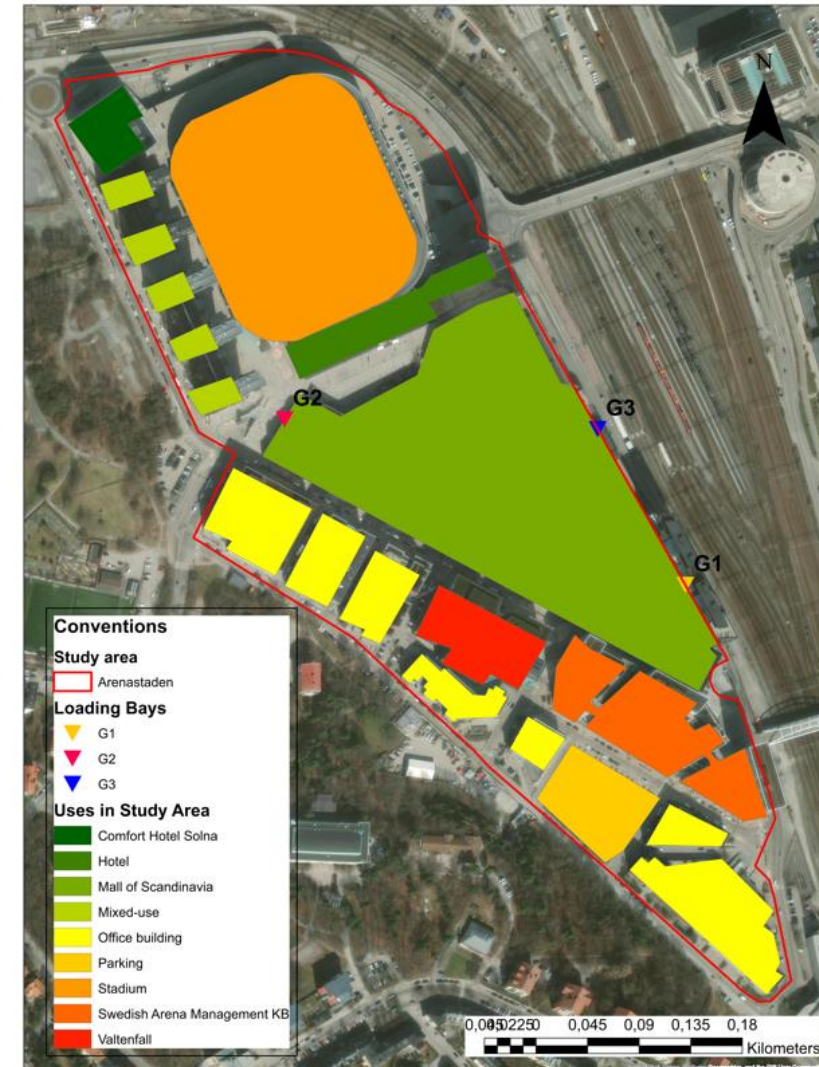
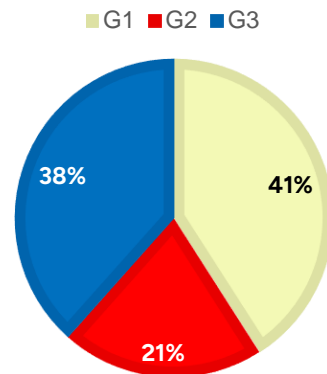
## Waste Management

Origin	Destination	M Truck	T Weight (kg)
Arenastaden	Lunda	4524	1307179.9
Arenastaden	Högdalens industriomr	936	2744994.5
Arenastaden	Länna arbetsomr	156	307
Arenastaden	Bro glesbygd	4212	695682.9
Total	-----	9828	4748164

## Type of package

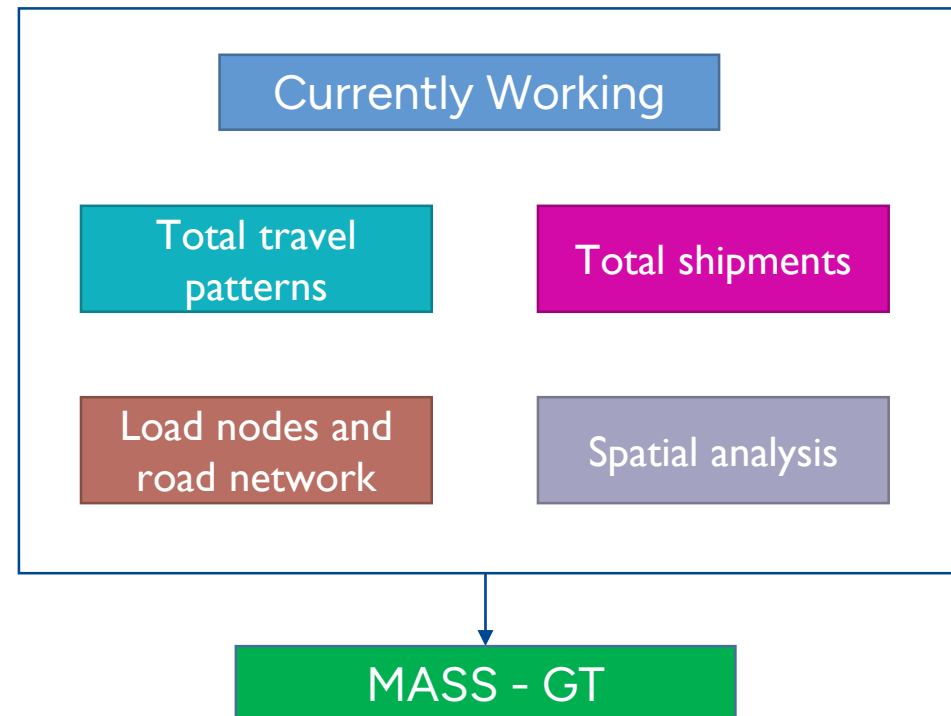
Type of delivery	G1	G2	G3
CW	17399	3023	4457
H	5390	432	2376
P	9683	1278	5706
PE	84830	46949	99606
S	2188	8622	31
Total	119490	60304	112176

