Engaging stakeholders for impact:

a guide to good practices and evidence-based strategies in EU-funded T&L projects

ZSI – Centre for Social Innovation

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Executive summary

Employing 10 million people and generating nearly 2 trillion Euro in turnover, the European Transport and Logistics (T&L) sector is a cornerstone of the Single Market. T&L is currently undergoing a profound transformation that is driven by sustainability requirements, rapid digitalisation, growing needs for data interoperability, and shifting regulatory and societal expectations – vital dimensions of Social Readiness. These developments reshape how freight operations are organised and how innovation is generated and absorbed in a highly interdependent ecosystem. Stakeholders across the sector operate under different mandates, constraints, and capacities, making their effective involvement a decisive factor for whether new solutions are adopted effectively and integrated into real operational environments. Stakeholder engagement is no longer a supporting activity but a foundational element for aligning technological innovation with operational realities and wider societal goals.

The stakeholder landscape is complex and multi-level, encompassing core actors (e.g., carriers, port authorities), enabling stakeholders (e.g., regulators, tech providers), and affected parties (e.g., local communities, NGOs); their relationships span vertical governance levels and horizontal operational networks. A systematic analysis of engagement within this landscape reveals several critical insights:

- **Engagement is a strategic imperative for impact:** Effective engagement is the key mechanism for bridging the gap between innovation and practical adoption, ensuring that R&I outputs become solutions that can be integrated into real operations. It aligns the short-term commercial focus of industry with the medium-term scope of projects and the EU's long-term goals.
- **Structural barriers hinder collaboration:** Engagement success is threatened by deeply rooted challenges, including regulatory fragmentation across Member States that stifles cross-border innovation, a significant digital maturity gap that excludes many SMEs, and fundamental misalignments in incentives and temporal priorities between commercial and public-sector stakeholders.
- **Co-Creation must be operationalised, not just invoked:** Moving beyond ad-hoc consultation to structured, iterative co-creation (e.g. using living labs, participatory design, and joint validation) is essential. This embeds stakeholder feedback directly into technical development, ensuring usability and building the collective ownership needed for sustained uptake.
- **Adaptive and transparent governance is non-negotiable:** A one-size-fits-all engagement strategy is destined to fail. Success requires flexible, modular approaches that can adapt to evolving project contexts and stakeholder needs, underpinned by transparent communication and decision-making to build and maintain trust.
- **Post-project exploitation demands early commitment:** The long-term viability of project outputs depends on early and continuous planning for exploitation, defining ownership, maintenance responsibilities, and integration pathways into existing ecosystems long before the project concludes.
- **Continuous learning must be built into engagement:** Iterative feedback loops, systematic monitoring, and adaptive governance are essential to ensure engagement remains purposeful, evidence-based, and capable of responding to emerging constraints.

To translate these insights into action, the paper proposes targeted recommendations. **Policy-makers** must embed and fund engagement requirements in funding instruments and accelerate regulatory harmonisation. **Project coordinators** should integrate engagement as a core design principle from the outset, creating tangible value for all parties. **Industry and research** need to build digital capacity across the supply chain and commit to long-term collaborative ecosystems. By adopting this strategic approach, stakeholder engagement can fulfil its role as the critical enabler of a resilient, inclusive, and competitive European T&L system, fully aligned with the long-term ambitions.

1. Introduction

The FOR-FREIGHT project addresses key challenges of multimodal freight transport to create tangible socio-economic and environmental benefits. Through commercialisation and innovation efforts, the project ensures that innovations are not confined to laboratory or pilot settings but become usable, scalable, and accepted by the communities that depend on them. This ambition is operationalised by connecting research results with the external world, identifying relevant actors, designing engagement activities, and monitoring how interaction with those actors generates impact.

1.1 Overview of EU T&L sector

The European Union's transport and logistics (T&L) system is a cornerstone of the Single Market. It enables cross-border trade, supports industrial competitiveness, and underpins social cohesion by connecting people and regions. In 2022, the EU's transportation and storage sector employed approximately 10.4 million people and generated about €1.9 trillion in turnover, accounting for nearly six percent of the Union's gross value added (Eurostat, 2025a). The sector is inherently multimodal, encompassing road, rail, maritime, inland waterways, and air freight. Inland freight transport remains dominated by road, which accounts for roughly 77 percent of inland freight activity, followed by rail and inland waterways that together represent around 23 percent (Eurostat, 2025b). Maritime ports, such as Rotterdam and Antwerp, handle significant shares of Europe's international cargo flows, while air freight remains vital for high-value and time-sensitive goods. Several drivers of transformation are playing a pivotal role in EU's T&L sector, as outlined below.

1.2 Strategic transformation drivers

Digitalisation. The European Commission's *Digital Transport and Logistics Forum (DTLF)* convenes public and private actors to advance interoperable data sharing, e-freight documentation, and end-to-end visibility; core prerequisites for efficient, synchromodal logistics (European Commission, 2024). Digital logistics platforms and common data models reduce administrative friction, shorten lead times, and enable better capacity use across modes, improvements that cascade into cost, reliability, and emissions benefits.

Sustainability. Transport produces about one quarter of the EU's greenhouse gas emissions, making decarbonisation a major policy priority (European Commission, 2024b). The European Green Deal and the Sustainable and Smart Mobility Strategy call for a 90 percent reduction in transport emissions by 2050, relative to 1990 levels (European Commission, 2020). Reaching this target requires a transition to zero- and low-emission vehicles, the deployment of alternative fuels such as hydrogen and advanced biofuels, and the electrification of road and rail systems. In 2025, the European Commission allocated €2.8 billion through the Connecting Europe Facility (CEF) to ninety-four projects modernising railways, ports, and inland waterways with a focus on climate-friendly transport (CINEA, 2025). These initiatives are complemented by national investments and Horizon Europe research projects that demonstrate clean logistics solutions in practice.

Multimodality and infrastructure integration. The EU's long-standing White Paper objective to shift 30 % of road freight > 300 km to rail or water by 2030 (and > 50 % by 2050) continues to anchor policy on terminals, corridors, and interoperability (European Commission, 2011). TEN-T policy operationalises this through corridor-based investments and standards (e.g., ERTMS, port rail links), aiming to make the core network fully functional by 2030. Recent corridor megaprojects (e.g., Alpine base tunnels) illustrate the scale of this re-balancing, with expected freight shifts from road to rail (AP, 2025).

