Optimisation for Multi-modal Freight Transport: The FOR-FREIGHT project case

Presenter: Dr. Orestis Manos , 03/07/2024

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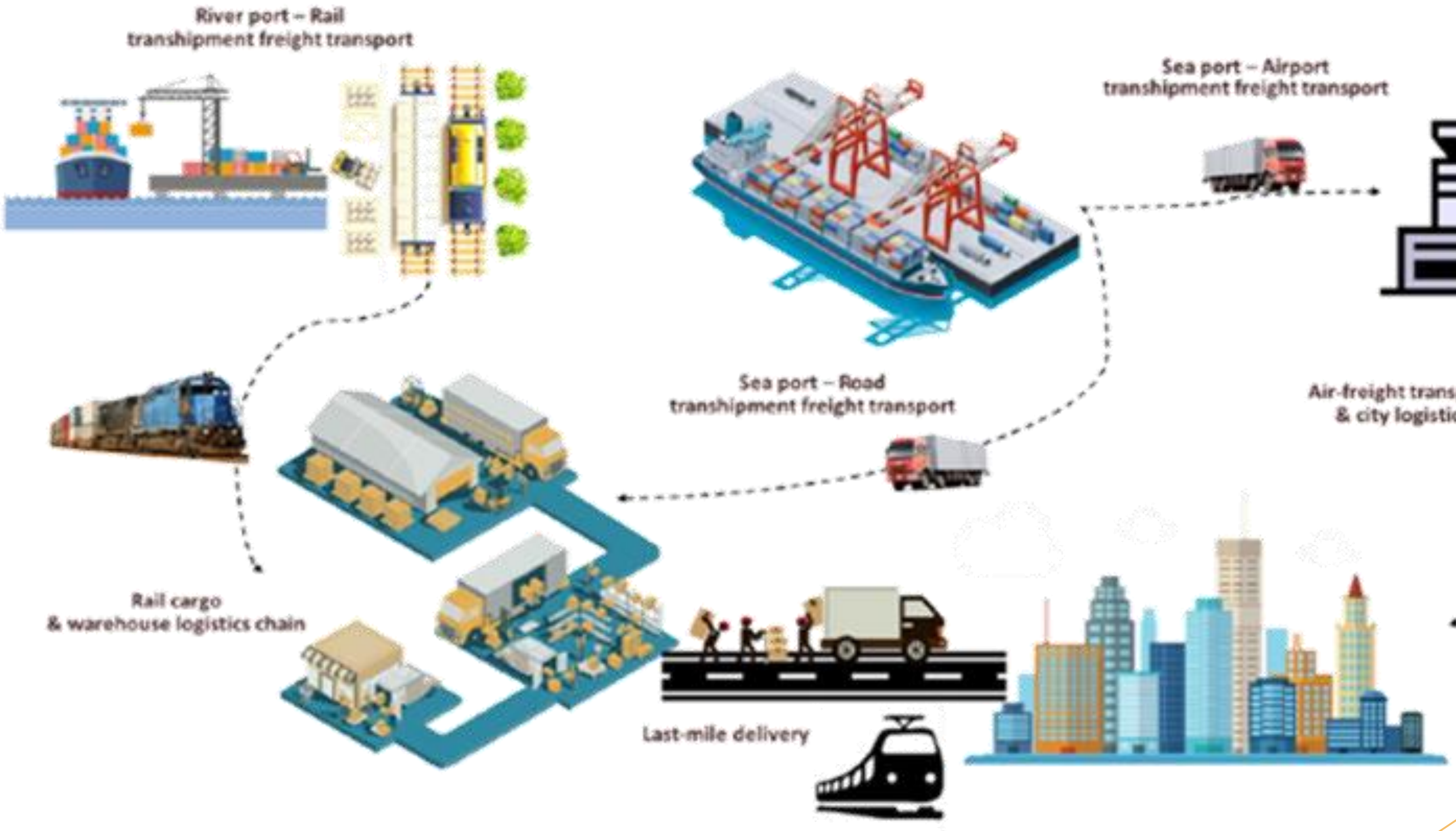
Multimodal Freight Transportation

