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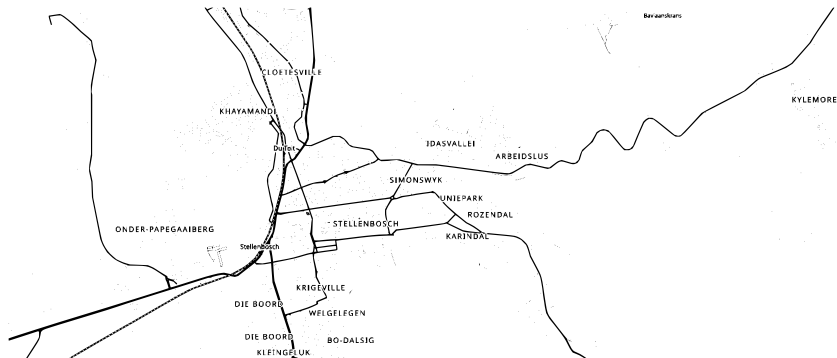
AN AGENT-BASED APPROACH TOWARDS MODELLING COST VERSUS CO₂ EMISSION TRADE-OFFS IN MULTI-MODAL MIDDLE-MILE LOGISTICS

Dominic Huskisson

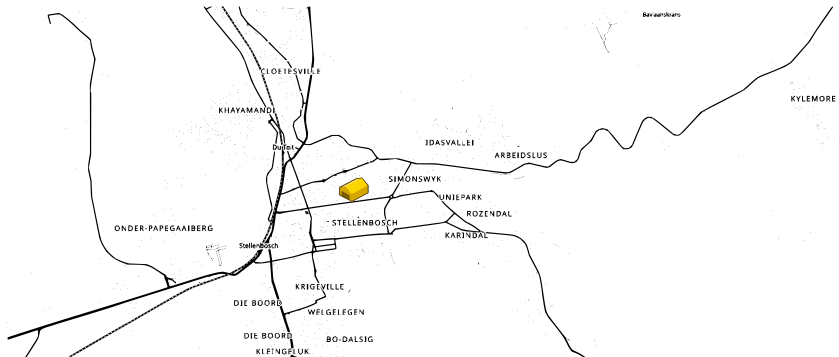


Stellenbosch Unit for Operations Research in Engineering
Department of Industrial Engineering

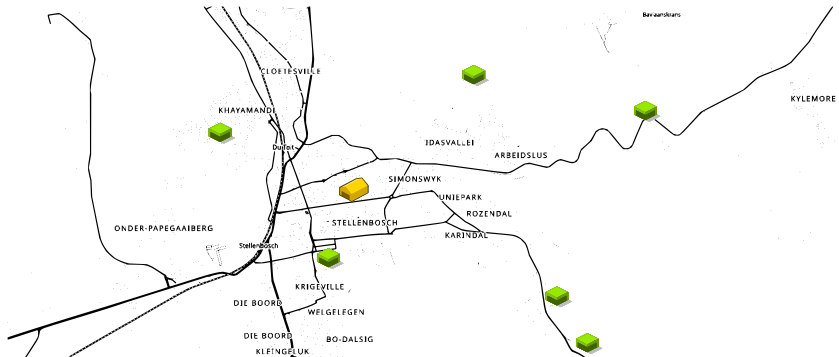
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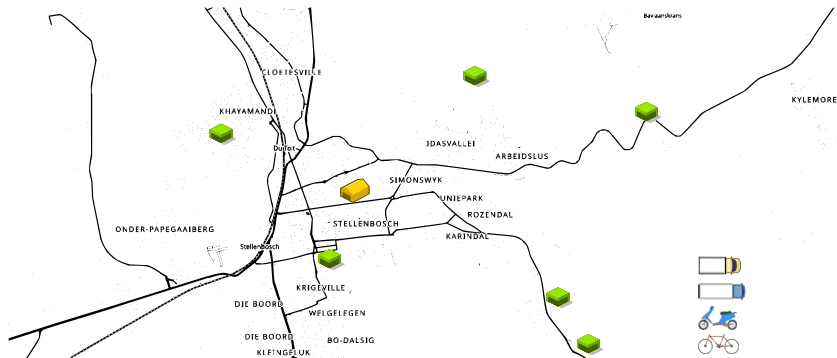
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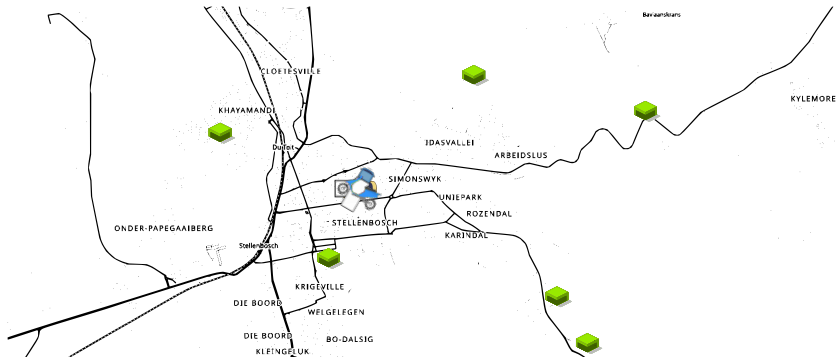
