

Progress towards Federated Logistics through the Integration of TEN-T into A Global Trade Network

Document Summary Information

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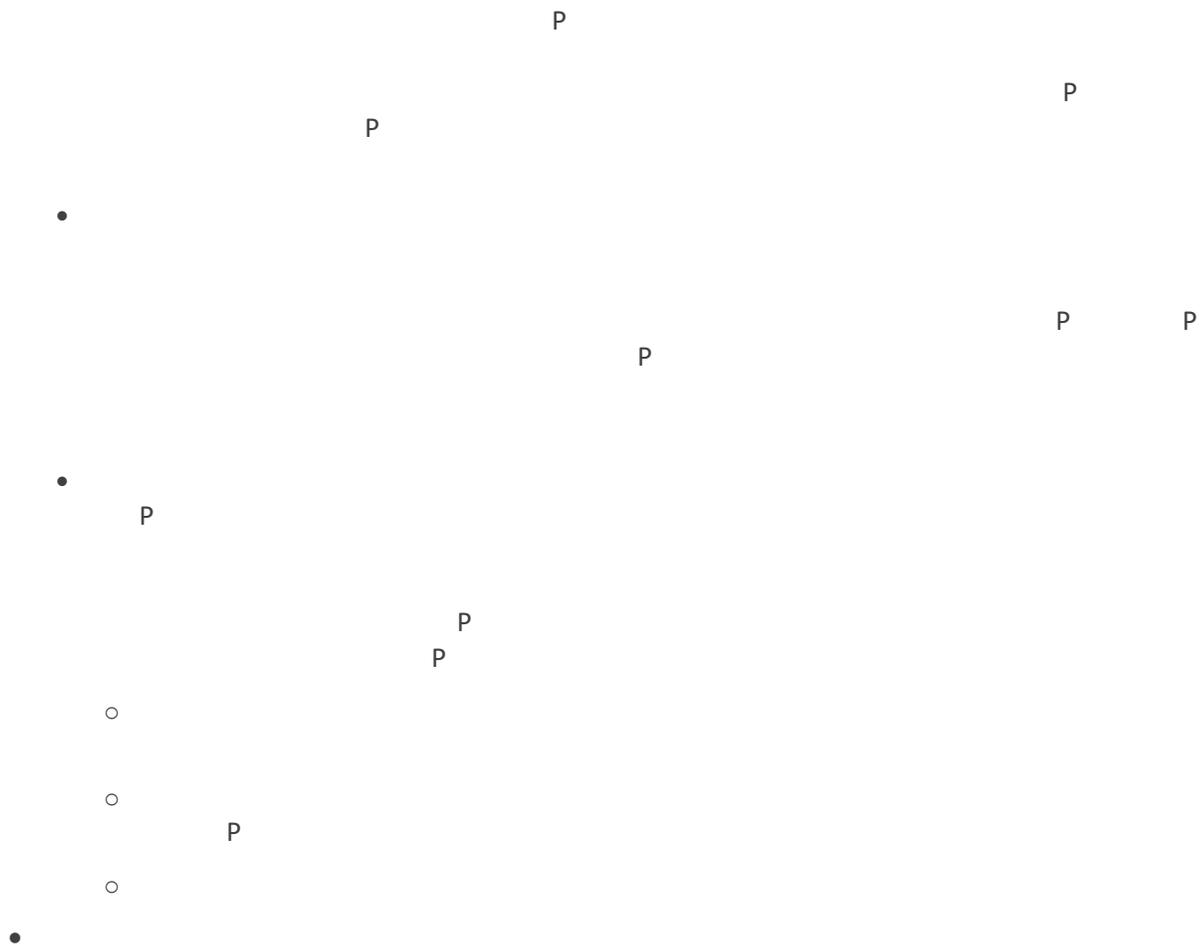
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Table 1: Adherence to PLANET’s GA Deliverable & Tasks Descriptions

	<p>existing models</p> <p>P</p> <p>P</p> <p>gap analysis</p>		
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Table 2: Models relationship with the EGTN platform			
Geopolitical uncertainties & tendencies	<ul style="list-style-type: none"> • • • 		
Risks identification & mitigation			

<p>Impacts calculation</p>	<ul style="list-style-type: none"> • • • 		
<p>Technology enabled & Services optimization driven adaptation</p>	<p>P</p> <p style="text-align: center;">P</p>		
<p>Infrastructure driven response</p>	<p>P</p>	<p>P</p>	

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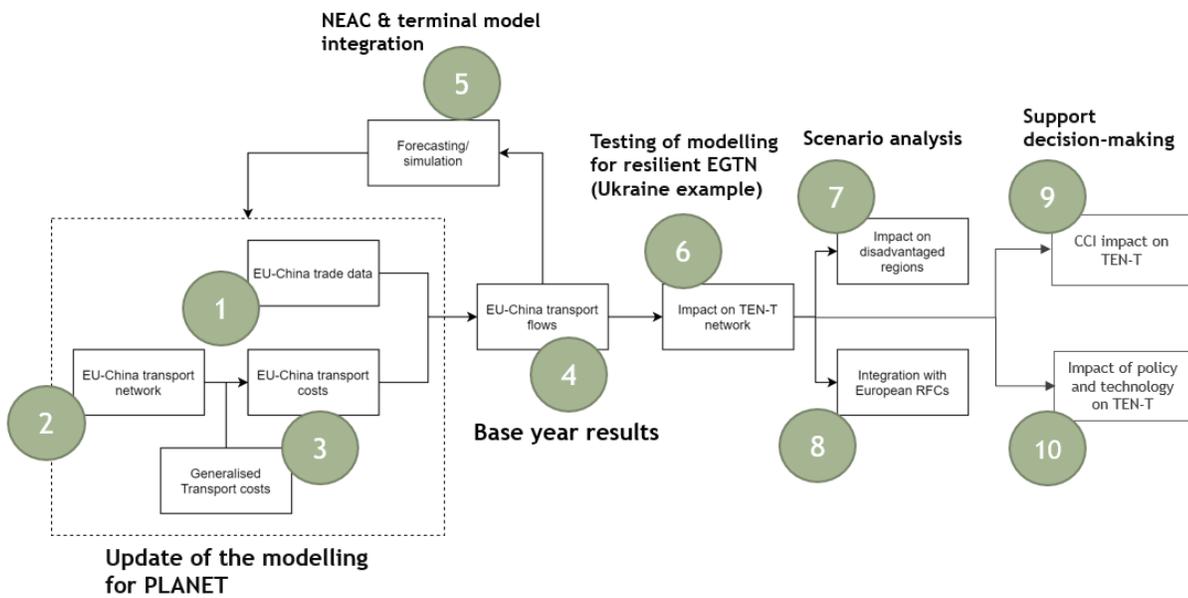


Figure 1: Overview of the method of the NEAC model for PLANET.

