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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
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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 complex problems are defined and addressed.

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EXECUTIVE SUMMARY

The EU Commission has set a clear strategy to meet the European Green Deal target towards transport-related greenhouse gas emissions reduction by 90% by 2050 and ensure that the EU transport sector is fit for a clean, digital and modern economy. To this direction, freight transport and logistics is playing a major role and belongs to the key pillars of transformation as it is facing critical challenges related to climate change, well-functioning supply chains and human centric services design.

On the one hand the high growth of freight transportation and on the other the need for transition to zero emission, makes it mandatory to establish a solid freight and logistics collaboration ground to speed up innovation and contribute to a successful transport transformation.

This deliverable is the 5th document of a series of actionable reports (so called 'cloud report') that have been produced by the BOOSTLOG consortium, covering different and comprehensive logistics domains (defined by BOOSTLOG as *clouds*). This deliverable focuses on assessing completed EU funded R&I Projects – from the 5th Framework Programme up to H2020 in the domain of **freight and logistics data sharing**. In the figure below, the main projects working on the freight and logistics data sharing topic are shown. Projects presented with the timeline reporting and also some relevant milestones of EU policies.

Figure 1. European funded R&I Freight and logistics data sharing projects

The main outcomes showcased in this document tackle the five main barriers hindering freight and logistics data sharing: Legal barriers, Resource availability barriers, Competition barriers, Institutional barriers and Coordination barriers detailed in Section 2.5.

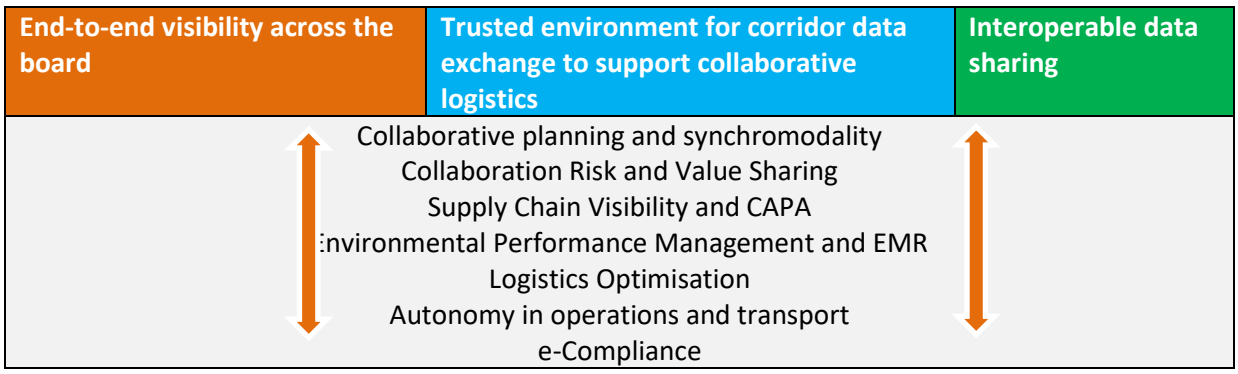
In Table 1, the **targeted impacts** of the projects and the assessment of their readiness level (not just technical but also market, operational, etc) is layered into 6 levels: Not demonstrated (ND), Theoretical Demonstration (TD), Proof of Concept (PoC), Implemented Small Scale (including

Niche Markets) (ISS), Implemented Medium Scale/Several Companies (IMS), Implemented Large Scale/Mainstream in Industry (ILS)

Table 1. Expected impacts, number of projects addressing it and readiness of the solutions

Targeted Impact	Nr. of projects	Status
Urban Support	2	IMS
Increase transport efficiency (load factors, empty trips, shorter delivery routes, reduce failed deliveries)	25	IML
Reduced emissions	2	ISS
Achieving and increase in modal shift to rail freight/waterways transport	5	ISM
Decrease of overall transportation and logistics cost	5	ISS

Besides the above impacts several other issues have been identified as strategic objectives of the EU as per the review of the deliverables of relative EU projects such as BOOSTLOG[1] and SELIIS[2].



Currently, the Emission Measurement and Reporting (EMR) provides data sharing protocols and solutions to seamlessly apply the GLEC framework in a more affordable way. EU policy objective on digitalization has supported the development of the eFTI regulation70 (DTLF) for paperless logistics and projects such as AEOLIX[3] and CEF project FENIX[4] & FEDERATED[5] were/are developing freight & logistics data sharing concepts.

[1] D4.1_Definition of high relevance topics for freight transport and logistics_v1
[2] D1.1 Stakeholder needs analysis - Business Innovation Agenda (Processes & KPIs)
[3] https://aeolix.eu/
[4] https://fenix-network.eu/
[5] http://www.federatedplatforms.eu/

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1 The BOOSTLOG project and scope of the deliverable

1.1 The BOOSTLOG project

Freight transport and logistics is facing critical challenges to address climate change, ensure supply chains are well functioning and people is served with required type of goods and services. In particular, cope with the expected growth of freight transportation and transition to zero emission logistics up to 2030 requires collaboration speeding up innovation.

BOOSTLOG Vision is transforming European freight transport and logistics R&I ecosystem to perform optimally[1] by 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 has identified 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 ii) develop and implement valorisation strategies and guidelines to speed up the technological and organisational innovation uptake, including the creation of the Innovation Marketplace and issue recommendations to increase impact of R&I public funding, iii) Define high potential & priority R&I gaps to make efficient uses of R&I investments and iv) Strengthen R&I impacts communication and Stakeholders engagement in the innovation process.

In the framework of the first of those actions, BOOSTLOG has mapped and assessed more than 160 EU-funded R&D since FP5 in different freight transport and logistics domains (i.e. the Logistics *Clouds*), so as to develop at 8 comprehensive and industry actionable reports. The fifth issue of those reports is the present document, that will focus on freight and logistics data sharing.

These reports will be later complemented by deliverables on valorisation strategies and guidelines for public R&I uptake (WP3), an innovation marketplace for R&I uptake (D3.3) and the identification of high priority and potential R&I gaps that need to be prioritized in future R&I actions targeting policymakers (WP4).

1.2 Scope of this deliverable

In the framework of BOOSTLOG WP2, "From R&I projects results to impact generation", Task 2.1 focused on the analysis of the EU funded projects: gathering Outcomes, Implementation Cases in specific Clouds. The present deliverable shows the second report stemming from task 2.2, i.e. focused analyses in selected Clouds:
i) freight and logistics data sharing, ii) coordination & collaboration iii) urban logistics, iv) logistics nodes, v) multimodal freight, corridors & transport networks, vi) modularization and transhipment. This report focuses on freight and logistics data sharing, showcasing both outcomes and implementation cases directly contributing to the field. To avoid overlaps, some cases with a minor impact on this cloud have been left out of this report as they have been or will be later showcased in other cloud reports (such as coordination and collaboration or logistics networks).

Having in mind the importance of freight and logistics data sharing the outline of the report focuses on identifying the relevant EU funded projects in terms of data sharing in freights and logistics. After identification of these projects, the outcomes and implementation cases will be gathered and interviews will be planned. Also, most relevant milestones of EU policies will be mapped out and presented. Overall the contents that will be included in the present report, include the following aspects: Challenges and positive impact regarding freight and logistics data sharing; Reasons of data sharing; Pain points of data sharing; Current state of data sharing; Interventions and solutions; Market analysis of current practices; Inventory of data sharing implementations and initiatives; Relative EU initiatives and legislation; Current practices; Project results and outcomes; Implementation cases; Potential implementation paths.

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2 Introduction and methodology

2.1 Background

A clear aim of the European Commission is to reduce CO_2 emissions in order to create a climate-neutral continent. Targeting freight emissions is one milestone in achieving this. Data sharing in logistics and freight helps achieve this. More in particular, certain initiatives, actions and projects are dedicated towards this scope. This includes the electronic freight transport information[6] and the Corridor freights information systems[7].

There is a variety of matchmaking platforms, products, projects, and initiatives used for collaboration and data sharing between stakeholders involved in freight logistics processes. Several of these platforms are listed below.

