ICONET - Living Labs Findings and Learning Conclusions

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SUMMARY

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- **Scope of Work and Objectives**
- **Living Labs, UCs, Business needs, KPIs and results found**
- **Learning Conclusions and Value Add**

Living Labs (LLs) objectives

a) To test the Physical Internet (PI) Proof of Concept (PoC) and Framework
    i. Business models, Architectural considerations and enablers
    ii. Generic PI Case Study GPICS
    iii. PI Hubs optimized plan
    iv. Technology
    v. Integration infrastructure
b) To measure, demonstrate and quantify business value, economic viability, innovation and benefits of PI
c) To reveal barriers, areas of further research and opportunities

LLs Findings

Use Cases, Objectives and KPIs

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Business Objectives

- Increase Rail market share
- Improve asset utilization
- Real time visibility & traceability
- Less congestion
- Improved Collaboration
- Data sharing and communication
- Cost Reductions

Use Cases

1. Intermodal Use case (IUC)
2. Single Wagon Load Case (SWLC)

KPIs

- 10% reduction in wagon/truck empty runs
- 5% additional capacity on railway
- 5% increase in direct train loading
- 10% less congestion
- 10% less CO2 emissions
- 10 % operation costs of participant nodes

LLs Findings

LL1 - Work performed and Results – RTS /PI Services

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KPI Benefit / Specific Description	Calculation Method	Target Value	Achievements
Improved asset/infrastructure utilization			
- Increased asset visibility (train)	Number of rail paths	> 300,000	315,649 (04/2019)
	Number of wagon events	> 4,000,000	4,883,418 events (since 03/19)
	Number of trains tracked	> 8,500,000	8,263,905 trains
Improved terminal management			
- Enhance terminal slot management	Number of slot requests per month	> 100	3,883terminal slot requests
- Enhanced community platform (RTS)	Number of active users	> 25	111 single users and 26 companies
- Improvement of executed slots	Number of executed slots / number of requests	> 90%	Feedback from terminals: “all requested slots were executed, apart from cancellation by the railway undertaking”

LLs Findings

LL1 - Work performed and Results- Simulation PI services

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Main KPIs	Scenario 1 Independent flows	Scenario 2 PI coordinated flows	% Change
% Empty runs	6%	0%	-6%
% Train usage	11%	19%	+8%
% Fill Rate (Train)	73%	83%	+10%
CO2 Emissions	10 t	7 t	-30%
Restriction delay (bridges)	5 min	3 min	-40%

LLs Findings

LL1 - Work performed and Results- Optimization services- Shunting yard

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Main KPIs 14 days@ 1000PI containers/ day (40’ con.)	Scenario 1 2D unoptimized Wagon loading (no of)	Scenario 2 2D optimized Wagon loading (no of)	% Change
- UC 1			
	Scenario 3 3D unoptimized wagon loading (no of)	Scenario 4 3D optimized wagon loading (no of)	

Main KPIs 14 days@ per destination (40’ con.)	Scenario 1 2D unoptimized Train loading (no of)	Scenario 2 2D optimized Train loading (no of)	
- UC 2			

LLs Findings

Use Cases, Objectives and KPIs

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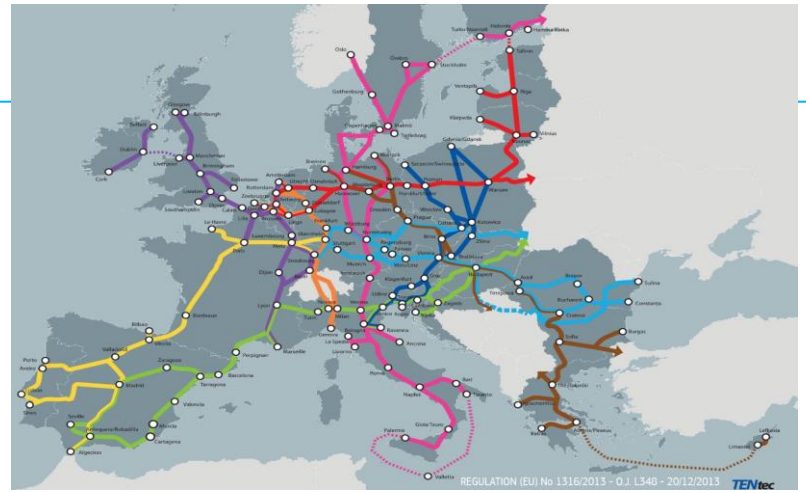
Use Cases

