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BOOSTLOG PROJECT

DELIVERABLE REPORT

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The BOOSTLOG project consortium consists of:

Part. No	Participant organisation name (short name)	Country
1 (Coordinator)	Alliance for Logistics Innovation through Collaboration in Europe, ALICE AISBL (ALICE)	BE
2	STICHTING SMART FREIGHT CENTRE (SFC)	NL
3	FUNDACION ZARAGOZA LOGISTICS CENTER (ZLC)	ES
4	STICHTING TKI LOGISTIEK (TKI Dinalog)	NL
5	HACON INGENIEURGESELLSCHAFT MBH (HACON)	BE
6	INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS (ICCS)	GR
7	Vlaams Instituut voor de Logistiek VZW (VIL)	BE
8	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V. (Fraunhofer)	GE
9	FIT Consulting SRL (FIT)	IT
10	FUNDACION DE LA COMUNIDAD VALENCIANA PARA LA INVESTIGACION, PROMOCION Y ESTUDIOS COMERCIALES DE VALENCIAPORT (VPF)	ES
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Definitions of terms used in this deliverable

Term	**Definition**
Experts	Persons with extensive knowledge or ability in an area of study or work.
Results	The main deliverables, publications etc. out of the projects. For EU Horizon 2020 projects, they are available through CORDIS projects pages
Outcome	Products, services, solutions or knowledge for business or policy applications aiming at addressing Pain Points and other value-added results potentially impacting the market (by creating it or transform it), the Companies operations as well as polices and regulation. Results that could set direction in Companies and Governments are considered Outcomes too.
Implementation Case	A concrete example in which causal links between public R&I funding and technology, organizational or process innovation in a specific logistics area can be established.
Logistics Cloud	A term used in the BOOSTLOG project to refer in a generic way to a freight transport and logistics domain providing flexibility in the way they are defined and addressed.
Innovation Marketplace	A virtual platform that links *Innovation Seekers* willing to solve a problem *(Pain point)* with *Innovation owners (innovators)* that can provide a solution, or with Experts who can unpack the problem and develop solutions

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EXECUTIVE SUMMARY

BOOSTLOG project vision lies in transforming European freight transport and logistics R&I ecosystem to perform optimally[1] boosting impact generation out of R&I investment contributing to EU policy objectives[2] and Companies sustainability and competitiveness generating value for society. Increasing visibility and support valorisation of EU funded R&I project Results, Outcomes and Implementation Cases in the freight transport and logistics is one of the strategies implemented to reach that vision.

This deliverable is devoted to the impact analyses of EU funding in the priority Clouds, KPIs and recommendations; specifically identifying key actions, characteristics and framework conditions that have facilitated reaching impact from R&I investment. Thus, this report contributes to provide insights on the alignments and misalignments of EU Policy objectives, company objectives and associated R&I policies as a starting point and a framework to: i) further complete with the additional cloud reports to be produced, and ii) be discussed with relevant stakeholders and improved accordingly.

The document is divided into two main sections, the first one devoted to analyse and relate Government (Policy and R&I), Companies objectives and sectoral-specific KPIs so clearer links can be established across stakeholders' groups, and the second one to identify key actions, characteristics and framework conditions (e.g. synergies across programmes, calls definition, programme definition) that have facilitated reaching impact from R&I investment.

5 Implementation cases from the Logistics Nodes Cloud Report (D2.5), 4 from the Freight and Logistics Data Sharing Cloud (D2.6), 5 from the Logistics Networks Cloud (D2.7) and 1 from the Physical Internet Cloud (D2.8) have been analysed in this deliverable.

LOGISTICS NODES CLOUD	FREIGHT AND LOGISTICS DATA SHARING	LOGISTICS NETWORKS	PHYSICAL INTERNET
Port of the Future	Collaborative transport coordination, intermediation & visibility platform	Train monitoring (Train Monitor)	Open Logistics Foundation
PREDICTOR Asset Management	Fast Customs Corridor	Multimodal short sea – rail transport service	
Port Environmental Index (PEI)	AEOLIX-Architecture for EurOpean Logistics Information eXchange	through-going corridor-wide rail transport- and logistics concept (RETRACK network)	
Poort Rail Shunting Optimization Tool	Electronic seals for international container movements	Cross-border dispatcher	

[1] R&I systems are complex ecosystems which need various elements to perform optimally. These include a solid public science base producing high quality outputs; strong business participation in innovation activities; fluid and abundant knowledge flows across R&I actors; and good framework conditions that allow business innovation to flourish. European semester thematic factsheet. Research & Innovation. https://ec.europa.eu/info/sites/info/files/file_import/european-semester_thematic-factsheet_research-innovation_en.pdf

[2] namely: decarbonization, emissions and congestion reduction, free and seamless movement of goods and sectorial digitalization capabilities upgrade. https://ec.europa.eu/info/priorities_en

LOGISTICS NODES CLOUD	FREIGHT AND LOGISTICS DATA SHARING	LOGISTICS NETWORKS	PHYSICAL INTERNET
Slot Booking App		Hub- and spoke concept to integrate smaller terminals via mega hubs (Intermodal Network 2015+)	

The genre of implementation cases can also give a preliminary idea on which clouds had the highest impact of EU funding. Indeed, logistics networks cloud followed by the cloud on data sharing, are the ones with more implementation cases operating in the market. Even though the same number of implementation cases has been found in the logistics nodes cloud, they are still in the Proof of Concept phase, and its impact will be fully realised in the coming years.

The analysis of the implementation cases has validated the conclusions and recommendations stemming from deliverable D3.2:

- The Sustainable Development Goals are a common framework for alignment between European Union, Companies.
    - R&I programmes are explicitly addressing Sustainable Development Goals and related KPIs, KPIs may need to be developed accordingly
- There is an important correlation between most of the Policy & Company social objectives. However, translating those objectives in concrete KPIs for R&I is not straightforward as there are too many Impact Indicators and KPIs.
    - Make a prioritization of most important Impact Indicators and KPIs to address particular policy and company objectives.
- For the market-oriented implementation cases, the assessment of the pathway towards impact clearly validates the existence of the valley of death. Therefore, although there are causal links between the research and the impact, most of the conditions to achieve that impact were more dependent on addressing other critical aspects such as regulations, market, social, commercial and industrialization readiness of the solution.
    - Define different readiness levels for R&I results to be realized as actual impacts beyond TRL.

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1 Introduction

1.1 BOOSTLOG project

BOOSTLOG vision is transforming European freight transport and logistics R&I ecosystem to perform optimally boosting impact generation out of R&I investment contributing to i) EU policy objectives towards climate neutrality, pollution, congestion and noise reduction, free movement of goods, internal security, digital transformation of logistics chains and data sharing logistics ecosystems and ii) companies' sustainability and competitiveness generating value for society.

In order to do so, BOOSTLOG focusses on 4 main areas of action:

i) Increase visibility and support valorisation of R&I project Results, Outcomes and Implementation Cases in the freight transport and logistics field:

   a. Maps and asses around 160 EU-funded R&D since FP5 in different freight transport and logistics domains[3], identifies and include main results, outcomes and implementation cases from projects in ALICE Knowledge Platform[4],

   b. Develops comprehensive and industry actionable reports (logistics cloud reports) including: a) logistics coordination & collaboration b) urban logistics, c) logistics nodes, d) freight and logistics data sharing e) multimodal freight, corridors & transport networks f) physical internet including modularization and the upcoming ones on g) zero emission energy and vehicles and h) digital technologies, to share progress made and highlight the impact achieved through R&I projects

ii) Overcome barriers for R&D deployment, identify and define valorization strategies and guidelines to speed up the technological and organisational innovation uptake, including the creation of the Innovation Marketplace within ALICE knowledge platform, examine which areas of research have achieved higher impact and issue recommendations to increase impact of R&I public funding,

iii) Identify and define high potential & priority R&I gaps to make efficient uses of R&I investments and provides recommendations to funding organizations (e.g. European Commission) and

iv) Boost impact of the project outputs towards end users of the freight transport and logistics system, establishing collaboration frameworks for the exchange of best practices in freight transport and logistics R&I at regional, national, European level, engaging with relevant stakeholders in the innovation process.

1.2 Scope of this deliverable

In the framework of BOOSTLOG area of action ii) addressed in Work Package 3, "*Accelerating public funded R&I uptake",* task 3.3 focusses on two main activities:

[3] All BOOSTLOG deliverables once submitted are available at the BOOSTLOG webpage: https://www.etp-logistics.eu/boostlog/

[4] https://www.etp-logistics.eu/knowledge-platform/

i) Analyse and relate Government (Policy and R&I), Companies objectives and sectoral-specific KPIs so clearer links can be established across stakeholders' groups and

ii) Analyse R&I impacts per cloud report and identify key actions, characteristics and framework conditions (and topic description) that have facilitated reaching impact from R&I investment.

The present deliverable (D3.5) shows the second report stemming from Task 3.3. It includes:

i) The main EU policy objectives relevant for freight transport and logistics (i.e. BOOSTLOG scope) already included in D3.2 and the compilation of most relevant European policy files for freight and logistics.

ii) The main company objectives and specific sectoral KPIs in regards of freight transport and logistics.

iii) Reports on the last Clouds released in BOOSTLOG, the Logistics Nodes Cloud (D2.5)[5] Freight and logistics data sharing (D2.6)[6], Logistics Networks (D2.7)[7] and Physical Internet (D2.8)[8] including:

   a. The expected impacts (and associated KPIs) from R&I projects assessed.

   b. The existing links and relations of EU Policy, R&I expected impacts (KPIs) and sectoral companies' objectives and clear indication on how and to what extent the KPIs support reaching the companies and policy objectives.

   c. An initial assessment of the alignment or misalignment among EU Policy Objectives, R&I objectives (KPIs) and sectoral companies' objectives.

   d. The state of the art and market practice before the public R&D investments took place and an assessment of how the public funds contributed to generate impact out of project R&I results further developing into Outcomes and Implementation Cases. Concretely, it includes i) further development of the TRL level beyond the funding period, ii) the level of deployment at company level and the estimated size of the operation for that company based on available benchmarks and iii) the phase of deployment of the new product and services as well as the reached or targeted market. Additionally, other impacts generated such as contribution to policies, education programmes, etc. are defined and assessed.

   e. Stakeholder specific recommendations to boost alignment areas and address misalignments.

The report identifies the framework conditions that supported that impact generation. A deeper analysis on the characteristics of the framework program and the topic description was performed in D3.2 for one of the clouds to understand the conditions that have facilitated reaching impact. This analysis will be replicated for the other clouds in the present document.

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[5] D2.6 Cloud report – Freight and logistics data sharing. https://www.etp-logistics.eu/wp-content/uploads/2022/08/Call_ImplementationCase_DataSharing.pdf

[6] D2.6 Cloud report – Freight and logistics data sharing. https://www.etp-logistics.eu/wp-content/uploads/2022/08/Call_ImplementationCase_DataSharing.pdf

[7] D2.7 Cloud report – Logistics Networks. https://www.etp-logistics.eu/wp-content/uploads/2022/11/Call_Alice-Inn-for-Logistics-Networks_v2-1.pdf

[8] D2.8 Cloud report – Physical Internet https://www.etp-logistics.eu/wp-content/uploads/2023/06/BOOSTLOG_D2.8-Cloud-Report_Physical-Internet_v2.1.pdf

Indeed, D3.5 completes the information in D3.2, including the overall analysis of the rest of BOOSTLOG Cloud Reports not included in D3.2, and assesses in which Logistics Cloud the EU funding had the highest impact.

The main company objectives and specific KPIs included in this report will be further discussed, complemented and validated by companies through surveys and interviews. It will provide recommendations for freight transport and logistics sector specific KPIs to measure impact of EU-R&I funding and the links with European policy objectives and Horizon Europe programme.

Additionally, it will include the European Commission DGs, Directorates and Units that have (or may have) a link to the freight transport and logistics sector, the Policy Objectives or to the Research Programme pursuing/contributing to that objective. Companies' sectorial objectives will also be mapped to identify alignments and miss matches between Companies and European Commission objectives.

1.3 Why this deliverable: aim, challenges and contribution

Research and Innovation are crucial to address Europe's economic and societal challenges and are key drivers of productivity and economic growth as demonstrated by ample empirical evidence.[9] R&I contribute to reaping the new growth opportunities generated from knowledge, technological breakthroughs, process and product innovations, and new business models in a fast-changing world that support economic performance and help tackling societal challenges.

This deliverable aims to contribute to identify and assess impacts out of R&I investments and identify gaps and misalignments between policy and company objectives and R&I programmes in support of those.

Achieving impact generation out of research is complex because of three main reasons:

i) *The valley of death* i.e. the time delay between research activities and the actual implementation in practice. It is difficult to translate scientific knowledge base into commercial goods and services and has been highlighted in many studies as a major problem of EU innovation ecosystem[10]. **In this deliverable we share and assess the path towards impact from 11 Implementation Cases and how they managed to successfully overcome the valley of death.**

ii) Unclear and non-existing KPIs to measure actual R&I impact. The Lamy Report[11] calls for extensive communication of impacts of research by beneficiaries which is indeed an important part of the dissemination and communication efforts of projects. However, capturing the whole breadth of R&I benefits is recognized as a complex operation.[13] In many cases, impact measurement is focussed exclusively on the ability of the private and public sectors to translate investment in R&I into patent applications[12]. Available indicators face indeed limitations[13] and defining them is complex.

[9] European Commission DG Research. (2017). *The Economic Rationale for Public R&I Funding and its Impact.*

[10] KETs: time to act. European Commission High Level Expert Group on KETs. (2015)

[11] Lamy High Level Group Report (2017). *LAB-FAB-APP, Investing in the European future we want*,

[12] Conte (2014). Efficiency of R&D Spending at national and regional level, Technical Report, Joint Research Centre, European Commission

[13] Research and innovation as sources of renewed growth. *European Commission Communication (2014) 339 final.*

Additionally, measurement linked to the intangible and the changing nature of innovation pose significant additional challenges.[13]. For this reason, ALICE embraced a more comprehensive methodology[14] beyond KPIs to assess R&I funded projects impact. **Concrete impacts out of R&I results are shared and quantified.** Although projects define KPIs to measure impact, these impacts are limited to the tests, pilots and living labs conditions in those projects. As such, these KPIs demonstrate a potential impact under very concrete conditions and with important assumptions so these benefits are not directly translated into actual impact at the end of the project as in most cases those pilots, tests and living labs are discontinued when the funding ends (i.e. entering in the *valley of death*) or the transferability is limited.

iii) Lack of alignment between stakeholders' objectives. Non-matching objectives between programmes and stakeholders i.e. linking broad policy objectives, R&I programmes objectives and overall logistics and broader transport system sectorial objectives makes it difficult to create a holistic framework for EU projects assessment that gathers roles, interests and associated KPIs for all stakeholders in a consistent way. ***An initial assessment of the alignment or misalignment among EU Policy Objectives, R&I objectives (KPIs) and sectoral companies' objectives for the cloud reports available is provided.***

The H2020 programme interim evaluation[15] identified several of these factors: regulatory obstacles, lack of standards, market fragmentation,[16] or customer acceptance of new solutions as important challenges for market uptake. ***Change can be accelerated through the alignment of EU Policy objectives, company objectives and associated R&I policies in support of those objectives***.

This report contributes to provide insights on the alignments and misalignments of EU Policy objectives, company objectives and associated R&I policies as a starting point and a framework to: i) further complete with the additional cloud reports to be produced, and ii) be discussed with relevant stakeholders and improved accordingly.

[14] ALICE Research Roadmaps Implementation Plan and Monitoring follow up. *(2018) Deliverable D3.3 SETRIS H2020 project. Grant agreement ID: 653739*

[15] European Commission (2017) *Executive Summary of the Interim Evaluation of H2020*. (SWD 220 & 221)

[16] European Commission DG R&I.. (2018). *Transitions on the Horizon: Perspectives for the European Union's future research and innovation policies*. *978-92-79-81266-8 - KI-02-18-425-EN-N*

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2 Methodology, information gathering and analysis

Impacts and policy objectives contribution and recommendations proposed in this report are based on in-house knowledge, analysis of past projects, outcomes and implementation cases, various interviews with practitioners and discussions from various events organised. The authors and many stakeholders engaged (e.g. expert interviewed) have extensive experiences with EU funded projects and have actively participated in all phases of R&I projects.

2.1 Inputs collected from Cloud Report

Several factors that have influenced the implementations of R&I projects have been gathered and reported, thus forming inputs to this report.

For Logistics Nodes Cloud, 21 projects from FP5, FP7 and HORIZON2020 have been selected for analysis as shown in *Figure 1*:

Figure 1. Past projects on Logistics Nodes.

For Freight and logistics data sharing, 35 projects from FP5, FP6, FP7 and Horizon 2020 have been analysed (*Figure 2*):

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Figure 2. Past projects on Freight and logistics data sharing

For Logistics Networks, 17 projects from FP5, FP6, FP7 and Horizon 2020 have been analysed (*Figure 3*):

Figure 3. Past projects on Logistics Networks

The project mapping for the contribution of the projects in the Physical Internet Cloud compiled below (Figure 4) includes 22 research and innovation (R&I) projects funded by FP7 and Horizon 2020 from 2011 to date.

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Figure 4. Past projects on Physical Internet

Note that some projects may be included in several cloud reports as they cover different topics that are part of the scope of different cloud reports.

16 Implementation cases have been identified: Port of the Future, PREDICTOR Asset Management, Port Envitonmental Index (PEI), Poort Rail Shuting Optimization Tool, Slot Booking App, Collaborative transport coordination, intermediation & visibility platform, Fast Customs Corridor, AEOLIX-Architecture for EurOpean Logistics Information eXchange, Electronic seals for international container movements, Conclusions for the Freight and logistics data sharing Cloud, Train monitoring (Train Monitor), Multimodal short sea – rail transport service, through-going corridor-wide rail transport- and logistics concept (RETRACK network), Cross-border dispatcher, Hub- and spoke concept to integrate smaller terminals via mega hubs (Intermodal Network 2015+) and Open Logistics Foundation.

Authors of each cloud report have conducted semi-structured interviews to practitioners who have participated in those R&I projects identified and the implementation cases owners have been consulted to check their cases. Many practitioners have made significant efforts to advance market uptake of outcomes of their projects, thus delivering concrete impacts on the logistics sector. Additionally, all implementation cases were validated by the owners.

2.2 Inputs collected from BOOSTLOG Events

The BOOSTLOG consortium has organised different events where information on projects and implementation cases has been collected:

- BOOSTLOG launch event[17], 24th March 2021

[17] Detailed information about the event can be found: https://www.etp-logistics.eu/boostlog-launch-event-boosting-the-impact-of-freight-transport-and-logistics-eu-funded-research-supporting-competitiveness-and-addressing-the-climate-challenge/

- BOOSTLOG WP4 Workshop on Identifying R&I priorities in logistics[18], 26th October 2021 and 1st March 2023
- BOOSTLOG Logistics Nodes Cloud Report Launch Event, 28th October 2022
- BOOSTLOG Logistics Networks Cloud Report Launch Event, 16th March 2023
- BOOSTLOG Physical internet Report Launch Event, June 2023, IPIC

Each of the events has been attended by various stakeholders. In BOOSTLOG, four types of stakeholders are considered:

- Company;
- R&I;
- Government;
- Others (including civil society and associations).

Detailed information about stakeholder engagement for the BOOSTLOG project can be found in D5.1 Plan for Stakeholder engagement, communication and dissemination.

2.3 Expected impacts and policy objectives of EU funded R&I projects analysis

The expected impacts and policy objectives of EU funded R&I projects have been identified in the mapping delivered in D2.1 as project attributes. The list of policy objectives identified for the EU funded R&I projects is:

- Digital transformation of logistics chains
- Climate neutrality
- Pollution
- Data sharing logistics ecosystems
- Free movement of goods
- Noise
- Internal security
- Congestion

A detail of these policy objectives is included in chapter 3.

2.4 Impact of the Outcomes and Implementation Cases

Different parameters have been used to analyse the impact of the most relevant outcomes from each cloud (identified as Implementation Cases):

i) Further development of the TRL level beyond the funding period.

[18] Detailed information about the event can be found: https://www.etp-logistics.eu/online-workshop-on-identifying-ri-priorities-in-logistics-1000-1200-26th-oct-2021/

The current TRL level has been identified for the solutions proposed in the Implementation Cases according to the EC[19]. Technology readiness levels (TRL). Where a topic description refers to a TRL, the following definitions apply:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

ii) The phase of deployment of the new product and services as well as the reached or targeted market

- Level of penetration and market acceptance
  - *Market penetration* is a measure of how much a product or service is being used by customers compared to the total estimated market for that product or service.
  - *Market acceptance* is the level of satisfaction with a *product* or service in a target *market* that merits continued or increased supply of the *product* or service.
- TAM-SAM-SOM analysis and business plans (when available). Below the general TAM-SAM-SOM methodology is described (Figure 5). Due to the inhomogeneous data available for the different implementation cases a qualitative approach of the proposed market assessment was performed.
  - Total Addressable Market (TAM). TAM looks at the entire potential value of the overall market (think, the total value for a product sale in the target area in a given year). The market size estimation is a huge number, and probably unattainable by one company. TAM can provide a framework for a market's potential and stability. To calculate TAM, add up all product sales across the market.
  - Serviceable Addressable Market (SAM). SAM refers to the specific potential audience for a product or offering (the total value of the specific product produced by a company for the target audience). This is the maximum market value of your company based on this target market. To calculate SAM, add up all the relevant product sales across the market.
  - Serviceable Obtainable Market (SOM). SOM is a representation of the proportion of the SAM that a company is likely to obtain. Assuming the product of a company is not the only one available in the market (multiple manufacturers/service providers), that number will be smaller than the SAM. To calculate SOM, divide last year's revenue by last year's SAM. This is the market share. Now multiply the market share by the dollar-value SAM for this year. For launching a new product, SOM can be estimated by conducting competitive

[19] Extract from Part 19 - Commission Decision C(2014)4995. G.

analysis and estimating the SOM based on factors such as web traffic, marketing mix, and ad spend.

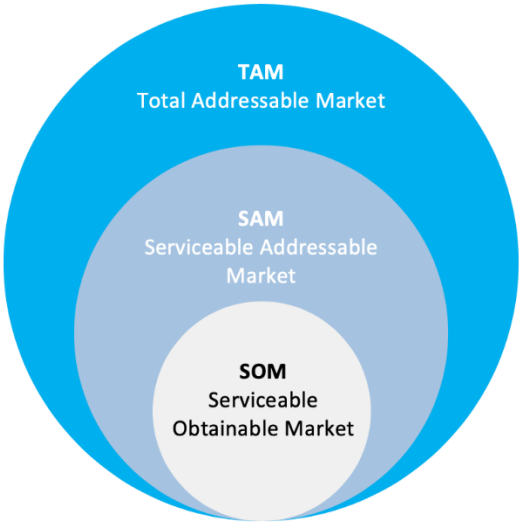

Figure 5. TAM, SAM, SOM methodology.

On top of the company implementation cases, other impacts generated such as contribution to policies, education programmes, etc. are defined and assessed. The parameters used to analyse the impact of the most relevant outcomes in these cases identified as Implementation Cases has been:

- Operational, social and market impact: if solutions or outcomes have been concretely adopted by project partners to develop a new service or product
- Influence on policy: If solutions, measures our outcomes have been included in local SUMP/SULP or also regional or national planning documents.
- Scalability and growth potential: depending mainly on the level of involvement of different kind of stakeholders, in particular private actors.

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3 EU policy, companies and R&I programmes objectives and KPIs

In this chapter, the objectives at policy, company and Research and EU Innovation Programmes, and projects KPIs is reported as the starting point to:

- Identify the existing links and relations of EU Policy, R&I expected impacts (KPIs) and sectoral companies' objectives and a further analysis on how and to what extent the R&I KPIs support reaching the companies and policy objectives.
- Do an initial assessment of the alignment or misalignment among EU Policy Objectives, R&I objectives (KPIs) and sectoral companies' objectives.

Based on desk research, the Sustainable Development Goals are a common framework for alignment between European Union and companies:

- European Union priorities are aligned with the Sustainable Development Goals[20] (SDG). Significant or moderate progress has been made in the European Union in the last five years[21].
- A recent publication of Global Reporting Initiative[22] analyses a sample of over 200 companies around the world that produced a GRI report in 2020. 83% of companies state that they support the Sustainable Development Goals, recognizing the value of aligning their reports with the Goals;

3.1 EU policy objectives relevant for freight transport and logistics

***climate neutrality*, *pollution*, *congestion*, *noise*, *free movement of goods*, *internal security*, *digital transformation of logistics chains* and *data sharing logistics ecosystems* are the main EU policy areas relevant for freight transport and logistics**

The European Commission established the priorities for the period 2019-2024[23]. These priorities are also aligned with the Sustainable Development Goals[24]. In the European report[21], it is highlighted that that overall, the goal-level assessment in 2023´s SDG monitoring report shows that the EU has progressed strongly towards many socioeconomic goals over the most recent five-year period of available data, while trends in the environmental domain have been less favourable. It is also highlighted that while the impacts of the COVID-19 pandemic are largely visible for most of the indicators, more recent developments such as those caused by Russia's military aggression against Ukraine are only partly reflected in the available data.