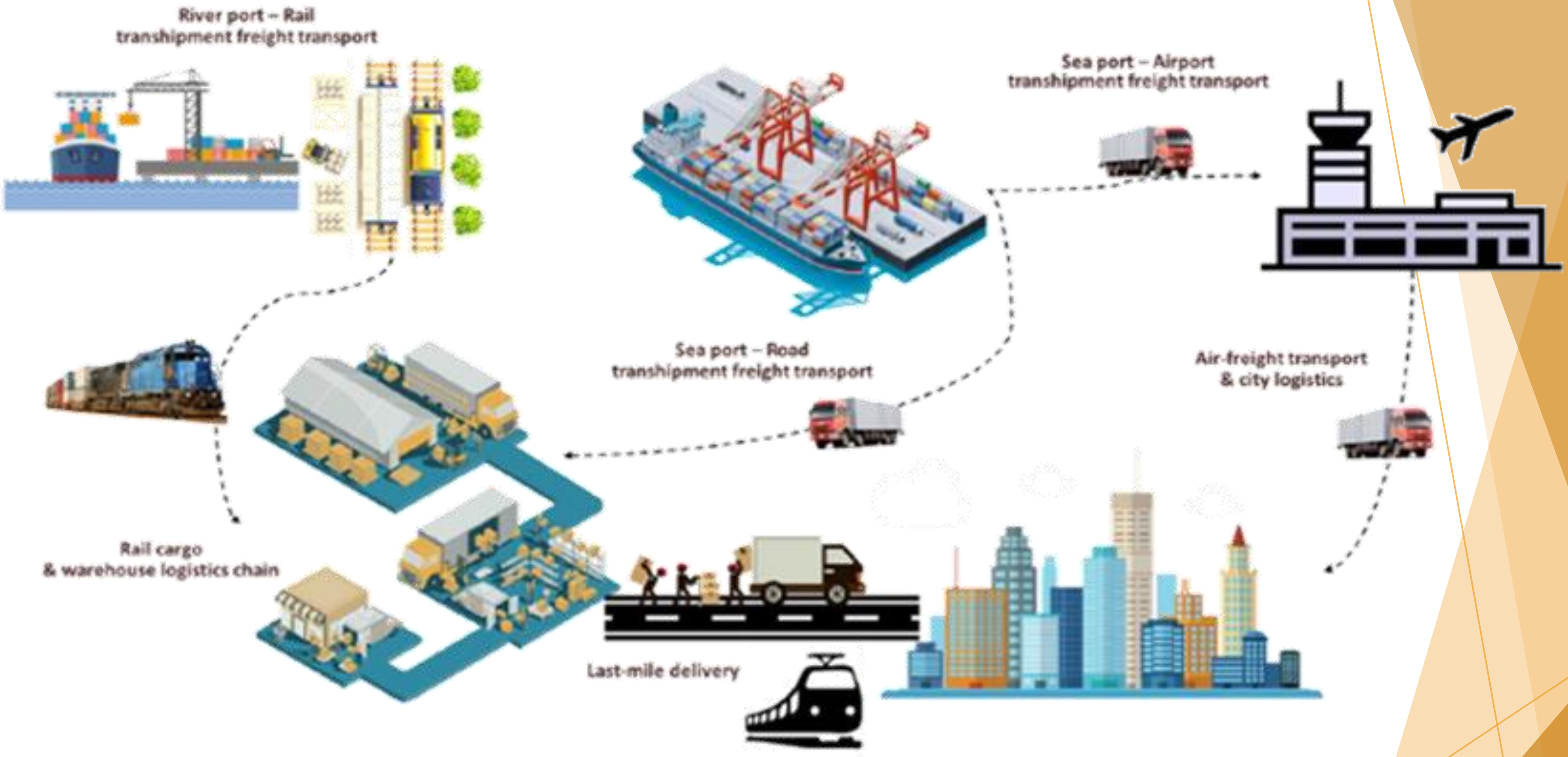
Port of Galati (RO)

Port of Piraeus – Athens International Airport (GR)



Port of Valencia – Metro De Madrid (ES)