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- **trade dataset**

- **an intercontinental transport network**

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- **generalised transport costs**

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Table 3: Generalised costs input parameters in the NEAC model

Qualitative results of the model

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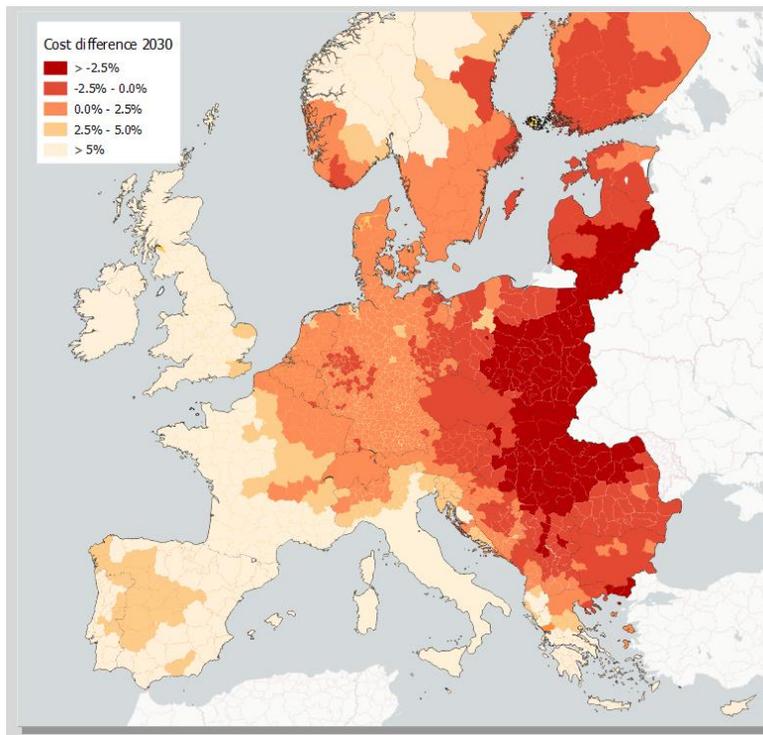


Figure 2: Example of NEAC model results.

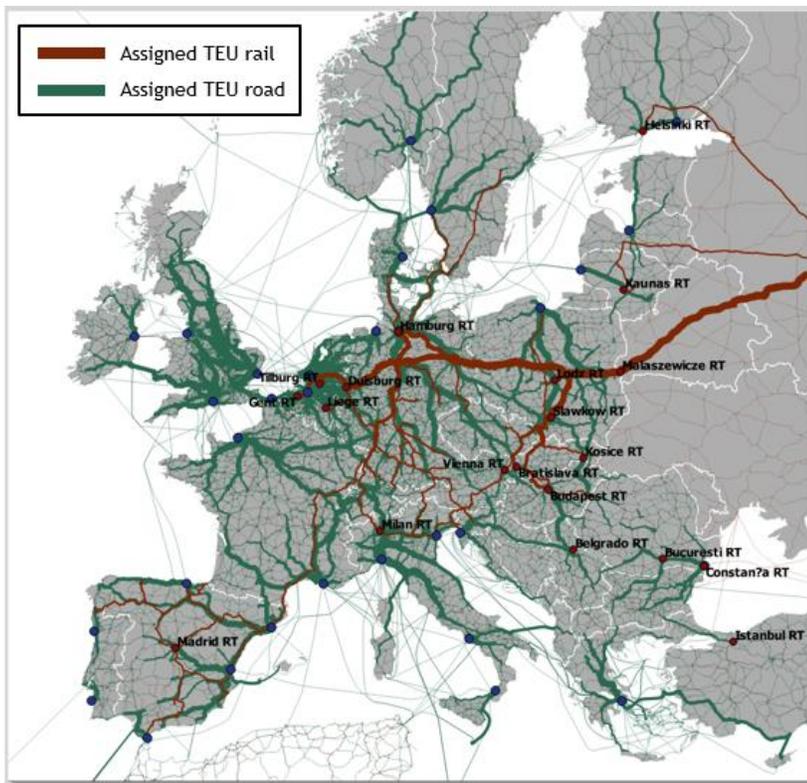


Figure 3: Example of NEAC model results: modelled network flows of containers.

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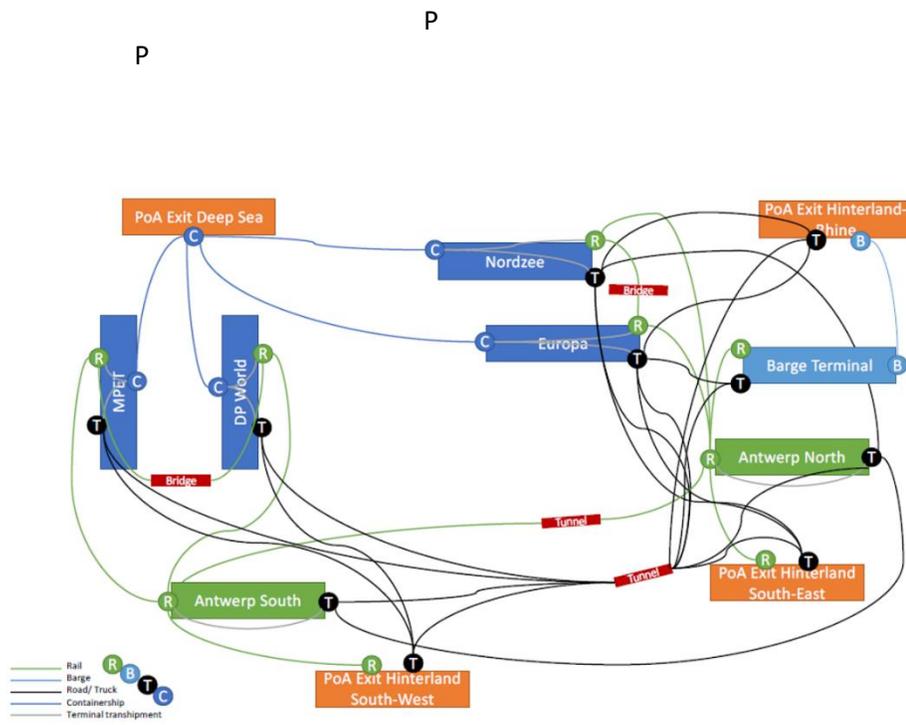


Figure 4: Example of PI Node (Mega-Hub) representation.

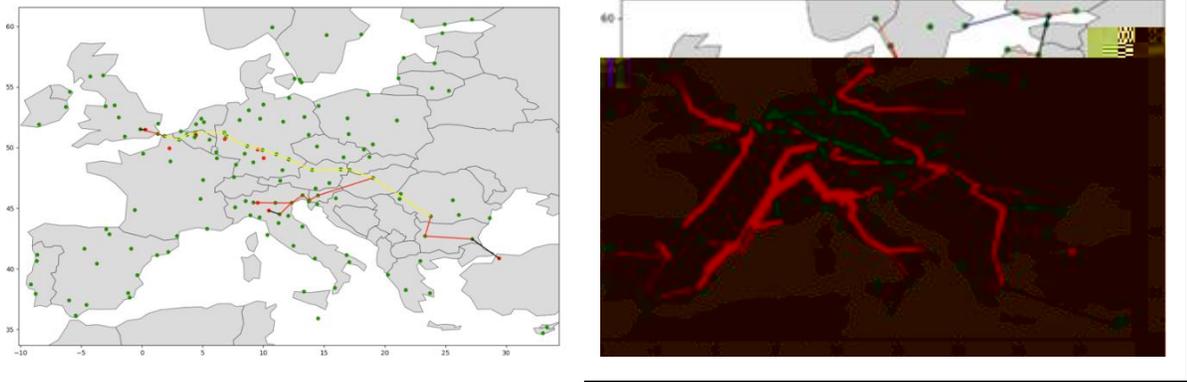


Figure 5: Example of applications on infrastructure investment, and disruption criticality.