Socioeconomic and workforce aspects. The transport and logistics sector stands among Europe's largest employers, yet it continues to grapple with deep structural challenges. Many of its core sub-sectors, including road and rail freight, face an ageing workforce and persistent difficulties in attracting new entrants. Simultaneously, automation and digitalisation are reshaping the skill landscape, redefining what it means to work in logistics. Digital transformations are, in essence, also labour transitions, and their success depends not only on technological readiness but on the human capacity to adapt. An effective stakeholder engagement strategy therefore plays a decisive role: it ensures that innovation is implemented through collaboration rather than disruption, and that new technologies strengthen, rather than fragment, existing professional networks.

The European Investment Bank (EIB) has repeatedly underscored the centrality of stakeholder participation in achieving sustainable and inclusive development. Its guidance notes emphasise that early, continuous, and meaningful engagement builds ownership, mitigates social risks, and enhances the long-term resilience of transport systems (EIB, 2020; 2020b). When engagement is integrated from the outset and sustained throughout a project's lifecycle, it enables mutual learning between institutions, operators, and workforces. This approach not only improves the acceptance of innovation but also supports the broader transition toward a just, people-centred logistics ecosystem.

1.3 Role of R&I projects

EU-funded research and innovation (R&I) projects in transport and logistics serve as experimental "living labs" that bridge technological innovation with socio-economic transformation. Under the Horizon Europe framework, these projects are designed not just to develop new tools or pilots[1]; they also align the frameworks themselves with broader policy goals and real-world needs. They bring together industry, public authorities, researchers, and civil society in multi-actor consortia, creating a sandbox where new solutions can be co-created and tested in practice. This collaborative approach is now embedded in the EU's impact-oriented funding philosophy: project proposals must articulate how stakeholders will be involved to ensure that outputs translate into meaningful outcomes and long-term impact (European Commission, 2020a; EIB, 2020).

In effect, stakeholder engagement is both a means and an end in Horizon Europe – a mechanism to steer innovations towards user needs, and a key criterion for assessing a project' potential to deliver lasting socioeconomic benefits. Involving societal actors affected by the innovations, R&I projects help ensure that innovative ideas move beyond the laboratory and take root within the communities that apply and sustain them, fostering practical change rather than mere technological advancement.

The FOR-FREIGHT use cases underline how R&I initiatives operate as real-world negotiation spaces in which technological pathways are continuously revised in response to stakeholder feedback. This iterative refinement was particularly visible in process-mapping workshops and joint validation of DSS components, where user input shaped requirements around data models, UX, and deployment constraints. In this way, R&I initiatives serve not only to produce innovations but also adjust the norms, expectations, and operational cultures in which these innovations must function (Lampert, Neuner & Dais, 2025).

[1] for further information, consult the ERA-LEARN website: https://www.era-learn.eu/support-for-partnerships/cross-cutting-issues-and-additional-activities/knowledge-valorisation-and-stakeholder-engagement/stakeholder-engagement

1.4 Why stakeholder engagement

Stakeholder engagement is a unifying thread across EU transport research, policy, and funding frameworks. The Horizon Europe programme requires strong participation from industry, public authorities, research institutions, and civil society to ensure that project outcomes reflect operational realities and social expectations. Most important aspects regarding the stakeholder engagement in T&L Sector are as follows:

1. **Alignment with user needs.** Collaborative design among shippers, carriers, infrastructure managers, and regulators ensures that new digital tools and logistics models solve real-world problems rather than remain pilot-scale experiments (European Commission, 2024a).
2. **Building networks.** Engaging stakeholders from different modes and regions creates joint ownership of solutions to common problems. By connecting, say, a port authority with inland terminal operators and software providers, a project can foster ecosystems of collaboration rather than isolated pilots.
3. **Impact-oriented integration toward bridging supply and demand.** Impact-oriented engagement ensures that technologies, processes, and models are adapted to real organisational environments (Lampert, Neuner & Dais, 2025). It functions as a mechanism through which technical outputs are translated into operational practices. Engagement activities like strategic workshops may help, for example, carriers and rail operators convert DSS prototypes into concrete operational requirements (data schemas, user interfaces and deployment models), significantly increasing the likelihood that the tools would be adopted beyond the projects' lifetime.

A useful distinction can be made between informing stakeholders as in terms of dissemination and actively involving them in shaping solutions. Engagement that focuses on co-development goes beyond sharing progress updates; it embeds stakeholder perspectives directly into the design, testing, and refinement of project outputs. Stakeholders help assess operational feasibility, regulatory fit, organisational constraints, and potential impacts, ensuring that innovations evolve in line with real-world needs. In FOR-FREIGHT, early involvement of operators and authorities allowed the consortium to adjust technical components, such as data models or optimisation features, based on concrete insights related to privacy requirements, workflow realities, or deployment constraints. Engagement therefore acts as an iterative design practice that guides project direction and strengthens the likelihood of sustained uptake (Lampert, Neuner & Dais, 2025).

1.5 Existing stakeholder engagement frameworks

The centrality of stakeholder involvement in EU transport and logistics projects is reflected in the variety of frameworks developed to support structured, transparent, and inclusive engagement processes. Building on the practices described above, these frameworks provide conceptual guidance for identifying relevant actors, organising their participation, and aligning project outputs with societal needs. Stakeholder engagement is a cornerstone of Societal Readiness and responsible research and innovation (RRI), and its associated models offer pathways for translating collaborative principles into actionable methods across different project phases. While frameworks differ in scope and depth, their collective goal is to enhance collaboration, inclusivity, and representativeness, aligning technological advancement with societal and environmental objectives. Ultimately, they play a key role in making the digital and green transition a reality.

In practice, no single standardized or dominant concept governs stakeholder engagement. Instead, a range of conceptual and operational frameworks coexist, from helix-based innovation models to sectoral, organizational, and multi-actor participatory approaches, each offering different perspectives for mapping and managing stakeholder relations throughout project lifecycles (Dooms et al. 2019; Yatskiv (Jackiva) et al. 2022).

These widely used frameworks, among others, identified several approaches to categorise, map and include stakeholders.