BOOSTLOG focus on the policy objectives/priorities relevant for integrated freight transport and logistics systems. Through BOOSTLOG, a monitoring system has been worked out to identify relevant policy files and follow up their process of adoption (i.e. starting phase in which a proposal is prepared by the European Commission and follow up processes in the European Parliament and Council until

[20] https://ec.europa.eu/info/strategy/international-strategies/sustainable-development-goals_en

[21] Sustainable development in the European Union — Monitoring report on progress towards the SDGs in an EU context — 2023 edition https://ec.europa.eu/eurostat/en/web/products-flagship-publications/w/ks-04-23-184

[22] GRI 2022. https://www.globalreporting.org/about-gri/news-center/most-companies-align-with-sdgs-but-more-to-do-on-assessing-progress/

[23] European Commission Priorities 2019-2024. *https://ec.europa.eu/info/priorities_en*

[24] https://ec.europa.eu/info/strategy/international-strategies/sustainable-development-goals_en

the initiative is formally adopted and put in to force. In Annex I, a mapping with 20 relevant European Policy initiatives can be found. Most relevant information on European Union priorities, Strategies and policy initiatives is included below.

The European Green Deal[25] aims to achieve **climate neutrality** by 2050. Moreover, the **European Climate Law**[26] writes into law the goal set out in the European Green Deal. The Green Deal includes as an objective that *Transport should become drastically less polluting, especially in cities* and advocates for a combination of measures to address **pollution** and **congestion** issues. As a next step for the development of the Green Deal in the field of transport, the European Commission adopted the **Sustainable and Smart Mobility Strategy**[27] in 2020. The mobility strategy is complemented with an action plan listing 82 initiatives in 10 key areas for action ('flagships') with concrete measures to be adopted over the next four years. Most relevant objectives of the Sustainable and Smart Mobility Strategy are, by 2030: 100 European cities will be climate neutral and by 2050: rail freight traffic will double. Additionally, creating zero-emission airports and ports and making connected and automated multimodal mobility a reality by freight to seamlessly switch between transport modes.

To build on the strategy and proposals, the European Commission adopted in July 2021 a set of proposals called **Fit for 55**[28] to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels[29].

Within this package the main policy initiatives relevant to freight and logistics have been adopted and are currently in force[30]. Namely:

- 50% reduction of **emissions from vans** by 2030 and zero emissions at 2035 was adopted in 2023[31].
- **Revision of the EU Emission Trading System**[32]. The Revision of the ETS Directive was adopted by the council[33] and the parliament[34] in 2023. The deal includes a more ambitious reduction target for the EU ETS sectors of 62% by 2030; revised parameters for the Market Stability Reserve (MSR); the expansion of the EU ETS to cover maritime shipping; a new and separate ETS for buildings, road transport, and additional sectors (ETS 2); and a strengthened commitment to use ETS revenues to address distributional effects and spur innovation.

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25 The European Green Deal. Brussels, COM (2019) 640 final

26 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119

27 https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12438-Sustainable-and-Smart-Mobility-Strategy_en

28 https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541

29 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

30 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55-delivering-proposals_en

31 https://www.europarl.europa.eu/news/en/press-room/20230210IPR74715/fit-for-55-zero-co2-emissions-for-new-cars-and-vans-in-2035

32 https://ec.europa.eu/info/files/revision-eu-emission-trading-system_en

33 https://www.consilium.europa.eu/en/press/press-releases/2023/04/25/fit-for-55-council-adopts-key-pieces-of-legislation-delivering-on-2030-climate-targets/

34 https://www.europarl.europa.eu/legislative-train/package-fit-for-55/file-revision-of-the-eu-emission-trading-system-(ets)

- Revised **Alternative Fuels Infrastructure Regulation** requires Member States to expand charging capacity[35]. In July 2023, the European Parliament approved new rules on more alternative fuel stations for cars and trucks. For trucks and buses, charging stations must be provided every 120 km. These stations should be installed on half of main EU roads by 2028. Hydrogen refuelling stations along core TEN-T network will have to be deployed at least every 200 km by 2031.

In December 2021, the Commission published further proposals, targeting **greater efficiency and more sustainable travel** of which, the most relevant for freight transport and logistics are:

- **Revision of the TEN-T Regulation[36]** The Trans-European Transport Network (TEN-T) policy develops a Europe-wide network of railway lines, roads, inland waterways, maritime shipping routes, ports, airports and railroad terminals. The ultimate objective is to close gaps, remove bottlenecks and technical barriers, as well as to strengthen social, economic and territorial cohesion in the EU. For the completion of the TEN-T the core network should be completed by 2030, the newly added extended core network by 2040 and the comprehensive network by 2050. Some of the key elements of the European Commission proposal concerned:
  - The introduction of a new intermediary deadline of 2040 to advance the completion of major parts of the comprehensive network.
  - New standards for transport links, such as a minimum speed of 100 km/h for freight;
  - Reduced waiting times at border crossings, longer freight trains, transport of lorries by train along the network;
  - That rail freight corridors are to be integrated into the TEN-T corridors, to create nine 'European Transport Corridors' that integrate rail, road, and waterways;
  - Increased number of transhipment terminals and their handling capacity;
  - 424 major cities on the TEN-T network will have to develop Sustainable Urban Mobility Plans that promote zero-emission transport and the greening of the urban fleet, by 2025**.**

  Several developments, amendments and updates have been worked out since then through regular legislative processes[37]**.**

- **Communication on the New EU urban mobility framework (non-legislative)[38]**. Based on latest available data, the transport sector is the largest contributor to nitrogen oxide emissions, and a significant contributor to particulate matter emissions[39]. Urban freight accounts for a significant part of ambient **noise** in cities and impacts air quality as it generates 30 to 50% of transport-related pollutants such as particulate matters (PM) or Nitrogen Oxide (NOx)[4]. Growing demand for e-commerce delivery will result in 36% more delivery vehicles in inner cities by 2030, leading to a rise in both emissions and traffic congestion without effective intervention. Without effective intervention, urban last-mile delivery emissions and traffic congestion are on track to increase by

[35] https://oeil.secure.europarl.europa.eu/oeil/popups/summary.do?id=1670400&t=d&l=en

[36] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12532-Trans-European-transport-network-TEN-T-revised-guidelines_en

[37] https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-ten-t-regulation-review

[38] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12916-Sustainable-transport-new-urban-mobility-framework_en

[39] EEA (2017). *Air Quality in Europe – 2017 Report*. European Environment Agency.

over 30% in the top 100 cities globally[40]. The new framework includes a renewed focus on recharging and refuelling infrastructure for electric and hydrogen vehicles in cities, zero-emission city logistics and last-mile deliveries, Urban Nodes & TEN-T networks, as well as digital solutions supporting the deployment of high-quality public transport in urban environments.

Cities are recognized as important elements of a well-functioning TEN-T network. Among main objectives:

- To support quicker and more efficient zero-emission logistics in urban nodes, enough multimodal terminals and freight consolidation centres.
- Alternative delivery solutions, such as cargo bikes and inland waterways should also be considered and better utilised in urban logistics, with automated deliveries and drones (unmanned aircraft) being increasingly used in the future, where appropriate.
- To support regions and cities in the roll-out of effective sustainable urban mobility plans in particular addressing Sustainable Urban Logistics Plans (SULP), based on zero-emission vehicles and solutions;
- Support voluntary data sharing between all types of stakeholders to make urban freight transport more efficient, sustainable and competitive (in connection with the Digital Transport and Logistics Forum).

Relevant to this initiative is the Expert Group on Urban Mobility[41] that includes a subgroup of freight and logistics led by ALICE in collaboration with POLIS and ACEA

In July 2023 the European Commission released the **Greening Freight Transport package**[42]. Despite being the backbone of the EU's Single Market, freight transport is also responsible for over 30% of CO2 emissions. And as the EU economy grows, emissions are likely to rise unless decarbonisation measures are put in place. The proposals will now be considered by the European Parliament and the Council in the ordinary legislative procedure and includes the following relevant files:

- **Revision of the Weights and Dimensions Directive of HDVs**[43]. The Weights and Dimensions Directive sets the maximum authorised dimensions of heavy-duty vehicles used in national and international commercial transport and the maximum authorised weights of HDVs used in international commercial transport. This proposal seeks to ensure the free movement of goods, remove obstacles to traffic between EU Member States and improve the conditions of competition. The directive was amended twice. In 2015[44] to make reduce greenhouse emissions and improve road safety and working conditions for drivers. In 2019[45] were introduced measures promoting the roll-out of zero-emission trucks and buses, usually heavier than the conventional ones, mostly due to the added weight of the battery. The Sustainable and Smart Mobility Strategy announced the

[40] World Economic Forum (2020). The Future of the Last-Mile Ecosystem. Transition Roadmaps for Public- and Private-Sector Players

[41] https://transport.ec.europa.eu/news-events/news/new-expert-group-urban-mobility-begins-work-2022-10-20_en

[42] 'Greening Freight Transport'. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3767 .

[43] https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_3770

[44] Directive 2015/719/EU

[45] Regulation 2019/1242/EU

review of the Weights and Dimensions Directive with the main objectives to speed up the uptake of zero-emission HDVs and boost intermodal freight transport operations.

- **Establish EU framework for harmonised measurement of transport and logistics emissions**[46]. As part of the European Green Deal, the Commission work programme 2022 contained a legislative initiative on an EU framework for harmonised measurement of transport and logistics emissions. This initiative sets out a common framework to calculate and report transport-related greenhouse gas emissions. It can be applied by both the passenger and freight sectors. Transparent information will allow service providers to monitor and reduce their emissions and improve the efficiency of their transport services and will enable users to choose the most sustainable option. The general objective is to incentivise the reduction of emissions from transport and logistics and to contribute to the improvement of the environmental performance of transport through the following specific objectives:
  - providing a single EU framework for calculating GHG emissions data of transport operations/services in freight and passenger sectors.
  - making available reliable and comparable information on the GHG intensity of individual transport services.
  - facilitating the uptake of GHG emissions accounting in business practice. Due to the international outreach of transport and logistics, this initiative will give due consideration to the possibility to deliver a framework enabling further alignment on a global scale.
- **More efficient use of rail capacity**. Rail tracks are expensive to build and, in the EU, increasingly congested. The proposed Regulation[47] will optimise their use, improve cross-border coordination, increase punctuality and reliability, and ultimately attract more freight companies to rail. Current rules on capacity management are decided annually, nationally, and manually. This does not favour cross-border traffic (around 50% of rail freight crosses borders); the fractured approach leads to delays at borders. This, in turn, hinders the functioning of the Single Market. Delays due to congestion caused by uncoordinated maintenance work are also common. The proposal for a regulation on the use of railway infrastructure capacity in the single European railway area builds on the industry-led Timetable Redesign Project. The aim is to better respond to the different needs of the rail sector: stable timetables and flexible train runs adapted to just-in-time supply chains for freight shippers.

Additionally, the **Revision of Combined Transport Directive**[48] proposal from the European Commission is expected in Q3 2023. The objective of the initiative is to facilitate an increase in the share of rail, short-sea shipping, and inland waterways. The revision aims at improving the existing support by

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[46] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the accounting of greenhouse gas emissions of transport services https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13217-Count-your-transport-emissions-CountEmissions-EU_en

[47] Proposal for a **regulation on the use of railway infrastructure capacity in the single European railway area,** amending Directive 2012/34/EU and repealing Regulation (EU) No 913/2010 https://transport.ec.europa.eu/document/download/9393e22e-72ee-440d-a983-e2ee116e11ba_en?filename=COM_2023_443_0.pdf

[48] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13010-Sustainable-transport-revision-of-Combined-Transport-Directive_en

extending the scope, increasing ways to the choice and level of support measures and thereby incentivising intermodal or multimodal transport in the EU in view of a more sustainable modal composition of the transport system.

Additionally, **Reducing carbon emissions of Heavy Duty Vehicles** and reviewing emissions reduction roadmaps is a very relevant initiative. Road transport is a major contributor to climate change, and CO2 emissions from heavy-duty vehicles have grown by 25 % since 1990, accounting for over a quarter of road transport CO2 emissions. The proposal sets CO2 requirements for new trailers and targets 100 % of newly registered urban buses to be zero-emissions vehicles from 2030[49]. This proposal is part of the European Green Deal and is currently on hold due to the 'checks and balances' part of the ordinary legislative process[50].

Economy that Works for People[51] One of the main pillars within this priority is the single market[52] aiming at **free movement of goods** among others. Single market and a truly integrated freight transport and logistics systems are the two faces of the same coin. Still, a lot of burden is created due to cross-border issues in rail freight transport, or e-commerce, but also in case of emergencies such as the COVID-19 outbreak that highlighted the barriers still in place but also the need to be united as included in the *COVID-19 Guidelines for border management measures to protect health and ensure the availability of goods and essential services*[53]for the efficient, free movement of goods and services. This area is very sensitive from a political point of view and therefore R&I may have a limited impact. Freight transport and logistics actors are building innovative solutions to reduce this burden not only addressing the internal market but also in connecting to global markets and supply chains and very recently to UK due to BREXIT.

On 17 May 2023, the Commission put forward proposals for the most ambitious and comprehensive reform of the EU Customs Union since its establishment in 1968[54].

Promoting our European way of life[55] within this policy area, freight transport and logistics contribute to the **internal security** objective. It is the European Commission ambition to *take the Customs Union to the next level, equipping it with a stronger framework that will allow us to better protect our citizens and our single market. It will propose a bold package for an integrated European approach to reinforce customs risk management and support effective controls by the Member States*[56]. Global trade is a key

[49] The proposed regulation integrates and repeals Regulation (EU) 2018/956 on monitoring and reporting of CO2 emissions and fuel consumption of new heavy-duty vehicles.

[50] The European Economic and Social Committee is preparing an opinion on the proposal, scheduled for adoption during the plenary session on 12-13 July 2023

[51] *European Commission Priority: An economy that works for people*. https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people_en

[52] *European Commission Single Market Strategy.* https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/internal-market_en

[53] COVID-19 Guidelines for border management measures to protect health and ensure the availability of goods and essential services. COM (2020) 1753 final.

[54] https://taxation-customs.ec.europa.eu/customs-4/eu-customs-reform_en

[55] European Commission Priority: Promoting our European way of life https://ec.europa.eu/info/strategy/priorities-2019-2024/promoting-our-european-way-life_en

[56] A Union that strives for more. My agenda for Europe By candidate for President of the European Commission Ursula von der Leyen (2019).

element and international freight, and logistics chains need to deal with international borders efficiently.

A Europe fit for the digital age[57] The recent European Commission Communication acknowledges the future **digital transformation of logistic chains**[58]. Digital and other technologies such as artificial intelligence, autonomous transport, electrification, Internet of Things, blockchain, automation and robotic systems, further digitalisation, new transport modes, 5G and 6G, supercomputing, will play an important role as Key Enabling Technologies (KETs) for more sustainable and efficient freight transport and logistics. These technologies combined with a proper data strategy[59] will create the digital capability to build up a truly integrated transport system for sustainable and efficient logistics.

As part of the **Sustainable and Smart Mobility Strategy**[60] actions for all transport sectors as well as for cross-modal are included on **data sharing logistics ecosystems** building on the developments of the Digital Transport and Logistics Forum[61]. More generally, digitalisation is already reshaping the transport sector, leading to strongly improved logistics across transport modes[62].

Moreover, the European Commission launched the **European industrial strategy**[63] to ensure that its industrial ambition takes full account of the new circumstances following the COVID-19 crisis and helps to drive the transformation to a more sustainable, digital, resilient and globally competitive economy. Although freight and logistics demonstrated the value as an industry to keep Europe running and it is one of the most important sectors accountings for around 10% GDP, industry strategy has little focus on **logistics competitiveness**.

3.2 Company objectives in freight transport and logistics

While every business might have specific objectives according to the industry they operate, the corporate objectives usually fall in these three categories:

- **Economic & competition (Profit)** aiming at keeping the company operating and in business, increasing productivity of people and resources, creating revenues and reducing costs to increase profits ensuring healthy finance and cash flows. Additionally, focusing on growth and/or a combination of growth and selecting those business segments with bigger margins. Reaching the right customers and suppliers with excellence customer service, operations and staying ahead of competition in the marketplace the company operates are important competition objectives.
- **People** & company culture aiming at providing employees with support and matching their needs and interest achieving employee attraction and retention, building the organization ideals and values, diversity, and inclusion as well as change management.

[57] European Commission Priority: A Europe fit for the digital age. *https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en*
[58] Shaping Europe's digital future, COM (2020) 67 final.
[59] A European strategy for data, COM (2020) 66 final.
[60] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789
[61] Digital Transport and Logistics Forum, DTLF (*www.dtlf.eu*). Commission Expert Group (E03280).
[62] Proposal for a Regulation on electronic freight transport information (COM/2018/279 final) and Proposal for a Regulation establishing a European Maritime Single Window environment and repealing Directive 2010/65/EU (COM/2018/278 final).
[63] https://ec.europa.eu/growth/industry/strategy_en

- **Social & Planet** aiming at giving back the value to the society ensuring fair trade, protecting the environment, supporting local communities and in general supporting the Sustainable Development Goals.

Freight Transport and logistics is a basic function of companies to achieve their primary objectives. While in the past it was solely treated as an economic (cost) function and as an element for competition, lately the social dimension is becoming more and more important due to the implications of transport and logistics on climate, pollution, congestion and noise.

The essence of logistics is the flow that encompasses all the steps and processes involved in delivering the materials or goods of a company to another company or end consumers. It involves not only physical flows but also information flows and triggers financial flows when the material and goods are effectively handed to a company and the end users.

The most relevant freight transport and logistics company objectives are:

- Increasing **efficiency & productivity**
- Fulfilling **customer** requirements and ensuring product availability.
- Rapid response, **flexibility and agility**
- Fewer unexpected events, **reliability and resilience**
- Minimum **inventory**
- Reduced transportation and logistics **cost**

The effectiveness of freight transport and logistics is different for each company according to the priority objectives.

ALICE identified in its Research and Innovation Roadmaps (2014)[64] the following **indicators to achieve the company objectives** for freight transport and logistics:

Increase:

+ Load factors: weight and cube fill of vehicles
+ Volume flexibility (Time to +/- capacity)
+ % synchromodal
+ Asset utilization
+ Supply Chain Visibility
+ Reliability of transport schedules
+ Order fulfilment
+ Transport routes optimization (reducing Kms)
+ Automatic data exchange
+ Cargo and logistics units integrated in the automatic data exchange
+ Upside / Downside supply chain adaptability and flexibility

Decrease:

- Empty Kilometres
- Waiting time in terminals

[64] https://www.etp-logistics.eu/about-alice/documents-publications/

- Risk factor reduction
- End-to-end transportation time
- Travel distance to reach the market
- Cargo lost o theft of damage
- Lead times

Additionally, established **impact indicators of freight transport and logistics operations are**:

- Energy consumption
+ Renewable energy share
- Greenhouse gas emissions

3.3 R&I programmes objectives and KPIs

Minimise transport systems' negative impacts on climate and the environment, reduce congestion, improve accessibility and the mobility of people and freight by developing new concepts of freight transport and logistics were important and key objectives set for the Smart, Green and Integrated Transport section of Horizon 2020[65] and will continue to be in Horizon Europe[66] programme. A growing need of adaptation is also expected to deal with the COVID-19 crisis. EU and other public R&I investments are fundamental to achieve policy, economical and societal objectives.

List of expected impacts (and KPIs) identified for the EU funded R&I projects in each cloud:

- Decrease of environmental impact (CO_2 emissions/unit of transport; Local pollutants/unit of transport)
- Reduction of congestion on the road network (Number of eliminated trucks per year; Reduction of average trip time for other road vehicles; Increase in average travel speed for other road vehicles)
- Modal shift (Absolute productivity of various transport modes in ton*km; Market share in % per mode, measured in ton*km)
- Improved capacity utilisation of barge, train and truck (TEU/barge-km; TEU/train-km; TEU/barge/train/ truck-km)
- Decrease cost of transport & overall logistics (Cost/unit of transport; Fuel cost/unit of transport; % of cost decrease /TEU)
- Improved inventory management (Reduction of inventory levels at nodal and end-to-end levels; Reduction of total working capital; Reduction of product stockouts)
- Increased transport reliability and responsiveness (% On Time In Full Delivery; Better customer service; % Customer Case Fill On Time)
- Increase management capacity of terminals and productivity
- Improved operations in terminals (Improved connection time at ports and terminals: Dwell time; waiting time. Improved transfer time. Increased network speed /reduced waiting times)
- On-time arrival rate (% cancelled routes)
- Improved terminal capacity utilization and efficiency (Terminal throughput; Number of movements; Slot availability; Transhipment time; Truck waiting time; Quay productivity)

[65] Smart, Green and Integrated Transport, H2020 Programme section https://ec.europa.eu/programmes/horizon2020/en/h2020-section/smart-green-and-integrated-transport

[66] https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en

- Decrease travel times (Average travel time/delivery c. Increase delivery reliability; % On Time In Full Delivery)
- Improve energy consumption (Energy consumption/unit of transport)
- Increase transport efficiency (Average load factor; Number of vehicles/total units of transport; Vehicles*km; Number of journeys; - Number of failed deliveries)
- Improve the performance of the European Transport (Hyper-connected network of logistics hubs and clusters to optimize transport in the network; Increase average door-to-door vehicle load factor; Increase intermodal transport in the network)
- Improve long distance-city distribution connectivity (% Decrease in operational handling)

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4 Analysis and relation of EU policy, company objectives and R&I projects expected impacts

4.1 Contribution of the Expected Impact of R&I projects to the policy & company objectives

Table 1 links the expected IMPACTS (and their related KPIs) with the policy and company objectives identified in the mapping of the projects (D2.1).

From the expected IMPACTS and KPIs identified to have a direct impact on the POLICY objectives, most of the IMPACTS hit on several POLICY objectives, contributing to a greater extent to meeting them.

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Table 1. Contribution of the expected impacts to the policy objectives.

EXPECTED IMPACT	KPI	POLICY OBJECTIVE	COMPANY OBJECTIVES
Decrease of environmental impact	CO_2 emissions/unit of transport; Local pollutants/unit of transport	climate neutrality pollution	climate neutrality n.a.
Reduction of congestion on the road network	Number of eliminated trucks per year; Reduction of average trip time for other road vehicles; Increase in average travel speed for other road vehicles	pollution and congestion climate neutrality	efficiency climate neutrality
Modal shift	Absolute productivity of various transport modes in ton*km; Market share in % per mode, measured in ton*km	climate neutrality	climate neutrality
Improved capacity utilisation of barge, train and truck	TEU/barge-km; TEU/train-km; TEU/barge/train/ truck-km	climate neutrality	climate neutrality efficiency
Decrease cost of transport & overall logistics	Cost/unit of transport; Fuel cost/unit of transport; % of cost decrease /TEU	competitiveness*	cost
Improved inventory management	Reduction of inventory levels at nodal and end-to-end levels; Reduction of total working capital; Reduction of product stockouts	competitiveness*	inventory
Increased transport reliability and responsiveness	% On Time In Full Delivery; Better customer service; % Customer Case Fill On Time	competitiveness*	flexibility and agility
Increase management capacity of terminals and productivity		competitiveness*	productivity
Improved operations in terminals	Improved connection time at ports and terminals: Dwell time; waiting time. Improved transfer time. Increased network speed /reduced waiting times	competitiveness*	efficiency & productivity
On-time arrival rate	% cancelled routes	competitiveness*	reliability
Improved terminal capacity utilization and efficiency	Terminal throughput; Number of movements; Slot availability; Transhipment time; Truck waiting time; Quay productivity	competitiveness*	efficiency & productivity
Decrease travel times	Average travel time/delivery; Increase delivery reliability; % On Time In Full Delivery	congestion	reliability
Improve energy consumption	Energy consumption/unit of transport	climate neutrality	climate neutrality
Increase transport efficiency	Average load factor; Number of vehicles/total units of transport; Vehicles*km; Number of journeys; Number of failed deliveries	climate neutrality pollution and congestion	climate neutrality efficiency & productivity
Improve the performance of the European Transport	Hyper connected network of logistics hubs and clusters to optimize transport in the network; Increase average door-to-door vehicle load factor; Increase intermodal transport in the network	data sharing log ecosystems digital transform of log chains free movements of goods climate neutrality competitiveness*	climate neutrality efficiency & productivity flexibility and agility reliability and resilience

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EXPECTED IMPACT	KPI	POLICY OBJECTIVE	COMPANY OBJECTIVES
Improve long distance-city distribution connectivity	% Decrease in operational handling	competitiveness*	efficiency & productivity

** New policy objective detected and not identified in the first stage of the project.*

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4.2 Designing call for proposals and selecting right proposals for higher impacts

The mapping of the projects performed in D2.1 includes the mapping of the policies addressed (*Table 2, Table 3 and Table 4*) by the projects and the impacts expected according to the topic calls (*Annex II, Annex III and Annex IV*).

