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BOOSTLOG PROJECT

DELIVERABLE REPORT

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The BOOSTLOG project consortium consists of:

Part. No	Participant organisation name (short name)	Country
1 (Coordinator)	Alliance for Logistics Innovation through Collaboration in Europe, ALICE AISBL (ALICE)	BE
2	STICHTING SMART FREIGHT CENTRE (SFC)	NL
3	FUNDACION ZARAGOZA LOGISTICS CENTER (ZLC)	ES
4	STICHTING TKI LOGISTIEK (TKI Dinalog)	NL
5	HACON INGENIEURGESELLSCHAFT MBH (HACON)	BE
6	INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS (ICCS)	GR
7	Vlaams Instituut voor de Logistiek VZW (VIL)	BE
8	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V. (Fraunhofer)	GE
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Contents

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EXECUTIVE SUMMARY

The main objective of WP4 is to develop a holistic framework for identification, assessment and consensus building around priority R&I Gaps with high potential contribution to EU policy objectives that need to be prioritized in future R&I actions. This deliverable shows the outcome of the first iteration of this process and the identified future R&I actions.

D4.3 builds on the results of the BOOSTLOG online survey for the definition of high relevance topics for freight transport and logistics and their relevance in comparison with the External Influencing Factors (see D4.1). In combination with a gap analysis for R&I Logistics Clouds (see D4.2) and the comparison with regional and national logistics research work programmes a final set of recommendations was derived.

The following eleven recommended areas for research and innovation (R&I) are described in detail in this deliverable:

1. Connected networks in a sustainable society
2. Coping with the on-demand economy
3. Prepare for disruption – resilience and visibility to the next level
4. Modular loading units for e-commerce
5. Smart integration of information systems for trade, logistics and transport
6. Implementation of sustainability measurement schemes
7. Aligned measurement of carbon emissions of digitalized logistics
8. Automated and autonomous operation in logistics hubs
9. Cross-sectoral, sustainable multimodal implementations of Physical Internet solutions
10. Regional Logistics Decarbonization
11. Dealing with driver shortage

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1 Methodology and input collection

Work package 4 of the BOOSTLOG project deals with the development of a holistic framework for identification, assessment and consensus building around priority research and innovation (R&I) gaps. One of the main tasks is the collection of input and feedback from project partners, ALICE members and also external stakeholders.

The identification and evaluation of promising logistics concepts and external influencing factors, like societal trends and economic drivers or key enabling technologies, and the first set of recommendations were described in deliverable D4.1[1].

The mapping of existing projects for the most relevant logistics concepts is summarised as relevant R&I gaps and published in D4.2[2].

The activities of BOOSTLOG WP4 provide value against the policy objectives of the EU. The identification of R&I gaps provides insights into the required additional R&I activities where the integrated freight transport and logistics system can contribute to achieve the goals set in, amongst others: the European Green Deal (COM(2019) 640 final)[3] and Fitfor55 package[4], Europe fit for the Digital Age[5] and Economy that Works for People[6].

D4.3 summarises the outcome of the above mentioned in **eleven recommendations for the work programme 2023/24**. D4.3 gives a set of recommended topics for further R&I activities. Therefore, logistics concepts, trends, technologies, and gaps from D4.2 are summarized in a first collection of recommendations.

A second iteration of the whole process is planned to start in project month 21. All results will be updated and evaluated.

2 Collection of recommendations for future research and innovation activities

This chapter shows eleven concrete recommendations for future R&I with clear indications of the linked logistics concepts, possible external influencing factors and matching the expected impacts. The description of the topic in this deliverable 4.3 of the BOOSTLOG project is the result of the process described in the previous chapter.

