Deliverable 3.2 (V1.0)

Drivers and barriers of collaboration in logistics networks

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[1] **DATA** = data sets, **DEC** = Websites, patent filings, videos, etc; **DEM** = Demonstrator, pilot, prototype, **ETHICS**; **OTHER**; **R** = Document, report.

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Abbreviations

AI	Artificial Intelligence
AHP	Analytical Hierarchy Process
BER	Block Exemption Regulations
CJEU	European Court of Justice
CTN	Collaborative Transport Networks
DAHP	Distance-based Analytical Hierarchy Process
DSS	Decision Support System
DPA	Data Processing Agreements
EC	European Commission
ERP	Enterprise Resource Planning
ESG	Environmental, social, and governance
EU	European Union
FDM	Fuzzy Delphi Method
GDPR	General Data Protection Regulation
HC	Horizontal Collaboration
HOC	Hub Operation Category
ICT	Information & Communication Technologies
IoT	Internet of Things
LSP	Logistics Service Provider
MIM	Mean Index Method
MP	Marketplace
NCA	National Competition Authorities
NIS	Network and Information Security
PS	Pilot Site
SC	Supply Chain
SEM	Structural Equation Model
TFEU	Treaty of the Function of the European Union
TOC	Transport Operation Category
VC	Vertical Collaboration
WP	Work Package
WPL	Work Package Leader

Publishable Executive Summary

ADMIRAL seeks to develop and pilot AI-driven solutions for managing logistics supply chains to reduce transport and logistics emissions and to increase transparency, resilience, and stakeholder cooperation. This deliverable reports the results of the Task 3.2 - Drivers, barriers, legislation and contractual boundaries towards horizontal collaboration - carried out in the project's Work Package 3 - Business models for sustainable transports.

The primary aim of Deliverable 3.2 is to identify and propose strategies for designing the ADMIRAL Marketplace to effectively overcome common collaboration barriers - built as collaborative by design and maximize the expected project impact.

To identify and propose strategies, a two-way approach was followed: "Desktop research" to identify the key characteristics (barriers, drivers, and strategies) of horizontal and vertical collaboration in logistics, highlighting the strategies with the highest potential to enhance environmental sustainability, and "Co-definition workshops" carried out with the project pilots to confirm the literature findings and tailor them to the specific needs of the ADMIRAL Marketplace. As a result, specific strategies have been proposed to address recurring logistics collaboration barriers and ensure the successful operation of the Marketplace.

The main study conclusions can be summarised as follows:

- To overcome collaboration barriers, strategies such as establishing clear governance frameworks, fostering open communication, and leveraging advanced technologies are essential for creating a resilient and efficient supply chain.
- Legislation and contractual considerations are crucial in logistics marketplaces to ensure compliance with legal standards, protect all parties, and manage risks.
- The ADMIRAL marketplace's successful operation hinges on meticulous legal and regulatory compliance, ensuring fair competition, robust data protection, and comprehensive cybersecurity.
- Information sharing resistance is a major challenge for collaborative logistics.
- The ADMIRAL marketplace serves as the main strategy to overcome this challenge, addressing issues such as the lack of interoperability, standardization, security, etc.
- Green strategies that can be employed towards logistics collaboration in the context of ADMIRAL Marketplace.

1 Introduction

1.1 Purpose of the report

ADMIRAL seeks to develop and pilot AI-driven (Artificial Intelligence-driven) solutions for managing logistics supply chains, including related missions to reduce transport and logistics emissions and increase transparency, resilience of logistics supply chains, and stakeholder cooperation. One key vision - and an expected result - of the ADMIRAL project is to develop a digital marketplace that enables emissions-aware logistics services planning and purchasing. The marketplace, called the ADMIRAL Marketplace (ADMIRAL MP), aims to connect all relevant logistics value chain actors from shippers to consumer deliveries, especially adding emissions data sharing services. Additionally, the ADMIRAL marketplace works as a channel for solution developers to distribute their innovative and sustainability-focused solutions to the market.

Specifically, WP3 aims to better understand the collaborative value creation, value delivery, value capturing and value sharing business models in novel transportation horizontal networks and marketplace. The objective is to innovate, develop and demonstrate potential new collaborative governance practices and business models based on research studies and all pilots and emerged cooperation competence skills and AI platform related functionalities. WP3 also clarifies the need for contractual framework development, necessary legal boundaries and contributes needed legislative issues. This report continues the efforts of WP3 in analysing new business models (Task 3.1, Del. 3.1) for sustainable transport by studying key drivers, barriers, and strategies in multimodal logistics collaboration, with a focus on both horizontal and vertical collaboration, and aiming to address value chain interests and mitigate risks of suboptimization. The deliverable reports the results of the Task 3.2 - Drivers, barriers, legislation and contractual boundaries towards horizontal collaboration - carried out in the project's Work Package 3 - Business models for sustainable transports.

Following the analysis of the reference studies (T3.1), T3.2 continues the work by identifying key drivers and barriers and demonstrating them explicitly including logistics and operational issues, emission gains and new business opportunities. Barrier and driver study covers also regulation and contracting issues. Legislation study carried out includes EU competition policy (antitrust) and environmental (e.g., green deal) aspects, but also pooling and logistics network widening related legislative constraints/opportunities. The scope of Deliverable 3.2 - Drivers and barriers of collaboration in logistics networks is to explore and enhance collaboration in logistics operations by identifying key barriers, drivers, and strategies, with a particular focus on digital logistics marketplaces.

The primary aim of Deliverable 3.2 is to identify and propose strategies for designing the ADMIRAL Marketplace to effectively overcome common collaboration barriers – built as collaborative by design.

Deliverable 3.2 provides a detailed literature review, defines vertical and horizontal collaboration, and introduces a methodological framework applied at ADMIRAL pilot sites to validate and select strategies and legal considerations for overcoming collaboration challenges. The deliverable concludes with key findings to guide further development and operation of the ADMIRAL Marketplace. It gives information to Task 3.3 Exploration of new innovative Business models, Task 3.4 Network development and governance practices, Task 3.5 The concept of multimodal marketplace and innovation platform functionality, and to WP4 – Marketplace development, WP5 – Pilots, WP6 – Impact assessment.

1.2 Methodology of the Report

The methodological framework used in this report is two-fold. On one hand it assesses the extant literature to identify common drivers, barriers and strategies in logistics collaboration, while on the other hand it validates the review results for their applicability in the ADMIRAL pilot sites to propose solutions that could be used in the development of the ADMIRAL Marketplace.

The methodology of the report unfolds in a two-way approach:

- **Desktop research**: A comprehensive literature review was conducted to identify the key characteristics of horizontal collaboration (HC) and vertical collaboration (VC) in logistics. Barriers, drivers, and strategies were categorized based on the project scope and requirements. Additionally, strategies with the highest potential to overcome collaboration barriers and enhance environmental sustainability were highlighted. Furthermore, the main strategies aimed at overcoming these barriers were cross-examined with the challenges faced by the ADMIRAL Marketplace, providing valuable insights for its implementation. The research also included an analysis of regulatory and contractual aspects, focusing on European Union (EU) competition policies (antitrust), environmental considerations, and constraints and opportunities related to pooling and logistics network expansion.

- **Co-definition workshops**: A five-step validation process was carried out with the project pilots to confirm the literature findings and tailor them to the specific needs of the Marketplace. Through internal co-definition workshops with the pilots, key drivers and barriers in multimodal logistics (including logistics and operational challenges, emission reduction goals, and new business opportunities) were identified. The importance of these factors was then validated by pilot stakeholders within the scope of the ADMIRAL Marketplace. As a result, specific strategies have been proposed to address recurring logistics collaboration barriers and ensure the successful operation of the Marketplace.

Figure 1, below, presents an overview of the methodology, starting from the analysis of the extant literature to the final synthesis of the results and the proposition of specific strategies for digitally aid logistics collaboration, through the ADMIRAL Marketplace.

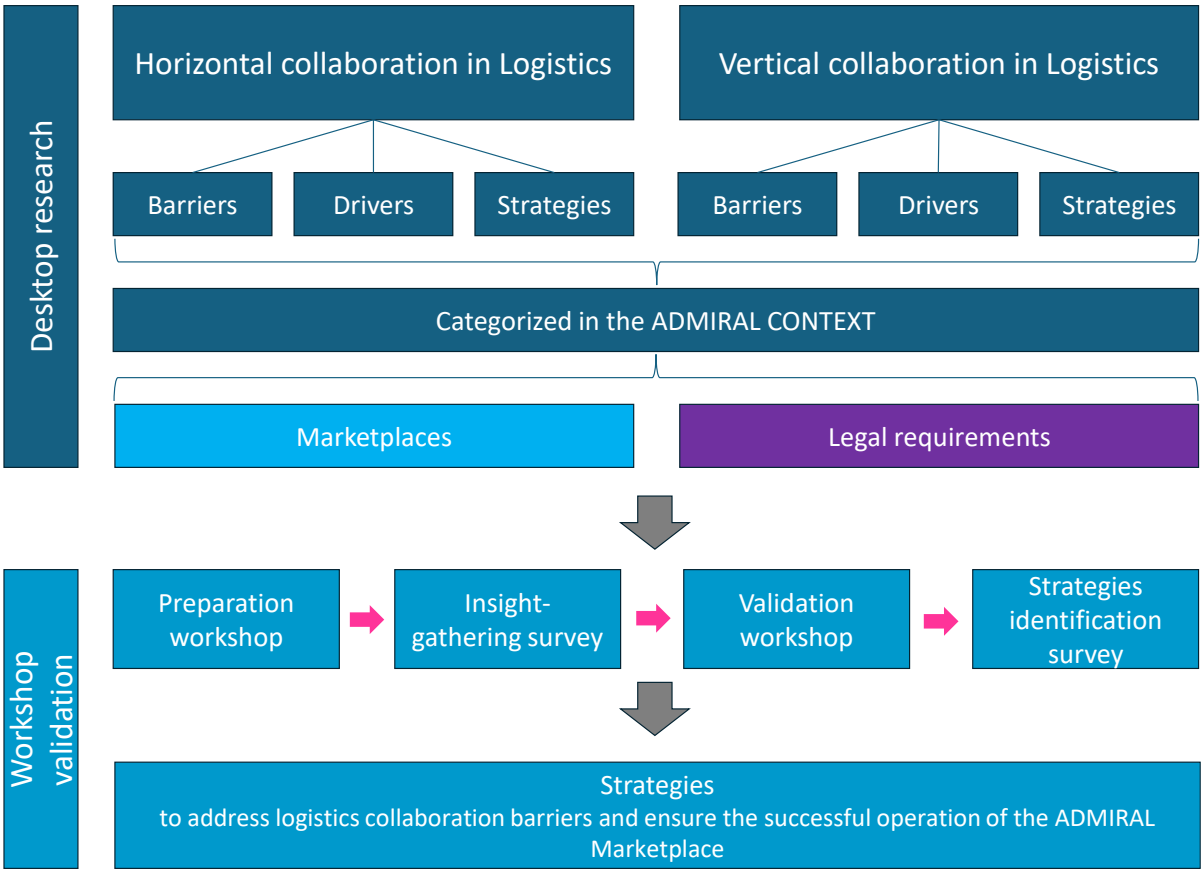

Figure 1. Overview of the report methodology

Regarding the co-definition workshops, a methodological framework has been developed for validating and selecting the most appropriate drivers, barriers, and strategies for the ADMIRAL Marketplace. This framework incorporates collaborative tools and involves the participation of all ADMIRAL project partners, not only those at the pilot sites. Since the primary objective is to identify strategies to overcome the identified barriers, a holistic approach has been adopted to ensure the effectiveness of this process.

1. **Preparation workshop:** An online workshop ("Drivers and Barriers towards Collaboration in Transport and Logistics", 23/4/2024) aiming to inform the participants about the methodological framework for the identification and validation of drivers and barriers, and to help them understand which of the identified topics are pertinent to their pilot site operations.

2. **Insight-gathering survey:** An online survey (mid-May 2024) to gather detailed insights into the drivers, barriers, and other factors impacting horizontal and vertical collaboration in the ADMIRAL pilot sites, uncovering two key aspects: the types of collaboration utilized within each pilot site and the barriers/drivers affecting both vertical and horizontal collaboration.

3. **Validation workshop:** A physical workshop (held in Vilnius, Lithuania on May 28-29, 2024) aiming to validate the most common responses from the ADMIRAL consortium and present the linkages between barriers, strategies, and expected project impacts. Participants had the opportunity to discuss the results and share their views on barriers and potential strategies for the ADMIRAL project.

4. **Strategies identification survey:** Pilot site partners were asked to identify strategies specific to overcoming the barriers at their respective pilot sites through a tailored online questionnaire. A tailored online questionnaire (ANNEX IV) was sent to each pilot site, asking relevant partners to identify strategies addressing the most significant barriers identified at their sites.

5. **Analysis and synthesis of results:** The results are validated and analysed to develop and propose a comprehensive list of strategies for overcoming the barriers that project partners are expected to encounter during the operation of the ADMIRAL Marketplace.

1.3 Structure of the report

The deliverable is structured as follows. Chapter 1 introduces the deliverable, and the methodologies used. Chapter 2 provides an understanding of the collaboration in logistics operations, defining the main characteristics of vertical and horizontal collaboration. Chapter 3 presents the detailed finding of the literature review concerning the barriers, drivers, and strategies, with a special focus on digital logistics marketplaces. Chapter 4 presents the methodological framework that was employed across the ADMIRAL pilot sites for the validation and selection of the most appropriate strategies and legal considerations to overcome typical logistics collaboration barriers and ensure the successful development and operation of the ADMIRAL Marketplace. Finally, key findings are concluded in Chapter 5, feeding further works in the project.

2 Understanding logistics collaboration

This section defines the various forms and benefits of collaboration within logistics and supply chain management. It explores how partnerships between firms can enhance efficiency, drive innovation, and optimize overall value chain performance. The following subsections provide insights into key types of collaboration. Subsection 2.1 discusses collaboration as a strategic tool for optimizing value chain interests. Subsection 2.2 focuses on vertical collaboration, which involves partnerships between different stages of the supply chain, such as buyers and suppliers. Subsection 2.3 provides an overview of horizontal collaboration, where firms at the same level in the supply chain, including competitors, work together to achieve mutual benefits.

2.1 Collaboration as leverage to optimize value chain interests

In today's business world, factors such as global markets, evolving customer needs, and sustainability are having a significant impact. Companies are continuously seeking new ways to make their logistics and supply chain operations more efficient and responsive to dynamic market demands to remain competitive. Supply chains, spanning from the initial supplier to the end-user, including reverse logistics, require the identification of optimal strategies for inter-firm integration and overall chain optimization (Kotzab et al., 2019).

Prior to 2010, research funded by the EU predominantly focused on technical innovations within transport infrastructure, vehicles and Information & Communication Technologies (ICT) (Cruijssen, 2020). Nowadays, companies find that collaboration is an effective way to improve how they operate and meet their goals for being economically, environmentally, and socially responsible.

However, a single company can seldom successfully compete in isolation (Aloui et al., 2020; Vanovermeire & Sörensen, 2014; Stellingwerf et al., 2018; Cao & Zhang, 2011). Resource constraints are a significant disadvantage affecting the existence, development, and growth of companies, especially the small and medium (SMEs) ones, hindering efficiency at the firm level. These constraints often involve a shortage of resources and competences (Paradkar et al., 2015).

Collaboration facilitates access to various capabilities (Soosay & Hyland, 2015), as well as overall supply chain efficiency and resilience (Lofti & Larmour, 2021) through a seamless shift from independent supply chains to interconnected global supply networks (Cruijssen, 2020). Logistics and supply chain collaboration involves two or more independent firms working together, and in some cases, even acting as a single entity (Kotzab et al., 2018). This partnership includes sharing information and adjusting business practices to execute joint supply chain operations and improve overall performance (Lotfi & Larmour, 2021; Soosay & Hyland, 2015). Collaboration can take different forms, such as working with unrelated or competing organizations at the same level (horizontal collaboration), fostering hierarchical relationships within a supply chain (vertical collaboration, e.g., between buyers and sellers), or combining both approaches (integrated and lateral collaboration).

While there are instances of successful collaboration, it is overstated to claim that the logistics industry has undergone a significant paradigm shift and has universally transitioned from competition to collaboration (Cruijssen, 2020). Managing these collaborations is challenging because they are typically long-term, and partners need to develop trust among them, and understand each other's abilities, needs, and, sometimes, weaknesses. Companies must rely more on each other, be less opportunistic, and give up some control to their partners. Collaborations are also complicated, unclear, and sometimes even risky but can, on the other hand, deliver substantial benefits and advantages to the involved partners (M. Ralston et al., 2017; Whipple & Russell, 2007).

There are significant reasons for two or more organizations to engage in collaboration; for the collaboration itself to be successful however, whether it is horizontal or vertical, the partners must establish a certain level of commitment and trust (Soosay & Hyland, 2015) and share mutual objectives so “each participant [to] share gains and losses equally” (Lofti & Larmour, 2021, p.42). The goals and objectives must also be clear (Soosay & Hyland, 2015), as entering collaborations of any type may pose liabilities if not managed properly.

Effective governance is essential for both vertical and horizontal collaboration to thrive based on trust and open communication. Successful collaboration necessitates formalized agreements, especially in horizontal collaborative relationships, where coordination failures and risks, as well as unclear partner responsibilities, are more prevalent compared to vertical collaboration (Lofti & Larmour, 2021). Nevertheless, supply chain management discourse has progressed form the strategic level (trust, commitment, etc.) to consider operational aspects as well, such as collaborative purchasing, vendor management inventory and online collaboration (Sudusinghe & Seuring, 2022).

Usual reasons for firm collaboration may include process efficiency, flexibility (resilience & agility), business synergy, better quality, innovation, and sustainability (Cao & Zhang, 2011; Lofti & Larmour, 2022).

Process efficiency denotes the degree to which a supply chain partner gains a competitive edge over rivals through collaboration. Collaborative processes can take various forms, including sharing information with partners, sharing assets, enabling joint logistics or other operations, participating in joint decision-making, jointly managing risks, and engaging in the joint development of products or services. Demonstrations of process efficiency include reductions in lead time, operating costs, and inventory levels, as well as improvements in service or product characteristics and a lower environmental footprint (Cao & Zhang, 2011; Vanovermeire & Sörensen, 2014).

Greater flexibility refers to the responsiveness and agility of collaborating supply chain partners. These terms highlight a company's ability to quickly adapt to changes in customer requirements, unforeseen events, or similar circumstances. Real-time data sharing among diverse supply chain partners and collaborative predictions enhances the agility and resilience of the entire supply chain.

This, in turn, boosts customer interest in a product or service and strengthens the overall robustness of the supply chain (Scholten & Schilder, 2015; Cao & Zhang, 2011). Supply chain **resilience** refers to the ability of a supply chain to withstand and recover from disruptions, challenges, or unexpected events while maintaining its essential functions and operations. It involves the capacity to anticipate, adapt to, and mitigate risks, ensuring continuity of supply and minimizing the impact of disruptions on the overall performance of the supply chain. Resilient supply chains are characterized by their flexibility, redundancy, transparency, and responsiveness, allowing them to effectively manage disruptions and recover quickly to maintain business continuity and meet customer demands. Recent research indicates that both main types of collaboration, vertical and horizontal, can help organizations to increase resilience within and across supply chains, when governance and competition are managed sensibly (Lofti & Larmour, 2022).

Collaboration among supply chain partners enhances **business synergies** in several ways. It optimizes resource use by allowing partners to work together efficiently, utilizing shared resources such as transportation capacity and common ICT infrastructure. Additionally, it enables collective risk management, where partners collaborate to share and manage risks, fostering a more resilient business ecosystem. By combining purchasing power and negotiating better deals, companies also benefit from economies of scale, which ultimately lead to overall cost reduction. These collaborative practices enable businesses to make the most of shared resources, create a stronger and more resilient business environment, and reduce costs while fostering the development of new products and services (Cao & Zhang, 2011; Simatupang & Sridharan, 2002).

Quality improvements can be achieved through various supply chain collaboration mechanisms, offering benefits to the supply chain, its partners, and ultimately, customers. These include the sharing of knowledge and best practices, which fosters continuous improvement. Real-time information sharing enables the prompt identification and resolution of issues, ensuring higher quality outputs. Joint quality control efforts result in a more comprehensive and effective quality assurance process. Additionally, collaborative partners can engage in joint problem resolution, pooling their resources to address challenges quickly and efficiently (Cao & Zhang, 2011; Doganay & Ergun, 2017; McLaren et al., 2002). By sharing knowledge, learning together, and solving problems jointly, collaborating partners can introduce **innovation** in the form of new processes, products, and services. This is crucial in today's environment with shorter product life cycles and ever-changing customer demands. Such collaboration enhances the agility and competitiveness of the entire supply chain, potentially leading to a leading market position (Soosay et al., 2008; Cao & Zhang, 2011; Jimenez-Jimenez et al., 2019).

Supply chain collaboration is a key enabler of **sustainability**, promoting resource efficiency, shared environmental goals, reduced carbon footprints, circular economy practices, innovation for sustainability, risk mitigation, and stakeholder engagement. Collaborative efforts allow partners to

optimize the use of resources such as raw materials, energy, and transportation, contributing to reduced environmental impact and supporting sustainable practices. When supply chain partners align on common sustainability objectives, it fosters a collective commitment to minimizing environmental harm. Collaboration in areas like transportation and logistics leads to optimized routes, lower emissions, and overall reduced carbon footprints. Additionally, collaborative initiatives encourage circular economy principles such as recycling and reuse. By fostering innovation, collaborative partnerships can focus on sustainability, leading to the development of eco-friendly products, processes, and technologies (Chen et al., 2017; Morali & Searcy, 2013; Arrigo, 2021).

To capitalize on the benefits of supply chain collaboration, companies rely, as mentioned earlier, on various collaboration types, with the two most prominent types being collaborations across supply chains – or vertical collaborations – and collaboration between supply chains – or horizontal collaborations.

2.2 Vertical collaboration overview

Vertical collaboration (VC) happens when multiple organizations, such as manufacturers, distributors, carriers, and retailers, collaborate by sharing responsibilities, resources, and performance information to enhance overall supply chain efficiency (Cruijssen, 2020; Lofti & Larmour, 2022). It refers to inter-firm cooperation within a supply chain, involving collaboration with organizations either upstream or downstream in the supply chain.

VC in transport and logistics is a well-researched topic (Basso et al., 2019), at least from a dyadic "buyer-supplier" point of view (Soosay & Hyland, 2015; Sudusinghe & Seuring, 2022). It takes many forms requiring different breadth/depth of collaboration and governance structures that range from transactional relations, cooperative agreements, strategic alliances and joint ventures to vertical integration. According to Tokman et al. (2007) (cited in Soosay & Hyland, 2015), the higher uncertainty tends to drive firms towards controlling activities through long-term collaborative relationships or vertical integration, rather than relying on short-term relationships.

Sudusinghe & Seuring (2022), reviewed the literature to identify usual practices in VC. According to the authors, VC encompasses a wide range of practices relevant to supply chain collaboration that improve environmental, social and economic sustainability performance. These range from established concepts such as information sharing, risk mitigation and responsibility sharing, trust and commitment and various integrations to more contemporary and specific practices regarding incentives for sustainability, green purchasing, just-in-time processes, and vendor managed inventory. Examples of VC activities are summarized in the following table (Table 1).

Table 1. Vertical collaboration activities/types in transport and logistics

VC activities/types	Description	Key Characteristics
Information sharing	Sharing core business data with key suppliers/customers	Sales forecasts, production plans, order tracking and tracing, delivery status, stock level
Joint problem solving & knowledge creation	Collaboration in addressing shared challenges and generating new knowledge	Process improvements (distribution, inventory management and procurement) - e.g., green purchasing
Joint planning & decision synchronization	Collaborative planning and decision making	Manufacturing, budgeting, and demand planning
Leveraging and sharing resources and skills	Collaborate to effectively use resources and capacities among partners' operations	Common use of transport and distribution networks, skills, and capabilities.
Joint risk mitigation & performance measurement	Setting joint performance targets, responsibilities and risk mitigation frameworks	Identify risks in advance and set Performance (PI) and Key Performance Indicators (KPI) across the supply chain
Operational integration	Integration and alignment of processes and operations	Technological systems, infrastructures, logistics operations

The related benefits of vertical collaboration that are recorded in recent literature are considerable and refer to the triple bottom line of sustainability performance (Sudusinghe & Seuring, 2022). Potential benefits identified in bibliography include cost reductions (Lofti & Larmour, 2022; Fawcett et al., 2008; Soosay & Hyland, 2015; Sudusinghe & Seuring, 2022), higher revenues (Fawcett et al., 2008; Sudusinghe & Seuring, 2022), decreased process times (Fawcett et al., 2008; Soosay & Hyland, 2015), more flexible and resilient supply chains (Lofti & Larmour, 2022; Fawcett et al., 2008; Soosay & Hyland, 2015), as well as more innovative (Lofti & Larmour, 2022; Soosay & Hyland, 2015) and sustainable (Soosay & Hyland, 2015; Sudusinghe & Seuring, 2022) overall operations.

However, although VC has recorded important benefits, there are still some caveats that require attention. Most of multimodal freight transport and logistics stakeholders operate in dysfunctional information silos (Soosay & Hyland, 2015), through unconnected proprietary legacy systems that lack necessary standardization aspects (Cruijssen, 2020); sometimes, within contradictory contextual and legislative settings (e.g., different laws across EU) (Lofti & Larmour, 2022).

Table 2 presents an overview of the most important potential benefits and challenges of vertical collaboration in transport and logistics, derived from the literature above.

Table 2. Potential benefits and challenges of vertical collaboration in transport and logistics

Potential benefits of VC	• **Cost/waste reductions across the supply chain**: Elimination of unnecessary processes, economies of scale (stock/inventory reduction, flow efficiency), asset utilization. • **Increased revenue**: Resulting from higher sales, improved pricing strategies, or expanded market share. • **Decreased times**: Reduction in the duration required to complete a specific task, operation, or workflow (e.g., order cycle). • **Flexibility and resilience**: Responding to changing demands and operating requirements • **Risk management**: Identifying, assessing, and mitigating potential threats or uncertainties to achieve organizational objectives. • **Process efficiency**: End-to-end operations for improved customer satisfaction and increased market responsiveness (e.g., Increased inventory turnover). • **Quality and innovation – new knowledge**: Creation of novel advancements to enhance products, processes, or services. • **Sustainability**: Supply chain collaborations to achieve environmental performance.
Challenges in VC	• **Regulatory forces &compliance**: Legal framework incompatibility across EU. • **Coordination & accountability**: Governance considerations of intricate supply chains and multiple stakeholders. • **Dysfunctional silos - limited share of proprietary information**: Organizational structures and practices that inhibit the flow of information and collaboration. • **Low levels of trust among firms - commitment issues**: Reliability, integrity, and willingness of partners to fulfil their obligations in collaborative endeavours. • **Standardization**: Unconnected proprietary legacy systems that lack necessary standardization aspects and mismanaged standards. • **Different power structures between organizations**: Unequal distribution of information - dependency on the supply chain "leader". • **Cultural forces & socio-economic considerations**: Influencing collaboration behaviours, attitudes, and practices within a given context.

2.3 Horizontal collaboration overview

This section follows the work that has been performed in Del. 3.1: Horizontal collaboration business models, to further investigate their characteristics in the context of ADMIRAL Marketplace. Horizontal collaboration (HC) models refer to partnerships between companies that are typically competitors or operate at the same stage of the supply chain, rather than at different levels as in vertical collaboration (Basso et al., 2019; Ferrell et al., 2020). These models involve companies pooling resources, sharing information, and aligning their operations to achieve mutually beneficial outcomes, such as cost reduction, improved efficiency, and enhanced market reach. HC can take various forms, including joint distribution networks, or shared logistics services. It is particularly valuable in logistics industry where companies face similar challenges, such as transportation costs, environmental pressures or supply chain disruptions. By collaborating, companies can achieve economies of scale, reduce redundancies, and improve service quality without necessarily merging or losing their individual identities. HC also allows companies to innovate collectively, enhancing competitiveness and responding more effectively to market changes. Trust, transparency, and

strategic alignment are critical components of successful horizontal collaboration, as companies must anticipate worries on profit-sharing, and competitive concerns.

These models vary in level of integration and scope, as can be seen in the following table (Table 3).

Table 3. Horizontal collaboration activities/types in transport and logistics

HC activities/types	Description	Key Characteristics
Coordinated transport	Basic collaboration involving joint planning and scheduling	Shared route information, coordinated delivery schedules
Shared resources	Sharing assets like vehicles, warehouses, or personnel	Pooling resources (e.g., trucks, warehouses), inventory optimization, cost savings through shared infrastructure
Joint services	Offering combined services to customers	Bundling services (e.g., transportation and warehousing), enhanced customer value, traffic and environmental benefits
Strategic alliances	Long-term partnership	Mutual trust and commitment, economies of scope, economies of scale
Ad-hoc integrations	Collaboration without formal agreement	Informal relationships, better utilization of resources

Cooperation between logistics parties has become one of the most effective approaches to improving the efficiency and sustainability of freight transport (Goldsby et al., 2014). Horizontal collaboration promotes knowledge sharing, resource sharing and joint problem solving. Cruijssen (2006) showed that HC brings benefits in terms of faster response, innovation, cost reduction and growth. Leitner et al. (2011) backed up these statements with figures; they found that logistics providers could save 15% if they shifted the main leg to rail and optimized the collection and distribution of goods to and from transhipment points. HC helped competitors based in Spain to reduce the number of journeys by 14% and cut fuel consumption and carbon dioxide emissions by 17%. So, by working together, it is also possible to eliminate congestion, improve safety and reduce environmental impact. However, horizontal cooperation faces practical problems and challenges (Table 4) such as trust and information deficits. Basso et al. (2019) claimed that the practical problems can vary greatly depending on the type of horizontal collaboration.

HC requires a high degree of digital maturity; a wide range of information and communication technologies are used to create more productive, adaptable, responsive and long-term solutions. Technologies such as cloud, Internet of Things (IoT), big data, mobile apps, machine learning and AI can help the Logistics Service Providers (LSP) to establish a real-time exchange of information about participants, mutual benefits, transportation resources and associated costs, etc. (Abideen et al., 2023).

Table 4 presents an overview of the most important potential benefits and challenges of horizontal collaboration in transport and logistics.

Table 4. Potential benefits and challenges of horizontal collaboration in transport and logistics

Potential benefits of HC	• **Faster response:** Enables companies to quickly share information and resources, allowing them to respond more rapidly to market changes and customer demands, enhancing overall agility. • **Innovation:** Firms can pool their diverse expertise and insights, fostering a culture of innovation that leads to the development of new products, services, and processes. • **Cost reduction:** Shared resources lead to economies of scale, allowing participating companies to lower operating costs through bulk purchasing, shared logistics, and combined efforts in production and distribution. • **Greater efficiency:** Optimized vehicle utilization by coordinating routes and schedules among partners, resulting in fewer empty runs and more efficient use of transport resources. • **Environmental benefits:** Optimized transport routes and shared logistics, companies can significantly reduce fuel consumption and emissions, contributing to a more sustainable supply chain. • **Inventory optimization:** Collaborative efforts in demand planning and resource sharing lead to lower inventory levels, reducing holding costs and minimizing waste. • **Improved customer service:** By enhancing coordination and communication, horizontal collaboration ensures on-time delivery and superior service quality, leading to increased customer satisfaction and loyalty.
Challenges in HC	• **Competition law concerns:** Cooperation between competing firms can lead to legal issues under antitrust laws, as joint activities may be viewed as collusion or anti-competitive behaviour, requiring careful navigation to ensure compliance. • **Trust and coordination challenges**: Successful horizontal collaboration hinges on building mutual trust among partners, which can be difficult; without it, effective coordination and communication may suffer, hindering collaborative efforts. • **Information sharing risks**: Sharing sensitive data can pose risks, such as breaches of confidentiality or misuse of proprietary information, making firms hesitant to fully engage in open communication about their operations. • **Complexity**: Managing collaborative networks can introduce complexities, including the need for clear governance structures, effective communication channels, and the ability to navigate differing organizational cultures and processes. • **Loss of autonomy**: In collaborative arrangements, companies may need to make compromises that can limit their decision-making power and operational freedom, potentially impacting their competitive positioning.

3 Drivers and Barriers for logistics collaboration: Current affairs in research and practice

This section explores the various factors that influence logistics collaboration within supply chains, focusing on barriers, drivers and underlying strategies for vertical and horizontal collaboration. In subsection 3.1, the focus is on vertical collaboration, examining the specific barriers that organizations face, such as power imbalances and regulatory challenges, while also highlighting effective strategies and drivers that can facilitate better cooperation between different levels of the supply chain. Meanwhile, subsection 3.2 shifts the focus to horizontal collaboration, analysing the unique challenges encountered among organizations at the same level, including competitive concerns and information sharing risks. This section aims to provide a comprehensive overview of the current research and practical applications in the field, offering insights into how logistics collaboration can be optimized for improved operational efficiency and effectiveness.

3.1 Vertical Collaboration

3.1.1 Drivers for vertical collaboration in logistics

Several key drivers motivate organizations to engage in vertical collaboration, including the need to reduce costs, enhance service quality, respond to increasing customer demands, and adapt to market volatility. Technological advancements, sustainability initiatives, and competitive pressures also play significant roles in encouraging closer cooperation among supply chain partners. By fostering deeper collaboration, companies can achieve greater efficiency, flexibility, and resilience in an increasingly complex logistics environment.

Summarizing the literature findings (Table 5), the drivers for vertical collaboration in logistics can be grouped into the following key categories:

1. **Technology and Innovation**: Organizations leverage advanced technologies like AI, blockchain, and IoT to enhance efficiency, visibility, and automation. Collaboration fosters a culture of innovation, accelerates R&D, and enables access to diverse expertise for problem-solving and performance improvements.

2. **Economic and Efficiency**: Cost reduction is critical, achieved through optimized procurement, streamlined operations, and data analytics. Collaborative efforts help minimize delivery times, improve asset utilization, and increase revenues by expanding market reach and optimizing resources.

3. **Governance and Regulation**: Compliance with regulations such as Scope 3 emissions requirements and faster conflict resolution are essential. Collaboration ensures adherence to sustainability mandates and facilitates smoother communication and issue resolution.

4. **Market and Business**: Responding to increased customer demand, improving global market positioning, and ensuring supply chain resilience are vital. Strategic synergies and competitive advantages are formed through collaboration to better serve customers and maintain continuity in operations.

5. **Sustainability**: Reducing environmental impacts, such as carbon emissions, and promoting ethical sourcing align with corporate social responsibility, ensuring long-term ecological balance and sustainability throughout the supply chain.

The following table (Table 5) summarizes the main drivers that have been identified in the literature.