Framework	Stakeholder Categories / Dimensions	Description / Key features	Example Studies / EU Projects in the T&L sector
Triple / quadruple / quintuple helix	3–5 actors: Academia, Industry, Government, Civil Society, *(+Environment)*	Models the evolution of innovation collaboration; Quintuple adds environmental dimension	Calzada (2020) — *Smart Cities (penta-helix)*; Morea et al. (2024) — *Hydrogen Valleys (quintuple helix;*
Sectoral/ Functional/ Organizational Approaches	Sector-specific roles: e.g., ports, logistics, airlines, academia	Maps sectoral ecosystems and operational functions within the transport system; enables targeted innovation strategies.	Yatskiv et al. (2022) — *Freight Transport (functional)*; Koumoutsidi et al. (2022a) — *Urban Air Mobility (sectoral)*; Mitropoulos et al. (2021) — *Hyperloop systems*
Multi-actor approach and living labs	Multiple stakeholder types including users, policymakers, and industry	Involves multiple stakeholder types in research and innovation, uses living labs as collaborative spaces	van der Velden et al. (2024) — *Agricultural Living Labs (H2020)*;
Structured Consultation and Co-Creation	Inclusive participation across institutional and user groups	Multi-phase engagement, integration of standardization activities, external stakeholder engagement	Dondi et al. (2021) — *CHILD-UP social innovation*

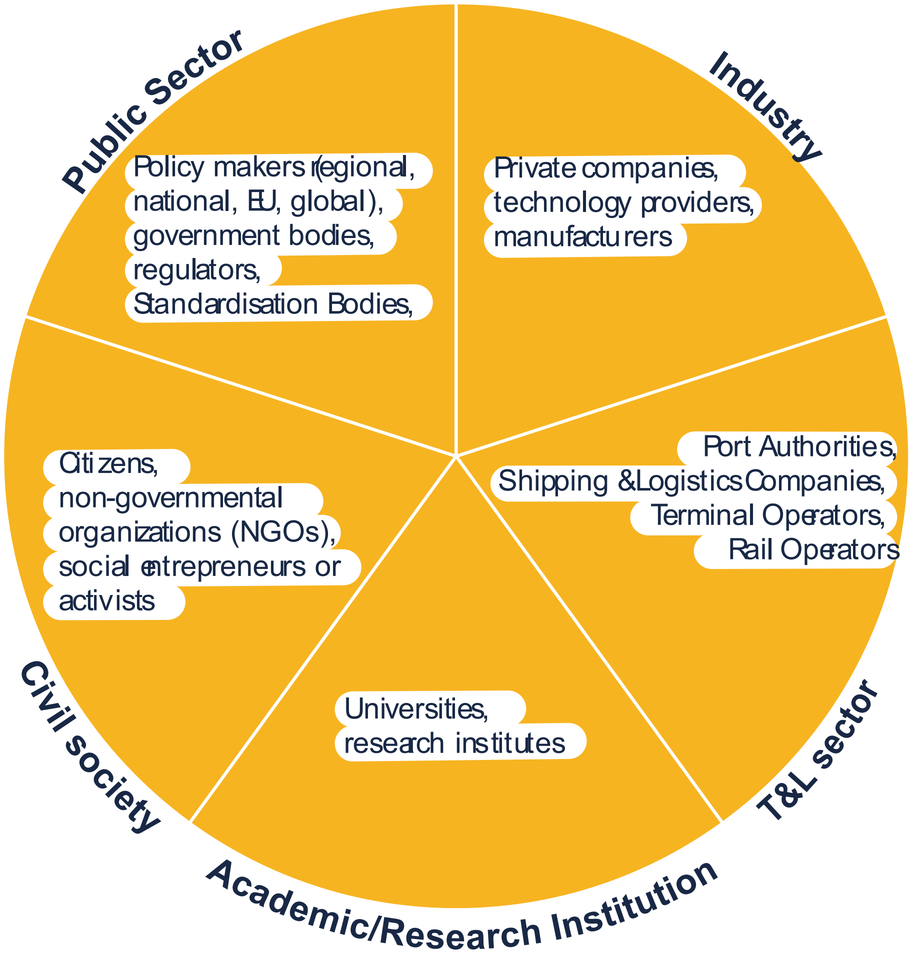
Table 1Existing stakeholder engagement frameworks

Current approaches for stakeholder management, also in the T&L sector are moving beyond simple public-private partnerships to more complex configurations, in an effort to increase Societal Readiness. The actual involvement in the process differs depending on the project phase and the significance of influence during the project.

2. Stakeholder landscape in EU Transport & Logistics R&I

2.1 Who are the key stakeholders?

Based on scientific literature on stakeholder identification and mapping in the T&L sector (Dooms et al. 2019; Notteboom et al. 2015), as well as an extensive validation process within the consortium of the FOR-FREIGHT project, typical stakeholder categories identified include:

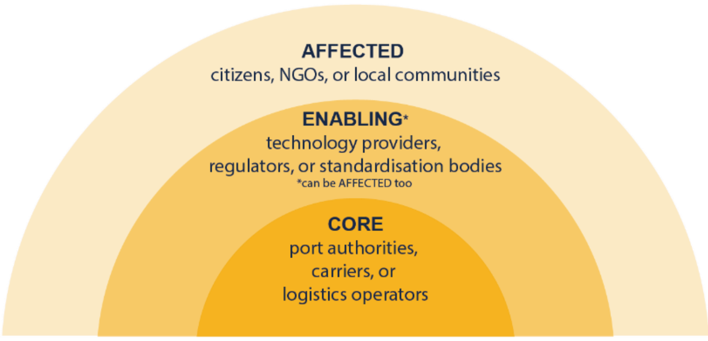


2.2 Mapping interests, influence, and relationships

These categories, however, are not fixed, and their roles shift depending on the type of innovation, the geographical scope, and the regulatory setting of each initiative. However, defining a robust classification offers a basis for understanding how different stakeholder groups interact and where their interests converge or diverge, which in turn helps to analyse the broader relational dynamics.

The stakeholder landscape in European T&L is characterised by interdependent actors whose influence extends across regulatory, operational, technological, and societal domains. Mapping these relationships requires identifying both vertical linkages, i.e. between EU, national, and regional levels, as well as horizontal networks what connect public authorities, private operators, technology developers, and civil society. Influence is not merely a function of institutional authority but also of knowledge, data ownership, and active participation in policy fora such as the Sustainable Transport Forum or the Digital Transport and Logistics Forum (fill in already cited works).