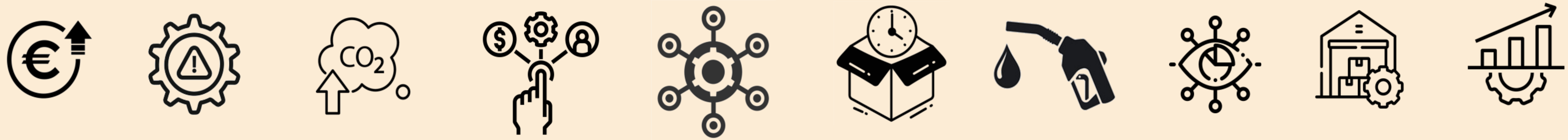
Identified obstacles



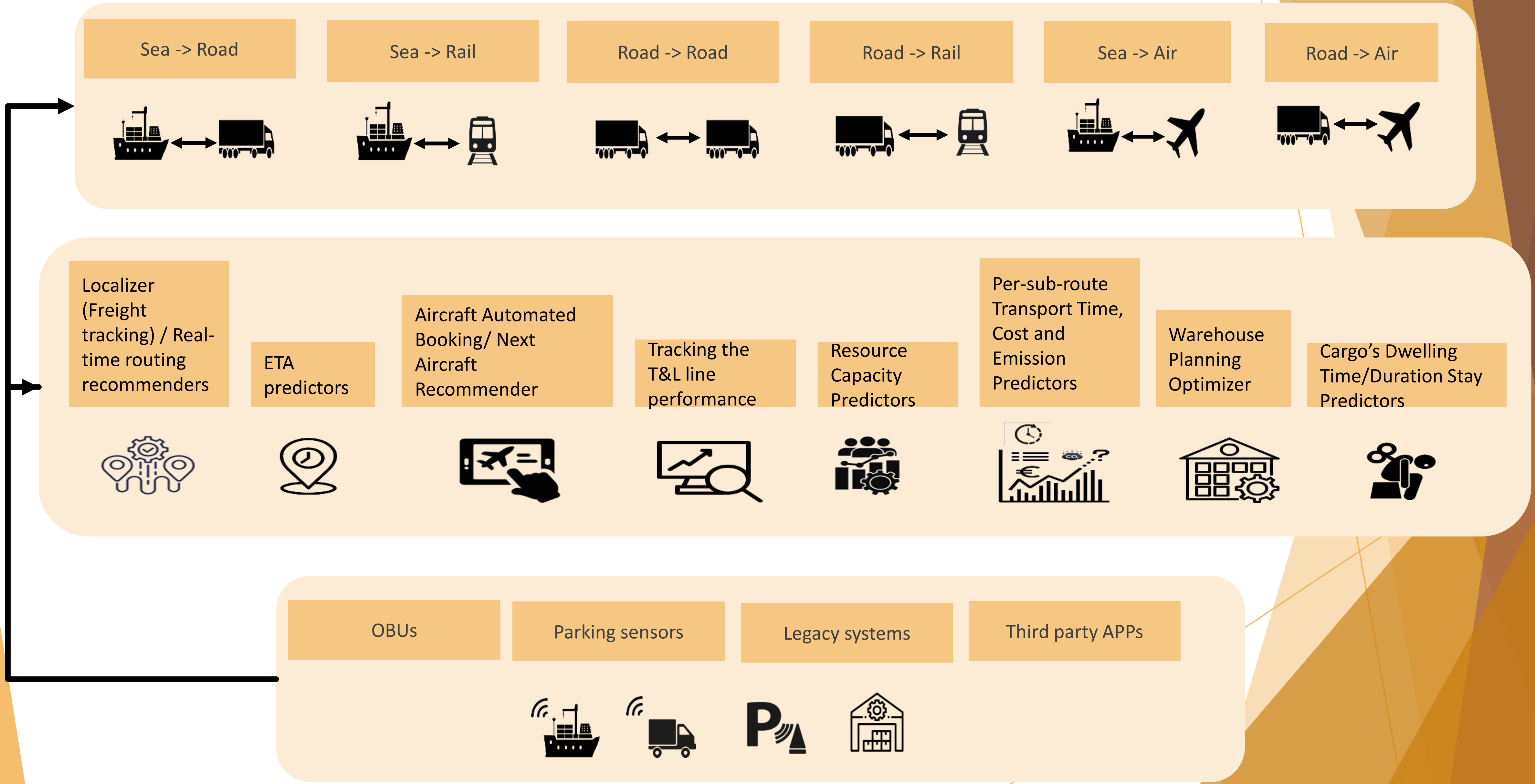
- Lack of unified management systems via common interfaces (low interoperability)
- Low digitalization/automation of the logistics processes
- Sub-optimal resource planning based on outdated information