4.2.1 Logistics Nodes Cloud

Logistics Nodes are centres of freight transport where a large activity of cargo logistics and related services are concentrated with different degree of added value. Located at strategic points of interconnection along the main supply chain routes, logistics nodes cover maritime, river, inland ports, airports, intermodal terminals as well as other hubs such as distribution centres or warehouses.

However, the Logistics Nodes Cloud concentrates on five specific infrastructures – Maritime & River ports, inland ports & hubs, container depots, intermodal terminals and airports –, and three types of improvements – operational safety & (cyber-)security, operational efficiency and operational sustainability & environmental impacts –. Following this approach, 21 projects were selected, as these are considered key projects with important contributions to the progress and evolution of the logistics nodes.

The project mapping for the contribution of the projects in the Logistics Nodes Cloud is compiled in Table 2 below.

Table 2. Mapping of the policies addressed by the projects in the Logistics Nodes Cloud.

POLICY OBJECTIVE / PROJECT	***ARCC***	***CARGO ANTS***	***CHINOS***	***CLUSTERS 2.0***	***COFASTRANS***	***COREALIS***	***DOCKINGASSIST***	***DOCKSTHEFUTUR***	***ECOHUBS***	***FUTUREMED***	***INTERFACE***	***INTERMODEL EU***	***INTE-TRANSIT***	***LOGIMATIC***	***OPTIYARD***	***PIXEL***	***RCMS***	***SAIL***	***SMART-PORT***	***SMARTSET***	***SUPPORT***
Digital transformation of logistics chains	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X			X
Climate neutrality						X														X	
Pollution									X	X											
Data sharing logistics ecosystems		X	X	X					X		X		X			X		X		X	X
Free movement of goods													X								
Noise						X															
Internal security		X	X										X	X							
Congestion	X	X			X	X	X			X				X	X		X	X	X	X	X

The mapping of the projects addressing the policies objectives reveals a greater contribution to digital transformation of logistics chains (with 18 projects), congestion (with 13 projects each), pollution (with 3

projects), and data sharing logistics ecosystems (with 10 project). The rest of the policies have been addressed to a lesser extent by the projects in the Logistics Nodes Cloud (Figure 6).

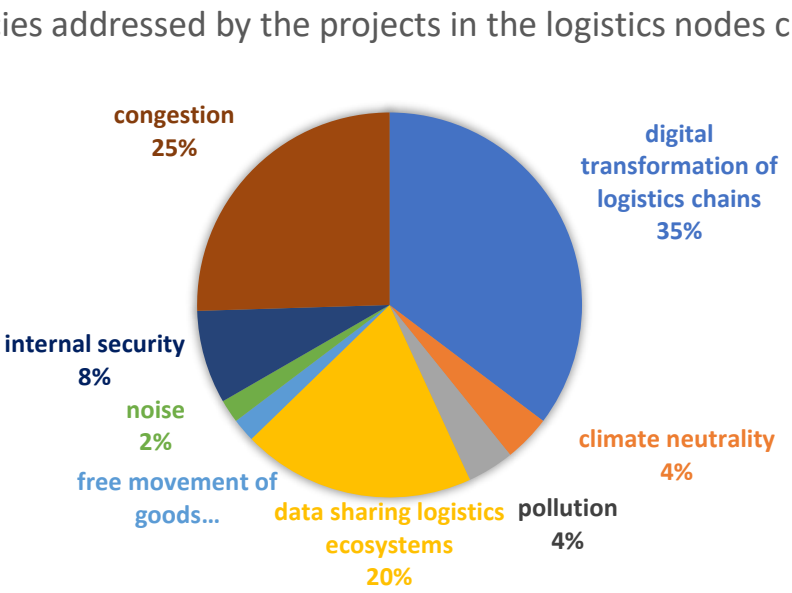

Figure 6. Policies addressed by the projects in the Logistics Nodes Cloud.

4.2.2 Logistics Networks Cloud

Logistics Networks in the context of BOOSTLOG deal with multimodal freight transport on corridors or networks. They are basically composed of three layers, (1) Network infrastructures and their interfaces, (2) Transport services and (3) Supply chain / Logistics services.

Key projects within the Logistics Networks Cloud primarily adress the "Transport services" layer and the following aspects:

- Transport corridors or networks (focus on rail, waterways, road, air);
- Interfaces between networks (country-country borders) and between networks/lines and terminals (access to other modes);
- Nodes as origin / destination / connection points;
- Traffic management (dispatching);
- Transport services planning and operations/production (synchromodality);
- Contingency management.

As a result, 17 key projects were identified with important contributions to the improvement of Logistics Networks.

The project mapping for the contribution of the projects in the Logistics Networks Cloud is compiled in Table 3 below.

Document elaborated with the support of the BOOSTLOG project has received funding from *the European Union's Horizon 2020 research and innovation programme* under grant agreement No 101006902

Table 3. Mapping of the policies addressed by the projects in the Logistics Networks Cloud.

POLICY OBJECTIVE / PROJECT	***ARCC***	***CREAM***	***FR8RAIL III***	***GET SERVICE***	***GIFTS***	***INTERFACE***	***LESSTHAN WAGONLOAD***	***LOGISTAR***	***MOSES***	***NEWS***	***NOVIMAR***	***RETRACK***	***SMART-RAIL***	***SYNCHRO-NET***	***TELLISYS***	***TIGER DEMO***	***VIWAS***
Digital transformation of logistics chains	X	X	X	X	X	X		X			X	X	X	X		X	X
Climate neutrality	X	X		X		X	X			X				X	X		
Pollution							X							X		X	
Data sharing logistics ecosystems	X	X	X	X	X	X		X			X		X	X		X	X
Free movement of goods		X										X	X				
Noise																	
Internal security																	
Congestion	X						X							X		X	

The mapping of the projects addressing the policies objectives reveals a greater contribution to digital transformation of logistics chains (with 13 projects), data sharing logistics ecosystems (with 12 project), climate neutrality (with 8 projects), congestion (with 4 projects), pollution and free movement of goods (with 3 projects each). The plocy objectives noise and internal security have not been specifically addressed by the projects in the Logistics Networks Cloud (Figure 7).

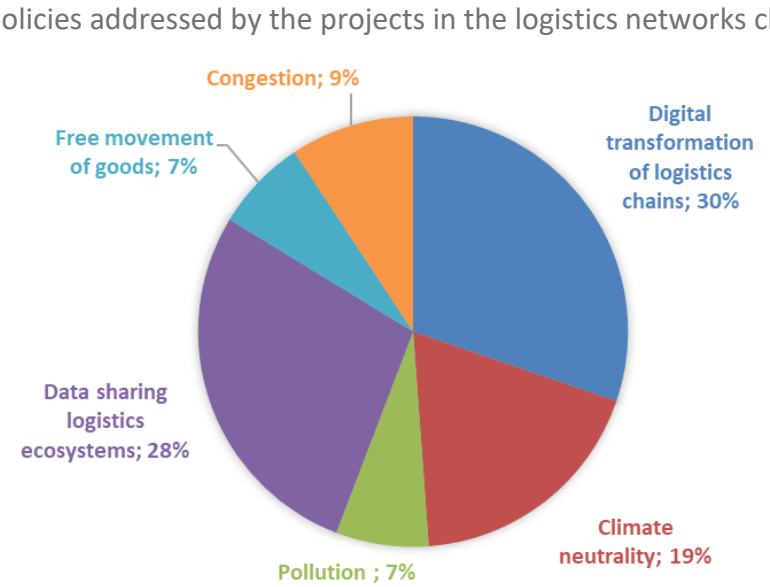

Figure 7. Policies addressed by the projects in the Logistics Networks Cloud.

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4.2.3 Physical Internet Cloud

The Physical Internet (PI) transfers principles of data exchange on the Internet to goods transport in the real world, i.e. in the internet world, data finds a way without human intervention and neither the sender nor the recipient know the path data packets take. PI aims optimum use of vehicles, assets and the existing infrastructure through open and shared logistics networks and flexible routing to maximise efficiency and sustainability in transport and logistics.

22 projects were identified as these key projects with important contributions to the progress and evolution of the Physical Intertnet.

The project mapping for the contribution of the projects in the Logistics Nodes Cloud is compiled in Table 4 below.

Table 4. Mapping of the policies addressed by the projects in the Physical Internet Cloud.

POLICY OBJECTIVE / PROJECT	***CO3***	***iCargo***	***MODULUSHCA***	***AEOLIX***	***AEROLEX***	***COG-LO***	***CO-GISTICS***	***CLUSTERS 2.0***	***DYNEHUBS***	***ICONET***	***EPICENTER***	***LESSTHANWAGONLOAD***	***LEAD***	***LOGISTAR***	***PLANET***	***NEXTRUST***	***SELIS***	***SENSE***	***SYNCHRONET***	***STARGATE***	***Ulaads***	***URBANIZED***
Climate neutrality													X			X					X	X
Pollution													X								X	X
Congestion										X			X			X					X	X
Data sharing logistics ecosystems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Free movement of goods						X	X	X	X	X	X	X										
Digital transformation of log chains	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Modal shift												X	X					X			X	X

The mapping of the projects addressing the policies objectives reveals a greater contribution to *Digital transformation of logistics chains* (with 22 projects, 100% of the projects) and *Data sharing logistics ecosystems* (with 20 projects, 91% of the projects). A medium contribution to *Free movement of goods* (with 7 projects), and *Modal shift* and *Congestion* (with 5 projects for each policy). The rest of the policies have been addressed to a lesser extent by the projects in the Physical Internet Cloud (Figure 8).

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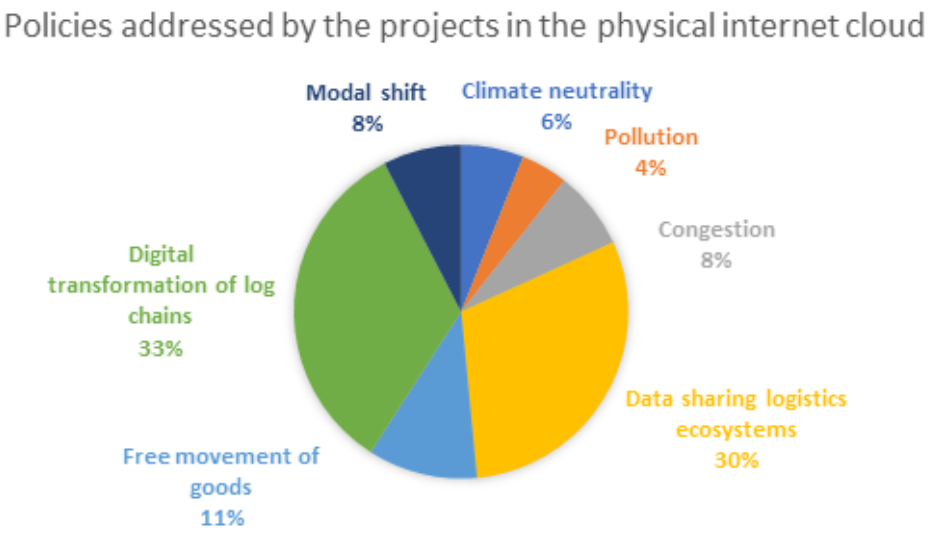

Figure 8. Policies addressed by the projects in the Physical Internet Cloud.

4.3 Analysis of the Expected Impacts and how these KPIs create positive impact regarding policy objectives

4.3.1 Logistics Nodes Cloud

The expected impacts from R&I projects that were validated by experts in the BOOSTLOG validation workshop for the Logistics Nodes Cloud were as follows:

- Decrease of environmental impact
- Reduction of congestion on the road network
- Modal shift
- Decrease cost of transport & overall logistics
- Increased transport reliability and responsiveness
- Increase management capacity of terminals and productivity
- Improved operations in terminals
- Improved terminal capacity utilization and efficiency
- Improve energy consumption
- Improve the performance of the European Transport
- Improve long distance-city distribution connectivity

Table 5 presents the relation of the projects addressing the different expected impacts validated by the experts.

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Table 5. Expected impacts KPIs and projects addressing them in the Logistics Nodes Cloud.

EXPECTED IMPACTS	KPIs	PROJECTS
Decrease of environmental impact	GHG emissions	CARGO ANTS, CLUSTERS 2.0, COFASTRANS, COREALIS, DOCKStheFUTURE, ECOHUBS, INTERFACE, INTERMODEL EU, PIXEL, RCMS, SMARTSET
	Local pollutants	PIXEL, RCMS
Reduction of congestion on the road network	Reduced vehicles movements / Nr. of vehicles	CLUSTERS 2.0
Modal shift	Efficient connections with other transport modes	CLUSTERS 2.0, COREALIS, DOCKStheFUTURE, PIXEL, RCMS
Decrease cost of transport & overall logistics	Fuel cost	CHINOS
	Cost/unit of transport	ARCC, COFASTRANS, COREALIS, DOCKStheFUTURE, PIXEL
Increased transport reliability and responsiveness	% On time	ARCC, CHINOS
Increase management capacity of terminals and productivity	Better capacity management with reduced costs	COFASTRANS, COREALIS, CHINOS, DOCKStheFUTURE, ECOHUBS, PIXEL, RCMS
Improved operations in terminals	Improve the operations	COFASTRANS, CHINOS, LOGIMATIC
Improved terminal capacity utilization and efficiency	Improve the efficiency	COFASTRANS, COREALIS, LOGIMATIC
Improve energy consumption	Energy consumption/unit of transport	CHINOS, CLUSTERS 2.0, SMARTSET
Improve the performance of the European Transport	Hyperconnected	ARCC, CHINOS
	Increase door to door	CHINOS
Improve long distance-city distribution connectivity	% Decrease in operational handling	CLUSTERS

From the expected impacts from projects validated by the experts in the workshop (i.e. for which projects demonstrated potential impact), we can identify the projects that have addressed the expected impacts identified in D2.1. Also, the project contributing impacts not directly indicated in the topic.

In Annex II, the expected impacts (from the topic's definition) are identified (from D2.1). In blue, the expected impacts validated by experts. In green the impacts validated by the experts not explicitly addressed by the topic. In orange, expected impacts specified in the topics but not achieved by the projects.

Figure 9 shows the % of projects targeting the expected impacts from the Logistics Nodes Cloud validated by experts. *Improved terminal capacity utilization and efficiency and improved operations in terminals* were not validated in any project. *Increased transport reliability and responsiveness* as well as *improve performance of the European Transport*, were validated in 50% or less of the projects. The expected impacts *improve long distance-city distribution connectivity, improve energy consumption, decrease cost of transport & overall logistics, modal shift, reduction of congestion on the road network* and *decrease of environmental impact*, were validated in 100% of the projects.

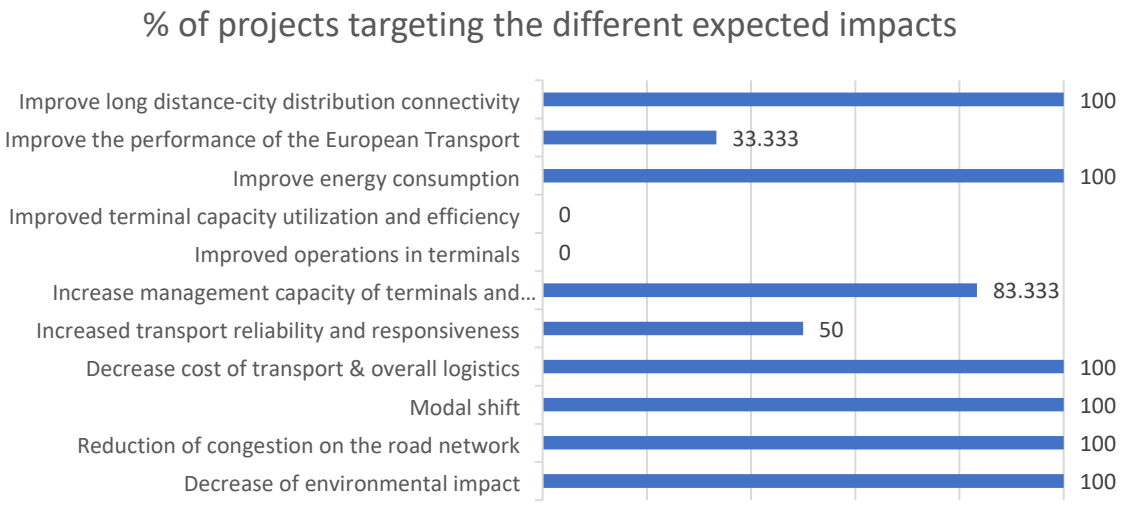


Figure 9. % of projects targeting the different expected impacts from the Logistics Nodes Cloud validated by experts.

In addition to the above expected impacts, some of the projects have achieved impacts that had not been initially identified for 4 of the validated topics (see Figure 10):

- For *Modal shift* and *Decrease cost of transport & overall logistics*, 1 project achieved each of these expected impacts that are not included in the topic definition.
- For *Improved operations in terminals* and *Improved terminal capacity utilization and efficiency*, 2 projects achieved each of these expected impacts not included in the topic definition.

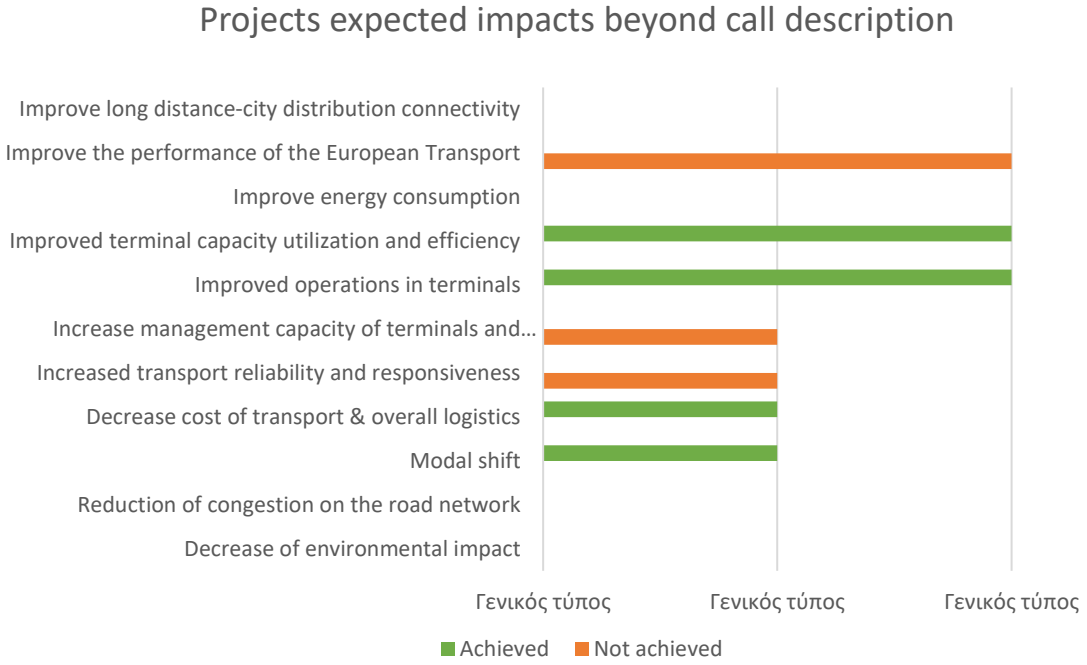


Figure 10. Projects impacts beyond expected for the Logistics Nodes Cloud.

With the analysis performed in Annex II (expected impacts from the calls vs the impacts validated by the experts) we can further elaborate:

It can be observed that some projects did not achieve the expected impacts on 3 topics: *Increased transport reliability and responsiveness, increase management capacity of terminals and productivity and improve the performance of the European Transport*. The reason identified for this non-compliance is that the projects did not address what was included in the call linked to that particular topic.

Topics related to *decrease of environmental impact are usually linked with the topics of decrease cost of transport & overall logistics* (4 projects), increase management capacity of terminals and productivity (5 projects), improve energy consumption (2 projects) and modal shift (3 projects).

-A decrease of environmental impact usually produced *improved operations in terminals and improved terminal capacity utilization an efficiency*, even though it was not identified as an expected impact in the call.

4.3.2 Logistics Networks Cloud

The expected impacts from R&I projects - validated by experts in the BOOSTLOG validation workshop for the Logistics Networks Cloud - were as follows:

- Decrease of environmental impact
- Reduction of congestion on the road network
- Modal shift
- Improved capacity utilisation of barge, train and truck
- Decreased cost of transport & overall logistics; Increased transport efficiency
- Increased transport reliability and responsiveness
- Improve the performance of the European Transport
- Improve long distance-city distribution connectivity

Table 6 presents the relation of the projects addressing the different expected impacts validated by the experts.

Table 6. Expected impacts KPIs and projects addressing them in the Logistics Networks Cloud.

IMPACTS	KPI	Projects
Decrease of environmental impact	GHG emissions/Unit of transport	GET SERVICE, LessThanWagonLoad, NEWS, SYNCHRO-NET, TelliSys
	Energy consumption/Unit of transport	ARCC, CREAM
Reduction of congestion on the road network	Number of eliminated truck movements/a	LessThanWagonLoad, SYNCHRO-NET, TIGER DEMO
Modal shift	Absolute productivity [tkm]	CREAM, LessThanWagonLoad, MOSES, RETRACK, Smart-Rail, TIGER DEMO, ViWaS
	Market share in [%] per mode, related to [tkm]	CREAM, MOSES, NEWS, NOVIMAR, RETRACK, Smart-Rail, SYNCHRO-NET, TelliSys, TIGER DEMO

IMPACTS	KPI	Projects
Improved capacity utilisation of barge, train and truck	Capacity utilisation [%], related to loading capacity [t]: barge, train, truck and/or to loading length [m] (train)	GET SERVICE, LOGISTAR, RETRACK, TelliSys, ViWaS
	Lead time [h]	ARCC, Smart-Rail, SYNCHRO-NET, TIGER DEMO
Decreased cost of transport & overall logistics Increased transport efficiency	Operational cost/unit of transport	ARCC, CREAM, FR8RAIL III, GIFTS, LessThanWagonLoad, NEWS, NOVIMAR, Smart-Rail, TelliSys, TIGER DEMO, ViWaS
	Share of empty runs per mode [%], related to [vehicle-km]	GET SERVICE, SYNCHRO-NET
	Transport performance per mode [tkm/vehicle-km]	SYNCHRO-NET
Increased transport reliability and responsiveness	Share of on-time deliveries [%]	ARCC, GET SERVICE, GIFTS, LOGISTAR, LessThanWagonLoad, NEWS, Smart-Rail, SYNCHRO-NET
	Reduction of (rail) process times	ARCC, CREAM, INTERFACE, TIGER DEMO, ViWaS
	Availability of rolling stock and ships	FR8RAIL III, INTERFACE, NEWS, NOVIMAR
Improve the performance of the European Transport	Hyper connected network of logistics hubs and clusters to optimize transport in the network, Number of intermodal connections	ARCC, CREAM, GET SERVICE, GIFTS, LOGISTAR, LessThanWagonLoad, MOSES, Smart-Rail, SYNCHRO-NET, TelliSys, TIGER DEMO
	Capacity utilisation [%] of the (rail) network	FR8RAIL III, SYNCHRO-NET
	Share of intermodal transport on total transport [%], related to [tkm]	CREAM
Improve long distance-city distribution connectivity	Direct accessibility of urban areas by long-haul transport	NOVIMAR, TIGER DEMO, ViWaS

The approach followed by the experts in the Logistics Network cloud to validated the impacts was different to the other clouds. The experts in the cloud identified the impacts according to the results clainmed by the projects (following the call specifications. The experts in the workshop validated the impacts of the projects (i.e. for which projects demonstrated potential impact). With this, the projects that have addressed the expected impacts identified in D2.1 can be pinpointed. Also, if there is any project contributing impacts not previously identified in the project.

In Annex III, the expected impacts (from the projects) are identified (from D2.1). In blue, the expected impacts validated by experts. In the case of impacts validated by the experts not explicitly identified in the projects would be green. Expected impacts specified in the projects but not achieved by the projects would be orange.

Figure 11 shows the % of projects targeting the expected impacts from the Logistics Networks Cloud validated by experts. *Improved inventory management* was not validated in any project. *Decrease travel times and Increased transport efficiency* weres validated in 50% and 687% of the projects respectively. The rest of the impacts identified for the projects included in the Logistics Network Cloud were validated by the experts in more than 85 %.