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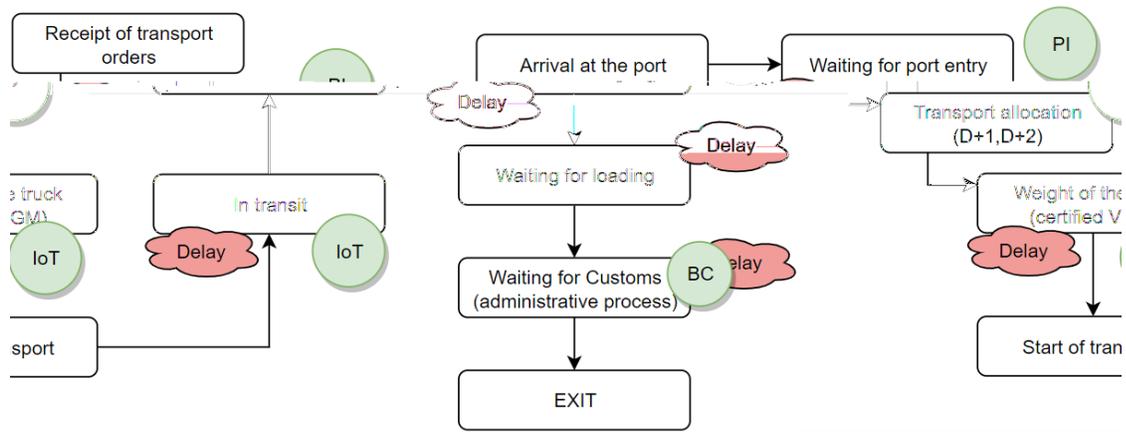


Figure 6: Process diagram of road transport.

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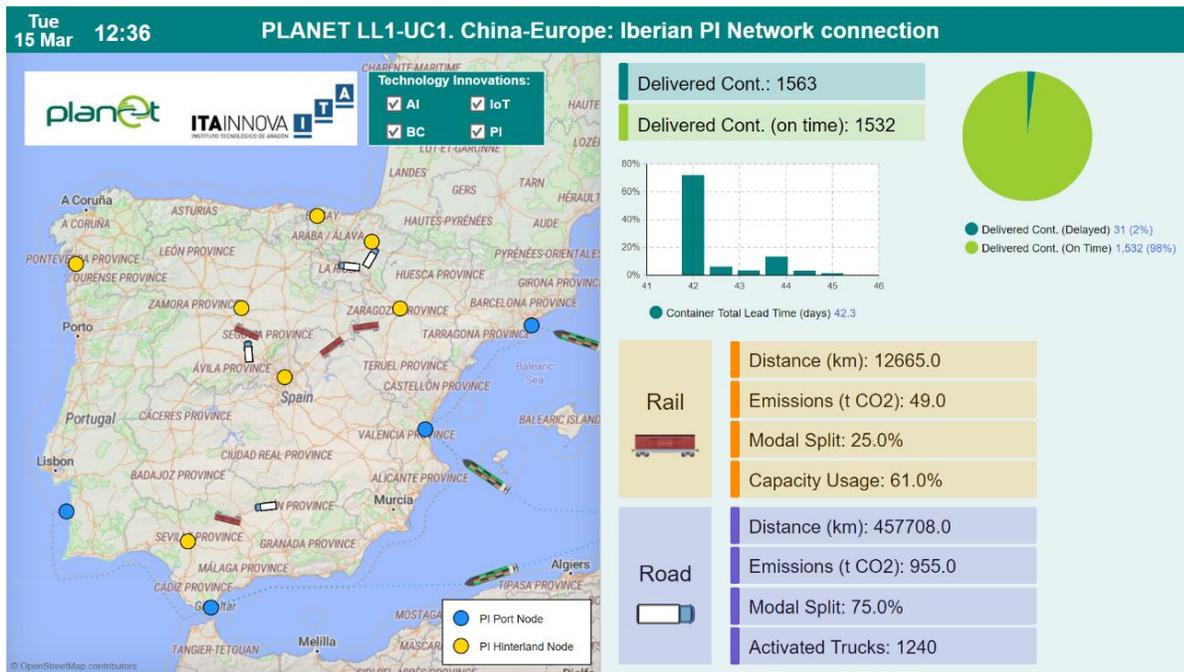


Figure 7: Main view of the PI Network Simulator.

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- P P P P P
- P P P P P

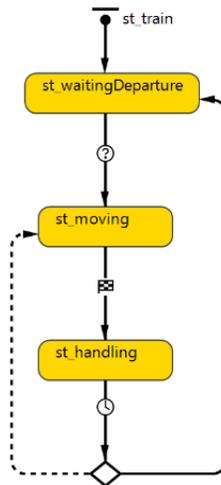


Figure 8: PI Transport agent (train type) state chart.

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node_id	node_name	node_lat	node_lon	node_type
0	Shanghai	31,2219444	121,4894444	0
1	Valencia	39,4697500	-0,3773900	0
2	Barcelona	41,3450000	2,1416700	0
3	Zaragoza	41,6447000	-0,9720000	1
4	Madrid	40,4167061	-3,7035825	1
5	Algeciras	36,1310806	-5,4487057	0
6	Bilbao	43,2630043	-2,9349916	1
7	Sevilla	37,3886299	-5,9953403	1
8	Pamplona	42,8168700	-1,6432300	1
9	Valladolid	41,6521339	-4,7285619	1
10	Pontevedra	42,4298860	-8,6446200	1
11	Sines	37,9499962	-8,8666632	0

Figure 9: Input data template for PI Nodes.