Table 5. Drivers for vertical collaboration

Cate-gory	Driver	Description	Reference
Technology and innovation	Technological advances or innovative tools	Access external innovative expertise in artificial intelligence, blockchain, and Internet of Things (IoT) in logistics operations to enhance efficiency, visibility, and automation	Fawcett et al., 2008 Cheng et al., 2010 Guan et al., 2012 Singh et al., 2018 Huang et al., 2020 Solaimani & van der Veen, 2022
	Ability to foster innovation	Foster a culture of experimentation and creativity, leading to accelerated R&D cycle times, enabling rapid prototyping, testing, and implementation of new ideas, technologies, and processes to drive continuous improvement	Fawcett et al., 2008 Singh et al., 2018 Huang et al., 2020 Solaimani & van der Veen, 2022
	Access to expertise and knowledge	Tapping into diverse perspectives, specialized capabilities, and novel insights from external partners or stakeholders and expanding the collective knowledge base to address complex challenges and drive performance improvements	Soosay et al., 2008 Guan et al., 2012 Singh et al., 2018 Huang et al., 2020 Solaimani & van der Veen, 2022
Economic and efficiency	Costs reduction[2]	Maintain competitiveness and profitability through optimized procurement strategies and streamlined operational processes to minimize expenses through strategic sourcing, implementing just-in-time practices, and leveraging data analytics	Fawcett et al., 2008 Guan et al., 2012 Singh et al., 2018 Chen et al., 2017 Huang et al., 2020 Ho et al., 2019 Solaimani & van der Veen, 2022 Kalaiarasan et al., 2022 Zhang et al., 2023
	Minimize delivery times	Minimize delays and waiting times through streamlined processes, optimized inventory management, and agile supply chain orchestration to ensure reliable fulfilment of customer orders through robust demand forecasting, efficient transportation	Fawcett et al., 2008 Singh et al., 2018 Zhang et al., 2023

[2] operational costs

Cate-gory	Driver	Description	Reference
		management, and proactive risk mitigation strategies	
	Better use of assets and resources	Improve overall operational performance and profitability through maximizing the efficiency and productivity of resources such as vehicles, equipment, and facilities	Fawcett et al., 2008 Singh et al., 2018 Chen et al., 2017 Zhang et al., 2023
	Improve operational efficiency and productivity	Drive sustainable growth and competitive advantage within the market through collaboration for optimizing operational processes, leveraging technology, and investing in employee training	Fawcett et al., 2008 Cheng et al., 2010 Singh et al., 2018 Huang et al., 2020
	Increased revenues	Increase sales or revenue opportunities resulting from synergistic efforts, expanded market reach, and improved product/service offerings	Cheng et al., 2010 Guan et al., 2012 Singh et al., 2018 Kalaiarasan et al., 2022 Zhang et al., 2023
	Access to resources	Leverage external assets to optimize operations, enhance scalability, and mitigate risks	Guan et al., 2012 Huang et al., 2020
Governance and regulation	Regulation and Legislation compliance *(e.g., Scope 3 regulation)*	Compliance due to stricter regulations and laws, power dynamics or operational necessities	Cheng et al., 2010 Soosay & Hyland, 2015 Sudusinghe & Seuring, 2022 Kalaiarasan et al., 2022
	Sustainability requirements *(e.g., ESG, etc.)*	Compliance with SCOPE 3 requirements across the supply chain	Soosay & Hyland, 2015 Solaimani & van der Veen, 2022 Sudusinghe & Seuring, 2022 Kalaiarasan et al., 2022 Stenzel & Waichman, 2023
	Faster conflict resolution	Proactive communication channels, conflict resolution mechanisms, and collaborative problem-solving approaches to address disputes swiftly, prevent escalation, and maintain positive relationships	Guan et al., 2012
Market and business	Increased customer demand and satisfaction	Decision to meet expectations for faster delivery, personalized experiences, and seamless omnichannel interactions, necessitating agile supply chain strategies, robust inventory management, and responsive customer service	Fawcett et al., 2008 Guan et al., 2012 Singh et al., 2018 Cleophas et al., 2019 Kalaiarasan et al., 2022 Zhang et al., 2023
	Better market global positioning/Competition	Differentiation/Competitive advantages through value-added services to secure market share, enhance efficiency, deliver superior customer value, extending geographical coverage, accessing new markets, and increasing market share	Fawcett et al., 2008 Cheng et al., 2010 Guan et al., 2012 Singh et al., 2018 Huang et al., 2020

Cate-gory	Driver	Description	Reference
	Reliability/Resilience	Maintain continuity of operations, ensuring resilience and adaptability within the supply chain through robust risk management strategies, real-time visibility, and agile response mechanisms	Fawcett et al., 2008 Guan et al., 2012 Singh et al., 2018 Huang et al., 2020 Solaimani & van der Veen, 2022 Kalaiarasan et al., 2022 Zhang et al., 2023
	Developing strategic synergies	Developing strategic partnerships to achieve shared long-term objectives and create mutual value within the supply chain ecosystem	Cheng et al., 2010 Guan et al., 2012 Chen et al., 2017 Singh et al., 2018 Huang et al., 2020
Sustainability	Reduce environmental impacts	Achieve long-term ecological balance and meet regulatory requirements through reducing carbon emissions, minimizing environmental impact, and promoting ethical sourcing and transport practices	Soosay & Hyland, 2015 Solaimani & van der Veen, 2022 Sudusinghe & Seuring, 2022 Kalaiarasan et al., 2022 Stenzel & Waichman, 2023
	Ensuring social welfare	Enhance corporate social responsibility within the supply chain through reducing carbon emissions, minimizing environmental impact, and promoting ethical sourcing and transport practices	

3.1.2 Barriers to vertical collaboration

While vertical collaboration in logistics offers numerous benefits, several barriers can hinder its successful implementation. These obstacles often arise from misaligned objectives, a lack of trust between partners, and concerns over data sharing and transparency. Additionally, differing organizational cultures, inadequate technological integration, and regulatory complexities can create friction, making collaboration challenging. Overcoming these barriers requires their meticulous identification and description.

Overall, barriers to vertical collaboration in logistics can be categorized into five key areas:

1. **Technology and Innovation**: Lack of systems standardization and technological incompatibility hinder communication and integration across supply chains. Additionally, knowledge asymmetry and insufficient skills or training slow down innovation and collaboration.

2. **Economic and Efficiency**: Inadequate cost appraisal makes it difficult to accurately assess the financial impact of collaboration, limiting its adoption.

3. **Governance and Regulation**: Barriers include unclear operational goals, lack of governance frameworks, inconsistent performance measurements, intellectual property concerns, and lack of trust. Complex regulations and cultural differences further complicate collaboration.

4. **Market and Business Models**: Resistance to change, protection of competitive advantages, customer demand challenges, and conflicting operational practices reduce the willingness of firms to collaborate.

5. **Information Sharing**: Hesitancy to share information, unequal distribution of power, and reluctance to share data hinder the flow of knowledge between partners, limiting the effectiveness of collaboration.

The main barriers in VC in logistics are summarized in the following table (Table 6).

Table 6. Barriers to vertical collaboration

Cate-gory	Barrier	Description	Reference
Technology and Innovation	**Lack of system standardization**	Lack of seamless system communication at the technical and semantics levels that hinder communication across the supply chain - *Lack of harmonized standards to measure Scope 3 emissions*	Cruijssen, 2020 Fawcett et al., 2008 Kalaiarasan et al., 2022 Singh et al., 2018 Soosay & Hyland, 2015 Stenzel & Waichman, 2023 Sudusinghe & Seuring, 2022
	Technological incompatibility	Lack of systems, siloed systems and system incompatibility	Cruijssen, 2020 Fawcett et al., 2008 Kalaiarasan et al., 2022 Singh et al., 2018 Soosay & Hyland, 2015 Stenzel & Waichman, 2023 Sudusinghe & Seuring, 2022
	Knowledge and innovation asymmetry	Challenges related to scaling-up and accelerating (open) innovation - *An excessive fixation or obsession with creating and adhering strictly to business cases, often at the expense of considering broader strategic goals, new developments, or long-term sustainability*	Solaimani & van der Veen, 2022
	Lack of skills, knowledge, training	Insufficient education, development, or skill-building initiatives for individuals involved in collaborative supply chain activities, resulting in potential inefficiencies, misunderstandings, and suboptimal performance	Kalaiarasan et al., 2022 Singh et al., 2018;
Economic and efficiency	**Inadequate cost appraisal**	Deficiencies in accurately assessing and evaluating the costs associated with various processes	Fawcett et al., 2008

Cate-gory	Barrier	Description	Reference
Governance and regulation	**Lack of clear operational goals and outcomes**	Unclear operational objectives and inconsistent outcomes	Fawcett et al., 2008
	Lack of governance planning	Inadequacy of established frameworks, policies, or protocols governing the formation, operation, and management of partnerships - *Synchronizing different tiers and modes for vertical collaboration*	Cleophas et al., 2019 Fawcett et al., 2008 Kalaiarasan et al., 2022 Singh et al., 2018
	Inconsistency in performance measurement	Inconsistencies between various performance indicators, goals, or metrics within an organization or across different entities - *Unsystematic measurement and monitoring of performance*	Fawcett et al., 2008 Singh et al., 2018
	Lack of intellectual property protection	Tendency to overprotect individual competitive advantages - *core capabilities, cost advantages* – or lack of intellectual property protection	Fawcett et al., 2008 Huang et al., 2020 Kalaiarasan et al., 2022 Solaimani & van der Veen, 2022;
	Lack of trust	Concerns about partner reliability, and ambiguity in decision-making processes	Soosay & Hyland, 2015 Singh et al., 2018 Chen et al., 2017 Huang et al., 2020 Sudusinghe & Seuring, 2022
	Cultural and language difficulties	Inherent challenges in communication, decision-making processes, and relationship-building	Soosay & Hyland, 2015
	Conflict over differing needs between partners	Degree of collaboration needs differ between industries, leading to sub-optimal outcomes	Soosay & Hyland, 2015 Kalaiarasan et al., 2022
	Complex legislation and regulation compliance	Regulatory frameworks, compliance requirements, and contractual obligations across different jurisdictions - *high levels of uncertainty leading to high costs for firms to report emissions*	Soosay & Hyland, 2015 Lofti & Lamour, 2022 Stenzel & Waichman, 2023
	Lack of Commitment	Reluctance among partners to fully engage, invest, or prioritize collaborative efforts, hindering the achievement of shared goals and mutual benefits	Fawcett et al., 2008 Singh et al., 2018
Market and business model	**Resistance of companies to change due to risk aversity**	Difficulties to shift companies' focus from individual competitive advantage to a collaborative view - *Lack of willingness to share risks and rewards*	Fawcett et al., 2008 Soosay & Hyland, 2015 Singh et al., 2018 Huang et al., 2020 Solaimani & van der Veen, 2022
	Individual competitive advantage protection	Tendency to overprotect individual competitive advantages or lack of intellectual property protection	Fawcett et al., 2008 Huang et al., 2020 Solaimani & van der Veen, 2022 Kalaiarasan et al., 2022

Cate-gory	Barrier	Description	Reference
	Customer demand challenges	Misunderstanding and miss-quantifying customer preferences, needs, and purchasing behaviour	Fawcett et al., 2008
	Disparate operational practices and routines	Varying methods and procedures employed by different organizations or departments within a supply chain.	Soosay & Hyland, 2015
Information sharing	**Resistance to information sharing**	Hesitancy to exchange data, knowledge, or insights within collaborative networks or business relationships. Inefficient flow and updates, inaccurate information, lack of timely information, low information accuracy.	Fawcett et al., 2008 Soosay & Hyland, 2015 Singh et al., 2018 Solaimani & van der Veen, 2022 Sudusinghe & Seuring, 2022 Huang et al., 2020 Kalaiarasan et al., 2022 Stenzel & Waichman, 2023
	Unequal distribution of power and information sharing among partners	Certain entities hold significantly more influence or access to critical data than others. This can create dependency, hinder effective decision-making, and limit the ability of less powerful partners to contribute meaningfully.	Soosay & Hyland, 2015 Solaimani & van der Veen, 2022

3.1.3 Strategies to overcome barriers for vertical collaboration in logistics

The main strategies to overcome barriers or VC unfold around the heart of collaboration and include building transparent information systems, cross-functional collaboration, and collaborative planning across the supply chain (Kulp et al., 2004; Mentzer et al., 2000; Monczka et al., 1998, as cited in Fawcett et al., 2008, Huang et al., 2020; Solaimani & van der Veen, 2021).

Accurate comprehensive measures for sustainability (Fawcett et al., 2008; Singh et al., 2018) are regarded as a significant way to overcome inadequate information sharing and increase customer responsiveness. Fawcett et al. (2008) also support that **supplier alignment and rationalization** is needed to face the inconsistency of operating goals among supply chain (SC) partners, and lead to consistent on-time delivery. They also argue that to handle the lack of willingness to share risks and rewards among partners, an **effective use of pilot projects** could be employed. **Process documentation and ownership clarity** should be clearly defined to resolve the lack of willingness to share information (Fawcett et al., 2008).

Huang et al. (2020) advocate in favour of a **collaborative initiative for incentive alignment** (i.e., sharing costs, risks, and benefits) through long-standing relationships founded on defined mechanisms between partners. Moreover, having shares with suppliers establishes and strengthens loyalty and trust. The benefits of such a relationship include opportunities of cost reduction.

Adopting a **strategic SC vision** in VC (Fawcett et al., 2008; Solaimani & van der Veen, 2021) and **strategic alignment around joint objectives** (Huang et al., 2020; Solaimani & van der Veen, 2021) are crucial to overcome the lack of stakeholders' alignment with the shared vision, the lack of top management commitment and the inadequate information sharing and achieve shared exploitation of existing resources. However, it is not just the top management commitment that needs to be addressed, but the overall the human factor involved. Fawcett et al. (2008) highlight the necessity to invest in **managerial and employee support**, as well as the need for cross-trained experienced managers and **supply chain education and training** (Fawcett et al., 2008; Sudusinghe & Seuring, 2022).

Information sharing is a key component of horizontal collaboration; thus, building of an **open information sharing culture** between SC partners, based on a common understanding of the reason for sharing information, is pivotal (Fawcett et al., 2008; Huang et al., 2020; Stenzel & Waichman, 2023).

The role of the last downstream actor of a supply chain (i.e., end-consumers) is usually left out in the discussion of SC collaboration. However, Soosay & Hyland (2015) and Solaimani & van der Veen (2021) point out the importance of **co-creation with end-consumers**, which should not be seen as passive recipients of products and services, rather than active members in the supply chain management collaboration; enhanced by the advances in electronic media and telecommunications. Solaimani & van der Veen (2021) moreover advocates in favour of both **consumers and suppliers' early involvement** to strengthen collaborative relationships upstream and downstream the supply chain. Additional to the above, Solaimani & van der Veen (2021) explicitly state the importance of formulating **open innovation** practices to reinforce collaboration among SC partners and advance the current understanding of supply chain innovation.

Collaboration in logistics could be supported by the development of **multi-tier perspective** in relationships among the different supply chain actors (Soosay & Hyland, 2015; Sudusinghe & Seuring, 2022), since those have been moved beyond the traditional dyadic considerations (e.g., buyers-suppliers) to holistic (polyadic) approaches that engage all partners in the supply chain (Operations, process, and supply management). These multi-tier perspectives should be support by the development of a certification system for the partners involved (Fawcett et al., 2008; Sudusinghe & Seuring, 2022).

Vertical integration strategies typically focus on bringing together strategic resources and essential connections within both the company's value chain and the broader industrial chain. However, a key challenge remains: the lack of comprehensive harmonization and integration. In particular, data interoperability issues arise when suppliers in the same supply chain use different calculation methods or interpret inputs inconsistently. It is essential therefore to focus on **technological integration strategies**, aligning systems with suppliers and customers to improve sustainability

outcomes (Sudusinghe & Seuring, 2022; Zhang et al., 2023; Stenzel & Waichman, 2023). Additionally, **standardization** plays a critical role in overcoming these obstacles and facilitating collaboration, as well as **infrastructure integration** (Cruijssen, 2020).

Table 7 summarizes the main strategies (also called "bridges") that have been identified in the literature, divided into ten categories: Partnership-driven design; Cooperation fairness; Extroversion & openness; Leadership & Strategic Decision making; Objectives alignment; Operational & procedural alignment; Organizational culture & Employee support; Partner assessment; Technical integration; Sustainability.

Moreover, the strategies with the highest potential to help overcome barriers to **environmental sustainability** (directly or indirectly) are highlighted in green in the table.

Table 7. Strategies (bridges) to overcome barriers in vertical collaboration

Main strategy category	**Strategies** - Bridges between barriers and potential benefits	**Reference**
Partnership-driven design (1)	Co-create with end-consumers (1a)	Soosay & Hyland, 2015 Solaimani & van der Veen, 2021
	Cross-functional collaboration (1b)	Fawcett et al., 2008 Solaimani & van der Veen, 2021
	Early supplier and customer involvement (1c)	Solaimani & van der Veen, 2021
	Effective use of pilot projects (1d)	Fawcett et al., 2008
	Joint product development (1e)	Solaimani & van der Veen, 2021
	Multi-tier perspectives (1f)	Soosay & Hyland, 2015 Solaimani & van der Veen, 2021 Sudusinghe & Seuring, 2022
	Open innovation (1g)	Solaimani & van der Veen, 2021 Chesbrough, 2003 Chesbrough, 2006
	Resources sharing (1h)	Huang et al., 2020
	Understanding of the elements that constitute effective collaboration (1i)	Huang et al., 2020
	Vertical and horizontal coalitions combination (1j)	Cleophas et al., 2019
Cooperation fairness (2)	Trust-based alliances (2f)	Fawcett et al., 2008 Solaimani & van der Veen, 2021 Huang et al., 2020
Extroversion & openness (3)	Industry-university partnerships (3a)	Solaimani & van der Veen, 2021
	Joint knowledge creation (3b)	Huang et al., 2020 Solaimani & van der Veen, 2021
	Open information sharing culture (3c)	Fawcett et al., 2008 Huang et al., 2020 Stenzel & Waichman, 2023
Leadership & Strategic Decision making (4)	Centralized decision-making for effectiveness (4a)	Solaimani & van der Veen, 2021
	Neutral leadership (4d)	Solaimani & van der Veen, 2021 Huang et al., 2020
	Servant leadership & enlightened despotism (4e)	Solaimani & van der Veen, 2021
	Strategic SC vision (4f)	Fawcett et al., 2008 Solaimani & van der Veen, 2021
	Using chain advisory councils (4g)	Fawcett et al., 2008

Main strategy category	**Strategies** - Bridges between barriers and potential benefits	**Reference**
Objectives alignment (5)	Incentive alignment (5a)	Huang et al., 2020
	Ownership clarity (5b)	Fawcett et al., 2008
	Strategic alignment around joint objectives (5c)	Huang et al., 2020 Solaimani & van der Veen, 2021
	Supplier alignment and rationalization (5d)	Fawcett et al., 2008
Operational & procedural alignment (6)	Collaborative planning across the supply chain (6a)	Fawcett et al., 2008
	Infrastructure integration (6b)	Cruijssen, 2020 Sudusinghe & Seuring, 2022 Zhang et al., 2023
	Process documentation (6c)	Fawcett et al., 2008
	Process integration (6d)	Cruijssen, 2020 Sudusinghe & Seuring, 2022 Zhang et al., 2023
Organizational culture & Employee support (7)	Continuous collaboration culture improvement (7a)	Solaimani & van der Veen, 2021
	Cross-trained experienced managers (7b)	Fawcett et al., 2008 Sudusinghe & Seuring, 2022
	Managerial and employee support (7c)	Fawcett et al., 2008
	Supply chain education and training (7d)	Fawcett et al., 2008
Partner assessment (8)	Certification (partners) (8a)	Fawcett et al., 2008 Sudusinghe & Seuring, 2022
	Due diligence in partner selection (8c)	Fawcett et al., 2008 Sudusinghe & Seuring, 2022
	Prior collaborative history with a partner (8d)	Huang et al., 20120209
Technical integration (9)	Technology integration – Standardization (9a)	Cruijssen, 2020 Sudusinghe & Seuring, 2022 Zhang et al., 2023 Stenzel & Waichman, 2023
	Use of systems for collaborative cooperation (ERP, CDSS) (9b)	
Sustainability (10)	Accurate comprehensive measures for sustainability (10a)	Fawcett et al., 2008 Singh et al., 2017
	Collaborative communication for sustainability (10b)	Huang et al., 2020 Sudusinghe & Seuring, 2022
	Design for sustainability (10c)	Ramanathan et al., 2014 Sudusinghe & Seuring, 2022 Solaimani & van der Veen, 2021

3.2 Horizontal Collaboration

The main benefits of horizontal collaboration include enhanced efficiency, reduced costs, and improved overall supply chain performance. However, implementing horizontal collaboration in logistics is often more challenging than vertical collaboration, as it requires coordination and trust between competitors at the same level of the supply chain, whereas vertical collaboration typically involves more straightforward integration between partners with complementary roles and aligned incentives. Therefore, there are significant barriers to implementing HC practices, as these may

involve challenges in communication, potential conflicts of interest, and the need for effective management to address logistics complexities (Serrano-Hernandez et al., 2017; Ferrell et al., 2020; Jepsen, 2014; Verdonck et al., 2013; Xu, 2013) and are presented in detail in the following subsections.

Specifically, horizontal collaboration in transport and logistics significantly **reduces costs and enhances efficiency**, as highlighted by Jepsen (2014). By optimizing truck loading rates, sharing warehouse space, and pooling resources for joint purchases of vehicles, fuel, and information technologies, companies achieve considerable cost savings and increased productivity (Xu, 2013; Verdonck et al., 2013; Cruijssen et al., 2007b). Collaboration also allows logistics providers to offer more frequent deliveries, reducing inventory costs and enhancing competitiveness (Xu, 2013). Additionally, by sharing knowledge and resources, logistics providers can introduce new specialized services and cater to larger customers, thereby protecting and expanding their market space (Cruijssen et al., 2007b).

Moreover, horizontal collaboration leads to substantial **environmental benefits** by reducing greenhouse gas emissions, air and water pollution, noise pollution, traffic congestion, and accidents. Joint route planning and increased truck load factors make logistics activities more sustainable (Jepsen, 2014). Sharing warehouse space reduces the number of required warehouses and deliveries, further minimizing emissions and land use. External factors such as regulations, customer requirements, and competition also drive companies toward collaboration. Successful collaborations often employ advanced Enterprise Resource Planning (ERP) and Decision Support Systems (DSS) to support strategic and tactical decisions (Buijs & Wortmann, 2014). However, the success of these systems depends on timely user feedback and continuous improvement (Karam, Reinau, & Østergaard, 2021b). Effective horizontal collaboration relies on clear agreements, trust, and fair allocation of costs and benefits, as identified by Badraoui et al. (2024), who emphasize the importance of timely and complete information exchange, formalized collaboration processes, and prioritizing integrity over competency in partner selection.

3.2.1 Drivers for horizontal collaboration in logistics

Drivers for horizontal logistics collaboration represent the motivating factors that encourage entities at the same supply chain level to work together synergistically. These drivers facilitate the creation of strategic partnerships by promoting shared goals, efficiency, and mutual benefits. Recognizing and leveraging these drivers is essential for entities looking to initiate and sustain successful horizontal logistics collaboration. Cruijssen et al. (2007) categorize drivers of horizontal collaboration into four thematic groups. The first category is cost and productivity-related, which includes barriers such as cost reduction, sharing resources, and gaining new knowledge and skills. The second category is customer service-related, which involves providing better quality services, complying with customer requirements, and specialization. The third category is market position-related, which covers aspects

such as better market position, more clients, growth, and higher differentiation. The fourth category is other-related, which includes developing new standards, overcoming regulatory barriers, and addressing other issues. This category can also be renamed as the regulatory-related barrier, as it is frequently mentioned in recent research (Palmieri et al., 2019; Ferrell et al., 2020; Jepsen, 2014). Recent research on this topic (Badraoui et al., 2024; Palmieri et al., 2019; Pomponi et al., 2013; Serrano-Hernandez et al., 2017; Ferrell et al., 2020; Jepsen, 2014; Xu, 2013), suggest an additional category that can be included in Cruijssen's model, related to environmental benefits. Several internal drivers have been also identified (Badraoui et al., 2024; Mason et al., 2007; Pomponi et al., 2013; Schmoltzi and Marcus Wallenburg, 2011; Serrano-Hernandez et al., 2017; Ferrell et al., 2020; Xu, 2013; Palmieri et al., 2019; Jepsen, 2014; Cruijssen et al., 2007b) that motivate companies to engage in horizontal collaboration:

- Cost reduction through decreased transportation distances and fewer trucks;
- Increased productivity;
- Efficient deployment of assets, leading to better resource management and expanded company capacities;
- Sharing of resources and facilities with other entities;
- Exchange of experiences, skills, and knowledge, providing access to additional expertise;
- Service quality improvements, diversification of services, portfolio extension, increased responsiveness, and overall value creation for customers, enhancing on-time performance;
- Better market position by extending geographical coverage, accessing new markets, and increasing market share;
- Fostering growth and competitiveness;
- Driving innovations;
- Boosting company reputation and status;
- Offering incentives and gain-sharing opportunities;
- Reducing risks;
- Lowering environmental impact (e.g., pollution, traffic accidents, congestion);
- Providing access to extra financial resources;
- Promoting networking.

However, following the same approach that was used in VC review, the drivers for horizontal collaboration in logistics can be grouped into the following key categories (Table 8):

1. **Technology and Innovation**: Collaboration enables access to advanced technologies (AI, blockchain, IoT), fosters innovation, and brings in external expertise to enhance efficiency and automation.

2. **Economic and Efficiency**: Key goals include cost reduction, better asset use, and improved operational efficiency, leading to higher revenues through streamlined processes and optimized resource management.

3. **Governance and Regulation**: Compliance with regulations (e.g., Scope 3) and sustainability requirements (e.g., ESG) are critical drivers, ensuring adherence to legal and environmental standards.

4. **Market and Business**: Collaboration helps meet rising customer demands, improve market positioning, and enhance supply chain resilience and adaptability.

5. **Sustainability**: Reducing environmental impact and promoting social welfare through ethical and sustainable practices are essential for long-term ecological balance.

The following table (Table 8) summarizes the main drivers that have been identified in the literature, reorganizing them in categories similarly to the VC drivers' analysis in section 3.1.

Table 8. Drivers for horizontal collaboration

Cate-gory	Driver for horizontal collaboration	Description	Reference
Technology and innovation	Technological advances or innovative tools	Need to access external expertise in innovative tools and solutions such as artificial intelligence, blockchain, and Internet of Things (IoT) in logistics operations to enhance efficiency, visibility, and automation	Cruijssen et al., 2007 Xu, 2013
	Ability to foster innovation	The ability to foster a culture of creativity and experimentation, leading to accelerated research and development (R&D) cycle times, enabling rapid prototyping, testing, and implementation of new ideas, technologies, and processes to drive continuous improvement	Fawcett et al., 2008 Singh et al., 2017 Huang et al., 2020 Solaimani & van der Veen, 2021
	Access to expertise and knowledge	Tapping into diverse perspectives, specialized capabilities, and novel insights from external partners or stakeholders and expanding the collective knowledge base to address complex challenges and drive performance improvements	Cruijssen et al., 2007

Cate-gory	Driver for horizontal collaboration	Description	Reference
Economic and efficiency drivers	Costs reduction	Need to maintain competitiveness and profitability through optimized procurement strategies and streamlined operational processes to minimize expenses through strategic sourcing, implementing just-in-time practices, and leveraging data analytics (e.g., reduced purchasing costs, reduced inventory costs, reduced overall product cost)	Jepsen, 2014 Xu, 2013 Verdonck et al., 2013
	Better use of assets and resources	Improving overall operational performance and profitability through maximizing the efficiency and productivity of resources such as vehicles, equipment, and facilities	Cruijssen et al., 2007
	Improve operational efficiency and productivity	Driving sustainable growth and competitive advantage within the market through collaboration for optimizing operational processes, leveraging technology, and investing in employee training	Fawcett et al., 2008 Cheng et al., 2010 Singh et al., 2017 Huang et al., 2020 Xu, 2013 Verdonck et al., 2013
	Increased revenues	Increase in sales or revenue opportunities resulting from synergistic efforts, expanded market reach, and improved product/service offerings	Cruijssen et al., 2007 Xu, 2013
Governance and regulation drivers	Regulation and Legislation compliance (e.g. Scope 3 regulation)	Compliance due to stricter regulations and laws, power dynamics or operational necessities	Cheng et al., 2010 Soosay & Hyland, 2015 Sudusinghe & Seuring, 2022 Kalaiarasan et al., 2022 Jepsen, 2014 Palmieri et al., 2019 Ferrell et al., 2020
	Sustainability requirements (e.g. ESG, etc.)	Compliance with SCOPE 3 requirements across the supply chain	Xu, 2013 Pomponi et al., 2013 Jepsen, 2014 Hernandez et al., 2017 Palmieri et al., 2019 Badraoui et al., 2024
Market and business drivers	Increased customer demand and satisfaction	Decision to meet expectations for faster delivery, personalized experiences, and seamless omnichannel interactions, necessitating agile supply chain strategies, robust inventory management, and responsive customer service	Cruijssen et al., 2007b
	Better market global positioning/Competition	Differentiation/Competitive advantages through value-added services to secure market share, enhance efficiency, deliver superior customer value, extending geographical coverage, accessing new markets, and increasing market share.	Cruijssen et al., 2007b

Cate-gory	Driver for horizontal collaboration	Description	Reference
	Reliability/Resilience	Maintain continuity of operations, ensuring resilience and adaptability within the supply chain through robust risk management strategies, real-time visibility, and agile response mechanisms	Fawcett et al., 2008 Guan et al., 2012 Singh et al., 2017 Huang et al., 2020 Solaimani & van der Veen, 2021 Kalaiarasan et al., 2022 Zhang et al., 2023
Sustainability drivers	Reduce environmental impacts	Achieve long-term ecological balance and meet regulatory requirements through reducing carbon emissions, minimizing environmental impact, and promoting ethical sourcing and transport practices	Xu, 2013 Pomponi et al., 2013 Jepsen, 2014 Hernandez et al., 2017 Palmieri et al., 2019 Badraoui et al., 2024
	Ensuring social welfare	Enhance corporate social responsibility within the supply chain through reducing carbon emissions, minimizing environmental impact, and promoting ethical sourcing and transport practices	

3.2.2 Barriers to horizontal collaboration

Barriers in horizontal logistics collaboration are obstacles or challenges that prevent smooth coordination and cooperation among entities operating at the same level in the supply chain. These barriers can make it difficult to share resources, information, and responsibilities, and therefore impede the effectiveness of collaborative efforts. To engage in successful horizontal collaboration, organizations must identify and understand these barriers, as addressing them is crucial for fostering effective and sustainable partnerships within the logistics sector.

HC barriers could be classified in into a set of categories. Basso et al. (2019) identified 16 practical issues and categorized them into four groups: (1) collaboration design (e.g., coalition formation and size challenges of building efficient, stable, sustainable, and fair collaboration); (2) planning and operations (e.g., information flow, coordination mechanisms, practitioner knowledge, fulfilment and standards, and high-tech practical issues); (3) business/market (e.g., challenges faced at the strategic level; issues that threaten the core business of a company and its impact on the whole market); and (4) behaviours/human factors (e.g., trust and cultural issues). Similarly, Pan et al. (2019) identified three crucial categories of HC barriers: design, management, and communication technologies. Following extensive literature review that encompassed the previous mention findings, Karam et al. (2021b) defined 31 barriers to HC, classified into five categories.

Karam et al. (2021a) applied fuzzy Delphi method (FDM) and the analytical hierarchy process (AHP) to identify and prioritize barriers hindering the successful implementation of Collaborative Transport Networks (CTN) in freight transport sector. The FDM involved expert opinions to identify and categorize barriers, while the AHP facilitated the prioritization of these barriers. The results show (in

the case of Denmark) that the biggest inhibitor group of HTC is human factors, followed by information quality. The most important single barrier is the lack of trust among partners followed by the lack of trust in the methodologies and coordinator (both from the group of behaviours and attitudes). In the first five barriers there is also lack of information accuracy, difficulty in finding suitable partner, and collaboration on the core business functions.

On the other hand, Karam et al. (2021b) applied Mean Index Method (MIM) to their data obtained from the experts and obtained similar results for the seven most important and seven least important barriers; in between there are some oscillations.

Similarly, Le et al. (2021) examined correlations between potentially influential factors for horizontal collaboration among 161 logistics companies in Vietnam. They used the structural equation model (SEM) to test the conceptual model and relationships among variables, and determined that managers should focus on information sharing, reputation, and trust in partners to enhance service quality, performance, and competitive advantage.

Trust among partners could be regarded as one of the most critical issues to implementing horizontal collaboration in logistics. Daudi et al. (2016) performed a systematic literature review on this aspect, and determined four specific behavioural barriers and thirteen criteria that affect partners trust, where these criteria serve as measurable indicators for empirical investigation.

Within the scope of this study's analysis, following the same approach that was used in VC review, the barriers to vertical collaboration in logistics can be categorized into five key areas (Table 9):

1. **Technology and Innovation**: A lack of system standardization and technological incompatibility hinders communication and integration across the supply chain, making collaboration challenging.

2. **Economic and Efficiency**: Inadequate cost appraisal makes it difficult to accurately assess the financial impact of collaboration, limiting its adoption.

3. **Governance and Regulation**: Collaborative efforts often suffer from unclear goals, inadequate governance planning, lack of intellectual property protection, and complex regulatory frameworks.

4. **Market and Business Model**: Companies are often resistant to collaboration due to risk aversion, a preference for protecting individual competitive advantages, and challenges in understanding customer demand.

5. **Information Sharing**: There is a widespread reluctance to share relevant data and insights, leading to inefficient information flow and inaccuracies.