A structured mapping exercise distinguishes between **core**, **enabling**, and **affected stakeholders**. **Core actors** such as port authorities, carriers, or logistics operators directly shape multimodal integration and digital transformation. **Enabling stakeholders** such as technology providers, regulators, or standardisation bodies determine interoperability, governance, and compliance pathways. **Affected stakeholders** such as citizens, NGOs, or local communities introduce new, previously unknown or disregarded but relevant perspectives to be taken into account, to ensure an alignment with societal needs and values, and to contribute to a sustainable future. Note that a stakeholder can be an enabler and being affected at the same time.



Relationships among these categories are dynamic and may also be influenced by regulatory reforms, data-sharing frameworks, and green-transition targets (add known references). Mapping thus moves beyond static classification to model feedback loops of influence, which is key in capturing how co-creation activities, data flows, and decision rights shape innovation uptake [Haddaway et al. (2017); Scrich et al. (2024)]. Applying advanced methods like social network and impact pathway analysis would further allow R&I projects to prioritise high-leverage interactions where stakeholder alignment most strongly affects decarbonisation, resilience, and digital interoperability goals.

2.3 Stakeholder dynamics in EU projects

Publicly funded R&I projects in the EU typically involve different stakeholder groups, as stated earlier in this section, which means they are structurally multi-actor and multi-level. Each of these have a different role and power. Policy-makers, for instance, have a high formal authority but limited operational control; infrastructure owners or managers, such as port or terminal authorities or airport operators, control critical physical assets and tend to be risk-averse, while T&L operators, such as shipping lines or rail operators tend to be driven by commercial interests and at least some risk-taking; research organisations typically provide methodologically sound analyses and evidence-based recommendations, while technology providers (often SMEs) provide digital or physical services and drive technological development; end-user or societal stakeholders, on the other hand, are involved in projects to articulate their needs and expectations, as well as constraints and acceptance of the developed solutions.

Dynamics may change along the project life cycle. Depending on the actual level of co-creation, we can observe the following pattern in publicly funded R&I projects in T&L:

1. **co-definition and planning**
    - initial stakeholder mapping and analysis (importance, influence, interest);
    - formation of advisory boards or stakeholder panels that often include representatives of each stakeholder group involved in the project;
    - problem framing and selection of use cases, unless they have largely been done in the pre-project phase (e.g. during the proposal writing);
2. **co-creation and design**
    - using interactive formats, such as workshops, living labs, or design sprints, the key stakeholders (at least operators, technology providers, and public authorities) jointly specify functional requirements and integration pathways;

- multi-criteria methods make trade-offs between needs, expectations, project resources/constraints, as well as environmental and social objectives visible, which allows communicating decisions transparently;

3. **pilot implementation and validation**
    - technology development and real-world demonstrations in operational environments, which require detailed alignment of operational procedures, data exchange and standards, safety concerns, and proper risk management;
    - iterative refinement of solutions in response to stakeholder feedback and performance analysis;
4. **exploitation, scaling, and governance transfer**
    - [co-]creation of post-project business models, negotiation regarding ownership and maintenance responsibilities for platforms, services, standards, etc.;
    - deployment of solutions in different contexts;
    - integration into existing ecosystems (rail and port systems, regional T&L partnerships, industry associations, etc.) or creation of new governance system;

Across these phases, there is a constant negotiation between the project world and the real world, i.e. between work plan, deliverables, milestones, deadlines, and budget constraints on the one side, and contracts, regulations, and competition on the other side.

Moreover, the collaboration between the above-mentioned actors may be affected by power asymmetries and difference resource distribution, which can typically be gleaned when looking at the agenda-setting power, control over critical data and results, or the regulatory process. This, in turn, can have an influence on who can influence development pathways (e.g. veto developments or prevent change), whose interests or risks are being prioritised, or even whose cost are externalised.

These factors need to be taken into account, when setting up a stakeholder engagement, so that the benefits are mutually shared and the outcomes support the project goals and envisioned wider impacts.

3. Challenges in stakeholder engagement

Stakeholder engagement in the European transport and logistics sector often unfolds within complex organisational, regulatory, and economic environments. Even when interests are broadly aligned, the practical conditions under which different actors operate can create friction, misunderstandings, or uneven commitments. Engagement processes therefore need to account for structural constraints, organisational priorities, and the varying capacities of stakeholders to participate meaningfully. The following subsections portray some of these challenges throughout the engagement lifecycle to give an indication of what to expect. Note that a project or larger endeavour does not need to have all the answers upfront; some challenges may be brought to the attention of and be collaboratively addressed, together with a representative group of stakeholders.

3.1 Misaligned incentives and time horizons

When planning a stakeholder engagement, a potential misalignment of incentives and time horizons ought to be considered and taken care of, as they can negatively affect the process and, in the worst case, derail it completely, which might have even wider negative consequences. Identifying these challenges early helps avoid avoidable tensions, supports clearer expectation-setting, and ultimately increases the likelihood that engagement activities contribute to shared benefits and to the wider impacts envisioned by the project.

Undoubtedly, business players like operators or transport companies underly short-term planning, as they must meet quarterly performance targets, continuously optimise the utilisation of their assets, and manage operational risks. Innovations – including those coming from R&I projects – often disrupt established processes or require upfront investments. Without clear near-term returns, they are difficult to justify internally, which clashes with the medium-term nature of publicly funded projects which typically run between 3-4 years, during which they are expected to deliver demonstrators, assessments, and roadmaps. This time window might not align with investment decision cycles or regulatory processes.

Public value objectives, such as a decarbonisation, air quality, or safety and digitalisation objectives are often long-term. While EU-funded projects need to make their contributions to such impacts visible, in order to be funded, those contributions and related project activities may not be obvious to involved stakeholders. The engagement planning needs to factor this in, to ensure that all involved parties are aware of and aligned with the goals across these time horizons.