1. Intermodal Tracking
2. Smart-Contract monitoring
3. Dynamic Rerouting
4. 4a Containers prioritization
   4b Route Optimization



Business Objectives

- Visibility intermodal transport
- Delivery reliability
- Synchromodality
- Leadtime reduction
- Alternative routing
- Efficient Scheduling
- Smart contracts

KPIs

- Over 10% increased efficiency intermodal corridors with cost, service and inventory improvements
- Over 10% improvement in meeting SLAs by increased reliability intermodal corridors for synchromodality
- Over 10% CO2 reduction by improved corridor environmental performance

LLs Findings

LL2- Work performed and Results- Simulation PI Services

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KPIs	UC1	UC2	UC3	UC4a	UC4b
		Qualitative Assessment			
CO2	-20% (190 to 150 gr/km)	N/A	N/A	N/A	-33% due to trains
Lead Time (Actual, Not Contractual)	-25%	Reduced		-8% for high priority order	+0.3% - A bit slower but within SLA
(Overall) Transport Cost	-10% (intermodality & Optimized Resource Planning)	Reduced due to earlier issue realization and reaction		Similar (fast lane premium handling cost - SLA violation savings)	-5% due to lower train rates
Reliability % increase of on-time delivery	+5% (90% to 95%)	Increased due to informed and timely reaction		+17% of on-time delivery of priority order, -10% SLA violations	N/A
Multimodal Share	+50% (20% to 30%)	N/A	N/A	N/A	+18% in rail transport
Reaction Time (on incidents)	N/A	Significant reduction due to real-time awareness of cargo and Network status		N/A	N/A

LLs Findings

Use Cases, Objectives and KPIs

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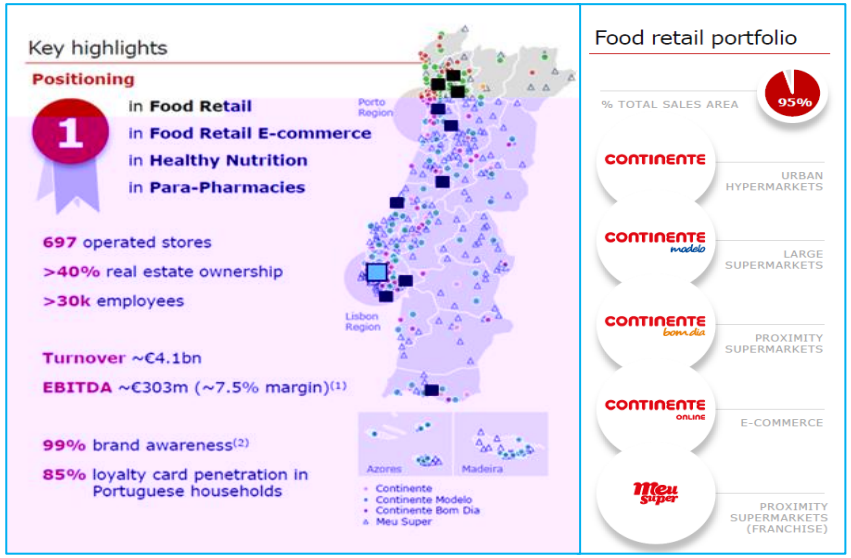
Use Cases

1. Centralized Vs Decentralized order preparation and distribution model
2. Most appropriate store to pick orders



Business Objectives

- Optimize fulfilment of eCommerce purchase orders (local stores as PI nodes)
- Stock Outs reduction
- Improved delivery in regions
- Decrease Lead times
- More efficient network (involve 3rd parties)
- Integrate operational last mile service models
- Reduce operational costs and environmental emissions

KPIs

- 5% decrease total stock e-commerce holdings
- 25% less stockouts of product substitutes
- 25% decrease of average delivery lead time
- 10% decrease of order fulfillment total cost