Platform/Product/Project	Key points
Cluster Community System – Clusters2.0 project[8] (CluCS)	• IT platform • Resource management • Operational synchronization • Logistic optimization (reduced costs & waiting times) • Applications in hubs, terminals, warehouses • Increased visibility
CargoStream[9] - Clusters2.0 project	• Reduced truck transportation • Improved vehicles fill rates & multi-modal transportation • Distribution routes optimization • Synchronise supply chain requirements • Reduced road transport road and cost, CO2 emission • Overall sustainability
Mix-Move-Match[10]	• SaaS solution for supply chain • Logistic services • Reduced cost in transport • Hyper-connectivity • Stakeholder collaboration • Cargo consolidation • Stock visibility • Loading unit optimization • Performance monitoring • Transport management • Support bookings • Operations control

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R1056
[7] https://transport.ec.europa.eu/transport-themes/digital-transport-and-logistics-forum-dtlf_sv#subgroup-2--corridor-freight-information-system
[8] https://www.clusters20.eu/
[9] http://www.cargostream.net/
[10] https://www.gs1pt.org/wp-content/uploads/2018/03/MIX-MOVE-MATCH-VI-SEMIN--RIO-BPC.pdf

	• Mobility
NEXTRUST[11]	• Increase efficiency and sustainability in logistics • Supply chain networks • Logistics service providers (LSPs) • Intermodal operators • Smart visibility software • Real-time utilization of transport assets • Increased sustainability
AEOLIX[12]	• Cloud-based collaborative logistics ecosystem • Supply chain visibility • Interoperability • Decentralized information sharing • Automation of data flow • Optimised transport services • Reduced costs • Reduced CO_2 emission
SELIS[13]	• Platform for pan-European logistics applications • Network of logistic communities • Agile green transportation chains • Secure infrastructure • Shared information and tools for data acquisition and use
ALICE roadmaps[14]	• Supply chain management innovation • Systems & Technologies for Interconnected Logistics • Real-time (re)configurable supply chains in (global) supply chain networks • End-to-end supply chains visibility • Data interoperability, ownership & governance • Autonomous logistics operations • Transhipment technology
TradeLens platform[15]	• Supply chain platform • Data sharing • Supply chains collaboration • Digitization & automation of cross-organizational business processes
Naviporta[16]	• Supply chain management for shippers and cargo owners • Connects all relevant stakeholders • Interoperability support in the supply chain
DTLF - CEF projects[17]	• Digital transport and logistics • FEDeRATED:

[11] https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-transport/logistics/nextrust
[12] https://aeolix.eu/
[13] https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-transport/logistics/selis
[14] http://www.etp-logistics.eu/
[15] https://www.tradelens.com/
[16] https://naviporta.com/
[17] https://www.dtlf.eu/#

	• Digital co-operation • Data-sharing infrastructure for freight transport and logistics • FENIX: • Establishing federated architecture for data sharing • Offer interoperability
eCustoms[18]	• Online cloud platform for international shipping • Processes automation • Data sharing and documentation services • Digitalization of logistics
ENTRANCE EU Matchmaking Platform[19]	• Connect stakeholders • Increase visibility for transport solutions

2.2 Why freight and logistics data sharing?

Data sharing is considered a technology currently extremely useful to if not all, the vast majority of business sectors. Plainly put, data sharing is the ability to distribute the same data with multiple stakeholders maintaining the same accuracy and consistency across all entities. Data sharing has a variety of different applications, such as data dissemination amongst the different departments of an organization and internal data augmentation in order to gain better insights. Thus, a well perceived definition would be "*Data sharing in a supply chain is referred to as the extent to which crucial and/or proprietary information is available to other actors of the supply chain for the completion of their daily operations.*"[20] [21]

The digitization of freight and logistics offers a variety of advantages as well as certain barriers and limitations. Data sharing will help accelerate said digitalization. Freight and logistics data sharing can result into improved multi-modal optimization and management. Experts ascribe a high importance to data sharing in transportation and logistics (90% compared to 83% for other sectors). Reasons that can account for this include:

1. Real-time data that can be captured with IoT sensors will be essential for management, monitoring, and shipping processes.
2. Economical gain. Analytics will allow for risk management and stock prediction. Minimizing thus, any loses.
3. Data sharing will also allow for freight forecasting and will enable more informed decision making when obtaining freight rates and invoice auditing.
4. Enhanced multi-modal shipping offerings as a result of freight data sharing.
5. Collaboration amongst all the relevant stakeholders (i.e., suppliers, manufacturers, service providers etc.)

Based on these reasons as well as on the fast digitalization of many different procedures many organizations opt for freight and logistics data sharing because amongst others 1) it has proven to boost their performance seeing as it allows for real-time monitoring that affects deliveries, stock etc., 2) it is of course a way to fight and reduce bureaucracy by going paperless and providing and sharing all the necessary information electronically, 3) data sharing allows for

[18] https://myecustoms.com/en/home/
[19] https://www.entrance-platform.eu/
[20] https://www.sciencedirect.com/science/article/pii/S0925527317302050
[21] The logistics data sharing infrastructure Whitepaper, TKI, Dinalog August 2020

safer and faster transactions, 4) once again real-time data access allows for real-time decision making and it also helps in the automation of various procedures that would otherwise cost time and money, 5) data sharing also allows business network building, 6) optimization of capacity and shipping as well as other freight procedures and 7) it offers a universal legal compliance and enforcement in order to ensure secure data sharing.

Freight and logistics data sharing, although it has now become almost a necessity, still requires further development. Support for data sharing for procedures optimization would enable transport operators, law enforcement agencies, logistic service providers and other relevant stakeholders to optimize their processes such as 1) increased visibility of multimodal transport solutions, 2) establishment of a sustainable multimodal logistics network, 3) improved capacity planning, 4) data sharing for several regulatory processes and 4) prediction of freight flows.

Table 3. Challenged and expected impacts identified in the ALICE' Roadmap on Freight and Logistics Data Sharing by area of intervention

Challenge	Impact
Freight digitalization	• Regulating data acceptance • Regulating dangerous and waste cargo transport • Exchange information required for waste transport • Regulating and accelerating information exchange regarding international transport orders • Sharing real-time logistics trip data • Peer-to-peer interoperable solutions for freight information systems
Logistics data sharing	• Digitize data sharing between industry stakeholders and authorities • Establish a cross-border data space for data processing
Paperless procedures	• Usage of e-Documents in cross-border transport • Utilization of electronic means for compliance with EU rules regarding freight transport • E-documents for inspection by authorities • E-document to prove compliance with transport rules • E-documents for transactions • Environmental impact
Establish data sharing infrastructures	• Provide control to data owners • Provide protection regarding sensitive data • Overcome reluctance over data sharing • Provide flexible and sustainable way for data sharing
Data Sharing for operations optimization	• Optimize supplier-contractor communication • Minimize unnecessary procedures • Real-time monitoring of transport conditions
Establish a data sharing transport ecosystem	• Sustainable logistics. Lead times and waiting time for end-users will be minimised • Staying competitive • Supply chain visibility will allow companies to know the locations of their cargo, to have direct knowledge regarding demand and stock.

2.3 Data Sharing Pain Points

Lack of digitalisation. As it was aforementioned, digitalization is key in the logistics and freight sectors. However, data still remains "locked" into legacy systems. These systems need to "open up" and make the data available. In addition, the relevant data sharing infrastructure needs to be established to allow for secure and homogeneous data sharing.

Standardization. The use of APIs for data sharing is advised. The development of standard APIs and standardization guidelines will enable flexible, effective, and secure data sharing. The EU supports this notion seeing as oftentimes heterogeneous data needs to be harmonized in order to achieve the data standards set on various levels. In particular, the European Committee for Standardization has developed several data standards such as NeTEx, the Standard Interface for Real-time Information (SIRI)c and Datex2 with this aim as a desired outcome. Various organizations opt for identifying normalized methods for data identification that will be broadly applied.

Governance issue. Policies that establish the exact roles of each stakeholder in any data sharing process are quite certain a necessity. These policies are mostly dependent on the structure of the involved organizations as well as data control. Parameters involved in this point include:

a. Ethics
b. Privacy
c. Resources
d. Framework for partnerships
e. Data protection
f. Data access
g. Establish an overall governance framework
h. Policy planning
i. Operational governance processes
j. Regulatory compliance requirements

Fragmentation of the Logistics market. Currently, the way the value chain is established allows for digital interventions almost at every step. The freight ecosystem involves several players that are directly linked with data sharing. Such players can be divided in the following categories: 1. Transport management systems, 2. Freight-warehouse exchange platforms, 3. Tender platforms, 4. Warehouse management systems, 5. Automation solution providers, 6. Tracking providers, 7. Automation solution providers, 8. Data providers. In order to increase the transparency and the efficacy of the value chain, the logistics markers can be segmented into 1. An Intelligence fragment that involves data analysis and processing, AI and machine learning and sensor and connectivity aspects of data sharing, 2. An Automation fragment that includes all the automation processes and 3. An integration fragment that includes digital ecosystems, cloud computation, digital twins and logistics platforms.

Profit sharing. Hight investment in digitalization is necessary in order to achieve the aspects mentioned in this report. Because of its fragmentation, the logistics market faces certain economic challenges. There are several profit-sharing models utilized in freight. Some have proposed a model that divides the gains equally and uniformly among the partners. This model is based on multi-agent-auctions[22]. The partners provide quotes for each request received and if the request received will generate a profit then the bid is considered positive whereas if the request will result in loses then the bid is considered negative. Another most complex profit sharing model was proposed by Krajewska et al., 2006, and was based on operations research game theory and combinatorial auctions[23].

Perceived competitive advantage. Digitalized documents, task automation, IoT sensors and other assets that allow for real-time visibility provide the relevant stakeholders with a competitive edge.