3.2 Regulatory fragmentation (challenges + DTLF efforts)

Beyond the challenges created by diverging incentives, stakeholders also have to navigate a regulatory landscape that is far from harmonised across the EU. Regulatory fragmentation across EU Member States, where national rules and standards diverge or remain unaligned, continues to represent a major barrier to innovation, interoperability, and cooperation in the transport and logistics (T&L) sector. Freight operators and EU-funded projects encounter a patchwork of national regulations in areas such as documentation, data formats, and procedural requirements. For example, although EU directives have long promoted the creation of national single windows for maritime reporting, inconsistent implementation has led to parallel systems with limited interoperability. A European Parliament review concluded that, due to insufficient coordination between national and local reporting requirements, “the administrative burden on ship operators remained heavy” (European Parliament, 2022). Similarly, while the electronic consignment note (e-CMR) was designed to enable paperless operations, not all Member States recognise it legally, forcing companies to maintain hybrid procedures.

Such fragmentation increases complexity and costs and undermines the smooth functioning of cross-border logistics. It also impedes digital interoperability, as information systems cannot communicate effectively if each Member State enforces distinct standards or technical specifications. For businesses, this uncertainty discourages investment in innovative digital tools, since a solution proven in one country may not be accepted or compliant in another (European Commission, 2020; EIB, 2020). The outcome is a de facto segmentation of what should be a single European transport market, limiting economies of scale and hampering collaboration between multimodal stakeholders. Fragmentation also complicates stakeholder cooperation. When regulatory frameworks differ across borders, joint innovation becomes more cumbersome. Logistics actors may face duplicative administrative procedures or uncertainty about liability and compliance, weakening the willingness to collaborate on cross-border or multimodal projects.

Recognising these systemic inefficiencies, the EU has launched a series of coordination mechanisms to foster regulatory convergence and digital interoperability. The Digital Transport and Logistics Forum (DTLF), established by the European Commission, brings together public authorities, industry representatives, and research actors to advance harmonised solutions for freight data exchange (European Commission, 2024a). Through multi-stakeholder working groups, the DTLF has developed reference architectures for trusted data sharing and contributed to shaping the Electronic Freight Transport Information (eFTI) Regulation (European Commission, 2020b). The eFTI Regultion (EU 2020/1056) establishes a uniform legal framework requiring all Member State authorities to accept freight information electronically through certified platforms by 2027. This harmonisation is expected to reduce administrative burdens, facilitate information exchange, and ensure that data provided in one Member State is legally valid in another.

Complementary initiatives have been supported through the Connecting Europe Facility (CEF). Projects such as FENIX demonstrated that different national and private platforms could interoperate through a federated data-sharing architectures (European Commission, 2021). Their results now inform the design of the European Mobility Data Space (EMDS), which aims to federate existing transport data ecosystems while issuing recommendations for harmonisation and interoperability (European Commission, 2023). The EMDS initiative supports data discoverability, governance, and interoperability, enabling logistics operators to access infrastructure and traffic information across Member States through shared interfaces.

3.3 Digital divide and innovation gaps (EU Digital Decade targets)

These efforts toward greater interoperability also highlight a parallel challenge: not all actors in the European T&L sector possess the same capacity to participate in, or benefit from, digital transformation. While digitalisation offers major efficiency and transparency gains, its benefits are distributed unevenly across modes, regions, and company sizes. The European Commission (2020) observes that digital uptake in the T&L sector remains fragmented, with large operators deploying advanced analytics and automation, whereas small and medium-sized enterprises (SMEs) rely on legacy systems or manual procedures. This divergence generates a two-speed logistics ecosystem in which innovation diffuses slowly, and systemic efficiency improvements are constrained (EIB, 2020).

The European Union's Digital Decade initiative sets a comprehensive agenda for digital transformation by 2030 across four pillars: digital skills, secure and sustainable infrastructure, the digitalisation of businesses, and the digitalisation of public services (European Commission, 2021). A key objective is that more than 90 % of SMEs reach at least a basic level of digital intensity (Eurostat, 2024). Yet recent data reveal that only about 58 % of EU SMEs had currently achieved a basic level of digital intensity in 2023, leaving a large gap to the target (Eurostat, 2024). These disparities illustrate how the digital divide persists not only between large and small enterprises but also across regions and workforce groups.

In the transport and logistics sector this divide presents challenges particularly for stakeholder engagement and innovation uptake. SMEs and small infrastructure operators often face financial, technical and regulatory barriers to adopting digital solutions: high upfront costs, limited IT expertise, and interoperability issues that hamper compatibility with larger systems.

Although the FOR-FREIGHT documentation does not explicitly report systematic under-representation, varying digital maturity across stakeholders required differentiated capacity-building and tailored documentation approaches to ensure broad uptake (Lampert, Neuner & Dais, 2025). If these divides are not addressed, the innovation gap will hinder digital adoption and reduce the system-wide impact of initiatives. Inclusive stakeholder engagement strategies, tailored training, phased entry mechanisms, and support for smaller actors, are essential to ensure that digital transformation is both equitable and effective.

3.4 Communication gaps

Similarly, within EU-funded research and innovation projects, communication gaps frequently emerge as a secondary challenge in stakeholder engagement. These gaps have several dimensions, including limited knowledge of standardisation and low awareness among local communities (Lindner et al., 2023), as well as language barriers that hinder inclusive dialogue (Dondi et al., 2021). Although transparency is an explicit objective of most frameworks, it is often impeded by complex standards development processes and the difficulty of conveying technical concepts clearly. Structural silos also prevent knowledge exchange, with some researchers excluding theoretical discussion from participatory activities (van der Velden et al., 2024). Furthermore, inconsistent engagement timing, particularly when stakeholders are only involved in later project stages, can restrict mutual understanding and trust. Taken together, these findings suggest that, although communication is widely acknowledged as crucial for effective participation, systematic strategies for addressing jargon, technical complexity and initial knowledge alignment remain underdeveloped in many projects.

4. Good practices and success factors

4.1 Inclusive co-creation

Inclusive co-creation is central to stakeholder-driven innovation. It operationalises the principle that impact arises not from technology deployment alone but from the joint definition of problems and validation of solutions (Gianfrate et al., 2023). Within EU R&I contexts, inclusivity entails a balanced representation of public, private, and societal actors, ensuring that small and medium-sized enterprises, local authorities, and user groups influence system design. Iterative co-creation activities accelerate consensus on technical standards and functional priorities, while early-stage inclusion mitigates resistance during implementation (Lampert, Neuner & Dais, 2025).