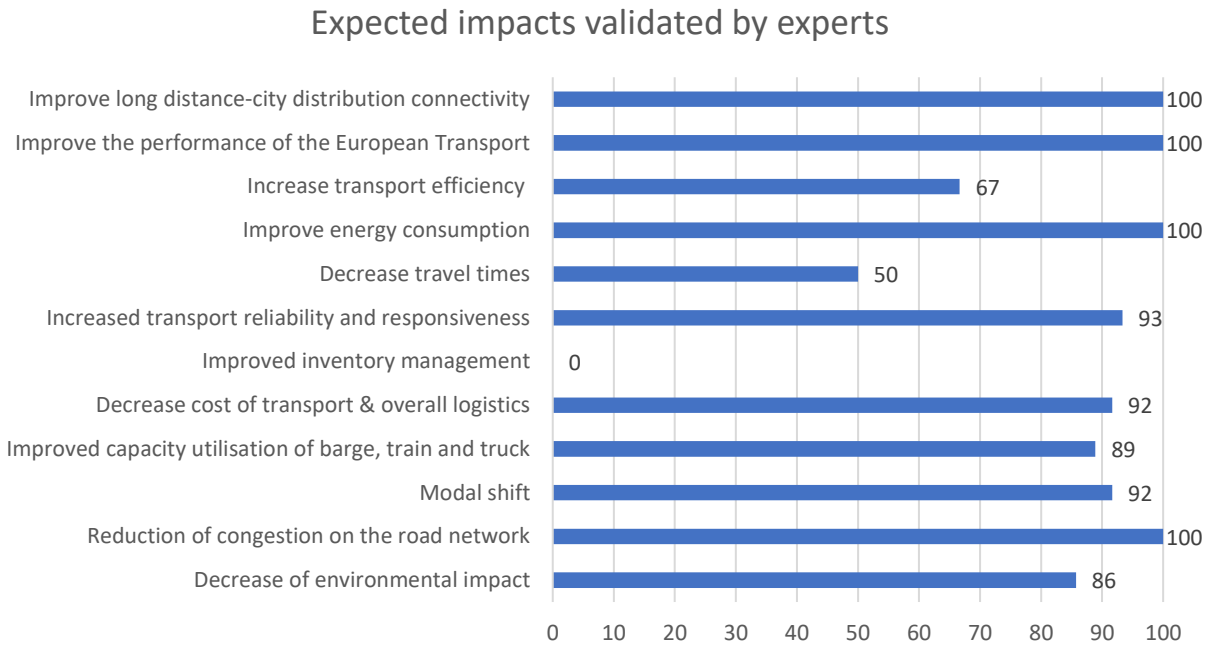


Figure 11. % of projects targeting the different expected impacts from the Logistics Networks Cloud validated by experts.

The Logistics Networks Cloud did not identify impacts achieved beyond the expected impacts identified in the projects or expected impacts not achieved indicated by the experts.

4.3.3 Physical Internet Cloud

A set of expected impacts from the R&I projects have been validated by experts in the BOOSTLOG validation workshop for the Physical Internet Cloud.

- Increased transport reliability and responsiveness
- Decrease travel times
- Increase transport efficiency
- Modal shift
- Reduction of congestion on the road network
- Decrease cost of transport & overall logistics
- Decrease of environmental impact

Table 7 presents the relation of the projects addressing the different expected impacts validated by the experts.

Table 7. Expected impacts KPIs and projects addressing them in the Physical Internet Cloud.

IMPACTS	KPI	Projects
Decrease of environmental impact	GHG emissions / local pollutants	LEAD, NEXTRUST, Ulaads, URBANIZED
Reduction of congestion on the road network	Reduced vehicles movements / Nr. of vehicles	ICONET, LEAD, NEXTRUST, Ulaads, URBANIZED

Modal shift	Efficient connections with other transport modes	LESSTHANWAGONLOAD, LEAD, SENSE STARGATE, Ulaads, URBANIZED
Decrease cost of transport & overall logistics	Fuel cost / cost/unit of transport	CO3, iCargo, MODULUSHCA, AEOLIX,
Increased transport reliability and responsiveness	% On time	AEROFLEX, COG-LO, CO-GISTICS, CLUSTERS 2.0, DYNEHUBS, ICONET, EPICENTER, LESSTHANWAGONLOAD, LEAD, LOGISTAR, PLANET, NEXTRUST, SELIS, SENSE, SYNCHRONET, STARGATE, Ulaads, URBANIZED
Decrease travel times	average travel time/delivery c. Increase delivery reliability / % on Time In Full Delivery	AEROFLEX, COG-LO, CO-GISTICS, CLUSTERS 2.0, DYNEHUBS, ICONET, EPICENTER, LESSTHANWAGONLOAD, LEAD, LOGISTAR, PLANET, NEXTRUST, SELIS, SENSE, SYNCHRONET, STARGATE, Ulaads, URBANIZED
Increase transport efficiency	Increase load factors / reduce empty trips/kms / shorter delivery routes / reduced failed deliveries	CO3, iCargo, MODULUSHCA, AEROFLEX, COG-LO, CO-GISTICS, CLUSTERS 2.0, DYNEHUBS, ICONET, EPICENTER, LESSTHANWAGONLOAD, LEAD, LOGISTAR, PLANET, NEXTRUST, SELIS, SENSE, SYNCHRONET, STARGATE, Ulaads, URBANIZED

The expected impacts from the PI projects validated by the experts allow the identification of the projects that have addressed the expected impacts previously identified in D2.1, as well as come contributions nor directly indicated in the topic call.

In Annex IV, the expected impacts (from the topic's definition) are identified (from D2.1) for the Physical Internet Cloud. In blue, the expected impacts validated by experts. In green the impacts validated by the experts not explicitly addressed by the topic.

Figure 12 shows the % of projects targeting the expected impacts from the Physical Internet Cloud validated by experts. *Decrease of transport and overall logisitcis* and *Modal shift* were validated by 75*% of the projects. Increase transport efficiency* was validated in 95% of the projects. The expected impacts *Decrease travel times*, *Increased transport reliability and responsiveness*, *Deduction of congestion on the road network* and *Decrease of environmental impact were validated in 100% of the projects*.

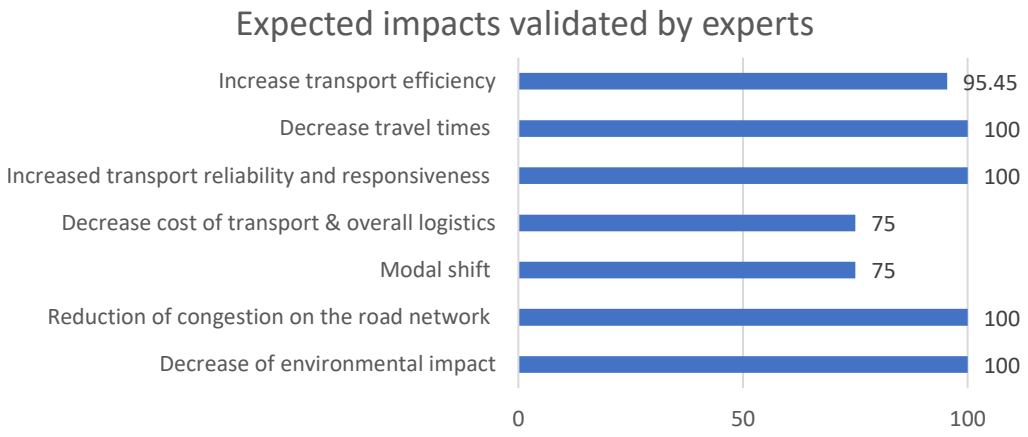


Figure 12. % of projects targeting the different expected impacts from the Physical Internet Cloud validated by experts.

In addition to the above expected impacts, some of the projects have achieved impacts that had not been initially identified for 4 of the validated topics (see Figure 13):

- For *Increase transport efficiency*, 1 project achieved each of these expected impacts that are not included in the topic definition.
- For *Decrease cost of transport & overall logistics* and *Modal shift,* 5 projects achieved each of these expected impacts not included in the topic definition.

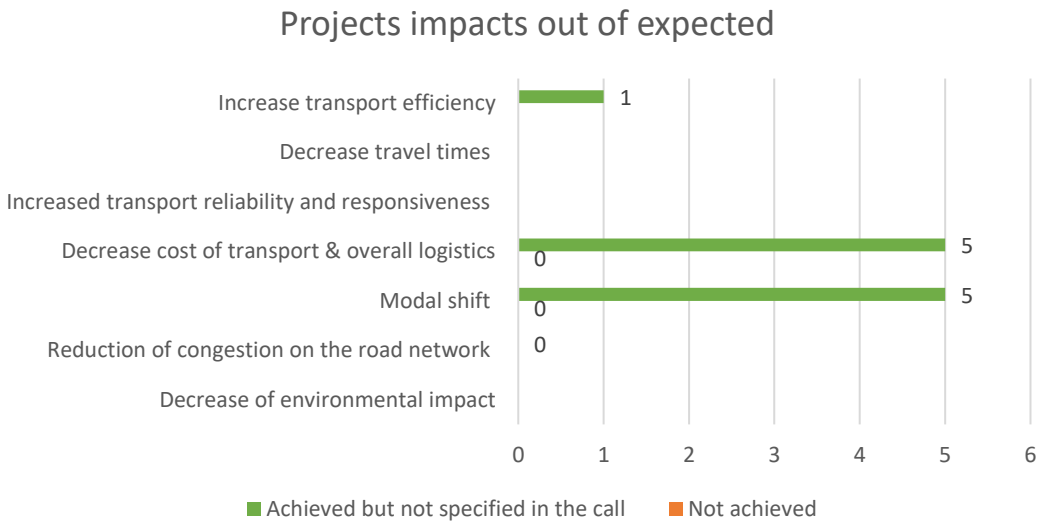


Figure 13. Projects impacts beyond expected for the Logistics Nodes Cloud.

With the analysis performed in Annex IV (expected impacts from the calls vs the impacts validated by the experts) we can further elaborate:

1 It can be observed that all projects achieved the expected impacts identified in the topics calls.

2 Topics related to *Increase transport efficiency* and *Decrease environmental impact* are usually linked with the topics of *Decrease cost of transport & overall logistics* (5 projects) and *Modal shift* (5 projects).

3 Analysis of the R&I impact per Cloud & key actions identification, characteristics, framework conditions and market assessment

Implementation Cases are concrete examples in which causal links between public R&I funding and technology, organizational or process innovation in a specific logistics area can be established. Indeed, Implementation Cases are outcomes where research results have been further developed and have been deployed as commercial solutions, have generated a new market or have contributed to new policies.

3.1 Logistics Nodes Cloud

BOOSTLOG has identified **5 Implementation cases** in the framework of Logistics Nodes Cloud by developing any logistics model or solution.

These are mainly focused on improving ports, due to the importance of maritime transport nowadays. But there are some also targeting airports and railway terminals. While some of them remain in the testing area after the project ending, there are others that have attracted companies to further develop them aiming to obtain a commercial product.

3.1.1 5G Port of the Future

Solution: 5G Model-Driven Real-Time Control module to coordinate and support the port operations in real-time to improve port's competitiveness with a better and faster handling general cargo.

Main Beneficiaries: terminal operators in ports.

Description:

This implementation case comes from the COREALIS project, aiming at defining the future era of the European ports proposing a strategic, innovative framework.

The key feature of our solution is digitization, which is crucial to addressing the challenges faced by ports. The 5G Model-Driven Real-Time Control module made use of a 5G network as well as some disruptive technologies (IoT, AI, AVR…) with the objective of coordinating and supporting port operations in real-time. By combining distributed sensing with an intelligent remote-control system, the solution optimizes operations and reduce costs and pollution. AR, VR, and AI all play important roles in achieving these goals, while 5G dedicated networks technology serves as reliable enabler for the system to connect all field devices, especially mobile ones.

The optimization of operations is obtained using a Digital Twin of the port and dedicated operating research algorithm to allocate the freights in the warehouse area in the best way and to check preventively with VR simulations the feasibility and effectiveness of loading operations. An Expert System assists the seaport operators in registering and storing the freights at their arrival, in selecting the right freight to load according to the specific needs and assists the forklift drivers in finding and placing freights properly. The situational awareness is achieved thanks to 5G connected cameras and sensors that enable the tracking of freights and forklifts in real time.

Thus, these technologies created the core of the module, a digital twin with a 5G/LTE Network that reproduces the current situation in the seaport terminal.

Achievements:

- Operation monitoring in real-time uses cameras and image processing to detect and localize freight, and GPS to track the position of vehicles. Notably, forklifts used to move materials are monitored using GPS, and the information is transmitted through 5G to the air control system, which improves efficiency and reduces costs.
- Logistics management relies on an expert system, an app, and AR content to coordinate and provide real-time assistance to all operations in the seaport from registration to storage and loading.
- The digital twin of the port terminal provides a concrete real-time situational awareness of the terminal through VR, helping in the planning of operations and preventing errors through the simulation of operations.

The Control Module performs real time operations in the Port logistics and supports operating decisions based on real-time analytical processing. While the control module detects general cargo in a shorter time than usual human-driven communications, it enables a better management, higher reliability and increased efficiency in the cargo handling. This solution will lead to:

- Reduction of vessel downtime at the seaport for general cargo loading operations, increasing port throughput.
- Optimisation of the storage and handling of general cargo goods at port terminals and automated management of position information, tracking and monitoring of goods.
- Digitalization of movement and operation handling optimization contribute to handle operations with high reliability, while reducing average operation time and equipment usage.

In addition, thanks to taking operating decisions based on real-time analytical processing, the speed rate of the operations is increased, and the operational costs, fuel consumption and machine working hours are reduced, with a positive environmental impact. Automation of operations as a better warehouse management and effectiveness of the container terminal operation not only increase overall efficiency and competitiveness of the Port but contributes significantly to reduce CO2 impact creating the blueprint for a sustainable "Port of the Future" concept.

Framework conditions and actions that supported this result (Conditions met to success):

- Framework conditions:
    - EU policies objectives: ports are the major gateway for both import and export flows and the volume of traffic of marine ports is expected to increase. However, the increasing demand collides with actual inefficiency, significant waste of time and the consequent increase of costs, fuel consumption and associated CO2 emissions. For this reason, Port operators are looking to solve these problems with smart, scalable, and sustainable solutions, in line with the Paris Climate Agreement and scientific recommendation, to halve the emissions by 2030. Digital technologies are crucial in addressing these challenges and transforming port operations.
    - Potential market: the market for the General Cargo automation is very broad. Digitalization is essential for the terminal operators to improve their business. Automation of key assets, new technologies integrated with a fast an efficient 5G network, interworking of IoT applications are the key factors towards the Port of the Future concept for a more sustainable world.

- Actions that supported the expected results:

- Improvements in efficiency and environmental friendliness of mobility, transport and logistics in Europe.
- Key to the design and development of the solution were the funds from EC H2020 Mobility for Growth program supported the design and development of the solution received by the COREALIS project.
- The 5G based Model-Driven Real-Time Control module for managing general cargo proved its potential in the port of Livorno in early deployment showing interesting figures. It reduced inefficiencies of 13% for vessel operations time, 28% for unloading and storage operations and 17% for the forklift usage, with a consequent 8% reduction in CO2 emission.
- Further support from Ericsson to finance next steps of the solution evolution.
- Leverage on the Port network and connected stakeholders in order to address solution to market need.

Further development of the TRL level beyond the funding period: TRL 6 → TRL 7

COREALIS, a Port of the Future project, proposes a strategic, innovative framework, for cargo ports to handle upcoming and future capacity, traffic, efficiency, and environmental challenge. Ericsson, as a partner of the COREALIS project, introduced innovative and cutting-edge technologies in the Port of Livorno digitalizing Port Operations leveraging on 5G and IoT applications.

Ericsson began to develop the Port of the Future use cases in COREALIS project assessing and testing the new 5G innovative solutions and exploring how these can optimize port operations and produce economic and sustainability value. After COREALIS, Ericsson has further developed the solution and studied the outcomes from this project solution by a project named the 5G Port of the Future.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

Currently, Ericsson has completed the minimum viable product evaluation at the Port of Aveiro and confirmed the positive results they previously achieved in the proof-of-concept (PoC) conducted in the European H2020 project COREALIS in Livorno.

Target market: Logistic operators, Seaport for general cargo handling, Port's stakeholders.

Phase of deployment of the new product and services as well as the reached or targeted market:

The development of the solution matches TRL 7, as it has been demonstrated in an operational environment (Port of Aveiro).

They are now ready to transform the solution into a commercial product by finalizing the business analysis and actively promoting their solution to port terminals to acquire more potential customers. They are also preparing a list of different product bundles that they can sell, to adapt the functionalities of the solution to the needs of the ports, as well as the pricing strategy for the different types of ports[67].

Scalability, potential for growth and replication:

[67] https://www.ericsson.com/en/ericsson-one/connecting-the-harbors-of-the-future-the-5g-general-cargo-solution

According to the deployment of this solution, it is not possible to provide a deeper analysis including the addressable market, level of penetration and market acceptance, since it is not fully commercially deployed and available for all the customers yet. Based on the information available, we can offer the following conclusions:

- Terminal port operators in logistics nodes operating with general cargo (from ports to airports to inland ports) comprise the Total Addressable Market (TAM) of this solution. These terminal operators are the primary beneficiaries, enhancing the competitiveness of logistics nodes, improving the handling of cargo through real-time coordination and support and represent a broad range of potential customers within the T&L industry.
- Taking into account the current level of development of the solution, the subset of terminal operators that can be realistically targeted as Serviceable Addressable Market (SAM) are the terminal operators located in the European port that can directly benefit from 5G Model-Driven Real-Time Control module. Specifically, those ports with a level of infrastructure that allows the application of this 5G system, which can gain the benefits of the digitalisation and real-time management of operations that the solution offers.
- The solution is ready to be commercialized and is configured to be adaptable to different European ports, depending on their characteristics and needs. The solution has great potential, however, given that its business model has not fully deployed and the level of resources is limited, its Service Obtainable Market (SOM) is still reduced. Based on the current trends towards the application of disruptive technologies in ports, the replication and scalability of these solutions for SOM means that more ports can be considered as a potential customer for the coming years.

Impact in the CLOUD → VERY HIGH 

3.1.2 PREDICCTOR Asset Management

Solution: Predictor tool that incorporates a powerful predictive analytics approach, offering a more advanced approach compared to traditional static preventive maintenance tools found in ERP systems, that allows for dynamic monitoring and dynamic prediction of the total life-cycle cost of port assets.

Main Beneficiaries: Terminal Operators, even though it can be applied to any company operating a fleet.

Description:

This implementation case comes from the COREALIS project, which aims to shape the future of European ports by leveraging cutting-edge technology to address key challenges such as efficiency or environmental sustainability.

As part of the project, various pilots were conducted to assess their effectiveness. Of particular interest is the pilot carried out in the Port of Piraeus, where the COREALIS Predictor Asset Management tool was tested.

The data comes from a module which collects real-time equipment data and maintenance historical and the tool consists of the equipment List, the maintenance schedule and an AI algorithm. Through continuous

improvement and learning, this predictive capability enables better decision-making and cost optimization over time.

In essence, this tool can be described as a machine learning-based Just-in-Time inventory system designed to prolong the lifespan of yard equipment, enhance its availability, and decrease inventory costs and space requirements. Its primary function is to monitor and dynamically predict the life cycle costs of port assets.

Achievements:

The PREDICTOR Asset Management monitors and predicts dynamically the life-cycle cost of port assets and has proven that it is feasible to shift from standard maintenance plans that are based either on manufacturer guides or standard mileage to custom plans for each individual piece of equipment (in this case yard trucks), minimise both the amount of spare parts used and the inventory space required to store them and improve their operational availability due to the reduction of unexpected breakdowns. As a result, it brings multiple financial and operational benefits.

- Reduced Asset Downtime: Use AI based predictive maintenance (PdM) modules to fix issues in assets before they produce breakdowns that will reduce the downtime of vehicles (the algorithm is 85/90% accurate in terms of breakdowns).
- Reduced Maintenance Costs: Planned maintenance is costly as it relies on time-based checking. Through the PREDICTOR Asset management, the asset-specific data is accurate in predicting future failures which leads to less frequent maintenance.
- Optimize Spare Parts Inventory: Operational efficiency and elongated yard equipment life cycle, reducing the use of spare-parts, lubricants, tyres, etc.

Framework conditions and actions that supported this result (Conditions met to success):

- Framework conditions:
    - Traditional preventive maintenance methods are costly and do not take into account the specific conditions of each asset, resulting in repairs not being carried out when they are needed, increasing the cost of this process and leading to port inefficiencies. Predictive maintenance addresses these limitations by taking into account the operational conditions of vehicles, using data collected from individual assets to predict potential failures. In this way, repairs are only performed when necessary and maintenance efforts are optimised, minimising unnecessary costs.
    - Logistics nodes are strategic points in the transition to zero emissions pursued by the EU, boosting the development of new solutions that, through the optimisation of processes, accelerate this process. The system proposed falls within this type of solutions. It increases the efficiency of processes and its planning, reducing costs, energy consumption and GHG emissions.
- Actions that supported the expected results:
    - Key to the design and development of the tool were the funds from EC H2020 Mobility for Growth program supported the design and development of the solution received by the COREALIS project.
    - Also, the tool was demonstrated and validated at Port of Piraeus through its development for the Living Lab in the COREALIS project.
    - Accuracy and evaluation of the PREDICTOR through a DAMVI algorithm to validate the proper usefulness of the model.

- The system is kept after the project in the port of Piraeus.

Further development of the TRL level beyond the funding period: TRL 8 → TRL 9

The PREDICTOR Asset Management achieved a TRL 8 level at the end of COREALIS project[68], presenting a significantly mature technology readiness, demonstrated at Port of Piraeus. Even though the targeted TRL was the demonstration of the innovation in a relevant environment, the early stages of testing revealed that the predictive maintenance algorithm that was based on two years of historical data was performing above expectations. After a series of tests, Piraeus Container Terminal (PCT) focused on the prediction of fast-moving parts such as engine filters and tyres that would allow to reduce inventory storage space and achieve cost savings. Since November 2020, PREDICTOR has been successfully utilized to predict maintenance schedules for PCT's entire fleet of yard trucks.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

Based on the market analysis[69], the global PdM market is projected to grow at a significant compound annual growth rate of 25-30% from 2020 to 2025.

The benchmark highlights several prominent vendors in the predictive maintenance solutions market, including Bosch, Huawei, IBM or SAP. It is reasonable to assume that anything not patented by these vendors is not considered a key differentiator in their offerings. However, it is challenging to determine which specific commercial solution aligns with each patent or published method, limiting our observations to a technology portfolio-level assessment.

Target market: any organization operating a fleet.

Phase of deployment of the new product and services as well as the reached or targeted market:

The PREDICTOR Asset Management t is considered to reach TRL9 in the short term with actual system proven in operational environment.

Scalability, potential for growth and replication:

Based on the scalability/transferability analysis of the assets, the addition of a new technology (AI) has been a key point for the growth of this solution, given that other tools in the sector focused on asset management do not rely on advanced machine learning algorithms that are tailored for imbalanced classification tasks.

From the available information, this solution has not yet been deployed and commercialized in the market, although it has been verified that it is ready to carry out this last step. However, it has been estimated that:

- The TAM of the PREDICTOR Asset Management comprises all companies operating assets, irrespective of their size on the industry. The solution's applicability goes further than terminal operators to include a broad range of potential customers who can benefit from the predictive analysis functions of the tool (for example, could even be used in warehouse equipment such as forklifts.).

[68] https://www.corealis.eu/wp-content/uploads/2021/09/D6.2.pdf

[69] https://www.globenewswire.com/news-release/2020/03/25/2006290/0/en/Global-Predictive-Maintenance-Market-to-Garner-23-01-Billion-by-2026-at-30-2-CAGR-AMR.html

- The SAM narrows this TAM, whose subset of companies could be focused on terminal operators specifically, being the primary beneficiaries of this services. Among others, it provides answers to more concrete operators such as port and inland waterway ports operators.

Impact in the CLOUD → VERY HIGH 

3.1.3 Port Environmental Index (PEI)

Solution: quantitative indicator of the environmental performance of ports which combines diverse sciences to achieve the results as it includes atmosphere emissions but also noise, odours and light pollution.

Main Beneficiaries: ports/port authorities.

Description:

Between the efforts made by PIXEL project (Port IoT for Environmental Leverage) to create a framework of the ports of the future, the project focused on reducing the impact on climate change and the environment of port activities.

To that end, the Port Environmental Index (PEI) was developed. This metric collects environmental data from heterogenous sources and combines them into a single quantitative composite indicator. Based on this input, PEI is able to use the complex algorithms developed, the collected data is homogenised and used to calculate the composite indicator which quantifies the environmental performance of the port. Thus, the index offers a complete vision of the environment, including atmosphere emissions but also those regarding noise or odours, as well as the light pollution generated and the production of waste and the water waste.

This index allows the user to analyse in real-time the factors that most affect its own environmental efficiency and compare the progress of that based on a dashboard easy to use and understand, helping to assess and monitor the overall environmental impact of ports, creating a comprehensive, standardized, and transparent methodology to quantify most relevant environmental aspects of ports and its related impacts into a single metric (flexibly adaptable to comprise different impacts depending on the port concerns).