Real-world problems generation

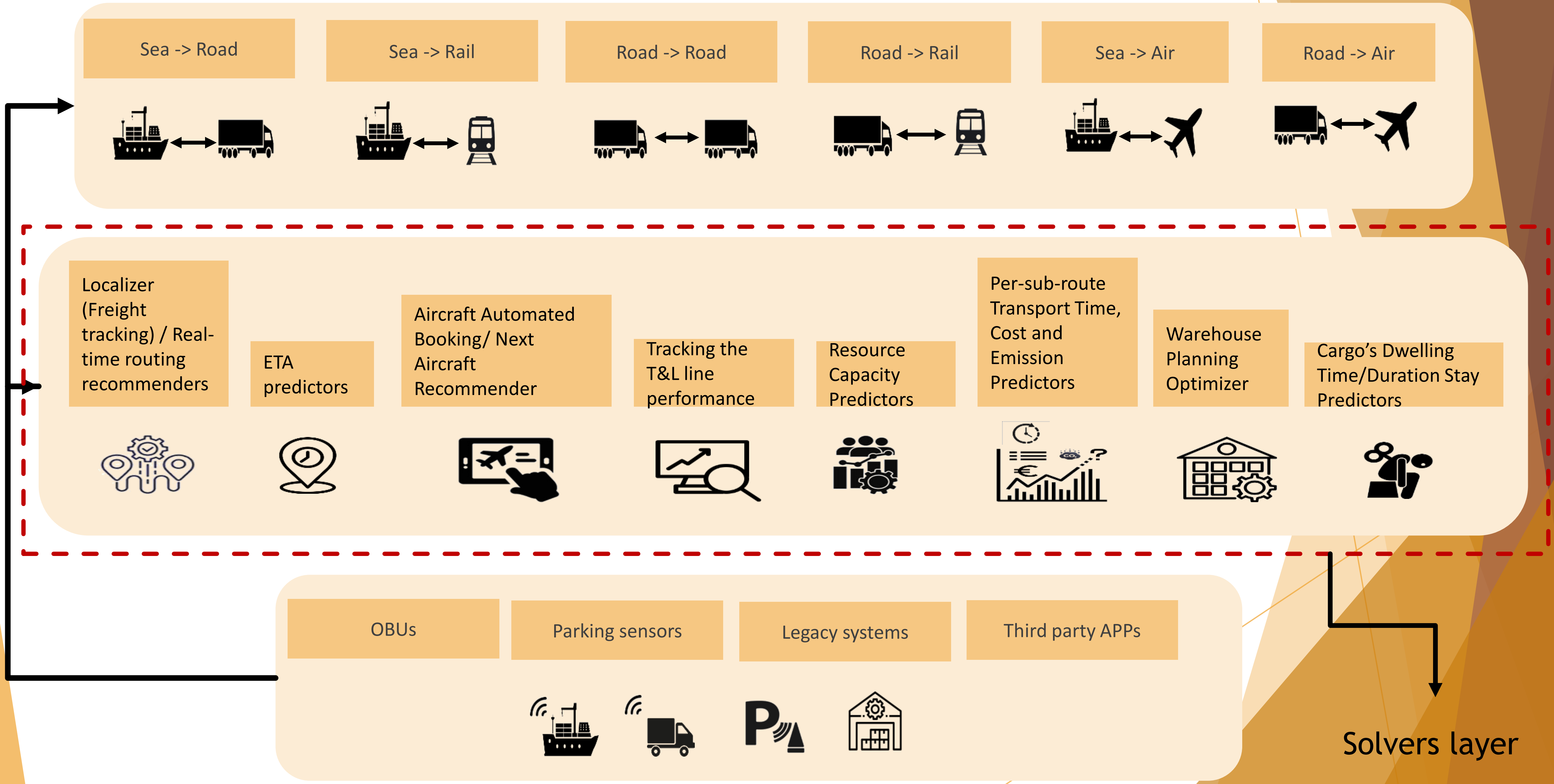
- Increased Costs
- Number of handling errors
- Increased GHG emission
- Sub-optimal resource allocation
- Sub-optimal costumer service
- Long delivery times
- Strong dependence on fuel
- Limited Visibility
- Sub-optimal inventory management
- Sub-optimal T&L line performance