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[1] https://www.etp-logistics.eu/wp-content/uploads/2021/12/BOOSTLOG_D4.1_Definition-of-high-relevance-topics-v1_final.pdf

[2] https://www.etp-logistics.eu/wp-content/uploads/2022/02/BOOSTLOG_D4.2-Gap-analysis-for-RI-Logistics-Clouds_final.pdf

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN

[4] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541

[5] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en

[6] https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people_en

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Table 1: Coverage of identified gaps from D4.2 by the recommendations

R&I question	Physical internet	Synchromodality	Interconnected logistics networks	E-commerce delivery concepts	Supply chain visibility	Supply chain resilience	Data sharing
1. How do interconnected networks need to be designed to help resolve resource scarcity?	×	×	×				
2. How can logistics concepts streamline the growing impact of e-commerce channels?	×		×	×			
3. How to achieve increased robustness of supply chains using multi-platform forecasting?					×	×	
4. Which new modular loading unit design could best support increasing e-commerce flows?	×			×			
5. What basic conditions should be met in terms of alignment of digital systems to ensure that information can be exchanged between subsystems?		×	×				×
6. How to advance the critical assessment of sustainability impact of innovations?	This topic is horizontal to the gaps identified in D4.2.						
7. How to align GHG emissions reporting of digitalized logistics chains?	×		×				×
8. How to use automation and operational autonomy within logistics hubs to improve efficiency?	This topic covers the main gap identified in D4.2, where 95% of the projects analysed did not address this concept.						
9. How to make co-modal transport systems ready for the Physical Internet?	×	×	×				
10. How to radically reduce carbon emissions of regional transport flows?	This topic is horizontal to the gaps identified in D4.2.						
11. How can the logistics sector respond to the driver shortages?	This topic is horizontal to the gaps identified in D4.2.						

2.1 Connected networks in a sustainable society

This action is intended to provide an answer on	How do interconnected networks need to be designed to help resolve resource scarcity?
Logistics concepts	Physical internet, synchromodality, connected corridors & hubs
Related trends	sustainability, circular economy, resource scarcity
Related key-enabling-technologies	AI, data science, digital twins
Gaps covered (identified in D4.2)	Physical internet, synchromodality, and interconnected logistics networks

Society is moving towards a situation in which resources need to be better utilised, amongst others for reducing waste, reducing the dependence on unevenly used assets, and moving towards a more circular society. Already today, at times supply chains are confronted with resource unavailability, increasing scarcity and rising prices as a result, in the short and medium run. This means that the capabilities to reallocate resources across the economy and between supply chains needs to be strengthened. Supply chains connectivity is a key determinant. Although supply chains are already connected, this connectivity will need to increase in the near future.

There is no clear picture yet on how these connected supply chains and networks will help in solving the resource scarcity issues and how they need to be designed accordingly. It also is necessary to think about the organisation of these networks and the coordination of information and physical flows, given this specific challenge. The actual impact of these interconnected supply chains and networks (towards the Physical Internet) should also be measurable in terms of the impact on emissions and resource utilisation on a sectoral and economy level. It also needs to become clear in which technologies the industry should invest in order to cope with this transition and how data is exchanged between multiple actors and transport modes.

There is a need to provide system-level scenarios, models and demonstrators for the further development of interconnected supply chains and networks, moving towards the Physical Internet. In this context, system-level implies the networks-of-networks of companies, at the level at which they could potentially collaborate (as opposed to supply chain level). This will help industry to get a better picture of required future investments. These scenarios should also evaluate the impact on supply chain performance indicators, but also on the collaborative network level and on wider society metrics (macro-economic, sustainability and social equity). Another important task is to provide insights into the required technological solutions and data-sharing frameworks that enable the transition and operational connection between supply chains and networks. Furthermore, scenarios should collect, integrate and analyse network-wide data from users, infrastructures and vehicles along the supply chain.

2.2 Coping with the on-demand economy

This action is intended to provide an answer on	**How can logistics concepts help to organise the growth of e-commerce channels and mitigate its potentially increasing impact on the environment?**
Logistics concepts	Physical internet, connected networks, e-commerce delivery concepts, zero-emissions vehicles
Related trends	sustainability, on-demand economy, e-commerce
Related key-enabling-technologies	IoT, AI, data science, digital twins
Gaps covered (identified in D4.2)	Physical internet, interconnected logistics networks, and e-commerce delivery concepts

The COVID-19 situation provided new incentives and contexts for customers to use online channels for their purchase. Although the growth trend was already clearly visible before the pandemic, the new situation accelerated the development of online shopping behaviour and the associated omni-channel service offering.