[22] Gomber P., Schmidt C., Weinhardt C., 1997, Elektronische Märkte für die dezentrale Transportplanung, Wirschaftsinformatik 39(2), p. 137-145

[23] Krajewska M.A., Kopfer H., 2006, Collaborating freight forwarding enterprises: request allocation and profit sharing, accepted for publication in OR Spectrum

In order to create competitive automated logistics business models, data sharing is key. Data sharing can allow any organization to analyze the data and gain valuable insights to support them. In addition, data sharing in freight would allow better monitoring of orders, stocks, deliveries, and suppliers pipeline also providing the stakeholders with a competitive edge.

2.4 Current State of Data Sharing

Data sharing in freight can be broadly divided into private sector to private sector, public sector to public sector and private sector to public sector. In order to establish an effective freight ecosystem (i.e., improved intermodal connectors), the freight private sector requires data from the public sector. On the other hand, processes involved in the freight sector also result in the producing a large amount of data which relevant stakeholders sometimes stovepipe due to privacy concerns. The public sector may sometimes be allowed access to limited data that is not sufficient when making decisions. Therefore, the public sector had to depend on modeling and simulation tools. However, if the public sector would have access to freight datasets it would allow for the development of a holistic view leading thus to more informed decision-making and subsequently to an improved freight ecosystem.

DATA SHARING AND THE PHYSICAL INTERNET

The Physical Internet approach is based on three layers of interconnectivity: physical, digital and operational. An interconnected logistics scenario utilizing a common data model regarding urban logistics offers many benefits such as less traffic congestion and less pollution. In the last mile modular logistics approach a collaborative effort in performing the consignment enables sharing transport means and coupling delivery with pick up. The figure below shows the stakeholders and the data sharing that can be achieved among them.

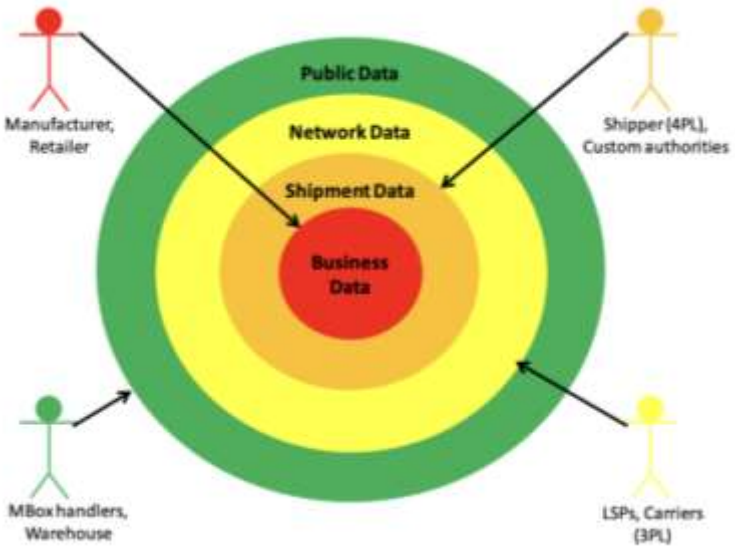

Figure 1. Relevant freight stakeholders and data sharing.

CHALLENGES & POTENTIALS OF A LOGISTICS DATA SPACE

Data management has been proven to be highly efficient and effective for logistics companies. Seeing as logistics are a key discipline in Industry 4.0 implementation, data sharing and digitalization has become a necessity. All the relevant processes involved in data sharing such as machine learning allow the stakeholders to enhance internal process and customer supply chain optimization.

The large amount of data collected in logistics makes data analysis and utilization quite difficult. The International Data Spaces (IDS) aims to tackle this issue by establishing a secure virtual space data sharing. Because of the specific parameters, a logistics data space community was established.

As is evident, data homogeneity is key. Key performance indicators (KPIs) would allow to identify the expected impact of the adopted measures.

Table 4. Expected Impacts KPIs and projects addressing them

Expected Impact	KPIs	Projects
Data sharing	ICT solutions implemented	**SMART, LogiCon, OTN, TIMON, SELIS, AEOLIX, LOGISTAR, PortForward, FIspace**
Enhanced urban support	Smart systems adaptation for urban support	**SMARTFREIGHT, GALENA**
Environmental	Reduced emissions	**iCargo, Transmetrics**
Enhanced port engineering (i.e. management, organization, etc)	Smart tool implementation	**RISING, COMCIS, SAIL, SMART, GIFTS, Finest, Instant Mobility, TelliSys, ADVANCE, TT, ICONET, LOGISTAR, PortForward, Transmetrics, SYNCHRO-NET, EURIDICE, SUPPORT**
	Advanced technology implementation	**SMARTCM, B2B-ECOM, RISING**
	Co-modality	**INTEGRITY, iCargo, TelliSys, TIMON, E-FREIGHT**

2.5 Barriers and guidelines to achieve the benefits of an optimised and sustainable freight and logistics data sharing

As it was mentioned above there are certain barriers associated with optimized and sustainable freight and logistics data sharing. In particular:

1. **Legal barriers. Such barriers include:**
   a. Lack of formal contract. An often time consuming and costly process.
   b. Lack of legal basis for partnerships. Public funding limitation in some areas.
   c. Control of data by technology contractor. Resulting to complicated procedures of data sharing.
   d. Security sensitivities. Oftentimes, security restrictions may prohibit the stakeholders from providing freight data.
   e. Overall data sharing. Legal limitations may sometime not allow data sharing between some countries.
2. **Resource barriers. Including:**
   a. Certain SMEs companies face difficulties in providing freight data due to lack of resources.
   b. Funding difficulties can result in reduced participation of stakeholders.
   c. (Big) Data heterogenicity - due to the different data sources as well as the amount of data collected, sometimes costly data pre-processing is required.
3. **Competition barriers. Including:**
   a. Data sensitivity. This, of course, is a significant barrier for many stakeholders seeing as there is a pre-existing concern that private, sensitive data may reach the competition.
   b. Data disclosure.
4. **Institutional barriers. Including:**

a. Negotiation processes to arrange funding agreements, sometimes required in freight projects.
b. Public-private cooperation. Sometimes interests don't align.
c. Different operational procedures between organizations. Freight data collected from one organization may not always cater to the needs of another.
d. Compatibility. Some projects with freight data perform specific pre-processing that leads to data set differences.

5. **Coordination barriers. Such barriers include:**
   a. Data diversity
   b. Reduced awareness. The stakeholders often want to be ensured that the data they will share will not be used by the government for regulatory enforcement.
   c. Improper coordination. In order to acquire freight data, coordination with the stakeholders is key.
   d. Cross-country sharing. Sharing across different countries with different boundaries is a common issue when dealing with sharing freight data seeing as the coordination between the different agencies is not always very simple.

2.6 Defining areas of intervention, solutions and Key factor of success

In order to address the challenges brought by legal, coordination and resource barriers, by the competition or by other institutional barriers certain interventions have been established to overcome said challenges and enable freight data sharing.

Legal interventions:

- Overcoming legal barriers is especially tricky seeing as certain legal or contractual solution needs to be established. However, legal solutions that can help with these barriers include nondisclosure agreements. In terms of data sharing, it is significant to protect the data and therefore ensure that the relevant stakeholders are willing to sign a nondisclosure agreement or other privacy agreements. Other data agreements are also an effective intervention seeing as they might allow for several data applications with decreased cost. This is extremely useful for freight data seeing it would enable data utilization from several stakeholders.

- Data scrubbing is another legal intervention. The willingness of the relevant stakeholders to remove sensitive information from the data to be shared is another key factor of success.

- Legislations. Legislations can be a very effective measure of intervention seeing as they often carry the necessary provisions for data protection that can motivate the relevant stakeholders to participate in a project and share the appropriate data.

Resource interventions: as expected, funding is another key factor of success.

Competition interventions. Technological and innovative factors are key for data sharing. Automated technology can be part of transportation vehicle identification without certain limited procedures. As mentioned above data scrubbing can also be a measure of competition intervention.

Institutional interventions. Ensuring the proper stakeholder engagement in regard to data sharing is also important in freight and logistics data sharing.

Coordination interventions. Related interventions include stakeholder engagement as well as raising awareness regarding the benefits of data sharing.

