Collaborative optimization model to solve horizontal collaboration among stakeholders using VRP

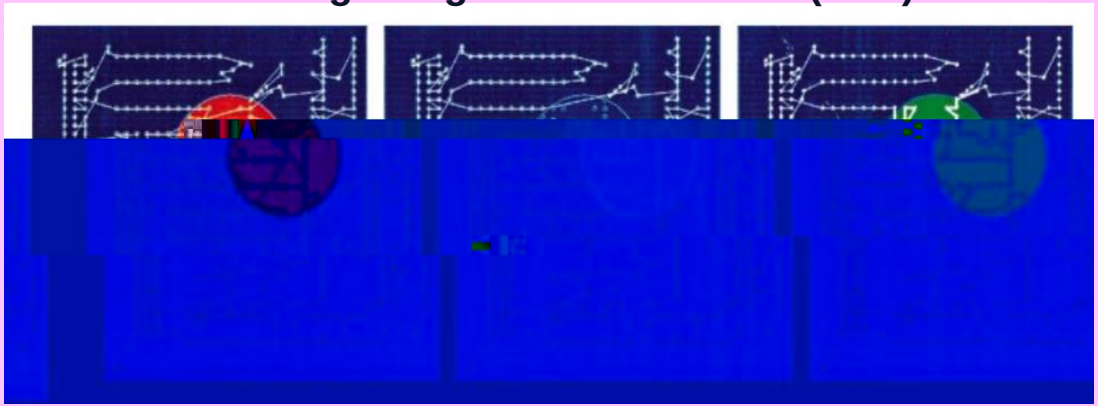
LOGISTAR - Enhanced data management techniques for real time logistics planning and scheduling

LOGISTAR: Global optimization

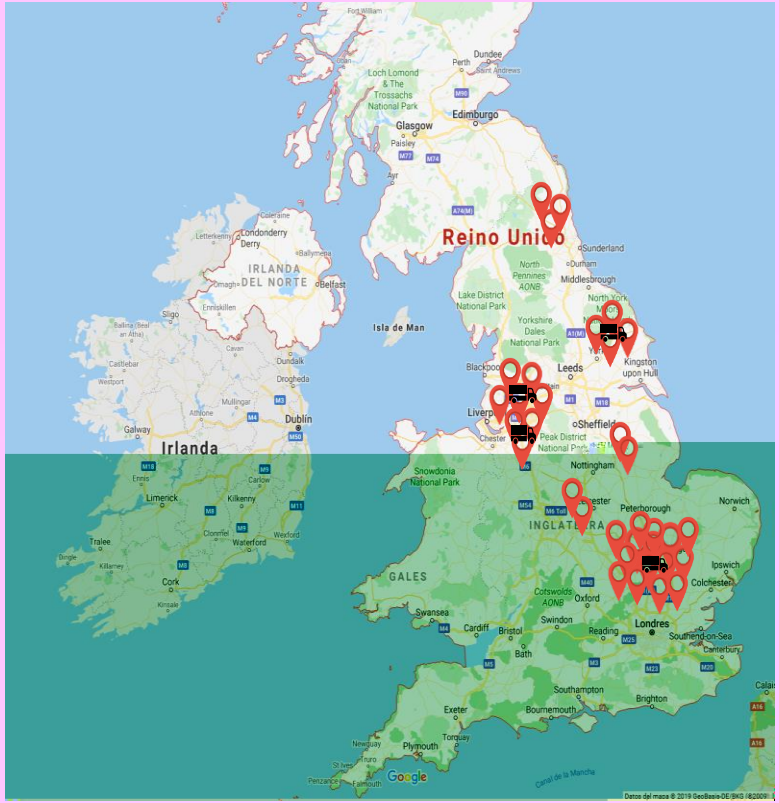
The LOGISTAR project focuses on optimizing distinct multi-point route VRP problems:

- Capacity and type of good restricted
- Co-loading, pickup and delivery restricted
- Multi-depot, backhauling and time-dependent

Large neighborhood Search (LNS)