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The industry is developing promising logistics solutions to cope with the growing demand of e-fulfilment. In many cases however it is observed that solutions focus on a specific part of the supply chain or last mile only. In some cases, it can be questioned whether the solution in a specific part of the chain is disturbing processes elsewhere in the end-to-end supply chain. In other words, an e-fulfilment solution which shows positive impact in a part of the chain may cause an overall negative impact in a full supply chain. One example is that the increased use of rapid fulfillment (delivery within the hour) leads to fragmentation on the supply side of the local hubs within cities, which leads to overall increased stocks and additional shipments/trips.

There is a strong need to be able to evaluate the impact of new promising logistics concepts providing last-mile solutions in the scope of the full end-to-end supply chains. The growing required capacity to cope with e-fulfilment flows needs to be coordinated amongs e-fulfillment providers and their last-mile solution providers (which is in many cases an outsourced activity) in a better way to make sure that this capacity is aligned and performance in terms of utilisation is maximised. This should cover both last-mile (delivery) performances as well as the first-mile (pick up) of returned goods purchased online. It is also important to address the changing behaviour of retailers and consumers in this respect, because this will change the way supply chains will need to be organised and become transparent also in the light of more sustainable logistics solutions. The other way around might also be true; better sustainable solutions in delivery concepts will lead to other incentives for consumers and retailers and therefore change their behaviour. The sustainability of these solutions should be considered around economic, environmental but also social factors.

This action leads to a more holistic view on the implementation of last-mile solution in the context of a full supply chain operation. This will in turn lead to insights into the alignment of these solutions and the impact this has within an end-to-end supply chain setting, including return flows. These end-to-end solutions will lead to other choices in sustainable use of assets within the chain, based on the changing consumer and retailer behaviour.

2.3 Prepare for disruption – resilience and visibility to the next level

This action is intended to provide an answer on	**How to achieve increased robustness of supply chains using multi-platform forecasting?**
Logistics concepts	SC visibility, SC resilience
Related trends	Sustainability, resource scarcity and depletion, reshoring
Related key-enabling-technologies	AI, agility to plan, forecast and adapt
Gaps covered (identified in D4.2)	supply chain visibility and supply chain resilience

The worldwide and European supply chains have experienced several disruptions in recent years. The Covid-19 pandemic, natural and human caused disasters (like the Russia-Ukraine war), recent changes in trade agreements (Brexit) or the blockage of main trade routes (Suez disruption): all these have had significant negative effects on supply chain execution and have together exacerbated the spatial and dynamic imbalance in freight flows around the world. Disruptions often occur outside the scope of single partners in a supply chain, and in many cases, timely information about the effect on individual shipments is not available. Rather than by investing in robustness or flexibility, supply chains used to absorb disruptions with disconnected stock positions, which has led to bullwhip effects across the chain and across complete supply networks for different commodities. This approach has now proven to be a suboptimal solution and could be avoided in the future.

Industry stakeholders within a supply chain are in need of improved predictive information at 3 levels:

- Operational: improved continuous visibility of orders, resources and shipments en-route, to optimize ordering processes, allow communication of delays to partners and improve allocation of assets to transport processes.
- Tactical: improved ability to make planning robust and flexible and to help anticipate short-term (effects of) disruptions, based on end-to-end supply chain information. Improved predictions are also expected to lead to better collaborative decision approaches.
- Strategic level: Improved situational awareness and risk management capabilities to create more resilient supply chain design, securing service level agreements at the lowest long-term costs.

Many solutions are available already to get better visibility and to achieve better steering information within supply chains. But it also turns out that to be able to reach next level robustness in supply chains, information available at one single point in the supply chain needs to become available throughout the entire chain. Furthermore, information that is available at sources outside of the operational supply chain tends to be crucial for decision support tools. The challenge is to connect all relevant data to achieve the strategic, tactical and operational information which is needed for supply chains to become more robust and responsive. The challenge should be addressed at the technological level as well as at the organisational level. The adoption of new key enabling technologies will need to lead, for instance, to other ways of collaborative decision making. The goal should be to strengthen supply chains, their players and infrastructure reliability.