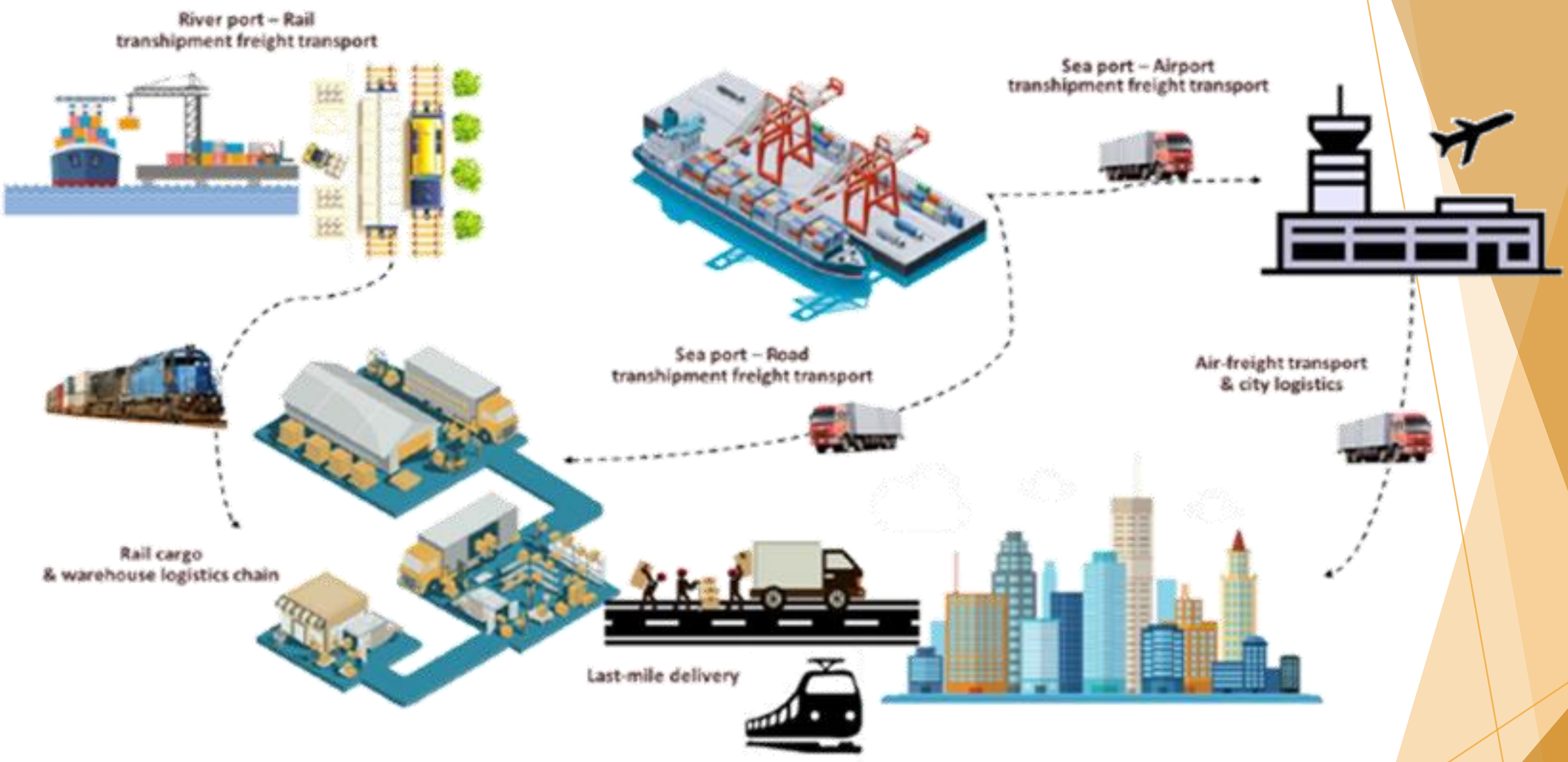
FOR-FREIGHT’s platform



FOR-FREIGHT’s platform



Key advancements



- Establishment of a scalable, sustainable multimodal logistics ecosystem
- Prioritization of interoperability, efficiency, and seamless connectivity.
- Introduce innovative features to enhance logistics operations.
- Optimization of multimodal logistics services for both stakeholders & customers

Involved Technologies

Big Data

Development of a (Big) Data database for handling all the necessary non & real time data of warehouse's status, arrivals predictions, truck/vessel/cargo location & conditions.