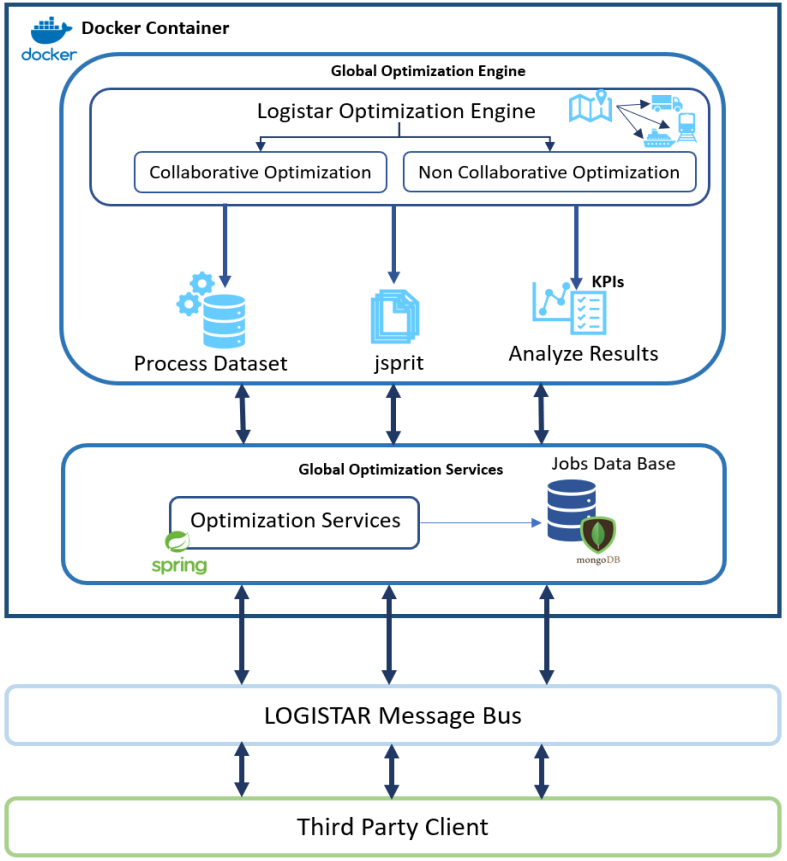


LOGISTAR: Global optimization



- Process Data
- Search Solution
- Best Solution
  - Performance of the Algorithms
  - KPIs

LOGISTAR: Global Optimization Module Architecture



LOGISTAR: Global Optimization Module Architecture

Selected JSprit framework as the optimization engine

- https://jsprit.github.io/
- Java-based lightweight and flexible framework based on LNS
- Scalates well to distinct VRP variants

Implementation of the model

- Selection of routing engine
- Implementation of cost function
- Implementation of new restrictions
- Evaluation on data provided by stakeholders