IdSim	PI (Physical Internet)	AI (Artificial Intelligence)	IoT (Internet of Things)	BC (Blockchain)	Delivered Containers	Delivered Containers (On Time)	% Containers Delivered On Time	Container Average Lead Time (days)	Rail Distance (km)	Rail Emissions (t CO2)	Rail Modal Split (%)	Rail Capacity Usage (%)	Road Distance (km)	Road Emissions (t CO2)	Road Modal Split (%)	Road Activated Trucks	Total Distance (km x 10e6)	Total Emissions (t CO2)	
0	0	0	0	0	3500	2741	78%	43,0	29850	35	9,5	20	1636058	3427	90,5	3166	1,7	3462	
1	0	1	0	0	3500	2652	76%	43,6	22410	33	9,5	24	1197844	2517	90,5	3166	1,2	2550	
2	0	0	1	0	3500	3108	89%	42,0	32277	34	9,5	25	1636058	3427	90,5	3166	1,7	3462	
0	1	0	1	1	3500	2661	76%	43,6	18831	33	9,5	28	1197844	2517	90,5	3166	1,2	2550	
0	0	1	0	0	3500	3264	93%	42,1	27159	35	9,5	22	1632775	3420	90,5	3166	1,7	3455	
0	1	1	0	0	3500	3311	95%	42,0	20149	32	9,5	26	1197844	2517	90,5	3166	1,2	2549	
0	0	1	1	1	3500	3266	93%	42,1	21148	34	9,5	27	1636058	3427	90,5	3166	1,7	3461	
0	1	1	1	1	3500	3322	95%	42,0	16276	32	9,5	31	1197844	2517	90,5	3166	1,2	2549	
20	0	0	0	0	3500	2853	82%	43,0	38670	74	19,5	32	1140166	2393	80,5	2819	1,2	2467	
20	1	0	0	0	3500	2701	77%	43,7	32101	69	19,5	35	1060377	2227	80,5	2819	1,1	2296	
20	0	0	1	1	3500	2852	81%	43,0	31973	74	19,5	38	1140166	2393	80,5	2819	1,2	2467	
20	1	0	1	1	3500	2711	77%	43,7	29273	69	19,5	38	1060377	2227	80,5	2819	1,1	2296	
20	0	1	0	0	3500	3343	96%	42,1	33620	74	19,5	36	1140166	2393	80,5	2819	1,2	2467	
20	1	1	0	0	3500	3337	95%	42,1	29016	68	19,5	38	1060377	2227	80,5	2819	1,1	2295	
20	0	1	1	1	3500	3341	95%	42,1	28032	74	19,5	43	1140166	2393	80,5	2819	1,2	2467	
20	1	1	1	1	3500	3350	96%	42,1	25947	68	19,5	42	1060377	2227	80,5	2819	1,1	2295	
50	0	0	0	0	3500	2894	83%	43,1	47174	105	27,7	37	1024948	2151	72,3	2530	1,1	2256	
50	1	0	0	0	3500	2708	77%	43,8	38067	97	27,7	41	957832	2011	72,3	2530	1,0	2108	
50	0	0	1	1	3500	2895	83%	43,1	39470	105	27,7	43	1024948	2151	72,3	2530	1,1	2256	
50	1	0	1	1	3500	2718	78%	43,8	36646	97	27,7	43	957832	2011	72,3	2530	1,0	2108	
50	0	1	0	0	3500	3357	96%	42,2	40958	105	27,7	42	1024948	2151	72,3	2530	1,1	2256	
108	21	50	1	1	0	3500	3313	95%	42,3	35712	97	27,7	43	957832	2011	72,3	2530	1,0	2108
256	22	50	0	1	1	3500	3355	96%	42,2	34679	105	27,7	49	1024948	2151	72,3	2530	1,1	2256
108	23	50	1	1	1	3500	3329	95%	42,3	34889	97	27,7	44	957832	2011	72,3	2530	1,0	2108
002	24	100	0	0	0	3500	2921	83%	43,3	54506	144	37,5	44	883624	1858	62,5	2188	0,9	2
869	25	100	1	0	0	3500	2699	77%	44,3	48726	132	37,5	43	825332	1737	62,5	2188	0,9	1
001	26	100	0	0	1	3500	2918	83%	43,3	47052	143	37,5	50	883624	1858	62,5	2188	0,9	2
869	27	100	1	0	1	3500	2712	77%	44,3	48071	132	37,5	44	825332	1737	62,5	2188	0,9	1
002	28	100	0	1	0	3500	3342	95%	42,5	52289	144	37,5	46	883624	1858	62,5	2188	0,9	2
869	29	100	1	1	0	3500	3380	94%	42,7	47178	132	37,5	44	825332	1737	62,5	2188	0,9	1
002	30	100	0	1	1	3500	3339	95%	42,5	45802	144	37,5	51	883624	1858	62,5	2188	0,9	2
869	31	100	1	1	1	3500	3293	94%	42,7	45836	132	37,5	46	825332	1737	62,5	2188	0,9	1

Figure 10: Parameters variation experiment.



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- 1. Examining changes in the Rohlig Suus business processes thanks to increased visibility of goods by IoT implementation along the New Silk Road**

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- 2. Examining changes in the Polish Post business processes thanks to implementation of the EPCIS and standardization of information flow**

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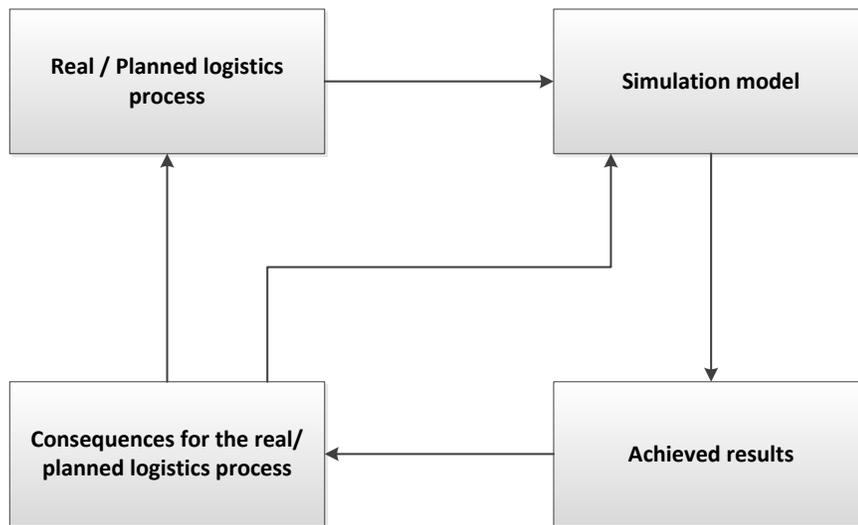


Figure 11: The classic design of the multiple simulation process.

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Research methodology in the field of process analysis

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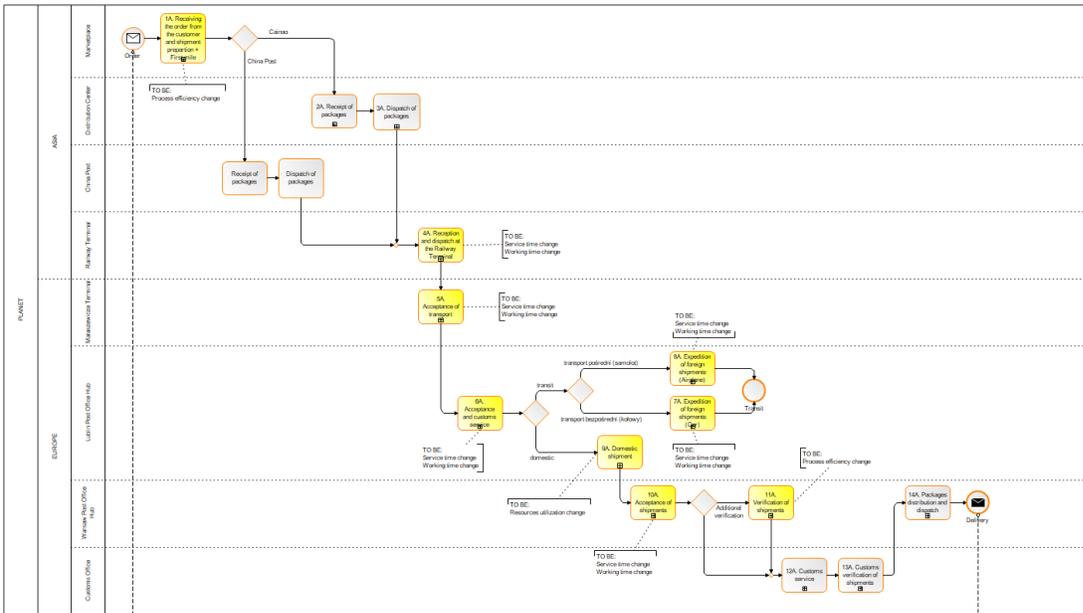


Figure 12: Polish Post Use Case.