Cloud Technology

Back-end Apps and APIs facilitating AI-based decision making, data processing & optimization.

Digital Twins

Support flexible and dynamic E2E transport planning.

Simulating optimal situations based on real time data for **support DSS to improve truck planning & staying at port/terminal and reduce traffic congestion**.

Operational simulations could be exploited for supporting decision-making processes.

AI

DSS on use of resources and end-to-end multimodal transport planning optimization.

Provide real-time door-to-door tracking, forecast of optimal routing and ETA, resource utilization and E2E multimodal transport planning, minimizing the cost function computed based on the defined KPI aspects (resource utilization, time, cost and GHG emissions).

4G/5G/Wi-Fi

E2E communication & interconnection of the diverse systems participating in the overall operations (port arrival notice, ERP, customs clearance, airflight booking etc.)

Robotics

Build an automated/teleoperated semi-autonomous robotic manipulator for cargo/load picking-up and placing activities.

Blockchain

SC governance based on BC for time reduction in the administrative and operational processes, provided by a Hyperledger Fabric blockchain platform.

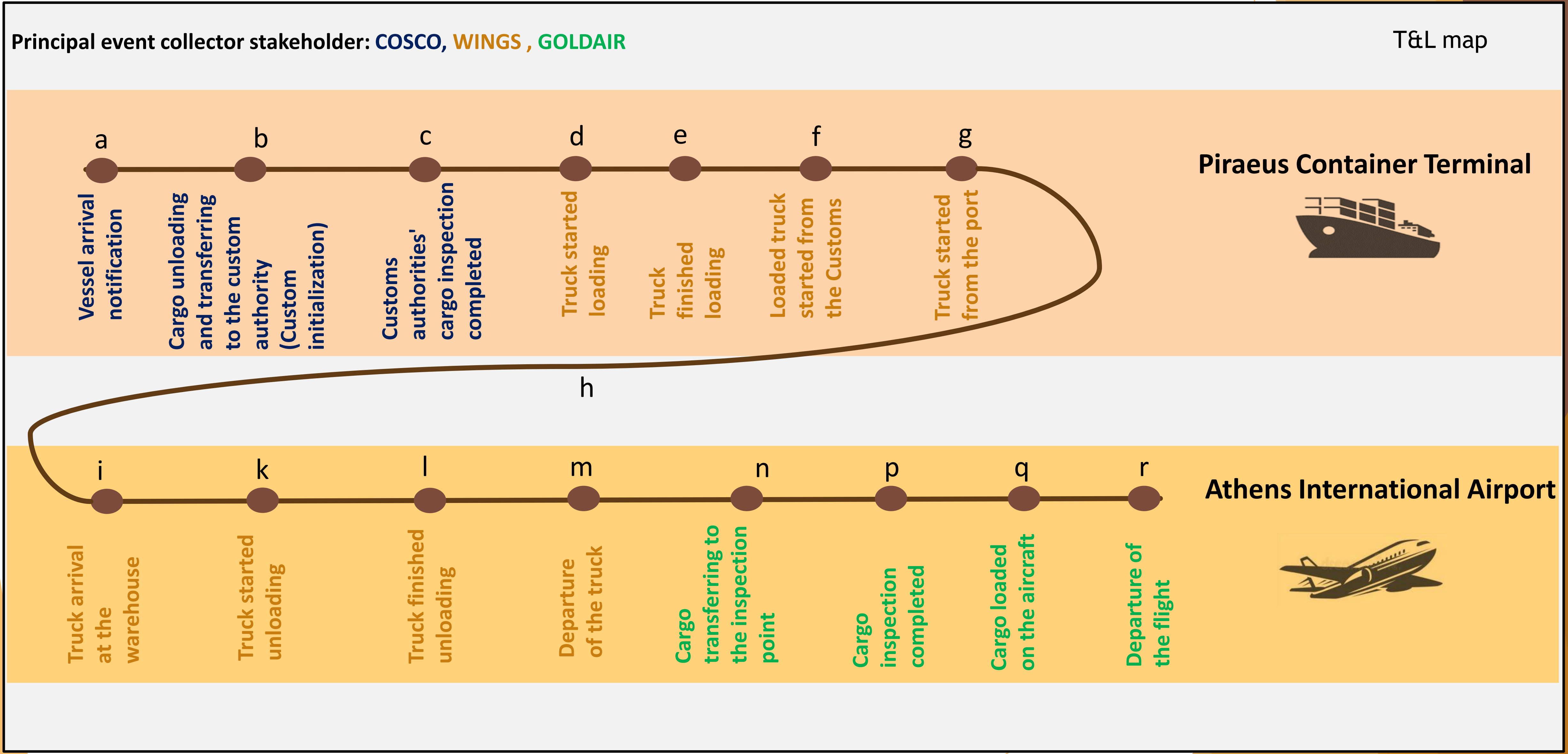
Enhance transparency, traceability, security and fragmentation of the logistic processes and transactions between actors.