## Delivery points



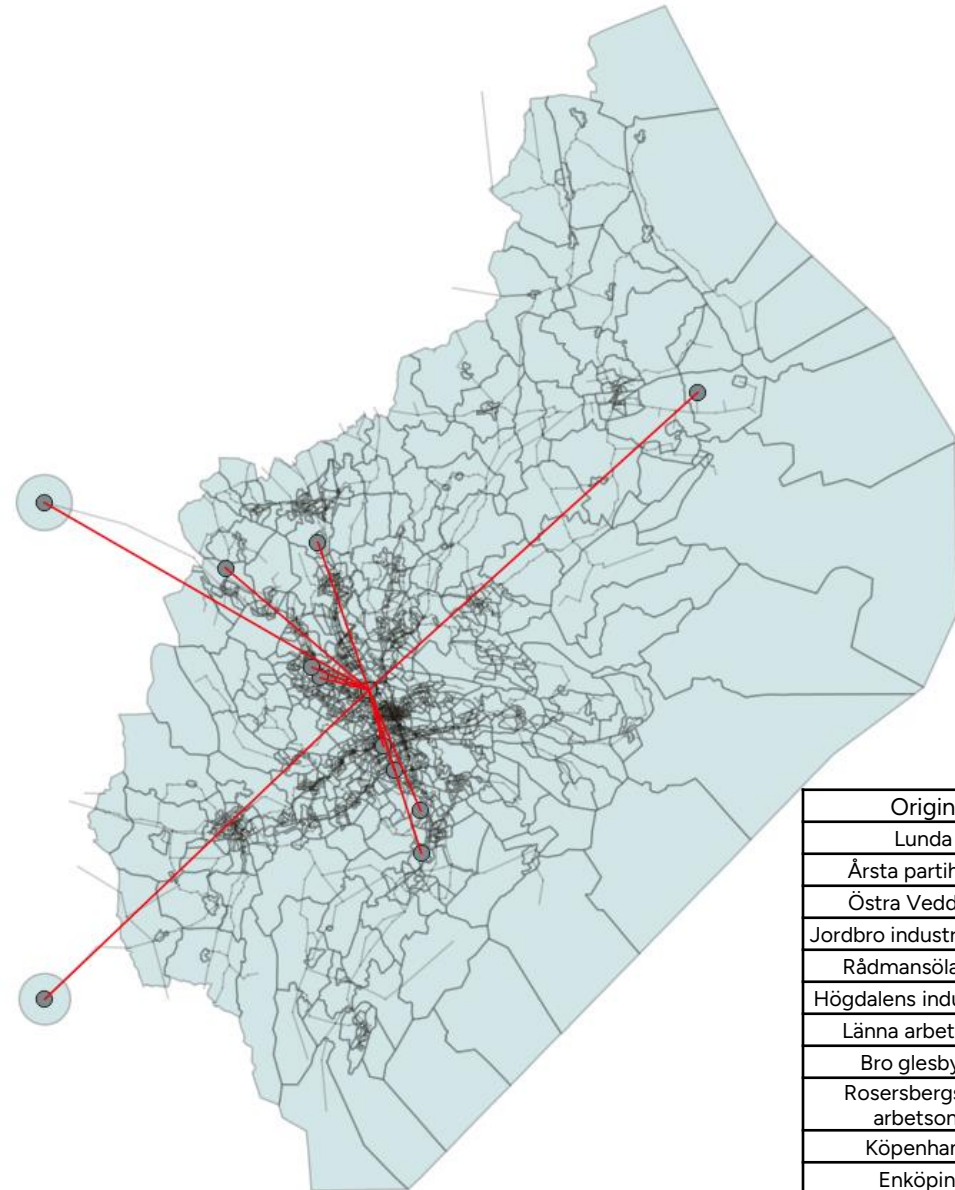
# Current U.S. Data Analysis - Arenastaden

- Only Small, Medium and Large (Trucks) are used in freight distribution operation. Vans (700 kg) are also used;
- Euro 4, 5 and 6 trucks (all sizes) are used. Small trucks and Vans are electric (3% 2022 and 2023, 8% 2024);
- Autonomous driving waste will be tested in 2024, implementation planned to 2025.