Good practice involves combining participatory design sessions with structured feedback mechanisms to capture diverse experiential knowledge. This approach aligns with the European Commission’s guidelines[2] on citizen and stakeholder engagement in R&I. The resulting socio-technical alignment enhances not only adoption but also legitimacy, as co-created outputs are perceived as collectively owned solutions which support both competitiveness and sustainability in T&L.

4.2 Clear communication and transparency regarding decisions

Early expectation-setting, iterative consultation, and transparent communication are both a procedural requirement and mechanism for trust-building detecting misalignment during implementation. Clarity in how and why decisions are taken, especially when balancing stakeholder expectations and resource constraints, instils confidence. Transparency encompasses accessibility of vital information, traceability of inputs to decisions, and proactive communication of current and foreseen activities and results (Lampert, Neuner & Dais, 2025).

Furthermore, transparent governance increases stakeholders’ willingness to share experiences, contacts, and data, as well as to adopt co-developed solutions. Communication strategies should combine technical precision with inclusive language to bridge disciplinary and institutional barriers. Embedding transparency in engagement design through regular reporting, feedback loops, and co-validation of results creates a culture of accountability, which is essential for a sustained collaboration.

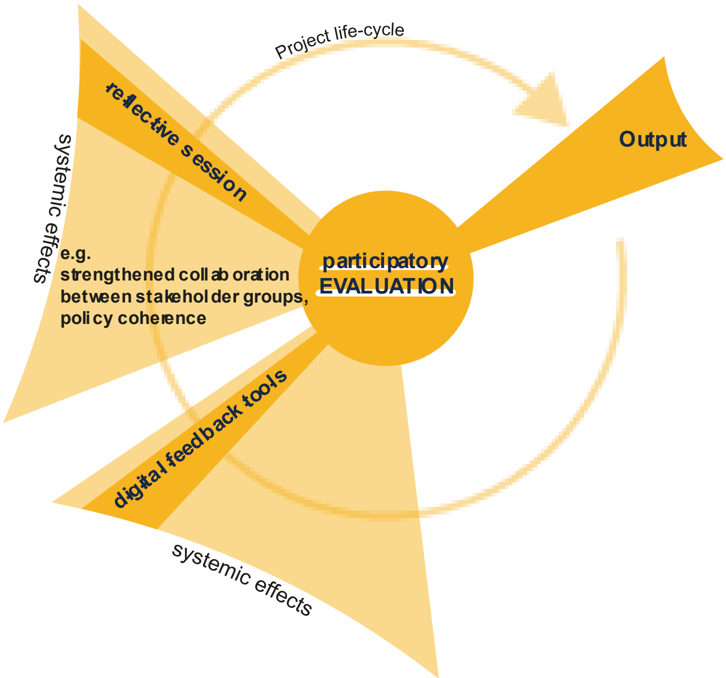
4.3 Flexible governance (adapting engagement strategy to stakeholder needs)

Governance models in EU T&L projects need to balance structure and adaptability, as a rigid engagement design risks obsolescence as project contexts evolve, as well as losing stakeholders' commitment along the way. An adaptive governance allows iterative adjustments of stakeholder roles, priorities, and engagement intensity. In other words, it pays off to keep adapting the engagement strategy to meet emerging – but not always immediately recognisable – stakeholder needs.

Flexibility is best achieved through a modular engagement planning, i.e. by distinguishing core activities like consultations from adaptive modules, such as living labs or multi-modal pilots. Establishing light-weight

[2] More information available at https://www.era-learn.eu/support-for-partnerships/governance-administration-legal-base/governance-structure-and-committees [last access: 2025-11-11]

steering groups and rotating facilitation ensures continuity without entrenching hierarchies or creating boredom. After each module or phase, a review of the activities carried out and achieved results will help determine the need for adaptation.



4.4 Monitoring and evaluation (tracking engagement quality, satisfaction, and impact)

Monitoring and evaluation (M&E) of stakeholder engagement are essential for demonstrating the added value and facilitate learning across beyond the project scope. Quantitative indicators like the number of engaged entities, workshop frequency, or implementation rate of stakeholder inputs should be carefully balanced with qualitative assessments aiming at capturing satisfaction, trust, and other soft factors such as perceived influence. The burden of M&E activities on the engaged stakeholders should be kept light, to keep the commitment high throughout the entire engagement.

State-of-the-art approaches in participatory evaluation include embedding reflective sessions and digital feedback tools within the project life-cycle. Evaluation should not only account for outputs but also identify systemic effects such as strengthened collaboration between stakeholder groups or policy coherence. By institutionalising M&E processes, R&I consortia ensure that engagement translates into tangible impact rather than symbolic participation.

5. Recommendations

5.1 Recommendations for policy-makers

Policy-makers play a crucial role in creating an enabling environment for meaningful stakeholder engagement. EU authorities should embed engagement requirements in T&L funding instruments to ensure that early co-creation phases are budgeted and mandatory under programmes such as Horizon Europe, CEF[3], or DEP[4] - national authorities should mirror these requirements. Furthermore, harmonisation of regulatory and data frameworks – such as the implementation of the eFTI Regulation and TEN-T governance reforms – ought to explicitly include stakeholder consultation processes to avoid fragmentation and further push for interoperability.

To connect regional innovation ecosystems with EU-level policy, policy-makers should establish permanent multi-level platforms (e.g. building on the Sustainable Transport Forum and DTLF). Systematically collecting and disseminating stakeholder-engagement metrics through CINEA's impact reporting might allow benchmarking and continuous improvement.

These measures support the institutionalisation of participatory innovation as a structural component of European T&L policy and directly contribute to the Green Deal and Digital Decade targets.

5.2 Recommendations for project coordinators

Start stakeholder engagement early and treat it as a core design dimension, not a work package. Embed stakeholder engagement activities across work packages – which typically include requirements, pilots, evaluation, exploitation, – rather than isolating them in a dedicated work package with limited scope and influence. Ensure that key stakeholder representatives are co-owners of major decisions, especially on pilot design and exploitation planning. Clarify the scope and aims of stakeholder engagement early and often, communicate limitations transparently.

Design engagement formats that create tangible value for each stakeholder type. To mediate diverging goals and to overcome short-term vs long-term misalignments, coordinators should ensure that each major stakeholder group experiences concrete benefits within the project's time frame. The underlying principle should be to jointly define those benefits with each stakeholder group, rather than assuming a generic, diffuse benefit from participation.