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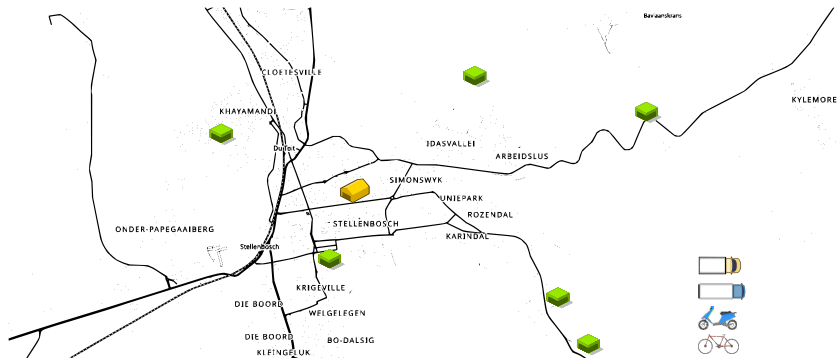
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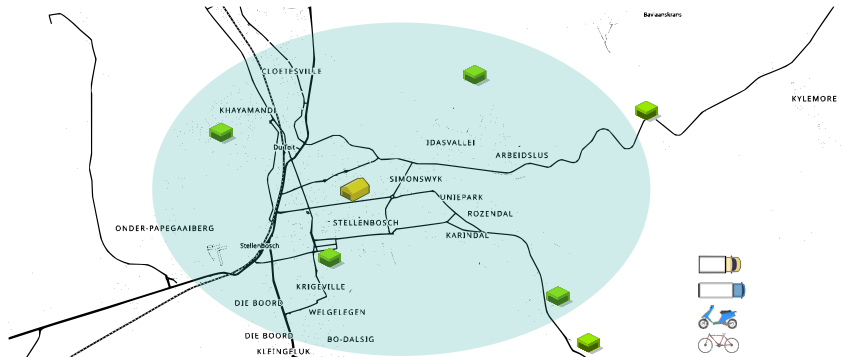
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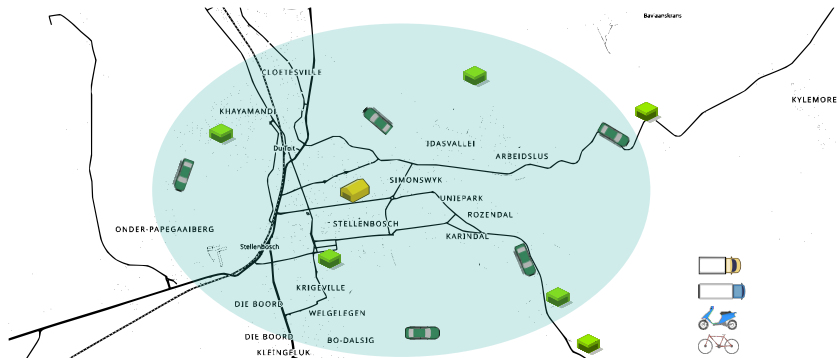
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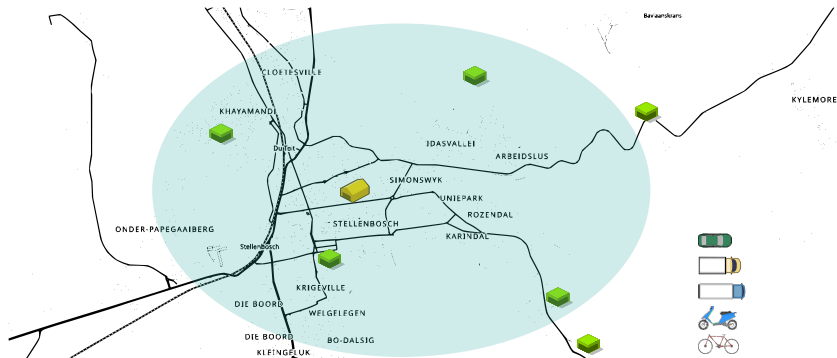
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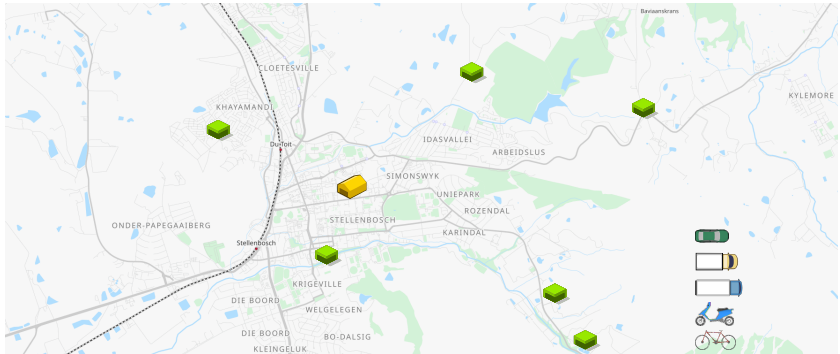
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Visual concept