IoT

Monitoring of roller cages in real-time, providing detailed information on:

- Moment when the van/truck leaves DHL warehouse loaded with the roller cages towards MDM Depot.
- Arrival of van/truck with roller cages at MDM Depot.
- Moment when roller cages are loaded into the MDM trains.
- Arrival of the roller cages at the final destination.

Greek Use Case example – T&L map



Greek Use Case example - Business flow

Port part

Port legacy systems

As port decision makers desires a volume of freight to be transported at a specific place, meeting specific delivery criteria such as earliest time of arrival, minimal GHGs emissions/ costs.

The port decision maker selects the E2E route of his/her preference after considering the options from the WMS.

GR_13-GR_16 solvers provide the information about the latest time of departure from the port.

Port legacy systems

The port decision maker coordinates the intra port activities (Custom clearance time etc) to catch the latest time of truck departure from the port

Port legacy systems/OBU

Departure of the truck

Airport warehouse

Warehouse legacy systems

Flight options

The platform informs the WMS site manager about the request

The WMS automatically answers to the request and suggest the required resources to deliver it.

Warehouse legacy systems

GR_07, GR_08

The Warehouse manager greenlights the request proceeding.

The Site manager gets the message that the truck has departed.

Greek Use Case example - E2E route planning for the minimization of CO_2

Target of the solver

Predictive analytics for the reduction of GHG emission.

T&L line

(PCT)

(AIA)

World destination

Problem statement

Which is the best route in terms of minimum CO_2 emissions through the E2E chain starting from A to the desired destination

Acquired CSV by the legacy systems

	A	B	C	D	E	F	G
1	Flight	Cost/kg (euros)	StartTime	TimeOfArrival	CO2(t)	Transits	End_Destination
2	Air_France	70	1/1/2023 6:00	1/1/2023 7:30	30	0	Madrid
3	Swiss	30	1/1/2023 8:00	1/1/2023 18:30	50	1	Madrid
4	Lufthansa	35	1/1/2023 9:00	1/1/2023 14:30	40	1	Madrid
5	Aegean	60	1/1/2023 0:00	1/1/2023 15:30	25	1	Madrid
6	Alitalia	90	1/1/2023 6:00	3/1/2023 18:30	30	0	Rome
7	Swiss	30	1/1/2023 8:00	1/1/2023 14:30	50	1	Rome
8	Lufthansa	35	1/1/2023 9:00	2/1/2023 15:30	40	2	Rome
9	Aegean	60	1/1/2023 0:00	4/1/2023 15:30	25	3	Rome
10	Swiss	30	1/1/2023 6:00	1/1/2023 7:30	30	1	Brussels
11	Lufthansa	35	1/1/2023 8:00	1/1/2023 18:30	50	1	Madrid