Achievements:

The metric is a useful tool for assessing trends in the overall environmental performance of the ports. The index uses IoT technologies, and the information is provided to a dashboard in real-time. Thus, by using the index the ports will have immediate feedback on the environmental effects of their operations and will be able to take instantaneous corrective actions to mitigate adverse environmental situations.

The metric will enable the ports to address what-if scenarios and assess the environmental return on financial investment and whether they are making progress in terms of their performance or their deteriorating – it can be used as a tool to understand the beneficial impact of measures implemented in ports (e.g., LNG-propelled machinery or off-shore energy supply) –.

Finally, this indicator of the environmental performance of ports could enable inter-port comparisons in terms of environmental performance and bring awareness on how different port activities affect the environment.

Framework conditions and actions that supported this result (Conditions met to success):

- Framework conditions: The shipping industry in general and port activities in particular can have significant adverse effects on both human health and the environment. As a result, many communities have expressed concern about the adverse environmental and health effects they are experiencing due to exposure to emissions related to port operations. Furthermore, even though all ports are required by law to monitor and mitigate their environmental impacts, there is currently a lack of a comprehensive standardised methodology that leverages information technology in general and IoT technologies in particular to provide information on the elemental performance of a port. This index, outcome of the PIXEL project, bridges this gap and leverages IoT technology to improve the environmental performance of small and medium-sized ports.
- Actions that supported the expected results:
    - Improvements in efficiency and environmental friendliness of mobility, transport and logistics in Europe.
    - First, funds from EC H2020 Mobility for Growth program supported the design and development of the methodology and technology of the PEI, in the context of PIXEL project.
    - Also, from the PIXEL project living labs, the index proved its potential and remained in three of the four ports: currently is still being used in the ports of Piraeus, Bordeaux, Mont Falcone and Thessaloniki. As a result:
        - The index facilitates the reduction of the environmental impact of port activities through the direct measurement and modelling capabilities (e.g., greenhouse gases by 15-20%).
        - Ports can optimise their use of resources by including the appropriate monitoring parameters of environmental-related activities and act on them.
        - The environmental performance planning capabilities are enhanced to improve the port's green image and attract new customers.
    - After the finalisation of the project, PIXEL Consortium became an Association to exploit the product.
    - The tool was installed and tested in the Port Authority of Vigo in March 2022. The deployment of PEI was performed in the context of another EC-funded RIA (PortForward).
    - Leverage on the Port network and connected stakeholders in order to address solution to market need.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

It was defined that the maturity of the software artifact in October 2021 (end of PIXEL project) was TRL 7: a fully functional stable technology.

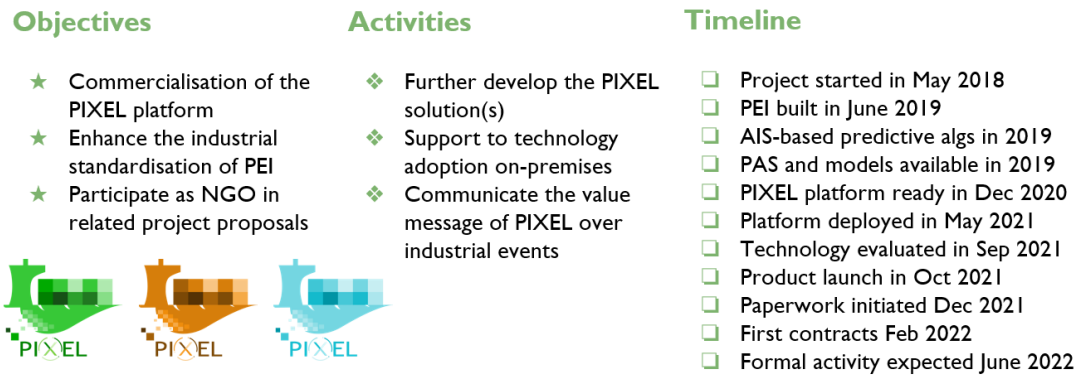
Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

Although after the finalization of the PIXEL project, PIXEL consortium became an Association to exploit the product, the PEI solution has not been deployed at the time of this report. Its first phase of deployment is considered to reach TRL 9 in the short term as the actual system prototype demonstration in an operational environment (in 4 ports) took place during the PIXEL project and after its finalization (Port Authority of Vigo). Also, the PEI team made relevant advances to the conversion to a formal product.

Target market: ports/port authorities.

Phase of deployment of the new product and services as well as the reached or targeted market:

As abovementioned, in order to commercialize the product, PIXEL Consortium is becoming an Association. See below the promotional banner:



As this action is not yet completed, the tool has not yet become a formal product with the commercialisation channel in place. However, this has not prevented partners to respond to demanding needs. Since March 2022, the tool is being installed and tested in the Port Authority of Vigo.

Scalability, potential for growth and replication:

As in the previous cases, this product has not yet been officially launched on the market, but it is possible to offer some insights about the TAM-SAM-SOM analysis.

The PEI solution targets the ports industry as its main beneficiaries. Considering that all ports worldwide have the potential to implement and benefit from this performance indicator, the TAM for PEI encompasses the entire global ports market.

Regarding the SAM, the metric aims to a market that includes the subset of those port that are involved in improving their environmental performance, working on solutions to support the port's operations towards mitigation, control and monitoring of their emissions and climate change impact.

On this basis, the SAM is the subset of those specific ports that proactively engage with integrating these solutions into their environmental monitoring and assessing practices. Given the high level of development of this solution and that no similar solutions are offered in the market, it is considered that it could be applied in all ports interested in this solution.

Impact in the CLOUD → VERY HIGH ★★★★★

3.1.4 Port Rail Shunting Optimization Tool

Solution: Decision Support System (DSS) for helping and supporting the planning and the management of rail shunting operations within the port area.

Main Beneficiaries: The Port Authority, for testing and taking strategic/tactic decisions and for monitoring the infrastructure; the Shunting Manager, for having a support in the organization of the activities; and the

Maritime Terminal operators, for collaborating in the research of the optimal efficiency of the port system and for visualizing the infrastructure state.

Description:

The innovation project from which the idea comes is TEBETS (Technological Boost for Efficient port Terminal operations following safety-related events), an Italian R&D project within the national competence centre on critical infrastructure. This project supported the design of a Digital Twin that was also applied in the CEF e-BRIDGE project in a logistic node (shunting area in a port), speeding up the implementation phase and provided the right consolidations/refinements until arriving the current pilot phase.

The solution is a digital platform consisting of a system composed by a Decision Support Systems Tool and a Digital Twin:

- DSS for the planning and the management of rail shunting operations within the port area. It consists of a scheduling module which finds the best starting and ending time for each considered operation of every train to manage, and a re-scheduling module for unpredictable events such as delays.
- Digital Twin for simulating the operations. It can be made available to different process operators for simulating and monitoring the state of the infrastructure over time. It uses Stop and Regression Points on the GIS map.

Achievements:

This tool improves the ports freight transfer made from the railway station to the maritime terminals, and vice versa, with high potential to increase share of railways and promote modal shift. The solution, thanks to a scheduling and re-scheduling model, can manage unpredictable events, driving down operational costs and congestion in ports and increases operation efficiency and sustainability. In summary, the main advantages of this tool are:

- Support for the prior sizing of resources needed to perform the service.
- Support for the scheduling of activities.
- Assignment of available resources to scheduled activities in order to regularly perform the service.
- Real-time re-scheduling to better address the management of extraordinary operations and unpredictable events.
- System status monitoring.

Framework conditions and actions that supported this result (Conditions met to success):

- Framework conditions:
  - A modal shift from road to rail transport is currently being pursued in order to reduce negative externalities that road transport involves, such as GHG emissions, both in port contexts and in the territories in general.
  - The fight against climate change involves the reinforcement of modal shift for freight toward train and ship, accelerating the development of key solutions to promote the efficiency of freight transport and modal shift.
- Actions that supported the expected results:
  - The Italian R&D project within the national competence center on critical infrastructure initially helped to support the Research and Development phase, in which different aspects

(process, optimization approach, feasibility, and so on) were studied in-depth (TEBETS project).

- Then, the European CEF Project EBridge was used to speed up the implementation phase and provide the right consolidations/refinements until arriving the pilot phase in which they currently are.

Further development of the TRL level beyond the funding period: TRL 6 → TRL 7

This optimisation tool is in a pilot phase and was already deployed for the "scheduling" in an integrated manner with the software used by the shunting operator in the port of Genova. Currently, this module is in test & pilot phase and will be extended to the "rescheduling".

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

Port Rail Shunting Optimization Tool is considered to reach TRL 7 in the short term.

Target market: port authorities and railway operators, being them the ones that can promote the implementation of this collaborative solution for the increase of the rail modal share.

Phase of deployment of the new product and services as well as the reached or targeted market:

The solution is being prepared for approaching the market in the next future with realities with whom they are already collaborating and by exploiting also, where applicable, the synergies with the new opportunities that public funds, like for example PNRR and Next Generation EU, could provide.

The exploitation roadmap started with a period of internal, focused on creating awareness about the potential benefits of the solution, then, the results obtained throughout the study and testing have been promoted in standardization bodies to ensure its adoption and applicability, while searching for synergies and new opportunities that could be provided by public funds as abovementioned.

Scalability, potential for growth and replication:

Port Rail Shunting Optimization aims to a service that might be replicated, aiming to a public-private cooperation and collaboration, with the support of a group of potential partners to collaborate. Therefore, even though the current market is established in Italy, and considering the abovementioned benefits, the potential clients of the service might be extended to the whole Europe. However, as explained before this solution is not commercially fully deployed but is still being tested, validated and adjusted. As a result, the analysis TAM-SAM-SOM conducted is a first approximation, a more in-depth analysis is not currently possible.

The TAM for the Port Rail Shunting Optimization Tool comprises all ports and terminals that are engaged in rail shunting operations within their infrastructure. This includes worldwide ports of various sizes that rely on rail transportation for freight transfer between railway stations and maritime terminals. The potential growth is notable, given that the TAM size is vast considering its global scale and the potential growth and scalability due to widespread adoption of these rail shunting activities.

Those ports and terminals seeking solutions to enhance the efficiency of rail shunting operations within their activities are the subgroup of Serviceable Available Market. The SAM is focused on port authorities, shunting manager and maritime terminal and rail operators that can adopt and use this DSS.

The SOM represents that portion of the SAM where the solution can realistically be adopted and served. The size of it may vary depending on the capabilities and resources taking into account factors such as market penetration of the solution. However, it has a high growth and scalability potential as it follows the same widespread adoption patterns of the TAM and SAM, having high potential to increase the share of railways and promote modality shift.

Impact in the CLOUD → VERY HIGH 

3.1.5 Slot Booking App

Solution: web application that assists the operations of freight delivery and pick-up in airports, reducing waiting and idle times and optimizing the personnel planning and the transparency and smoothness given to these processes.

Main Beneficiaries: Freight Forwarders as long as they can access an easy booking and avoid waiting; Ground handlers because their capacity is smoothened and their processes are faster; and the Airport, which has more insight and a better performance.

Description:

The Clusters 2.0 project facilitated the roll out, implementation and test for market fit of the Slot Booking Application, a web application aiming at improving the visibility of the air cargo slot booking process.

The solution allows different actors in the air cargo supply chain to plan, execute and track their shipments. It represents a solution to coordinate and communicate with freight forwarders and trucking companies online and in real-time with a three-step process: A fast registration of the drivers and the shipment, the slot management itself, and the sharing of data to facilitate the exchange of freight details between trucking companies, freight forwarders and ground handlers.

Achievements:

The key pain points the solution addresses are as follows:

- Congestion of the cargo hub.
- Truck wait times at the ground handler's facilities and associated, costly driver overtime.
- Inefficient resource planning at GHA due to lack of visibility on who is coming when and for what.
- Inefficient resource planning of freight forwarder / trucking company due to lack of predictability of wait/turnaround time.
- Stress for front desk staff and drivers due to discussion on who's to be served first.
- A lot of paperwork and administration.
- Missed cut off times, missed SLAs, bad customer service.

The waiting time for freight forwarders when picking up or delivering cargo is significantly reduced for two main reasons: 1) they are able to reserve a time slot for this process; 2) they are able to skip the queue and be assigned to a gate when arriving at the ground handlings agent.

The app also offers benefits to ground handling agents by allowing them to know in advance which forwarder is going to pick up the cargo and when, thus ensuring good planning of personal resources, enabling the slots to go faster and reducing waiting time costs.

In summary, the solution provides the following improvements:

- Better capacity utilization.
- Better personnel planning.
- Less waiting times.
- Removing peak demands.
- Removing idle times.
- Transparency.

Framework conditions and actions that supported this result (Conditions met to success):

- Framework conditions:
    - EU policies objectives: climate change mitigation, protection of water and resources, pollution prevention and control and increase interoperability among existing transport actors, are just some of the aspects pursued by the EU strategy, which is strongly committed to achieving a transition to sustainability covering all sectors. The usage of Slot Booking is an important driver for sustainability – both socially, environmentally and economically:
        - Socially: using slot booking eliminates waiting times for truck drivers up to 90% (reported savings by users), as well as the associated stress, overtime, and disputes upon arrival.
        - Environmentally: slot booking reduces carbon footprint by eliminating waiting time and congestion at the hub and its surroundings, efficiency gains support growth without the need to invest in concrete and build additional warehouses.
        - Economically: streamlined, digitized process drive efficiency and productivity gains, efficient, sustainable processes attract more business and hence more jobs, our user-friendly solutions help attracting (also young) staff and keeping them on board.
    - Industry shift on air cargo operations and trend of using technological disruptive advancements to enable communication and coordination between different actor in the air cargo SC.
- Actions that supported the expected results:
    - Improvements in efficiency and environmental friendliness of mobility, transport and logistics in Europe.
    - Funds from EC H2020 Mobility for Growth program supported the roll out, implementation and test of the solution, in the context of Clusters 2.0 project. Public funding was used to testcase the application in the communities of Brussels Airport, Heathrow and Liege.
    - During the testing, the implementation was only done with the coalition of the willing, so only a limited part of the community participated. Further extension of the functionality, that was highlighted to be missing during the pilot implementations, together with the agreement in the community to move to maximal use of the applications are key factors to success. Also here, change management is a key element to get to this point where the community agrees on this maximal use.
    - After the finalisation of the project, the solution results proven first success in Brussels Airport Community.

- Financing for further development was done in partnership with Brussels Airport Company and through community co-funding initiative driven by Air Cargo Belgium.
- Nallian and Air Cargo Belgium closely collaborated with Brussels Airport Community for testimonials towards other potential customers. This active participation of users and stakeholders facilitates interest from other airports and ground handlers. On top of the testimonials, KPI's on improvements realized help to convince potential customers.
- Streamlined operations introduced by the three-step process for coordinating and communicating with freight forwarders, truck companies and ground handlers. This allows fast and efficient registration of drivers and shipments and aimed to a proper slot management and data sharing.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

Public funding was used to testcase the application in the communities of Brussels Airport, Heathrow and Liege. It supported them in the change management and learnings on the day to day operations of the community collaboration. At the end of the Clusters 2. project, the level of maturity achieved was TRL 7.

After the project, the Brussels Airport community has further adopted and expanded the use of the application with support of Air Cargo Belgium and thanks to the improvements made by Nallian.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

During the project, they have been testing and elaborating different business models. However, it was not easy to identify the fair share for each participant in the business model. Examples of experiments conducted include:

- Incentives for first periods of use to first convince about technology and only pay as soon as benefit is seen.
- Penalties for incorrect use, which limits the advantage of other stakeholders in the process.
- Encourage move to 100% use through the business model.

The Slot Booking App has been continued developed adding new functionalities and improvements and promoted to other airports. This tool is now part of the Truck Visit Management Solution of Nallian and, at the same time, Air Cargo Belgium further support the Brussel community towards 100% if the application. Financing for further development was done in a partnership with Brussels Airport Company and through community co-funding initiative driven by Air Cargo Belgium. In return for their investments, they get a privilege in the definition of new functionalities, but also receive a kick-back from further sales.

Truck Visit Management represents a solution to coordinate and communicate with freight forwarders and trucking companies online and in real-time with a three-step process: A fast registration of the drivers and the shipment, the slot management itself, and the sharing of data to facilitate the exchange of freight details between trucking companies, freight forwarders and ground handlers. The project was implemented in the Brussels Airport community, where it's made available on BRUcloud, the Brussels Airport Company implementation of the Nallian datasharing platform. On BRUcloud, several functionalities are offered to the Brussels Air Cargo community.

Further market development was done partly through direct sales, and partly through partnerships with companies that offer in-house systems for ground handlers. For them, extending their implementation of the

in-house system with a collaborative component, helps them achieve added value for the ground handlers in their in-house processes, but also enables the ground handlers to differentiate with respect to their competitors as they improve the process of their customers.

Target market: air cargo logistics.

Phase of deployment of the new product and services as well as the reached or targeted market:

During the project 15 companies joined and the solution has significantly reduced the waiting times, saving up to hours at peak times. The number of companies involved grew up to more than 50 after the Clusters 2.0 project. Currently, the BRU-achievements have been implemented in other airports internationally and are active now in Singapore (Changi), US (DFW, LAX) and Liege too. The benefits and claims are more than frequent. Some of these claims are:

> "With the Slot Booking App we achieved a 50% drop in waiting times on export and 25% on import, together with an immense cut in overtime for the drivers."

Scalability, potential for growth and replication:

The TAM for the Slot Booking App solution gathers all airports and air cargo supply chain stakeholders globally that engage in freight delivery and pick-up operations. This includes airports of various sizes and locations that handle air cargo, freight forwarders involved in booking and managing shipments and ground handling agents responsible for coordinating cargo movement on the ground. The TAM is relevant, considering the widespread use of airports and the potential for adoption of the solution, with further potential implementations planned in a number of big international airports and global rollout for a leading ground handling agent.

The subset of airports and air cargo supply chain stakeholders that are actively seeking solution to improve the delivery and pick-up operations is selected as the SAM. This subgroup narrows the market to those who are ready to adopt those solutions to streamline their air cargo processes.

Given the high potential of scalability of this solution, the SOM comprises these SAM stakeholders that can realistically apply this slot booking process solution into their current processes. A proper deployment and adoption of this solution and its possibilities for data sharing can influence other SC actors such as inland ports to adopt such a solution and create a common data sharing space.

Impact in the CLOUD → VERY HIGH ★★★★★

3.2 Freight and logistics data sharing Cloud

3.2.1 Collaborative transport coordination, intermediation & visibility platform

Solution: A digital platform to facilitate collaborative transport coordination, intermediation & visibility across the supply chain

Main Beneficiaries: Shippers & Freight forwarders

Description: The first implementation case is the creation of the The Logit One Platform (L1) for collaborative transport coordination, intermediation & visibility. The platform:

- Manages multimodal processes with a footprint on ocean freight
- Focuses on contracted carrier rates, but can be integrated to spot marketplaces
- Is independent, so we do not take commercial ownership of contracted rates
- Provides a walled-in environment for a group of authorized shippers, LSPs, carriers
- Establishes full data integration between these parties

The platform was realised as a result of the COMCIS project. COMCIS was a two-year project to explore the possibilities and commercial viability of employing situational awareness tools to solve problems of data fragmentation, delay and inconsistency throughout the global supply chain. The project used the Common Framework supporting interoperability between ICT systems in logistics and deployed a three-layer architecture based on:

1. Aggregating data from multiple sources without requiring changes to the underlying IT systems;
2. Standardising data so that it could be processed by value-added services, independent of its original source and format;
3. Consolidating data to create on-time, qualified and derived information that could support operational decisions by delivering the right information to the right person, at the right time, in a user friendly way.

The COMCIS project ended in September 2013, but the ideas and technologies continued to be developed by the participants. Logit-One specifically combined the results of COMCIS with those of previous projects (D2D and FREIGHTWISE) to develop a multimodal planning platform for freight deliveries that provided visibility of cargo en-route. The use cases of the project included shipment of goods from mainland China to Europe via the Port of Antwerp and delivery to the last mile. The platform developed to a commercial product that led to the acquisition of Logit-One by Transporeon and the integration of the functionalities of the platform to Transporeon's Transport Management Platform.

Achievements: Logit-One that produced and eventually commercialized the platform, was acquired by Transporeon and the functionalities of the platform were integrated to Transporeon's Transportation Management Platform that empowers shippers, forwarders, carriers and retailers to move, manage and monitor freight. This was done as part of the Visibility Hub functionality that merged the functionalities of the L1 platform for ocean freight visibility with Transporeon's hinterland connections visibility. Currently, the multimodal planning functionalities of both platforms are integrated to achieve seamless flows between ocean traffic and hinterland deliveries.

The resulting product gives the following benefits to its users:

1. Global reach: Collaborate seamlessly with partners and jointly act as a virtual global LSP
2. Quality of service: Show customers that you are in control, flexible and agile
3. Reliability of delivery: Provide reliable forecasts, and handle incidents proactively
4. Simplify work: Automate repetitive processes, freeing up resources for added value activities
5. Speed up processes: Responding to RFQs, or invoicing demurrage & detention to customers
6. Reduce your operational costs: Have more insight in costs, and avoid last-minute actions
7. Lower total cost of ownership: Considering all cost factors at once - no suboptimization

Framework conditions and actions that supported this result (Conditions met to success):

Public funding supported the research activities during the design, implementation and dissemination phases. It supported a number of activities including conducting experiments, collecting data, and analyzing the results. Through the participation in COMCIS participants became more qualified and managed to expand their network that allowed further development of the product and the identification of market opportunities.

Commitment of the researchers, the exploitation of the network built during the project and the willingness to fund the products until reaching market maturity.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

The platform was the result of the projects D2D where door-to-door transport chain management functionalities were explored, SMART-CM where secure trade lanes for door-to-door container management were added, COMCIS, that was a milestone project in the effort for the creation of the platform, explored mobilizing freight data via data consolidation and finally, the platform became federated with the rest of the FENIX Federated platforms, reaching TRL 9. As a result, Logit-One that produced and commercialized the platform, was acquired by Transporeon and the functionalities of the L1 Platform were integrated to Transporeon's Transportation Management Platform that empowers shippers, forwarders, carriers and retailers to move, manage and monitor freight. This was done as part of the Visibility Hub functionality that merged the functionalities of the L1 platform for ocean freight visibility with Transporeon's hinterland connections visibility. Currently, the multimodal planning functionalities of both platforms are integrated to achieve seamless flows between ocean traffic and hinterland deliveries.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

During the project, partners explored the potential to create holistic views of supply chains, beyond the boundaries of a single actor's operational responsibilities, and offer information services that can benefit logistics service providers, terminal operators, ocean carriers, port authorities and customs administrations in their respective activities.

COMCIS used the so-called Common Framework, which supports interoperability between ICT systems in logistics and provides a basis for semantic (i.e. content-related) standards in the transport and logistics sector. Key elements of the Common Framework are part of the UBL version 2.1 standard. A link is being established between the Common Framework and the GS1 Logistics Interoperability Model. It deployed a 3-layer architecture that supports B2B (Business-to-Business) and B2A (Business-to-Administration) communications by:

- aggregating data from multiple sources, each with their own format and frequency, making it easier to access data that is spread throughout the supply chain.
- standardising the data so that it can be processed by value-added services, independent of its original source and format.
- consolidating the data to create on-time, qualified and derived information that can support operational decisions: delivering the right information to the right person, at the right time, in a user-friendly way.

The potential for implementing the concept across a wide range of situations was explored, from an operationally driven, hinterland-focused case like ECT to a strategically driven, global case.

Extensive practical testing was carried out to ensure that the system is robust and ready to be implemented in businesses of any size, from global shipping giants to local logistics agents.

Target market: Global Supply Chains

Phase of deployment of the new product and services as well as the reached or targeted market:

Currently, the platform is operated by Transporeon integrated to the Tranport Management Platform (https://www.transporeon.com/en/platform). It has 158.000 connected carriers and 1.400 shippers/freight forwarders form more than 100 countries.

Scalability, potential for growth and replication:

Professional actors benefit from greater operational control; with more relevant and comprehensive information and fewer barriers to communication they can react sooner to deviations in the supply chain, and identify opportunities for further improvement. By raising the quality of services, actors can also create added value for their customers. The project helps stakeholders understand the value of multiple information channels, offer advice on how to use them, and demonstrate the resulting benefits. While results are demonstrated on this site using examples from industry leaders, COMCIS solutions have been designed to be equally useful to SME's. In terms of scalability, the project results have already reached maturity and addressing the global market and further growth may only focus in expanding the offered functionalities. Project results may be taken up by potential competitors that operate or plan to operate similar transport management platforms.

Impact in the CLOUD → VERY HIGH 

3.2.2 Fast Customs Corridor

Solution: New Business Model for "shuttle train loading and dispatching" supported by digitilization of processes for e-customs and the use of e-seals on containers.