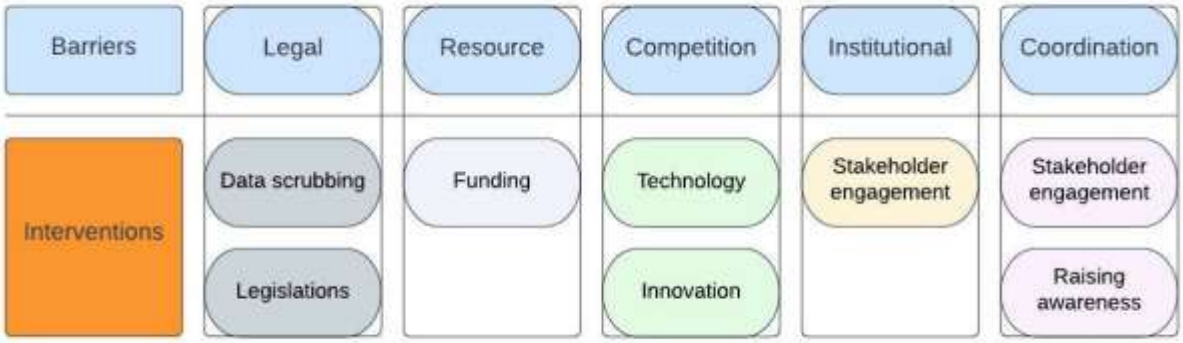

Figure 2. Main areas of intervention to address the challenges associated to *Freight and Logistics Data Sharing.*

2.7 Methodology

This report provides background information on freight and logistics and focuses on the reasons that make data sharing in logistics and freight important. It also highlights all the relevant challenges and barriers as well as the potential interventions to overcome said issues and reach the desired success and positive impact.

In order to gain a better understanding on the ecosystem of data sharing in freight and logistics, in-depth expert interviews will take place with the coordinators or main participants of the projects such as Technical Managers or Pilot/Living Lab Leaders of the identified related projects. In particular, seven actors were interviewed in order to create a sufficient and holistic overview for this report.

Based on our knowledge in regard to the field of logistics and the as obtained from professional experience as well as relevant research, the interviews with the respondents were conducted.

In the framework for a roadmap "Towards Zero Emissions Logistics 2050" [24] published by ALICE in 2019 the challenge of zero emission logistics is stated and a clear pathway to address it is established. Freight demand growth is one of the five key solution areas identified. It involves supply chain restructuring, localization and nearshoring, decentralization of production and stockholding, 3D printing, dematerialization and consumer behavior.

The present report will focus on identifying the current situation of data sharing in the freight sector, the challenges as well as the positive impact that digitalizing can have. In addition, relevant EU projects and initiatives will be listed. The results from the interviews conducted will be analyzed.

[24] https://www.etp-logistics.eu/wp-content/uploads/2019/12/Alice-Zero-Emissions-Logistics-2050-Roadmap-WEB.pdf

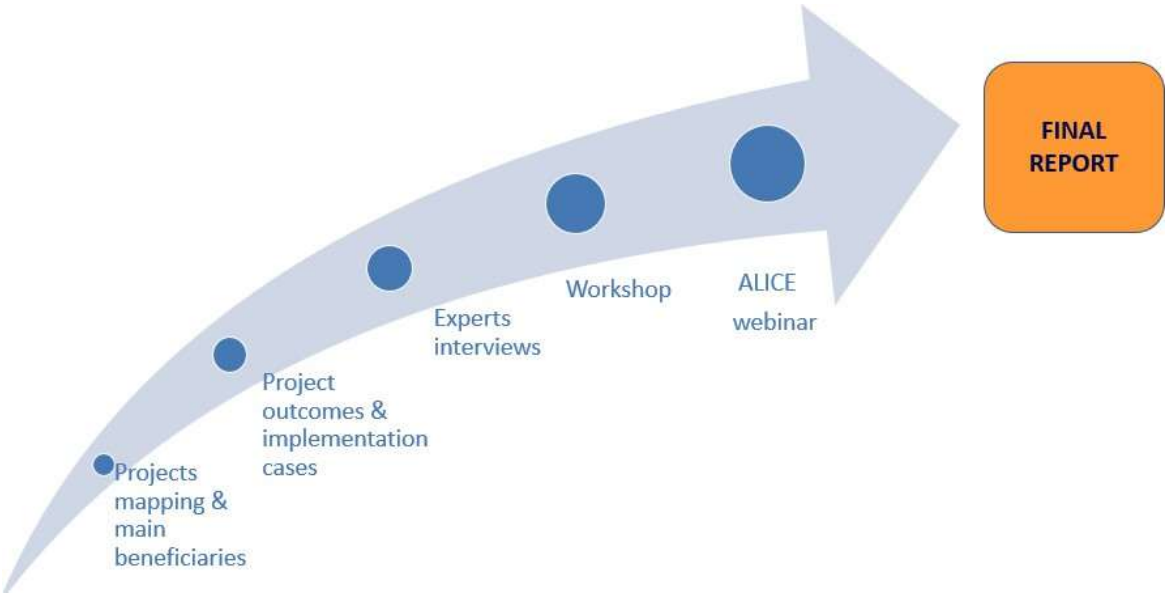

Figure 3. Methodology for the development of a BOOSTLOG cloud report

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3 Market analysis of current practices

3.1 Data sharing implementations & Relative EU initiatives and legislation

3.1.1 Electronic freight transport information (eFTI)

The main finding in regard to the digitalization of transport documents are:

1. The fact that multiple legal requirements result to multiple and non-interoperable systems for electronic documents and information exchange.
2. As a result, the issue of low level of acceptance of electronic documents arises.
3. Consequently, the vast majority of freight transport operations within EU involve the use of paper documents. In fact, data from 2021 shows that less than 1% of freight transport operations within EU are paperless.
4. The subsequent market impact is high cost and increased inefficiencies for the stakeholders, barriers to single market as well as to multimodality**.**

The eFTI regulation elements are:

- B2A information already required by EU and MS legislations.
- Obligation for all EU MS authorities to accept the electronic information.
- Common requirements such as: data processing and interfaces, certification required for harmonization purposes, acceptance, and security.
- Technological neutrality.
- Ensure that certified systems will be eFTI platforms. Such systems include eCRM solution, PCS, TMS or ERP. [25]

3.1.2 DTLF Paperless Transport

DTLF[26] is divided into two different subgroups: 1. Paperless transport and 2. Corridor freight information system. The mandate regarding subgroup 1 is as follows:

1. DTLF I recommends EU action on paperless transport
2. EU Commission's DG MOVE proposes eFTI regulation
3. DTLF II subgroup 1 advises and assists in the establishment and implementation of eFTI sub legislation
4. eFTI is established and divided into implementation acts
5. eFTI is implemented

3.1.3 TACHOnet platform

The Telematics Network for the Exchange of Information Concerning the Issuing of Tachograph Cards (TACHOnet) messaging system is a platform for information exchange in regard to drivers' cards, in order to ensure that drivers do not hold more than one card. The connection to TACHOnet messaging system is carried out either directly through a TransEuropean Services for Telematics between Administrations (TESTA) connection or indirectly through a Member State already connected to TESTA. [27]

[25] https://unece.org/sites/default/files/2021-10/T%2BL10%20-%20EU%20Project%20eFTI%20-%20update.pdf
[26] https://unece.org/sites/default/files/2021-10/T%2BL10%20-%20EU%20Project%20eFTI%20-%20update.pdf
[27] https://transport.ec.europa.eu/transport-modes/road/tachograph/tachonet_en

3.1.4 RESPER network

The European Union driving license network (RESPER) is a network that was established for implementation of Directive 2006/126/EC of the European Parliament and of the Council, that defines the exchange of driving license information in the European Union. Taking part on this system would enable easy and efficient information exchange among member countries in order to ensure that individuals are issued one driving license. Greece, Ireland, Luxembourg, Latvia, Malta, the Netherlands, Poland, Romania and Sweden have already joined RESPER, yet the majority of EU countries still have not.[28]

3.1.5 ERRU system

The European Register of Road Transport Undertaking (ERRU) was set up by the European Commission in order to monitor the compliance of road transport with the rules in force. This system enables information exchange between Member States. In particular, it is utilized when exchanging information about transport management and road transport activities, the most serious infringements which may lead to the loss of good repute as well as other infringements committed by hauliers in any Member State.[29]

3.1.6 RIS transport logistics services

River Information Services (RIS) transport logistics services are designed to optimize traffic and transport processes in inland navigation. For example, they can be utilized in order to enhance data exchange between water and shore in real-time exchange. RIS services offer a variety of benefits regarding intermodal transport-logistics chains. Data sharing with RIS services includes traffic information, traffic management, information for transport and logistics, fairway information, waterway changes, harbor dues, etc.

3.1.7 IMI system

The Internal Market Information (IMI) System is a tool for information exchange on the posting of drivers. It is considered a secure, multilingual online tool that facilitates the exchange of information between public authorities. It is utilized by the Members states to facilitate cooperation in regard to the posting of drivers in the road transport sector. [30]

[28] https://www.regitra.lt/en/news/regitra_to_join_the_european_union_driving_licence_network
[29] https://joinup.ec.europa.eu/collection/eu-semantic-interoperability-catalogue/solution/erru-european-register-road-transport-undertaking/about
[30] https://transport.ec.europa.eu/news/european-commission-kicks-trainings-national-authorities-how-use-internal-market-information-system-2021-12-07_en

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4 Project Results and Outcomes

The identified relevant projects were broadly divided into 4 main categories as are analyzed below. In terms of data sharing, the projects are listed in the ICT and smart tools for logistics and management in freight. Regarding port efficiency, the projects can be found under Enhanced port engineering by smart approaches implementation. In addition, two projects: SMARTFREIGHT and GALENA have been identified to work towards offering support to urban areas.