LLs Findings

LL3 - Work performed and Results- Simulation PI Services

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Main KPIs	Scenario 1. Local fulfilment	Scenario 2. PI Network fulfilment	% Change
% Vans Fill Rate	63%	92%	+29%
Distance per order (Km)	2.52	2.32	-8%
Average Transport Cost per Order (Eur)	7.10	5.4	-24%
Num Orders Delivered	415	549	25%
% Stockout	25%	0%	-25%

LLs Findings

LL3 - Work performed and Results- Simulation scenarios

Number	Description	Results (week) (As-Is Vs To-Be)
Sim V0.1	To adopt the generic PI framework into the urban eCommerce distribution network.	<u>Operational:</u> 15% better fill rate (van) 25% reduction daily trips 18% reduction in lead time <u>Economic:</u> 12% reduction in total transport cost 9% reduction in total order fulfilment cost (per order) <u>Environmental:</u> 18% reduction of CO2 emissions
Sim V0.2	To validate the inventory control mechanisms and the stockout evaluation system	
Sim V1.1	To investigate relationship of main nodes, darkstores and clients (considering distances, product range, capacity, costs and replenishment)	
Sim V2.1	To evaluate effects of multi network urban eCommerce distribution	

LLs Findings

Use Cases, Objectives and KPIs

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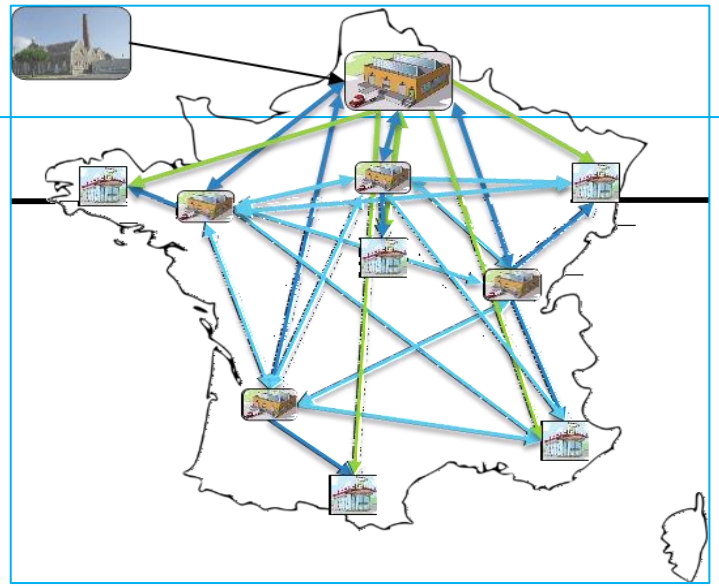
Use Case

1. Examine the PI network (vs Regional Vs Centralized supply Chain networks)
2. Fully PI Integrated scenario



Business Objectives

- Increase number of hubs and inventory flows thus promoting WaaS model
- Improve asset utilization by more dynamic operations
- Cost reductions in operational activities and e-Warehousing solutions
- Reduce stock-outs & Optimize fill rates

KPIs

- 15% increase of warehousing nodes participating
- 15% increase in e-Warehousing booking volumes
- 10% increase in meeting SLAs
- 10% increase in CO2 reduction via improved environmental performance

LLs Findings

LL4 - Work performed and Results –Simulation scenarios

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KPI	Scenario 1. Centralized Supply Chain	Scenario 2. Regional PI Supply Chain	% Change
QoS Lead time (h)	9.2	3.3	-64.1%
Distance Week 1-4 (Dest. Customers) (km)	*7,148.0*	*2,893.0*	-
Total Distance (km)	8,138.0	7,557.0	-7.1%
Handling Cost (€)	*33,453.0*	*28,548.2*	-
Transport Cost (€)	*12,369.0*	*11,486.6*	-
Total Cost (€)	45,822.8	40,034.9	-12.6%
Total CO_2 Emissions (t)	23.3	21.6	-7.1%