- The case for a solution
- Formalised research aim
- Briefly explain simulation
- Expound on agent-based modelling
- Case Study
- KPI's
- Preliminary results

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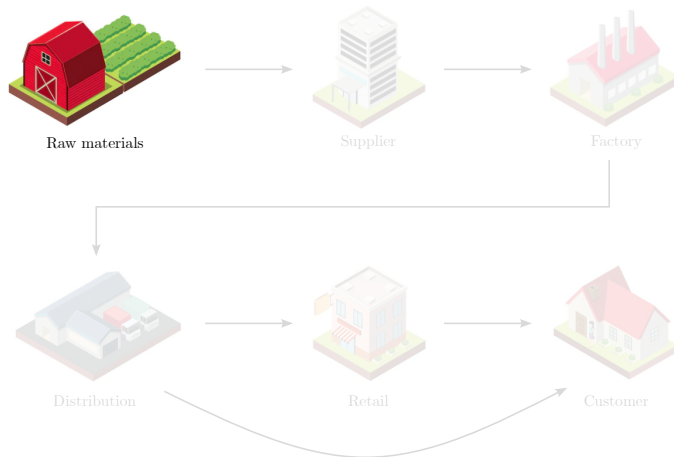
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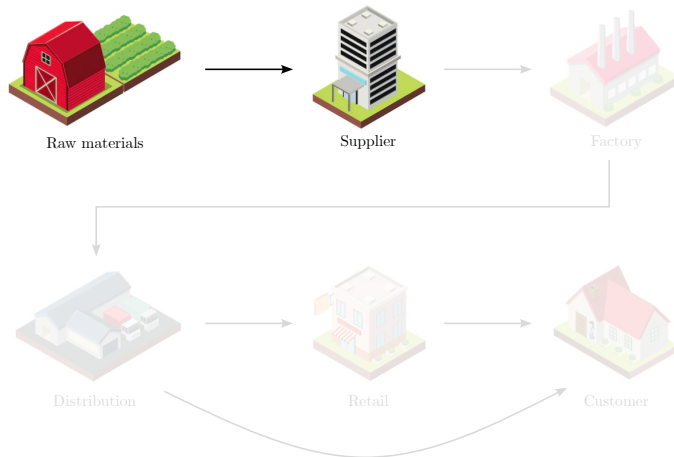
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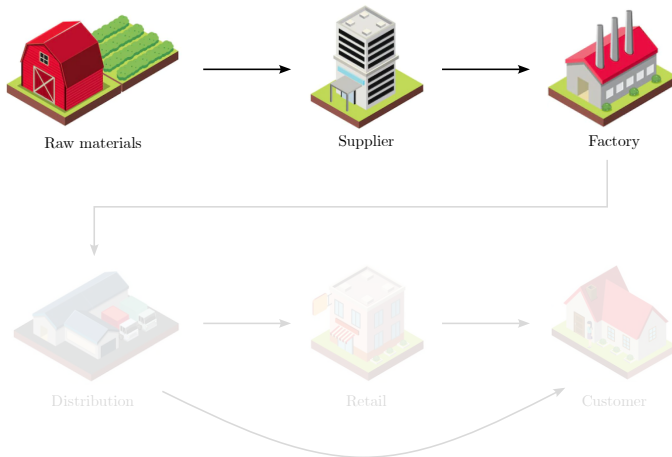
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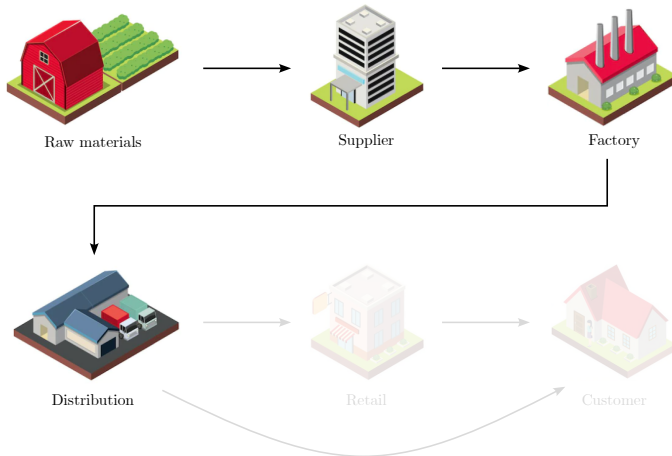
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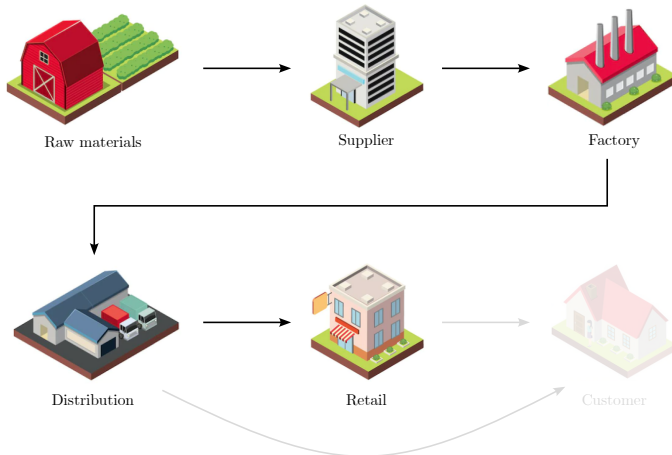
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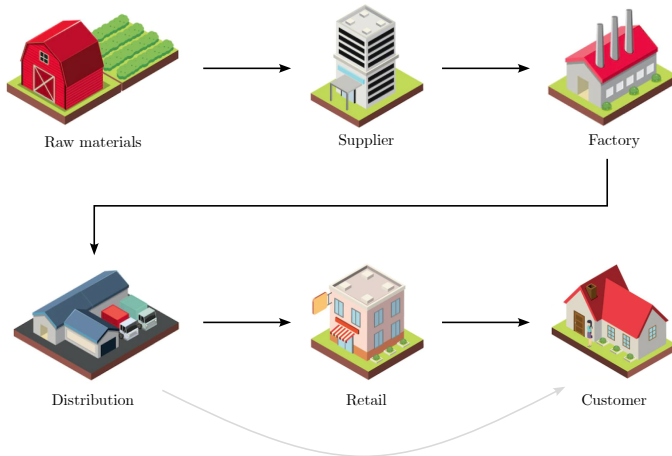
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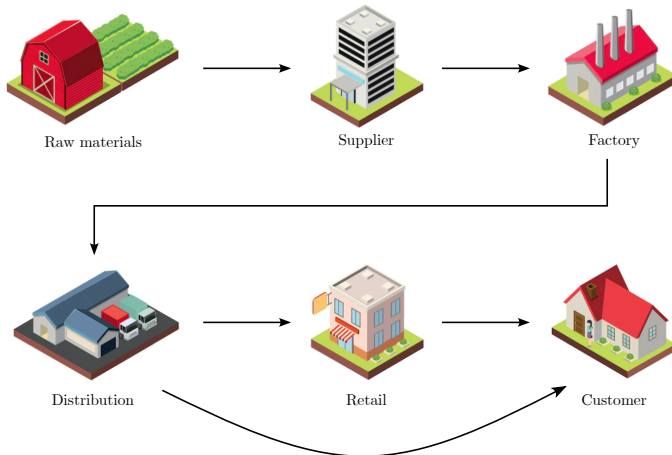
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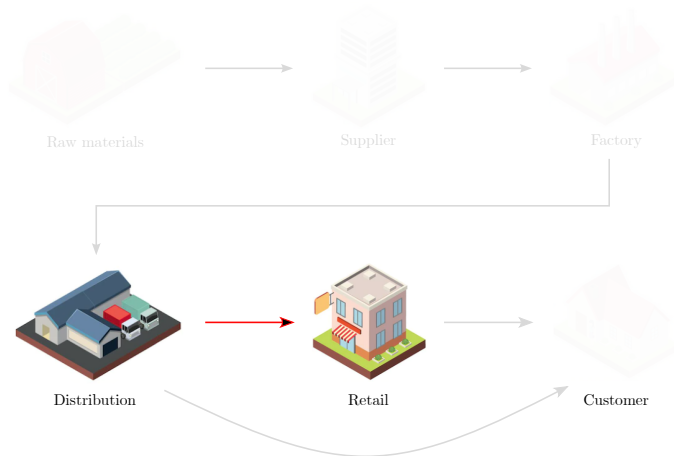
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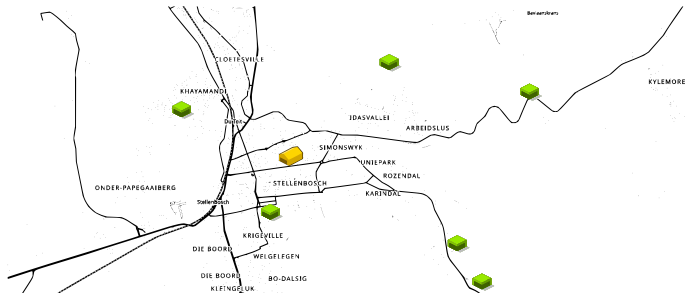
The case for a solution



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Formalised research aim

Primary aim:

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- Design a **generic framework** for providing decision support pertaining to the middle-mile delivery logistics of a distributor.