Table 9. Barriers to horizontal collaboration

Cate-gory	Barrier of horizontal collaboration in logistics	Description	Reference
Technology and Innovation	**Lack of system standardization**	Lack of system standardization (e.g., heterogenous formats) that hinder communication across the supply chain - Lack of harmonized standards to measure Scope 3 emissions	Karam et al., 2021a; Karam et al., 2021b; Le et al., 2021
	Technological incompatibility	Lack of systems and system incompatibility	Karam et al., 2021a; Karam et al., 2021b; Le et al., 2021
Economic and efficiency	**Inadequate cost appraisal**	Inadequacies in accurately assessing and evaluating the costs associated with various processes	Fawcett et al., 2008
Governance and regulation	**Lack of clear operational goals and outcomes**	Lack of systems and system incompatibility	Karam et al., 2021a; Karam et al., 2021b; Le et al., 2021
	Lack of governance planning	Inadequacy of established frameworks, policies, or protocols governing the formation, operation, and management of partnerships (e.g., synchronizing different tiers and modes for vertical collaboration)	Le et al., 2021; Karam et al., 2021a; Karam et al., 2021b
	Lack of intellectual property protection	The interface between an organization and its external environment. Tendency to protect individual competitive advantages (e.g. core capabilities, cost advantages) or lack of intellectual property protection	Karam et al., 2021a; Karam et al., 2021b
	Lack of trust	Concerns about partner reliability, and ambiguity in decision-making processes	Le et al., 2021
	Complex legislation and regulation compliance	Complex regulatory frameworks, compliance requirements, and contractual obligations across different jurisdictions (e.g., high levels of uncertainty leading to high regulatory costs for firms to report emissions)	Karam et al., 2021a; Karam et al., 2021b
	Lack of commitment	Reluctance among partners to fully engage, invest, or prioritize collaborative efforts, hindering the achievement of shared goals and mutual benefits	Le et al., 2021; Karam et al., 2021a; Karam et al., 2021b
Market and business model	**Resistance of companies to change due to risk aversion**	Difficulties to shift companies' focus from individual competitive advantage to a collaborative view - Lack of willingness to share risks and rewards	Le et al., 2021; Karam et al., 2021a; Karam et al., 2021b
	Individual competitive advantage protection	The interface between an organization and its external environment. Tendency	Karam et al., 2021a; Karam et al., 2021b

Cate-gory	Barrier of horizontal collaboration in logistics	Description	Reference
		to protect individual competitive advantages (e.g. core capabilities, cost advantages) or lack of intellectual property protection	
	Customer demand challenges	Misunderstanding and miss-quantifying customer preferences, needs, and purchasing behaviour	Fawcett et al., 2008; Karam et al., 2021a; Karam et al., 2021b
Information sharing	**Resistance to information sharing**	Hesitancy to exchange relevant data, knowledge, or insights within collaborative networks or business relationships. Inefficient flow and updates, inaccurate information, lack of timely information, low information accuracy.	Karam et al., 2021a; Karam et al., 2021b; Le et al., 2021

3.2.3 Strategies to overcome barriers and challenges

Moreover, Xu (2013) emphasizes the significance of **clearly defined entry and exit rules**. He suggests that an elective entry rule ensures the smooth progress of the collaboration, while a well-defined exit rule minimizes disruptions for the other participants.

Trust can be enhanced through the implementation of collaborative approaches that either minimize the need for extensive information sharing or ensure more secure information exchange among partners. **The utilization of blockchain technology** has proven to be an effective tool in mitigating such risks (Karam et al., 2021).

Sternberg et al. (2022) also support that setting clear limits to show who the users are and what resources they share, is key to success. Stenberger (2022) and Xu (2013) also point out the importance of deciding **how to share profits fairly** to ensure a long-lasting collaboration. Ferrel et al. (2020) believe that a system rewarding flexibility can make companies more open about their delivery terms. They even suggest a way to measure and reward this flexibility. To handle the sharing issue, Xu (2013) and Ferrell et al. (2020) suggest using cooperative game theory. Due to their complexity however, they recommend a mix of simple game theory and practical rules like sharing based on shipped load or served numbers. Karam et al. (2021) propose that a cost-profit sharing mechanism should also consider partners' characteristics, such as size and contribution, which mathematical approaches often overlook; they advocate for a negotiated-based policy. Yet, they recognize the risk that larger partners might exploit their market position to the disadvantage of smaller partners. Thus, they recommend designing **multiple profit-sharing policies**, enabling partners to negotiate and select rules that align with their collaboration.

I**nformation sharing** is another major HC barrier, mainly due to: the information about logistics is not complete, it doesn't flow well or get updated efficiently, it can be inaccurate, and the way information is given is not the same for everyone (heterogeneous information formats). These issues make it hard for partners to communicate (Karam et al., 2021). Experts suggest that before starting to work together, it's important to make sure that everyone is ready to use digital tools for sharing information. They also claim that it is preferable to be clear about what kind of information is needed and to standardize how information is shared.

In addition, **sharing sensitive data** is getting attention. Xu (2013) believes that if there's someone in charge (e.g., a trustee) who organizes and makes decisions for the collaboration, and he/she collects private information about partners' logistics, it should be ensured that information remains confidential. This is especially true in centralized collaborations where there's one organizer. But in collaborations where partners make their own decisions using set rules (decentralized), they need to design the system in a way that avoids giving away too much information.

Navigating the challenges of horizontal cooperation involves the creation of a legal framework that safeguards each partner and addresses issues related to **anti-competitive laws** (Sternberg et al., 2022). Once again, the presence of a trustee party is essential in steering the collaboration, ensuring compliance with competition laws, and upholding the strict confidentiality of shared information (Karam et al., 2021).

Table 10 summarizes the main strategies (bridges) that have been identified in the literature, divided into ten categories: Partnership-driven design; Cooperation fairness; Extroversion & openness; Leadership & Strategic Decision making; Objectives alignment; Operational & procedural alignment; Organizational culture & Employee support; Partner assessment; Technical integration; Sustainability.

Moreover, the strategies with the highest potential to help overcome barriers to **environmental sustainability** (directly or indirectly) are highlighted in green in the table.

Table 10. Strategies to overcome barriers in horizontal collaboration

Main strategy category	**Strategies** - Bridges between barriers and potential benefits	**Reference**
Partnership-driven design (1)	Effective use of pilot projects (1d)	Fawcett et al., 2008
	Joint product development (1e)	Solaimani & van der Veen, 2021
	Multi-tier perspectives (1f)	Soosay & Hyland, 2015 Solaimani & van der Veen, 2021 Sudusinghe & Seuring, 2022
	Open innovation (1g)	Solaimani & van der Veen, 2021 Chesbrough, 2003 Chesbrough, 2006
	Resources sharing (1h)	Huang et al., 2020

Main strategy category	**Strategies** - Bridges between barriers and potential benefits	**Reference**
	Understanding of the elements that constitute effective collaboration (1i)	Huang et al., 2020
	Vertical and horizontal coalitions combination (1j)	Cleophas et al., 2019
Cooperation fairness (2)	Anti-competitive laws compliance mechanism (2a)	Sternberg et al., 2022 Karam et al., 2021
	Costs/benefits allocation mechanism (2b)	Badraoui et al.,2024
	Data privacy (2c)	Stenzel & Waichman, 2023
	Fair profit sharing (2d)	Sternberg et al., 2022 Xu, 2013 Ferel et.al, 2020 Karam et al. 2021
	Swift and equitable dispute resolution mechanism for contractual obligations (2e)	Pomponi et al., 2013 Jepsen, 2014 Sternberg et al., 2022
	Trust-based alliances (2f)	Fawcett et al., 2008 Solaimani & van der Veen, 2021 Huang et al., 2020
Extroversion & openness (3)	Industry-university partnerships (3a)	Solaimani & van der Veen, 2021
	Joint knowledge creation (3b)	Huang et al., 2020 Solaimani & van der Veen, 2021
	Open information sharing culture (3c)	Fawcett et al., 2008 Huang et al., 2020 Stenzel & Waichman, 2023
Leadership & Strategic Decision making (4)	Centralized decision-making for effectiveness (4a)	Solaimani & van der Veen, 2021
	Clearly defined entry and exit rules / setting limits (4b)	Xu, 2013; Sternberg et al., 2022
	Command-and-control-based relationships (4c)	Xu, 2013
	Neutral leadership (4d)	Solaimani & van der Veen, 2021 Huang et al., 2020
	Servant leadership & enlightened despotism (4e)	Solaimani & van der Veen, 2021
	Strategic SC vision (4f)	Fawcett et al., 2008 Solaimani & van der Veen, 2021
Objectives alignment (5)	Incentive alignment (5a)	Huang et al., 2020
	Ownership clarity (5b)	Fawcett et al., 2008
	Strategic alignment around joint objectives (5c)	Huang et al., 2020 Solaimani & van der Veen, 2021
Operational & procedural alignment (6)	Collaborative planning across the supply chain (6a)	Fawcett et al., 2008
	Infrastructure integration (6b)	Cruijssen, 2020 Sudusinghe & Seuring, 2022 Zhang et al., 2023
	Process documentation (6c)	Fawcett et al., 2008
	Process integration (6d)	Cruijssen, 2020 Sudusinghe & Seuring, 2022 Zhang et al., 2023
Organizational culture & Employee support (7)	Continuous collaboration culture improvement (7a)	Solaimani & van der Veen, 2021
	Cross-trained experienced managers (7b)	Fawcett et al., 2008 Sudusinghe & Seuring, 2022
	Managerial and employee support (7c)	Fawcett et al., 2008
	Supply chain education and training (7d)	Fawcett et al., 2008

Main strategy category	**Strategies** - Bridges between barriers and potential benefits	**Reference**
Partner assessment (8)	Certification (partners) (8a)	Fawcett et al., 2008 Sudusinghe & Seuring, 2022
	Cooperation feedback ratings (8b)	Karam et al., 2021
	Due diligence in partner selection (8c)	Fawcett et al., 2008 Sudusinghe & Seuring, 2022
	Prior collaborative history with a partner (8d)	Huang et al., 2020
Technical integration (9)	Technology integration - Standardization	Cruijssen, 2020 Sudusinghe & Seuring, 2022 Zhang et al., 2023 Stenzel & Waichman, 2023
	Use of systems for collaborative cooperation (ERP, CDSS)	Buijs & Wortmann, 2014 Karam et al. 2021b
	Utilization of technology in contracts (e.g., blockchain)	Karam et al., 2021
Sustainability (10)	Accurate comprehensive measures for sustainability	Fawcett et al., 2008 Singh et al., 2017
	Collaborative communication for sustainability	Huang et al., 2020 Sudusinghe & Seuring, 2022
	Design for sustainability	Ramanathan et al. Sudusinghe & Seuring, 2022 Solaimani & van der Veen, 2021

3.3 Underlying green strategies for environmental sustainability in logistics collaboration

The vision of the ADMIRAL project is “to change the mindset of the logistics and transport industry to take the emission level minimization as the main target of the industry operations by providing tools for companies to respond to the pressure of consumers and society”, by developing solutions to increase collaboration. However, as described in the previous sections, there are several barriers that need to be overcome to achieve collaboration (both VC and HC), and thus specific strategies must be employed. On top of that, lies the environmental sustainability goal of ADMIRAL, and the need to change the mindset of logistics stakeholders from cost/time target driven operations, to environmental based targets. In view of this, Tables 7 & 10 spotted the strategies that are related to overcoming barriers towards environmental sustainability.

In addition, Sections 3.1 and 3.2 provide the results of the desktop research and the authors interpretation for the identification of the potential strategies to overcome the identified barriers and achieve efficient vertical and horizontal logistics collaboration.

An additional analysis that directly correlates strategies to specific barriers can offer valuable insights for the report. By mapping each strategy to its corresponding barrier, this approach helps clarify

which actions are most effective in overcoming challenges, providing a more targeted framework for implementation. Specifically, Table 11 summarizes these correlations, detailing the strategies and green strategies that can be employed to address each barrier across both categories of collaboration—horizontal and vertical. This summary allows project partners to identify which strategies are most relevant to their unique collaboration challenges, facilitating more effective planning and decision-making within the ADMIRAL Marketplace.

Table 11. Available strategies to overcome barriers for logistics collaboration

Barriers	**Strategy**
Lack of systems standardization	1b Cross-functional collaboration 1d Effective use of pilot projects 9a Technology integration – Standardization 9b Use of systems for collaborative cooperation (ERP, CDSS)
Technological incompatibility	1b Cross-functional collaboration 1d Effective use of pilot projects 9a Technology integration – Standardization
Knowledge and innovation asymmetry	1a Co-create with end-consumers 1c Early supplier and customer involvement 1e Joint product development 1h Resources sharing 3b Joint knowledge creation 3c Open information sharing culture 4a Centralized decision-making for effectiveness 4c Command-and-control-based relationships 4d Neutral leadership 4e Servant leadership & enlightened despotism 4g Using chain advisory councils
Lack of skills, knowledge, training	7a Continuous collaboration culture improvement 7b Cross-trained experienced managers 7c Managerial and employee support 7d Supply chain education and training 8a Certification (partners) 8b Cooperation feedback ratings 8c Due diligence in partner selection 8d Prior collaborative history with a partner
Inadequate cost appraisal	2b Costs/benefits allocation mechanism 2d Fair profit sharing 6a Collaborative planning across the supply chain
Lack of clear operational goals and outcomes	1b Cross-functional collaboration 1e Joint product development 1f Multi-tier perspectives 1g Open innovation 5a Incentive alignment 5d Supplier alignment and rationalization 6c Process documentation 6d Process integration

Barriers	Strategy
Lack of governance planning	4a Centralized decision-making for effectiveness 4b Clearly defined entry and exit rules/setting limits 4c Command-and-control-based relationships 4d Neutral leadership 4e Servant leadership & enlightened despotism 4f Strategic SC vision 4g Using chain advisory councils 5b Ownership clarity 6a Collaborative planning across the supply chain 6c Process documentation 10a Accurate comprehensive measures for sustainability 10b Collaborative communication for sustainability 10c Design for sustainability
Inconsistency in performance measurement	1b Cross-functional collaboration 1d Effective use of pilot projects 1f Multi-tier perspectives 5d Supplier alignment and rationalization 6a Collaborative planning across the supply chain 6c Process documentation 6d Process integration 10a Accurate comprehensive measures for sustainability 10c Design for sustainability
Lack of intellectual property protection	1e Joint product development 1g Open innovation 2a Anti-competitive laws compliance mechanism 2f Trust-based alliances
Lack of trust	1i Understanding of the elements that constitute effective collaboration 2a Anti-competitive laws compliance mechanism 2c Data privacy 2f Trust-based alliances 4b Clearly defined entry and exit rules/setting limits 4d Neutral leadership 4e Servant leadership & enlightened despotism 4f Strategic SC vision 4g Using chain advisory councils 8d Prior collaborative history with a partner
Cultural and language difficulties	3b Joint knowledge creation 7a Continuous collaboration culture improvement 7b Cross-trained experienced managers 7c Managerial and employee support 7d Supply chain education and training
Conflict over differing needs between partners	5a Incentive alignment 5b Ownership clarity 5c Strategic alignment around joint objectives 5d Supplier alignment and rationalization 8c Due diligence in partner selection 8d Prior collaborative history with a partner 10a Accurate comprehensive measures for sustainability 10b Collaborative communication for sustainability 10c Design for sustainability

Barriers	**Strategy**
Complex legislation and regulation compliance	2a Anti-competitive laws compliance mechanism 10a Accurate comprehensive measures for sustainability 10c Design for sustainability
Lack of commitment	4a Centralized decision-making for effectiveness 4b Clearly defined entry and exit rules/setting limits 4g Using chain advisory councils 5a Incentive alignment 5b Ownership clarity 8b Cooperation feedback ratings 8c Due diligence in partner selection 8d Prior collaborative history with a partner
Resistance of companies to change due to risk aversion	1h Resources sharing 7a Continuous collaboration culture improvement 7b Cross-trained experienced managers 7c Managerial and employee support 7d Supply chain education and training
Individual competitive advantage protection	1a Co-create with end-consumers 1d Effective use of pilot projects 2a Anti-competitive laws compliance mechanism 2c Data privacy 2f Trust-based alliances
Customer demand challenges	1a Co-create with end-consumers 1c Early supplier and customer involvement 1d Effective use of pilot projects 3b Joint knowledge creation 10c Design for sustainability
Disparate operational practices and routines	1d Effective use of pilot projects 6a Collaborative planning across the supply chain 6b Infrastructure integration 6c Process documentation 6d Process integration 10b Collaborative communication for sustainability 10c Design for sustainability
Resistance to information sharing	3a Industry-university partnerships 3b Joint knowledge creation 3c Open information sharing culture 7a Continuous collaboration culture improvement 7d Supply chain education and training
Unequal distribution of power and information sharing among partners	1a Co-create with end-consumers 1c Early supplier and customer involvement 1e Joint product development 3b Joint knowledge creation 3c Open information sharing culture 4a Centralized decision-making for effectiveness 4c Command-and-control-based relationships 4d Neutral leadership 4e Servant leadership & enlightened despotism 4g Using chain advisory councils

The analysis provides a comprehensive set of strategies to overcome barriers in achieving sustainable logistics collaboration. It emphasizes the importance of aligning leadership, operational, and cultural practices to foster effective cooperation. By addressing challenges such as technological incompatibility, lack of skills, inconsistent performance measurements, and resistance to change, the table highlights collaborative planning, cross-functional efforts, standardized processes, and trust-building mechanisms as critical elements. The overarching theme is that by integrating resources, fostering innovation, and aligning incentives, logistics companies can overcome obstacles and prioritize **Partnership-driven design** strategies emphasize open innovation and sharing of resources between partners. **Leadership and strategic decision-making** strategies focus on the alignment of supply chain visions, ensuring that suppliers' objectives are rationalized and aligned with the overall goals of the partnership. There is also an emphasis on aligning incentives and ensuring strategic alignment around joint objectives.

In terms of **operational and procedural alignment**, the importance of documenting processes is stressed, engaging in collaborative planning across the supply chain, and integrating processes and infrastructure to enhance cooperation. The **organizational culture and employee support** strategies emphasize the need for cross-trained managers, as well as supply chain education and training to facilitate smooth collaboration.

Partner assessment is also crucial, which includes certifying partners, evaluating prior collaborative history, and conducting due diligence during partner selection. Finally, **technical integration** strategies are focused on standardizing technology, while the **sustainability** aspect emphasizes accurate measurement and designing for sustainability to ensure that environmental goals are met throughout the logistics operations.

3.4 Marketplaces as strategic facilitators for logistics collaboration

3.4.1 Benefits, challenges and barriers

The ADMIRAL **Marketplace** aims to connect logistics actors of multiple levels (vertical and horizontal), serving as a management tool for the whole supply chain infrastructure and related emissions. Additionally, it will work as a channel for developers to distribute their innovative and sustainability-focused solutions to other parts of Europe. ADMIRAL Marketplace will improve the visibility of the whole supply chain emissions, such that companies have considerably better possibilities to purchase their logistics and transportation services based on emissions rate and comply with the incoming regulation requirements.

The significant impact potential is founded on the capability that the marketplace allows to incorporate the whole supply chain between the producer of goods and the buyers. Therefore, collaboration among logistics partners is the fundamental aspect that ADMIRAL marketplace should

facilitate. Tables 12 & 13 present the additional literature review finding on logistics marketplaces' benefits and challenges.

Table 12. Benefits of Logistics Marketplaces

Benefits	Reference
Defragmentation: Reduces complexity and fragmentation of information	Wang et al., 2007 Wang et al., 2011 Cruijssen, 2020 Zang & Ma, 2022 Li & Li, 2022 Chen et al., 2023
Comparability and transparency: Increase openness of the offered demand/supply	Pan et al., 2019 Cruijssen, 2020
Security: Certification and rating systems	Giordani et al., 2018 Cruijssen, 2020
Partnership flexibility: On the spot partnerships without seeking long-term partnerships	Kale et al., 2016 Cruijssen, 2020
Regulatory role: Marketplace administrators ensure information and service providers reliability	Giordani et al., 2018
Cost/waste reductions across the chain: Lower search costs, reduced transaction costs, economies of scale (stock/inventory reduction, flow efficiency), asset utilization.	Wang et al., 2007 Kale et al., 2016 Cruijssen, 2020 Parodos et al., 2022 Zang & Ma, 2022 Li & Li, 2022
Flexibility and resilience: Wider accessibility of a large base of buyers or suppliers, flexible partnership configuration (on the spot)	Wang et al., 2007 Pan et al., 2019 Parodos et al., 2022
Increased revenue: Resulting from higher sales, improved pricing strategies, or expanded market share.	Wang et al., 2007 Li & Li, 2022 Parodos et al., 2022 Chen et al., 2023
Process efficiency: Business processes automation, more efficient planning, execution and responsiveness of all supply chain players.	Wang et al., 2007 Wang et al., 2011 Cruijssen, 2020 Zang & Ma, 2022 Vincze et al., 2022 Parodos et al., 2022 Chen et al., 2023
Service quality: Improvement in service quality and end-customer experience.	Wang et al., 2007 Zang & Ma, 2022
Visibility: Inter-organization information connectivity, real time visibility, improved pipeline visibility.	Wang et al., 2007 Cruijssen et al., 2007 Wang et al., 2011 Chen et al., 2023

Table 13. Challenges for Logistics Marketplace implementation

Challenges	Reference
Commission: Fees to the platform administrator for the provide services. Flat payments per transaction or payments proportional to the transaction magnitude	Zang & Ma, 2022 Chen et al., 2023
Cost optimization: Depending on the bid prices submitted by carriers	Pan et al., 2019

Challenges	Reference
Lack of market understanding: Inaccurate judgment of the demand market and misunderstanding of end-customer preferences	Giordani et al., 2018 Zang & Ma, 2022
Openness and reluctance to participate: Hesitancy to collaborate due to competition or aversion to take risks	Kale et al., 2016 Pan et al., 2019 Zang & Ma, 2022 Chen et al., 2023
Brand and reputation: Unprofessional behaviour of partners may result in brand damages	Giordani et al., 2018
Added value: Balanced added-value proposition should be ensured for the participating companies	Giordani et al., 2018
Limited scope: Services regard load posting and matching services mainly	Kale et al., 2016

The analysis of the sections 3.2 and 3.3, provide a deep understanding of barriers to logistics collaboration (vertical and horizontal), as well as the strategies to overcome them. Similarly, Table 14 presents the main barriers to marketplaces in the context of logistics collaboration, using the categorization applied in previous sections.

Table 14. Description of barriers to marketplaces in the context of logistics collaboration

Barrier category	Barrier	Description	Reference(s)
Economic and efficiency	Cost increases	Flat payments per transaction or payments proportional to the transaction magnitude may increase overall product costs	Zang & Ma, 2022 Chen et al., 2023
	Inadequate cost appraisal	Inadequacies in accurately assessing and evaluating the costs associated with various processes	Pan et al., 2019 Zang & Ma, 2022 Chen et al., 2023
Governance and regulation	Lack of clear operational goals and outcomes	Unclear operational objectives and inconsistent outcomes	Wang et al., 2011
	Lack of trust	Concerns about partner reliability, and ambiguity in decision-making processes	Wang et al., 2011
	Cultural and language difficulties	Challenges in communication, decision-making processes, and relationship-building	Wang et al., 2011
	Conflict over differing needs between partners	Degree of collaboration needs differ between industries	Wang et al., 2011
Market and business model	Brand and reputation	Unprofessional behaviour or sub-par performance from the partner that may risk shipment and damage brand reputation significantly	Giordani et al., 2018
	Imbalanced added value proposition	The value-proposition is not significant or balanced among the collaborating parties	Giordani et al., 2018
	Resistance of companies to change due to risk aversity	Difficulties to shift companies' focus from individual competitive advantage to a collaborative view - Lack of willingness to share risks and rewards	Pan et al., 2019 Zang & Ma, 2022 Chen et al., 2023

Barrier category	Barrier	Description	Reference(s)
	Individual competitive advantage protection	The interface between an organization and its external environment. Tendency to protect individual competitive advantages (e.g. core capabilities, cost advantages) or lack of intellectual property protection	Pan et al., 2019 Zang & Ma, 2022 Chen et al., 2023 Wang et al., 2007
	Customer demand challenges	Misunderstanding and miss-quantifying customer preferences, needs, and purchasing behaviour	Zang & Ma, 2022
Information sharing	Unequal distribution of power and information sharing among partners	Unequal distribution of power and information among the partner of the supply chain	Wang et al., 2011

The barriers that can hinder logistics collaboration into four main categories: Economic and Efficiency, Governance and Regulation, Market and Business Model, and Information Sharing. Under the Economic and Efficiency category, barriers include cost increases due to flat or proportional transaction fees and inadequacies in accurately appraising costs associated with processes. The Governance and Regulation category highlights barriers such as unclear operational goals and outcomes, lack of trust between partners, cultural and language difficulties, and conflicts arising from differing needs between partners.

The Market and Business Model category identifies barriers like risks to brand and reputation from unprofessional behaviour or poor performance by partners, imbalanced value propositions, and resistance to change due to risk aversion. Companies also face challenges in shifting focus from individual competitive advantages to collaborative efforts, along with difficulties in understanding and quantifying customer demands. Lastly, under the Information Sharing category, the main barrier is the unequal distribution of power and information among partners, which can disrupt the balance and efficiency of the supply chain collaboration.

In comparison with the barriers identified in VC and HC, the category “Technology and Innovation” is excluded, since the marketplace is developed to bridge these barriers. In addition, some barriers that have been identified in other categories are also missing, due to the operational model of the marketplace that overcomes them, i.e., Lack of governance planning; Inconsistency in performance measurement; Lack of intellectual property protection; Complex legislation and regulation compliance; Lack of Commitment; Market and business model; Disparate operational practices and routines; Resistance to information sharing.

3.4.2 Legislation and contractual considerations for logistics collaboration

Legislation and contractual considerations are crucial in logistics marketplaces to ensure compliance with legal standards, protect all parties, and manage risks. ANNEX I (Legislation & Contractual Considerations for Logistics Collaboration) presents in detail those elements, providing stakeholders with a general overview of key legislation and contractual considerations relevant for the Admiral project. Clear contracts define roles, responsibilities, and liability, fostering trust and accountability. They also help prevent disputes, protect intellectual property, and ensure smooth, lawful operations, enhancing efficiency and reliability in the marketplace. The ADMIRAL marketplace, intended to enhance collaboration among logistics service providers and cargo owners across the EU, requires adherence to various legal and regulatory frameworks. Key areas of focus include antitrust and competition law, privacy and data protection, and cybersecurity. Compliance with EU competition law, particularly concerning prohibited agreements and abuse of dominance, is critical to avoid significant penalties. The marketplace must ensure transparent and lawful cooperation among participants, guided by EU regulations and case law from the European Court of Justice (CJEU).

Regarding the establishment of contractual terms, which are a critical part in developing ADMIRAL Marketplace, they highly depend on business interests and business plans. However, there are certain key contractual elements that we considered are necessary to be established in the contracts which will be directly concluded between the ADMIRAL marketplace operator and transportation and logistics service providers and between the ADMIRAL marketplace operator and transportation and logistics services' customers.

- Contractual terms between the ADMIRAL marketplace operator and transportation and logistics service providers inter alia must include: transportation and logistics services provider's obligations on how to use the marketplace, on creation of the service provider's account, on acceptance of orders; restrictions of inappropriate and illegitimate use of the marketplace; rights of the marketplace to change or set new features of the marketplace at any time and to change the terms; rights of the marketplace to monitor the service provider's activities in the marketplace and if necessary due to breach of the terms of applicable law to remove, limit the services of the service provider; requirements of the services to be provided by the service provider (if relevant); limitations of liabilities of the marketplace (e.g. not responsible for the orders submitted to the service provider); payments terms; requirements on communication with the client; use of intellectual property and confidential information terms; requirements and limitations (if relevant) of advertisement and marketing; clarifications, disclaimers on the relationship between the parties; privacy policy terms; other standard contractual terms (e.g. subject of the contract, standard general obligations and rights of the parties, termination rights and etc.).

- Contractual terms between the ADMIRAL marketplace operator and transportation and logistics services' customers inter alia must include: customer's obligations on how to use the marketplace, on creation of the customer's account, on submission of orders; restrictions of inappropriate and illegitimate use of the marketplace; rights of the marketplace to change or set new features of the marketplace at any time and to change the terms; limitations of liabilities of the marketplace (e.g. not responsible for the orders submitted to the service provider); use of intellectual property and confidential information terms; clarifications, disclaimers on the relationship between the parties; privacy policy terms; other standard contractual terms (e.g. subject of the contract, standard general obligations and rights of the parties, termination rights and etc.).

Privacy and data protection, governed by the General Data Protection Regulation (GDPR)[3], requires transparent data handling practices, detailed privacy notices, and robust internal compliance mechanisms. The ADMIRAL marketplace must implement stringent data protection measures, including data processing agreements and impact assessments. Cybersecurity is another crucial aspect, especially with the impending NIS 2 Directive[4], which mandates rigorous security measures for essential entities. The ADMIRAL marketplace must establish comprehensive cybersecurity policies, risk management frameworks, and incident response protocols to safeguard data and maintain regulatory compliance.

The ADMIRAL marketplace's successful operation hinges on meticulous legal and regulatory compliance, ensuring fair competition, robust data protection, and comprehensive cybersecurity. By adhering to EU competition law, the marketplace can facilitate lawful cooperation among logistics providers, preventing anti-competitive practices. Compliance with GDPR ensures transparent and secure handling of personal data, fostering trust among participants. Additionally, implementing rigorous cybersecurity measures as mandated by the NIS 2 Directive will protect against cyber threats and ensure the integrity of the marketplace. These legal and regulatory considerations are vital for establishing a secure, competitive, and compliant collaborative logistics environment, ultimately contributing to the ADMIRAL project's long-term success.

[3] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), *OJ L 119, 4.5.2016, p. 1–88* ("**GDPR**").

[4] Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (NIS 2 Directive), *OJ L 333, 27.12.2022, p. 80–152.*

4 Validation of Collaboration Frameworks for Application in ADMIRAL

This section outlines the process of assessing and validating collaboration models within the context of the ADMIRAL project. This involves applying a structured validation approach to determine the suitability and effectiveness of existing horizontal collaboration frameworks aligned with the task aims outlined in section 1.1. Section 4.1 presents the Validation Methodological Framework, detailing the approach and criteria used for validation, while Section 4.2 focuses on the Results Analysis, providing insights into how the validated frameworks align with ADMIRAL's objectives and identifying potential areas for adaptation or improvement in the ADMIRAL Marketplace.

4.1 Validation methodological framework

Based on the previous analysis for the identification of drivers, barriers, and strategies to overcome the barriers, a methodological framework has been developed, to validate the findings and select the most appropriate for application in the ADMIRAL Marketplace and across the project pilots.

The methodology incorporates collaborative tools and requires the participation of ADMIRAL project partners, including those beyond the pilot sites. Given that the primary objective of this process is to propose strategies for overcoming identified barriers, a holistic approach has been adopted that comprises five main steps, each involving relevant collaborative activities (Figure. 2).

Figure 2. Methodological framework schema

Here is an overview of the key steps taken to identify drivers, barriers, and strategies for enhancing collaboration in the ADMIRAL project. These steps outline the process from initial preparation to the final analysis and synthesis of results.

1. **Preparation workshop:** An online workshop titled "Drivers and Barriers towards Collaboration in Transport and Logistics" was organized on April 23, 2024, with the participation of the ADMIRAL

pilot partners. The workshop aimed to inform the participants about the methodological framework that has been selected for the identification and validation of drivers and barriers affecting horizontal and vertical logistics collaboration, and to help them understand which of the identified topics are pertinent to their pilot site operations. Additionally, the organizers (CERTH/HIT) informed the participants about the requirements of the online survey (step 2), which would address drivers, barriers, legislation, and contractual boundaries affecting logistics collaboration in each ADMIRAL pilot site.

2. **Insight-gathering survey:** In the second step, an online survey was organized to gather detailed insights into the drivers, barriers, and other factors impacting horizontal and vertical collaboration in the ADMIRAL pilot sites. The online questionnaire (ANNEX II) was distributed in mid-May 2024 and was designed by the University of Ljubljana, UPM, and CERTH/HIT. It aimed to uncover two key aspects: the types of collaboration utilized within each pilot site and the barriers/drivers affecting both vertical and horizontal collaboration. Through the survey, pilot site partners identified the collaboration types relevant to their use cases, the barriers and drivers impacting their operations, and the relative priority (weighting) of these barriers and drivers.

3. **Validation workshop:** The third step involved a physical workshop titled “Strategies to Mitigate Barriers and Accelerate Collaboration in Transport and Logistics.” This workshop aimed to validate the most common responses from the ADMIRAL consortium and present the linkages between barriers, strategies, and expected project impacts. During the workshop, the most frequently identified barriers from the previous step were analysed, and relevant strategies were validated. The workshop took place in Vilnius, Lithuania, during the consortium meeting on May 28-29, 2024. CERTH/HIT, the organizers, prepared an interactive online questionnaire using the Mentimeter tool (ANNEX III). In addition to online responses, participants had the opportunity to discuss the results and share their views on barriers and potential strategies for the ADMIRAL project. The outcomes of this workshop informed the fourth step of the framework.

4. **Strategies identification survey:** In the fourth step, pilot site partners were asked to identify strategies specific to overcoming the barriers at their respective pilot sites. A tailored online questionnaire (ANNEX IV) was sent to each pilot site, asking relevant partners to identify strategies addressing the most significant barriers identified at their sites.

5. **Analysis and synthesis of results:** In the final step, all the results were validated and analysed to develop and propose a comprehensive list of strategies for overcoming the barriers that project partners are expected to encounter during the operation of the ADMIRAL Marketplace.

4.2 Results Analysis

4.2.1 Insight-gathering survey results

Barriers and drivers for horizontal and vertical collaboration were evaluated and ranked using an online survey powered by 1KA, an open-source application developed by the Centre for Social Informatics at the Faculty of Social Sciences, University of Ljubljana. The 1KA platform is designed for user efficiency, minimizing the number of clicks required to complete operations.

The online questionnaire (ANNEX III) was distributed to all ADMIRAL pilot site partners, including those from Slovenia-Croatia, Finland, Portugal-Spain, and Lithuania. The questionnaire was designed by the University of Ljubljana in collaboration with UPM and CERTH/HIT. The questionnaire was distributed online and a document version of the questions is provided in Annex III. It comprised 43 questions with an estimated average response time of 7 minutes and 6 seconds.

The survey remained open from April 16 to June 20. A total of 14 responses were received: 8 respondents provided complete data for both horizontal and vertical collaboration, while 6 respondents provided partial data, focusing only on horizontal collaboration, according to the provided instructions. The following Table 15 provides an overview of the responses.

Table 15. Overview of the responses per pilot

Pilot identification	Partner	Answers scope
1 (Slovenian-Croatian pilot.)	Pošta Slovenije	HC and VC
1 (Slovenian-Croatian pilot.)	Croatian post	HC
1 (Slovenian-Croatian pilot.)	Pošta Slovenije	HC and VC
1 (Slovenian-Croatian pilot.)	Locodels	HC
2 (Finnish pilot.)	Steveco	HC and VC
2 (Finnish pilot.)	VTT	HC and VC
3 (Portugal-Spain pilot.)	APS	HC and VC
3 (Portugal-Spain pilot.)	LNEC	HC
3 (Portugal-Spain pilot.)	MARLO	HC and VC
4 (Lithuanian pilot.)	Transport Innovation Association	HC and VC
4 (Lithuanian pilot.)	CargoSign	HC
4 (Lithuanian pilot.)	KFEZ	HC
4 (Lithuanian pilot.)	Normalis tech (NORM)	HC
4 (Lithuanian pilot.)	Trevio	HC and VC

The respondents first identified the types of collaboration recognized at their pilot sites and then ranked the importance of various barriers' and drivers' categories. Following this, they assessed the importance of specific barriers and drivers within each category accordingly.