Figure 2. Freight and logistics data sharing projects (FP5, FP6, Fp7 and HORIZON2020)

4.1 Projects for ICT and smart tools for logistics and management in freight

SMART through information sharing and collaboration among relevant supply chain stakeholders aims at providing consumers-based services. Based on smart product identification and tagging technology, a distributed-software-architecture was be used to enable real-time data sharing, to offer decision support and collaboration. These tools were then used for in-store support. The objective of this project was the establishment of automated warehouse and supply chain processes in a networked business environment that via a unique product identification leading in the integration with consumer services.

LogiCon addresses several areas such as: logistic connectivity via the utilization of smart solutions and platforms with the involvement of a various SMEs, engaging freight-related communities to encourage smart-approaches adoption for green and sustainable transformation and promoting cooperation in a global freight management ecosystem for flow synchronization and optimization. The aim of this project was to establish the implementation of ICT solutions for logistics to align with the communication needs that arise. In combination with ICT solutions a new business models for cooperation purposes in regard to co-modal supply chains. By utilizing these solutions, the relevant stakeholders are enabled to participation in international trade and commerce flows. These solutions mostly surround data connectivity and aim at cost reduction.

OTN created virtual service hubs for harmonization purposes in order to enable easier visualization of freight-related data. These consequently enabled innovation applications. This project was set to

address the following challenges: 1. Enhanced data aggregation and harmonization for transparent and efficient utilization, 2. Increased value extraction and data accuracy and 3. Stimulation of new services and opportunities. The establishment of an automated flexible dataset was another purpose of this project. It combined different type of data and utilized various smart tools such as spatial (GI), dynamic data streams and non-spatial (OD) data and visualisation tools and pattern detection algorithms in order to address its aims. The solution provided by OTN is an open service that enables data access to open data sets as well as to an innovation environment.

TIMON focuses on increased freight safety and sustainability by incorporating cooperative commination and data processing tools and applications that would enable information transfer and provide several services to rivers, businesses and several relevant stakeholders in freight. The aims of the project were: 1. to deliver to the stakeholders' needs regarding transport services, 2. To identify open data sets that can be used for data harmonization in order to provide real-time information, 3. enable cooperative sensing in ITS, 4. Make use of the information collected from smart tools and AI systems, 5. Develop communication networks between vehicles and VRU, 6. Utilize information collected from drivers' phones (i.e. traffic data), 7. Implement ITS services and 8. Design a testbed site and a urban area validation environment. In conclusion, this project utilizing cooperative networks and open data sets will enable access to real-time services for optimized multimodal mobility.

SELIS objectives were to provide a "platform for pan-European logistics applications". The adoption of a wide range of logistics approaches, the establishment of innovative agenda, the creation of a consortium of logistics stakeholders and ICT providers, the formation of an innovative research environment for data sharing and knowledge identification are some of the activities that were implemented in the framework of this project that aimed at establishing a network of dedicated intelligent public information areas of logistics communities, the SELIS Community Hubs (SCN). These hubs were created in order to establish next gen, collaborative and green transport chains. The overall concept was to provides a "lightweight ICT structure" that would enable logistics data sharing at a strategic as well as operational level.

AEOLIX provided a cloud-based collaborative logistics ecosystem for building and managing (logistics-related) information pipelines to address the fragmentation and lack of connectedness of ICT-based information systems for logistics decision making. The adoption of pan-European logistics solutions that are needed to boost efficiency and productivity while reducing environmental impact requires supply chain visibility, which is facilitated by easy access to, interchange, and use of relevant and abundant logistics-related information. The optimal utilization of logistics-related data is significantly hampered by legacy barriers. This digital business environment developed by AEOLIX increased supply chain visibility, allowing for more sustainable and efficient commodities transportation across Europe. The ecosystem supported the integration of supply-chain-related transportation business activities through logistics software solutions for cloud-based connectivity and interaction, allowing for more efficient logistics supply chain collaboration than is currently possible. AEOLIX provided low-cost connectivity of local ICT platforms and secure data sharing all aligned with sustainable factors for the environment.

LOGISTAR is a freight transport platform that uses artificial intelligence (AI) to improve the prediction and optimization of freight transport systems. For this purpose, a real-time decision-making tool and a real-time visualization tool for the transportation of goods were developed, with the aim of providing information and services to the various agents involved in the logistics supply chain. The aim was to enable better coordination between freight transport operators, their clients, and other stakeholders, such as warehouse or infrastructure managers. Logistar also offers automated negotiation techniques and constraint satisfaction problem solving techniques. This will make it an outperformer of market products and services such as freight exchange systems, collaborative platforms, transport control towers, and routing systems. To make logistics more efficient and effective, transport volumes,

modes, and capacities need to be integrated, and cooperation between all actors along the logistics chain needs to be encouraged.In order to support this, LOGISTAR is focused on better using capacity and data sharing to optimize transport operations.

FIspace aimed to a multi-domain Business Collaboration Space that employs FI technologies to enable seamless collaboration in open, cross-organizational business networks. Eight working Experimentation Sites were established in Europe where Pilot Applications are tested in Early Trials for Agri-Food, Transport & Logistics and preparations will be made for industrial uptake by engaging with players and associations from relevant industry sectors and the IT industry. The insights gained underscore the need for innovative ICT solutions that can improve collaboration within business networks. FIspace will create a standard for cross-organizational business collaboration that will address the needs that are arising in the industry such as the need for improved ICT solutions that will allow for more efficient and effective business networks.

4.2 Projects for Enhanced port engineering by smart approaches implementation

RISING examined how information about inland waterways transport can be used to create solutions and services that support complete transport chains. River Information Services (RIS) are present in European waterways in a variety of levels of sophistication. The software developed in the framework of the project was added to existing RIS systems, allowing thus transport operators to better plan their routes and track their progress. Additionally, existing transport management systems were enabled to incorporate information on route planning, execution and monitoring. A key outcome of RISING is the establishment of a coherent set of events, messages and services to provide RIS information to logistics chain operators using inland waterway transport. RISING improved existing systems through adoption rather than inventing everything from scratch.

TIGER Project developed under the 7FP addressed 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, are adopted. 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 equipment, 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.

Whilst TIGER is developed up to the pilot test phase, **TIGER DEMO** was based on the pilots and turned 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, and allowed the full commercial exploitation of the new Ports/Dry Ports/Inland distribution production process.

COMCIS focused on improving the integration of customs processes, improving interfaces between sea and land, as well as parts of the logistics chain. This project created an interoperability between

e-freight systems developed in previous EU projects as well as in commercial undertakings. This allowed for more efficient and reliable shipping between different countries and businesses. For the purposes of this project, data were collected container security agencies, port communities, logistics network, terminal operators, etc., in order to help make decisions about logistics in the chain.

INTRANSYS provides freight and transport information to SMEs as well as cost-effective services. Transport Management Systems (TMS) provide partial solutions. To get the most out of TMS, long and expensive integration processes are required and none of the existing solutions can provide real-time data to help make optimized decisions. This project aimed at developing a new, highly competitive, and integrated platform that provides real-time integration allowing transport companies to optimize their operations in real time, 24/7. INTRANSYS provides the system as a complete package, making it easy to customize and set up, reducing thus the time and cost required to get started.

SAIL developed an integrated ICT tool that can support the flow of goods and logistics supply through a port/ dry port. This tool will be used by businesses operating in these areas. Ports are increasingly crowded, and many goods have to be stored on shore or in nearby warehouses. Many cities are running out of space to put ports, so they're building them outside of the traditional port boundaries and connecting them by rail or road. At this new terminal, operators can leave and collect their goods as if they were in the port. They can also leave and collect their goods at any other terminal in the port. By moving the time-consuming processing of containers inland, the flow of cargo among ships and land transportation networks is sped up. The dry port is a facility that can handle a lot of the logistics related to shipping goods by sea, including customs clearance, storage, and maintenance of containers. The SAIL project developed a Decision Support System (DSS) and a Discrete Event Simulation (DES) to help manage port intermodal facilities in a European context, optimizing intermodal management between the terminals in order to achieve optimal transportation and improve environmental impact.

GIFTS provided applications for operating rooms (e.g., tracking and monitoring the door-to-door journey, travel management assistance, fleet management), as well as all e-commerce functions and door-to-door cargo insurance, transport chain (including the coordination of orders, electronic document management, electronic payment). The main goal of GIFTS was to develop an integrated operational platform for managing door-to-door freight transport in an intermodal environment throughout Europe. The GIFTS aim is 1. to create a system that will help freight transport operations run more efficiently and be accessible to smaller companies, 2. to set up and operate the GIFTS platform and the Freight Data Network available to all participants in the supply chain and to all users in a door-to-door mode via an Internet connection using a terrestrial/satellite mobile connection between the Service Center and the user and 3.to develop a fully functional management system for registration, authentication, audit trails, security, billing, etc.