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Secondary aim:

Formalised research aim

Primary aim:

- Design a **generic framework** for providing decision support pertaining to the middle-mile delivery logistics of a distributor.

Secondary aim:

- Implement (on a personal computer) an instantiation of the framework capable of analysing the solutions to an **agent-based model** formulated over a rolling planning horizon.

Inputs:

- time-stamped commodity demand volumes,
- time windows,
- details about a set of delivery modes,
- data describing the fleets of available delivery vehicles, and
- information related to the delivery transport infrastructure.

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Objective:

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- Attain high-quality trade-offs between **minimising the total operational cost and minimising the environmental impact** of the entire delivery assignment and routing schedule.

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Decision variables:

- Vehicle types, and
- the proportion of the various vehicle types.

Formalised research aim

Outputs:

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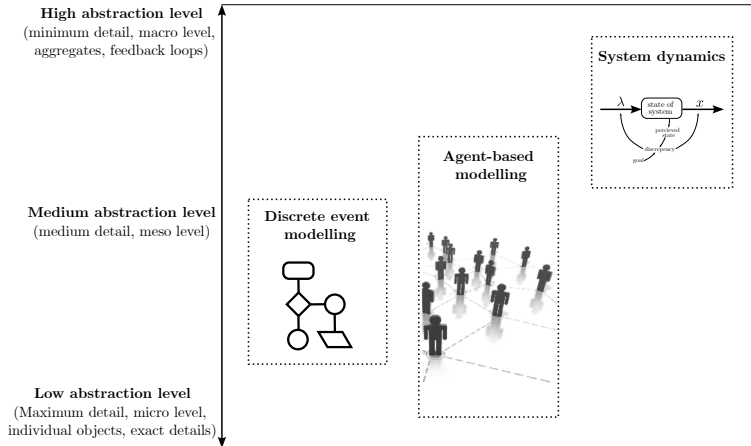
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- an assignment of vehicles of the appropriate transportation modes to service the set of retailers,
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- delivery schedules.

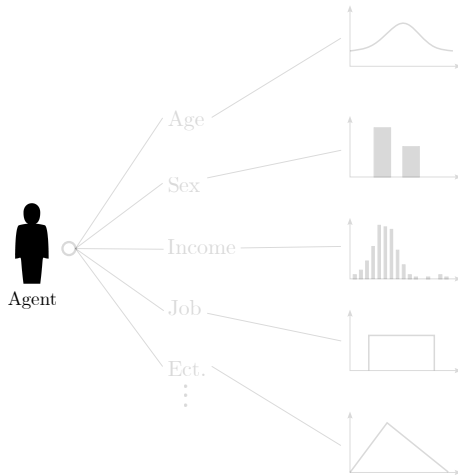
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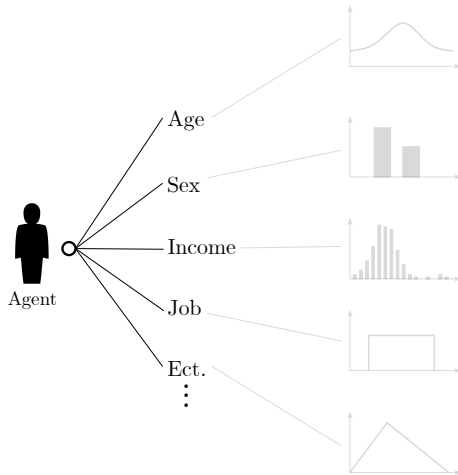
Simulation



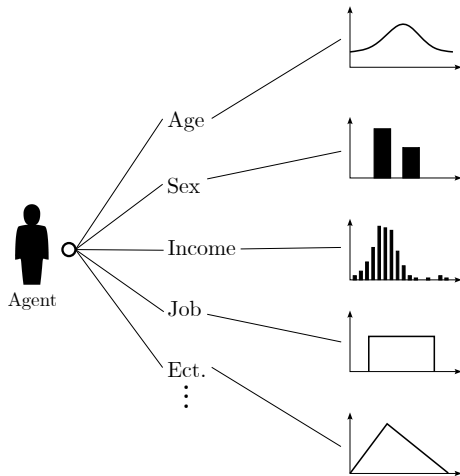
Agent-based modelling



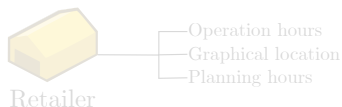
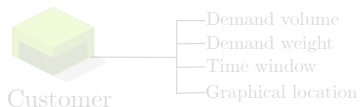
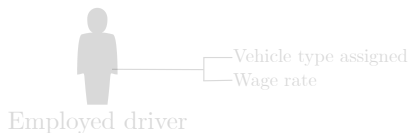
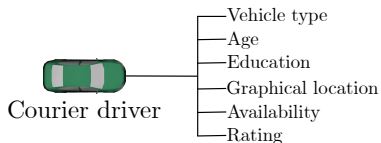
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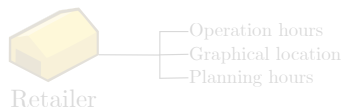
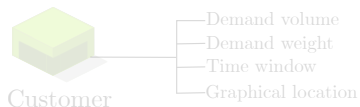
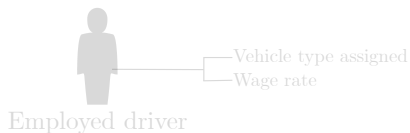
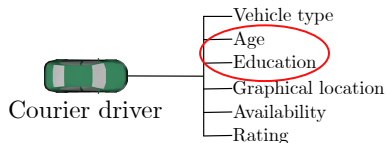
Agent-based modelling