Barriers and drivers were evaluated using a five-point Likert scale, ranging from "not important" to "very important." Following the traditional Analytic Hierarchy Process (AHP) approach, which is

based on pairwise comparisons of criteria (barriers and drivers) at each level, the Distance-based AHP (DAHP) method was used to streamline the process. The DAHP method reduces the number of required questions for ranking criteria and computing criteria weights at each level.

The main steps of the DAHP (Zong and Wang, 2017) method are summarized below:

i. Criteria are organized in a multilevel hierarchy structure developed by Thomas L. Saaty in the 1970s. Figures below show the two-level structures for drivers and barriers separately.

ii. At each level, the criteria $(C_1, \dots, C_n)$ are evaluated separately.

iii. The pairwise criteria comparison scores are defined by using data obtained from the survey statistics. This step must be repeated at each level. Weights obtained at each level must then be joined to obtain the final weights.

iv. Let $F = \{(f_{i1}, f_{i2}, f_{i3}, f_{i4}, f_{i5})\}$ be the set of ranking vectors associated with the criteria set, which contain preferences of the survey's participants.:

- f_{i1} is the number of surveyors that evaluated the criteria C_i (chosen barrier or driver) as "*Very important*".
- f_{i2} is the number of surveyors that evaluated the criteria C_i (chosen barrier or driver) as "*Important*"
- f_{i3} is the number of surveyors that evaluated the criteria C_i (chosen barrier or driver) as "*Fairly important*".
- f_{i4} is the number of surveyors that evaluated the criteria C_i (chosen barrier or driver) as "*Slightly important*".
- f_{i5} is the number of surveyors that evaluated the criteria C_i (chosen barrier or driver) as "*Not important*".

v. On the basis of the defined set, F criteria can be ranked, from the most important to less relevant, by the relation:

"criterion C_i is more important than the criterion C_j" or in an equivalent form "$C_i \succcurlyeq C_j$" when $\sum_{l=1}^{5}(f_{il} - f_{jl}) \cdot a^{l-1} \geq 0$, where $a = \min_{t \in \mathbb{N}}\{10^t | f_{ij} \leq 10^t;\ i, j = 1, \dots, 5\}$.

vi. Then, the distances between all pairs of criteria are measured. Then, the maximum distance between all pairs of criteria is computed as:

$$D = \max_{0 \leq i \leq j \leq n} \left\{ d(C_i, C_j) = \sqrt{\sum_{l=1}^{5}(f_{il} - f_{jl})^2} \right\}. \quad (1)$$

The defined distance will be used in the next step to define the AHP pairwise comparisons matrix.

vii. The pairwise comparison matrix A uses previously defined relation and distance. The elements $a_{ij}, i,j = 1,\dots,n$ of the matrix are defined using Equation (1) and the Saaty relative importance evaluation scale from 1 - Equal importance to 9 - Very much more important:

$$a_{ij} = \begin{cases} \left[\frac{9 \cdot d(C_i,C_j)}{D}\right]; & C_i \succcurlyeq C_j \\ 1 \quad ; & C_i = C_j \quad \text{for } i,j = 1,\dots,n. \\ 1/\left[\frac{9 \cdot d(C_i,C_j)}{D}\right]; & C_j \succcurlyeq C_i \end{cases} \tag{2}$$

The criteria weights can be computed using the arithmetic mean:

$$w_i = \frac{1}{n}\sum_{j=1}^{n} \frac{a_{ij}}{A_j} \text{ for } i = 1,\dots,n \tag{3}$$

where $A_j = \sum_{i=1}^{n} a_{ij}$ for $j = 1,\dots,n$.

viii. Because of the approximations used, the consistency of the method must be checked by using the maximum eigenvalue (λ_{max}) technique. Then, the Consistency Ratio (CR) is computed as the quotient between the Consistency Index and the Random Index (RI). In the case of strong consistency, the Consistency Ratio must be less or equal to 0.1; weak consistency can be reached when the Consistency Ratio is less or equal to 0.2.

The Consistency Index (CI) is defined as:

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{4}$$

where the approximation of the maximum eigenvalue is $\lambda_{max} = \sum_{i=1}^{n} A_i \cdot w_i$.

In addition to the ranks, the CRs were also calculated, which in some cases have values greater than 0.2. This means that the consistency of the scoring needs to be checked in more detail to identify the reasons for this and make the results obtained more relevant. However, the results obtained can be used in subsequent analyses. This is the first approach that attempts to rank berries and drivers in a horizontal/ vertical logistic collaboration.

In ANNEX V (Hierarchies of Barriers and Drivers), encompasses tables that present the weights of barriers and drivers for both horizontal and vertical collaboration based on the overall project partner responses. These tables highlight the most important barriers and drivers within each category for both types of vertical and horizontal collaboration. This analysis informed the third step of the methodology, which involved the strategy validation workshop.

Additionally, in the same ANNEX, four tables are included that present the barriers and drivers for horizontal and vertical collaboration at each pilot site. Respondents from each site assigned weights to the barriers and drivers based on the types of collaboration (vertical and/or horizontal) identified

at their location. This analysis contributed to the fourth step of the methodology, which involved the strategy validation workshop.

Concluding remarks on barriers ranking in ADMIRAL pilot sites

To summarize the findings, Table 16 presents the ranking of barriers to logistics collaboration in ADMIRAL, for both horizontal and vertical collaboration types.

Table 16. Ranking of barriers to logistics (horizontal and vertical) collaboration

Horizontal collaboration barriers	Vertical collaboration barriers
Resistance to information sharing	Resistance to information sharing
Inadequate cost appraisal	Inadequate cost appraisal
Unequal distribution of power and information sharing among partners	Lack of systems standardization
Lack of Commitment	Unequal distribution of power and information sharing among partners
Resistance of companies to change due to risk adversity	Disparate operational practices and routines
Lack of clear operational goals and outcomes	Technological incompatibility
Lack of systems standardisation	Resistance of companies to change due to risk aversity
Complex legislation and regulation compliance	Knowledge and innovation asymmetry
Lack of trust	Individual competitive advantage protection
Lack of governance planning	Lack of clear operational goals and outcomes
Individual competitive advantage protection	Lack of Commitment
Disparate operational practices and routines	Lack of trust
Conflict over differing needs between partners	Lack of Skills. knowledge. training
Technological incompatibility	Customer demand challenges
Lack of intellectual property protection	Conflict over differing needs between partners
Inconsistency in performance measurement	Complex legislation and regulation compliance
Customer demand challenges	Lack of governance planning
Knowledge and innovation asymmetry	Inconsistency in performance measurement
Cultural and language difficulties	Lack of intellectual property protection
Lack of Skills, knowledge, training	Cultural and language difficulties

Note: ranking scale

Very High
High
Medium
Low

From the combined data in the Table 16, as well the results presented in ANNEX V, the following conclusions about the importance of barriers can be drawn:

Horizontal Collaboration

- **Top barrier:** "Resistance to information sharing" is the most significant barrier, with a score of 0.451, indicating that sharing information between companies poses the biggest challenge for successful collaboration and optimized supply chain operations.

- **Second barrier:** "Inadequate cost appraisal" follows (0.247), highlighting difficulties in accurately evaluating and agreeing on costs.
- **Other barriers** like "Unequal distribution of power and information sharing" (0.050) and "Lack of commitment" (0.047) are less critical but still present concerns.

Vertical Collaboration

- **Top barrier:** "Resistance to information sharing" remains the top barrier, scoring even higher in vertical collaboration with a score of 0.518.
- **Second barrier:** "Inadequate cost appraisal" (0.191) is also an important issue, though slightly less prominent than in horizontal collaboration.
- **Additional challenges**, such as "Lack of systems standardization" (0.075) and "Unequal distribution of power" (0.058), emphasize the need for harmonization in processes and power dynamics.

Key Insights

- **Information sharing resistance** is a major challenge for both types of collaboration, but it's more significant in vertical collaboration. **This enhances the importance of the ADMIRAL marketplace and upgrades its role as the main strategy to overcome the information sharing resistance, validating the results of section 3.4.1.**
- **Cost appraisal issues** are significant in both forms, though slightly more prominent in horizontal collaboration.
- Lower-ranked barriers, such as "Cultural and language difficulties" and "Lack of intellectual property protection," are seen as less critical but could still affect collaboration.

The focus on information sharing, cost appraisal, and system standardization highlights that logistics collaboration is often hindered by challenges related to trust, alignment, and transparency.

Concluding remarks on drivers ranking in ADMIRAL pilot sites

To summarize the findings, Table 17 presents the ranking of drivers for logistics collaboration in both horizontal and vertical collaboration types.

Table 17. Ranking of drivers to logistics (horizontal and vertical) collaboration

Horizontal collaboration drivers	Vertical collaboration drivers
Increased revenues	Better use of assets and resources
Regulation and Legislation compliance	Improve operational efficiency and productivity
Improve operational efficiency and productivity	Regulation and Legislation compliance
Reduce environmental impacts	Minimize delivery times
Costs reduction	Increased customer demand and satisfaction

Minimize delivery times	Technological advances or innovative tools
Technological advances or innovative tools	Costs reduction
Better use of assets and resources	Increased revenues
Sustainability requirements (e.g. ESG, etc.)	Sustainability requirements (e.g. ESG. etc.)
Increased customer demand and satisfaction	Reduce environmental impacts
Access to resources	Ability to foster innovation
Access to expertise and knowledge	Reliability/Resilience
Faster conflict resolution	Developing strategic synergies
Ensuring social welfare	Access to resources
Reliability/Resilience	Faster conflict resolution
Ability to foster innovation	Better market global positioning Competition
Developing strategic synergies	Access to expertise and knowledge
Better market global positioning Competition	Ensuring social welfare

Note: ranking scale

Very High
High
Medium
Low

The drivers for horizontal collaboration are primarily centred on financial benefits and regulatory compliance, while vertical collaboration drivers emphasize resource optimization and improving operational efficiency. Both types of collaboration prioritize compliance and efficiency but differ in their focus on financial outcomes versus operational and customer satisfaction goals. This distinction is crucial for stakeholders to adapt their collaboration strategies accordingly. Specifically:

- **Financial incentives** such as increased revenues are more critical in horizontal collaboration compared to vertical collaboration.
- **Operational efficiency** and **compliance with regulations** are important drivers for both horizontal and vertical collaboration, though they are prioritized differently.
- **Environmental impact reduction** is more emphasized in horizontal collaboration.
- **Customer satisfaction and demand** are more significant in vertical collaboration, reflecting the focus on end-customer relations.
- **Technological advancements** and **cost reduction** are lower in priority for both types of collaboration but still present.

4.2.2 Strategy validation workshop results

In the previous chapter, the most important barriers and drivers were identified both across the ADMIRAL pilot sites and in relation to the project's overall scope. During the validation workshop held in Vilnius, Lithuania, participants selected and validated strategies and strategy categories to address these barriers. First, participants prioritized the strategy categories (Figure 3) within the

context of the Admiral Marketplace, followed by selecting the most important strategies within each of the ten categories (Table 18).

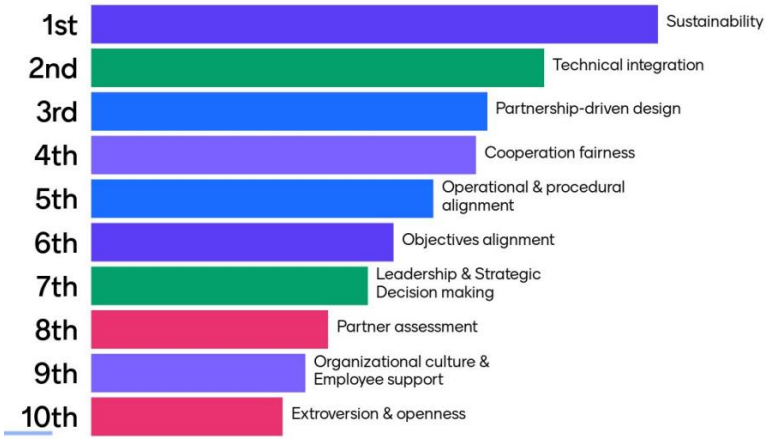

Figure 3 Ranking of the Strategies categories for consideration at the ADMIRAL Marketplace

As might be expected, the most important strategy category is the Sustainability, as the Admiral As might be expected, the most important strategy category is the Sustainability, as the Admiral project pilot sites aim to make the supply chain sustainable, green and valuable. This is followed by the Technical Integration, as the existence of integration and interconnection at the technological level are expected to bring significant benefits to the management of supply chains and their evolution. Partnership-driven design and the cooperation fairness show that designing services based on fair cooperation is an important priority for the partners of the Admiral project. Each of these ten strategy categories includes related strategies, which participants were asked to prioritize based on the challenges they face in their business operations. The following table (Table 18) presents the three most important strategies of each strategy category.

Table 18. selecting the most important strategies for each of the ten categories

Strategy category	Top-3 Strategies		
1: Partnership-driven design	Early supplier and customer involvement (14)	Co-create with end-consumers (13)	Effective use of pilot projects/ Joint product development/ Open innovation (8)
2: Cooperation fairness	Data privacy (17)	Fair profit sharing (13)	Costs/benefits allocation mechanism Swift and equitable dispute resolution mechanism for contractual obligations (11)
3: Extroversion & openness	Open information sharing culture (14)	Industry-university partnerships (5)	Joint knowledge creation (5)

Strategy category	Top-3 Strategies		
4: Leadership & Strategic Decision making	Strategic Supply Chain vision (20)	Clearly defined entry and exit rules / setting limits (17)	Neutral leadership Strategic Supply Chain vision (9)
5: Objectives alignment	Strategic alignment around joint objectives (17)	Ownership clarity (13)	Incentive alignment (11)
6: Operational & procedural alignment	Process integration (23)	Collaborative planning across the supply chain (15)	Infrastructure integration (8)
7: Organizational culture & Employee support	Continuous collaboration culture improvement (17)	Supply chain education and training (12)	Cross-trained experienced managers (9)
8: Partner assessment	Cooperation feedback ratings (15)	Due diligence in partner selection (14)	Certification (partners) (14)
9: Technical integration	Technology integration – Standardization (21)	Use of systems for collaborative cooperation (ERP, CDSS) (1)	Utilization of technology in contracts (e.g., blockchain) (1)
10: Sustainability	Accurate comprehensive measures for sustainability (14)	Design for sustainability (6)	Collaborative communication for sustainability (1)

The technology integration and standardization are quite important, as these are actual problems and each one of the different stakeholders use a different data model to express their needs. As there are some processes at a supply chain, the process integration is a crucial strategy for overcoming the barriers, as it is better to understand a whole system as a network rather than as many different smaller networks operating in silos.

Continuous improvement of the collaboration culture can help a marketplace evolve, as fostering a spirit of cooperation between different companies will enhance their understanding of the marketplace and contribute to achieving its goals.

Afterwards, ADMIRAL project partners ranked strategies aimed at addressing the two most significant barriers to horizontal (Figure 4) and vertical collaboration (Figure 5). As it was expected, for overcoming the barriers of Horizontal Collaboration the collaborative planning across the supply chain and the continuous collaboration culture improvement combined with the culture of open information sharing are quite important. The openness of information sharing was also recognised for overcoming the barriers of vertical collaboration, however the standardization and the technology integration is the first recognised strategy for this type of collaboration.

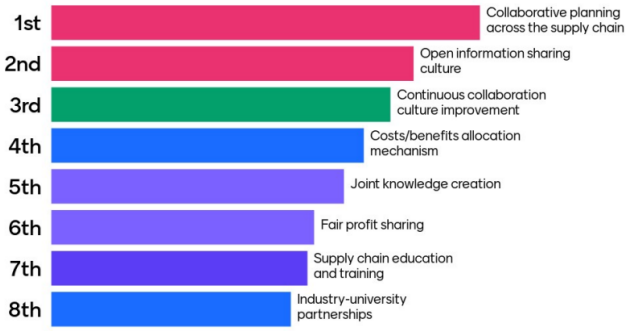

Figure 4. Ranking of strategies for HC barriers: Costs reduction, technological advances or innovative tools

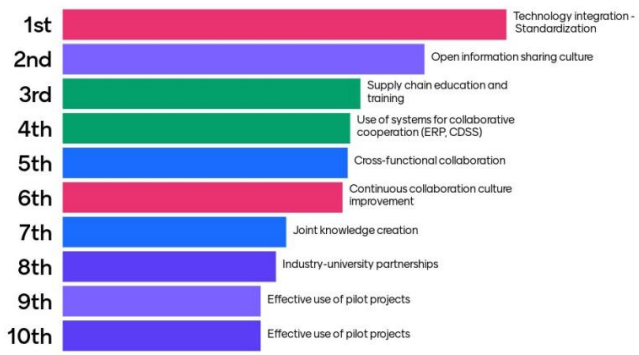

Figure 5. Ranking of strategies for VC barriers: Minimize delivery times, better use of assets and resources

In the final interactive session, participants identified the five most important impact areas they expect from the ADMIRAL Marketplace (Figure 6), along with their related expectations (Figure 7).

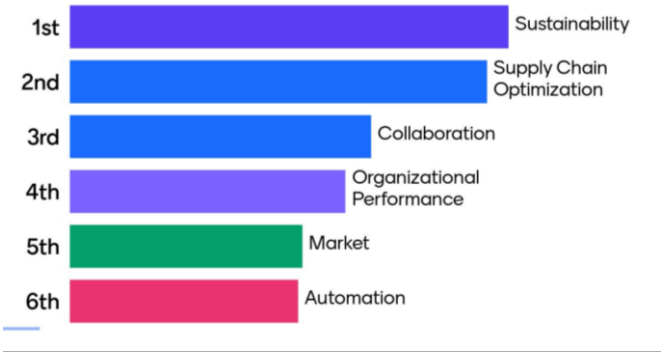

Figure 6. Impact expectations from a Marketplace

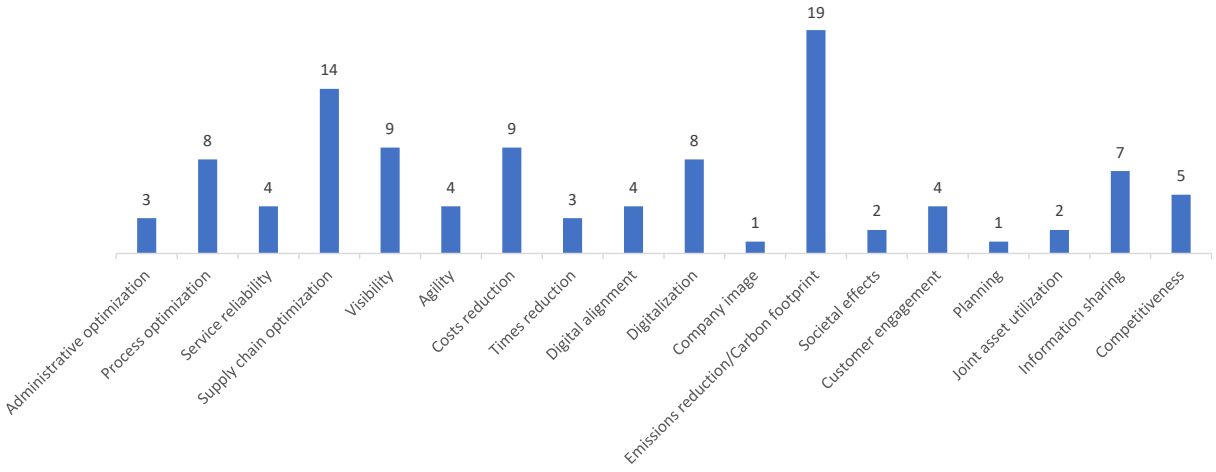

Figure 7. Impact Areas expectations from the Admiral Marketplace

Regarding the expected impacts from the marketplace, participants prioritized sustainability and the optimization of the supply chain process, as anticipated. As a result, when discussing the ADMIRAL

Marketplace, emissions reduction and supply chain optimization emerged as the most significant impact areas. Additionally, as noted in previous responses, cost reduction, digitalization, and information sharing were also recognized as key factors. It is important to emphasize that stability was identified as a priority both in the pilot site responses and from the perspective of the ADMIRAL Marketplace.

4.2.3 Strategies identification across pilot sites

In the fourth step of the methodology, the pilot site partners were tasked with identifying strategies to address the barriers unique to their respective pilot sites. A customized online questionnaire was distributed to each site (ANNEX IV), requesting that the relevant partners rank strategies to overcome the most significant barriers identified at their pilot site.

Findings per pilot

Slovenian - Croatian pilot

The most significant barriers to HC include inadequate cost appraisal, resistance to information sharing, technological incompatibility, resistance to change, and lack of trust. Technological incompatibility and lack of trust were not spotted as critical to VC, stating as important the Unequal distribution of power and information sharing among partners. The corresponding strategies to address these barriers, both in HC and VC, emphasize collaborative planning, fair profit sharing, open information sharing culture, technology integration, resource sharing, and data privacy. The recommended strategies focus on fair profit sharing, open information sharing culture, cross-functional collaboration, and strategic supply chain vision.

Finnish pilot

The most significant barriers to HC include inadequate cost appraisal, resistance to information sharing, lack of systems standardization and lack of clear operational goals and outcomes. The latter was not considered as critical to VC, stating instead as important the Unequal distribution of power and information sharing among partners. The corresponding strategies to address these barriers emphasize costs/benefits allocation mechanism, continuous collaboration culture improvement, open information sharing culture, technology integration, and supplier alignment. The recommended strategies focus on fair profit sharing, open information sharing culture, cross-functional collaboration, and supplier collaboration.

Portuguese - Spanish pilot

The most significant barriers to HC include inadequate cost appraisal, resistance to information sharing, resistance of companies to change due to risk aversity, individual competitive advantage protection, and unequal distribution of power and information sharing among partners. Unequal distribution of power and information sharing among partners were not identified as critical to VC,

stating as important the inadequate cost appraisal. The corresponding strategies to address these barriers emphasize joint knowledge creation, resource sharing trust-based alliances, open information culture and collaborative planning. The recommended strategies in Slovenian – Croatian pilot place therefore greater importance to collaborative and knowledge issues, rather than to technological elements.

Lithuanian pilot

The most significant barriers to HC include resistance to information sharing, lack of Commitment, conflict over differing needs between partners, and unequal distribution of power and information sharing among partners. Lack of Commitment, and conflict over differing needs between partners were not identified as critical to VC, stating as important the inadequate cost appraisal. The corresponding strategies to address these barriers, emphasize joint knowledge creation, open information culture, ownership clarity, joint product development, co-creation with end-customers, and the development of a cost/benefit allocation mechanism. The recommended strategies in this pilot focus also on collaborative and knowledge issues, as well as commitment, rather than to technological elements.

Summary of findings

Overall, the ranking of strategies for overcoming the most significant barriers in horizontal collaboration (HC) highlights key approaches to enhance cooperation. For inadequate cost appraisal, the top strategies include *collaborative planning across the supply chain* and a *fair profit-sharing mechanism*. To address resistance to information sharing, creating an *open information sharing culture* and promoting *continuous collaboration improvement* are prioritized. Overcoming technological incompatibility requires *technology standardization* and the use of systems for collaborative cooperation. For companies resistant to change due to *the risk-averse companies in the supply chain*, strategies like *resource sharing, managerial support*, and *cross-training managers* are vital. To build trust, the ranking emphasizes *data privacy, trust-based alliances*, and *neutral leadership***,** while *supplier alignment* is crucial for setting clear goals. Tackling unequal distribution of power and information requires *open information sharing culture*, and *early supplier and customer involvement*. Lastly, *ownership clarity* in ranking higher as a mean to overcome lack of commitment and conflict over partner needs, while joint product development and open information sharing are prioritized to tackle Unequal distribution of power and information sharing.

Strategies for overcoming barriers in vertical collaboration (VC) focus on enhancing fairness, information sharing, and adaptability. To address inadequate cost appraisal, strategies like *fair profit sharing*, a *cost/benefit allocation mechanism*, and *collaborative planning* are prioritized. For resistance to information sharing, an *open information sharing culture* and *continuous collaboration improvement* are emphasized. Tackling unequal distribution of power and information requires *co-creation with end-consumers, early supplier and customer involvement*, and *neutral leadership*. For

resistance to change due to the *risk-averse companies in the supply chain*, fostering *managerial support, resource sharing*, and *cross-trained managers* is critical. Customer demand challenges are met through *joint knowledge creation, pilot projects*, and *sustainable design*. Individual competitive advantage protection also requires strategies to build strong *trust-based alliances***.**

The detailed strategy ranking per pilot is presented in ANNEX VI.

4.2.4 Strategies for successful implementation of the ADMIRAL Marketplace

The ADMIRAL Marketplace is, by definition, a collaborative platform that aims to bring together a diverse group of logistics and supply chain actors, in terms of their business operations and position in the supply chain. They can either be on the same levels of operations (i.e., freight forwarders), or in different ones (i.e., manufacture and transport operations), posing a greater importance to the need of implementing both horizontal and vertical collaboration. Therefore, in order to achieve its primary goal ADMIRAL Marketplace should overcome the barriers identified previously in HC (Table 5) and VC (Table 8) analysis, using the relevant strategies.

However, the marketplace is already developed to bridge some of these barriers, and specifically those referring to “Technology and Innovation”, since the marketplace is designed to solve the technologies problems, such as the lack of interoperability, standardization etc.

In addition, barriers that have been identified in other categories are also addressed, due to the operational model of the marketplace, i.e.,

- Lack of governance planning: the ADMIRAL MP proposes a framework that oversees the operations, transactions, and overall functioning of the marketplace.
- Inconsistency in performance measurement: the ADMIRAL MP employs standardized and reliable methods for evaluating and tracking the performance of various elements within the marketplace.
- Lack of intellectual property protection: the ADMIRAL MP adequate safeguards creations, inventions, and proprietary information of individuals and businesses that participate in the marketplace.
- Complex legislation and regulation compliance: the ADMIRAL MP successful operation hinges on meticulous legal and regulatory compliance, ensuring fair competition, robust data protection, and comprehensive cybersecurity (ANNEX I).
- Lack of Commitment and Resistance to information sharing: the ADMIRAL MP foundation is the commitment of the participating partners, as they participate voluntarily, accepting the need and the subsequent benefits of sharing information and the overall use of the marketplace services.

- Market and business model: the ADMIRAL MP is developed as an innovative business model that disrupts current and fragmented business models, towards new and collaborative market paradigms.
- Disparate operational practices and routines: the ADMIRAL MP is based in developing consistent and coordinated methods and procedures for the different participants.

Figure 8 summarizes the remaining barriers to logistics marketplace implementation, which are also confirmed by the literature review (Section 3.4.1).

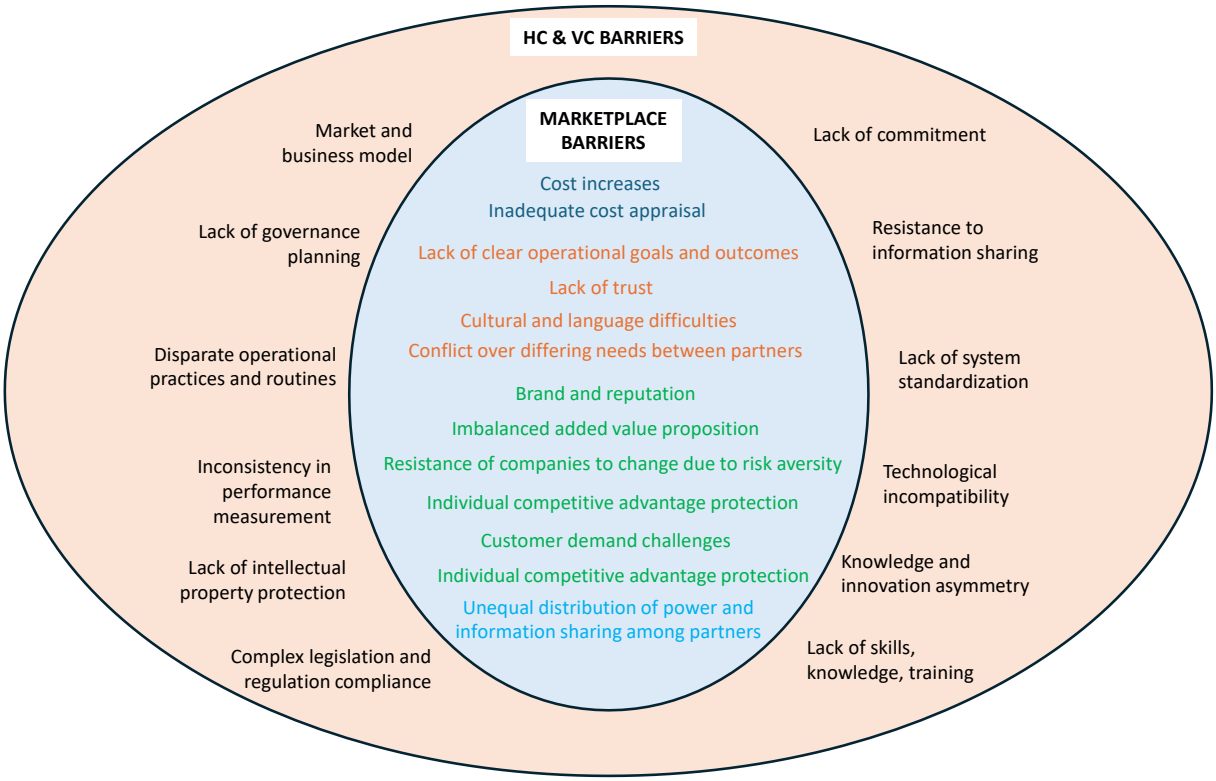

Figure 8. Barriers to logistics marketplace implementation

The aforementioned barriers could be further correlated with the strategies to overcome VC and HC collaboration (sections 3.1.3, 3.2.3) and lead to a list of suggested strategies to successfully implement ADMIRAL Marketplace (Table 19) (bold font highlights the green strategies from Table 11).

Table 19. Suggested strategies to overcome barriers in ADMIRAL Marketplace implementation

Barrier category	Barrier	Strategies
Economic & efficiency	Inadequate cost appraisal	Costs/benefits allocation mechanism; Fair profit-sharing mechanism; **Collaborative planning across the supply chain**
Governance and regulation	Lack of clear operational goals and outcomes	Cross-functional collaboration; Joint product development; Multi-tier perspectives; **Open innovation; Incentive alignment**; **Supplier alignment and rationalization**; **Process documentation**; **Process integration**
	Lack of trust	Understanding of the elements that constitute effective collaboration; Anti-competitive laws compliance mechanism; Data privacy; Trust-based alliances; Clearly defined entry and exit rules/setting limits; Neutral leadership; Servant leadership & enlightened despotism; **Strategic SC vision**; Using chain advisory councils; **Prior collaborative history with a partner**
	Cultural and language difficulties	Joint knowledge creation; Continuous collaboration culture improvement; **Cross-trained experienced managers**; Managerial and employee support; **Supply chain education and training**
	Conflict over differing needs between partners	**Incentive alignment**; Ownership clarity; Strategic alignment around joint objectives; **Supplier alignment and rationalization**; Due diligence in partner selection; **Prior collaborative history with a partner; Accurate comprehensive measures for sustainability**; Collaborative communication for sustainability; **Design for sustainability**
Market and business model	Brand and reputation	Trust-based alliances; Effective use of pilot projects; Early supplier and customer involvement
	Imbalanced added value proposition	Trust-based alliances; Co-create with end-consumers; Early supplier and customer involvement; Joint knowledge creation
	Resistance of companies to change due to risk aversion	**Resources sharing**; Continuous collaboration culture improvement; **Cross-trained experienced managers**; Managerial and employee support; **Supply chain education and training**
	Individual competitive advantage protection	Co-create with end-consumers; Effective use of pilot projects; Anti-competitive laws compliance mechanism; Data privacy; Trust-based alliances
	Customer demand challenges	Co-create with end-consumers; Early supplier and customer involvement; Effective use of pilot projects; Joint knowledge creation; **Design for sustainability**

Barrier category	Barrier	Strategies
Information sharing	Unequal distribution of power and information sharing among partners	Co-create with end-consumers; Early supplier and customer involvement; Joint product development; Joint knowledge creation; Open information sharing culture; Centralized decision-making for effectiveness; Command-and-control-based relationships; Neutral leadership; Servant leadership & enlightened despotism; Using chain advisory councils

5 Conclusions and summary of key findings

This report continues the efforts of WP3 in analysing new business models for sustainable transport by studying key drivers, barriers, and strategies in multimodal logistics collaboration, with a focus on both horizontal and vertical collaboration; aiming to address value chain interests and mitigate risks of suboptimization.

The primary aim of Deliverable 3.2 is to identify and propose strategies for designing the ADMIRAL Marketplace to effectively overcome common collaboration barriers – built as collaborative by design.

To fulfil the deliverables aims, the report followed a two-way approach: (a) Desktop research and (b) Co-definition workshops: A five-step validation process was carried out with the project pilots to confirm the literature findings and tailor them to the specific needs of the Marketplace.

Vertical collaboration in logistics refers to the strategic partnership between different levels of the supply chain, such as manufacturers, suppliers, distributors, and retailers, to enhance operational efficiency and performance. This type of collaboration can take various forms, from information sharing and process synchronization to joint innovation and long-term partnerships. However, achieving successful vertical collaboration is often hindered by several barriers, including technological incompatibility, lack of trust, and regulatory complexities. Despite these challenges, key drivers such as cost reduction, improved customer service, and technological advancements motivate companies to pursue closer partnerships. To overcome these barriers, strategies such as establishing clear governance frameworks, fostering open communication, and leveraging advanced technologies are essential for creating a resilient and efficient supply chain.

On the other hand, the main benefits of **horizontal collaboration** include enhanced efficiency, reduced costs, and improved overall supply chain performance. Additionally, by sharing knowledge and resources, logistics providers can introduce new specialized services, protecting and expanding their market space. Moreover, horizontal collaboration leads to substantial **environmental benefits** by reducing greenhouse gas emissions, air and water pollution, noise pollution, traffic congestion, and accidents. However, implementing horizontal collaboration in logistics is often more challenging than vertical collaboration, as it requires coordination and trust between competitors at the same level of the supply chain, whereas vertical collaboration typically involves more straightforward integration between partners with complementary roles and aligned incentives. The main strategies (bridges) to overcome HC barriers include partnership-driven design; Cooperation fairness; Extroversion & openness; Leadership & Strategic Decision making; Objectives alignment; Operational & procedural alignment; Organizational culture & Employee support; Partner assessment; Technical integration; Sustainability.

Legislation and contractual considerations are crucial in logistics marketplaces to ensure compliance with legal standards, protect all parties, and manage risks. Clear contracts define roles, responsibilities, and liability, fostering trust and accountability. They also help prevent disputes, protect intellectual property, and ensure smooth, lawful operations, enhancing efficiency and reliability in the marketplace.