LLs Findings

LL4 - Work performed and Results –Simulation scenarios

Number	Description	Results (4-week) (As-Is Vs To-Be)
Sim V2.1	To validate the effect of delivery & replenishment strategy (nearest /with stock, static/ dynamic) deployed in PI distribution setup	Operational: Dynamic- stock 10% to 71% reductions in respective parameters Economic: Dynamic- nearest to client 29% total reduction in total costs (handling/storage/transport) Environmental: Dynamic- nearest to client 29% reduction in CO2 emissions

PI Services

LL1 - PI Hub	OLI Layers			
Use Cases	Encapsulation	Shipping	Networking	Routing
1. Intermodal Use Case		X	X	X
2. Single Wagon Load	X			
LL2 - PI Network	Web-Logistics	Shipping	Networking	Routing
1. Intermodal Tracking		X		
2. Smart Contract Monitoring	X	X	X	X
3. Dynamic Rerouting		X	X	X
4a. Container Prioritization		X	X	X
4b. Modal Shift			X	X
LL3 - eCommerce				
Use Cases	Encapsulation	Shipping	Networking	Routing
1. PI e-commerce order fulfilment	X		X	X
2. PI e-commerce network expansion		X		
LL4- WaaS				
Use Cases	Encapsulation	Shipping & Tracking	Networking	Routing & Optimization
1. Simplified PI network	X ✓	X ✓	✓	✓
2. Integrated PI network	X ✓	X ✓	✓	✓

LLs Learning Conclusions

Lessons learned & Conclusions

- The PI concept offers benefits and can realistically shape the Logistics of tomorrow
- The novel PI interconnected services (Shipping, Networking, Routing, Encapsulation) led to:
  - Harmonised seamless information flows enhancing interconnectivity
  - Shared network capabilities
  - Advanced analytics to optimize processes and secure efficiency
  - More informed decision making based on real time dynamic IoT technological advancements
  - Secured transactional ledgers
- Needed work: interoparability, standardization, data governance & sharing before a more mature PI version materializes
- Vertical and Horizontal collaborations (as early PI adaptations) and technology offerings are the catalysts to a more inter-related supply chain schema and PI realization
- Business users and technology partners alike can trigger industry momentum for faster developments. Feasibility studies show promising outlook.
- Authorities /Governments can fuel initiatives through macroeconomic policies (example tax incentives)

LLs Learning Conclusions

Value Add

Business Community

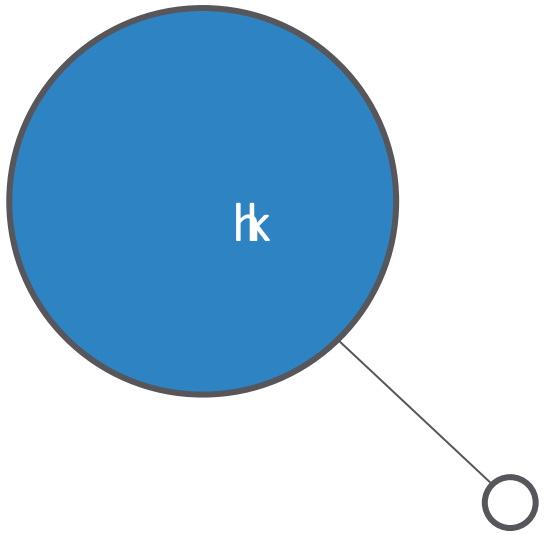
- Demonstrated the benefit and PI capabilities in supply chain domain with tangible benefits /measured cost reductions in relevant prototypes
- Showed the ability of the technological solutions to
  - Enhance visibility
  - Optimize resource allocation and assist asset utilization
  - Secure transactions with technological solutions
- Illustrated the PI services and networking ability to orchestrate and manage T&L operations while interfacing information leading to more informed, cost effective, real-time decision making

Technology providers

- The elements necessary to interface existing infrastructure to PI building blocks
- Research cloud and edge computing in the PI scope (integrate services and analytics)
- Necessary tested ingredients to produce a robust, credible environment to support the network and Logistics operators' needs with protocols and digital solutions
- Knowledge to further enhance and research findings for a more detailed PI offering & digital means

Physical Internet vision

- A step closer to the shaping and realization of the PI in the short to long term future
- Identified barriers/ challenges and areas of further research
- Engaged industry partners and stakeholders to a more defined concept
- Provided work to future R&D projects to build on



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