FINest developed an Internet-enabled ICT platform that supports the optimization of international transport and logistics business networks within the network. There is a great need for new ICT solutions for optimizing collaboration and information exchange in collaborative business networks. Future Internet technologies can facilitate fundamental improvements in business efficiency in the industry and have a positive impact on society and the environment. The FInest project established solutions and provided detailed specifications for technical implementation, by identifying a representative set of real-life use cases with detailed plans to conduct large-scale experiments, and developing a suitable digital environment for traffic, transport, and logistics research.

Instant Mobility created the concept of a virtual "transportation and mobile internet", an information and service platform capable of supporting a new type of connected applications centered on stakeholder groups such as intermodal passengers, drivers and passengers, passenger operators, lorry operators, road operators and traffic managers. The project defined the requirements for future

digital and smart technology tools and enablers so that all services can be used by any Internet-connected user, whether using a portable, vehicle-mounted or fixed terminal. Instant Mobility also examined the non-technical framework conditions that may support or hinder the eventual deployment of FI-enabled online services in the T&M field.

iCargo aimed to promote and extend the use of ICT to support new logistics services such as: combining freight, vehicles, infrastructure systems, and services, resources, and information. To achieve this, iCargo allowed real-world objects, new planning services including CO2 computing capabilities, and existing systems to co-exist and collaborate efficiently and affordably for logistics stakeholders. It also designed and implemented a decentralized ICT infrastructure. The iCargo infrastructure included smart charging elements to facilitate automated reactive decision-making and integrate information from ongoing execution (all modes of transportation) into planning processes to optimize environmental performance, including real-time information on traffic and transport infrastructure conditions.

TelliSys via an interdisciplinary European consortium of experts in freight forwarding, manufacturing, and science delivered concepts, prototypes, and proof of concepts via extensive test runs. A complementary set of evaluation methods, profitability calculations, and risk mitigation actions ensured the project's success. The scientific goal was to develop an intelligent transport system applicable to road, rail, coastal and inland navigation, which consists of a modular set of volume-optimized and traceable MegaSwapBoxes (MSBs), adapted trailer and tractor for road transport. An important means of reducing transport emissions is by increasing the share of essentially more resource-friendly transport modes. The ideas and contributions of this project resulted in a holistic approach towards achieving this goal.

PortForward has a holistic approach that will lead to a smarter, greener and more sustainable port ecosystem. Among other things, this includes the introduction of an Internet of Things concept for port assets (i.e., infrastructure, vehicles, cargo, staff). In order to establish the sustainable port ecosystem, PortForward will implement IoT concept for port procedures as well as socio-economic analysis of the interface of the port with the adjacent territory and the port city, and the overall logistics chain.

ADVANCE developed an innovative decision support platform that can help organizations manage their logistics operations more effectively. The software provides a two-fold view of transportation needs and decision-making based on the latest information and the best smart technology tools. Intelligent information management enables strategic planning and instant decision making to visualize large amount of data.

TransformingTransport (TT) demonstrated how Big Data can be used to improve mobility and logistics services by improving operational efficiency, delivering better customer experience, and fostering new business models. Big data have a significant impact on the economy and society in the mobility and logistics sector. Big data is expected to bring value of US $ 500 billion worldwide in the form of time and fuel savings and 380 megatons of CO2 savings in mobility and logistics. Freight transport activity is projected to increase by 40% in 2030, transforming current mobility. Significant streamlining of the logistics process will have a significant impact.

ICONET created a new networked architecture for interconnected logistics hubs that will allow for more efficient and customer-friendly shipping by using information-centric networking principles. According to this goal, cargo that is considered a smart physical packet is based on the cargo's "content" that impacts key commercial obligations such as cost, optimization, routing, efficiency, and promotion of the EU's green agenda. As a result, the consortium specifically consists of (a) warehousing as a service, (b) fulfilling e-commerce as a service, and (c) synchro modality as a service.

The project explored the use of PI-based logistic configurations in simulation, prototyping, and validation. With analysis and simulation, optimal topologies and distribution policies for PI were determined. The implementation of the project was based on a sequence of stages of modeling and design/prototyping, learning and experimentation, feedback, and interaction with the wider business community, including the ALICE logistics platform, as well as with members of other partner associations.

Transmetrics developed a new product designed for midsize businesses that help predict asset management and forecasting optimization. The platform makes it easy to scale and speed up the sales process. Transmetrics is a next-generation product that brings significant efficiency improvements to mid-sized logistics companies, which make up a significant portion of the transport industry. In the shipping industry, the storage and movement of empty containers is a costly and energy-intensive process, which also contributes to CO2 emissions. The need to track daily cargo demand and forecast potential variations due to holidays, extreme weather conditions, market fluctuations, and other factors is critical. An AI-based tool will help operators reduce carbon emissions and costs by improving efficiency.

SYNCHRO-NET is a powerful and innovative modal supply chain eco-NET that promotes the adoption of slow steam concepts and synchro modality to relieve supply chain stress and reduce emissions and costs cost-effectively. It provides a highly robust solution to improve the reliability and service level of logistics users for logistics operations. At the core of the SYNCHRO-NET solution is an integrated optimization and simulation approach that incorporates: real-time synchro modal logistics optimization (e-Freight compatible), simulation and control system for decelerated vessels, synchronized modal risk/benefit analysis statistical modeling and a dynamic stakeholder impact assessment solution.

EURIDICE is an information services platform that improves the logistics, business processes, and public policy aspects of freight transportation by combining services at different levels. The EURIDICE platform allows users to combine services from different entities, as well as to explore a variety of contexts in order to find the best possible service for any given task. This is done by using advanced technologies, such as service-oriented architectures and mobile technologies. Additionally, the platform utilizes semantic web and domain ontologies to automatically identify services and dependencies. The cargo is located in a highly secure location, with a number of intelligent agents deployed to optimize its distribution and ensure its safety. If there are any abnormalities or threats detected, the agents alert the appropriate personnel for decision making. The EURIDICE platform provides a variety of private and public sector organizations with real-time "bottom-up" monitoring of goods, logistics services providers with synchronization of schedules across multi-modal routes, public authorities for automated security and public safety control, infrastructures for emergency management, and congestion prevention.

SUPPORT worked with representatives from various stakeholders in order to develop next-generation security solutions for ports throughout Europe. Thus, benefiting both the ports themselves and the wider community, by preventing illegal immigration and trafficking of drugs, weapons, and illicit substances. SUPPORT delivered public formal specifications and open standards-based tools that can be utilized to upgrade security at EU ports. The importance of port security is clear, as any disruptions could lead to serious life-threatening consequences, as well as huge economic losses. The challenges of port security are due to the complex nature of maritime traffic and the lack of efficient connections between ports and other government agencies, such as the police and transportation logistics operators.

SMART_CM focuses on advanced technology research and implementation that would work towards overhauling the entire container transport system. They have developed new concepts for processes

and technologies that can be implemented in a set of world-scale demonstrators covering different supply chain corridors. SMART_CM aims to foster co-operation between businesses in the transport of containers, in order to improve security. It developed custom security solutions for business to business (B2B) and business to consumer (B2C) containers. The solutions are compliant with international Customs operations. The project developed a neutral service platform for secure and interoperable data communications. Allowing thus, different actors in the container industry to communicate with each other more easily and efficiently. In the framework of the project, advanced applications that can help operators manage their containers more dynamically and effectively were also established.

B2B-ECOM developed content for intelligent catalogues that help electrical equipment component manufacturers, and their supply chain partners connect with their customers, including major players who serve smaller businesses.B2B-ECOM established a framework that helps organizations interoperate and reuse applications and services. B2B-ECOM is aligned with EU standards.B2B-ECOM helps businesses to connect with each other more closely, so that they can work together to improve the customer experience, feedback and services. It offers catalogues and online services designed specifically for small businesses, which revolutionize engineering.

INTEGRITY validated targeted and verifiable benefits through real operational business and customs operations in door-to-door supply chains in the main trade corridor of China to the EU through the ports of Yantian, Rotterdam and Felixstowe, using all modes of transport within the EU to various countries. A safe and efficient intermodal transport system is a common goal of all relevant stakeholders in the supply chain. INTEGRITY balances these challenges, connecting all elements of the supply chain through accurate, reliable, timely, value-added tracking and status data, enhancing trade facilitation through the use of high-quality, neutral, sophisticated equipment, including seaport scanning equipment, for all legitimate interest groups, large or small. In the framework of this project, procedures and technologies that will allow for supply chain visibility, security, and predictability were developed.