The ADMIRAL marketplace's successful operation hinges on meticulous legal and regulatory compliance, ensuring fair competition, robust data protection, and comprehensive cybersecurity. By adhering to EU competition law, the marketplace can facilitate lawful cooperation among logistics providers, preventing anti-competitive practices. Compliance with GDPR ensures transparent and secure handling of personal data, fostering trust among participants. Additionally, implementing rigorous cybersecurity measures as mandated by the NIS 2 Directive will protect against cyber threats and ensure the integrity of the marketplace. These legal and regulatory considerations are vital for establishing a secure, competitive, and compliant collaborative logistics environment, ultimately contributing to the ADMIRAL project's long-term success.

The process of assessing and validating collaboration models within the context of the ADMIRAL project, to determine the suitability and effectiveness of existing horizontal collaboration frameworks for the project's goals, lead to the following conclusions:

- In the context of logistics collaboration, several key barriers have been identified that impact the effectiveness of both vertical and horizontal partnerships. One of the primary challenges is resistance to information sharing. This issue is particularly pronounced in vertical collaboration, where the reluctance to share information can significantly impede progress. The ADMIRAL marketplace plays a crucial role in addressing this challenge. As the primary strategy for overcoming information sharing resistance, its importance is underscored, corroborating the findings of section 3.4.1. Cost appraisal issues also present notable obstacles in logistics collaboration. While these issues are present in both vertical and horizontal collaborations, they are slightly more concerning in the latter. Additionally, there are lower-ranked barriers such as cultural and language difficulties, and a lack of intellectual property protection. Although these are considered less critical, they still have the potential to influence collaboration efforts negatively. Overall, the focus on information sharing, cost issues, and system standardization highlights how logistics collaboration is often hindered by challenges related to trust, alignment, and transparency. Addressing these barriers is essential for improving the efficiency and effectiveness of collaborative logistics strategies.

- The drivers for horizontal collaboration are heavily oriented towards financial benefits and regulatory compliance, while vertical collaboration drivers focus more on optimizing resources and improving operational efficiency. Both collaboration types prioritize compliance and efficiency but differ in the emphasis on financial versus operational and customer satisfaction outcomes. This differentiation is critical for stakeholders to tailor their collaboration strategies according to the type of partnership they are engaging in.

The ADMIRAL Marketplace is by definition a collaborative platform that aims to bring together a diverse group of logistics and supply chain actors, in terms of their business operations and position in the supply chain. They can either be on the same levels of operations (i.e., freight forwarders), or in different ones (i.e., manufactures and transport operations), thus enhancing the need of horizontal and vertical collaboration. Therefore, in order to achieve its primary goal ADMIRAL Marketplace should overcome the barriers by employing specific strategies. However, the marketplace is already developed to bridge some of these barriers, and specifically those referring to "Technology and Innovation", since the marketplace is designed to solve the technologies problems, such as the lack of interoperability, standardization etc. In addition, barriers that have been identified in other categories are also addressed, due to the operational model of the marketplace, i.e., Lack of governance planning; Inconsistency in performance measurement; Lack of intellectual property protection; Complex legislation and regulation compliance; Lack of Commitment; Market and business model; Disparate operational practices and routines; Resistance to information sharing.

The correlation of MP barriers to the identified strategies, lead to the proposed strategies for designing the ADMIRAL Marketplace to effectively overcome common collaboration barriers, as detailed presented in Table 19 (Section 4.2.4). The table outlines various strategies to address barriers encountered in the implementation of the ADMIRAL Marketplace. The barriers are categorized into economic & efficiency, governance & regulation, cultural and language difficulties, conflict over differing needs between partners, market and business model, and information sharing. Each category lists specific barriers and corresponding strategies to overcome them. For instance, to address inadequate cost appraisal, strategies like costs/benefits allocation mechanisms and fair profit-sharing mechanisms are suggested. To mitigate lack of trust, measures such as trust-based alliances and compliance with anti-competitive laws are recommended. The table emphasizes cross-functional collaboration, joint knowledge creation, strategic alignment, and effective communication as key strategies to tackle the diverse challenges in the ADMIRAL Marketplace.

Figure 10 focuses specifically on the green strategies that can be employed towards logistics collaboration in the context of ADMIRAL Marketplace.

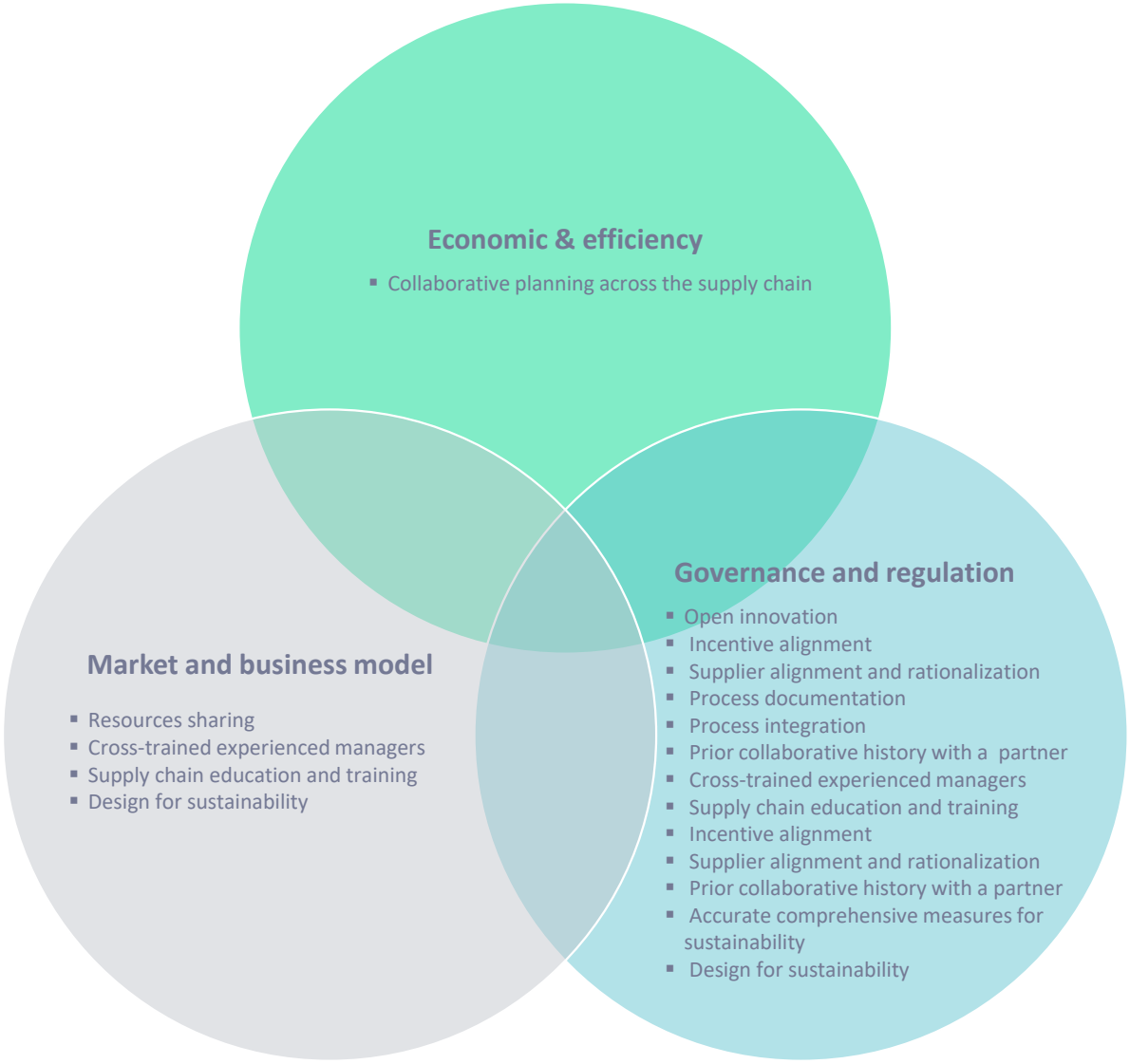

Figure 9. Green strategies towards logistics collaboration within ADMIRAL Marketplace

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ANNEX I Legislation & Contractual Considerations for Logistics Collaboration

I.1 Legislation and contractual considerations for logistics Collaboration

The ADMIRAL marketplace is set to operate across several EU Member States, therefore the EU and national regulatory frameworks determine the legal considerations for the operation of the ADMIRAL marketplace, its participants and partners.

This Section focuses on providing stakeholders with a general overview of key legislation and contractual considerations relevant for the Admiral project, which is set to establish cooperation framework between logistics service providers and buyers, e.g. cargo owners, through the ADMIRAL marketplace.

The purpose of legal analysis in this section is to help stakeholders to understand the extent to which cooperation is permissible and determine the most suitable forms of cooperation for the Admiral project.

It must be emphasized that this Section provides general guidance on the most important EU law regulatory areas which are relevant for interested parties considering participation in the ADMIRAL marketplace as well as stakeholders active in the decision-making process concerning the design of the ADMIRAL marketplace mechanism. However, this document does not replace the need to conduct case-by-case legal compliance assessment for the ADMIRAL marketplace with respect to each jurisdiction where it will be operational as well as compliance assessment for each participant or partner.

Any changes to the design of the mechanism of the ADMIRAL marketplace and each participant's individual circumstances can also be determinative in assessing the full scope of the legal compliance obligations for the ADMIRAL marketplace and any of its participants and partners. Hence, Section 4 of this deliverable shall not be construed as legal advice in a particular situation or case. Undertakings are responsible for compliance with applicable law and regulations, and therefore are advised to seek appropriate legal advice in order to ensure such compliance. Also, this document has been prepared on the basis of legal acts that are applicable on the date of this document. This document or any separate part of it may and must be considered solely as an opinion of the authors of this document.

I.1.1 Antitrust and Competition Law Considerations

I.1.1.1 Why Antitrust and Competition Law requirements are important?

The cooperation between the economic operators causes risk from Competition Law perspective. 'Competition Law' and 'Antitrust' are interchangeably used terms covering (i) prohibited agreements (incl. 'cartels') and (ii) abuse of dominance. Traditionally, in Europe, 'Competition Law' is the preferred option. Competition Law imposes prohibitions which apply to all undertakings, irrespective of the activity they are engaged with. Non-compliance with the prohibitions set by Competition Law may lead to high fines, liability for damages suffered by third persons, director disqualification, criminal liability, void (unenforceable agreements), legal costs and reputational damage.

Different from many other areas of law, not all Competition Law requirements are intuitive or self-evident, therefore great attention should be given to efforts in understanding the EU competition law concepts.

I1.1.1.1 EU competition law

In EU, there are national and EU competition laws. National competition laws are often equivalent or very similar to EU competition law. However, EU competition law is applied where the conduct affects trade between EU Member States. Whereas the European Commission (**"EC"**) and national competition authorities (**"NCAs"**) are charged with enforcing EU competition laws, and the ADMIRAL marketplace concerns shipping services most which are of cross-border nature, it is reasonable to assume that EU competition law is more likely to be applied to activities concerning the ADMIRAL marketplace. For this reason, in this document we focus on EU competition law obligations.

EU competition law prohibits agreements between undertakings, decisions by associations of undertakings and concerted practices which prevent, restrict or distort competition. This prohibition and the specific obligations arising from therefrom are scrutinized in greater detail in sub-sections below.

Abuse of dominance prohibition is enforced against unilateral behaviour on a specific market and typically is not enforced against new market players and in new and competitively dynamic markets. In EU competition law this prohibition is governed by Article 102 of the Treaty on the Functioning of the European Union[5] (**"TFEU"**).

Business combinations subject to EU Merger Control rules require undertakings to notify and obtain approval from the EC before implementation of the transaction. Also, advantage in any form whatsoever conferred by national public authorities are subject to state aid rules. Both EU Merger

[5] OJ C 202, 7.6.2016.

Control rules and state aid rules are considered as part of the EU competition law, however, given the nature of the Admiral project, we further analyse only the scope of EU competition law concerning prohibited agreements.

I.1.1.1.2 Importance of CJEU case law and EC guidance in interpretation of EU competition law

Different from many other areas of law - despite that EU competition law provisions are enshrined in statutory law such as TFEU - the business entities seeking to comply with EU competition law and to understand the scope of their obligations in specific situations must also take into account the case law of the European Court of Justice (**"CJEU"**) and various "soft law" resources of the EC (e.g.., EC guidelines.

I.1.1.1.3 Enforcement of EU competition law

As it was stated above, EC and NCAs are charged with EU competition law enforcement. When an infringement is suspected, e.g. on the basis of complaint, leniency application, the EC and (or) NCAs may start an investigation into an alleged EU competition law infringement.

The EC and also NCAs possess extensive investigative rights[6] which include, among other, the power to conduct unannounced inspection to the premises of an undertaking (colloquially referred to as "dawn raid"); search premises; examine any information, irrespective of the medium on which they are stored (i.e. including electronically stored information); ask questions to individuals; request for information and impose fines against undertakings if they fail to cooperate.

Besides EC and NCAs, national courts of the EU Member States are also charged with application of EU competition law.

I.1.1.2 Prohibited agreements

I.1.1.2.1 Article 101 TFEU structure

Article 101 TFEU stipulates what conduct is covered by the 'prohibited agreement' concept. Article 101(1) TFEU prohibits all agreements between undertakings, decisions by associations of undertakings and concerted practices which may affect trade between Member States and which have as their object or effect the prevention, restriction or distortion of competition within the internal market.

Article 101(2) TFEU sets out that any agreements or decisions prohibited pursuant to Article 101(1) TFEU are automatically void and, thus, unenforceable. According to CJEU case law, whether the

[6] See Council Regulation (EC) No 1/2003 of 16 December 2002 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty, *OJ L 1, 4.1.2003, p. 1–25*.

prohibited agreements infringement is void, depends on whether the part or the clause that infringes the prohibition can be separated from the agreement as a whole.[7]

Article 101(3) TFEU sets the requirements for exemptions from the prohibition under Article 101(1) TFEU. Firstly, the conduct may fall within category of conduct for which Article 101(1) TFEU is inapplicable. Such exemptions are established under 'Block Exemption Regulations'. Second, Article 101(1) TFEU is inapplicable in case the conduct in question satisfies the 'individual exemption' conditions.

Specifically, Article 101(3) TFEU establishes four conditions, all of which must be satisfied in order for the conduct to be 'individually exempted': (1) contributes to improving the production or distribution of goods or to promoting technical or economic progress; (2) allows consumers a fair share of the resulting benefit; (3) does not impose on the undertakings concerned restrictions which are not indispensable to the attainment of these objectives; (4) does not afford concerned undertakings the possibility of eliminating competition in respect of a substantial part of the products in question.

In order for the conduct to meet 'individual exemption' requirements, it requires complex economic, evidence-based assessment[8].

I.1.1.2.2 Article 101 TFEU structure

Article 101(1) TFEU contains five conditions that all must be found for the conduct to infringe said provision:

- the cooperation must involve two or more undertakings;
- cooperation must take form of an agreement, concerted practice or decision of an association of undertakings[9];
- the cooperation must have as the object or effect the prevention, restriction or distortion of competition;
- the prevention, restriction or distortion of competition must be appreciable; and
- the prevention, restriction or distortion of competition must affect the trade between Member States.

[7] CJEU Judgment 30 June 1966, Case 56-65, *Société Technique Minière*, ECLI identifier: ECLI:EU:C:1966:38, p. 250.
[8] The assessment criteria are further detailed under EC Guidelines on the application of Article 81(3) of the Treaty, *OJ C 101, 27.4.2004, p. 97–118*.
[9] Since the Admiral project does not directly concern activities of business associations, decisions of associations do not fall within the scope of this document.

I.1.1.2.3 Notion of "undertaking"

Article 101(1) TFEU applies only to undertakings – entities engaged in an economic activity, regardless of the legal status and the way in which it is financed.[10] Any activity consisting in offering goods and services on a given market is considered as 'economic activity'.[11] Actions of employees are attributable to the undertakings for which they work,[12] regardless if they have formal authorizations to perform specific activities.

Given that Admiral project participants either provide shipping services or are offering goods, all Admiral project participants, including the operator of the Admiral marketplace can be therefore assumed to qualify as undertakings.

I.1.1.2.4 Notions of 'agreement' and 'concerted practice'

'An agreement' under EU competition law encompasses much more than agreements made in writing. A mere concurrence of wills[13] (i.e. consensus) to conduct themselves in a specific way is sufficient to qualify a bilateral contact as an agreement. Therefore, there is no requirement under EU competition law that the agreement must be made in writing, no requirement for the agreement to be titled as "contract" or "agreement", etc.

'Concerted practice' means a form of coordination which falls short of an agreement, however, the implied concurrence of wills is observed. Specifically, 'a concerted practice' is found if three elements exist: (i) alignment (i.e. concertation or collusion) of behaviour between undertakings; (ii) subsequent market behaviour pursuant collusion and (iii) a causal link between the alignment and the specific market behaviour.[14] 'Concerted practice', according to CJEU case law, is a form of coordination between undertakings which, without having reached the stage where an agreement has been concluded, knowingly substitutes practical cooperation between them for the risks of competition.[15]

'Concerted practice' can take different forms, e.g. through exchange of commercially sensitive information, signalling of future behaviour or through third party (such as an advisor).

In light of the above, there is a broad set of activities within the Admiral marketplace by its participants, marketplace operator and partners, which could fall within the remit of the notions of

[10] CJEU Judgment of 23 April 1991, Case C-41/90, *Klaus Höfner*, ECR 1991 I-01979, ECLI identifier: ECLI:EU:C:1991:161, para 21.
[11] CJEU Judgment of 18 June 1998, Case C-35/96, *EC v Italy*, ECR 1998 I-03851, ECLI identifier: ECLI:EU:C:1998:303, para 36.
[1212] CJEU Judgment of 21 July 2016, Case C-542/14, *VM Remonts*, ECLI identifier: ECLI:EU:C:2016:578, para 24.
[13] CJEU Court of First Instance („CFI") Judgment of 26 October 2000, Case T-41/96, *Bayer AG*, ECR 2000 II-03383, ECLI identifier: ECLI:EU:T:2000:242 para 69.
[14] CJEU Judgment of 8 July 1999, Case C-49/92 P, *Anic*, ECR 1999 I-04125, ECLI identifier: ECLI:EU:C:1999:356, para 118.
[15] CJEU Judgment of 14 July 1972, Case 48-69, *ICI v EC,* ECR 1972 00619, ECLI identifier: ECLI:EU:C:1972:70 para 64.

'agreement' or 'concerted practice', and therefore require to safeguard compliance with EU competition law requirements.

I.1.1.2.5 Restriction of competition

An agreement or concerted practice falls within the scope of Article 101(1) TFEU prohibition if it has either the object or effect to prevent, restrict or distort competition. The distinction between 'restrictions by object' and 'restrictions by effect' is important, since if an agreement or concerted practice qualifies as 'restriction by object', it is not necessary to demonstrate that it has adverse effects on competition.

The underpinning principle behind Article 101(1) TFEU, is that undertakings must determine their own behaviour on the market independently. Whilst it is not prohibited for undertakings to adapt themselves intelligently to the conduct of their competitors on the market, it is prohibited for undertakings to engage in any direct or indirect contact between undertakings (by way of agreement, concerted practice or decision by an association of undertakings) that is likely to influence the commercial strategy of competitors.

I.1.1.2.5.1 'Restriction by object' category

The following behaviour is generally considered to fall within the 'restriction by object' category of restrictions:

- fixing purchase or selling prices or any other trading conditions;
- limiting or controlling production, markets, technical development, or investment;
- sharing markets or customers or sources of supply;
- exchanging commercially sensitive information that reduces uncertainty about future market behaviour.

Regarding supply relationships between companies within different levels of supply chain, 'restriction by object' category covers:

- imposing fixed or minimum resale prices:
- imposing export bans;
- imposing certain territorial or customer restrictions.

The behaviour examples which fall under 'restriction by object' category provide concrete examples of cooperation forms which are not permissible for the ADMIRAL marketplace or its partners.

According to CJEU case law, behaviour falls within 'restriction by object' category if **it reveals a sufficient degree of harm to competition**; and regard must be had to the content of its provisions, its objectives and the economic and legal context of which it forms a part. When determining that context, it is also necessary to take into consideration the nature of the goods or services affected, as well as the real conditions of the functioning and structure of the market or markets in question.[16]

I.1.1.2.5.2 'Restriction by effect' category

If specific conduct does not fall within the 'restriction by object' category, the actual or potential anticompetitive effects must be proven to establish an infringement of Article 101(1) TFEU. The assessment of an effect restriction is made on a case-by-case basis. In general, anticompetitive effects may be found where parties to the agreement or concerted practice individually or collectively possess market power and the agreement contributes to the creation, maintenance or strengthening of that market power or allows the parties to exploit such market power.[17]

Market power is understood as the ability to maintain prices above competitive levels for a significant period of time or to maintain output in terms of product quantities, product quality and variety or innovation below competitive levels for a significant period of time. In markets with high fixed costs undertakings must price significantly above their marginal costs of production in order to ensure a competitive return on their investment. When competitive constraints are insufficient to maintain prices and output at competitive levels, the undertakings have market power within the meaning of Article 101(1) TFEU.[18]

In general, finding 'restriction by effect' requires an extensive economic analysis of the arrangement in question in the market context in which it exists.[19] Nevertheless, the ADMIRAL marketplace and its members should establish internal control mechanisms which would enable the ADMIRAL marketplace and its members observe their market shares in the potential relevant markets connected to their activities, as this measure would facilitate compliance with competition laws.

[16] CJEU Judgment of 11 September 2014, Case C-67/13 P, *Cartes bancaires*, ECLI identifier: ECLI:EU:C:2014:2204, para 53.
[17] E.g. EC Guidelines on the application of Article 81(3) of the Treaty, *OJ C 101, 27.4.2004, p. 97–118*, point 25.
[18] E.g. EC Guidelines on the application of Article 81(3) of the Treaty, *OJ C 101, 27.4.2004, p. 97–118*, point 25.
[19] CJEU Judgment of 28 February 1991, Case C-234/89, *Delimitis*, ECR 1991 I-00935, ECLI identifier: ECLI:EU:C:1991:91, para 13.

According to CJEU, a restrictive agreement is not capable of having an appreciable effect on competition fall outside of Article 101(1) TFEU prohibition.[20] The EC in its *'De Minimis Notice'*[21] indicates that if cooperation does not fall within 'restriction by object' category, restrictive agreements between actual or potential undertakings (i.e. agreements between undertakings operating at the same level of supply chain) are permissible if the aggregate market share held by the parties to the agreement does not exceed 10 % on any of the relevant markets affected by the agreements. For agreements between non-competitors (i.e. undertakings operating at different levels of supply chain), each undertaking's individual market share threshold is 15 %. However, both thresholds are reduced to 5 % if in the same relevant market restrictive agreements are entered into by different suppliers or distributors.[22]

The relevant market is a specific concept in Competition Law, and especially fundamental in appraising the relative competitive strength of undertakings, and in particular it makes it possible to calculate market shares. Therefore, it is instrumental in navigating considerations concerning 'restriction by effect' category competition restrictions. 'Restriction by effect' category infringements are established in relation to the specific relevant market(s).

The EC 'Market Definition Notice'[23] provides guidance on how the EC applies the concept of relevant market in its enforcement of EU competition law.

In short, each relevant market consists of product and geographic dimensions:

> product market comprises all those products that customers regard as interchangeable or substitutable to the product(s) of the undertaking(s) involved, based on the products' characteristics, their prices and their intended use, taking into consideration the conditions of competition and the structure of supply and demand on the market;
>
> geographic market comprises the geographic area in which the undertakings involved supply or demand relevant products, in which the conditions of competition are sufficiently homogeneous for the effects of the conduct or concentration under investigation to be able to be assessed, and which can be distinguished from other geographic areas, in particular because conditions of competition are appreciably different in those areas.

[20] CJEU Judgment of 9 July 1969, Case 5-69, *Völk v Vervaecke*, ECR 1969 00295, ECLI:EU:C:1969:35, para 5/7.
[21] Communication from the Commission — Notice on agreements of minor importance which do not appreciably restrict competition under Article 101(1) of the Treaty on the Functioning of the European Union (De Minimis Notice), *OJ C 291, 30.8.2014, p. 1–4*.
[22] This rule aims to address cumulative foreclosure effect of parallel networks of agreements having similar effects on the market.
[23] Communication from the Commission – Commission Notice on the definition of the relevant market for the purposes of Union competition law, C/2023/6789, *OJ C, C/2024/1645, 22.2.2024, ELI: http://data.europa.eu/eli/C/2024/1645/oj*.

It must be noted that the EC is not bound to apply the definition of a relevant market from its past decisions in future cases, i.e. market definition is based on the facts of the case, and the competitive concerns under consideration in individual cases also can shape the definition of a relevant market in an individual case.[24]

I.1.1.2.6 Block exemption regulations & cooperation types based on supply chain levels

Some types of restrictive agreements are considered to have positive economic effects and therefore exhaustive analysis of such agreements is objectively unnecessary. Special EU block exemption regulations (**'BER'**) establish criteria (**'safe harbour'**) which, if satisfied by the restrictive agreement, determines that the agreement falls outside the scope of Article 101(1) TFEU prohibition.

Whereas the Admiral project envisions cooperation between transportation & logistics industry as well as supply chain actors, such cooperation may benefit directly from Transport BER[25], vertical BER[26] and the EC horizontal cooperation guidelines.[27] If the restrictive agreements comply with the criteria set under these legal acts, Article 101(1) TFEU does not apply to such agreements. However, BERs specifically exclude certain restrictions (which overlap with 'restrictions by object' concept) from the scope of exemptions.

If an agreement does not profit from a BER, it can still be assessed if it fulfils the cumulative conditions set under Article 101(3) TFEU.[28]

BERs and EC guidelines on application of Article 101 TFEU differentiate between:

- horizontal cooperation, which covers cooperation between actual or potential competitors, and
- vertical cooperation, which refers to cooperation concerning activities encompassing different supply chain levels.

[24] EC 'Market Definition Notice', points 14, 16 and 18.
[25] Council Regulation (EC) No 169/2009 of 26 February 2009 applying rules of competition to transport by rail, road and inland waterway, *OJ L 61, 5.3.2009, p. 1–5.*
[26] Commission Regulation (EU) 2022/720 of 10 May 2022 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices, C/2022/3015, *OJ L 134, 11.5.2022, p. 4–13*.
[27] Other BER's concern activities which are less relevant to the Admiral project:
Commission Regulation (EU) 2023/1066 of 1 June 2023 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to certain categories of research and development agreements, C/2023/3443, *OJ L 143, 2.6.2023, p. 9–19*. This BER applies to research and development agreements, including agreements which include provisions on the assignment or licensing of intellectual property rights to one or more of the parties or to an entity established by the parties to carry out the joint or paid-for research and development or joint exploitation of the results.
Commission Regulation (EU) 2023/1067 of 1 June 2023 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to certain categories of specialisation agreements, C/2023/3448, *OJ L 143, 2.6.2023, p. 20–26*. This BER applies to agreements under which, for instance, one or more parties agree to fully or partly cease production of certain products, or parties agree to produce certain products jointly.
[28] See section **Error! Reference source not found.**.2.1.

According to EC 'Horizontal co-operation guidelines' point 16[29], two undertakings are treated as actual competitors if they are active on the same product market and geographical market. Therefore, as a practical rule of thumb, horizontal cooperation encompasses activities within the same supply chain level.

The distinction between horizontal and vertical cooperation is relevant because the EU competition law rules apply differently to these forms of cooperation.

I.1.1.2.6.1 Transport BER

Transport BER applies to a wide array of agreements in the field of transport by rail, road and inland waterway, including, among others, the application of technical improvements or technical cooperation (see Article 1 Transport BER). Therefore, the scope of Transport BER directly overlaps with the activities planned within the remit of Admiral project. Accordingly, the comments below provide comments on the activities within the scope of the Admiral project which can be considered as permitted by the Transport BER and thus in compliance with EU competition law.

Nevertheless, while assessing the compliance of the ADMIRAL marketplace individual features concerning technical cooperation, careful consideration of objectives and the economic and legal context shall be assessed with respect to each individual feature of the ADMIRAL marketplace. This caution is warranted by recent EC practice, in which EU competition law infringement was found in relation to cooperation on product technical development.[30] Specifically, if the cooperation reduces competition product quality, eliminates competition between ADMIRAL marketplace members, such cooperation is unlikely to fall within the scope of Transport BER 'safe harbour'.

Article 2(1) Transport BER explicitly states that Article 101(1) TFEU shall not apply against the provided list of practices if the object and effect of it is, among others, cooperation by means of (see **(a)-(g) points in bold**):

[29] See more detailed explanation on the concept of horizontal cooperation, incl. assessment criteria to determine if an undertaking is actual or potential competitor in EC 'Horizontal co-operation guidelines' (Communication from the Commission – Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements C/2023/4752, *OJ C 259, 21.7.2023, p. 1–125*). According to point 16 of EC 'Horizontal co-operation guidelines', two undertakings are treated as actual competitors if they are active on the same product market and geographical market. An undertaking is considered as a potential competitor of another undertaking if, in the absence of the agreement, it is likely that the former, within a short period of time, would undertake the necessary additional investments or other necessary switching costs to enter the relevant market on which the latter is active. This assessment has to be based on realistic grounds; the mere theoretical possibility to enter a market is not sufficient.

[30] See e.g. EC Decision adopted on 08/07/2021, Case AT.40178, *Car Emissions*. In this case the EC found that five car manufacturers possessed the technology to reduce harmful emissions beyond what was legally required under EU emission standards. Nevertheless, the car manufacturers avoided to compete on using this technology's full potential to clean better than what is required by law.

(a) the standardization of equipment, transport supplies, vehicles or fixed installations;

This provision, describing permissible cooperation scope, is likely to cover the ADMIRAL marketplace activities connected to the potential establishment of specific requirements for its partners (incl. technical specifications) re GHG emission calculations, incl. specific requirements for equipment, procedures and instructions to be used by the ADMIRAL marketplace and its partners for GHG emission calculations.

This point also may be construed as permitting the ADMIRAL marketplace to set up uniform requirements (e.g. specifications) for digital tools and integration of various IT tools within the ADMIRAL marketplace.

(b) the exchange or pooling, for the purpose of operating transport services, of staff, equipment, vehicles or fixed installations;

This point, describing as permissible the exchange or pooling of staff, equipment, vehicles or fixed installations, is relevant if ADMIRAL marketplace enables different transportation and logistics services providers to pool and share capacities available to them in order to achieve higher GHG savings than compared to situation where there was no cooperation.

(c) the organization and execution of successive, complementary, substitute or combined transport operations, and the fixing and application of inclusive rates and conditions for such operations, including special competitive rates;

This provision may be construed as specifically permitting transportation and logistics services providers (e.g. ADMIRAL marketplace participants) to provide combined transport services, i.e. enabling multimodal, LTL and LCL cargo types to be provided.

(d) the use, for journeys by a single mode of transport, of the routes which are most rational from the operational point of view;

This clause can be construed as specifically permitting transportation and logistics services providers (e.g. ADMIRAL marketplace participants) to cooperate on selecting the route for the delivery of shipment.

(e) the coordination of transport timetables for connecting routes;

This provision can be construed as specifically permitting transportation and logistics services providers (e.g. ADMIRAL marketplace participants) to cooperate on cargo delivery timetables in order to increase efficiency when cargo is delivered by using several shipping providers (e.g. LTL cargo).

(f) the grouping of single consignments;

This provision can be construed as specifically permitting transportation and logistics services providers (e.g. ADMIRAL marketplace participants) to cooperate on grouping single consignments (e.g. where different products are of the same commodity type (e.g. dairy products) in order to improve efficiency and (or) increase GHG savings.

(g) the establishment of uniform rules as to the structure of tariffs and their conditions of application, provided such rules do not lay down transport rates and conditions.

This provision can be construed as specifically permitting transportation services providers (e.g. ADMIRAL marketplace participants) to cooperate on defining uniform tariff elements, i.e. what service element (or value element) is captured by individual tariff elements. As a result, having uniform descriptions of tariff elements, purchasers are better prepared to compare services offered by individual service providers.

This provision specifically clarifies that this clause does not apply to setting transport rates and conditions. The latter arrangements, arguably, could fall under Article 101(1) TFEU prohibition and within the 'restrictions by object' category.

I.1.1.2.6.2 EC Horizontal cooperation guidelines

Horizontal cooperation is considered to refer to cooperation between actual or potential competitors on the same relevant market[31]. EC 'Horizontal co-operation guidelines' set out principles for the assessment of horizontal cooperation agreements and concerted practices under Article 101 TFEU.[32]

Given that the ADMIRAL marketplace concerns transportation and logistics sector, we will further present more details on purchasing agreements[33], information exchange,[34] standardization agreements,[35] standard terms[36] and sustainability agreements[37].

[31] See Section 4.1.2.5. for explanation on the concept of 'relevant market'.
[32] Point 2 of EC 'Horizontal co-operation guidelines.'
[33] Chapter 4 of EC 'Horizontal co-operation guidelines.'
[34] Chapter 6 of EC 'Horizontal co-operation guidelines.'
[35] Chapter 7 of EC 'Horizontal co-operation guidelines.'
[36] Chapter 8 of EC 'Horizontal co-operation guidelines.'
[37] Chapter 9 of EC 'Horizontal co-operation guidelines.'

Joint purchasing agreements

Joint purchasing agreements refers to situations where two or more purchasers jointly negotiate and conclude an agreement with a given supplier relating to one or more trading terms governing the supply of products to the cooperating purchasers.[38]

Such situations are relevant in case any of the ADMIRAL marketplace members decide to jointly negotiate and conclude an agreement with a given supplier.

Joint purchasing agreements are less likely to risk infringement of Article 101 TFEU if, first, it is made clear to suppliers that the negotiations are conducted on behalf of its members and that the members will be bound by the agreed terms and conditions for their individual purchases, or that the joint purchasing arrangement purchases on behalf of its members. However, it is not required that the joint purchasing arrangement members are disclosed, in particular where they are small- or medium-sized undertakings and/or account for only a limited share of the joint arrangement's purchases from a supplier.[39]

Second, the members of the joint purchasing arrangement have defined the form, scope and functioning of their cooperation in a written agreement, so that its compliance with Article 101 TFEU can be verified and checked against the actual operation of the joint purchasing arrangement.[40]

However, joint purchasing agreements are highly likely to risk infringement of Article 101 TFEU and even be considered as 'buying cartel' (i.e. fall within 'restriction by object' category) if the purchasers do not engage in joint negotiations, but instead coordinate or influence purchasers' individual negotiations with suppliers or their individual purchases from suppliers.[41]

Also, joint purchasing agreement may risk of Article 101(1) TFEU infringement, due to its restrictive effects on competition (i.e. fall within 'restriction by effects' category) if the members have market power on the relevant selling market or purchasing markets. According to the EC, in most cases it is unlikely that market power exists if the members of the joint purchasing arrangement have a combined market share not exceeding 15 % on the relevant purchasing market(s) as well as a combined market share not exceeding 15 % on the relevant selling market(s). In any event, if the members' combined market shares do not exceed 15 % on both the purchasing and the selling markets, it is likely that the conditions of Article 101(3) TFEU are fulfilled, unless the arrangement involves a 'by object' restriction of competition.[42]

[38] Point 278 of EC 'Horizontal co-operation guidelines.'
[39] Point 282(a) of EC 'Horizontal co-operation guidelines.'
[40] Point 282(b) of EC 'Horizontal co-operation guidelines.'
[41] See for more details 279-284 points of EC 'Horizontal co-operation guidelines.'
[42] Points 286 and 291 of EC 'Horizontal co-operation guidelines.'