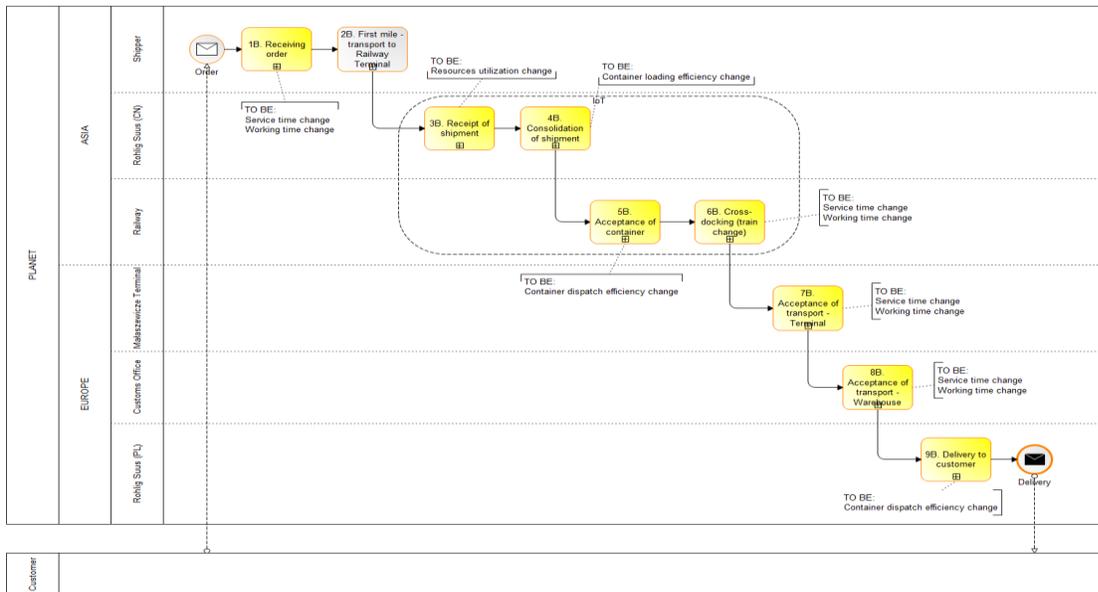


Figure 13: Rohlig Suus Use Case.

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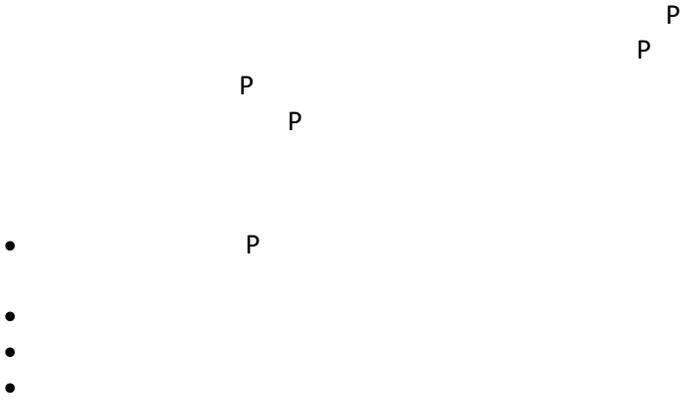




Figure 14: Main view of the last mile delivery model.

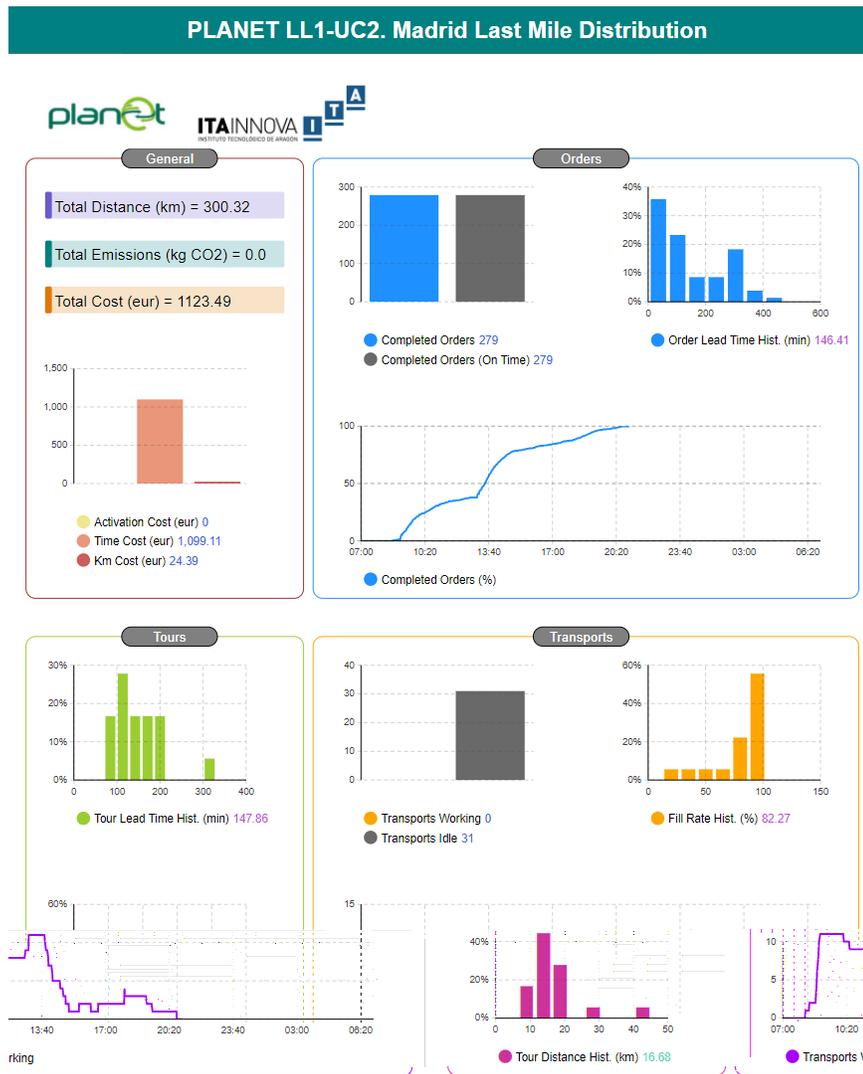


Figure 15: Stats panel of the last mile delivery model.

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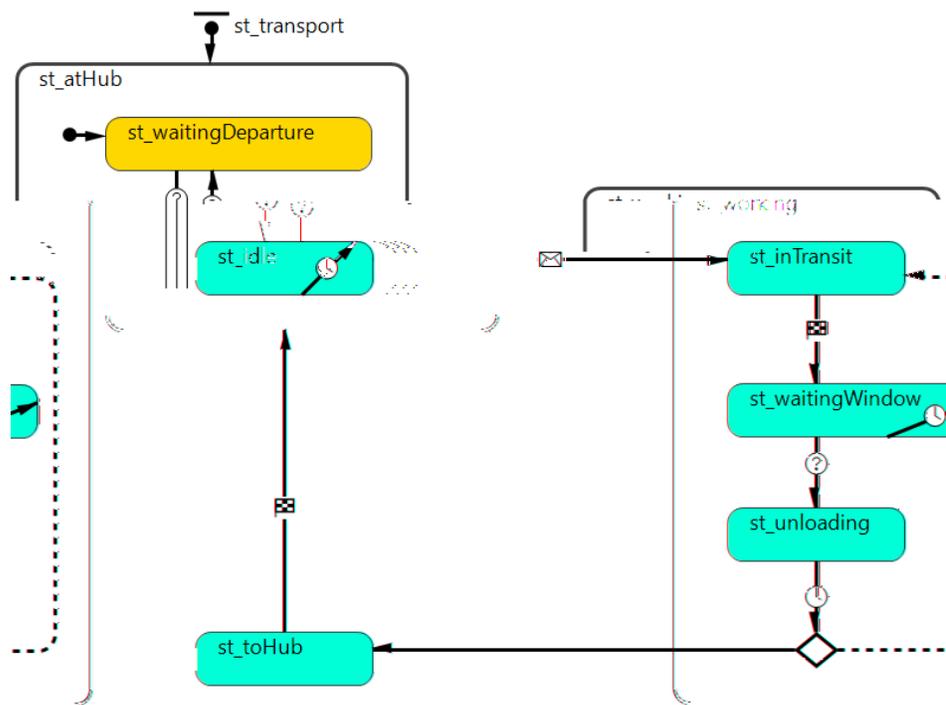