Solver Output

```
Enter the destination you want to go to: Madrid
```

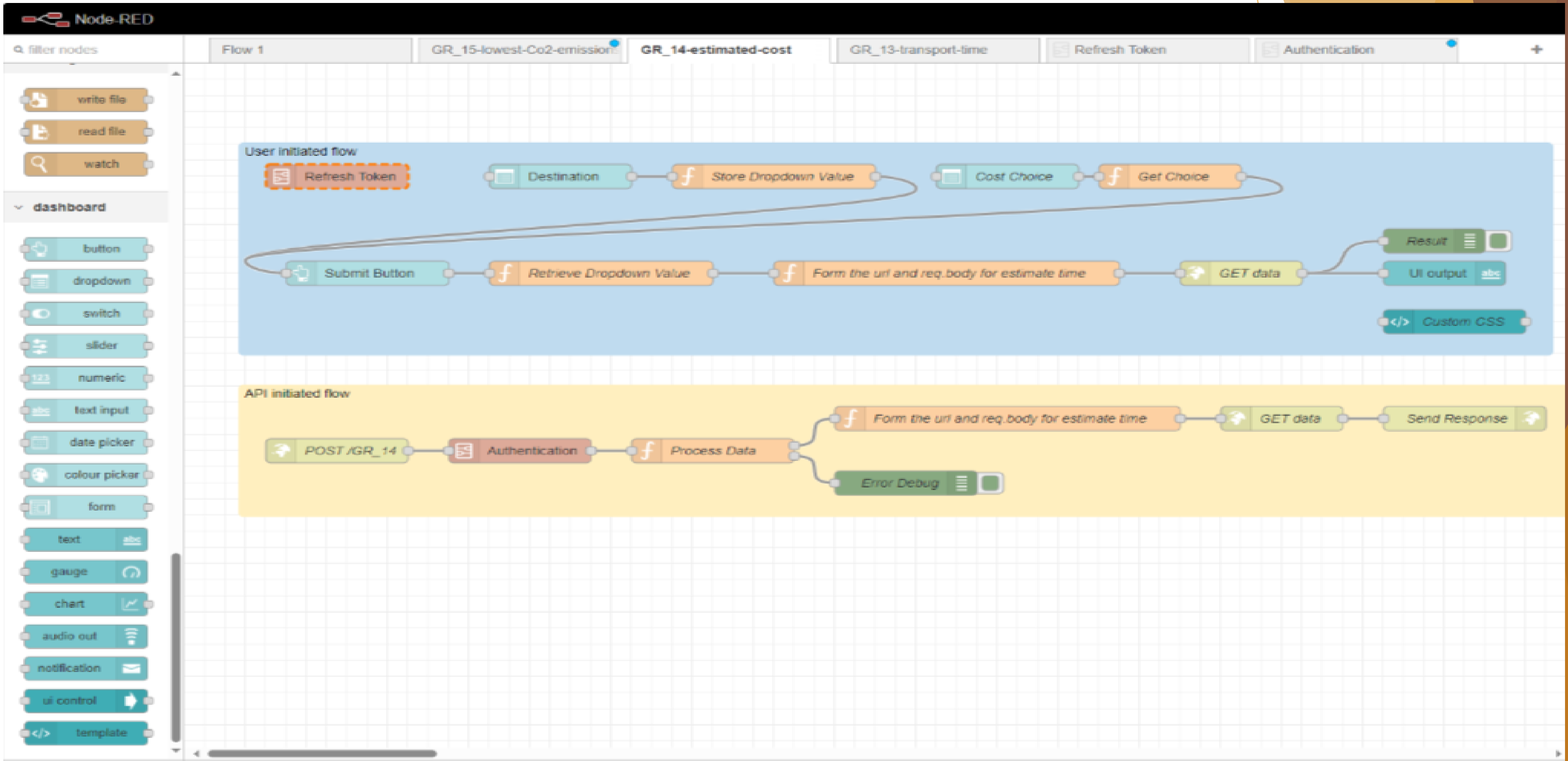
```
Choose a criterion for finding the best flight:
1. Cost_per_kg
2. Lowest CO2 Emission
3. Fewer Number of Transits
4. Earliest time of arrival
Enter the number corresponding to your choice: 2
```

```
Best Flight According to Lowest CO2 Emission for
the Destination Madrid:
ProductID                    ABC123
Flight                       Aegean
Cost_per_kg                      60
StartTime       2023-01-02 12:00:00
TimeOfArrival   2023-01-02 15:30:00
CO2(t)                        25000
Transits                          1
End_Destination              Madrid
```

```
Route 1 - Option with Minimum CO2 Emissions: 06:0
0 - Predicted CO2 Emissions: 0.84 Kgr
Route 1 - Total CO2 Emissions of the End-to-End J
ourney: 25000.84 Kgr
Route 2 - Option with Minimum CO2 Emissions: 06:0
0 - Predicted CO2 Emissions: 1.82 Kgr
Route 2 - Total CO2 Emissions of the End-to-End J
ourney: 25001.82 Kgr

Route 1 has lower total CO2 emissions.
```

Greek Use Case example – Workflow engine : The "Brain" of FOR-FREIGHT platform



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