Use structured, iterative co-creation methods throughout the project lifetime. Move beyond ad-hoc workshops towards a structured process comprising participatory methods, such as multi-criteria decision analysis, scenario workshops, living labs, or serious games.

Broaden representation while keeping engagement manageable. Identify affected but under-represented stakeholder groups. These may not only include societal actors but small carriers, drivers, or warehouse and dock workers. The way to deal with a wide range of different stakeholder groups is to cluster them and bundling activities where possible. Use proportional engagement formats for them. This will avoid overloading the core stakeholder groups while ensuring that the broader stakeholder groups feel well-integrated.

[3] CEF - Connecting Europe Facility for Energy, Transport, and Digital.
More information available at https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en [last access: 2025-11-11]
[4] DEP - Digital Europe Programme
https://digital-strategy.ec.europa.eu/en/activities/digital-programme [last access: 2025-11-11]

Monitor and evaluate stakeholder engagement. Define clear engagement criteria, e.g. inclusion, continuity of engagement, satisfaction, or usefulness, and use periodic feedback loops to adapt the engagement strategy if needed.

Plan for post-project governance and exploitation from the project start. Define early, e.g. during the proposal stage, who will most likely own, maintain, and further develop the foreseen project outputs like platforms, services, tools, standards, or processes. Where relevant and possible, integrate outputs in existing community structures and use memoranda of understanding or similar instruments to formalise commitments beyond the project duration.

5.3 Recommendations for industry and research

Industry and research communities are crucial to shaping the long-term impact of stakeholder engagement in European transport and logistics (T&L). Their collaboration determines how effectively new technologies, standards, and governance models are translated into practice. The quality of engagement depends on how well research and industrial partners integrate social, organisational, and policy dimensions into technical development (FOR-FREIGHT, 2024). The following recommendations address both sector-specific and cross-sectoral needs for more inclusive, interoperable, and innovation-driven ecosystems. At the same time, they help increase Societal Readiness.

Building digital capacity across the supply chain is a fundamental priority. While large operators increasingly integrate artificial intelligence, Internet-of-Things (IoT) systems, and advanced analytics, smaller enterprises often lack the skills and resources to keep pace (European Commission, 2021; EIB, 2023). Targeted initiatives such as the European Digital Innovation Hubs (EDIHs) and the Digital Transport and Logistics Forum (DTLF) can help reduce entry barriers for small and medium-sized enterprises by providing shared training, technical assistance, and affordable access to digital tools. Collaboration between logistics providers, research institutions, and sector associations is equally vital for establishing open-source testbeds and training environments that reflect real operational needs. Evidence from FOR-FREIGHT shows that inclusive pilot environments improve learning outcomes and allow actors with lower digital maturity to engage meaningfully in data-driven ecosystems (FOR-FREIGHT, 2024).

To sustain these gains, industry and academia must move beyond short-term pilots toward long-term collaborative ecosystems that link research outputs with large-scale industrial deployment. Effective partnerships require harmonised data governance, open access to research infrastructures, and early integration of industrial and societal stakeholders into project design. Cross-sectoral coordination with EU initiatives such as the European Mobility Data Space (EMDS) ensures that results remain interoperable and policy-relevant (European Commission, 2023). Finally, engagement should be treated as a continuous co-creation process rather than a procedural obligation. The FOR-FREIGHT experience demonstrates that feedback loops among researchers, operators, and regulators improve data-sharing models and clarify regulatory barriers, making European logistics innovation more resilient, inclusive, and sustainable.

6. Conclusions

This paper has shown that stakeholder engagement used to strengthen Societal Readiness and impact creation is not a peripheral activity in EU transport and logistics R&I but a structural condition for meaningful innovation. The sector is undergoing profound transformation driven e.g. by digitalisation, the decarbonisation agenda, multimodal integration, and shifting workforce dynamics. These changes create both opportunities for new forms of coordination and challenges that cannot be resolved by technological development alone.

Across the analysis, several themes emerge. First, stakeholder engagement enables alignment between technological innovation and operational realities. Without early and continuous involvement of carriers, terminal operators, authorities, users, and other societal actors even sophisticated tools risk remaining pilot-scale artefacts rather than becoming embedded practice. Second, engagement helps bridge fragmented regulatory, organisational, and data environments by creating shared understandings and trust-based cooperation. Third, uneven digital readiness, regulatory inconsistencies, and communication barriers remain persistent obstacles that require targeted strategies. Finally, EU R&I projects such as FOR-FREIGHT demonstrate that co-creation, adaptive governance, and differentiated engagement approaches improve the usability, legitimacy, and long-term impact of research outcomes.

Taken together, these findings support a shift from viewing engagement as a requirement to seeing it as an enabler of system-level change. When embedded into the design, implementation, and evaluation of R&I projects, stakeholder engagement functions as an integrative practice that supports the EU's broader objectives for a sustainable, resilient, and human-centred T&L ecosystem.

To realise this vision and propagate Societal Readiness, stakeholders across the T&L landscape are urged to adopt a more structured and forward-looking approach to engagement. Policy-makers should continue to embed clear engagement requirements in EU and national funding instruments, ensuring that adequate resources are allocated to early co-creation, multi-level consultation, and harmonised implementation of regulations. Industry actors should invest in digital readiness and commit to collaborative development environments in which operational needs and innovation goals can be aligned. Research organisations should integrate participatory methods, transparent communication, and iterative validation processes into all R&I activities so that technical development progresses in tandem with organisational and societal learning.

These collective actions will help transform engagement into an instrument that supports regulatory convergence, fosters digital interoperability, and accelerates the transition to low and zero carbon-based logistics systems. Strengthening engagement is not only an investment in better project outcomes but also in the long-term resilience, inclusiveness, and competitiveness of European transport and logistics.

Stakeholder engagement in European T&L has entered a new phase determined by digitalisation, esp. digital integration, decarbonisation directives, and an increasing demand for Societal Readiness. As T&L systems evolve into complex data-driven ecosystems, stakeholder engagement cannot be confounded within the traditional consultation approach; it needs to be extended towards continuous collaboration based on shared digital platforms and governance frameworks. To meet the demands of future R&I funding programmes and to heed calls for adopting a Societal Readiness approach, ambitious projects are well-advised to integrate participatory foresight, social impact assessment, and ethical governance of emerging technologies.