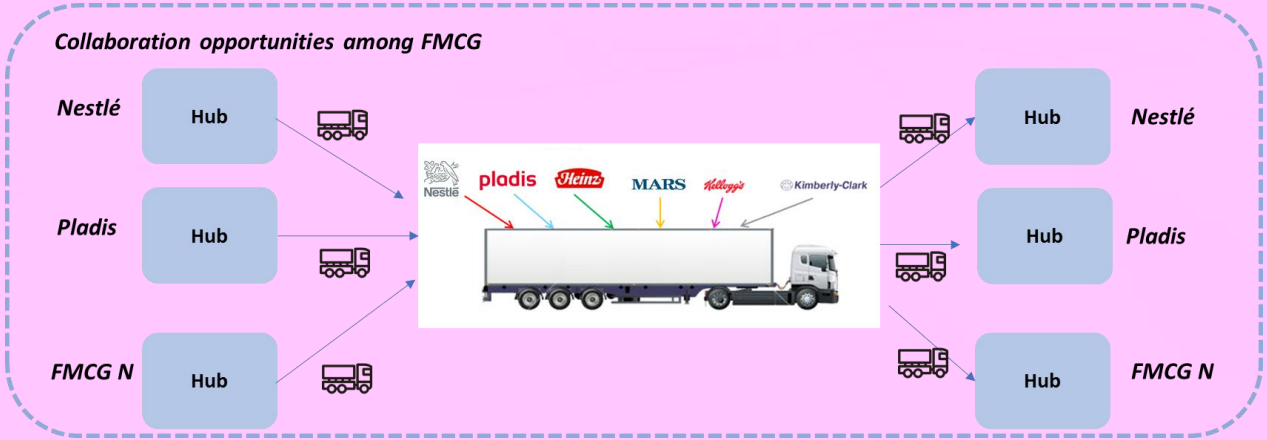
Linving Labs

- Living Labs
  - **Backhauling and Co-loading**
    - Process of **various information** coming from the different companies
      - schedules, resources, constraints, truck, positions... empty return legs…
    - The operators will have an **overall overview of the status** of the operations through the real-time dashboards and the real-time information on road transport system.
  - **Synchromodality**
    - Real time **re-planning due to a disrupting event**: corrective and preventive
      - Planning of synchromodal routes basing on real time events.
      - Dynamic assignation of freight transport networks.
    - Real time **status on goods movements**: position of vehicles, arrival time of cargo fleets.

Living Lab 1

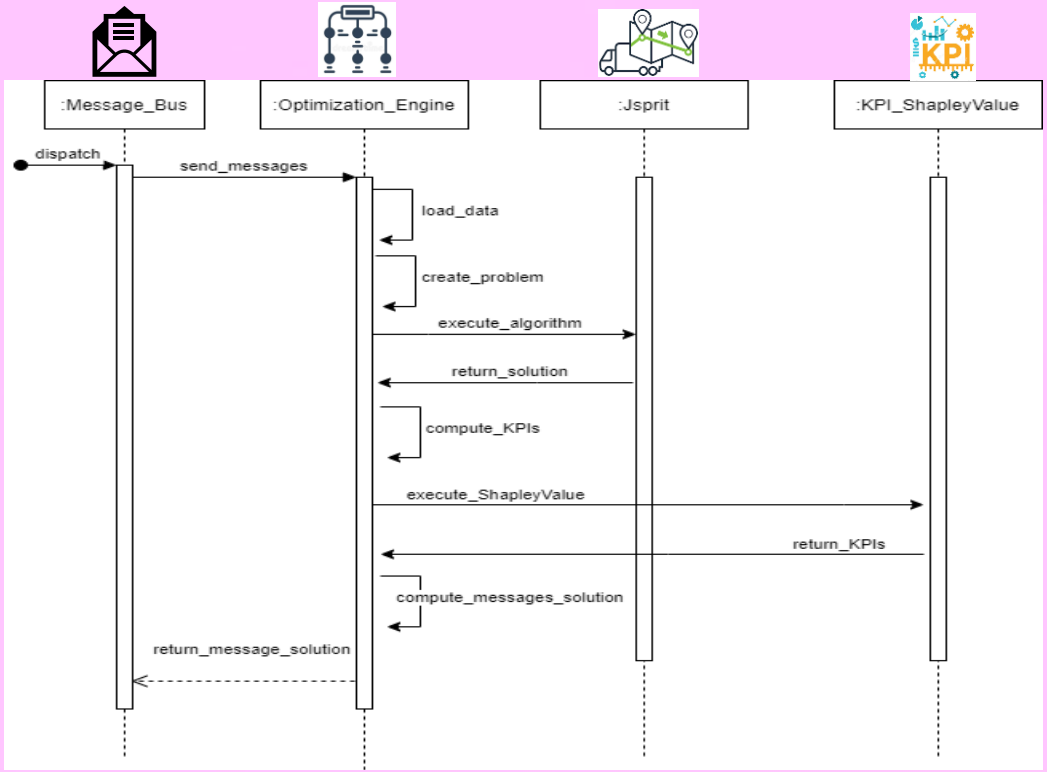
Backhauling and Co-loading

To improve backhauling management
Overall overview of the status of the operations