Figure 16: Transport agent state chart.

order_id	order_mode	order_idhub	order_lat	order_lon	order_earlytime	order_latetime	order_servicetime	order_items	order_weight
0	delivery	0	40,180669	-3,709061	09:00	21:00	5	6	79,00
1	delivery	0	40,211365	-3,583947	09:00	21:00	5	5	65,00
2	delivery	0	40,210577	-3,583877	09:00	21:00	5	7	65,00
3	delivery	0	40,210577	-3,583877	09:00	21:00	5	6	60,00
4	delivery	0	40,203720	-3,582040	09:00	21:00	5	10	51,65
5	delivery	0	40,207770	-3,575340	09:00	21:00	5	4	51,00
6	delivery	0	40,210445	-3,569476	09:00	21:00	5	3	49,00
7	delivery	0	40,210445	-3,569476	09:00	21:00	5	4	48,19
8	delivery	0	40,212069	-3,574136	09:00	21:00	5	6	47,20
9	delivery	0	40,212708	-3,573695	09:00	21:00	5	7	42,58
10	delivery	0	40,213519	-3,575775	09:00	21:00	5	6	41,75

Figure 17: Input data template for orders.

tour_id	tour_idtransptype	tour_start_timestamp	tour_end_timestamp	tour_distance_km	tour_drivingtime_min	tour_servicetime_min	tour_timetotal_min
0	3	2021-07-01 08:22:00	2021-07-01 11:36:26	13,09	60,44	132	192,44
1	3	2021-07-01 08:48:00	2021-07-01 10:28:57	15,11	69,76	30	99,76
2	2	2021-07-01 08:44:00	2021-07-01 13:59:31	29,06	134,12	180	314,12
3	3	2021-07-01 12:58:00	2021-07-01 14:54:51	11,23	51,85	65	116,85
4	2	2021-07-01 08:50:00	2021-07-01 16:13:28	15,3	70,59	138	208,59
5	2	2021-07-01 08:56:00	2021-07-01 14:47:38	18,51	85,41	83	168,41
6	3	2021-07-01 12:59:00	2021-07-01 14:37:18	7,87	36,31	62	98,31
7	2	2021-07-01 08:52:00	2021-07-01 13:52:27	17,07	78,78	101	179,78
8	2	2021-07-01 08:53:00	2021-07-01 14:13:48	11,48	52,98	88	140,98
9	3	2021-07-01 12:48:00	2021-07-01 15:04:23	15,56	71,81	63	134,81
10	3	2021-07-01 08:45:00	2021-07-01 13:49:29	12,17	56,18	63	119,18

Figure 18: Tours results table.

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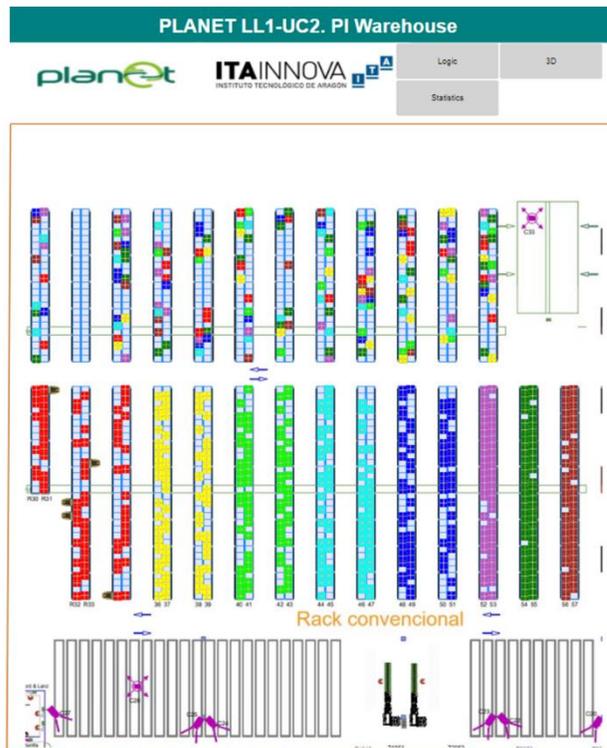


Figure 19: Main 2D view of the PI warehouse model.



Figure 20: Main 3D view of the PI warehouse model.

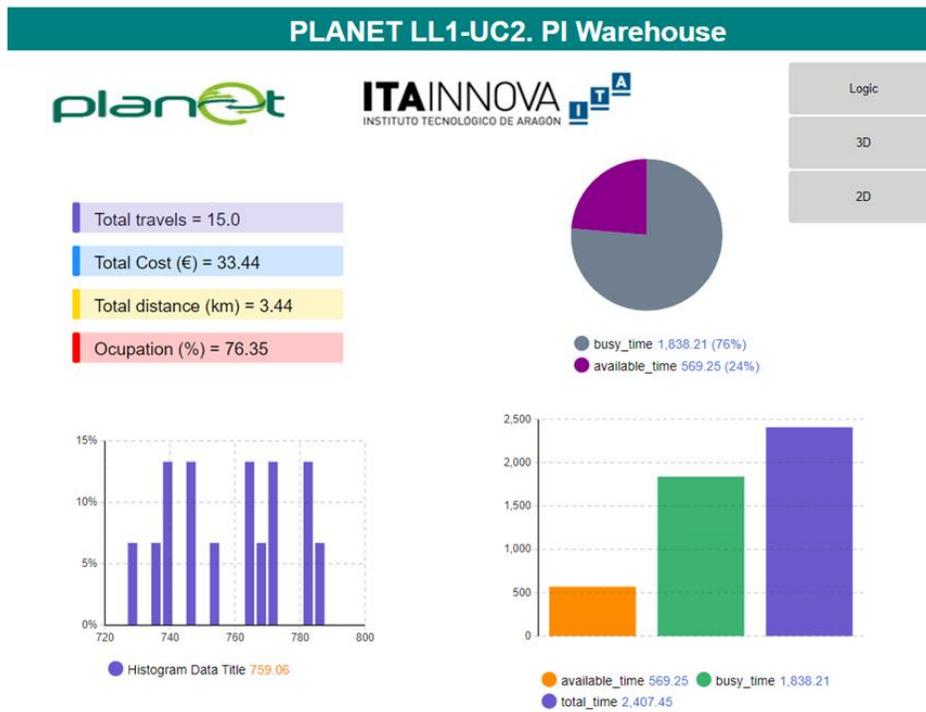


Figure 21: PI warehouse model statistics panel.

job_order	fam_1	fam_2	fam_3	qtty_1	qtty_2	qtty_3	items
job_1	1			10			1
job_1	1			10			1
job_1	1			10			1
job_1	1			10			1
job_2	2			10			1
job_2	2			10			1
job_3	3			10			1
job_3	3			5			1
job_medium_rotation	4	5		9	1		2
job_medium_rotation	5			10			1
job_medium_rotation	4	5		3	4		2
job_low_rotation	6	7	8	4	3	3	3

Figure 24: PI warehouse model orders input table (collaborative scenario).