Information exchange

Cooperation through the ADMIRAL marketplace is very likely to take form of exchange of various information. It must be emphasized that exchange of commercially sensitive information can result in 'Concerted practice' which is prohibited under Article 101(1) TFEU.[43] Therefore, great care and preventive measures must be taken in order to ensure compliance with competition laws. For this reason, before any exchange of information, several aspects must be assessed attentively such as the nature of the information considered to be exchanged, access to the information, information collection procedures, limitations to information distribution.

Information exchange includes the exchange of (i) raw, unorganized digital content that may need processing in order to make it useful (raw data); (ii) pre-processed data, that has already been prepared and validated; (iii) data that has been manipulated in order to produce meaningful information of any form, as well as (iv) any other type of information, including non-digital information. It includes physical information sharing and digital data sharing between actual or potential competitors.[44]

Information can be exchanged directly or through a third party such as a service provider, platform, online tool or algorithm.[45]

An information exchange only falls within Article 101(1) if it establishes or is part of an agreement between undertakings, a 'concerted practice'. The concept of a concerted practice implies, in addition to the participating undertakings concerting with each other, subsequent conduct on the market and a relationship of cause and effect between the two.[46]

As the ADMIRAL marketplace is an online platform it is important to note that use of pricing algorithms by individual undertakings may be permitted, however, the use of algorithms to agree (set) on essential parameters of competition (price, quantity, etc.) leading to collusion is typically a 'by object' restriction of competition, irrespective of market conditions.[47]

Therefore, if the ADMIRAL marketplace includes use of algorithms, these tools shall not be enabled with the functionality to set prices or other terms for the ADMIRAL marketplace members.

Apart from facilitating collusion, an information exchange can also lead to anti-competitive foreclosure on the same market where the exchange takes place or on a related market. Such foreclosure can materialize on the same market, when the exchange of commercially sensitive

[43] See Section 4.1.2.3.
[44] Point 367 of EC 'Horizontal co-operation guidelines.'
[45] Point 368 of EC 'Horizontal co-operation guidelines.'
[46] Point 375 of EC 'Horizontal co-operation guidelines.'
[47] Point 379 of EC 'Horizontal co-operation guidelines.'

information places competitors that do not take part in the exchange at a significant competitive disadvantage compared to the undertakings that participate in the exchange. This type of foreclosure is possible if the information concerned is of strategic importance in order to compete on the market and the exchange covers a significant share of the relevant market. This may be the case, for instance, in data-sharing initiatives, where the data shared is of strategic importance, covers a large share of the market and competitors' access to the shared data is prevented.[48]

Also, information exchange may also lead to anti-competitive foreclosure of third parties in a related market. For instance, undertakings that apply non-transparent and discriminatory terms of access to shared information may limit third parties' ability to detect trends for potential new products on related markets.

Considering those issues, the ADMIRAL marketplace should establish clear and transparent rules for interested parties regarding joining the ADMIRAL marketplace.

Article 101(1) TFEU applies where an exchange of commercially sensitive information is likely to influence the commercial strategy of competitors, thereby creating or being capable of creating conditions of competition which do not correspond to the normal conditions of the market in question.[49]

In general, as commercially sensitive information it is considered information on:

- pricing,
- costs,
- capacity,
- production,
- quantities,
- market shares,
- customers,

- plans to enter or exit markets, or concerning other important elements of a firm's strategy that undertakings active in a genuinely competitive market would not have an incentive to reveal to each other.[50]

[48] Point 382 of EC 'Horizontal co-operation guidelines.'
[49] Point 384 of EC 'Horizontal co-operation guidelines.'
[50] Point 385 of EC 'Horizontal co-operation guidelines.'

Also, information that contains a lot of detail and enables the identification of the undertaking(s) that provided it will be more commercially sensitive than aggregated information, where the attribution of information to particular undertakings is sufficiently difficult or uncertain, or where the data are aggregated across a range of different products, especially if the products have different characteristics or belong to different markets.[51]

Therefore, if any exchange of information will take place at the ADMIRAL marketplace, it must be observed that the nature of the information does not fall within the abovementioned topics and, if feasible, the information that is intended to be exchanged, is sufficiently aggregated.

Moreover, frequent exchanges of information that facilitate a better common understanding of the market and monitoring of deviations increase the risks of an infringement of Article 101(1) TFEU. However, since real-time data for business is important for decision-making and the highest competitive advantage is obtained by automated real-time information exchange, what constitutes a frequent or infrequent exchange of information, depends on the circumstances of the nature of information and the market in question.[52]

On the other hand, information which is generally considered as not commercially sensitive, includes information concerning the general functioning or state of an industry; public policy or regulatory matters; non-confidential technical issues relevant to the industry in general, such as standards or health and safety matters; general, non-proprietary technology and related issues, such as the characteristics and suitability of particular equipment (but not a particular company's plans regarding the adoption of specific equipment or technology); general promotional opportunities relevant to the industry in general (but not a particular company's promotional plans); non-strategic educational, technical or scientific data that results in consumer benefits and non-strategic information needed to build new business partnerships between undertakings.[53] Furthermore, the exchange of historical information is also unlikely to be commercially sensitive, as it is unlikely to be indicative of competitors' intended conduct or to facilitate a common understanding on the market.[54]

Turning to practical compliance solutions, the limitations of the cooperation would have to consider that participants in a reciprocal data-sharing arrangement such as a data pool should in principle only have access to their own information and the final, aggregated, information of other participants. According to EC, technical and practical measures can ensure that a participant is unable to obtain commercially sensitive information from other participants individually. In addition, the management

[51] Point 391 of EC 'Horizontal co-operation guidelines'; for further explanations see also points 390-392 of EC 'Horizontal co-operation guidelines.'
[52] Point 405 of EC 'Horizontal co-operation guidelines.'
[53] Point 386 of EC 'Horizontal co-operation guidelines.'
[54] Point 393 of EC 'Horizontal co-operation guidelines'; for further explanations see also point 394 of EC 'Horizontal co-operation guidelines.'

of a data pool can be assigned to a trustee that is subject to strict confidentiality rules as regards the information received from participants in the data pool. Undertakings that manage a data pool should also ensure that only information that is necessary for the implementation of the legitimate purpose of the data pool is collected.[55]

Standardization agreements

The Admiral project foresees objectives such as collection of information on GHG emission estimates which may be practically met through agreeing on various standards and procedures.

According to the EC 'Horizontal co-operation guidelines',[56] standardization agreements have as their primary objective the definition of technical or quality requirements with which current or future products, production processes, value chain due diligence processes, services or methods may comply. Standardization agreements can cover various issues, such as technical specifications in services markets where compatibility and interoperability with other services is essential. The terms of access to a particular quality mark or for approval by a regulatory body can also be regarded as a standard, as well as agreements setting out sustainability standards. Nevertheless, while sustainability standards have similarities with the standardization agreements addressed, they also have certain special features.[57]

I.1.1.2.6.3 Vertical BER

Vertical BER[58] applies to vertical cooperation agreements between undertakings operating at different levels of the production or distribution chain[59]. Different to horizontal cooperation, vertical agreements are generally considered as procompetitive, therefore Article 2 of Vertical BER provides general exemption ('safe harbour') for all vertical agreements, except (i) agreements which do not meet Vertical BER conditions; (ii) agreements containing 'hardcore restrictions' and agreements containing excluded restrictions).

Typical vertical agreements related to supply and purchase of goods or services, distribution and certain agency agreements.

[55] Point 408 of EC 'Horizontal co-operation guidelines.'
[56] Point 436 of EC 'Horizontal co-operation guidelines.'
[57] Guidance on sustainability standards compliance with Article 101 TFEU is provided in Chapter 9 of EC 'Horizontal co-operation guidelines.'
[58] Commission Regulation (EU) 2022/720 of 10 May 2022 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices, C/2022/3015, *OJ L 134, 11.5.2022, p. 4–13*.
[59] Communication from the Commission COMMISSION NOTICE Guidelines on vertical restraints 2022/C 248/01, C/2022/4238, *OJ C 248, 30.6.2022, p. 1—85* (**'EC Vertical guidelines'**), point 10.

Vertical BER 'safe harbour' applies on condition that the market share held by the supplier does not exceed **30%** of the relevant market on which it sells the contract goods or services and the market share held by the buyer does not exceed **30%** of the relevant market on which it purchases the contract goods or services.

In case of multi-party agreement, where an undertaking buys the contract goods or services from one undertaking that is a party to the agreement and sells the contract goods or services to another undertaking that is also a party to the agreement, the market share of the first undertaking must respect the market share threshold provided for in that paragraph both as a buyer and a supplier in order for Vertical BER 'safe harbour' to apply.

Article 4 of Vertical BER lists 'hardcore restrictions', which are generally considered as 'by object' restriction of competition.[60] If an agreement contains such terms, it is excluded from Vertical BER 'safe harbour' in its entirety.[61] Example of 'hardcore restrictions' include agreements which restrict the buyer's ability to determine its sale price, without prejudice to the possibility of the supplier to impose a maximum sale price or recommend a sale price, provided that they do not amount to a fixed or minimum sale price as a result of pressure from, or incentives offered by, any of the parties[62].

Other hardcore restrictions listed under Article 4 of Vertical BER applies in the context of:

exclusive distribution system;

selective distribution system;

if the supplier operates neither exclusive, nor selective distribution system, and restricts the territory into which, or of the customers to whom, the buyer may actively or passively sell the contract goods or services;

prevention of the effective use of the internet by the buyer or its customers to sell the contract goods or services;

restrictions agreed between a supplier of components and a buyer who incorporates those components.

[60] Point 179 of 'EC Vertical guidelines.'
[61] Point 177 of 'EC Vertical guidelines.'
[62] Article 4(a) of Vertical BER.

Article 5 of Vertical BER lists 'excluded restrictions'. If an agreement contains such contractual terms, these contractual terms do not benefit from Vertical BER 'safe harbour'. 'Excluded restrictions' under Article 5 of Vertical BER concerns the following obligations:

> non-compete obligation, the duration of which is indefinite or exceeds 5 years;
>
> obligation causing the buyer, after termination of the agreement, not to manufacture, purchase, sell or resell goods or services;
>
> obligation causing the members of a selective distribution system not to sell the brands of particular competing suppliers;
>
> obligation causing a buyer of online intermediation services not to offer, sell or resell goods or services to end users under more favourable conditions via competing online intermediation services.

Please note that Article 5 of Vertical BER must be consulted in individual case as it also lists derogations and additional details which may be relevant in particular cases.

If the vertical cooperation agreement does not meet Vertical BER conditions, vertical restrictions in such agreements can be qualified as 'restrictions by effect' if lead to anti-competitive outcomes such as foreclosure, softening of competition or collusion.[63] In general, such risks arise if a supplier supplies its goods or services on an exclusive basis, buyer exclusively buys from the supplier.

I.1.2 Regulatory Compliance and Governance Challenges

I.1.2.1 Privacy and Data Protection Considerations

Even though the ADMIRAL marketplace is not planned to be oriented to business-to-consumer operations and will mainly focus on business-to-business relations, personal data processing and privacy requirements must still be adhered to in the course of implementation of the Admiral project. This Section will focus on key compliance requirements with regard to privacy and data protection regulations applicable in the EU.

Since the GDPR[64] came into power in 2018, EU data protection regulation has been relatively harmonized throughout the EU. Nonetheless, national authorities in different EU member states have passed diverging guidance and case law has developed unevenly throughout the EU; therefore, local considerations must be taken into account when addressing specific compliance questions in a

[63] Point 11 of 'EC Vertical guidelines.'

[64] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), *OJ L 119, 4.5.2016, p. 1–88* ("**GDPR**").

particular jurisdiction. Fines imposed under the GDPR are substantial – they can reach 20 million EUR or 4 percent of the organization's global turnover, whichever is higher.[65] Considering this and that the ADMIRAL marketplace is planned to operate in several EU jurisdictions, it is advisable not only to take into account any guidelines or practice of the data protection authority in the establishment jurisdiction of the ADMIRAL marketplace operator, but also to consider the practice of data protection authorities in other jurisdictions where the ADMIRAL marketplace is planned to be operational in order to mitigate the risk of regulatory scrutiny.

The GDPR lays down rules relating to the protection of natural persons with regard to the processing of personal data and rules relating to the free movement of personal data.[66] Personal data is any information about an identified or identifiable person, also known as the data subject, and can include:

- general information (name, surname, age, nationality).
- contact details (e.g., address (both physical and email), telephone number).
- official information (e.g., ID card/passport number, employment information, such as position in a company).
- device information (e.g., Internet Protocol (IP) address, browser information).

The data processing operations are carried out by two main roles: either by a data controller or a data processor. A data controller determines the purposes and means of the processing of personal data, meanwhile a data processor processes personal data on behalf of the data controller.[67]

All processing done by either the data controller or data processor must adhere to the main principles of the GDPR (stipulated in Art. 5 of the GDPR) and must be based on one of the legal grounds, provided for in Art. 6 of the GDPR. In essence, the GDPR stipulates that all processing must be conducted in a fair, lawful and transparent manner, for a specified and legitimate purpose and period of time, and should involve only such personal data which is necessary for the fulfilment of said purpose.

The main compliance obligations with the GDPR (and the requirement to be able to demonstrate compliance therewith) falls under responsibility of the data controller,[68] which, in the ADMIRAL

[65] Art. 83(5) of the GDPR.
[66] Art. 1(1) of the GDPR.
[67] Art. 4(7) and 4(8) of the GDPR.
[68] Art 5(2) of the GDPR.

marketplace instance, will likely be the ADMIRAL marketplace operator.[69] Therefore, the ADMIRAL marketplace operator is obliged to both comply and be able to demonstrate compliance with the GDPR requirements. For the purposes of this Section, the analysis will be limited to key compliance requirements and will not cover an extensive analysis of the GDPR and rules of data protections contained therein.

I.1.2.1.1 Transparency Principle in the ADMIRAL Marketplace

As mentioned above, two of the key principles of the GDPR is transparency and accountability. In the context of the ADMIRAL marketplace, the operator must provide information to data subjects on who is processing the personal data related to their use of the ADMIRAL marketplace and why. Such information must be provided in a concise, transparent, intelligible and easily accessible form, using clear and plain language.[70] Such privacy notice must, at the least ,contain:

- the identity and the contact details of the ADMIRAL marketplace operator and the contact details of the data protection officer (if one is assigned).
- main information on the data processing operations:
- the purposes of the processing for which the personal data are intended.
- the legal basis for the processing.
- where the processing is based on the legitimate interests of the data controller or a third party, such legitimate interests also must be clearly identified.
- the period for which the personal data will be stored, or if that is not possible, the criteria used to determine that period.
- the recipients or categories of recipients of the personal data.
- any personal data transfers outside the EEA and legal basis of such data transfers.
- information on the data subject rights granted to all data subjects, including the procedure on how said rights are implemented. Where data subject consent is used as basis for processing, information should be provided on how consent can be withdrawn.
- whether the provision of personal data is a statutory or contractual requirement, or a

[69] Please note, however, that the status of each participating subject in the Admiral project (the ADMIRAL marketplace operator, the service providers, clients and/or other involved parties) may differ depending on the particularities of the legal relationships concerned, data processing operations present, rights and obligations established between the parties and other considerations.

[70] Art. 12(1) of the GDPR.

requirement necessary to enter into a contract, as well as whether the data subject is obliged to provide the personal data and of the possible consequences of failure to provide such data.

- the existence of automated decision-making, including profiling, and, at least in those cases, meaningful information about the logic involved, as well as the significance and the envisaged consequences of such processing for the data subject.

These requirements are usually met by a finely drafted privacy notice or policy. In case of the ADMIRAL marketplace, it will have to delineate all data processing operations conducted in the ADMIRAL marketplace platform or related to its users, such as profile creation, contract conclusion, service provision and purchase, dispute resolution, payments, account management or any other functionalities or operations provided by the ADMIRAL marketplace which involve the processing of personal data.

If tracking technologies (such as cookies, pixels and URL tracking)[71] are planned to be used in the ADMIRAL marketplace, it is also crucial to adhere to the ePrivacy Directive.[72] In particular, under the ePrivacy Directive, the ADMIRAL marketplace operator is required to:

- **Implement a prior-consent mechanism**: All cookies and trackers on the ADMIRAL marketplace shall remain inactive until users have provided explicit consent for their activation. This ensures user control over the collection and storage of personal data and information related to their device and browsing activity.

- **Provide transparent tracking information**: the ADMIRAL marketplace shall disclose clear and comprehensive information about all cookies and trackers utilized within the domain. This information should be presented in plain language that is easy for users to understand, fulfilling the transparency principle of the GDPR.

- **Obtain user consent through a user-friendly mechanism**: the ADMIRAL marketplace shall request user consent for all non-mandatory cookies and trackers in a user-friendly manner. This method should be clear, unambiguous, and not unduly burdensome for users to grant or withdraw consent.

- **Enable easy withdrawal of consent**: the ADMIRAL marketplace shall grant users the ability to

[71] Please note that the European Data Protection Board has issued 14 November 2023 Guidelines 2/2023 on Technical Scope of Art. 5(3) of ePrivacy Directive, in essence stating that the scope of the ePrivacy Directive is neither limited by (i) the technology used to conduct tracking, nor (ii) whether the information collected constitutes the definition of personal data under the GDPR, therefore substantially expanding the initial scope of the ePrivacy Directive.

[72] Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector, *OJ L 201, 31.7.2002, p. 37–47.*

refuse or withdraw consent for cookie usage as easily as they can provide it. This upholds the user's right to data privacy and control over their information.

Finally, it is advisable to allow the ADMIRAL marketplace users to modify their privacy settings in a user-friendly manner by making privacy settings available in the profile management / settings section of the ADMIRAL marketplace. Such functionality would enable the users to easily amend their initial privacy choices and may provide a privacy-driven solution, thus adding to the ADMIRAL marketplace adherence to the "data protection by design" principle enshrined in the GDPR.[73]

To sum up, the EU privacy regulation hinges upon clear, consistent and transparent communication and information provision to the data subject, empowering them to make informed decisions with respect to their privacy and personal data, and obliges the data controllers to facilitate such decision-making by creating robust transparency frameworks in all data processing operations based in the EU or concerning EU citizens.

I.1.2.1.2 Internal Compliance and Accountability

Compliance with the GDPR does not end with external documentation and due transparency. The ADMIRAL marketplace operator shall also ensure that internal data processing operations are in line with the principles and rules set out in the GDPR and ensure preparation of the appropriate internal data processing documentation, detailing such adherence and ensuring accountability as one of the core principles of the GDPR.

While the scope, amount, content and depth of said internal documentation may vary depending on the peculiarities of data processing operations carried out, it is generally advisable to have at least the following list of internal documentation, addressing specific obligations set out in the GDPR and detailing the methods of data protection compliance:

- **Personal Data Protection Policy** – a top-level document for managing privacy and ensuring accountability in an organization, which defines key terms used, principles and purposes of processing carried out, key requirements, controls, roles and their responsibilities, as well as either defines other, more specific issues or gives references to specialized internal documentation (e.g., access management, data retention principles data subject rights management policy etc.).

- **Records of Processing Activities**[74] – an internal register of processing activities, containing basic information on each individual processing activity (detailing processing purposes, data subjects' categories, processed personal data categories for each purpose, retention periods,

[73] Art. 25 of the GDPR.
[74] Art. 30 of the GDPR.

data recipients, processors, as well as other relevant information, such as how personal data security is ensured, how access to it is managed, etc.). This document is mandatory if

the data controller has more than 250 employees; or

the processing the data controller carries out is likely to result in a risk to the rights and freedoms of data subjects; or

the processing is not occasional; or

the processing includes special categories of data; or

the processing includes personal data relating to criminal convictions and offences.

The Lithuanian Data Protection Authority has recently reiterated the Working Party 29 position[75] in its recommendation[76] that in case the company does not have 250 employees, but the processing activities concern one or some of the previous mentioned instances, the obligation to keep the inventory of processing activities must still be adhered to with regard to those specific data processing operations.

- **Data Retention Policy**[77] – in line with the GDPR storage limitation principle, this policy describes the procedure of deciding how long a particular category of personal data will be kept, and how it will be securely destroyed (either due to end of retention term envisaged or due to a data subject's request 'to be forgotten'). Data Retention Schedule should also be maintained, which lists all personal data processed and the applicable retention periods for each such category. However, if an organization maintains an Inventory of Processing Activities, the content of the Data Retention Schedule can be merged with said Records.

- **Employee Privacy Notice**[78] – detailing similar provision as an external privacy policy described in Section 0, it is an internal privacy notice directed to the ADMIRAL marketplace employees, which explains how their personal data is going to processed (which could include video surveillance, health data, criminal background checks, etc.).

- **Data Protection Impact Assessment (DPIA) Procedure and Register**[79] – data protection impact assessments are carried out where personal data processing, taking into account the

[75] Working Part 29 was an EU-level consulting body, responsible for issuing guidance on interpretation and implementation of the GDPR. See Working Party 29 Position Paper on the derogations from the obligation to maintain records of processing activities pursuant to Article 30(5) GDPR, available on https://ec.europa.eu/newsroom/article29/items/topic/6936

[76] Lithuanian Data Protection Authority 16 April 2024 Recommendation on data processing records.

[77] Arts. 5, 13, 17 and 30 of the GDPR.

[78] Arts. 12 – 14 of the GDPR.

[79] Art. 35 of the GDPR.

nature, scope, context and purposes of the processing, is likely to result in a high risk to the rights and freedoms of natural persons (e.g., when new technologies are used, systematic and extensive evaluations are carried out, large scale processing, systematic monitoring, etc.). This procedure describes how the need to conduct a DPIA is identified, the process of conducting the DPIA, responsible roles involved in the process. Meanwhile, the Register ensures due recording of all DPIAs conducted, as well as their results.

- **Data Breach Response and Notification Procedure**[80] – this procedure details what to do before, during, and after a data breach. Furthermore, all data breaches need to be reviewed, evaluated and recorded in a Data Breach Register.

- **Data Breach Notification Form to the Supervisory Authority and to Data Subjects**[81] – material data breaches need to be formally notified to the appropriate supervisory authority within 72 hours of their discovery. Therefore, having a form prepared helps to streamline the notification process in tight-schedule situations. In some cases, impactful data breaches need to be also notified to the affected data subjects via a separate notification in line with the requirements of the GDPR.

- **Data Protection Officer Job Description**[82] – if an organization is obliged to or decides to assign a data protection officer, this is required to clearly define the responsibilities and requirements of the data protection officer, its involvement in decision-making and operations of the organization, as well as other requirements under the GDPR.

Please note that depending on the sophistication and maturity of an organization, as well as the fields of its operation, additional procedures may be deemed necessary to ensure full compliance. Therefore, it is crucial to approach each scenario individually. In case of the ADMIRAL marketplace and planned data processing operations, both internal and external, the exact list of required procedures and documentation may vary and may require additional documentation not included in this list. It is advisable to consult a data protection law specialist before proceeding with preparation of privacy documentation to both properly envisage the individualities of the ADMIRAL marketplace, as well as cover any specific data protection compliance issues that may arise throughout the development of the Admiral project.

I.1.2.1.3 Data Protection in Contractual Relations

The last major GDPR compliance branch is contractual relations and documentation with regard to data processing and personal data transfers. In this regard, two main types of contractual relations

[80] Arts. 4, 33, and 34 of the GDPR.
[81] Art. 33 and 34 of the GDPR.
[82] Arts. 37-39 of the GDPR.

may be prevalent in the implementation of the Admiral project – agreements with data processors (suppliers) and agreements with data recipients.

The GDPR mandates the utilization of Data Processing Agreements ("**DPAs**"). A DPA serves as a legally binding contract between a data controller and a data processor. This agreement explicitly outlines the respective rights and obligations of both parties concerning the nature and scope of processing activities undertaken with personal data. The primary purpose of a DPA is to establish legal certainty for both data controllers and processors, facilitating their compliance with the GDPR's obligations. In general, a DPA should at least cover the following:

- Data controller's documented instructions on the operations and data processing to be carried out by the controller (such as the purpose, duration, nature, and scope of processing, the categories of personal data and data subjects, the duration of the processing, data processing location and data access, any data transfers to be conducted, etc.).
- The processor obligation to ensure that persons authorized to process personal data have committed themselves to confidentiality or are under an appropriate statutory obligation of confidentiality.
- How the processor ensures the security of data processing in line with Article 32 of the GDPR, guaranteeing at minimum the same level of security for the personal data as the controller.
- The procedure of engaging other processors (sub-processors) while carrying out the agreed data processing operations.
- The scope of assistance to the data controller in fulfilment of the controller's obligation to respond to requests for exercising the data subject's rights, considering the nature of the processing, and the appropriate technical and organizational measures applied to do so.
- The scope of assistance to the data controller in fulfilment of the controller's obligation in ensuring personal data security, due data breach notification to supervisory authorities and data subjects, conducting DPIAs and prior consultations with supervisory authority,[83] considering the nature of processing and the information available to the processor.
- The obligation to, at the choice of the controller, delete or return all the personal data (including their copies) to the controller after the end of the provision of services relating to processing, and any statutory limitations on such return or deletion.
- The obligation to make available to the controller all information necessary to demonstrate

[83] Arts. 32-36 of the GDPR.

compliance with the obligations laid down in the GDPR.

- The procedure for audits or inspections conducted by the controller or another auditor mandated by the controller.
- Although not directly required under the GDPR, it is also highly recommended to include provisions on:
    - Indemnity and liability of the data controller, data processor, and sub-processors.
    - Grounds for termination.
    - Confidentiality measures.
    - Choice of applicable law and jurisdiction.
- Considerations for any additional data protection laws (e.g., ePrivacy Directive, NIS 2 Directive[84]) – to the extent applicable.

The content of data transfer agreements, being a subtype of DPA, can instead heavily depend on the factual data processing relationship between the data transferor and data recipient, the frequency of data transfers, its purpose and scope of data processed. Nonetheless, in practice, such agreements are generally concluded between two or more independent data controllers which may have differing legal basis and purposes for which the very same data is processed individually. In turn, each data controller must ensure that both their own data processing operations and the transfer itself adheres to the requirements of the GDPR, thus ensuring the legality principle enshrined in the GDPR. Therefore, it is advisable to cover:

- Obligations of both the data recipient and data transferor (including security measures, the purposes and legal basis for planned data transfers, confidentiality obligations, etc.);
- Procedure on data provision, in particular if the transfer is expected to be continuous or frequent (channels of data provision, format on how data is to be provided, how inaccuracies are reported and cured, etc.).
- Procedure on handling data subject requests, supervisory authority inquiries, data breaches, conducting audits and inspections.
- Indemnity and liability of the parties.

[84] Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (NIS 2 Directive), *OJ L 333, 27.12.2022, p. 80–152.*

- Applicable law and dispute resolution procedure.
- Grounds for termination and other general contractual clauses.

A level of complexity can be noted when personal data is transferred outside the EEA. In this case, such transfer is legal only if it falls complies with the requirements and instances indicated under the GDPR Chapter V. However, since no such transfers are planned under the current scope of the Admiral project, this is not elaborated on further.

In summary, due compliance with data protection requirements in the ADMIRAL marketplace may likely require in-depth analysis of planned data processing operations and attentive preparation of internal, external and contractual documentation. As personal data security cannot be ensured without implementing appropriate cybersecurity safeguards, the following subsection will cover a high-level overlook of key cybersecurity requirements that may be applicable in the context of the Admiral project.

I.1.2.2 Cybersecurity in the ADMIRAL marketplace

The ever-evolving cyber threat landscape necessitates robust cybersecurity measures across all industries. Cyberattacks can inflict significant financial losses, disrupt operations, and expose sensitive data, potentially leading to legal repercussions. Organizations that fail to implement appropriate safeguards may face regulatory fines, data breach notification obligations, and even civil lawsuits for negligence. A comprehensive cybersecurity framework is therefore crucial for mitigating these risks and fostering a secure digital environment.

In order to ensure comprehensive cybersecurity measure implementation, that such measures are continuously adhered to and that an organization is to be able to demonstrate such adherence, cybersecurity is to be implemented in a threefold manner:

- **Through processes**. An organization should establish formal security policies that outline acceptable use of technology assets, data handling procedures, incident response protocols, and access control mechanisms. These policies should align with relevant data privacy and cybersecurity regulations and industry best practices. The organization should also conduct periodic risk assessments to identify and prioritize potential security threats and vulnerabilities within the organization's systems and data, as well as implement a vulnerability management program to address identified vulnerabilities through patching, configuration hardening, or other appropriate measures.
- **Through the organization**. An organization should regularly train employees on cybersecurity best practices, including phishing email identification, password hygiene, and secure data

handling procedures. This promotes a culture of security awareness within the organization, which is crucial for mitigating human error-related security incidents. Furthermore, clear accountability structure for cybersecurity within the organization should be assigned. This could involve establishing positions, such as a Chief Information Security Officer, a Data Protection Officer or a Cybersecurity Incident Response Team, ensuring ownership of cybersecurity processes with the organization, as well as continuous monitoring and adherence to cybersecurity processes established within the company.

- **Through technology**. Finally, implementation of appropriate technological solutions to tackle cybersecurity threats is crucial to complete the cybersecurity framework in an organization. The solutions will depend on the specific factors applicable to a particular organization, but generally involve security firewalls, intrusion detection/prevention systems, data encryption, and endpoint security solutions (e.g., antivirus software), as well as maintaining consistent data backups to facilitate recovery in case of a cyberattack or system failure.

The NIS 2 Directive is the latest EU-wide effort to achieve a high common level of cybersecurity across the EU. It is aimed at medium-sized and larger enterprises, which qualify as essential or important entities that provide significant services in the EU (operating in sectors such as energy, transport, healthcare, sanitation, digital infrastructure, etc.). NIS 2 Directive comes into force in 18 October 2024, and until then member states shall pass implementing legal acts that are to detail how NIS 2 Directive requirements are ought to be implemented. NIS 2 Directive comes into force on January 2025, and by 17 April 2025, member states shall establish a list of entities that fall under the scope of NIS 2 Directive in their respective jurisdiction.[85] Until then, some EU Member States have published useful resources aiding in identification of whether a particular entity may anticipate being included in the upcoming important and essential entity list.[86]

Considering the proposed operation method for the ADMIRAL marketplace, the ADMIRAL marketplace operator may fall under the scope of NIS 2 Directive, for instance, if the ADMIRAL marketplace operator is to be qualified as an “Intelligent Transport Systems” operator as it is defined under the ITS Directive,[87] a “vessel traffic service” operator, as it is defined under the VTS Directive,[88]

[85] Art. 3(3) of the NIS 2 Directive.
[86] For instance, see the NIS 2 Directive qualification evaluation table made available by the Lithuanian Ministry of Defence, available online here: https://kam.lt/wp-content/uploads/2023/05/NIS2_Identifikavimo-kriterijai.pdf.
[87] Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport, *OJ L 207, 6.8.2010, p. 1–13* (**ITS Directive**), Art. 4(1).
[88] Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC, *OJ L 208, 5.8.2002, p. 10–27* (**VTS Directive**), Art. 3(o).

or "ICT service" provider, as defined in the Cybersecurity Act.[89] However, a separate assessment is necessary in order to determine whether the ADMIRAL marketplace and services provided therethrough are encompassed by the scope of NIS 2 Directive requirements.

NIS 2 Directive focuses on the governance requirements to be implemented by essential and important entities. As appropriate technical, operational, and organizational security measures can differ significantly,[90] for the purposes of this analysis, the following description expands the general requirements stipulated in NIS 2 Directive with examples from industry best practices. However, it does not analyse the specific security measures that may be appropriate with regard to the ADMIRAL marketplace.

Should NIS 2 Directive be applicable to the ADMIRAL marketplace, the following general cybersecurity requirements are to be noted:

Governance and Cybersecurity Risk Management.

- **Risk management Policy**. An organization should implement a comprehensive business and IT risk assessment and management framework to proactively identify, assess, prioritize, and mitigate potential threats to its cybersecurity posture.
- **Information Systems Security Policy**. An organization should also implement a comprehensive internal document describing the principles, measures and requirements for IT security and governance, as well as the roles, functions and responsibilities of IT security, cyber resilience, and IT infrastructure administration in the organization (such as the Chief Information Security Officer, Risk Officer, Incident Response Team, Compliance Officer, Data Protection Officer).
- **Business Continuity Plan.** This plan should encompass a business impact analysis to identify critical business functions and their potential downtime tolerance. Additionally, a Business Recovery Plan should be developed, outlining the steps required to restore critical operations after a disruptive event. Furthermore, the Business Continuity Plan should include elements such as a robust backup strategy, crisis management protocols, clear communication plans to

[89] Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013 (Cybersecurity Act), *OJ L 151, 7.6.2019, p. 15–69, Art. 2(13).*

[90] The security measures can differ considering the state-of-the-art and, where applicable, relevant European and international standards, as well as the cost of implementation and risks posed to a particular entity, as well as its risk appetite. When assessing the proportionality of those measures, due account shall be taken of the degree of the entity's exposure to risks, the entity's size, and the likelihood of occurrence of incidents and their severity, including their societal and economic impact (see NIS 2 Directive, Art. 21(1)).

ensure effective response and recovery during a crisis, as well as other business continuity considerations.

- **Incident Response Protocol.** This protocol should outline a structured approach to identifying, investigating, containing, eradicating, and recovering from cybersecurity incidents. It should encompass clear procedures for incident investigation, preventative measures to minimize future incidents, response actions to address ongoing incidents, notification protocols for relevant stakeholders (including regulatory bodies), and a comprehensive logging system to document all incident details. This comprehensive approach will ensure a swift and effective response to cyberattacks, minimizing potential damage and facilitating a smooth recovery process.

Organization and Human Resources Management.

- **Computer Hygiene**: Promoting good computer hygiene practices among employees is essential for maintaining a secure environment. This includes encouraging practices like strong password management, avoiding suspicious links and attachments, and keeping software applications up to date with the latest security patches.

- **Cybersecurity Education and Training**: Regular cybersecurity awareness training programs are crucial for educating employees on best practices to identify and mitigate cyber threats. These programs should address topics like phishing attacks, social engineering tactics, and secure data handling procedures, empowering employees to become a line of defence against cyberattacks.