Main Beneficiaries: Shippers & Freight forwarders, Rail Operators

Description: The TIGER Project addresses the issues of promoting sustainable logistics introducing innovative railway services connecting the sea ports of the European Union with the Hinterland. This is done with particular attention to the flows generated to/from the Far East and South East Asia, involving all European major Ports, suffering from traffic congestion. In particular, two North European, and three Mediterranean Ports are key actors in researching innovative logistics solutions in TIGER. The Inland distributions to/from the Ports are being completely restructured. New production concepts based on Ship to Train operations together with shuttle trains prosecution into Inland Dry ports. By doing so, Dry Ports constitute a sizeable extension of the yards, since they are capable of executing any Customs, handling and ancillary operations, up to delivery to final destinations. Such service restructuring is being achieved through substantial investments in ports/dry ports infrastructures, handling equipments, technology innovations, new intelligent management systems, modern production processes, and lengthening of the total value chain to/from the Dry ports up to the end users. Through TIGER, a coherent set, of innovative production cycles deliver better service, greater performances, faster transit times at a considerably reduced costs. These are the pre requisites for modal shift in favour of rail freight.

Achievements: The main achievements of the TIGER project and the follow-up TIGER-DEMO were:

- Transportation Genoa port decongestion: exploitation of the existing infrastructures connecting rail and dry port facilities
- High quality "door to door" delivery service : through improved rail transport and intelligent digital systems
- Transit time reduction via Genoa port: creation of new best practices, implementation of, the "extended port" approach and exploitation of "railway dry port"
- "Door to door" transport cost reduction connection of the whole logistic chain via train shuttle service
- Environmental cost reduction switching from traditional road trasport system to railway trasnport + conversion from paper-based data exchange to digital systems
- 28.091 TEUs global transit under the project's business model from April 2010 to July 2013
- «total costs» reduction concerning shuttle trains up to 26%
- Reduction of «operative costs» related to terminal up to 10%
- Reduction of transit time port – dry port up to 37,1%
- Dwell time reduction (due to various aspects, among which customs) up to 40%
- CO2 Emissions Reduction : estimated 4 kg/TEU

Framework conditions and actions that supported this result (Conditions met to success):

The second implementation case was the result of the TIGER project and the follow-up TIGER-DEMO project. The implementation case involved the creation of a fast Customs corridor. It enabled the transfer of goods from a maritime port to inland terminals while monitoring the goods path and location in an effort to postpone Customs clearance until the goods reached the inland terminal. The implementation case involved recommendations for regulatory interventions in the legal framework of Italy that enabled the creation of the fast Customs corridor. The case involved the tracking of truck routes during subject trips via GPS and monitoring for deviations or stops during the route as well as electronic seals for rail transfer. It was implemented for transfers between the Port of Genoa and the Rivalta Terminal Europa and by IKEA for transfers to IKEA Deposito Centrale 1 in Piacenza.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

The results of the project have reached TRL9 and are still being used by projects partners. Relevant regulatory adjustments were required for the full deployment of the business model suggested by the project that required about two years of negotiations until coming into force.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

Public funding supported the implementation case during design and demonstration phases and revealed the feasibility as well as the benefits stemming from its full implementation. Whilst TIGER is developed up to the PILOT TEST PHASE, Tiger Demo would accompany the pilots and turn them into full scale demonstrators. In fact, the market up-take of TIGER discoveries is subject to both the partners commitment and to their demonstration over a long period of time, following the pilot phase. During TIGER Demo, the fine tuning of the service performance was achieved, reaching the full commercial exploitation of the new Ports/Dry Ports/Inland distribution production process.

Target market: Maritime to dry port container deliveries

Phase of deployment of the new product and services as well as the reached or targeted market:

Currently, the project results have been taken up to achieve industrialized shuttle train services to/from Genoa using innovative industrialized tracking & tracing supported/shared by Italian Customs Agency for e-customs. Innovative RFID e-Seals for trains & reach stackers (whenever these are used to transfer containers over longer distances outside dry/maritime ports) are used for real time information. The project's suggested business model has been adopted achieving cooperation with intermodal partners, for managing integrated traffic flows and related information through a comprehensive rail traffic management system, simulation & monitoring.

Scalability, potential for growth and replication:

Project results can be studied adjusted and replicated in any maritime to dry port transfer via rail case. Project experiences along with the identification of gaps in national and EU regulatory frameworks, can be a valuable input for EU Member states that wish to create similar "fast" corridors to reduce the congestion in maritime ports that act as gateways for the EU.

Impact in the CLOUD → HIGH ★★★★

3.2.3 AEOLIX-Architecture for EurOpean Logistics Information eXchange

Solution: AEOLIX developed a cloud-based collaborative logistics ecosystem for configuring and managing (logistics-related) information pipelines. This digital business ecosystem creates visibility across the supply chain, enabling more sustainable and efficient transport of goods cross Europe

Main Beneficiaries: Supply Chain Actors

Description: The AEOLIX project developed a targeted solution to address end to end supply chain visibility, validated across Europe by the LLs. AEOLIX helps to connect the dots of the fragmented stakeholder landscape, technologies while maximizing the use of the EU-directives and initiatives. The AEOLIX Digital Innovation Hub (DIH) became the knowledge centre for distributing learnings and "knowledge" services around supply chain process improvement, enabled (and scaled) by the AEOLIX platform solution. The LLs, after the successful demonstration of the implementation of the AEOLIX principles became distribution channels for both the AEOLIX solution and the connected services in order to improve supply chain eco-system.

The novelties of the project include:

- a collaborative, secure and resilient IT architecture, which facilitates secure and trustworthy data management, privacy, identification, authentication and authorisation
- appropriate business models and public-private governance based on the specific requirements of AEOLIX for pan-European applications
- well-designed LLs for testing, validation, implementation and exploitation of AEOLIX.

Achievements: The main gap of AEOLIX was to overcome the market fragmentation and the lack of connectivity of ICT-based information systems for logistics decision making. An essential element of the approach was to ensure that for logistics actors connecting to and using the ecosystem in undemanding and

has a low level of complexity. The benefits are balanced for all Supply Chain stakeholders. AEOLIX simplified the information exchange, improved supply chain visibility, the data protection and access is fully customisable, the B2B approach is supported by the connectivity APIs, the Publish/subscribe pattern allows the connection of software created by third party and it is possible to integrate other platform & services.

The AEOLIX Platform support services provide not only an additional tool through the dashboard but a set of integration tools such as APIs (Application Programming Interfaces) and SDKs (Service Development Kits) to allow the integration of existing end-user systems or services and the possibility for development of new end-user applications. In this sense, the AEOLIX Platform provides SDKs (Service Development Kits) to develop or integrate software solutions or services for the AEOLIX Toolkit, enriching AEOLIX Platform services to help logistics stakeholders address the business needs of their processes or requesting specific cloud services. Finally, AEOLIX provides APIs to enable the connectivity of services, apps or devices running in different platforms (Java, .NET, JS...) to the AEOLIX Community Ecosystem in simplified technology integration. The AEOLIX platform provides a security framework based on a trusted model for cloud-oriented collaborative networks and security mechanisms (identity management, authentication/authorisation mechanisms). It is aligned with EU directives and recommendations such as the e-Identification and trust services described in the Digital Agenda for Europe and aligned with the Digital Single Market. The AEOLIX Platform will have three releases. The platform release 0 was the launch of the project (and not the platform itself) and targeted the whole supply chain community. The subsequent platform releases of the AEOLIX project will initiate different engagement strategies for different types of stakeholders. The AEOLIX consortium partners organised the first Platform Release 1.0 as a test fest event in September 2017 (in terms of connection) for shippers, LSPs and service providers to check the initial requirements for connecting different proprietary systems through APIs and to demonstrate the quick wins. The first Platform Release 1.0 includes the development of the main functionalities of the AEOLIX platform (connectivity engine, dashboard, and toolkit). It allows the basic data feeds to be visible in the dashboard and also show through the toolkit and APIs how the service providers can be connected.

Framework conditions and actions that supported this result (Conditions met to success):

The Former EU President Jean-Claude Juncker identified Jobs, Growth and Investment and A Digital Single Market as the main priorities for EU policy over the coming years. The goal is to foster growth, competiveness, jobs and the development of the internal market by making better use of the opportunities created by digital technologies. In order to take the digital agenda for transport further, the European Commission launched the Digital Transport and Logistics Forum (DTLF). The DTLF brings together stakeholders from transport and logistics industries to identify areas where common action is needed, to provide recommendations in particular addressing e-transport documents, working towards the optimisation of cargo flows through better use and exchange of data and standards for seamless data exchange. In the absence of a common framework, architecture, business model and governance structure for connecting corridors acrossborders using existing IT systems and services an ambitious project kicked off under the EC Horizon 2020 programme. AEOLIX was launched in September 2016 with the aim of contributing to the priorities of the EU policy, but also the optimisation of cargo flows, the facilitation of supply chain management, the reduction of administrative burdens and to make better use of existing resources.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

The AEOLIX platform was a proof-of-concept at the end of the project, demonstrating the feasibility and functionality of features that support new ways of enhancing supply chain visibility and interoperability by implementing and delivering services at TRL7. It is clear that an impact assessment cannot be easily realised for a platform and services that are being validated, and at a prototype stage or before larger scale exploitation requires a commercial state product and operation. First, it would be possible to analyse previous studies and project the potential (indirect) impact of the selected services and then how, through the platform, these can be enhanced. The overall impact of AEOLIX will depend on the set of future services provided by the platform and the penetration rate of the services. The capabilities of a platform such as AEOLIX can potentially enhance the impacts of different services and data.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

During the project, the AEOLIX Community Ecosystem was created that includes all stakeholders involved directly or indirectly:

- End Users, including logistics service providers (all modes), shippers, retailers, terminal operators, ports,
- forwarders, and other logistics businesses, that use the information and services delivered by AEOLIX for supply chain end-to-end visibility, exception handling and event management.
- Public Authorities at the local, national and European level, who provide rules and information, including Infrastructure managers – for all relevant modes of transport.
- Service Providers and Developers, who provide content and services to businesses, public operating agencies and logistics users, or who use the platform functionality (e.g. component APIs) to develop a service which can be offered to customers, either Business-to-Business or Business-to-Consumer Service Enablers, who provide vital services, such as telecommunications, telematics connectivity and financial disbursements, to service providers, technology suppliers
- Technology Suppliers, who provide on-board systems and mobile devices that, are used to deliver the end user services

AEOLIX User Community represents those data owners and data users who are going to "own and use" AEOLIX dashboards and toolkit of AEOLIX. AEOLIX Business Community represents stakeholders from industry and authorities; actively supply to the technical foundation of the dashboard and toolkit. This platform will contribute to establishment, validation and exploitation of AEOLIX.
AEOLIX developed a platform for connecting logistics information systems of different characteristics, intra- and cross-company, for immediate (real-time) exchange of information in support of logistics-related decisions.

Target market: Global Supply Chains

Phase of deployment of the new product and services as well as the reached or targeted market:

The ambition is to develop architecture for a distributed open system which will exchange information among key logistics actors (commercial companies as well as relevant authorities), enabling increased use and impact of such information in the value chain. The platform release 2.0 will involve the intelligence of the connectivity engine to provide added value through the toolkit services and dashboard benefits to each stakeholder. The last Platform Release 3.0 will showcase the final product of interest to the end users. It will also be possible to demonstrate the feasibility of the AEOLIX platform as a self-service platform demo within the AEOLIX website

and also to organise webinars as training /capacity building tools accompanied with appropriate training material on how to connect and use it for specific target groups. Information days, high level meetings, conferences and other communication tools will also be used for engaging stakeholders as already planned in the first year. Each release will be validated by users and their feedback will be collected to form requirements for the next release and these will be done in the test fests events.

Scalability, potential for growth and replication:

In terms of scalability, the project results can be realised upon the deployment of the next releases of the platform. AEOLIX is not just a technology but a holistic business model that creates value by bringing together consumers and producers. Opposed to the dominant business models since the industrial era, AEOLIX will be governed by a platform business model (PBM). Rather than owning production and inventory like most traditional businesses, a PBM creates value by facilitating exchanges between two or more users, allowing users to both produce and consume information. The value proposition of AEOLIX is a combination of technology and the content that the users will create on top of it. AEOLIX value will lie both in its ability to host and stream user-defined content (e.g. data, services or both), and visualize it in a customized way via its dashboard. AEOLIX will set up the basis for an engagement after the project life to ensure the continuation of the collaboration of the stakeholders within the innovation platform. The AEOLIX consortium is initiating the process of the ''AEOLIX Not-for-profit legal entity'' which would be responsible for the overall operation of a data and service centric platform for Europe-wide logistics services. This is in order to distinguish it from the current AEOLIX development and research activity. The makeup of this community would be similar in make-up to the Members of the AEOLIX Project, which comprises different types of supply chain stakeholders. The after project AEOLIX technical framework will consist of the technical platform and any functionality provided by the AEOLIX project (Dashboard, connectivity engine, SDK, etc.). Above all, the AEOLIX Legal Entity can play a key role in the market development process.

Impact in the CLOUD → MEDIUM 

3.2.4 Electronic seals for international container movements

Solution: Monitoring of customs related international movement of containers via the use of electronic seals.

Main Beneficiaries: Shippers & Freight forwarders

Description: SMART_CM aimed to advanced technology implementation and research in order to overhaul the complete container door-to-door transport chain so that it is more efficient, secure, market driven, and competitive. It systematically analysed current processes and systems, produces new innovative concepts for processes and technologies, and demonstrates all these in a set of 2 world scale Demonstrators covering 4 supply chain corridors. The project amongst other included the development of a module that focused on the monitoring of electronic seals installed on containers for international movement. The module was taken up and modified by Descartes in order to be integrated with their back-office system for the monitoring of their shipments.

Achievements: During the project execution, SMART-CM managed to produce the following results:

- An interoperable single window platform (neutral layer of SMART-CM platform abstract architecture) reached its third software release and was made available to actors for validation in real world environment

- Container authorised opening service was specified developed and tested by the customs
- Logistics visibility layer of the platform and six Added value services (VAS) was specified, developed and made available for validation through simulation by the industrial actors. They mainly deal with the monitor of the chain execution against initial plan and the provision of customised, by industrial actors, notifications & alerts on deviations. (Container ETA update / Container prior-to-arrival notification / Container delay alert generation / Container idle time alert at terminals/ Container geo-fencing alerts on region / E-mail notification alert handling for all VAS). - CSD technology functionality, sensors, power and communication infrastructure was enhanced and its second release was tested in real world demonstrations.
- Two advanced VAS, stimulating the research dimension of the project, were specified and confirmed regarding their feasibility for full operation in the future. They reached the level of a prototype development and validation through simulation within the project life cycle.
- Platform information exchange interfaces with additional sources of information (such as Vessel trackers), customs, third party logistics (3PL), shipping lines and terminal operators Internal systems and other service platforms were studied in detail also considering current applied or proposed standards by competent organisations. First level specification of information exchange protocols was achieved and in some cases implemented.

Framework conditions and actions that supported this result (Conditions met to success):

Public funding supported the research activities during the design, implementation and dissemination phases. It supported a number of activities including conducting experiments, collecting data, and analyzing the results.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

Presently, only one module developed during the project has achieved market maturity and has been taken up by Descartes.
Further development of the project results may be achieved by:

- Expanding the 'single window' approach of the project by developing and demonstrating a new platform service. The service will offer the carriers the possibility to create one Entry summary (ENS) declaration and to send it to the different involved EU customs in the required format (according to national specs) and communication channel.
- Demonstrating all platform services with the direct involvement of consignees, road / rail operators and customs in the global chains
- Marketing the neutral organization concept supported by SMART-CM
- Standardisation proposal consolidation through CEN workshop execution

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

The project result related to a software module supporting the monitoring of e-seals installed on containers for international freight shipments was taken up by Descartes (project partner) and integrated to their internal monitoring platform

Target market: Global Supply Chains

Phase of deployment of the new product and services as well as the reached or targeted market:

Currently, the above mentioned module has been integrated to the back-office for supply-chain monitoring of Descartes and can no longer be identified as a separate module

Scalability, potential for growth and replication:

Even though the potential for further development of the SMART-CM platform exists, there is minimum follow-up of the project results. Private investment by end users is required to make the necessary adaptation and integrate project results to existing platforms. At a conceptual level, the project technological results can become part of a comprehensive business model supporting the monitoring of global supply chains.

Impact in the CLOUD → LOW 

3.2.5 Conclusions for the Freight and logistics data sharing Cloud

The projects that managed to transform to implementation cases had to overcome a number of challenges that are still present when data sharing in logistics is sought after:

- Logistics companies often deal with sensitive information such as trade secrets, personal information, and financial data. Data privacy and security concerns can make companies hesitant to share their data.
- Logistics companies may not trust their partners or competitors to handle their data appropriately. This can lead to a lack of willingness to share data.
- Logistics data can be fragmented, with different companies using different systems, formats, and processes. This can make it challenging to integrate data from different sources.
- Incompatible technology can make it difficult to share data across different platforms and systems. Companies may need to invest in new technology to make data sharing possible.
- There may be legal and regulatory barriers to sharing data, particularly across different countries with different laws and regulations.
- The lack of standardization in data formats, sharing protocols, and interfaces can make it difficult to share data across different systems and platforms.
- Resistance to change can also make it challenging to implement data sharing initiatives, particularly if employees are not comfortable with new technologies or processes.
- Waning interest after the project end to follow up and develop project results
- Difficulty in sustaining project results until the market is ready for adoption

The main reasons that subject projects managed to achieve market maturity and develop into successful implementation case was that they were able to satisfy a number of success factors:

- Balanced Consortiums: Collaboration and partnerships between different stakeholders in the logistics industry such as shippers, carriers, and logistics service providers are essential for data sharing projects to succeed. Their collaboration with academia and research institutes helped to ensure that the necessary data are shared in a secure and efficient manner.

- Standardization: Standardization of data formats, data sharing protocols, and interfaces is essential to ensure that the data can be easily shared and used by different organizations.
- Data Governance: Data governance is necessary to ensure that the data is managed effectively and ethically. Organizations must have policies and procedures in place to govern the use and sharing of data in order to address any trust concerns
- Technology: Technology plays a crucial role in enabling data sharing projects. The use of advanced technologies such as blockchain, IoT, and AI can help to improve data security, quality, and governance.
- Change Management: Change management is critical to ensure that the stakeholders are prepared for the changes that will occur as a result of data sharing projects. Effective communication and training should be put in place to help stakeholders adapt to the changes.
- Business Value: Data sharing projects should deliver business value to the stakeholders. Organizations should identify the key benefits of data sharing and ensure that they are communicated effectively to all stakeholders.
- Timing of the project: Project results must materialize during a small time-window in order to develop to implementation cases. Achieving results too early requires investment in order to sustain them until they can fully develop to products. Being slightly late, allows the competition to enter the market and invest independently of projects with considerably more funds and stricter implementation timeframes, driving products of projects out of the market or even making them obsolete.
- Scope of the project: The scope of the project cannot be too general since the exploitation will not be evident immediately to the market and not too specific to be only exploitable by project partners.
- Persistence of key partners: Each project needs one or more champions that will take up the project results once the project ends. These champions must have both research and entrepreneurial skills with agile characteristics that will allow them to develop project results to their full potential.

3.3 Logistics Networks Cloud

BOOSTLOG has identified **5 Implementation cases** in the framework of Logistics Networks Cloud.

All the Implementation cases involve rail transport, one case is also related to multimodal transport. With respect to the intervention areas, three cases relate to transport and logistics services (cases 2, 3 and 5), one case to digitalisation of transport (case 1) and another to operations and processes or traffic management (case 4).

3.3.1 Train monitoring (Train Monitor)

Solution: Web-based software system for the monitoring of train movements

Main Beneficiaries: Combined transport operators, Train operators / Railway companies, potentially Shippers

Description: Train Monitor is a web-based software system for the monitoring of train movements. It is well suited for being used on the entire transport corridor considered by CREAM (NL/BE – EL/TR). Train Monitor has been adapted to the specific needs of Kombiverkehr – one of the biggest combined transport operators in

Europe – and integrates information on process steps connected with train handlings inside the transshipment terminals. Thanks to the modular system architecture it can easily be adapted for other operators and railway companies. Train Monitor consists of three functional modules: (1) RealTime for tracking and tracing of currently running trains, (2) HIM Information Manager for exchanging additional operation information and (3) File&View to store data appropriately and to exploit this data for ex-post analysis purposes. Besides this the system enables a multi-client access, backs on a sophisticated user ac-cess management for keeping secured data confidential and supports a number of languages (e.g., German, English, Italian, Slovenian).

Achievements: In 2007, when the CREAM project started, a long-standing deficit in rail transport was the availability of status information to smoothly integrate rail transport into logistics processes. Developments in the previous years had improved the situation e.g., on transalpine corridors. However, all in all the conditions continued to be poor for international rail freight, as on the routes between Western Europe and Southeast Europe. The IT system "Train Monitor" closed existing information gaps by

- integrating train operation data from numerous sources,
- showing automatically calculated values for the estimated time of arrival (ETA) and
- providing a train data base for quality statistics and operation analyses.

During the CREAM project period the system was piloted and introduced at Kombiverkehr, granting access to specific information/trains to their partners such as new-entrant railway operator Lokomotion (e.g., for the route Munich-Ljubljana) and the cooperating intermodal operator Adria Kombi (for the route Ljubljana – Halkali). For demonstration and testing purposes the system was also opened for all interested parties in- and outside CREAM to view the system for a limited period.

Framework conditions and actions that supported this result (Conditions met to success):

Apart from the funding received from the 6th framework programme, the development and implementation of Train Monitor has been supported by the following factors and framework conditions:

Internal factors of the project (CREAM):

- Right mix of partners, involving technical suppliers (e.g. Hacon), transport operating companies (e.g. Kombiverkehr, Lokomotion) and institutional organisations (UIC);
- Strong partner commitment for the project and aimed-at solution(s);
- Project team composed of experts with the same level of knowledge and "access" to the topic;
- Solution has been developed under real-life operation conditions. The monitoring of trains follows the business models applied, thus the sharing of responsibilities between the customers (e. g. the intermodal operators), the railway operators and the infrastructure managers.

External framework conditions:

- Interfaces between transport chain partners are defined in the TAF-TSI framework (Technical Specification for Interoperability relating to Telematics Applications for Freight Services). Such standardisation supports a better integration of the solution with individual company systems. TAF-TSI implementation has primarily taken place after CREAM and is still ongoing.
- RNEs Train Information System (RNE TIS; previously Europtirails) has been established as a central database for train monitoring information from international freight trains within Europe. This facilitates the extension of monitoring scope to other countries, partners and relations.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

The pilot solution, developed within CREAM, has been established as a operational product. Additionally, the knowledge and developments for Train Monitor have been also used for other systems such as Hacon's HAFAS Smart VMS system. Smart VMS (today: Hafas fleet) is a smart, scalable solution for fleet management, primarily used by rail and public transport operators. Using a platform-independent driver app for smartphones, tablets or on-board computers, the system collects the current vehicle locations in real time, communicates with the control center and transmits the data to various passenger information systems. The Smart VMS system together with the experience in train monitoring and ETA calculations forms the basis for the ETA Management Platform, which has been set up for the ELETA project and which is currently further developed.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

Train Monitor is exploited by Kombiverkehr's transport monitoring service team to control the operation of Kombiverkehr's European train transport network. Monitoring involves train and shipment tracking and thus status queries as to where the loading units are at what point in the transport chain. Customers are informed in case of irregularities (e.g., delays, loading deadline extensions, technical problems, etc.). To provide optimal support, Train Monitor has been further improved in the subsequent years. Train Monitor was one of the first monitoring IT solutions receiving data from Europtirails, the predecessor of RNE TIS. Meanwhile, it is connected to RNE TIS with a TAF/TAP TSI compliant interface.

Target market: (European) Freight train networks

Phase of deployment of the new product and services as well as the reached or targeted market: Train Monitor itself is a specialized system tailored to the specific needs of Kombiverkehr. The knowledge gained during the project phase has been integrated in other products and developments of Hacon (Smart VMS / Hafas fleet and ETA Management Platform) that are marketed commercially.

Scalability, potential for growth and replication:

So far, all trains within the Kombiverkehr network are integrated in Train Monitor, the system is scalable, further network extensions can be easily added. Due to the standardised integration of train monitoring information from RNE TIS, it is easy to set up separate applications for any other interested company.

Expected impacts mainly concern:

- Increased transport reliability and responsiveness;
- Decreased cost of transport & overall logistics; Increased transport efficiency.

Impact in the CLOUD → HIGH 

3.3.2 Multimodal short sea – rail transport service Turkey – Germany (via Trieste)

Solution: Multimodal short sea – rail transport concept

Main Beneficiaries: Logistics service providers (LSPs), Shippers

Description: The new intermodal transport concept combines short sea and rail transport. The development within CREAM have focussed on the route Turkey – Italy – Germany. Originating from the use of ferry services between the Turkish ports in Istanbul, Izmir and Mersin and the Italian Port of Trieste, the multimodal concept exhibits an innovative combination of these ferry boat connections on one side and a shuttle-train connection between Trieste and Worms (Germany), on the other side.