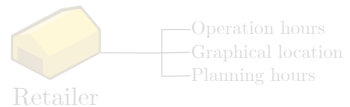
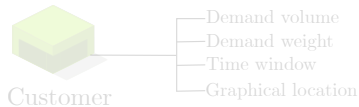
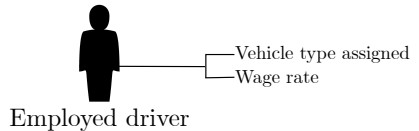
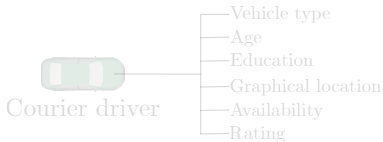
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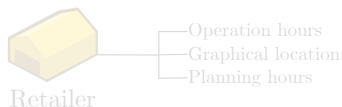
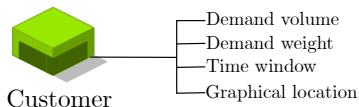
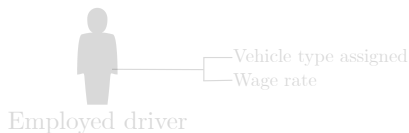
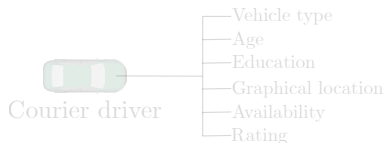
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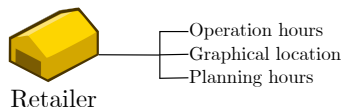
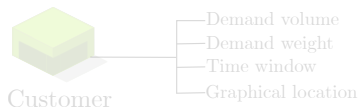
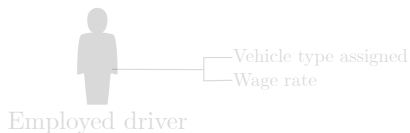
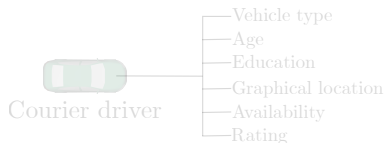
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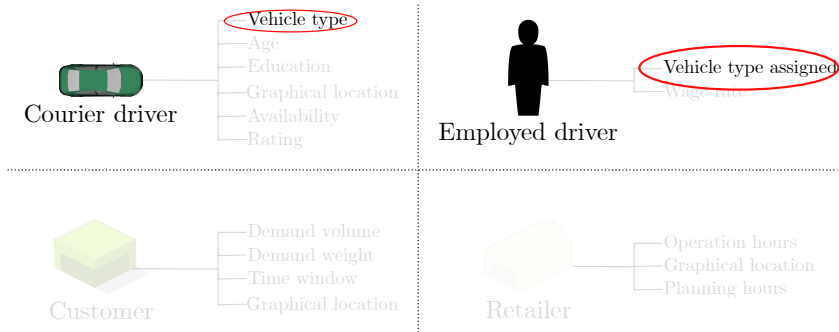
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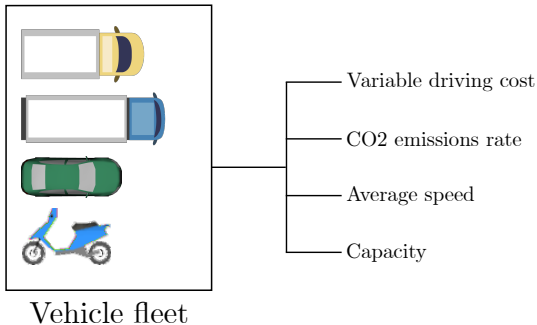