- **Supply Chain Security**: This program should encompass supplier risk assessments to identify potential vulnerabilities within the vendor ecosystem. Additionally, the organization should implement monitoring policies and security requirements to ensure vendors adhere to best practices. Supplier selection processes should incorporate security considerations, and contracts should clearly outline security expectations and responsibilities. Finally, ongoing monitoring and contract management are essential for maintaining a secure supply chain.

Technical Measures and Security.

- **Incident Management**: In addition to a well-defined Incident Response Protocol, ongoing technical monitoring and detection capabilities are crucial for timely identification of security incidents.

- **Cryptography and Encryption Policy**: The organization should implement a comprehensive policy outlining the appropriate use of cryptographic controls. This policy should specify

encryption algorithms, key management practices, and data classification guidelines to ensure the confidentiality and integrity of sensitive information.

- **Human Resources Security**: A robust security posture requires a focus on human resources. This includes establishing clear policies on acceptable use of technology assets and conducting background checks for personnel with access to sensitive data.
- **Access Control**: The organization should implement a layered access control system that restricts access to sensitive information and systems based on the principle of least privilege. This may involve the use of role-based access controls and multi-factor authentication (MFA) to ensure only authorized users can access specific resources.
- **MFA / Use of Secure Communications**: MFA should be mandated for all critical systems and accounts. Additionally, the organization should promote the use of secure communication channels, such as encrypted email and virtual private networks, to protect sensitive data in transit.
- **Change Management**: For organizations with frequent system or application changes, a formal change management process is essential. This process ensures that security considerations are integrated into all changes, minimizing the risk of introducing vulnerabilities.
- **Vulnerability Management and Disclosure**: The organization should implement a proactive vulnerability management program to identify and address security vulnerabilities within its systems and applications. This program should also include a responsible vulnerability disclosure policy outlining the process for reporting and remediating identified vulnerabilities.
- **Other Security Controls**: This may include maintaining robust backup and disaster recovery solutions, implementing system logging and monitoring to detect suspicious activity, and employing additional security measures tailored to the organization's specific needs.

This being said, NIS 2 Directive establishes a dependable starting framework in addressing cybersecurity in the ADMIRAL marketplace, even if it is not directly applicable thereto. As such, the ADMIRAL marketplace should nonetheless adhere to best industry standards and practices meeting or, where possible, even aim to exceed the baseline set by NIS 2 Directive. This will not only strengthen the ADMIRAL marketplace's overall cybersecurity posture but also demonstrate a proactive approach to data security, fostering trust with users and potentially mitigating future regulatory scrutiny.

I.1.2.3 Governance

To ensure the legal separation of activities between the ADMIRAL marketplace and the ADMIRAL project members, it is recommended to establish a distinct company. This new entity, referred to as the 'Admiral Project Company,' would be specifically created to execute the ADMIRAL project and could also operate the ADMIRAL marketplace. The feasibility of establishing such a company depends on the constitutional documents and national laws governing the activities of the ADMIRAL project members.

If an external partner is chosen to operate the ADMIRAL marketplace, the Admiral Project Company should enter into a contractual agreement with this external operator.

Before establishing the Admiral Project Company, several corporate structure considerations must be addressed, including:

i. Determining the distribution of initial capital contributions among the shareholders.

ii. Defining how voting rights will be allocated to ensure fair and effective decision-making.

iii. Establishing rules for how decisions will be made within the company.

iv. Establishing the corporate bodies:

- Shareholders' General Meetings: Outlining the frequency and governance of these meetings.
- Executive Management Bodies: Defining the roles and responsibilities of the board of directors, supervisory board, and/or CEO.

Additionally, it is essential to decide on the financing structure of the Admiral Project Company, whether it will be through equity contributions, loans, or a combination of both. Furthermore, the method for profit distribution among shareholders needs to be established.

These considerations ensure that the Admiral Project Company is well-structured, legally compliant, and capable of efficiently managing the ADMIRAL project and marketplace operations.

I.1.3 Intellectual Property Rights and Contractual Obligations

I.1.3.1 Intellectual Property Rights Management

Considering the scale and importance of the Admiral project, due protection, and management of involved intellectual property rights is crucial in the long-term success of the project itself, as well as in deterring any future conflicts or disputes with regard to intellectual property associated with both creation and functioning of the ADMIRAL marketplace.

This section will cover two key relevant subtypes of intellectual property in the context of the creation and implementation of the ADMIRAL marketplace – trademarks and copyright.

Please note that other intellectual property considerations may apply with respect to the specifics of the operation of the ADMIRAL marketplace, such as database rights management, domain name management, industrial design rights management, etc. However, this section covers focal intellectual property rights considerations in light of the foreseen ADMIRAL marketplace functioning model and further considerations may be applicable in the later stages of the Admiral project when the layout and specifications of the ADMIRAL marketplace and its functionalities are identified.

I.1.3.1.1 Trademark Law in the EU

A trademark is any sign which can be (i) represented graphically and which (ii) makes it possible to distinguish the goods or services of one person from those of another person.

A variety of signs can be used to create trademarks:

- Words (surnames, first names, artistic pseudonyms, names of legal entities).
- Letters, numbers.
- Drawings, emblems.
- Spatial forms.
- Colours, combinations of colours or compositions of colours.
- Other signs (sounds, smells, etc.) and combinations thereof.
- Any combination of the above (mixed signs).

A trademark's main function is to show the distinctive origin of a particular good or service. Trademark law forms an essential part of a system of undistorted competition in which companies must be in a position where customers associate the quality of their goods or services with them, and this can only be achieved if there is a sign by which those goods or services can be identified. In order for a trademark to perform this task, it must ensure that all the goods bearing the mark are produced under the control of a specific, dedicated undertaking which is responsible for the quality of the goods.[91]

[91] E.g., see EUCJ judgments: Judgment of 23 May 1978, Case C-102/77, *Hoffmann-La Roche & Co. AG v. Centrafarm*, ECLI identifier ECLI:EU:C:1978:108; Judgment of 11 July 1996; Judgement of 17 March 2005, Case C-228/03 *Gillette Company and Gillette Group Finland*, ECLI identifier ECLI:EU:C:2005:177, para. 25.

In general, there are three routes to get exclusive rights to a trademark. In a way of example, these routes are further illustrated in light of the law of the Republic of Lithuania:

- **National route**: by filing applications directly with the national trademark authority, under the relevant state law and procedure (in Lithuania, the responsible authority is the State Patent Bureau of the Republic of Lithuania and trademark applications are filed under the Law on Trademarks of the Republic of Lithuania)
- **International route**: whereby the protection provided by the international trademark registration is extended to the relevant territory (in Lithuania – under the Protocol of the Madrid Agreement Concerning the International Registration of Marks), and
- **EU trademark protection route**: in the EU, whereby any trademark, registered as EU trademark with the Register of EU trademarks, is also granted protection in all EU states (under EU Regulation 2017/1001 of the European Parliament and of the Council of 14 June 2017 on the European Union trademark).

An EU trademark registration grants exclusive rights to its proprietor therein.[92] In particular, the proprietor of an EU trademark shall be entitled to prevent all third parties not having his consent from using in the course of trade, in relation to goods or services, any sign where:

- the sign is identical with the EU trademark and is used in relation to goods or services which are identical with those for which the EU trademark is registered.
- the sign is identical with, or similar to, the EU trademark and is used in relation to goods or services which are identical with, or similar to, the goods or services for which the EU trademark is registered, if there exists a likelihood of confusion on the part of the public.

The course of trade includes, but is not limited to, the following:

- offering or supplying any goods / services or putting them on the market under the sign
- using the sign as a trade or company name or part of a trade or company name
- using the sign on business papers and in advertising

- using the sign in comparative advertising in a manner that is contrary to EU law.[93]

[92] EU Regulation 2017/1001 of the European Parliament and of the Council of 14 June 2017 on the European Union trademark, *OJ L 154, 16.6.2017, p. 1–99, ("**Trademark Regulation**")* Article 9(1).
[93] Trademark Regulation, Article 9(3).

Additional protections are granted to trademarks that have earned reputation throughout its prolonged use and recognizability in the market;[94] however, this shall not be elaborated on, as the Admiral project and any trademarks newly registered in the course thereof shall not result in a reputable trademark in the foreseeable future.

I.1.3.1.2 ADMIRAL Marketplace Trademark Considerations

As generally trademarks grant protection territorially, it is prudent to estimate in which territories does the trademark proprietor plan to operate and provide its goods or services before filing a trademark registration. Therefore, when considering the acquisition of trademark protection in the context of the Admiral project, such protection should at least be limited to the jurisdictions in which the ADMIRAL marketplace is planned to be operational. Considering the ADMIRAL marketplace planned operation scope, an EU trademark registration is likely to be the optimal way to proceed with initial trademark application, with the international route employed to the extent the protection is needed to be expanded outside the borders of the EU.

Considering the exclusive rights granted to an EU trademark owner, the acquisition of trademark protection in the course of implementation of the Admiral project can result in the following use cases:

- **Brand Recognition**. A trademark registration can allow the ADMIRAL marketplace to establish brand recognition and differentiate itself the market. Moreover, customers may be able to identify the brand and associate it with a certain level of service, quality and experience more easily.
- **Protection Against Infringement and Imitation**. A trademark registration may allow the ADMIRAL marketplace operator to take legal action against companies that copy their brand elements or offer similar services under confusingly similar names.
- **Control Over Brand Reputation**. A trademark registration may allow the ADMIRAL marketplace operator to act against unauthorized use of their brand and trademark, for example, in negative online reviews or misleading advertising by third parties.
- **Deterrence Against Counterfeiting**. A trademark registration may allow the ADMIRAL marketplace operator to maintain the origin and exclusivity of the services provided and protect the customers from falling victim to counterfeit or scam websites or other bad faith, untrustworthy third parties.

[94] E.g., Trademark Regulation, Article 9(2).

To sum up, a trademark registration brings a number of valuable assets and opportunities to the Admiral project and may prove crucial in order to ensure the longevity of the project.

Considering the ADMIRAL marketplace and its proposed operational model, where numerous transportation and logistics service providers showcase their services, clear and well-defined license agreements regarding trademark use become crucial. These agreements establish a framework for how service providers can utilize the ADMIRAL marketplace trademarks, and vice versa, ensuring the protection of interests of both parties.

I.1.3.1.2.1 Licensing Terms for ADMIRAL Marketplace Trademarks

Firstly, license agreements ensure brand consistency and consumer trust. By outlining the authorized use of the ADMIRAL marketplace trademarks (logos, slogans), the ADMIRAL marketplace operator maintains control over brand messaging and presentation. This consistency fosters client trust in the platform, as it signifies a curated selection of reliable service providers. Additionally, these agreements can prevent unauthorized or misleading use of trademarks by service providers, which could damage the ADMIRAL marketplace's reputation and potentially confuse potential clients.

Secondly, license agreements provide clarity and protection for both the platform and sellers. They clearly define the scope of permitted trademark use, preventing accidental infringements and potential legal disputes. This protects the platform owner's valuable intellectual property, while also safeguarding sellers from inadvertently violating trademark laws. Furthermore, license agreements can specify quality standards and brand association guidelines, ensuring that sellers using the platform's trademarks uphold a certain level of service, further strengthening the marketplace's overall brand value.

In practice, licensing is crucial when defining in what cases and how ADMIRAL service providers can use ADMIRAL marketplace trademarks in their communication with current and potential clients, their advertising or promotional materials and other cases where communication is directed to third parties (such as investors, governmental entities and so on). In order to achieve this, licensing terms shall be clearly defined in either general ADMIRAL marketplace terms of use or in individual contracts with the service providers operating and cooperating in the ADMIRAL marketplace.

ADMIRAL marketplace operator may also consider implementing and enforcing trademark use guidelines in the future, further regulating ADMIRAL marketplace trademark use cases and conditions, in particular concerning marketing / advertising use cases.

I.1.3.1.2.2 Licensing Terms for Service Providers' Trademarks

It is equally important to also delineate the terms and conditions for the service providers' trademarks use in the operation of ADMIRAL marketplace, as it is likely an unavoidable condition in due presentation of services offered through the ADMIRAL marketplace. Contractual arrangements with service providers should at the least contain appropriate rights to the ADMIRAL marketplace operator to use their trademarks for presentation and illustration purposes in the ADMIRAL marketplace environment.

If ADMIRAL marketplace functionalities are to allow service providers to moderate their own presentation and service description, permitting service providers to upload various content to the ADMIRAL marketplace, it is important to implement appropriate content standards, ensuring that the uploader owns or has the right to use any intellectual property rights that might exist in the content they post, particularly images and related trademark rights and copyright.

I.1.3.1.3 Copyright Law in the EU

Another crucial element of intellectual property protection in the context of the Admiral project is copyright management.

Copyright objects are literary, scientific, and artistic works. Works are protected under copyright law when they are an original creative work in the field of literature, science, and the arts, regardless of its artistic merit, manner of expression or form.[95] This, for example, includes:

- books and other writings (text-based works).
- cinematographic or photographic works.
- drawings, paintings, other illustrations, such as maps, plans, sketches.[96]

Copyright protection is also granted to computer programs, whether in source or object code, as both EU and international law considers software as literary works within the meaning of copyright law.[97]

[95] Art. 2(18) of the VIII-1185 Law of the Republic of Lithuania on Copyright and Related Rights ("**Lithuanian Copyright Law**"). Similar definition is provided in the Art. 2(1) of the 24 July 1971 Berne Convention for the Protection of Literary and Artistic Works ("**Berne Convention**"). As copyright law is generally significantly more fragmented in the EU in comparison to other intellectual property regulation, for illustrative and descriptive purposes, this section will mainly rely on Lithuanian regulatory landscape.

[96] Art. 2(1) of the Berne Convention.

[97] Art. 10(1) of the 1 January 1995 World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights ("**TRIPS Agreement**"), Art. 1(1) Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs, Art. 10(1) of the Lithuanian Copyright Law.

The creator of a copyrightable work, the author, is granted exclusive property rights[98] to the use of such work (also known as economic rights), and can authorize or prohibit the following acts:

- reproduction the work in any form or manner.
- publishing, translation of the work.
- adaptation, arrangement, or other modification the work.
- distribution of the work by sale, rent, lease, loan or other type of transfer for ownership or possession.
- display or performance of the work to the public.
- communication of the work to the public, including by making it available to the public on computer networks (on the Internet).[99]

In comparison to industrial intellectual property (such as trademarks or designs), copyright protection for a particular work is granted from its creation, without the need for registration or other official procedures.[100] Therefore, in practice, the transfer and licensing of copyrights is mostly regulated via agreements between rightsholders and either licensees (when the agreement provides for authorization of certain use of the works) or transferees (when the agreement provides for transfer of the exclusive property rights). Consequently, clear legal wording in such contracts is crucial to ensure that interests of all concerned parties are secured, and risks of future disputes and litigation are minimized.

When copyright objects are created internally by a company's employees, the ownership of exclusive rights depends on the employment contract with said employee and, if ownership issues are not covered by the employment contract, the state law governing such employment relationship. Under Lithuanian law, the economic copyright in a work created by an employee in the performance of his official duties or functions, passes to the employer for a period of 5 years, unless otherwise provided for in a contract (Art. 9(2) of the Copyright Law), with the exception for computer programs, in respect to which economic rights belong to the employer, unless otherwise provided for in a contract (Art. 10(2) of the Lithuanian Copyright Law).

[98] Copyright law also grants moral rights, such as the right to claim authorship or a right to object to any distortion or mutilation of the work (Art. 6bis(1) of the Berne Convention, Art. 14 of the Lithuanian Copyright Law); however, the granting of such rights may differ on the particular jurisdiction in question, as the granting of moral rights is not harmonized in international law (Art. 9(1) of the TRIPS Agreement).

[99] Art. 15(1) of the Lithuanian Copyright Law. Please note, however, that the scope of granted exclusive rights may differ depending on the jurisdiction in question (Art. 5(2) of the Berne Convention).

[100] Art. 13(1) of the Lithuanian Copyright Law.

In summary, contractual relations play a crucial role in determining the transfer and scope of use in terms of copyrightable works, thus clear contractual agreements with authors require utmost attention in order to ensure both legitimate and sustainable use of copyrighted works in an organization's business.

I.1.3.1.4 Copyright Management in the ADMIRAL marketplace

Within the ADMIRAL marketplace, due copyright management is especially important with regard to (i) the software and program code of the ADMIRAL marketplace platform, and (ii) any content (either text-based or graphic) published on the ADMIRAL marketplace, either by the ADMIRAL marketplace operator or other users of the ADMIRAL marketplace (service providers or clients).

In practice, the sustainable operation of the ADMIRAL marketplace platform hinges on the secure acquisition of intellectual property rights, particularly copyright, for its two critical components: the software that underpins its functionality and the content provided by its users (service providers and clients of the marketplace).

As the ADMIRAL marketplace software constitutes a copyrighted work, its ownership by the ADMIRAL marketplace operator is crucial for the platform's independent operation. Therefore, transfer of economic rights is the preferred approach in the Admiral project, especially if the Admiral project foresees to implement a novel software solution for the ADMIRAL marketplace. Acquisition of exclusive economic right ownership through well-drafted agreements should be prioritized to secure the complete bundle of economic rights, including the right to reproduce, distribute, modify, and prepare derivative works of the software. This, in turn, can empower the ADMIRAL marketplace operator to freely adapt and improve its functionalities for long-term success and ever-changing technological landscape.

While still viable, in particular if the Admiral project is to employ currently existing software solutions for implementation of the ADMIRAL marketplace, licensing essential software components can introduce limitations on the ADMIRAL marketplace development. For example, operator's ability to adapt the software can be obstructed, as limited modification rights could hinder the capacity to integrate new features, address security vulnerabilities, or optimize performance in accordance with user needs and technological advancements. A limited license can also pose limitations on distribution rights that can result in restriction to offer services in certain territories or through specific channels.

In terms of content provided by the ADMIRAL marketplace users (e.g., service descriptions, images, satisfaction surveys, comments, ratings, etc.), user-generated content on the ADMIRAL marketplace is also likely protected by copyright upon creation. Therefore, terms and conditions of the ADMIRAL marketplace should be tailored to its operational needs and, at the least, provide for the provision of

rights to the ADMIRAL marketplace operator to reproduce, distribute and publicly display the content uploaded on the ADMIRAL marketplace by its users within the scope of its services, since:

- Restricted reproduction rights could hinder the platform's ability to create backups, generate thumbnails, or integrate user content into marketing materials.
- Limitations on distribution rights could restrict the platform's ability to showcase user content across all its functionalities or through various channels.
- Restricted display rights could prevent the platform from showcasing user content in promotional campaigns or for purposes of fostering user engagement within the platform's ecosystem.

By prioritizing the acquisition of comprehensive economic ownership of its software and appropriate licenses to user-generated content, the ADMIRAL marketplace safeguards its long-term viability. This approach fosters control over core functionalities and user experience, facilitates seamless integration of content, and empowers the ADMIRAL marketplace operator to maximize the value of its intellectual property assets.

I.1.3.2 Contractual Obligations

ADMIRAL marketplace will involve a significant number of contractual relations between the ADMIRAL marketplace operator and several groups of counterparties: contractual relations will be established between the ADMIRAL marketplace operator and transportation and logistics service providers; between the ADMIRAL marketplace operator and transportation and logistics services' customers; between transportation and logistics services providers and customers of these services; between transportation and logistics services providers; and between the ADMIRAL marketplace operator and the ADMIRAL marketplace operator partners (i.e. providers of services to the Admiral marketplace itself).

In order to maximize legality and successful performance of such contractual relations, enhanced knowledge on Contracts Law and functioning market (commercial) practice is necessary.

Contracts law differs in different jurisdictions. However, there are numerous Contracts law principles relevant to all jurisdictions and certain regulations set out under EU or other international law which are relevant in ADMIRAL project.

I.1.3.2.1 Forms and means of contractual relations

In all jurisdiction's contracts may be concluded in various forms such as verbal or written form. In case of ADMIRAL project, which foresees conclusion of contracts digitally via the ADMIRAL platform,

written form contracts are relevant. Contracts in electronic form may be equated to written form contracts and are legally binding if they meet certain criteria. The process of forming electronic contracts is governed by various laws and regulations, which can vary depending on the jurisdiction.

In many jurisdictions, legally binding electronic contracts require electronic signatures which meet specific requirements. An electronic signature can be as simple as typing your name into a contract, ticking the agree mark or using more secure methods like digital signatures or encrypted signatures.

I.1.3.2.2 Relevant EU and other international regulations

There are certain EU and other international contractual law regulations which could be relevant to all or most of ADMIRAL marketplace contracts.

I.1.3.2.2.1 eIDAS Regulation

Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market[101] (**"eIDAS Regulation"**) sets the legal framework for electronic signatures in the EU. It also lays down the conditions under which Member States recognize electronic identification means of natural and legal persons, establishes a legal framework for electronic signatures, electronic seals, electronic time stamps, electronic documents, electronic registered delivery services and certificate services for website authentication[102]. eIDAS Regulation establishes that a qualified electronic signature shall have the equivalent legal effect of a handwritten signature, also that a qualified electronic signature based on a qualified certificate issued in one Member State shall be recognized as a qualified electronic signature in all other Member States[103]. eIDAS Regulation sets certain requirements that the electronic signature must meet in order to be considered as a qualified electronic signature.

I.1.3.2.2.2 Incoterms

Incoterms rules are established by the International Chamber of Commerce (ICC)[104] (**"Incoterms"**). It is a set of eleven three-letter trade terms, reflecting business-to-business practice in contracts for the sale and purchase of goods. Incoterms rules are a set of standards used in international and domestic contracts for the delivery of goods. These rules clarify who is responsible for tasks such as arranging transportation, insurance, customs clearance, and other logistics activities. The rules determine the risk burden of the parties. It defines where responsibility of the seller ends and begins of the buyer,

[101] Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC, *OJ L 257, 28.8.2014, p. 73–114*.
[102] Art. 1 of eIDAS Regulation.
[103] Art. 25 of eIDAS Regulation.
[104] Incoterms® Rules, International Chamber of Commerce (ICC). Available at: <https://iccwbo.org/business-solutions/incoterms-rules/>.

when the risk of loss and damage is transferred to the buyer. Incoterms are used in commercial practice because it allows to avoid different interpretations under different jurisdictions and also due to simplicity of drafting the contract terms.

In case of ADMIRAL marketplace, it is recommended to use Incoterms as a reference in standard agreements between transportation and logistics services providers and customers of these services.

I.1.3.2.2.3 Rome I Regulation

The Regulation (EC) No 593/2008 of the European Parliament and of the Council of 17 June 2008 on the law applicable to contractual obligations[105] (**"Rome I Regulation"**) sets out rules for determining the applicable law in the area of contractual obligations. Applicable law can be determined by the parties themselves[106] and, if they do not do so, this will be done on the basis of the default rules in Article 4 of the Rome I Regulation. Therefore, it is recommended to determine the applicable law by the parties themselves in all contracts concluded through the ADMIRAL marketplace or by the ADMIRAL marketplace operator.

I.1.3.2.2.4 E-Commerce Directive

Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market[107] (**"E-Commerce Directive"**) contains rules on the validity of contracts concluded by electronic means. In the context of the ADMIRAL marketplace, the E-Commerce Directive is relevant for companies providing online logistics services. It establishes certain legal standards for electronic contracting in the digital transportation sector. During the implementation of ADMIRAL marketplace it is recommended to review and adhere the requirements set out in the E-Commerce Directive on what information in the marketplace must be provided to the clients. The E-Commerce Directive also sets out principles of contractual obligations that are applicable during order placement and if there is no different agreement with the client (who is not a consumer) – we suggest to review such principles and, if considered necessary, establish respective different agreement terms with the clients to the extent permitted by the E-Commerce Directive.

[105] Regulation (EC) No 593/2008 of the European Parliament and of the Council of 17 June 2008 on the law applicable to contractual obligations (Rome I), *OJ L 177, 4.7.2008, p. 6–16*.

[106] Art. 3 of the Rome I Regulation.

[107] Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market ('Directive on electronic commerce'), *OJ L 178, 17.7.2000, p. 1–16*.

I.1.3.2.2.5 CMR Convention

Convention on the Contract for the International Carriage of Goods by Road[108] (**"CMR Convention"**) applies to every contract for the carriage of goods by road in vehicles for reward, when the place of taking over of the goods and the place designated for delivery, as specified in the contract, are situated in two different countries[109]. The CMR Convention establishes such rules as on conclusion and performance of the contract of carriage, liability of the carrier, rules on claims and actions. With respect to conclusion and performance of the contract of carriage, CMR Conventions establishes the contract of carriage shall be confirmed with consignment note, it also establishes what information shall be included in such consignment note, burden of expenses, certain obligations of the carrier to check the consignment note and condition of the goods and their packaging, liabilities of the sender, documents that shall be attached to the consignment note, etc.

I.1.3.2.3 Key contractual elements relevant in ADMIRAL marketplace

Contractual terms to be established depend on business interests and business plans. However, there are certain key contractual elements that we considered are necessary to be established in the contracts which will be directly concluded between the ADMIRAL marketplace operator and transportation and logistics service providers and between the ADMIRAL marketplace operator and transportation and logistics services' customers.

Please note that in the below lists not all contractual terms that should be covered by the agreements are listed as indications of such full, detailed and exhaustive terms are part of the contract drafting process, and the below lists are only recommendations on certain key elements of the contracts relevant in case of ADMIRAL marketplace.

I.1.3.2.3.1 Contractual obligations between the ADMIRAL marketplace operator and transportation and logistics service providers

Contractual terms between the ADMIRAL marketplace operator and transportation and logistics service providers inter alia must include:

- transportation and logistics services provider's obligations on how to use the marketplace, on creation of the service provider's account, on acceptance of orders;
- restrictions of inappropriate and illegitimate use of the marketplace;

[108] Convention on the Contract for the International Carriage of Goods by Road, United Nations, done at Geneva on 19 May 1956.
[109] Art. 1(1) of the CMR Convention.

- rights of the marketplace to change or set new features of the marketplace at any time and to change the terms;
- rights of the marketplace to monitor the service provider's activities in the marketplace and if necessary due to breach of the terms of applicable law to remove, limit the services of the service provider;
- requirements of the services to be provided by the service provider (if relevant);
- limitations of liabilities of the marketplace (e.g. not responsible for the orders submitted to the service provider);
- payments terms;
- requirements on communication with the client;
- use of intellectual property and confidential information terms;
- requirements and limitations (if relevant) of advertisement and marketing;
- clarifications, disclaimers on the relationship between the parties;
- privacy policy terms;
- other standard contractual terms (e.g. subject of the contract, standard general obligations and rights of the parties, termination rights and etc.).

I.1.3.2.3.2 Contractual obligations between the ADMIRAL marketplace operator and transportation and logistics services' customers

Contractual terms between the ADMIRAL marketplace operator and transportation and logistics services' customers inter alia must include:

(i) customer's obligations on how to use the marketplace, on creation of the customer's account, on submission of orders;

(ii) restrictions of inappropriate and illegitimate use of the marketplace;

(iii) rights of the marketplace to change or set new features of the marketplace at any time and to change the terms;

(iv) limitations of liabilities of the marketplace (e.g. not responsible for the orders submitted to the service provider);

(v) use of intellectual property and confidential information terms;

(vi) clarifications, disclaimers on the relationship between the parties;

(vii) privacy policy terms;

(viii) other standard contractual terms (e.g. subject of the contract, standard general obligations and rights of the parties, termination rights and etc.).

I.1.4 EU environmental aspects

In 2015, 195 countries adopted the Paris Agreement, pledging to limit the Earth's temperature rise to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit it to 1.5 degrees Celsius. The European Union (EU) and all its Member States have signed and ratified the Paris Agreement and are steadfastly dedicated to its execution. As part of this dedication, EU countries have agreed to strive for climate neutrality, aiming to make the EU the first climate-neutral economy and society by 2050.

Accordingly, the Green Deal[110] represents the new growth strategy of the EU. It aims to reshape the EU into a modern, resource-efficient, and competitive economy with net-zero greenhouse gas ("**GHG**") emissions by 2050.

GHG emissions from transport currently constitute approximately 25% of the EU's total GHG emissions and have been on the rise in recent years. It is acknowledged that significant transformations in the transport sector are imperative for the EU to realize its ambition of becoming the first climate-neutral continent by 2050[111]. Consequently, the Green Deal has prompted a series of legislative measures and guidelines aimed at curbing GHG emissions in transport which will be briefly outlined in the following sections.

I.1.4.1 Legal framework overview of GHG reduction by mode of transport

The following legal acts outline the imperative requirements aimed at mitigating GHG emissions across various modes of transportation:

[110] The Green Deal is a comprehensive plan proposed by the European Commission to tackle climate change and environmental degradation while promoting sustainable economic growth. It encompasses a wide range of policies and initiatives aimed at reducing greenhouse gas emissions, increasing energy efficiency, promoting renewable energy sources, transitioning to a circular economy, and protecting biodiversity.

[111] Access online: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/transport-and-green-deal_en.

- The EU Regulation on setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles[112] stipulates that starting from 1 January 2030, the following EU fleet-wide targets shall be implemented[113]: (a) for the average emissions of the new passenger car fleet, an EU fleet-wide target equivalent to a 55% reduction compared to the 2021 target; (b) for the average emissions of the new light commercial vehicles fleet, an EU fleet-wide target equivalent to a 50% reduction compared to the 2021 target.

- The EU Regulation on the deployment of alternative fuels infrastructure[114] establishes mandatory national targets aimed at facilitating the deployment of adequate alternative fuels infrastructure across the EU for road vehicles, trains, vessels, and stationary aircraft[115]. Member States are required to guarantee a minimum coverage of publicly accessible recharging points specifically designated for both light-duty[116] and heavy-duty electric vehicles on their road networks[117].

- The EU Regulation on decarbonizing the maritime sector (known as "FuelEU maritime") aims to primarily boost the demand for and consistent utilization of renewable and low-carbon fuels while diminishing GHG emissions from the shipping sector. This regulation targets a reduction in emissions by 2% by 2025 and up to 80% by 2050. It also emphasizes ensuring the seamless operation of maritime traffic and preventing distortions in the internal market.[118].

- In April 2023, the Council and the European Parliament reached a preliminary political agreement on a proposal aimed at decarbonizing the aviation sector and fostering a fair competitive environment for sustainable air transport (known as “ReFuelEU aviation”)[119]. Consequently, aviation fuel suppliers are mandated to ensure that all fuel provided to aircraft operators at EU airports contains a minimum percentage of Sustainable Aviation Fuel (SAF) starting from 2025. Moreover, commencing in 2030, a minimum portion of synthetic fuels is required, with both proportions gradually increasing until 2050. The specified percentages include 2% SAF by 2025,

[112] Regulation (EU) 2023/851 amending Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011.
[113] Regulation (EU) 2023/851, Article 1(1)(a); Regulation (EU) 2019/631, Article 1(5).
[114] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU.
[115] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU, Article 1(1).
[116] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU, Article 3(4).
[117]Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU, Article 4(1).
[118] Access online: https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/.
[119] Access online: https://www.consilium.europa.eu/en/press/press-releases/2023/04/25/council-and-parliament-agree-to-decarbonise-the-aviation-sector/.

6% by 2030, and 70% by 2050. Synthetic fuels must constitute 1.2% by 2030, rising to 35% by 2050.

These legal instruments form a comprehensive framework designed to address GHG emissions across various modes of transportation, promoting sustainable practices and contributing to the EU's overall climate objectives.

I.1.4.2 Implementing the GHG reporting requirements under the European Corporate Sustainability Reporting Directive

A pivotal component of the Green Deal is the European Corporate Sustainability Reporting Directive ("**CSRD**")[120], which came into effect in 2023 and must be transposed to the national laws of the Member States until July 2024.

The CSRD represents a new EU legislation[121] mandating that all companies falling under its purview regularly publish reports on the environmental, human, and social impacts of their operations. The aim is to enable investors, consumers, policymakers, and other stakeholders to assess the non-financial performance of these entities. Some companies will be required to report their 2024 data by 2025.

It applies to (i) large EU companies[122]; (ii) most businesses with operations or securities in Europe, including small and medium-sized enterprises ("SMEs") (with exemptions); (iii) non-EU parent companies with a cumulative group turnover in the EU exceeding EUR 150 million.

Following the implementation of the CSRD, the European Sustainability Reporting Standards (ESRS) were adopted[123]. ESRS E1, focusing on climate change, mandates businesses to disclose, among other things: (i) their adopted GHG emission reduction targets, encompassing targets for at least 2030, and 2050 where applicable, with clarity on whether these targets are science-based and the frameworks employed; (ii) their gross Scope 1, 2, and 3 GHG emissions, in addition to total GHG emissions, encompassing direct emissions from operations (Scope 1), indirect emissions from energy consumption (Scope 2), and other indirect emissions across their value chain (Scope 3), alongside information on emissions intensity based on net revenue; (iii) GHG removals and storage from their

[120] Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting.

[121] The CSRD extends the scope and reporting requirements of the existing Non-Financial Reporting Directive (NFRD), which has already been in place for large public interest entities (PIEs) to report since 2018.

[122] Companies (including EU and non-EU subsidiaries) that exceed two of the following three criteria: (i) 250 employees, (ii) net revenue of EUR 50 million, or (iii) total assets of EUR 25 million.

[123] Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards.

operations and value chains in metric tonnes of CO2eq, with detailed accounts of removal activities and calculation methodologies.

For the calculation and reporting of GHG emissions, the Global Logistics Emissions Council ("**GLEC**") Framework was adopted which offers companies a harmonized, efficient, and transparent way to calculate and report logistics emissions. GLEC Framework will be described in more detail in the following sections.

I.1.4.3 Overview of the Global Logistics Emissions Council Framework

As sustainability reporting requirements continue to escalate, notably with the introduction of the CSRD, supply chains will increasingly face greater data demands. To assist businesses in accurately and effectively reporting their carbon emissions, GLEC developed a data framework.

Aligned with ISO 14083 and recognized by the Greenhouse Gas Protocol, the GLEC Framework[124] is the recommended method for reporting logistics emissions to the Carbon Disclosure Project and for establishing targets consistent with the Science-Based Targets initiative.

The GLEC Framework categorizes overall GHG emissions into two main components: emissions associated with energy usage for transport or hub activities and emissions linked to the provision of this energy. Transport operation emissions, encompassing both hub and transport activity, constitute the tank-to-wheel emissions, while emissions from energy provision for transport activity or hub operations form the well-to-tank emissions.

I.1.4.4 Calculation of the GHG under the GLEC Framework

The ADMIRAL marketplace should base its operations on the GLEC Framework and its main principles (as will be shown below). Accordingly, contracts with logistics service providers should then include and adapt the main rules of GLEC Framework that logistics service providers would have to follow when calculating and, later, reporting the GHG emissions.