Living Lab 1

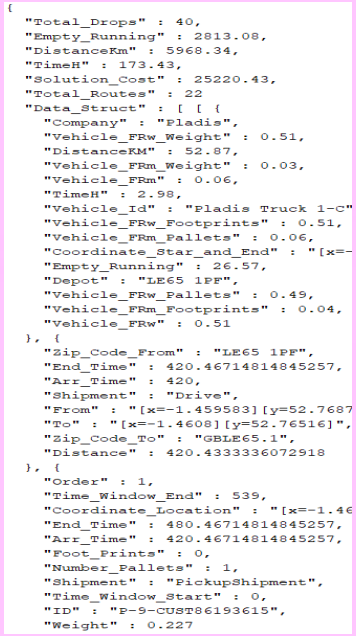
Optimization process flow



Living Lab 1

Input Data

Output Data



Living Lab 1

Results of a test case where a collaborative solution is created

01:00 - 02:00	[x=-1.4][y=5.7]	Pickup		(1p|0fp|0.23w - 01:00 h) - TW:(00:00-08:59) FILL:(1p - 0fp)
01:00 - 02:00	[x=-1.4][y=5.7]	Pickup		(2p|1fp|0.64w - 01:00 h) - TW:(00:00-08:59) FILL:(3p - 1fp)
02:00 - 02:42	GBLE65.1	Drive	B46 1AL	(38 km - 00:42 h)
02:42 - 03:42	[x=-1.7][y=5.5]	Pickup		(18p|9fp|9.98w - 01:00 h) - TW:(00:00-06:45) FILL:(21p - 10fp)
02:42 - 03:42	[x=-1.7][y=5.5]	Pickup		(14p|7fp|7.53w - 01:00 h) - TW:(00:00-06:45) FILL:(35p - 17fp)
02:42 - 03:42	[x=-1.7][y=5.5]	Pickup		(13p|6fp|6.66w - 01:00 h) - TW:(00:00-06:15) FILL:(48p - 23fp)
03:42 - 05:45	B46 1AL	Drive	S80 3EG	(111 km - 02:03 h)
05:45 - 06:45	[x=-1.0][y=5.2]	Delivery		(13p|6fp|6.66w - 01:00 h) - TW:(05:45-06:45) FILL:(35p - 17fp)
05:45 - 06:45	[x=-1.0][y=5.2]	Delivery		(14p|7fp|7.53w - 01:00 h) - TW:(06:15-07:15) FILL:(21p - 10fp)
05:45 - 06:45	[x=-1.0][y=5.2]	Delivery		(18p|9fp|9.98w - 01:00 h) - TW:(06:15-07:15) FILL:(3p - 1fp)
06:45 - 07:53	S80 3EG	Drive	GBLE11.5	(60 km - 01:07 h)
07:53 - 08:59	[x=-1.2][y=5.7]	Delivery		(2p|1fp|0.64w - 01:05 h) - TW:(08:59-09:30) FILL:(1p - 0fp)
07:59 - 08:59	[x=-1.2][y=5.7]	Delivery		(1p|0fp|0.23w - 01:00 h) - TW:(08:59-09:30) FILL:(0p - 0fp)
08:59 - 09:28	GBLE11.5	Drive	LE65 1PF	(26 km - 00:29 h)

Motivation for intermodality

- Growing transport volumes call for a shift in transport modes
  - Congestion, climate change and air pollution
- Move transportation volume from road-centered towards other alternatives
  - Improve the characteristics of logistic chains

Intermodality

Aims to integrate transport volumes and modes

- bundling of flows, switching the transport mode
- requires close cooperation between actors
- In line with EU transportation policy objectives, to foster a shift from road to rail
  - Reduce dependence on imported oil
  - Cutting carbon emissions by 60%

Intermodal containers

To enable intermodality we rely on intermodal containers

- Without handling the freight itself during changes of modes
  - There is no reloading nor unloading
- It enables efficient and effective solutions to share costs
  - Based on cooperation and integration
- Containers are used to transport materials across intermodal hubs

Optimization process

The approach is based on the optimization of a 3-way process

- Pre-haul (pickup process)
- Long-haul (door-to-door transit of containers)
- End-haul (delivery process)
  - Pre-haul and end-haul are usually road-based, while long-haul is considered for intermodal optimization
  - Objetive is to select intermodal routes and determine container flow so that a performance measure is optimized
  - Non trivial process

Optimization heuristic

Backtrack algorithm is widely used in transportation optimization as a general algorithm

- Some modifications to the general algorithm
- Branching factor is not static for all means of transport
- End-haul (delivery process)

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