Agent-based modelling



Agent-based modelling





Case study

Index	Geocode	Suburb	Qty	Total Boxes	Created
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2	-26.2557441553767, 27.8530539252317	Lenasia DC - Moletsane	7	1	2022/01/11 06:38
3	-26.1532047261376, 27.7810127336621	Lenasia DC - Kagiso	6	1	2022/01/11 07:00
4	-26.4581090940578, 27.7663940112543	Lenasia DC - Lawley	7	1	2022/01/11 07:00
5	-26.2127842718698, 28.4858571271261	East Rand DC - Springs	7	1	2022/01/11 07:00
6	-25.2590599916125, 28.1325106949337	PTA - Hammanskraal	11	1	2022/01/11 07:00
7	-25.5886563413439, 27.9792621369627	PTA - Garankuwa	5	1	2022/01/11 07:00
8	-26.2150966221058, 27.8769849636938	Lenasia DC - Meadowlands	11	1	2022/01/11 07:00
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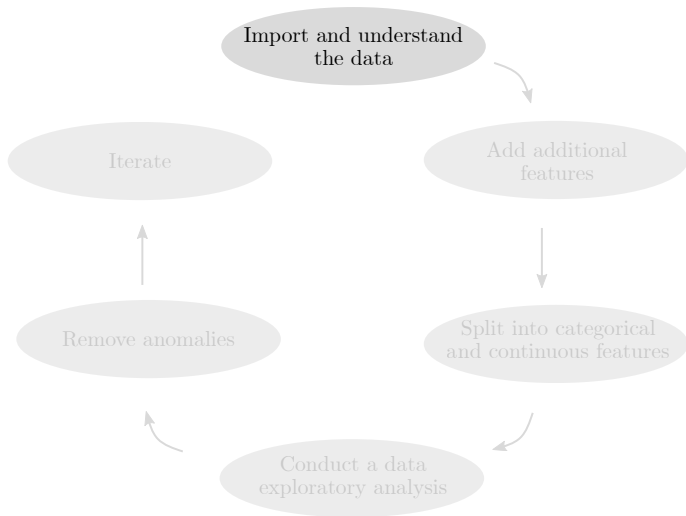
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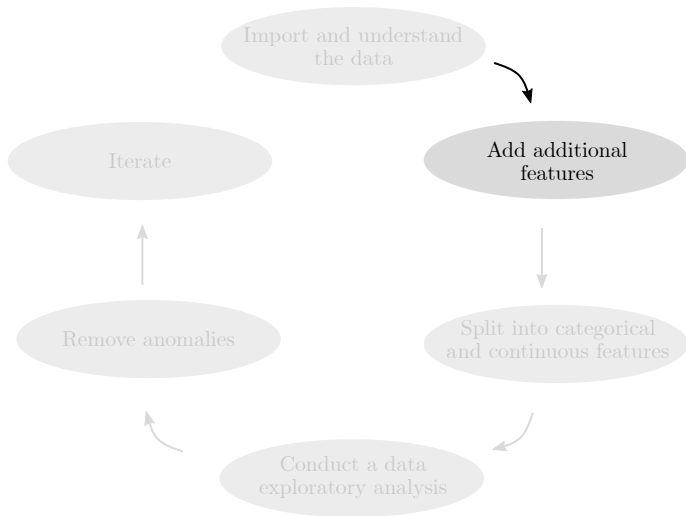
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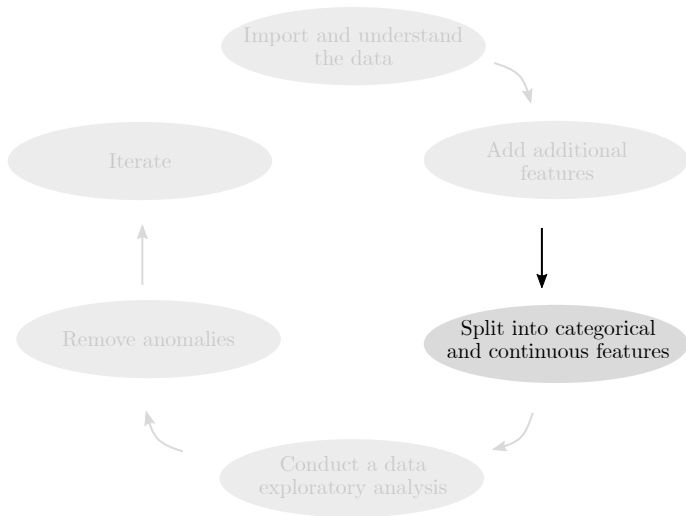
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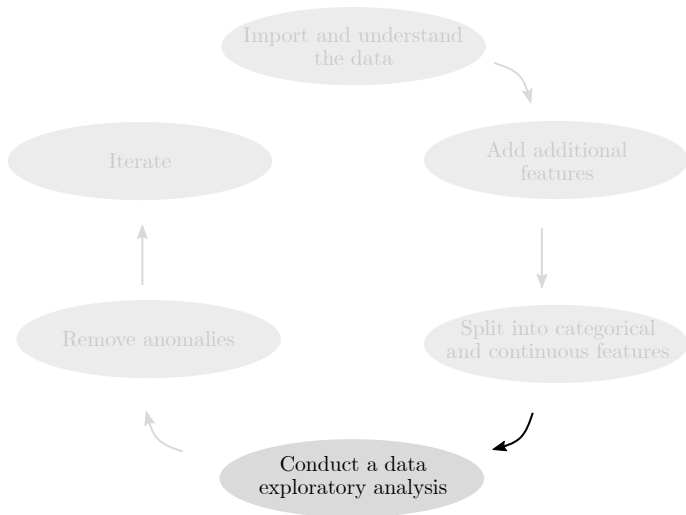
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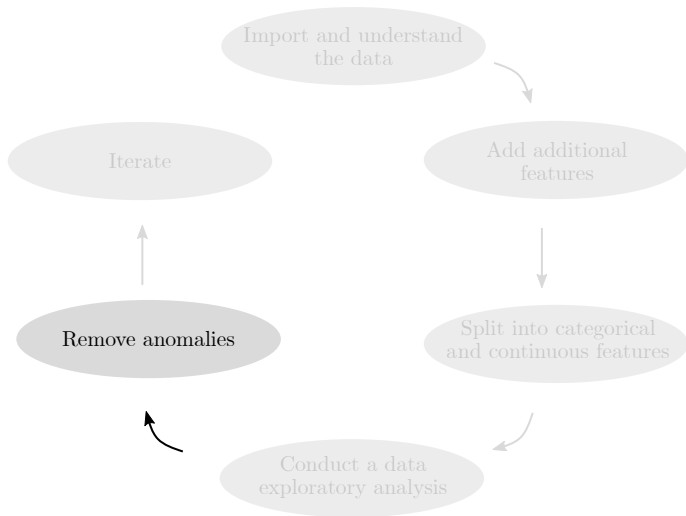
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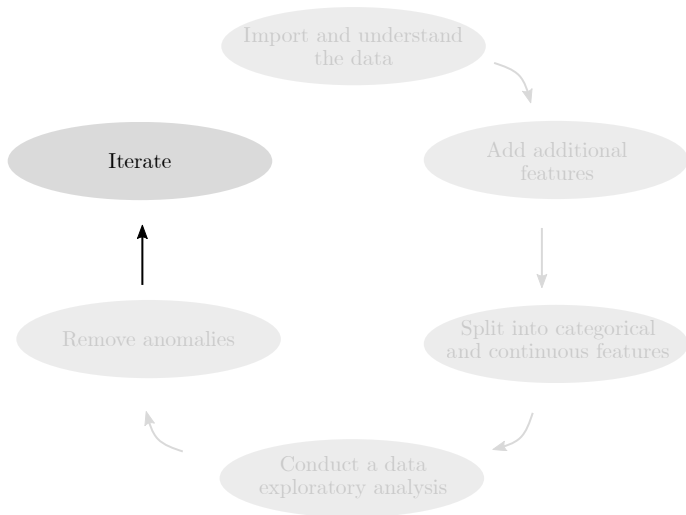
Case study



Case study



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More about the data:

- 204789 entries over the year,
- 333 operating days per year,
- 7 depots delivering to distinct regions,
- each depot delivers to between 80-350 retailers per day,
- requires a metaheuristic.