In detail the new transport concept works like this: Turkish commodities are loaded to semi trailers, capable for being used in intermodal transport, and are hauled to Istanbul, Izmir and Mersin ports. There the semi trailers are loaded on board of Ro-Ro vessels and are transported to Italy in a 3-days ship passage. After arrival in the Port of Trieste, the semi-trailers are transhipped on the intermodal block train towards Germany. The train trip to its destination, the intermodal transshipment terminal in Worms, required a transit time of less than one day. From Worms or via Ekol's distribution centre in Heppenheim the semi trailers were transported with German registered trucks to destinations in Germany or other West European countries.

Achievements: Turkish trucks travel up to 7.000 km in each round-trip on their journey to and from West European countries. Ekol Logistics – in collaboration with the CREAM project partners Kombiverkehr, Rail Traction Company and Lokomotion – has developed an effective and environmentally friendly solution to this problem. A new intermodal transport system which reduced the share of land transport to only 2.000 km.

Having started successfully in October 2008 with initially one weekly round trip, the frequency could be extended stepwise from year to year durung the CREAM project period up to seven weekly round trips at the beginning of 2012.

Framework conditions and actions that supported this result (Conditions met to success):

Apart from the funding received from the 6th framework programme, the development and implementation of the Multimodal short sea – rail transport service has been supported by the following factors and framework conditions:

Internal factors of the project (CREAM):

- Right mix of partners, involving a logistics company (Ekol), an intermodal operator (Kombiverkehr) and rail transport operating companies (Rail Traction Company, Lokomotion);
- Strong partner commitment for the project and the follow-up operations, especially by the lead promoting company (Ekol);
- Project team composed of experts with the same level of knowledge and "access" to the topic;
- Solution has been developed under real-life operation conditions.

External framework conditions:

- Bad quality on rail corridors between Turkey and Western Europe (both routes via Romania and Serbia affected) supported the development of alternative transport routes;
- Comparably good conditions on the rail leg between Italy and Germany in relation to corridor infrastructure and operation (e.g. less border waiting times).

Further development of the TRL level beyond the funding period:

Already during the project, the new concept has been implemented as a fully operational service. The concept is continuously improved and extended without any effect on the TRL level.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

With the new multimodal concept, Ekol succeeded in transferring main parts of transport onto railways and short sea. The concept has been established as an important element of the Ekol service offer; this is underlined by Ekols engagement as a RoRo company and as an owner or shareholder of terminals along the concerned routes.

Target market: LSPs, Shippers (focus on transport corridors between Turkey and Western Europe)

Phase of deployment of the new product and services as well as the reached or targeted market: Having started in 2008 with initially one weekly train round trip, the frequency could be extended stepwise from year to year up to seven weekly round trips at the beginning of 2012. Also in the following periods, Ekol's multimodal network has been further strengthened and extended with own shares in port terminals, extended consolidation points and further transport relations, additional extensions are in the pipeline.

Scalability, potential for growth and replication:

Recently, Ekol acquired a 65-percent share in Europa Multipurpose Terminals (EMT) in Trieste. Following further investments in the terminal, it will be possible to handle two separate Ro-Ro operations simultaneously and train loading capacity will grow to 10 daily trips. Since 2018, Ekol's Ro-Ro services also connects the Port of Lavrio in Greece in addition to the Turkish port destinations developed during CREAM. Further Ro-Ro services are planned between Trieste and other countries including Israel and Egypt. In Germany, meanwhile three consolidation centers have been developed, which are located in Köln, Ludwigshafen, and Kiel. Within Ekol's multimodal network, Germany acts as a transportation bridge to other European countries, offering services across Europe and Scandinavia.[70]

In parallel, the multimodal short sea – rail transport concept has been adapted and further developed by MARS Logistics, another turkish forwarding company. As Ekol, MARS transports cargoes from various regions in Turkey via Istanbul, İzmir and Mersin seaports and Ro-Ro services to Trieste. From there, the cargo is transported by rail to Luxembourg. Currently, there are six weekly round trips opertated between Trieste and the intermodal terminal in Bettembourg (Luxembourg). The last leg by road connects various destinations in Luxemburg, Belgium, the Netherlands, UK, France and Germany.[71]

In relation to Logistics Networks, the multimodal transport concept can be considered as a lighthouse initiative for multimodality. The concept combines different modes smartly, utilising each mode according to their best capabilities. Expected impacts mainly concern:

- Decreased travel times;
- Modal shift;
- Improved capacity utilisation of assets (specifically Ro-Ro ships and trains);

[70] <https://www.ekol.com/en/countries/germany/intermodal/>

[71] <https://www.marslogistics.com/en/intermodal-transportation>

- Reduction of congestion on the road network;
- Decreased environmental impact; Improved energy consumption.

Impact in the CLOUD → VERY HIGH 

3.3.3 New through-going corridor-wide rail transport- and logistics concept (RETRACK network)

Solution: Innovative trans-European rail freight service concept as an alternative to the national railways' single wagon system

Main Beneficiaries: Logistics service providers (LSPs), Shippers

Description: In 2007, multiple partners joined forces in the European RTD project RETRACK with the aim of simplifying single wagon transport and offering customers a new cross-border European portfolio with a reliable running schedule. RETRACK intended to develop a sustainable alternative concept to the national railways' single wagon system. The concept was expected to contribute to a significant modal shift of cargo from road to rail and to create an effective and scalable rail freight corridor between high demand regions in Western Europe and new high growth regions in Central and Eastern Europe. Important issues, tackled in this context were the integration of strategic port hubs (to provide access to the large goods repositories and generating the necessary volumes to make rail freight transport along the corridor economically feasible) and comparable short and guaranteed door-to-door delivery times of shipments. With this new rail freight service concept, the RETRACK partners aimed at demonstrating that rail freight services on trans-European corridors can be a competitive alternative to road haulage.

Achievements: During the project, a "demonstration train" was operated enabling the identification and testing of the possibilities and limits for new and innovative transport concepts on selected routes in practice between the hubs Köln-Eifeltor and Györ with a secondary hub established in the Rotterdam region. The RETRACK demonstration train is conceived as a "group of wagons train", i.e. transport volumes of various customers - usually being smaller than the amount suitable for a block train - are combined into a train set. The volumes have been composed of all kinds of goods – from agricultural products and powdery bulk cargo to semi-finished products from the coal and steel industry, chemical products incl. dangerous goods as well as machine parts and containers.

The train was operated by the RETRACK consortium members Central European Railways Rt. (Hungary), LTE Logistik (Austria) and Transpetrol GmbH (Germany), with Transpetrol assuming the role of a neutral train operator and railway undertaking for the German part of the service. In 2011, one year after the start of the first train with two customers and one departure per week, the service attracted more than 10 customers from various economic sectors and the frequency could be increased to three weekly departures between the hubs Köln-Eifeltor and Györ with train lengths of up to 740m and 2,300 tonnes in each direction.

Framework conditions and actions that supported this result (Conditions met to success):

The development and implementation of the RETRACK service has been supported by the following factors and framework conditions:

Internal factors of the project (RETRACK):

- Right mix of partners, involving a neutral train operator (Transpetrol), and different rail freight operators (Central European Railways Rt., LTE Logistik);
- Strong partner commitment for the project and the follow-up operations, especially by the lead promoting company (Transpetrol);
- Project team composed of experts with the same level of knowledge and "access" to the topic;
- Solution has been developed under real-life operation conditions.

External framework conditions:

- Bad quality of the national railways' single wagon system supported the development of such an alternative transport concept, operated by private companies;

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

During the project, a "demonstration train" has been operated on selected routes and transferred to a regular service. After the project the concept has been further developed to a fully operational network system, providing a logistical link between the most important economic centers in Europe.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

The operational RETRACK partners (Transpetrol, Central European Railways Rt., LTE Logistik) continued their cooperation also after the project and started a commercial freight train connection on the tested route. In 2014, after several partners had withdrawn from RETRACK, VTG decided to take control of the project. Since then, the VTG railway undertaking (Bräunert) operates under the name RETRACK. The new company, Retrack GmbH & Co. KG headquartered in Hamburg, is a subsidiary of VTG Rail Logistics.

Target market: LSPs, Shippers (focus on transport corridors between Turkey and Western Europe)

Phase of deployment of the new product and services as well as the reached or targeted market: In 2011, one year after the start of the first train with two customers and one departure per week, the service attracted more than 10 customers from various economic sectors and the frequency could be increased to three weekly departures between the hubs Köln-Eifeltor and Györ with train lengths of up to 740m and 2,300 tonnes in each direction. Today, VTG's RETRACK network provides a logistical link between the most important economic centers in Europe, covering Germany, Austria, the Czech Republic, Hungary and Slovakia. The focus is on three main corridors with nodes, feeders and distribution antennas.

Scalability, potential for growth and replication:

Individual wagons as well as wagon groups and complete freight trains can be mapped. The aim is to optimize freight transport by rail, taking into account all cost factors - from critical quantities to large-scale solutions. Retrack achieves this by intelligently linking all options available in the rail network of a given freight corridor. Thanks to its own locomotive pool, consisting of both diesel and electric trains, VTG Rail Logistics can carry out freight transportation just as flexibly on the network as single wagonload traffic as it can with groups of wagons or block trains.

In relation to Logistics Networks, the RETRACK transport concept demonstrates the possibility for developing a competitive rail transport offer for volumes below the block train and intermodal train segment. Expected impacts mainly concern:

- Decreased travel times;
- Decreased cost of transport & overall logistics; Increased transport efficiency
- Increased transport reliability and responsiveness;
- Improved performance of the European Transport;
- Modal shift;
- Improved capacity utilisation of assets (freight trains);
- Reduction of congestion on the road network;
- Decreased environmental impact; Improved energy consumption.

Impact in the CLOUD → VERY HIGH ⭐⭐⭐⭐⭐

3.3.4 Cross-border dispatcher

Solution: Implementation of a border dispatcher, to ensure and optimise smooth rail operations on the cross-border rail sections

Main Beneficiaries: Infrastructure managers, Rail operators

Description: One solution, analysed and developed in the Smart Rail project, is the implementation of a border dispatcher, to ensure and optimise smooth rail operations on the cross-border rail sections between the Netherlands (Betuweroute) and Germany (Oberhausen – Emmerich). These sections belong to the Rail Freight Corridors Rhine-Alpine (RFC1) and North Sea – Baltic (RFC8). The Betuweroute is a double track, electrified railway line between Rotterdam and Venlo dedicated for freight trains and equipped with ETCS level 2. It is fed by the Oberhausen – Emmerich line, which is also double track and electrified. The border station is located in Emmerich.

The border dispatcher is a joint function of the respective infrastructure managers Prorail (NL) and DB Netz (DE) and is located in the Central Office for border traffic in Duisburg. The idea of the border dispatcher is to connect the respective IM operation centres in the best way, optimise the coordination of dispatching decisions with respect to the concerned cross-border sections and bundle the information flows between railway operators (RUs) and infrastructure managers (IMs)

Achievements: The Smart Rail project outcomes have been implemented and tested in three so-called "Continuous Improvement Tracks" (CIT) during the project, focussing on different aspects of the SMART-RAIL concepts and furthermore aim to generate improvements on different corridors. CIT 3 targets the Rotterdam-Genoa corridor and deals with rail freight reliability in case of (unexpected) obstructions on the track. It specifically aims to increase the flexibility and reliability of rail freight transport within a multimodal transport system.

Framework conditions and actions that supported this result (Conditions met to success):

The development and implementation of the RETRACK service has been supported by the following factors and framework conditions:

Internal factors of the project (Smart-Rail):

- Right mix of partners, involving a rail infrastructure manager (ProRail) and experienced consulting companies and cooperating with parties outside the project (DB).
- Solution has been developed under real-life operation conditions.

External framework conditions:

- The concerned activity area is located on a Rail Freight Corridor (RFC1 Rhine-Alpine), which provides a good basis for the IM-IM and IM-RU cooperation.

Further development of the TRL level beyond the funding period:

The solution is operational, a further develpment of the concept is not known.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

As stated above, the border dispatcher is a joint function of the respective infrastructure managers Prorail (NL) and DB Netz (DE) and is located in the Central Office for border traffic in Duisburg.

Target market: Infrastructure managers (DE, NL), Rail operators (operating on the RFC1 Rhine-Alpine between the Netherlands and Germany)

Phase of deployment of the new product and services as well as the reached or targeted market: The border dispatcher function of ProRail and DB Netz is still operational. Meanwhile, there is also a border dispatcher on the Rail Freight Corridor North Sea - Baltic (RFC 8) for the Polish-German border route Frankfurt (Oder) - Rzepin.[72]

Scalability, potential for growth and replication:

In principle, the idea of a border dispatcher could be implemented at any European border or handover püoint between two IMs.

Even though the issue of developing and implementing a cross-border dispatching function cannot be considered as a groundbreaking technical innovation, developing solutions fostering cooperation seem to gain importance in view of multimodal and increasingly work-sharing transportation and logistics systems with multiple roles. A well-functioning of multimodal Logistics Networks can only be ensured if the operations of all unimodal networks and interfaces work themselves and especially across borders. Expected impacts mainly concern:

- Increased transport reliability and responsiveness;
- Decreased travel times;
- Decreased cost of transport & overall logistics; Increased transport efficiency.

Impact in the CLOUD → LOW ⭐⭐

[72] Handbuch Dispositionskonzepte SGV, DB Netz AG, 11.12.2022

3.3.5 Hub- and spoke concept to integrate smaller terminals via mega hubs (Intermodal Network 2015+)

Solution: Hub- and spoke concept to integrate smaller terminals via mega hubs in intermodal networks

Main Beneficiaries: Combined transport operators (Intermodal operators), Terminal operators

Description: The "Intermodal network 2015+" is one of three demonstrators within the TIGER Demo project, designed to integrate and connect small and medium-sized intermodal terminals to hinterland networks with transport volumes not sufficient to operate direct trains. The general idea is to interconnect intermodal trains with loading units for different destinations and to build new direct trains for destinations / terminals in the hinterland by (a) direct transhipment of loading units between trains or (b) by using intermediate storage of loading units in the terminal when incoming and outgoing trains are operated in different time windows. Trains that are dedicated to specific O/D intermodal services must arrive at the hub as a "bundle" within a defined time-window to enable direct transhipment of loading units between trains and avoiding intermediate storage due to train delays. All time-consuming and costly shunting and train formation processes are avoided because the trains enter and leave the terminal directly.

Achievements: As the construction and opening of the MegaHub Lehrte near Hannover was considerably postponed, the Intermodal Network 2015+ activities were shifted to the intermodal terminal München-Riem, which could offer comparable conditions for hub and train operations. The Intermodal Network 2015+ demonstration integrated the following operational and technical components which are necessary for an efficient and effective intermodal hub-and-spoke-concept:

- Direct long-haul train entrance with momentum and direct train departure;
- Automated longitudinal transport of loading units to reduce gantry crane-movements (this technique was not available in München-Riem);
- Customized train path and resource planning;
- Optimised terminal processes (supported by a Terminal operating System);
- Information and communication technology: tools for technical management, capacity management and train monitoring.

All "Intermodal Network 2015+" activities have been concluded successfully in 2015 within the project lifetime.

Framework conditions and actions that supported this result (Conditions met to success):

The development and implementation of the "Intermodal Network 2015" concept has been supported by the following factors and framework conditions:

Internal factors of the project (TIGER, TIGER Demo → Demonstator Intermodal network 2015+):

- Right mix of partners, involving an intermodal operator (Kombiverkehr) and a terminal operator (DUSS);
- Strong partner commitment for the project and the follow-up implementations;
- Project team composed of experts with the same level of knowledge and "access" to the topic;
- Solution has been developed under real-life operation conditions.

External framework conditions:

- Concrete plans existed for the construction of a MegaHub in the Hannover region in Lehrte. Even though the measures developed in TIGER could not be tested in Lehrte due to the postponement of the construction project, there was a realistic perspective for implementing the measures in regular operations.

Further development of the TRL level beyond the funding period: TRL 7 → TRL 9

As stated, during the TIGER Demo only demo operations have been performed in the intermodal terminal München-Riem. In 2020 - 5 years after the end of TIGER Demo - the MegaHub Hannover-Lehrte was set into operation featuring the MegaHub-specific technical design elements: transhipment tracks with a sufficient length (700m) to accommodate a complete train and with electrified ends allowing for operation of long-haul locomotives, three gantry cranes covering all six transhipment tracks, gantry crane operation supported by battery-powered driverless Automated Guided Vehicles (AGVs). These vehicles take over the longitudinal transport of loading units between the rail wagons.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks:

The MegaHub Lehrte is operated by the MegaHub Lehrte Betreibergesellschaft mbH, a subsidiary of DUSS. Trial operation in Hannover-Lehrte started in June 2021 with five train pairs per week connecting two terminal locations/regions in Germany (Osnabrück and Regensburg/Landshut). In April 2021, the German intermodal operator Kombiverkehr started additional train connections to the terminals in Ludwigshafen, Duisburg, Lübeck, Kiel, Hamburg, Nürnberg, München, Mannheim in Germany and Malmoe (SE), Verona (IT), Rotterdam (NL), Lovosice (CZ), Malaszewicze (PL).[73] Meanwhile, further extensions have been realised. All connected terminals are linked via the MegaHub as a central hub. The connections are designed so that the trains arrive between 8pm and 6am and have only short standing times.

Target market: LSPs, Shippers

Phase of deployment of the new product and services as well as the reached or targeted market: Target customers are addressed in particular via the largest intermodal operator in the MegHub Kombiverkehr. Customers using the MegaHub include Hellmann Worldwide Logistics and DHL.

Scalability, potential for growth and replication:

The concept is designed to integrate terminals of different character and size. Kombiverkehr has highlighted that "Terminals in northwestern and northeastern Germany can also benefit from the diverse routings to a large number of national and international economic centers via short feeder services. In the future, mixed trains will start from locations that are not able to handle whole trains for only one destination terminal, and their loading units will be loaded onto trains with a single destination in the MegaHub. From each terminal, all other connected terminal locations are possible via the MegaHub, as well as further antenna transports via gateways In relation to Logistics Networks, the "Intermodal Network 2015+" activities successfully demonstrated the concept to integrate smaller terminals into intermodal hinterland networks via Megahubs.

Expected impacts mainly concern:

[73]<https://megahub-lehrte.deutschebahn.com/megahub-lehrte/MegaHub-Kundeninfos/MegaHub-Verkehrsverbindungen-5141814>

- Decreased environmental impact; Improved energy consumption;
- Reduction of congestion on the road network;
- Modal shift;
- Decreased travel times;
- Improved performance of the European transport.

Impact in the CLOUD → VERY HIGH 

3.3.6 Conclusions for the Logistics Network Cloud

The analysis of projects in the domain of Logistics Networks revealed that many outcomes did not survive the project phase, which is often due to structural issues. All presented implementation cases within the Logistics Network Cloud managed to overcome such structural obstacles; here are in particular:

- Responsibility/leadership: during the project, these aspects are normally well defined by contracts between EU and consortium as well as between the consortium partners. By end of the project however, also these contracts terminate, which leads firstly to a lack of leadership and afterwards to missing allocation of tasks and responsibilities. No leadership - no initiative. The situation is even more complicated, if the consortium leader was a consultant or a research institute, for which it is not possible to take over leadership of operational services on commercial basis.
- Partner comittment: The same goes for the project partners, particularly those who are directly involved in the performance of the operation. As explained above, inter- or multimodal transport chains are complex and fragile. Their composition might have worked with partners committed to the same project goal and respective contracts. After the project however, the consortium (partners of the transport chains) often breaks up. It is then difficult to find suitable replacement partners - especially operative ones - in the short term. And the longer the "valley of death", the less likely successful implementation.
- Financing: The end of the R&I projects also means end of funding. It should be remembered that especially rail operation is expensive. A re-start-up phase after the project is necessary that needs additional financing. This financing must be provided or organised by a company leader, which probably does not even exist (see "leadership" above). Moreover, pre-financing of rail or barge services using innovative technologies (for the first time) is affected with extremely high risk. No bank would approve a loan on this.
- Business model: This is included in many R&I projects, however often only for formal reasons. In addition, business models must cope with changes of business partners (see above) and commercial priorities of the partners (see below). In general, business models as part of R&I project do cover these cases sufficiently. It is also questionable if this should be an obligation to (basic) research projects.
- Commercial partnerships: It lies in the nature of economy that business cases and commercial priorities of operating partners change. This might be due to internal (e.g., change of management and portfolio) or to external (e.g., competition situation, change of rules and regulations, energy crisis) reasons. In any case, the rather long-term set-up of R&I projects (including application phase) is not compliant with short-

term reaction times of market participants. As long as funding is granted, contracts with the Commission might be fulfilled, but afterwards operation that is no longer regarded as profitable will stop immediately.

Some success factors common to all or most implementation cases included in the Logistics Networks Cloud, are a right mix of partners, strong partner commitment for the project and the follow-up implementations, project teams composed of experts with the same level of knowledge and "access" to the topic and finally solutions that have been developed under real-life operation conditions.

All implementation cases generate positive impacts on environmental issues, capacity/costs and/or transport performance / connectivity through implenetation of outcomes in one ore more of the 7 intervention areas, highlighted in the Logistics Networks Cloud report: (1) Intermodality (Multimodality, Synchromodality), (2) Operations and processes, (3) Digitalisation, (4) Transport management; Transport service planning and controllling, (5) Network capacity management, (6) Contingency management (7) Last mile processes, concepts and technologies. The level of impact on Logistics Networks has been assessed as high or very high for 4 implementation cases and rather low for one implementation case as it addresses an only limited part of the network.

3.4 Physical Internet

There is 1 implementation case and two promising future cases (that come from ongoing projects developed with outcomes of previous projects). They are not yet implementation cases according to the definition of the BOOSTLOG project. However, they have advanced implementation of the Physical Internet Roadmap.

3.4.1 Open Logistics Foundation

Solution: The Open Logistics Foundation is a non-profit operating foundation advocating the promotion of open source applications in logistics.

Main Beneficiaries: all logistics stakeholders, particularly logistics operators and innovation providers.

Description:

The Foundation's primary goal is to facilitate collaborative development of open source solutions to existing problems in logistics and supply chain management. The Foundation develops common standards, tools, and services, which can be used commercially by any player in the industry. Collaborative development and the use of open source software and hardware ensures high process efficiency.

Achievements:

The Foundation offers various functions including:

- Operating an open and neutral platform for joint development of open source software and hardware components
- Publishing open source software and hardware components
- Establishing and maintaining an open source community
- Merging results from science, applied research, and practice into practical open source applications
- Developing and establishing de-facto standards
- Networking people and companies with relevant know-how
- Organising events
- Providing further education and training in the field of digitalisation

Further development of the TRL level beyond the funding period: TRL 7 à TRL 9

In many operational aspects of the logistics industry similar assets such as trucks, pallets, warehouse systems, are in use and sometimes even shared. One major issue however has been the differentiation in supply chain processes and their related IT solutions. This results in the major problem that close collaboration between companies is often made impossible just because the used processes and IT-systems and procedures are just not compatible. This is also one of the reasons why there are so few IoT and AI scale-up companies and solutions in logistics even though this would be an ideal playing field: start-ups can have a perfect solution for a process but if they want to implement it at another company, there are slight differences, because everyone's process is (perceived to be) unique even though the differences are minimal and not fundamental). There are just so many heterogeneous solutions out there. If the ambition is to increase efficiency through collaboration there's a clear need for streamlined solutions to overcome the barrier of nobody wanting to use IT-solutions outside of their own framework.

To overcome this, there was a need for a collaborative framework in which there is not a single party dominating all the others. Hence the concept of an open collaborative logistics platform. A common umbrella that provides free access and the opportunity to install updates. The Open Logistics Foundation has been set up by Fraunhofer IML as an open source community in which there cannot be one party dominating it. Through the Foundation, a large Logistics Service Provider (LSP) can share a process in the open source but if there are a number of others that want to adjust such process and there is a strong alignment on the modified process then it is the modified process that prevails. This is certainly new for the bigger parties but very interesting for the smaller ones.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks: n.a.

Phase of deployment of the new product and services as well as the reached or targeted market:

The foundation is fully operational with members committing to collaboration and creating an open source community. They are believers of that sustainability is something that can only be achieved together. This is also true for social sustainability from a digital perspective. Fully optimised processes can still result in suboptimal substantiation of single solutions, in which case you need to collaborate for which you need streamlined interoperable processes and the software to support it.

Scalability, potential for growth and replication:

The foundation will continue to grow its community to attract more members to participate and use the open resource tools created by the foundation to achieve more sustainable logistics operation.

3.4.2 Promising future cases

I) The DISCO project

Solution: DISCO (Data-driven, Integrated, Syncromodal, Collaborative and Optimized urban freight meta-system for new generation of urban logistics and planning with data sharing at European Living Labs) is a Horizon Europe project that supports more efficient and flexible use of urban space towards zero emission urban logistics.