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Table 5: LL1 UC1 expected technology impact.

Blockchain	<ul style="list-style-type: none">••
IoT	<ul style="list-style-type: none">••
AI	<ul style="list-style-type: none">••
Physical Internet	<ul style="list-style-type: none">••

Simulation scenarios in LL1 UC1

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Table 6: LL1 UC2 expected technology impact.

Blockchain	<ul style="list-style-type: none"> • • •
IoT	<ul style="list-style-type: none"> • •
AI	<ul style="list-style-type: none"> • • •
Physical Internet	<ul style="list-style-type: none"> • •

Simulation scenarios in LL1 UC2

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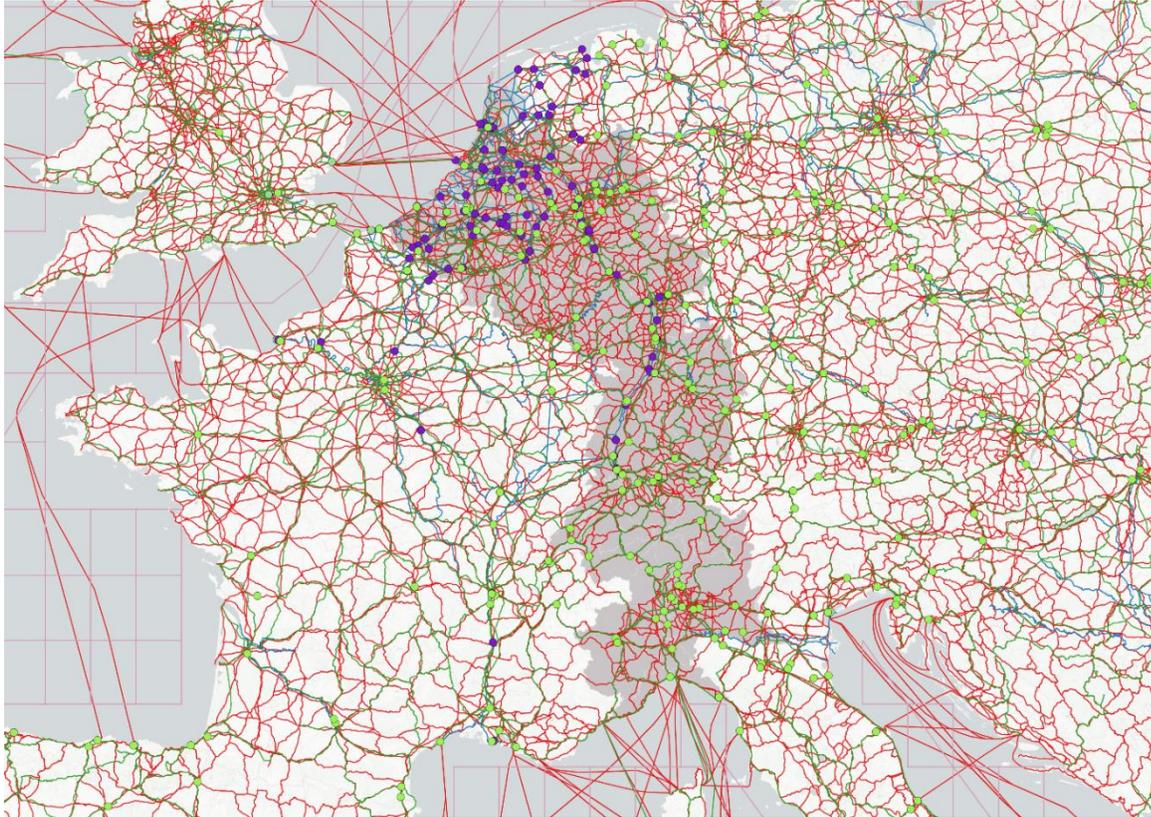


Figure 25: Snapshot of the network and transshipment points used in LL 2. ©Panteia

Simulation scenarios in LL2

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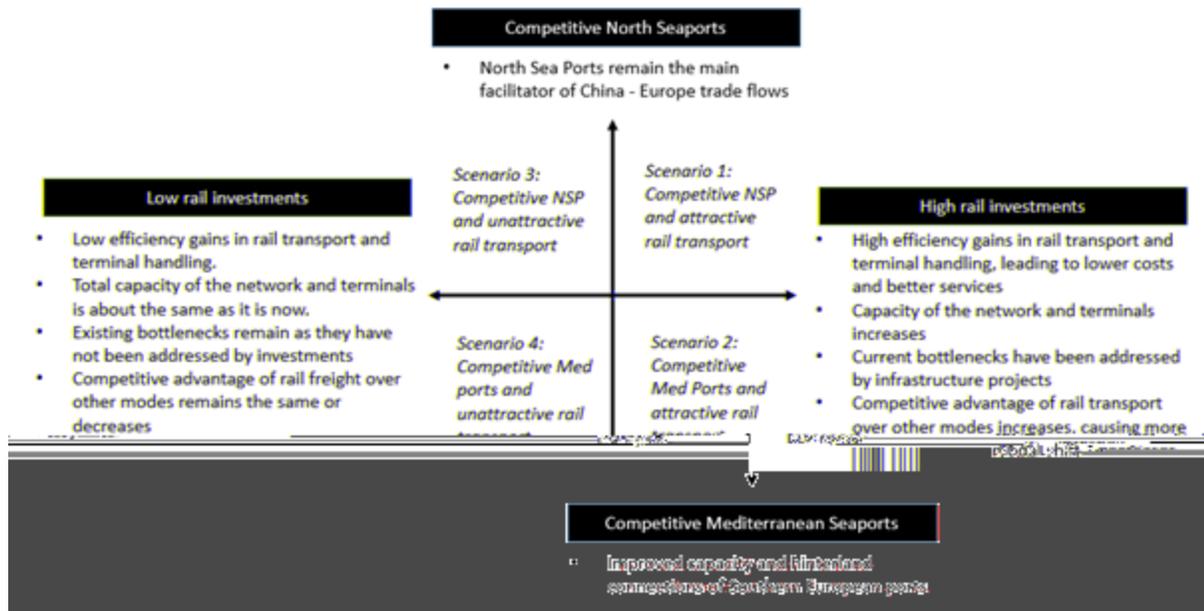


Figure 26: Four suggested Living Lab 2 use case 3 scenarios.