2.4 Modular loading units for e-commerce

This action is intended to provide an answer on	**Which new modular loading unit design could best support increasing e-commerce flows?**
Logistics concepts	Physical internet
Related trends	on-demand economy, e-commerce, sustainability
Related key-enabling-technologies	standardization & data modelling, IoT, digital twins
Gaps covered (identified in D4.2)	Physical internet, e-commerce delivery concepts

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E-commerce flows are growing fast and tend to become more fragmented, both at national and local distribution level. Research has shown that many independent flows of parcels are interconnected within individual parcel delivery networks, but the interoperability *between* networks is lacking at this point. At several stages in the e-fulfilment chain a number of handlings and transfers take place which lead to for instance relabelling or repacking of shipments. This is not sustainable, time-consuming and leads to errors in delivery. There is also an increasing call for traceability and optimisation of return shipments from consumers to avoid loss of value and increase the circularity of these e-commerce flows. One of the promising concepts to address these challenges is to introduce modular loading units in the industry which can be used for e-commerce shipments. In the Physical Internet modularity (based on pi-containers) allows for exchangeability between carriers and efficient encapsulation of customer level packages at different levels of loading units. The idea is that once, in parts of the e-fulfilment network, these loading units are implemented, shipments can be routed and organised between independent networks of service providers with full interoperability. Still, many pieces of the puzzle need to be solved.

Challenges to be addressed include, amongst others:

- What parts of the e-commerce supply chain could be redesigned using for strongly standardized modular loading units? Are there parts of the network that are not suitable for this transformation?
- What should be the design of these e-commerce dedicated loading units? Can they be used in other supply networks of the future as well?
- What does the introduction of these units mean in terms of standardisation of information, labels and documents?
- How does the e-commerce network become interoperable using the loading units throughout independent supply chains and what does this mean for industry stakeholders that are part of this transition?
- How to incorporate evolving behaviour of consumers and retailers in the design of logistics chains and the use of modular loading units?

2.5 Smart integration of information systems for trade, logistics and transport

This action is intended to provide an answer on	What basic conditions should be met in terms of alignment of digital systems to ensure that information can be exchanged between subsystems?
Logistics concepts	synchromodality, connected corridors & hubs
Related trends	digitalization, e-commerce
Related key-enabling-technologies	standardization & data modelling, IoT, digital twins
Gaps covered (identified in D4.2)	synchromodality, interconnected logistics networks, data sharing

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There is a strong trend to move to a fully paperless execution of supply chain operations., e.g. growing use of eCMR, eFTI regulations, data infrastructure developments, etc. Interconnected intermodal networks, the use of sustainable fleets and sharing of assets are promising concepts when it comes to reducing the external effects of transport & logistics. Despite great opportunities to connect fleet, traffic, service and trading subsystems, a recurring barrier is the integration of and use of data from different sources. In order to work towards a more interoperable use of these promising concepts it will be required to share and use information from the technological solution (ZEV, LEVV, loading unit, etc.) in combination with the flow of information concerning the shipment/cargo itself.

In practice, solutions exist everywhere that from the start have not been designed to be used in an interoperable way. This leads to legacy problems with standards, and a general difficulty at company level to invest in advancing digitised solutions. The question here is what basic conditions should be met in terms of digital information to ensure that solutions can act in an interoperable way in the near future. Many new solutions will be developed by the market, as the digitalization trends seems to be unstoppable. Also, these will most probably not be centralized solutions, but rather decentralised or federated solutions. The challenge is to define basic principles for such solutions to ensure that the transaction costs of connecting systems are kept as low as possible. These principles will need to address data governance, data markets, security of solutions and freedom to exchange information.