E-FREIGHT addressed 1. the difficulties that arise in trade between countries in Europe due to the logistics chains being disconnected. It also accelerates the development of EU and National Single Windows, to streamline transportation and freight reporting to authorities, in the context of joint modal transportation. In addition, safety and security issues improve the development of preventative and corrective measures and security capabilities of freight transport networks, especially to establish efficient cooperation between authorities and transport personnel to protect the environment, 2. the optimization of road, rail, and water transportation resources for coordination which require improved ways for transport stakeholders to establish cooperation and integrate processes. E-Freight introduced the Information Highway for Co-modality to establish a common end-to-end transportation process that incorporates regulatory compliance and "intelligent" monitoring and control and 3. nn centralized networks, which are prevalent in transportation services, coordination is achieved through the formal structure of the network and central communications. The move to a much more open environment to achieve co-modality goals relies on transport service providers to publish their services on the Internet in an easy-to-use way with independent web-based transport management systems.

4.3 Projects for Enhanced urban support

SMARTFREIGHT focused on making urban freight transport more efficient, environmentally friendly, and safe through smarter use of the distribution networks and improved delivery and return-load systems. The aim was to integrate urban traffic management systems with freight management and onboard systems in order to improve efficiency and safety. ICT enables collaboration between traffic and freight management operations, as a step towards an integrated urban transportation system,

and freight transportation will be monitored and controlled through open ICT services. Traffic management measures for individual vehicles were designed by means of on-board units and wireless infrastructure based on CALM (ISO Framework for Heterogeneous Communications in Mobile Environments). Different routing and control options will be possible depending on the specific vehicle, cargo, and traffic situation.

GALENA focused on the development of a robust and GPS-based liability binding application to make sure different transport operators can join a mutual transportation community to track and timestamp their trips, and to make sure deliveries happen safely and efficiently. An innovative hybrid system was developed to ensure a seamless, robust, and continuous handover of indoor/outdoor localization and PVT data between carriers and high value parcels. Urban freight transport is an important part of distributing goods throughout cities, and it can be difficult to manage and monitor flows. In the framework of this project, a hardware and software were developed to help organize freight and improve delivery to the last mile. Thus, providing a better understanding of how these technologies can be used together to improve transportation efficiency.

5 Implementation cases

For BOOSTLOG, the ***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. Therefore, 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.

The Implementation cases and European R&I projects selected in the data sharing domain will focus on their positive impacts and improvement in local policy development.

Data sharing in logistics has been addressed in many EU R&I projects, in which a range of impactful solutions have been pioneered, stemming into changes in paradigms and business models.

As pointed out by the seven (7) experts interviewed, data sharing in logistics is very complex, and effects of full implementation of policies and measures involves significant time and effort with evident but not easily quantified benefits. Nevertheless, there have been cases that R&I project results have managed to reach maturity and transform to financially sustainable commercial products.

BOOSTLOG has identified **four (4) implementation cases** that impacted freight and logistics data sharing. Two of them resulted through follow-up funded projects that managed both to raise the TRL of the results and broaden their functionalities.

Project Focus	Implementation case
ICT and smart tools for logistics and management in freight	Logit One Platform (L1) for collaborative transport coordination, intermediation & visibility
Enhanced port engineering by smart approaches implementation	Fast Customs Corridor for the Port of Genoa
ICT and smart tools for logistics and management in freight	AELOX spin-offs (e.g. Rail-Flow[31]), and ISO standard (ISO-23795-1)[32]
ICT and smart tools for logistics and management in freight	Descartes Customs Status module

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

[31] https://www.rail-flow.com/en/

[32] https://www.iso.org/standard/76971.html

- Provides a walled-in environment for a group of authorized shippers, LSPs, carriers
- Establishes full data integration between these parties

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. 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.

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.

The third implementation case resulted by project AEOLIX out of which 3 spin-offs and 1 ISO standard and 1 patent, 2 trademarks were generated. One of the spin-off is Rail-Flow that provides digital solutions to rail freight transport. The ISO standard, ISO 23795-1:2022, Intelligent transport systems — *Extracting trip data using nomadic and mobile devices for estimating C02 emissions — Part 1: Fuel consumption determination for fleet management*, specifying a method for the determination of fuel consumption and resulting CO2 emissions to enable fleet managers to reduce fuel costs and greenhouse gas (GHG) emissions in a sustainable manner by extracting trip data and speed profiles from the global navigation satellite system (GNSS) receiver of onboard unit of a vehicle.

Finally, the SMART-CM project created a tool for monitoring the international movement of containers and their customs status that was taken up by Descartes. The tool was further improved by the company and integrated in their service offering.

6 Potential Implementation paths

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.

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Annex I – Implementation cases

Name of organization: Logit One

Contact person (for further interview if applicable): Frank Knoors

Main R&I projects which have developed results/outcomes based on which you developed this implementation case (please fill in the following table and copy the table if more projects were concerned)

Project name	COMCIS
Funding body	European Union's Seventh Framework Programme (FP7)
Duration	24 months
Total Budget & funding received	4,338,339.59€ (2,899,585.00€ EU Funding)
Project objectives	Collaborative Information Services for Container Management
Other info/reference if applicable	http://www.comcis.eu/

Main Implementation Case/product or Solution

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.

Overview and key pain point addressed/Market addressed/Users/How the implementation case impacts on EU policies objectives

- Pain point: Visibility of the Supply Chain
- Market: Logistics
- User: Transport Operators, Logistics Service Providers, Shippers
- Impact: Full door-to-door transparency for DHL, partners, suppliers and customers, with the ability to act in time in case of deviations from plan

How Public funded supported the Implementation Case development and in which stages?

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.

How you Covered the Gap between the project Results & reaching the market?

(please provide a short description) With the commitment of participating researchers that had entrepreneur skills and provided private investment to sustain the product until reaching market maturity.

Which have been the main hurdles to overcome:

- Financing for further development
- The correct timing for the Value proposition towards customers

Which have been the key success factors to move from R&I results to an actual implementation?

(please provide a short description) Commitment of the researchers, the exploitation of the network built during the project and the willingness to fund the products until reaching market maturity

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Name of organization: CIRCLE

Contact person (for further interview if applicable: Alexio Picco

Main R&I projects which have developed results/outcomes based on which you developed this implementation case (please fill in the following table and copy the table if more projects were concerned)

Project name	TIGER
Funding body	European Union's Seventh Framework Programme (FP7)
Duration	24 months
Total Budget & funding received	5,924,115.11€ (3,599,946.24€ EU Funding)
Project objectives	TIGER Project addressed the issues of promoting sustainable logistics introducing innovative railway services connecting the sea ports of the European Union with the Hinterland. This was done with a focus to the flows generated to/from the Far East and South East Asia, involving all European major Ports, suffering from traffic congestion
Other info/reference if applicable	https://cordis.europa.eu/project/id/265478

Main Implementation Case/product or Solution

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.

Overview and key pain point addressed/Market addressed/Users/How the implementation case impacts on EU policies objectives

- Pain point: Congestion at maritime ports due to bottlenecks in Customs Clearance processes
- Market: International Supply Chains
- User: Customs Brokers, Logistics Service Providers, Shippers
- Impact: Faster transit times at a considerably reduced costs

How Public funded supported the Implementation Case development and in which stages?

(please provide a short description) 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.

How you Covered the Gap between the project Results & reaching the market?

The main gap to overcome was the adaptation of the regulatory framework to permit the transfer of goods towards inland dry-ports with fast customs procedures.

Which have been the main hurdles to overcome:

- Business models

- Regulatory adaptation to permit the full deployment of the demo

Which have been the key success factors to move from R&I results to an actual implementation?

Evident benefits from the demonstration phase, both market maturity and demand to adopt the results of the project.

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Name of organization: ERTICO-ITS Europe

Contact person (for further interview if applicable): Eusebiu Catana

Main R&I projects which have developed results/outcomes based on which you developed this implementation case (please fill in the following table and copy the table if more projects were concerned)

Project name	AEOLIX-Architecture for EurOpean Logistics Information eXchange
Funding body	H2020-EU.3.4. - SOCIETAL CHALLENGES - Smart, Green And Integrated Transport -Grant agreement ID: 690797
Duration	36 months
Total Budget & funding received	€ 16 220 106,25/€ 16 220 106,25
Project objectives	AEOLIX developed a cloud-based collaborative logistics ecosystem for configuring and managing (logistics-related) information pipelines. This digital business ecosystem will create visibility across the supply chain, enabling more sustainable and efficient transport of goods cross Europe.
Other info/reference if applicable	https://cordis.europa.eu/project/id/690797

Main Implementation Case/product or Solution

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 are reflected in all its components: (1) a collaborative, secure and resilient IT architecture, which facilitates secure and trustworthy data management, privacy, identification, authentication and authorisation; (2) appropriate business models and public-private governance based on the specific requirements of AEOLIX for pan-European applications; (3) well-designed LLs for testing, validation, implementation and exploitation of AEOLIX.

Overview and key pain point addressed/Market addressed/Users/How the implementation case impacts on EU policies objectives

- Pain point: market fragmentation- due to differences in user requirements, data models, system specification and business models. This legacy situation severely hampers the optimal use of logistics-related information.
- Market: International supply chain.
- User: Production, Suppliers, Warehouse, Intermediaries (forwarders), Terminal operators, Carriers, Public Authorities; Port Authorities.
- Impact: address end to end supply chain visibility

How Public funded supported the Implementation Case development and in which stages?