Main Beneficiaries: cities and logistics service providers.

Description:

For logistics service providers (LSP) the challenge consists of reducing the high cost of the last mile. For city or communal authorities, the challenge consist of providing an urban ecosystem that enables distribution of

goods within a safe, optimised, and ecological context, according to priorities. To create such an environment, cities require smart solutions and tools. In the concept of the Physical Internet, data are the fundamental key enabler to work towards an integrated and digital urban planning. Efficient operational activities are driven by real time data to make the correct and sustainable choice, especially dealing with urban logistics. The optimally located micro consolidation hubs and drop and pick-up zones are suitable nodes in an integrated network, and the different operation systems of the LSPs operating in the urban environment can be considered networks connecting to the network of networks.

Achievements:

The project has been successfully building on the concept of Physical Internet and practice maximise benefits of shared assets and optimise land use in cities which are extremely challenging for today's increased e-commerce. The project has addressed key challenges and by applying the concept of Physical Internet to achieve zero emissions urban logistics.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks: n.a.

Further development of the TRL level beyond the funding period: TRL 8 → TRL 9

The solutions piloted by the DISCO project are all with TRL 7 or above. These solutions were developed by previous projects with limited demonstration. During the DISCO, those solutions will be implemented with real business conditions to evaluate their impacts.

Phase of deployment of the new product and services as well as the reached or targeted market:

Partnership between cities and LSP is key to success of implementation of urban logistics solutions. The DISCO project facilitates such partnership and further evaluate business models and needs for policy supports.

Scalability, potential for growth and replication:

The project will be a good example of how to practice data sharing between the public and private sectors to achieve zero emission urban logistics goals.

II) The URBANE project

Solution: URBANE (Upscaling Innovative Green Urban Logistics Solutions Through Multi-Actor Collaboration and PI-inspired Last Mile Deliveries), is a Horizon Europe project that supports the transition path towards effective, resilient, safe and sustainable last-mile transport, through four Lighthouse Living La Labs and following cities.

Main Beneficiaries: cities and logistics service providers.

Description:

URBANE stands for Upscaling Innovative Green Urban Logistics Solutions Through Multi-Actor Collaboration and PI-Inspired Last Mile Deliveries. It is a 3.5-year project (2022-2026) on novel, sustainable, safe, resilient and effective last-mile delivery solutions, combining green automated vehicles and shared space utilisation models. The project will test high TRL level (TRL7/8) innovative solutions that can achieve efficient, replicable and sustainable last-mile delivery in four Lighthouse Living Labs (LL) in Helsinki, Bologna, Valladolid and Thessaloniki. Two Twinning LLs will be undertaken in Barcelona and Karlsruhe, demonstrating their own solutions using the Digital Twin Platform developed by the LEAD project. URBANE's commitment to upscaling is further strengthened by the engagement of six early adopters (Follower Cities) in feasibility studies of the innovations' adoption, thus stimulating the formulation of new LL communities across Europe. Analyse the physical, digital, social and business dimensions of complex last-mile logistics delivery systems.

The project analyses the physical, digital, social and business dimensions of complex last-mile logistics delivery systems based on the PI principles and existing practices of innovative urban logistics. It has developed a PI's practical guide to LLs to enable LLs to transfer their logistics nodes and networks by analysing what can be digitalised, what can be automated, what can be shared or collaborative, what kind of contracts and for what.

Achievements:

The project will demonstrate Physical Internet based urban logistics solutions and raise awareness of applications of Physical Internet, translating theoretical studies into real applications. That will be an important step to realise the Physical Internet roadmap.

Level of deployment at company level and the estimated size of the operation for that company based on available benchmarks: n.a.

Further development of the TRL level beyond the funding period: TRL 8 → TRL 9

SELIS created the framework of data sharing and collaborative modes among various stakeholders. The LEAD project developed digital infrastructure, e.g. the Digital Twin Platform, to enable test and evaluate various scenarios. Use of those projects' outcomes, the first demonstration project using PI-enabled innovative solutions for the last mile delivery was successfully granted by the URBANE project.

Phase of deployment of the new product and services as well as the reached or targeted market:

The concept of PI, PI roadmap and literature on PI are too theoretical for practitioners including city authorities in urban logistics to understand, thus reducing opportunities for real application. There is a need to describe the concept of PI in a language which can be easily understood by urban logistics practitioners including policy makers. Only by this way, PI can be further exploited by more R&I projects, thus being widely used in urban logistics.

Scalability, potential for growth and replication:

The project analyses the physical, digital, social and business dimensions of complex last-mile logistics delivery systems based on the PI principles and existing practices of innovative urban logistics. It has developed a PI's practical guide to LLs to enable LLs to transfer their logistics nodes and networks by analysing what can be digitalised, what can be automated, what can be shared or collaborative, what kind of contracts and for what. That will ensure future replication and scalability.

3.5 General conclusions

The cloud reports analysed in the present document showcase 15 implementations reaching impact, i.e. from project outcomes to:

- Commercial products or services exploited by companies as part of their solutions portfolio to address customers (e.g. Nallian, Transporeon, Descartes, Kombiverkehr)
- Transition internal company processes and operations (e.g. Ekol, Prorail, DB Netz)
- New start-ups and companies: RETRACK
- Transformative initiative addressing a sector or a market by NGOs/Associations: Open Logistics Foundation
- Implementation of new business or governance models: Port Environmental Index, Fast Customs Corridor

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4 Conclusions and recommendations – the way forward

This report has presented, among others, an analysis of the relation of policies, company objectives and R&D project expected impacts, with a specific focus on implementation cases both in the market and policy field.

Deliverable D3.2 already identified the following conclusions, stemming from an analysis of two cloud reports, as well as their corresponding recommendations:

Conclusion 1. the Sustainable Development Goals are a common framework for alignment between European Union, Companies

➔ Recommendation: R&I programmes are explicitly addressing Sustainable Development Goals and related KPIs, KPIs may need to be developed accordingly.

Conclusion 2. There is an important correlation between most of the Policy & Company social objectives. However, translating those objectives in concrete KPIs for R&I is not straightforward as there are too many Impact Indicators and KPIs.

➔ Recommendation: Make a prioritization of most important Impact Indicators and KPIs to address particular policy and company objectives.

Conclusion 3. For the market-oriented implementation cases, the assessment of the pathway towards impact clearly validates the existence of the valley of death. Therefore, although there are causal links between the research and the impact, most of the conditions to achieve that impact were more dependent on addressing other critical aspects such as regulations, market, social, commercial and industrialization readiness of the solution.

➔ Recommendation: Define different readiness levels for R&I results to be realized as actual impacts beyond TRL.

These preliminary conclusions have been confirmed with the in-depth analysis of 15 implementation cases in the following clouds: Logistics Nodes, Freight and Logistics Data Sharing, Logistics Networks and Physical Internet.

The genre of implementation cases can also give a preliminary idea on which clouds had the highest impact of EU funding. Indeed, the logistics networks cloud followed by the cloud on data sharing, are the ones with more implementation cases operating in the market. Even though the same number of implementation cases has been found in the logistics nodes cloud, they are still in the Proof of Concept phase, and its impact will be fully realised in the coming years.

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Annex I: Expected impacts for the Logistics Nodes Cloud.

						European Commission			European Parliament			Council		
Initiative	**Title of Act**	**Relevance for ALICE members**	**Type of Act**	**EC Work Programme**	**Topic/DG**	**Link EC initiative**	**Commission adoption**	**Feedback**	**Link to EU Parliament Legislative Train**	**Legislative observatory**	**Parliament Briefing**	**Council**	**Share Point**	**Related projects**
Reducing packaging waste – review of rules	Packaging and packaging waste, amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and repealing Directive 94/62/EC	High	Proposal for a regulation	2020/21	Environment	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12263-Reducing-packaging-waste-review-of-rules_en	2023 Q1	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-packaging-and-packaging-waste-directive-(refit)	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2022/0396(COD)&l=en	Arrived	https://www.consilium.europa.eu/en/policies/?filters=1650		
Reducing carbon emissions HDV	Reducing carbon emissions – review of emission standards for heavy-duty vehicles	High	Proposal for a regulation	2021	Climate	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13168-Reducing-carbon-emissions-review-of-emission-standards-for-heavy-duty-vehicles_en	2023 Q1-2	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-review-of-the-co2-emission-standards-for-heavy-duty-vehicles	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2023/0042(COD)&l=en	Departed	https://www.consilium.europa.eu/en/policies/?filters=1650		ZEFES
EU customs reform	EU customs reform	to monitor	Proposal for a regulation	2023	Union Customs	https://taxation-customs.ec.europa.eu/customs-4/eu-customs-reform_en	N/A	ongoing EU legislative *iter*	https://www.europarl.europa.eu/legislative-train/theme-an-economy-that-works-for-people/file-revision-of-the-union-customs-legislation	-	Departures	https://www.consilium.europa.eu/en/policies/?filters=1650		
Corporate sustainability reporting	Corporate sustainability reporting	High	Directive	2023 Q1	Corporate Sustainability	https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en	closed	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-review-of-the-non-financial-reporting-directive	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2021/0104(COD)&l=en	Arrived	https://www.consilium.europa.eu/en/policies/?filters=1650		ZEFES
eFTI (Subgroup 3 Digital Transport and Logistics Forum DTLF)	Electronic freight transport information (eFTI) – national provisions in scope, eFTI common data set & data subsets	High	Delegated Act	2023 Q1	Digital Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13663-Electronic-freight-transport-information-eFTI-national-provisions-in-scope-eFTI-common-data-set-data-subsets_en	2023 Q1	Upcoming Q1/2023	https://www.europarl.europa.eu/legislative-train/theme-transport-and-tourism-tran/file-electronic-freight-transport-information	-	Arrived	https://www.consilium.europa.eu/en/policies/?filters=1650		MULTIRELOAD, CRISTAL, (FENIX)

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Electronic freight transport information (eFTI)	Regulation on electronic freight transport information	High	Implementing act	2023 Q1	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13661-Electronic-freight-transport-information-eFTI-procedures-and-access-rules-for-competent-authorities_en	2023 Q1	Upcoming	https://www.europarl.europa.eu/legislative-train/theme-transport-and-tourism-tran/file-electronic-freight-transport-information	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2018/0140(COD)&l=en	Arrived	https://www.consilium.europa.eu/en/policies/?filters=1650		MULTIRELOAD, CRISTAL, (FENIX)
Data Act	Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on European data governance (Data Governance Act) COM/2020/767 final	High	Proposal for a Regulation	2022	Digital	https://digital-strategy.ec.europa.eu/en/library/data-act-proposal-regulation-harmonised-rules-fair-access-and-use-data		2023 Q1	https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-data-act	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2022/0047(COD)&l=en	Departed	https://www.consilium.europa.eu/en/policies/?filters=1650		MULTIRELOAD, CRISTAL
Horizon 2020 programme – final evaluation	Horizon 2020 programme – final evaluation	High	Staff working document - Evalutation	2022	R&I	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13444-Horizon-2020-programme-final-evaluation_en	final v 2023 Q4	closed	-		Departures	https://www.consilium.europa.eu/en/policies/?filters=1650		
Revision of Combined Transport Directive	Second review of Directive 92/106/EEC on combined transport of goods between Member States	High	Proposal for a directive	2022	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13010-Sustainable-transport-revision-of-Combined-Transport-Directive_en	2023 Q2	Upcoming Q2/2023	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-second-review-of-the-combined-transport-directive	/	Derailed	https://www.consilium.europa.eu/en/policies/?filters=1650		MULTIRELOAD
Revision of the Weights and Dimensions of HDV Directive	Review of the Council Directive 96/53/EC laying down for certain road vehicles circulating within the Community the maximum authorized dimensions in national and international traffic and the maximum authorized weights in international traffic	High	Proposal for a directive	2022	Transport	https://transport.ec.europa.eu/transport-modes/road/weights-and-dimensions_en	2023 Q2	Upcoming Q2/2023	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-weights-and-dimensions-directive	/	Departures	https://www.consilium.europa.eu/en/policies/?filters=1650		ZEFES
Commercial vehicles – weights and dimensions (evaluation)	Commercial vehicles – weights and dimensions (evaluation)	High	Proposal for a directive	2022	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13278-Commercial-vehicles-weights-and-dimensions-evaluation-en	2023 Q2	OPEN (13 July 2023 - 08 Sept.2023)	N/A	N/A	N/A	N/A		

Increasing the share of rail traffic	International freight and passenger transport – Increasing the share of rail traffic	Medium	Proposal for a regulation	2022	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13134-International-freight-and-passenger-transport-increasing-the-share-of-rail-traffic_en	2023 Q2	**Upcoming Q2/2023**	/	/	/	/		MULTIRELOAD
TEN-T - revised guidelines	Revision of Regulation on Union Guidelines for the development of the transEuropean transport network (TEN-T)	High	Proposal for a regulation	2020	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12532-Trans-European-transport-network-TEN-T-revised-guidelines_en	2022	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-ten-t-regulation-review	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2021/0420(COD)&l=en	departed	https://www.consilium.europa.eu/en/policies/?filters=1650		ZEFES
Low-emission vehicles – improving the EU's refuelling/recharging infrastructure	Revision of the Directive 2014/94/EU on the Deployment of Alternative Fuel Infrastructure	High	Proposal for a regulation	2020	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12251-Low-emission-vehicles-improving-the-EU%E2%80%99s-refuelling-recharging-infrastructure_en	2021	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-directive-on-deployment-of-alternative-fuels-infrastructure	/	expected arrivals	https://www.consilium.europa.eu/en/policies/?filters=1650		ZEFES
CountEmissions EU	EU framework for harmonised measurement of transport and logistics emissions – 'CountEmissions EU'	High	Proposal for a regulation	2021/22	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13217-Count-your-transport-emissions-CountEmissions-EU_en	2023 Q2	**OPEN (13 July 2023 - 08 Sept.2023)**	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-measurement-of-transport-and-logistics-emissions	/	Departures	/		ZEFES
Sustainable and Smart Mobility Strategy	Sustainable and Smart Mobility Strategy' together with an Action Plan	High	Strategy/non legislative	2020	Transport	https://transport.ec.europa.eu/transport-themes/mobility-strategy_en	dic-20	Closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-sustainable-and-smart-mobility	/	/	https://www.consilium.europa.eu/en/press/press-releases/2021/06/03/sustainable-and-smart-mobility-strategy-council-adopts-conclusions/		All
Urban Mobility Package	Sustainable transport – new urban mobility framework	High	Communication/Non legislative	2021	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12916-Sustainable-transport-new-urban-mobility-framework_en	2021	closed	see the individual wagons in this train	/	Departures	/		

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Cross-border road traffic rules	Revision of the Cross-Border Enforcement Directive	Low	Amended proposal for a directive	2021	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/2131-Cross-border-enforcement-of-road-traffic-rules_en	2023 Q2	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-directive-on-cross-border-enforcement-of-traffic-rules	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2023/0052(COD)&l=en	Departed	/		MODI, ZEFES
Multimodal digital mobility services	Multimodal digital mobility services	Medium	Proposal for a regulation	2021/22	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13133-Multimodal-digital-mobility-services_en	2023 Q1	**Upcoming Q1/2023**	https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-multimodal-digital-mobility-services	/	Departures	/		MULTI RELOAD
Electricity market – reform of the EU's electricity market design	Amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design	Low	Proposal for a regulation	2022	Energy	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13668-Electricity-market-reform-of-the-EUs-electricity-market-design_en	2022 Q1/Q2	closed	https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-internal-electricity-market	https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2023/0077(COD)&l=en	Arrived	/		ZEFES
Rail interoperability – EU harmonised specifications for trains, rail infrastructure, and passenger accessibility	amending Commission Regulations: (EU) No 321/2013, No 1299/2014, No 1300/2014, No 1301/2014, No 1302/2014, No 1304/2014 and Commission Implementing Regulation (EU) 2019/777	Medium	Implementing regulation	2022	Transport	https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13533-Rail-interoperability-EU-harmonised-specifications-for-trains-rail-infrastructure-and-passenger-accessibility_en	2022 Q4	closed	/	/	Arrived	/	/	MULTI RELOAD

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Annex II: Expected impacts for the Logistics Nodes Cloud.

PROJECT / Expected impact	Decrease of environmental impact	Reduction of congestion on the road network	Modal shift	Decrease cost of transport & overall logistics	Increased transport reliability and responsiveness	Increase management capacity of terminals and productivity	Improved operations in terminals	Improved terminal capacity utilization and efficiency	Improve energy consumption	Improve the performance of the European Transport	Improve long distance-city distribution connectivity
ARCC				50% reduction in costs for operating systems	10% improvement in the punctuality of outgoing trains in local hubs; optimised on-time departure and delivery; reduced dependency on and risk related to the human factor More accurate forecasting of departure and arrival times for customers					Increase cost-competitiveness of rail for freight forwarders will also contribute to bringing more freight transport to the rail secto Expected project impacts: Competitivenes	
CARGO ANTS	Efficient, safe low environment impact use of transport means within and between ports; Efficient and safe port and terminal operations						Efficient and safe port and terminal operations			Contribute to open up of e-freight developments to a wider community	
CHINOS	Reduce greenhouse gases and pollutant emissions, increasing the security of energy supplies, improving energy efficiency and increasing the use of renewable energy			Reduce the costs of the energy					Energy savings and energy efficiency		
CLUSTERS 2.0	Less emissions, carbon footprint, noise and land-use	Less congesti on	Increased inter-modality and higher resilience of the transport system					More efficient goods handling (30 % cost reduction) stimulating multi-modal transport solutions	Call: less energy	Increased inter-modality and higher resilience of the transport system; Improved door-to-door logistics performance (faster, cheaper and more reliable); Increased added value of hubs, integrating manufacturing and sharing resources to create logistics clusters with a much higher impact on local economies	Improved door-to-door logistics performan ce (faster, cheaper and more reliable)

COFASTRANS	Market uptake and innovations tackiling the challenges of Transport Specific programme in a sustainable way			Expected impact validated by the experts		Enhance growth performance by combining and transferring knowledge into disruptive and competitive solutions.	Expected impact validated by the experts	Expected impact validated by the experts			
COREALIS	Reduce impact on climate change and the environment of port activities		Efficient connections with other transport modes	Reduce operational and infrastructural costs of port activities		Better capacity management with reduced costs				Improve logistics efficiency and better integration of the port in the surrounding socio-economic area	
DOCKINGASSIST	Reduce operating expenses, CO2 emissions and fuel usage, lessening the environmental impact of shipping						Improve management and control of docking operation through software platform				
DOCKStheFUTURE	Reduce impact on climate change and the environment of port activities		Efficient connections with other transport modes	Reduce operational and infrastructural costs of port activities		Better capacity management with reduced costs				Improve logistics efficiency and better integration of the port in the surrounding socio-economic area	
ECOHUBS	Reduce impact on climate change and the environment of port activities									Intermodal regional and national transport	
FUTUREMED											
INTERFACE	Improved fuel efficiency and reduction of emissions. Sustainable mobility and intermodality										
INTERMODEL EU	Improved assessment of risks related to impacts of climate change									Improved, transparent and harmonised investment decision making at a European level and maintenance planning of the European transport infrastructure network	
INTE-TRANSIT						Provide training framework for port and Logistics personnel	Improve port interoperability (improvement of the flow of goods, cargo, traceability and visibility)			Strengthen communication links between port and relevant actors/authorities	

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LOGIMATIC							Expected impact validated by the experts	Expected impact validated by the experts		Promote innovation in order to maximise the potential of the European GNSS and its adoption	
OPTIYARD					Increase passenger comfort by improving insulation of door leaves, seating and technologies that allow facilitating modularity		Reduce structure weight avoiding certain materials/using composite materials. This action will help to reach the forecasted 15-30% Weight reduction in the primary structure		Reduce structure weight avoiding certain materials/using composite materials. This action will help to reach the forecasted 15-30% weight reduction in the primary structure		
PIXEL	Reduce impact on climate change and the environment of port activities		Efficient connections with other transport modes	Reduce the operational and infrastructural costs of port activities		Better capacity management with reduced costs					
RCMS	Reduce infrastructure operation energy intensity and subsequent CO_2, pollutants and noise emissions		Expected impact validated by the experts			Improve infrastructure capacity and incident management by means of added-value mobility services across different modes.				Deployment of alternative fuels infrastructure in Europe according to the Clean Power for Transport Package objectives	
SAIL						Support logistics chain of good flow and business operation in port and dry ports					
SMART-PORT											
SMARTSET	More use of renewables								More energy efficiency	Better transport and mobility	
SUPPORT										Improve coordination towards security in the industry.	

Table 8. Projects mapping of the expected impacts (from the topics) for the Logistics Nodes Cloud (D2.1 and experts validation).

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Annex III: Expected impacts for the Logistics Neworks Cloud.

PROJECT / Expected impact	Decrease of environmental impact	Reduction of congestion on the road network	Modal shift	Improved capacity utilisation of barge, train and truck	Decrease cost of transport & overall logistics	Improved inventory management	Increased transport reliability and responsiveness	Decrease travel times	Improve energy consumption	Increase transport efficiency	Improve the performance of the European Transport	Improve long distance-city distribution connectivity
GIFTS					X		X				X	
INTERFACE	Improved fuel efficiency and reduction of emissions Sustainable mobility and intermodality						X	X				
CREAM			X		X		X		X		X	
MOSES			X								X	
RETRACK			X	X								
GET SERVICE	X			X			X			X	X	
NEWS	X		X		X		X					
TELLISYS	X		X	X	X		X				X	
TIGER												
TIGER DEMO		X	X		X		X				X	X
VIWAS			X	X	X		X					X
AEROFLEX			x	x		x				x		

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ARCC				X	Automation of rail freight operations is expected to lead to more reliable and cost efficient solutions Expected project impact: 50% reduction in costs for operating systems		Automation of rail freight operations is expected to lead to more reliable and cost efficient solutions Expected project impacts: 10% improvement in the punctuality of outgoing trains in local hubs; Significantly improved punctuality and reliability; More accurate forecasting of departure and arrival times for customers		X		Increasing the cost-competitiveness of rail for freight forwarders will bring more freight transport to the rail sector Expected project impact: Competitivenes	
FR8RAIL III					X		X				X	
LessThanWagonLoad	X	X	X		X		X				X	
LOGISTAR	X			X	X		Increased reliability	Reduced transit times		10% higher load factors, 10% shorter delivery routes	X	
NOVIMAR			X		X		X					X
Smart-Rail			X	X	X		X				X	
SYNCHRO-NET	X	X	X	X			X			X	X	

Table 9. Projects mapping of the expected impacts (from the topics) for the Logistics Networks Cloud (D2.1 and experts validation).

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Annex IV: Expected impacts for the Physical Internet Cloud.

PROJECT / Expected impact	Decrease of environmental impact	Reduction of congestion on the road network	Modal shift	Improved capacity utilisation of barge, train and truck	Decrease cost of transport & overall logistics	Improved inventory management	Increased transport reliability and responsiveness	Increase management capacity of terminals and productivity	Improved operations in terminals	Improved terminal capacity utilization and efficiency	Decrease travel times	Improve energy consumption	Increase transport efficiency	Improve the performance of the European Transport	Improve long distance-city distribution connectivity
CO3															
CO-GISTICS															
ICARGO															
MODULUSHCA															
AEOLIX					X			X	X	X				X	
AEROFLEX			X	X		X							X		
CLUSTERS 2.0	Less emissions, carbon footprint, noise and land-use	Less congestion	Increased inter-modality and higher resilience of the transport system.							More efficient goods handling (30% cost reduction) stimulating multi-modal transport solutions.		Less energy consumed		Increased inter-modality and higher resilience of the transport system; Improved door-to-door logistics performance (faster, cheaper and more reliable); Increased added value of hubs, integrating manufacturing and sharing resources to create logistics clusters with a much higher impact on local economies	Improved door-to-door logistics performance (faster, cheaper and more reliable)
COG-LO	Lower emissions	10% shorter delivery routes			Reduction in fuel consumption		X				X		10% higher load factors		
DynaHUBS															
ICONET	30% reduction emissions	30% reduction in terms of congestion		Improved asset utilisation								30% reduction in terms of energy consumption			
LEAD														X	
LessThanWagonLoad	X	X	X		X		X							X	

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LOGISTAR	X			X	X		Increased reliability				Reduced transit times		10% higher load factors, 10% shorter delivery routes	X	
NEXTRUST	X	X											Reduce the number of delivery vehicles by at least 10% Improve truck and container load factors (+ 50% in test cases and overall stabilise load factors) and provide new 'back-load' possibilities		
PLANET	X		X		X			X					X	X	
SELIS													X	X	
SENSE													X	X	
Stargate													X	X	
SYNCHRO-NET	X	X	X	X			X						X	X	
URBANIZED															
ULaaDs															
ePICENTRE															

Table 10. Projects mapping of the expected impacts (from the topics) for the Physical Internet Cloud (D2.1 and experts validation).

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