2.6 Implementation of sustainability measurement schemes

This action is intended to provide an answer on	How to advance the critical assessment of sustainability impact of innovations?
Logistics concepts	Sustainability
Related trends	sustainability, circular economy, climate change
Related key-enabling-technologies	standardization & data modelling
Gaps covered (identified in D4.2)	This topic is horizontal to the gaps identified in D4.2.

It is still difficult to assess the impact of solutions on sustainability targets (including economic, environmental and social goals). This assessment is however extremely relevant during all stages of innovation, including preparation, implementation and evaluation.

- First, it is essential that those concept and ideas shall be selected that may provide high/highest sustainability impact by meeting the drafted objectives. However, at this stage of a project, a lot of information can only be estimated, maybe some initial experiences/data from pilot projects (ex-ante approach). Therefore, on the one hand, the submitter of the proposal/concept shall provide relevant information to sustainability impact performance categories in such a manner that, on the other hand, evaluators can compare different proposals on a level playing field and select those with the highest sustainability impact.

- Secondly, the running research or implementation projects shall provide proof that they meet the drafted sustainability impact by the use of data and information gained from project activities (ex-post approach). This may require a more detailed approach.
- Thirdly, in order to allow learning, ex-post evaluation of innovations should be strengthened to assess not only the contribution of the technology to making practices more sustainable at company or chain level, but also its upscaling potential (including any rebound effects). This validation should inform the stage of preparation of new projects.

The aim is to align initiatives for sustainability measurement schemes and assessment approaches that may be applicable to sustainability impact assessment of both: (European) funded R&I project as well as implementation projects run by industry only. It starts with the definition of sustainability KPIs relevant to the EU research agenda or CSR. This shall be followed by a framework that enables both ex-ante and ex-post sustainability assessment. Existing approaches on how to quantify sustainability KPIs for transport and logistics shall be aligned, new approaches may need to be derived. Here, also a harmonized set of conversion and emission factors need to be discussed. Examples cover existing and future transport or heating fuels as well as materials and concepts relevant for a circular economy. If relevant, the integration of a benchmark/target value for sustainability indicators shall be discussed. The elaborated framework needs to be reviewed by relevant stakeholder groups, i.e., European Commission, research and industry.

2.7 Aligned measurement of carbon emissions of digitalized logistics

This action is intended to provide an answer on	**How to align GHG emissions reporting of digitalized logistics chains?**
Logistics concepts	fostering collaboration, interconnected networks, PI, data sharing
Related trends	Digitalization, sustainability, circular economy, climate change
Related key-enabling-technologies	standardization & data modelling, data architecture
Gaps covered (identified in D4.2)	interconnected logistics networks, Physical Internet and data sharing

This action elaborates the standardized measurement of emissions due to increased digitalization, involving stakeholders such as ICT service providers (e.g. operators of data centres, …), ICT equipment producers, ICT users (e.g. LSP, shippers, …). The key trend highlighted here is the digitalization of the logistics sector. The ICT sector is already a large energy consumer, the increased use of ICT will add on this. However, efficiency increase (e.g., chip technologies, data centres) is also prospected so that contrary developments can be expected. Still, there is no common approach on how to estimate logistics-driven GHG emissions related to

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the use of ICT equipment and data servers in transport operations. Ongoing standardisation discussions on the quantification of GHG emissions arising from transport chain operations outlined both the lack and need to provide such an assessment framework in the near future. This will enable informed choices with regard to the future digitalisation of the logistics sector.

This action shall identify and align applicable approaches and elaborate the relevant framework. Such a framework shall further specify which carbon accounting approaches can help at what level (models, practical, real-time) for which type of information and communication needs (e.g., for transport/handling, supply chain, production, national/cross-border) and which standards should be aligned at EU and national levels to enable GHG info exchange between different roles as well as comparison of logistics chains

The action provides pilot use cases that prove the applicability and provide guidance for implementation of the elaborated assessment framework for measurement and reporting of GHG emissions arising from digitalization of logistics chains, as developed under recommendation 6 above.