Public funding supported the development and the implementation.

How you Covered the Gap between the project Results & reaching the market?

The main gap 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.

Which have been the main hurdles to overcome:

- Value proposition towards customers
- Business models

Which have been the key success factors to move from R&I results to an actual implementation?

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.

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Name of organization: FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV

Contact person (for further interview if applicable): Volker Kraft

Main R&I projects which have developed results/outcomes based on which you developed this implementation case (please fill in the following table and copy the table if more projects were concerned)

Project name	SMARTCM
Funding body	European Union's Seventh Framework Programme (FP7)
Duration	36 months
Total Budget & funding received	10,504,642.60€ (6,499,942€ EU Funding)
Project objectives	• Stimulate interoperable B2B co-operation in door-to-door container transport security. • Develop compliant application of B2B and B2A container security data solutions with international Customs operations. • Develop a neutral approach and service platform for secure and interoperable data communications. • Define added value services and chain visibility enabling techniques for fulfilling operational requirements of the actors • Develop prototypes of advanced applications in global container management, such dynamic scheduling at the containers • Assess large applicability of the above-mentioned project solutions by considering costs and benefits • Analyze existing business models in global container chain management and operation and study e-managing business models • Contribute to standards development for advancing of interoperability of technologies
Other info/reference if applicable	https://cordis.europa.eu/project/id/218547

Main Implementation Case/product or Solution

Monitoring of customs related international movement of containers via the use of electronic seals. The project result was taken up by Descartes (project partner) and integrated to their internal monitoring platform.

Overview and key pain point addressed/Market addressed/Users/How the implementation case impacts on EU policies objectives

- Pain point: Visibility of the supply chain
- Market: International supply chains
- User: Descartes

- Impact: Simplification of legal and operational procedures

How Public funded supported the Implementation Case development and in which stages?

Public funded supported the design and validation of the use case and revealed the feasibility of implementation and integration with the existing infrastructure

How you Covered the Gap between the project Results & reaching the market?

(please provide a short description) Private investment by the end user to make the necessary adaptation and integrate the project result to an existing platform

Which have been the main hurdles to overcome:

- Financing for further development

Which have been the key success factors to move from R&I results to an actual implementation?

The participation of an end user to the consortium that wanted to exploit the project results

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Annex II – Semi-structured interview guide

1. Project introduction

For more than two decades EU has invested in research and innovation (R&I) through various Framework Programmes from the 5th Framework Programme up to H2020, e.g. FP5 (1998-2002), FP6 (2002-2006), FP7 (2007-2013), and the ongoing HORIZON 2020 (2014 – 2020). This has contributed to the development of the freight and logistics data sharing sector through the creation of new companies, implementation of concepts in practice and through science based regulations. The BOOSTLOG project aims to boost impact generated from future EU funded R&I projects to contribute to EU policy objectives, address societal challenges and increase EU's competitiveness. The project will map more than 160 projects funded by FP5, FP6, FP7 and Horizon 2020, and identify successful implementation cases into the market and regulations and will develop actionable reports on various subjects prioritized by stakeholders. The project will assess the impacts generated, identify gaps and priorities for future funding programmes.

This Project is supported by the European Commission and framed as part of the activities in ALICE building on its network and past projects such as SENSE, SETRIS and WINN and is an integral part of ALICE outreach to R&I funding organizations.

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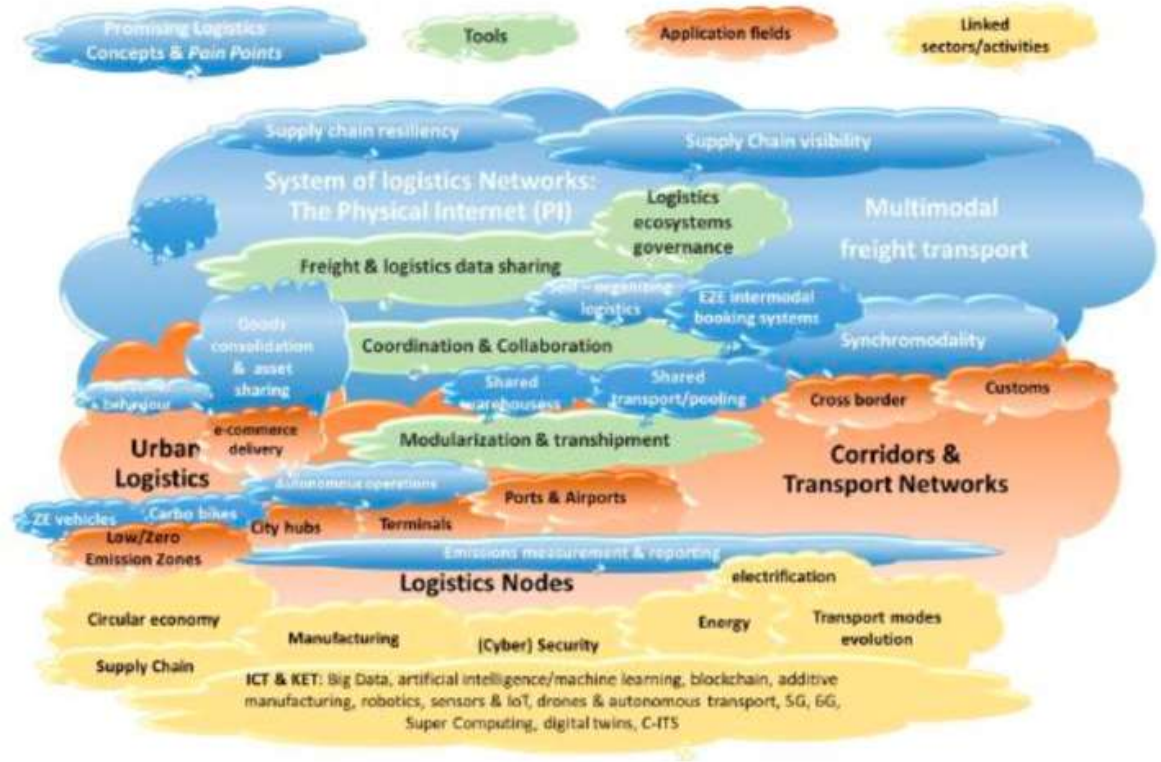
2. Freight and logistics data sharing diagram



- Is there an important cloud/subcloud missing?

3. Trends and societal drivers relevant/addressed for the cloud

LIST of trends and societal drivers:

Digitalization, profit sharing, competitive advantage, eFTI, DTLF Paperless transport, urban support, reduced emissions, urbanization, climate change

- Do you agree with this list of External Factors?
- Do you have any additional factors/drivers to suggest?
- Which are for you the 2/3 most critical/relevant?
- Which are the specific barriers to the freight and logistics data sharing sector (e.g. fragmentation of logistics market, data diversity)?

4. Relevant EU policies addressed

LIST of policies addressed by freight and logistics data sharing:

- **The European Green Deal**
- **Economy that Works for People**
- **Promoting our European way of life**
- **A Europe fit for the digital age**

- Which other policies you know are also relevant?
- Which is the EU policy this area has a greater impact in?

5. Most relevant projects in the cloud

- Are all relevant R&I project included in the diagram above?
- Do you have a suggestion of an important/relevant organization with good R&I results in this area?
- If yes? Which organizations and for which results? Who is the contact person?

6. Project participation of your organization

- Have your organization participated in other relevant projects? Which ones? Could you share some information references?
- Which are the most Relevant/Key R&I results project deliverables for each project? Could you share them with us?
- Which have been the key partners on those projects that generated results/outcomes and after project implementation?
- Overall, which is your conclusion on the projects in terms of:
    - Progress made
    - Level of adoption of results
    - Which have been for you the 2/3 key barriers for adoption?
    - Which would you think is the best (or best 2 projects) and why?

7. Project Outcomes

- Do you have any outcome out of these projects in this field?
- If a research center, is it your ambition to transfer/implement the knowledge?
    - How does your organization address that?
        - Through Market agreements on Knowledge Transfer to Companies.
        - Spin offs
        - Other
- What is the main barrier you faced when reaching the market :
    - Financing for further development.

  - Finding right (industry) partners
  - Value proposition towards customers.
  - Business models.
  - Other?
- Do you have outcomes out of R&I projects in other BOOSTLOG reports?

8. Implementation Cases

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.

Implement Cases are that research results have been further developed and have been deployed as commercial solutions, have generated a new market or have contributed to new policies and will stablish causal links between research funding and impact.

- Do you know any Implementation Cases out of these projects?
- If yes, which entity was the R&I/Outcome owner and which entity was the Innovation Seeker.
- Would you like ALICE/BOOSTLOG to promote the Implementation Case?

9. Final comments

- How could we improve the interviews?
- Would you like to join a workshop in which we will share the aggregated results and discuss conclusions with your peers?
- Any further comment.