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Polish Post

and Rohlig Suus

- Polish Post use case

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- **PP expected impact**

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- **Rohlig Suus use case**

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▪ **RS expected impact**

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Simulation scenarios in LL3

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Main decision addressed

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Key Performance Indicators

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- **real implementation**
tested within the Living Lab,
- **potential implementation**
simulated within the iGrafx platform,
- **remain unchanged**

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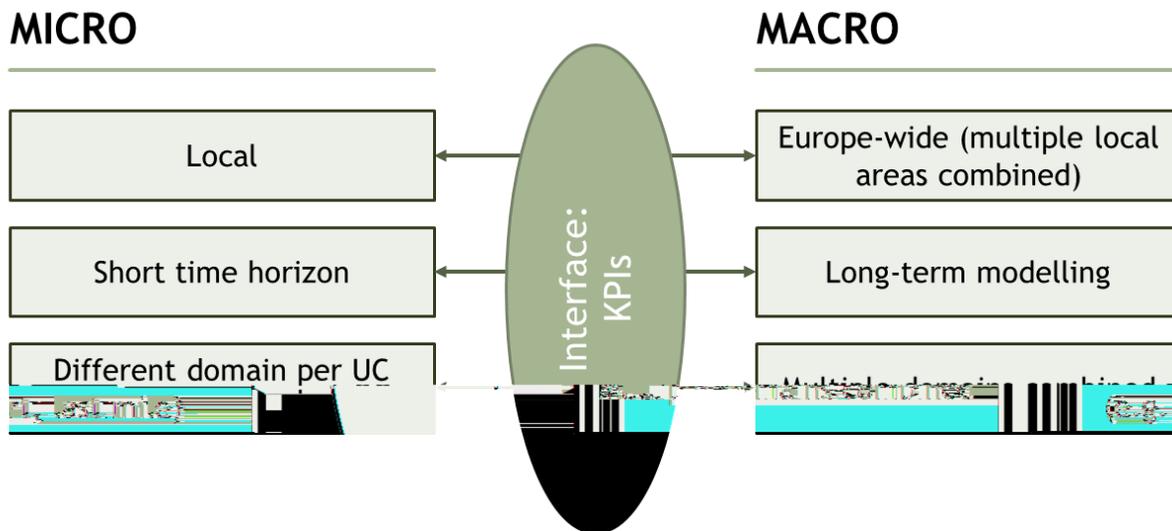


Figure 27: Alignment requirements between micro and macro level.

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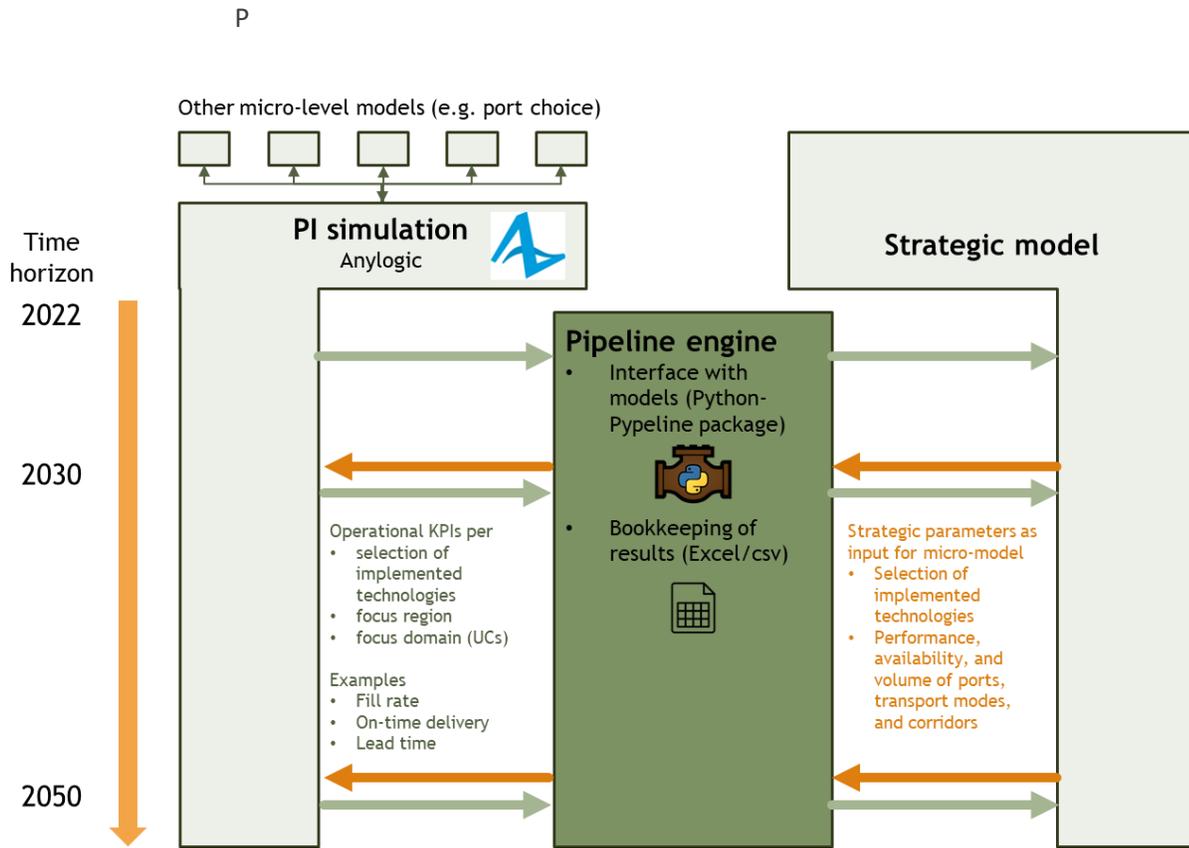


Figure 28: High-level visualization of modelling pipeline for the PLANET EGTN Service platform.

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Component	Sub-components
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Table 7: UC1 container dataset example.

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1			
2			
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4			
5			
6			P
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8			
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10			

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Table 8: UC1 PI Nodes considered.

0				P
1				P
2				P
3				
4				
5				P
6				
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8	P			
9				

10	P			
11				P



Figure 29: Main rail corridors in Spain. Source: Gobierno de España. Ministerio de Fomento.

Table 9: UC2 last mile distribution orders dataset.

Tipo de servicio	Identificador de la tarea	Fecha	Ruta	Secuencia	Empezar	Fin	Representante del cliente	País	Latitud	Longitud	Tiempo de servicio	ETA	Artículos	Peso	Volume
delivery	2524	16/07/2021	B06	1	09:00	21:00	2524	ESP	40,18067	-3,70906	6	09:28	1	1,37	0,02
delivery	1842	16/07/2021	B06	2	09:00	21:00	1842	Spain	40,21136	-3,58395	6	09:48	1	1,37	0,02
delivery	1823	16/07/2021	B06	3	09:00	21:00	1823	ESP	40,21058	-3,58388	6	09:54	1	1,37	0,02
delivery	2182	16/07/2021	B06	4	09:00	21:00	2182	ESP	40,21058	-3,58388	6	09:57	1	1,37	0,02
delivery	2222	16/07/2021	B06	5	09:00	21:00	2222	ESP	40,20372	-3,58204	6	10:04	1	1,37	0,02

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Volume Flow forecasting	P		P

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Table 10: Economic KPI.

Transport costs	<ul style="list-style-type: none"> • P • P
Handling costs	
Inventory holding costs.	
Penalty costs	
Delivery costs	

Table 11: Operational KPI.

Delivery time	
On time delivery	
Service quality	

Delays at nodes	
Utilization	
Fill rate	
Stockouts	
Link usage	
Modal split	P
Accuracy transport time	
Transparency of rail transport	

Table 12: Environmental KPI.

Emissions	
Congestion	
Corridor environmental index	

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ROHLIG SUUS

Analytics solutions	Description	Required Data	Data Sources
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ETA forecasting			P
			P
		P	

POLISH POST			
Analytics solutions	Description	Required Data	Data Sources
Volume forecasting	Flow	P	

		P	P P

Carbon Footprint Prediction			

ETA forecasting			
		P	P