2.8 Automated and autonomous operation in logistics hubs

This action is intended to provide an answer on	**How to use automation and operational autonomy within logistics hubs to improve efficiency?**
Logistics concepts	autonomous operations, autonomous transport, synchromodality
Related trends	sustainability, demographic change, resource scarcity
Related key-enabling-technologies	IoT, AI, self-driving vehicles
Gaps covered (identified in D4.2)	It covers the main gap identified in D4.2, where 95% of the projects analysed did not address this concept.

The automation of systems and infrastructures in logistics hubs is a topic of increasing relevance in logistics. Automation can change the flow of goods in terminals and improve efficiency by using more standardized handling processes. The use of robotic system, swarms of transport vehicles, smart devices and AI-based algorithms is already state-of-the-art in other domains, like manufacturing. The use of similar technologies in logistics operations will help to reduce the amount of repetitive human work and to achieve higher throughputs without the need to build additional logistics sites.

Nevertheless, automated and autonomous operations need to be aligned with the existing operations along the supply chain. Therefore, requirements, benefits and implementation barriers need to be assessed and connected to each other. The challenge will be to develop secure, sustainable, and transferable automation solutions for logistics hubs operating in connected supply networks.

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The action provides demonstrators that prove the implementation and applicability of automated and autonomous operations in logistics hubs whilst taking social (e.g. jobs loss/new jobs created), economic, and environmental impacts into account.

2.9 Cross-sectoral, sustainable multimodal implementations of Physical Internet solutions

This action is intended to provide an answer on	How to make multimodal transport systems ready for the Physical Internet?
Logistics concepts	PI, fostering collaboration, interconnected networks, synchromodality
Related trends	Digitalization, sustainability, circular economy, climate change
Related key-enabling-technologies	standardization & data modelling, data architecture
Gaps covered (identified in D4.2)	Physical Internet, interconnected logistics networks, synchromodality

ALICE developed the Physical Internet Roadmap as an effective way to achieve the transition towards a more interconnected logistics network and the system of logistics networks. To accelerate the transition to PI, transport modes and nodes need to become more interconnected as well. This topic concerns the implementation of steps in the PI Roadmap.

Key elements of this approach that are urgent are listed below.

- Logistics nodes, interconnected across networks:
  - Further standardization and interoperability of modular loading units, developing systems that can create this interoperability in a cost-effective way advancing in cost effective autonomous operations in nodes including modal transhipment.
  - Processes, procedures, and services must have an open access definition and scalability aspects need to be addressed.
- Achieving scalable intermodal logistics networks connectivity:
  - Demonstrate models and processes supported by Artificial Intelligence that can increase utilization of assets and resources in actual logistics service providers networks dynamically with the goal of increasing use of intermodal solutions. This will more the current logistics system towards network to network connectivity and operational synchromodality opportunities.
  - Demonstrate technologies and processes to achieve different type of flows compatibility over the logistics service provider networks involving shippers and retailers to that end.
- Collaborative and shared resources and processes across logistics networks.
  - Demonstrate protocols and services designed to ensure operational efficiency of freight movement irrespective of mode, nodal operations, and freight characteristics to increase

the efficiency and effectiveness of the transport and logistics systems across logistics models with sound business and governance models.
  - Develop and demonstrate scalability of the solutions providing open access mechanisms to the system of logistics networks.

The logistics concepts will aim to increase use of rail freight and inland waterways as well as making use of Zero Emission vehicles clearly assessing the benefits of such interconnectivity for example, including autonomous transport solutions. Projects are needed that

- build on digital and physical interconnectivity protocols and governance models (DTLF, FENIX and FEDERATED projects, modular load units and transhipment technologies).
- propose and demonstrate sound business and governance models as well as scale up solutions developed in previous projects and initiatives.
- focus will be on intra-European flows. Synergies with import and export maritime and other maritime containers flows could be addressed.
- have a clear leadership and strong role of logistics companies (retailers, shippers, Logistics Service Providers, Freight Forwarders) to demonstrate these concepts.
- demonstrate solutions across different industries and their logistics flows (e.g. FMCG, automotive, electronics, textile, food) building on sector-specific practices and solutions.