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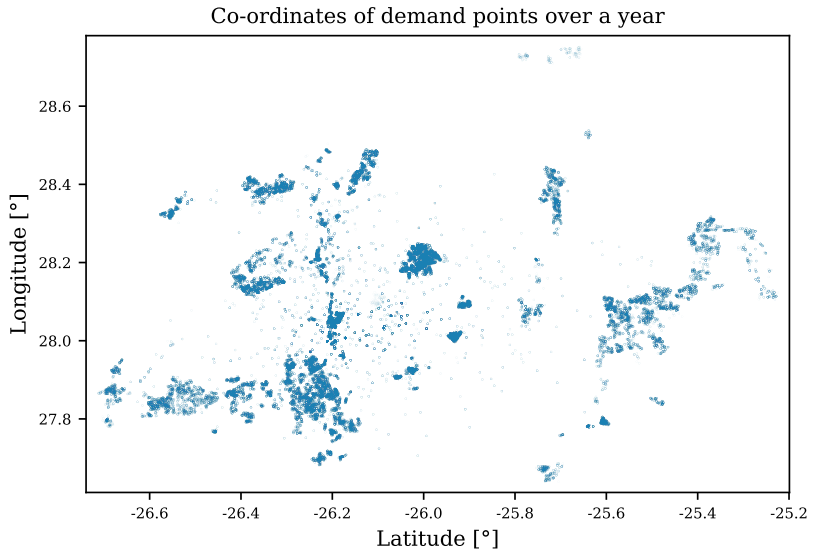
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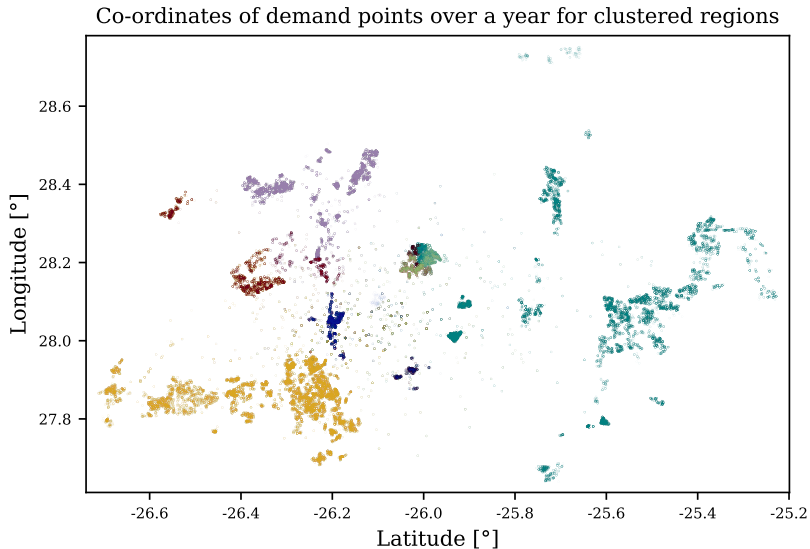
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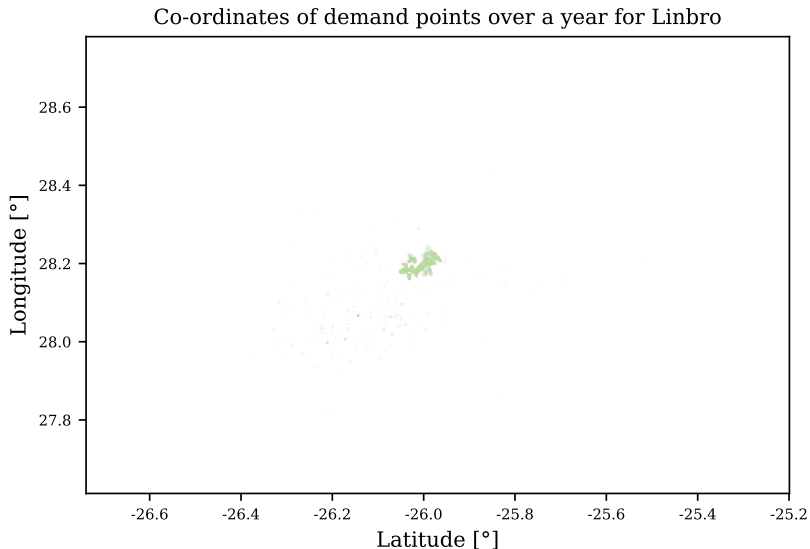
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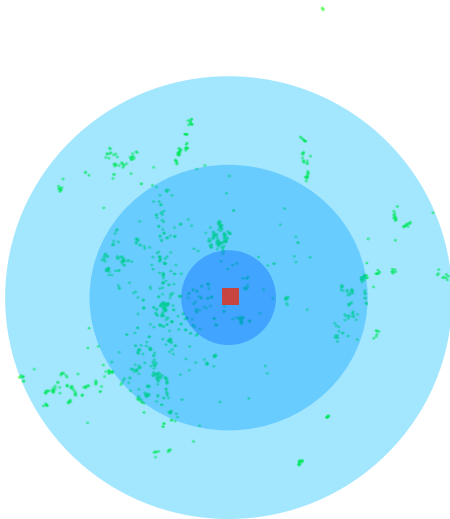
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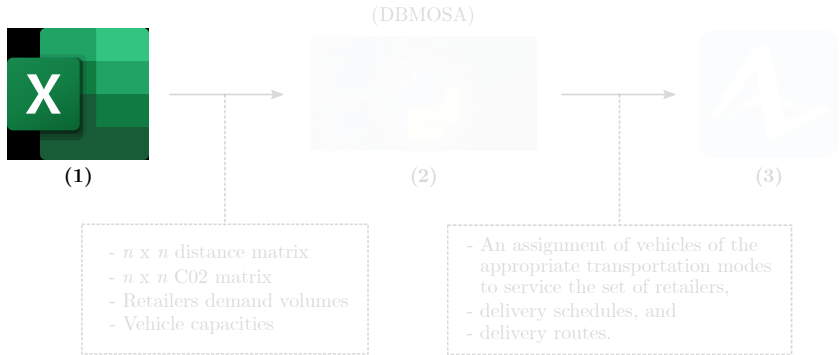