Guided by Societal Readiness, the next decade is expected to witness the substantiation of corporate digital and social responsibility through impactful stakeholder engagement, which will contribute to the EU's ambition for a human-centred, sustainable T&L transformation.

References

Associated Press (AP). (2025, Sept.). How 4 key infrastructure projects centred in Italy will reshape the European transit map.

Calzada, Igor. 2020. 'Democratising Smart Cities? Penta-Helix Multistakeholder Social Innovation Framework'. *Smart Cities* 3 (4): 1145–72. https://doi.org/10.3390/smartcities3040057.

CINEA (European Climate, Infrastructure and Environment Executive Agency). (2025, July 3). *CEF Transport: €2.8 billion in 94 projects to boost sustainable and connected mobility across Europe.*

Dondi, Claudio, Edoardo Gimigliano, Edwin Katerberg, Julie Raouane, and Monica Turrini. 2021. 'The Articulated Involvement of Stakeholders in Social Innovation Research. The CHILD-UP Approach'. *Studia Migracyjne – Przegląd Polonijny* 47 (4 (182)): 205–18. https://doi.org/10.4467/25444972SMPP.21.059.14812.

Dooms, Michael, Jason Monios, and Rickard Bergqvist, eds. 2019. 'Stakeholder Management for Port Sustainability: Moving from Ad-Hoc to Structural Approaches'. In *Green Ports: Inland and Seaside Sustainable Transportation Strategies*. Elsevier.

European Commission. (2011). White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource-efficient transport system (COM(2011) 144). Brussels: Eur-Lex.

European Commission. (2020). *Sustainable and Smart Mobility Strategy – putting European transport on track for the future.* Brussels: European Commission. Retrieved from: https://transport.ec.europa.eu/document/download/be22d311-4a07-4c29-8b72-d6d255846069_en

European Commission (2023). *European Mobility Data Space Initiative.* Brussels: European Commission.

European Commission. (2024a). *Digital Transport and Logistics Forum (DTLF).* Brussels: European Commission.

European Commission. (2024b). *Transport and the European Green Deal.* Brussels: European Commission.

European Parliament (2022). Maritime Transport Single Window Evaluation Report. Brussels: European Parliament.

Eurostat. (2024). *How digitalised have the EU's enterprises become?* Retrieved from https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240829-1

Eurostat. (2025a). Businesses in the transportation and storage sector (dataset tran_r_trst). Luxembourg: Eurostat. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Business_economy_by_sector_transportation_and_storage

Eurostat. (2025b). Freight transport statistics – modal split (dataset tran_hv_frmod). Luxembourg: Eurostat. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Freight_transport_statistics

European Investment Bank (EIB). (2020). Guidance Note for EIB Standard on Stakeholder Engagement. Luxembourg: EIB.

European Investment Bank (EIB). (2020b). Development Solutions: How to listen — The importance of inclusion to stakeholder engagement in transport. Luxembourg: EIB.

FOR-FREIGHT (2024). Deliverable D4.3: Initial Plan for Maximisation of Impact.

Gianfrate, Valentina, Margherita Ascari, Raffaele Giordano, Valentina Orioli, and Giovanni Ginocchini. "Co-design inclusive relations between Humans and environments adopting a citizen science approach." In Mediterranean Architecture and the Green-Digital Transition: Selected Papers from the World Renewable Energy Congress Med Green Forum 2022, pp. 421-431. Cham: Springer International Publishing, 2023. URL (preprint): https://files.osf.io/v1/resources/d4va3_v1/providers/osfstorage/67f7c34427ca8a78e18b8204?action=download&direct&version=1 [last access: 2025-11-11]

Haddaway et al. (2017). A framework for stakeholder engagement during systematic reviews and maps in environmental management. Environmental evidence 6, no. 1 (2017): 11. URL: https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-017-0089-8

Koumoutsidi, Annitsa, Ioanna Pagoni, and Amalia Polydoropoulou. 2022. 'A New Mobility Era: Stakeholders' Insights Regarding Urban Air Mobility'. *Sustainability* 14 (5): 3128. https://doi.org/10.3390/su14053128.

Lampert, Dietmar, Emma Neuner & Sofoklis Dais (2025). Stakeholder engagement for impact: a methodological reflection based on three European transport and logistics use cases. Proceedings of ICTR 2025.

Mitropoulos, Lambros, Annie Kortsari, Alexandros Koliatos, and Georgia Ayfantopoulou. 2021. 'The Hyperloop System and Stakeholders: A Review and Future Directions'. *Sustainability* 13 (15): 8430. https://doi.org/10.3390/su13158430.

Morea, Fabio, Alberto Soraci, and Domenico De Stefano. 2024. 'Mapping Leadership and Communities in EU-Funded Research through Network Analysis'. *Open Research Europe* 4 (December): 268. https://doi.org/10.12688/openreseurope.18544.1.

Notteboom, Theo, Francesco Parola, Giovanni Satta, and Lara Penco. 2015. 'Disclosure as a Tool in Stakeholder Relations Management: A Longitudinal Study on the Port of Rotterdam'. *International Journal of Logistics Research and Applications* 18 (3): 228–50. https://doi.org/10.1080/13675567.2015.1027149.

Scrich et al. (2024). Stakeholder Analysis as a strategic tool in framing collaborative governance arenas for marine litter monitoring. Marine Pollution Bulletin 198 (2024): 115799. URL: https://www.sciencedirect.com/science/article/abs/pii/S0025326X23012341

Van Der Velden, Daniel, Lies Debruyne, Laurens Klerkx, and Joost Dessein. 2024. 'Participation and Co-Theorising: How Stakeholder Interests and Scientific Outputs Clash in the Horizon 2020 Multi-Actor Approach'. *NJAS: Impact in Agricultural and Life Sciences* 96 (1): 2430004. https://doi.org/10.1080/27685241.2024.2430004.

Yatskiv (Jackiva), Irina, Thomas Brauner, Aleksejs Vesjolijs, and Vladimir Petrovs. 2022. 'Ec-Funded Projects' Lessons Learned In Earth Friendly Freight Transportation'. *Transport and Telecommunication Journal* 23 (4): 352–63. https://doi.org/10.2478/ttj-2022-0029.