2.10 Regional Logistics Decarbonization

This action is intended to provide an answer on	**How to radically reduce carbon emissions of regional transport flows?**
Logistics concepts	interconnected networks, synchromodality
Related trends	sustainability, climate change, digitalization
Related key-enabling-technologies	standardization & data modelling, agility to plan, forecast and adapt
Gaps covered (identified in D4.2)	This topic is horizontal to the gaps identified in D4.2.

In the EU R&I programmes the focus so far has dominantly been on city logistics and long haul decarbonization. Regional logistics involves the flows between urban areas within a day's distance, say below 500 km distance, usually performed with medium and heavy duty trucks. These are a major contributor to intra-European GHG emissions. The organizational principles differ from those for short and long distances, for different reasons. Often these are domestic flows, either part of national distribution networks or the domestic leg of international networks. If they are international, the competitiveness of rails and waterways will not be as high as on the long distances, which makes the share of road transport relatively high, unless niche-solutions are offered (as e.g. in synchromodal port hinterlands). The challenges in this particular part for instance to prepare shipments for intermodal solutions are not as evident as for the long-haul, from a business perspective. Given the expected increasing attractiveness of battery-electric solutions on these distances, tricks might switch relatively easily to clean energy, however. This special context also requires a dedicated approach to see how parts of the supply chain can be technologically improved, re-organised and operated in a more interconnected and sustainable way. How these fragmented flows can be organised in a sustainable way is an essential question to be addressed, from a decarbonisation perspective.

The focus of this action will be to assess in detail the current practices and flows across Europe of palletized goods and propose sound concepts and solutions to decarbonize those segments by 2030, especially increasing the use of battery-electric and intermodal solutions. Concepts and solutions will need to be demonstrated and impact assessed and measured.

2.11 Dealing with driver shortage

This action is intended to provide an answer on	**How can the logistics sector respond to the driver shortages?**
Logistics concepts	Physical internet
Related trends	Skilled workforce shortage, demographic change, inclusiveness, new work & social innovation
Related key-enabling-technologies	Cyber-physical systems, IoT, autonomous transport
Gaps covered (identified in D4.2)	This topic is horizontal to the gaps identified in D4.2.

The current heavy goods vehicle (HGV) driver shortage is the latest challenge in the European logistics sector. Alternative solutions to the problem include re-regulation (e.g. improving working conditions) and logistics innovation (platooning or driver-friendly relay systems). While the sector is working on some short term solutions, the driver shortage is also calling into question the long-term viability of the current organization of the transportation sector. Currently there is little knowledge of the cause and therefore no appropriate solution can be developed. Comprehensive studies are needed to conceptualise the current patterns and develop a solid understanding of the fundamental causes of the issue in social, economic and technology aspects. The identification of challenges in the following areas should help to find new concepts and approaches to overcome driving shortage:

- Frame conditions in current regulations (e.g. on driving and break times)
- Organisational issues in logistics operations, specifically with focus on road transport
- Societal changes due to the demographic changes in Europe

This should result into a set of recommendations to proactively address the issue covering the needs for appropriate policy and regulatory frameworks, new innovations helping the drivers, training and skills programmes, and investment for companies, academia and government to overcome driver shortage.

3 Summary and conclusion

In order to achieve the project's vision, 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 valorization 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.

WP4 tackles the third action – defining high potential and priority R&I gaps. In order to do so, deliverable 4.2 focused on analysing existing European funded projects for the most relevant Logistics Clouds and identifying gaps (i.e. topics poorly or not covered by those projects). These Logistics Clouds stemmed from a heat map developed in deliverable 4.1.

The present document builds upon the above-mentioned deliverables and derives concrete recommendations for future research. As shown in table 1 in section 2, all gaps were covered by the proposed recommendations, as they either targeted a combination of them or a horizonal approach to all of them.

In any case, this analysis will be later complemented by a second iteration of the gap analysis report (Deliverable 4.5) that will look into national and Horizon Europe-funded projects. Taking into consideration this new gap analysis, as well as new and upcoming trends, a final document on Recommendations for future R&D activities will be issued (D4.6).