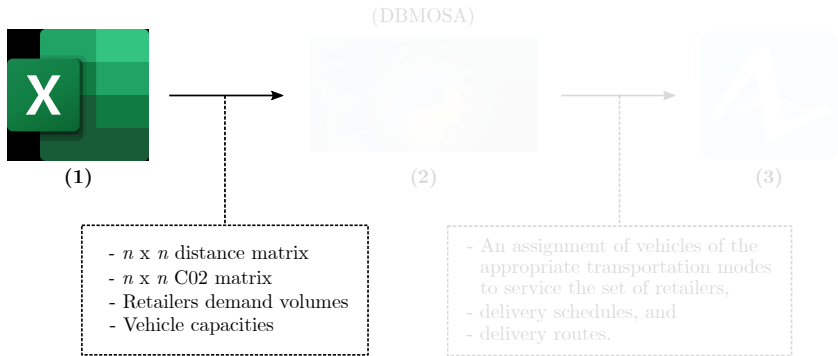




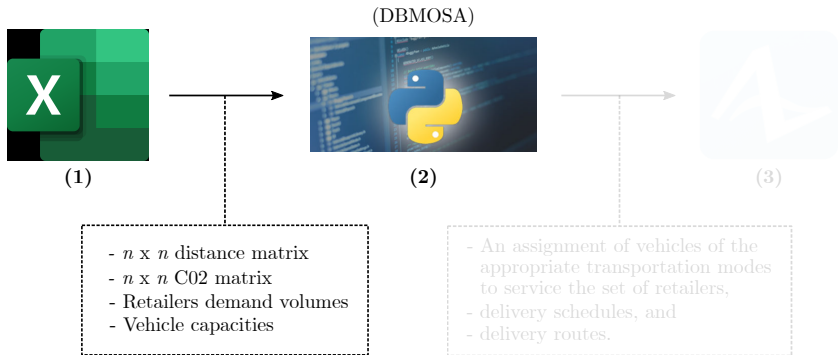
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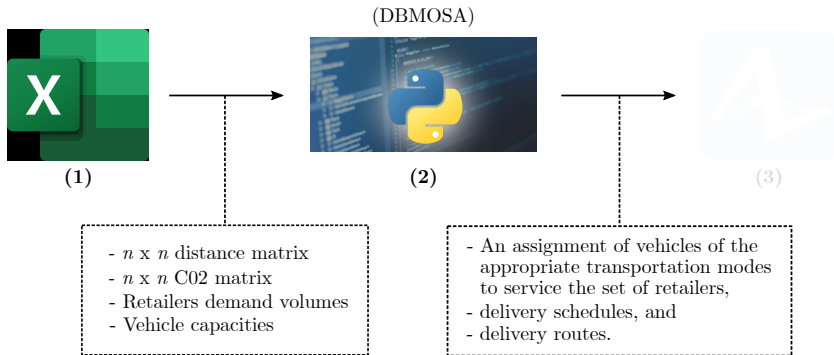
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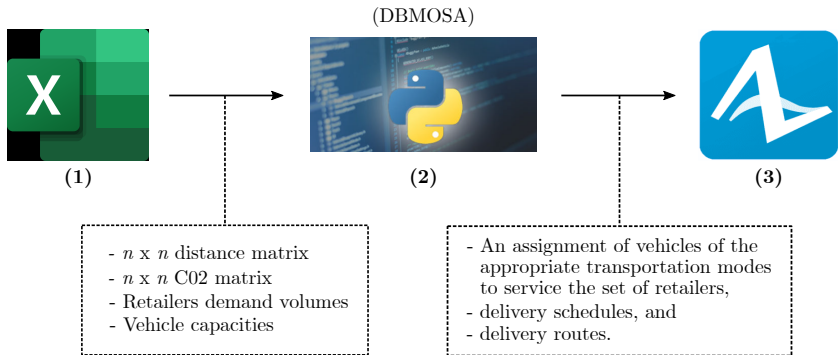
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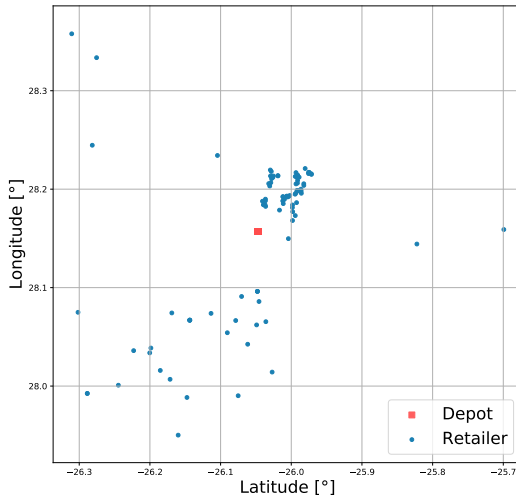
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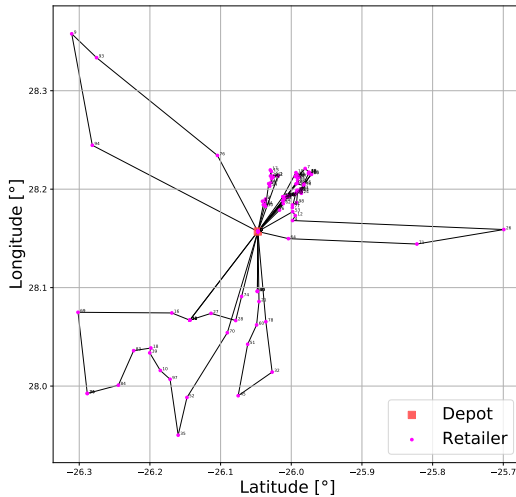
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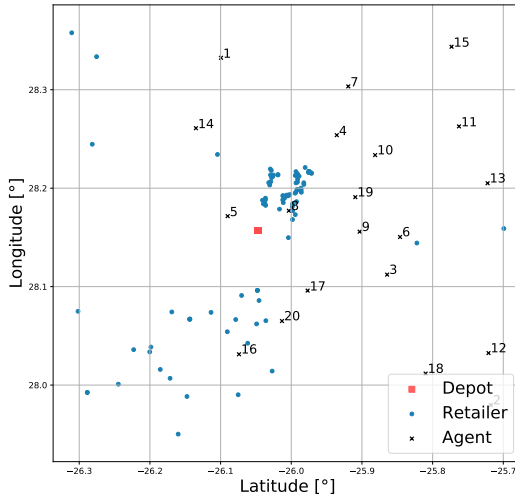
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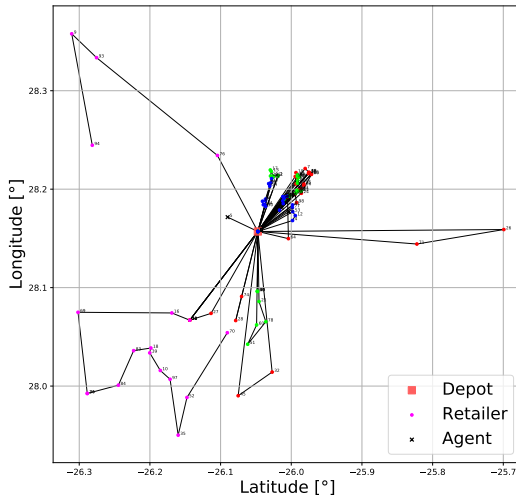
Case Study



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Case Study



Decision variables:

- Vehicle types, and
 - the proportion of the various vehicle types.
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- What proportion of courier drivers starts to become unhelpful?
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