# Traffic Assignment Step:

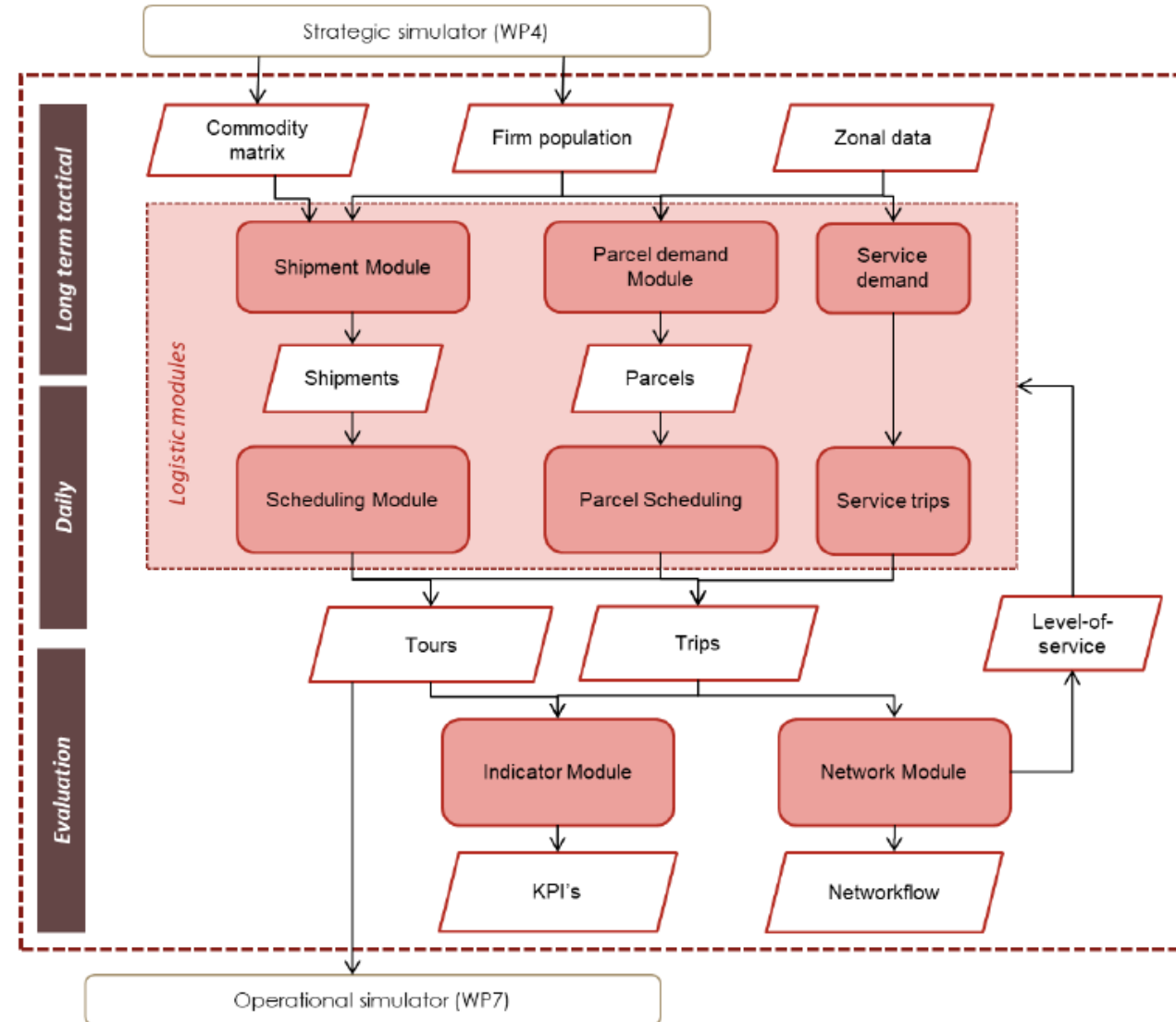
- **Network Module:** Calculate route choice for each freight trip and estimate global and local air pollutants (exhaust and non-exhaust);
- **Results:** Network with freight traffic intensities and disaggregated link emissions (vehicle type, load factor);
- **Dijkstra algorithm and STREAM report (freight transport) emissions.**



Origin	Destination
Lunda	Nationalarenan
Årsta partihallar	Nationalarenan
Östra Veddesta	Nationalarenan
Jordbro industriområde	Nationalarenan
Rådmansölandet	Nationalarenan
Högdalens industriomr	Nationalarenan
Länna arbetsomr	Nationalarenan
Bro glesbygd	Nationalarenan
Rosersbergs nya arbetsomr	Nationalarenan
Köpenhamn	Nationalarenan
Enköping	Nationalarenan

## Next Steps:

- Calibration of Tactical Freight Simulator with provided U.S. data (Truck, Tour, Shipment);
- Travel demand, route choice, emission calculations in road network. Heat maps consolidation;
- Scenario proposal: Vehicle dimensions switching, propulsion technology updates, route choices.







Thank you for your attention!

Helry Dias