The process for calculating GHG emissions from transport operations begins with identifying "transport chains." A transport chain commences when freight leaves a consignor, typically the point of shipment departure, and concludes upon its arrival at a consignee, typically the receiver of the shipment, or when the first non-transport-related operation is conducted on the freight.

The GLEC Framework computes emissions per transport chain. To ensure the inclusion of empty operations and the accounting of related emissions, vehicle usage in transport chains follows a round-trip approach for both emission intensity calculations and emissions allocation to

[124]Access online: https://www.smartfreightcentre.org/en/our-programs/global-logistics-emissions-council/calculate-report-glec-framework/.

consignments in shared transport. Thus, the return journey of a vehicle is factored in, even though freight typically moves from consignor to consignee in one direction only, ensuring comprehensive coverage of all emissions associated with a transport operation.

Once a transport chain is identified, it is segmented into Transport Chain Elements ("**TCEs**"). A TCE refers to freight carried by a single vehicle or passing through a single hub. Each change of vehicle or hub necessitates the identification of a distinct TCE, thereby requiring a separate calculation of its GHG emissions.

The sum of GHG emissions from each TCE equals the emissions of the entire transport chain, and the sum of emissions from all transport chains equals the organization's total freight and logistics emissions[125].

Therefore, the logistics service providers' calculations of GHG emissions should involve three steps: (i) determining the transport activity of the TCE; (ii) identifying the applicable emission intensity of the TCE by establishing the relevant Transport Operation Category or Hub Operation Category; and (iii) calculating the TCE's emissions by multiplying the transport activity by the emission intensity value. This could be directly established in the contracts.

I.1.4.5 Calculation of the activity of the Transport Chain Elements (TCE)

The transport activity of a TCE is measured in tonne-kilometres (tkm). Therefore, to determine the transport activity of a TCE, it is necessary to establish both the mass of freight transported (in metric tons or kilograms) and the distance covered (measured in kilometres, extending from consignor to consignee).

For the most accurate calculations it is therefore necessary to collect data of the actual distance. This data is usually known only by the carriers and each carrier will only know the distance of its own services. If it is not possible to collect such data, the distance is calculated by the measure of the shortest practical route.

The distance of a transport TCE is defined by the freight carried by a single vehicle (hub TCEs are associated with zero distance). Each change of vehicle or hub necessitates the identification and calculation of a separate TCE. Distance information must be collected for each TCE, either through direct measurement or estimation.

[125] Emissions of an organization are calculated by adding up all emissions from transport chains that are used by the organization as well as its subcontractors. As the GLEC Framework includes all modes of transport, as well as any hubs which are part of the transport chain, energy consumptions of contractors and any form of subcontractors, as well as their combustion and leakages, are included, independent of who is carrying out these operations.

It is then necessary to know the shipment mass data. Such information may be found on invoices or bills of loading within a Transport Management System.

In the GLEC Framework, the quantification of goods transported or handled is based on the actual shipment mass, inclusive of the product and packaging provided for transport by the shipper. When empty containers are transported, they are considered as freight, with the weight of the empty container equating to the mass of the transported and handled freight.

Once the mass and distance are established per TCE, the transport activity can be calculated, preferably in tonne-kilometres, using the formula: *MxT*, where:

M= Mass of a consignment (tonnes)

T= Transport activity distance of this specific consignment (km)

It is crucial to calculate the transport activity per shipment of each TCE separately. To determine the tonne-kilometres for an entire TCE, the tonne-kilometres of each shipment are then aggregated in a subsequent step.

I.1.4.6 Identification of the applicable emission intensity for the Transport Chain Elements (TCE)

To determine the applicable emission intensity for a specific TCE, it is essential to ascertain which Transport Operation Category (TOC) or Hub Operation Category (HOC) it can be associated with. A TOC represents a grouping of transport operations sharing similar characteristics, while a HOC represents a grouping of hub operations with similar characteristics, typically within a defined period, such as one calendar year. Each transport operation must be allocated to one specific TOC (or HOC), and they cannot be split between different categories.

To enhance transparency, various types of TOCs have been established, and each TOC must be classified into one of these types:

(i) TOC of freight only (general case);

(ii) TOC of freight only with multi-temperature vehicles;

(iii) TOC of vehicles carrying both passengers and freight (e.g., ferries);

(iv) TOC representing any other case. TOCs should encompass entire round trips made by vehicles.

For identifying a HOC, factors influencing the scale, composition, and characteristics of operations need consideration, such as:

(i) the number and type of hub operations contributing to the HOC, including freight handling, (un)loading, (de)boarding, and on-site transport;

(ii) the nature and consistency of hub operations included in the HOC, such as electrified or non-electrified operations;

(iii) etc.

The following steps are necessary to establish the emission intensity of a TOC or HOC:

(i) Establishing the activity data of the TOC or HOC (general approach, multi-temperature, or combined freight and passenger transport).

(ii) Determining the energy usage, related emission factors, and calculating the GHG emissions of the TOC or HOC (for freight only or combined freight and passenger transport).

(iii) Calculating the emission intensity of the TOC or HOC.

GHG emissions can be expressed as (i) CO2e per tonne-kilometre (or equivalent units) for transport or (ii) CO2e per tonne throughput (or equivalent units) for freight hub throughput.

To calculate TOC or HOC specific emission intensities, it is best to use (collect) primary or modelled data. Primary data can range from highly precise information, such as from fuel receipts or annual energy consumption spend, to aggregated values that reflect energy consumption or emission intensity for a year's worth of vehicle movements. Modelled data is data which is established using a model that considers primary data and/or GHG emission relevant parameters of a transport operation or hub operation[126].

I.1.4.7 Calculation of the Transport Chain Elements (TCE) emissions

For logistics service providers to calculate the emissions of an individual TCE, the transport activity or hub operation activity should be multiplied by the GHG emission intensity of the related TOC or HOC respectively.

The GHG emissions of transport operations consist of two components: an energy provision component and an operational component. This allows for the separate calculation of emissions from operation and energy provision. To determine the total GHG emissions of the TCE, the GHG

[126] Companies and tool providers model energy consumption and emissions using available information on types of goods consignment sizes, journey origin, destination and intermediate handling locations, and any information about the vehicles used, load factors, etc. The accuracy of the model's outputs will depend on the level of detail that is available about the transport operation and the assumptions made, as well as the model's algorithms. In general, assumptions that are made that rely on default data, rather than primary data, will increase the uncertainty of the output. It is important to ensure that the methods embedded into tools for modelling data are aligned with the GLEC Framework.

emissions from transport operation and the GHG emissions from energy provision are summed together.

I.1.4.8 Reporting emissions

After logistics service providers calculate their GHG emissions, it should then be reported to the ADMIRAL marketplace operator.

When reporting at the level of transport or hub services, the report can either apply to a single TCE or to a set of TCEs that comprise part of or a full transport chain. The identification of transport or hub services covered by the report can either be done by listing all services included or by specifying the period of time during which they were provided and used.

The logistics service providers' reports must include:

(i) the identification of the TCE(s) or transport chain(s) covered;

(ii) the absolute value of the total GHG emissions of the covered TCEs, including all related energy provision emissions;

(iii) the total GHG emission intensity of the TCEs covered by the report, including all related energy provision emissions, specifying the type of transport activity distance used;

(iv) a reference, specifying where all relevant supporting information can be found;

(v) the transport activity covered by the report, including a specification of the type of distance used;

(vi) the hub activity covered by the report;

(vii) GHG emissions related to all vehicle operations and hub operations;

(viii) the operational GHG emission intensity of transport operations and hub operations, and the transport activity distance used, or any other freight transport activity unit used (e.g., number of twenty-foot equivalent units (TEUs));

(ix) the total GHG emissions, transport activity and/or GHG emission intensities for each mode of transport and for each hub operation, specifying the type of transport activity distance used.

Furthermore, a report should include the following details to provide transparency and enable improvements of sustainability and efficiency of the operations:

(i) Split by service. All information provided needs to be split by service they are related to.

(ii) Split total operational and energy provision GHG emissions. The report must split the total GHG emissions into i) operational and ii) energy provision GHG emissions. Additionally, the report should provide a breakdown of GHG emissions by energy carrier.

(iii) Split of total GHG intensity. When reporting GHG intensity, an average for the entire organization as well as of the intensity of each transport mode must be provided.

Such or similar reports should therefore be done by service providers and made available to the ADMIRAL marketplace operator. As calculations (and the whole reports) are done by the service providers (or third persons) and not ADMIRAL marketplace operator, a contractual provision should be included to penalise service providers for providing (clearly) inaccurate estimates. Minimal or small deviations are normal, but if there is a large gap between the estimate and the actual number, contractual penalties should be imposed. Accordingly, the larger the gap, the higher the penalties.

The ADMIRAL marketplace operator, having such reports, will be able to calculate CO_2 footprint and allocate it between logistics stakeholders. In time, such procedure will also help to reduce CO_2 emissions at network level.

I.1.5 Application of traditional competition law on new business models on admiral marketplace

Section 0 contains general overview of Competition Law considerations, which, among other, are important both at (i) operational (i.e. day-to-day) level; and for (ii) a broader business set up.

Since the ADMIRAL marketplace functionalities are set to encompass exchanging various data and use of AI, this section explores further the concepts covered in Section 0 concerning (i) use of algorithms and (ii) exchange of information.

With respect to introduction of new business models on the ADMIRAL marketplace it is imperative to observe paramount Competition Law principles, first, that each undertaking must adopt its conduct on the market independently, and, second, that the form of coordination between undertakings which, without having reached the stage where an agreement has been concluded, knowingly substitutes practical cooperation between them for the risks of competition, is considered to be 'concerted practice'[127], i.e. a form of Article 101 (1) TFEU infringement.

The importance of the principles can be illustrated vividly by a recent CJEU judgment in *Eturas* case[128] which concerned actions of the online platform used by travel agencies and its users – travel agencies. The conduct of the online platform and its users were found to infringe Article 101 (1) TFEU. Users of the online platform had access to an internal message system operated by the

[127] CJEU Judgment of 14 July 1972, Case 48-69, *ICI v EC,* ECR 1972 00619, ECLI identifier: ECLI:EU:C:1972:70, para 64.
[128] CJEU Judgment of 21 January 2016, Case C-74/14, *Eturas*, ECLI identifier: ECLI:EU:C:2016:42.

platform. The online platform sent a message to about a proposal to limit the discount rate applied to transactions on the platform. Online platform users then received a system notification of the reduction and technical modifications that were made to apply this cap to the platform. In order for users to apply a different discount, they were required to carry out additional technical steps. In particular, the CJEU found that the online platform users receiving the messages via the platform and aware of the collusive practice (i.e. the online platform setting the prices charged for its users' services) can be presumed to be participating in the practice, unless they publicly distance themselves from the conduct or report it to authorities.

I.1.5.1 Use of AI

There are many aspects raising concerns about the use of AI compliance with Competition Law. For example, anti-competitive harms associated with AI can be divided into three categories: (1) the use of AI to implement anticompetitive agreements or strategies developed by humans; (2) the implementation of identifiable anticompetitive strategies by AI without explicit instructions by humans; and (3) AI coinciding with a reduction in competitive intensity without explicit evidence of anticompetitive strategies or agreements.[129]

The first category involves the most straightforward application of Competition Law (e.g. the use of AI to implement anticompetitive agreements amounts to prohibited agreement under Article 101(1) TFEU). Regarding the second category, firms using AI which develops anticompetitive strategies are likely to be liable for the effects of this conduct.

Whereas the third category of AI harm concerns tacit collusion which, if reached without any co-ordination among the firms involved, is usually not prosecuted. However, if AI enables tacitly collusive outcomes to be reached more efficiently, such AI tools could be subject to Article 101(1) TFEU.

[129] OECD Business and Finance Outlook 2021, *AI in Business and Finance*, Chapter 4 *"Competition and AI"*, 24 Sept 2021, https://doi.org/10.1787/ba682899-en.

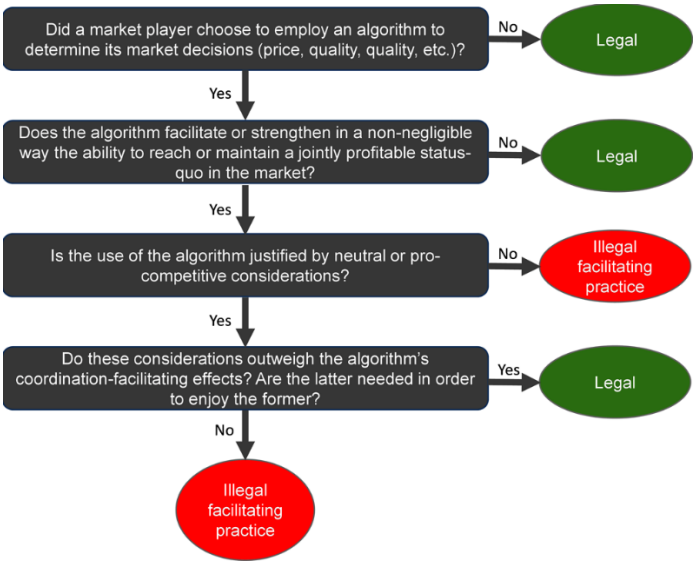

Figure 10 Decision-tree method developed by Gal for assessing whether decision-making algorithms constitute a facilitating practice[130]

It is planned that the ADMIRAL marketplace will possess and test an AI-based tool providing handling plans on schedules and cargo volumes from incoming shipments arriving by truck and train. At principal level, AI tool, which is limited to generating plans on schedules and collating information on cargo volumes from incoming shipments (e.g. spare cargo space capacities per each shipment), and which does not include sharing of pricing information in connection with the shipments, or other competitively sensitive data such as identification of Clients to whom the cargo belongs, does not appear to raise specific Article 101(1) TFEU infringement risks.

Also, the use of the above-mentioned AI tool has potential to be covered by Article 101(3) TFEU if it is found that the AI tool, among other circumstances, sufficiently contributes towards improving the efficiency of respective shipping processes (i.e. improves logistics conducted by truck and train) and does not eliminate competition in respect of a substantial part of the products in question.

I.1.5.2 Exchange of information

As previously discussed, among other requirements, it must be observed that the nature of information flowing through the ADMIRAL marketplace is not commercially sensitive. Therefore, development or changes to any solution, functionality or activity on the ADMIRAL marketplace must take place only after conclusion of individual assessment regarding compliance with Competition Law requirements.

[130] Gal, M. (2017), *Algorithmic-facilitated Coordination: Note for OECD Competition Committee Roundtable on Algorithms and Collusion*, OECD, https://one.oecd.org/document/DAF/COMP/WD(2017)26/en/pdf.

ANNEX II Insight-gathering survey

Questionnaire

Dear Admiral partners,

We kindly request your participation in completing the questionnaire for Task 3.2, focusing on drivers, barriers, legislation, and contractual boundaries impacting horizontal collaboration. This questionnaire aims to uncover two critical aspects: the types of collaboration utilized within your pilot projects and the barriers/drivers affecting both vertical and horizontal collaboration.

Your responses will play a pivotal role in our analysis, allowing us to rank these factors by importance. The most significant findings will guide our discussions, slated for Workshop 2 at the upcoming international meeting in Lithuania.

Thank you sincerely for your cooperation and valuable input.

Q1 - This questionnaire collects personal information. Please read the Privacy Notice for Research and confirm your agreement about the processing and handling of your personal data.

◌ Yes.

◌ No.

Q2 - Which pilot are you a part of?

◌ Slovenian-Croatian pilot.

◌ Finnish pilot.

◌ Portugal-Spain pilot.

◌ Lithuanian pilot.

Q3 - Partner name:

_____

Q4 - HORIZONTAL COLLABORATION

Horizontal collaboration refers to collaborative relationships between companies operating at the same level in the industry or supply chain, sometimes even among competitors.

For instance: transport alliances might be formed by a group of small carriers to achieve economies of scale through serving transport demands from many small shippers or a few large shippers.

A marketplace collaboration, as the one in ADMIRAL, is primarily understood as horizontal.

_____

Q5 - Are you currently or planning to engage in HORIZONTAL COLLABORATION with your partners or stakeholders as part of this pilot?

◌ Yes.

◌ No.

Q6 - Add a short description of HORIZONTAL COLLABORATION with your partners or stakeholders as part of this pilot.

_____

Q7 - Choose partners or stakeholders with whom you are currently collaborating or plan to collaborate horizontally in the pilot.

Multiple answers are possible

☐ Cargo owner.

☐ Transport operator.

☐ Freight forwarder and/or Custom broker.

☐ Port authority.

☐ Dry port.

☐ Multimodal platform.

☐ Berth service provider.

☐ Rail infrastructure manager.

☐ Road infrastructure manager.

☐ Logistics operator.

☐ Warehousing and storage provider.

☐ Courier service.

☐ Energy supplier.

☐ Technology provider, IT, software company.

☐ Financial institution.

☐ Consultancy firm.

☐ Other:

Q8 - The significance of BARRIERS in horizontal collaboration Barriers are obstacles that hinder organizations from collaborating effectively. The main categories of barriers include Technology and innovation, Economics and efficiency, Governance and regulation, Market and business model, and Information sharing.

_____

Q9 - Rank the importance of the following 5 main barrier categories for the success of your horizontal collaboration in the pilot

Please adjust the positions of the categories according to their perceived importance by assigning a number from 1 to 5 to each category, where 1 indicates the most important and 5 indicates the least important. Move categories from the left side to the right side.

Available categories:	Ranked categories:
_____	_____
Technology and innovation.	1. _____
Economics and efficiency.	2. _____
Governance and regulation.	3. _____
Market and business model.	4. _____
Information sharing.	5. _____

Q10 - Indicate the importance of the barriers listed below in the category of Technology and innovation for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Lack of systems standardization (e.g. heterogeneous format,	○	○	○	○	○

harmonized measurements of Scope 3 emissions, etc.).					
Technological incompatibility.	○	○	○	○	○
Knowledge and innovation asymmetry.	○	○	○	○	○
Lack of skills, knowledge, training.	○	○	○	○	○

Q11 - Indicate the importance of the barriers listed below in the category of Economics and efficiency for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Inadequate cost appraisal.	○	○	○	○	○

Q12 - Indicate the importance of the barriers listed below in the category of Governance and regulation for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Lack of clear operational goals and outcomes.	○	○	○	○	○
Lack of governance planning.	○	○	○	○	○
Inconsistency in performance measurement.	○	○	○	○	○
Lack of intellectual property protection.	○	○	○	○	○
Lack of trust.	○	○	○	○	○

Cultural and language difficulties.	○	○	○	○	○
Conflict over differing needs between partners.	○	○	○	○	○
Complex legislation and regulation compliance.	○	○	○	○	○
Lack of commitment.	○	○	○	○	○

Q13 - Indicate the importance of the barriers listed below in the category of Market and business model for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Resistance of companies to change due to risk aversity.	○	○	○	○	○
Individual competitive advantage protection.	○	○	○	○	○
Customer demand challenges.	○	○	○	○	○
Disparate operational practices and routines.	○	○	○	○	○

Q14 - Indicate the importance of the barriers listed below in the category of Information sharing for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Resistance to information sharing.	○	○	○	○	○
Unequal distribution of power and information sharing among partners.	○	○	○	○	○

Q15 - Are there any additional barriers significant for your horizontal collaboration?

_____

Q16 - The significance of DRIVERS in horizontal collaboration

Drivers are the factors that motivate organizations to pursue collaborations. The main categories of drivers include Technology and innovation, Economic and efficiency, Governance and regulation, Market and business model and Sustainability.

_____

Q17 - Rank the importance of the following 5 main drivers categories for the success of your horizontal collaboration in the pilot. Please adjust the positions of the categories according to their perceived importance by assigning a number from 1 to 5 to each category, where 1 indicates the most important and 5 indicates the least important. Move categories from the left side to the right side.

Available categories:	Ranked categories:
_____	_____
Technology and innovation.	1. _____
Economic and efficiency.	2. _____
Governance and regulation.	3. _____
Market and business model.	4. _____
Sustainability.	5. _____

Q18 - Indicate the importance of the drivers listed below in the category of Technology and innovation for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Technological advances or innovative tools.	○	○	○	○	○
Ability to faster innovation.	○	○	○	○	○
Access to expertise and knowledge.	○	○	○	○	○

Q19 - Indicate the importance of the drivers listed below in the category of Economics and efficiency for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Costs reduction.	○	○	○	○	○
Reducing delivery time.	○	○	○	○	○
Better use of assets and resources.	○	○	○	○	○
Improved operational efficiency and productivity.	○	○	○	○	○
Increased revenues.	○	○	○	○	○
Access to resources.	○	○	○	○	○

Q20 - Indicate the importance of the drivers listed below in the category of Governance and regulation for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Regulation and legislation compliance (e.g. Scope 3 regulation).	○	○	○	○	○
Sustainability requirements (e.g. ESG, etc.).	○	○	○	○	○
Faster conflict resolution.	○	○	○	○	○

Q21 - Indicate the importance of the drivers listed below in the category of Market and business model for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Increased customer demand and satisfaction.	○	○	○	○	○
Better market, global positioning and competition.	○	○	○	○	○
Reliability/Resilience.	○	○	○	○	○
Developing strategic synergies.	○	○	○	○	○

Q22 - Indicate the importance of the drivers listed below in the category of Sustainability for the success of your horizontal collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Reducing environmental impacts.	○	○	○	○	○

Ensuring social welfare.	○	○	○	○	○

Q23 - Are there any additional enablers significant for your horizontal collaboration?

_____

Q24 - VERTICAL COLLABORATION Vertical collaboration entails inter-firm cooperation within the supply chain, encompassing collaboration with organizations positioned either upstream or downstream in the supply chain. Vertical collaboration (VC) occurs when various organizations, including manufacturers, distributors, carriers, and retailers, come together to share responsibilities, resources, and performance information, all aimed at boosting the efficiency of the entire supply chain.

_____

Q25 - Are you currently or planning to engage in VERTICAL COLLABORATION with your partners or stakeholders as part of this pilot?

○ Yes.

○ No.

Q26 - Add a short description of VERTICAL COLLABORATION with your partners or stakeholders as part of this pilot.

_____

Q27 - Choose partners or stakeholders with whom you are currently collaborating or plan to collaborate vertically in the pilot.

Multiple answers are possible

☐ Cargo owner.

☐ Transport operator.

☐ Freight forwarder and/or Custom broker.

☐ Port authority.

☐ Dry port.

☐ Multimodal platform.

☐ Berth service provider.

☐ Rail infrastructure manager.

☐ Road infrastructure manager.

☐ Logistics operator.

☐ Warehousing and storage provider.

☐ Courier service.

☐ Energy supplier.

☐ Technology provider, IT, software company.

☐ Financial institution.

☐ Consultancy firm.

☐ Other:

Q28 - The significance of BARRIERS in vertical collaboration Barriers are obstacles that hinder organizations from collaborating effectively. The main categories of barriers include Technology and innovation, Economics and efficiency, Governance and regulation, Market and business model, and Information sharing.

_____

Q29 - Rank the importance of the following 5 main barrier categories for the success of your vertical collaboration in the pilot

Please adjust the positions of the categories according to their perceived importance by assigning a number from 1 to 5 to each category, where 1 indicates the most important and 5 indicates the least important. Move categories from the left side to the right side.
Available categories:

Ranked categories:

_____ _____

Technology and innovation. 1. _____

Economics and efficiency. 2. _____

Governance and regulation. 3. _____

Market and business model. 4. _____

Information sharing. 5. _____

Q30 - Indicate the importance of the barriers listed below in the category of Technology and innovation for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Lack of systems standardization (e.g. heterogeneous format, harmonized measurements of Scope 3 emissions, etc.).	○	○	○	○	○
Technological incompatibility.	○	○	○	○	○
Knowledge and innovation asymmetry.	○	○	○	○	○
Lack of skills, knowledge, training.	○	○	○	○	○

Q31 - Indicate the importance of the barriers listed below in the category of Economics and efficiency for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Inadequate cost appraisal.	○	○	○	○	○

Q32 - Indicate the importance of the barriers listed below in the category of Governance and regulation for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Lack of clear operational goals and outcomes.	○	○	○	○	○

Lack of governance planning.	○	○	○	○	○
Inconsistency in performance measurement.	○	○	○	○	○
Lack of intellectual property protection.	○	○	○	○	○
Lack of trust.	○	○	○	○	○
Cultural and language difficulties.	○	○	○	○	○
Conflict over differing needs between partners.	○	○	○	○	○
Complex legislation and regulation compliance.	○	○	○	○	○
Lack of commitment.	○	○	○	○	○

Q33 - Indicate the importance of the barriers listed below in the category of Market and business model for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Resistance of companies to change due to risk aversity.	○	○	○	○	○
Individual competitive advantage protection.	○	○	○	○	○

Customer demand challenges.	○	○	○	○	○
Disparate operational practices and routines.	○	○	○	○	○

Q34 - Indicate the importance of the barriers listed below in the category of Information sharing for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Resistance to information sharing.	○	○	○	○	○
Unequal distribution of power and information sharing among partners.	○	○	○	○	○

Q35 - Are there any additional barriers significant for your vertical collaboration?

_____

Q36 - The significance of DRIVERS in vertical collaboration

Drivers are the factors that motivate organizations to pursue collaborations. The main categories of drivers include Technology and innovation, Economic and efficiency, Governance and regulation, Market and business model and Sustainability.

_____

Q37 - Rank the importance of the following 5 main driver categories for the success of your vertical collaboration in the pilot.

Please adjust the positions of the categories according to their perceived importance by assigning a number from 1 to 5 to each category, where 1 indicates the most important and 5 indicates the least important. Move categories from the left side to the right side.

Available categories: Ranked categories:

_____ _____

Technology and innovation.	1. _____
Economic and efficiency.	2. _____
Governance and regulation.	3. _____
Market and business model.	4. _____
Sustainability.	5. _____

Q38 - Indicate the importance of the drivers listed below in the category of Technology and innovation for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Technological advances or innovative tools.	○	○	○	○	○
Ability to faster innovation.	○	○	○	○	○
Access to expertise and knowledge.	○	○	○	○	○

Q39 - Indicate the importance of the drivers listed below in the category of Economics and efficiency for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Costs reduction.	○	○	○	○	○
Reducing delivery time.	○	○	○	○	○
Better use of assets and resources.	○	○	○	○	○
Improved operational efficiency and productivity.	○	○	○	○	○

Increased revenues.	○	○	○	○	○
Access to resources.	○	○	○	○	○

Q40 - Indicate the importance of the drivers listed below in the category of Governance and regulation for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Regulation and legislation compliance (e.g. Scope 3 regulation).	○	○	○	○	○
Sustainability requirements (e.g. ESG, etc.).	○	○	○	○	○
Faster conflict resolution.	○	○	○	○	○

Q41 - Indicate the importance of the drivers listed below in the category of Market and business model for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Increased customer demand and satisfaction.	○	○	○	○	○
Better market, global positioning and competition.	○	○	○	○	○
Reliability/Resilience.	○	○	○	○	○
Developing strategic synergies.	○	○	○	○	○

Q42 - Indicate the importance of the drivers listed below in the category of Sustainability for the success of your vertical collaboration.

	Not important.	Slightly important.	Fairly important.	Important.	Very important.
Reducing environmental impacts.	○	○	○	○	○
Ensuring social welfare.	○	○	○	○	○

Q43 - Are there any additional drivers significant for your vertical collaboration?

_____

ANNEX III Mentimeter online questionnaire

01. Please rank the Strategies categories for consideration at the Admiral Marketplace (From the most important to the least one)

- Partnership-driven design (1)
- Cooperation fairness (2)
- Extroversion & openness (3)
- Leadership & Strategic Decision making (4)
- Objectives alignment (5)
- Operational & procedural alignment (6)
- Organizational culture & Employee support (7)
- Partner assessment (8)
- Technical integration (9)
- Sustainability (10)

02. Please select the three most important Strategies of the Category: 1 Partnership-driven design

- 1a Co-create with end-consumers
- 1b Cross-functional collaboration
- 1c Early supplier and customer involvement
- 1d Effective use of pilot projects
- 1e Joint product development
- 1f Multi-tier perspectives
- 1g Open innovation
- 1h Resources sharing
- 1i Understanding of the elements that constitute effective collaboration
- 1j Vertical and horizontal coalitions combination

03. Please select the three most important Strategies of the Category: 2 Cooperation fairness

- 2a Anti-competitive laws compliance mechanism
- 2b Costs/benefits allocation mechanism
- 2c Data privacy
- 2d Fair profit sharing
- 2d Trust-based alliances
- 2e Swift and equitable dispute resolution mechanism for contractual obligations

04. Please select the most important Strategy of the Category: 3 Extroversion & openness

- 3a Industry-university partnerships
- 3b Joint knowledge creation

- 3c Open information sharing culture

05. Please select the three most important Strategies of the Category: 4 Leadership & Strategic Decision making

- 4a Centralized decision-making for effectiveness
- 4b Clearly defined entry and exit rules / setting limits
- 4c Command-and-control-based relationships
- 4d Neutral leadership
- 4e Servant leadership & enlightened despotism
- 4f Strategic SC vision
- 4g Using chain advisory councils

06. Please select the two most important Strategies of the Category: 5 Objectives alignment

- 5a Incentive alignment
- 5b Ownership clarity
- 5c Strategic alignment around joint objectives
- 5d Supplier alignment and rationalization

07. Please select the two most important Strategies of the Category: 6 Operational & procedural alignment

- 6a Collaborative planning across the supply chain
- 6b Infrastructure integration
- 6c Process documentation
- 6d Process integration

08. Please select the two most important Strategies of the Category: 7 Organizational culture & Employee support

- 7a Continuous collaboration culture improvement
- 7b Cross-trained experienced managers
- 7c Managerial and employee support
- 7d Supply chain education and training

09. Please select the two most important Strategies of the Category: 8 Partner assessment

- 8a Certification (partners)
- 8b Cooperation feedback ratings
- 8c Due diligence in partner selection
- 8d Prior collaborative history with a partner

10. Please select the most important Strategy of the Category: 9 Technical integration

- 9a Technology integration - Standardization
- 9b Use of systems for collaborative cooperation (ERP, CDSS)
- 9c Utilization of technology in contracts (e.g., blockchain)

11. Please select the most important Strategy of the Category: 10 Sustainability

- 10a Accurate comprehensive measures for sustainability
- 10b Collaborative communication for sustainability
- 10c Design for sustainability

12. Please rank the strategies referred to the two most recognised barriers for HC (Costs reduction, Technological advances or innovative tools)

- Industry-university partnerships
- Joint knowledge creation
- Open information sharing culture
- Continuous collaboration culture improvement
- Supply chain education and training
- Costs/benefits allocation mechanism
- Fair profit sharing
- Collaborative planning across the supply chain

13. Please rank the strategies referred to the two most recognised barriers for VC (Minimize delivery times, Better use of assets and resources)

- Cross-functional collaboration
- Effective use of pilot projects
- Technology integration – Standardization
- Use of systems for collaborative cooperation (ERP, CDSS)
- Industry-university partnerships
- Joint knowledge creation
- Open information sharing culture
- Continuous collaboration culture improvement
- Supply chain education and training
- Effective use of pilot projects

14. Please rank from the most to the least important the following based on the Impact expectations you have from a Marketplace

- Supply Chain Optimization
- Organizational Performance

- Automation
- Market
- Sustainability
- Collaboration

15. Please select the five most important Impact Areas that you expect from the Admiral Marketplace

- Costs reduction
- Emissions reduction/Carbon footprint
- Process optimization
- Times reduction
- Administrative optimization
- Agility
- Planning
- Information sharing
- Service reliability
- Digital alignment
- Customer engagement
- Company image
- Competitiveness
- Joint asset utilization
- Societal effects
- Visibility
- Digitalization
- Supply chain optimization

ANNEX IV Strategies identification survey

Task 3.2 - Workshop 2 questionnaire: Strategies to mitigate barriers and accelerate collaboration in Transport & Logistics

The main aim of the survey is to prioritize the strategies for overcoming the most important barriers impacting vertical and horizontal collaboration in each pilot site.
Please fill in the questionnaire **no later than 20th of August** in order to leave as time to prepare the next steps based on your answers.

* Indicates required question

Co-funded by the European Union

1. Pilot site *

Mark only one oval.

- ◯ Slovenian - Croatian pilot *Skip to question 2*
- ◯ Finnish pilot *Skip to question 12*
- ◯ Portugal - Spain pilot *Skip to question 20*
- ◯ Lithuanian pilot *Skip to question 28*

Slovenian - Croatian pilot Horizontal Collaboration

2. Please rank the strategies reffered to the first recognised barrier for HC: Inadequate cost appraisal *

Mark only one oval per row.

	Costs/benefits allocation mechanism	Fair profit sharing	Collaborative planning across the supply chain
1	◯	◯	◯
2	◯	◯	◯
3	◯	◯	◯

3. Please rank the strategies reffered to the second recognised barrier for HC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

4. Please rank the strategies reffered to the third recognised barrier for HC: Technological incompatibility *

Mark only one oval per row.

	Cross-functional collaboration	Effective use of pilot projects	Technology integration - Standardization	Use of systems for collaborative cooperation (ERP, CDSS)
1	◯	◯	◯	◯
2	◯	◯	◯	◯
3	◯	◯	◯	◯
4	◯	◯	◯	◯

5. Please rank the strategies reffered to the fourth recognised barrier for HC: Resistance of companies to change due to risk aversity *

Mark only one oval per row.

	Resources sharing	Continuous collaboration culture improvement	Cross-trained experienced managers	Managerial and employee support	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

6. Please rank the strategies reffered to the fifth recognised barrier for HC: Lack of trust *

Mark only one oval per row.

	Understanding of the elements that constitute effective collaboration	Anti-competitive laws compliance mechanism	Data privacy	Trust-based alliances	Neutral leadership	Servant leadership & enlightened despotism	Strateg SC vision
1	◯	◯	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯	◯	◯
6	◯	◯	◯	◯	◯	◯	◯
7	◯	◯	◯	◯	◯	◯	◯
8	◯	◯	◯	◯	◯	◯	◯
9	◯	◯	◯	◯	◯	◯	◯

Slovenian - Croatian pilot Vertical Collaboration

7. Please rank the strategies reffered to the first recognised barrier for VC: Inadequate cost appraisal *

Mark only one oval per row.

	Costs/benefits allocation mechanism	Fair profit sharing	Collaborative planning across the supply chain
1	◯	◯	◯
2	◯	◯	◯
3	◯	◯	◯

8. Please rank the strategies reffered to the second recognised barrier for VC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

9. Please rank the strategies reffered to the third recognised barrier for VC: Unequal distribution of power and information sharing among partners *

Mark only one oval per row.

	Co-create with end-consumers	Early supplier and customer involvement	Joint product development	Joint knowledge creation	Open information sharing culture	Centralized decision-making for effectiveness
1	◯	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯	◯
6	◯	◯	◯	◯	◯	◯
7	◯	◯	◯	◯	◯	◯
8	◯	◯	◯	◯	◯	◯
9	◯	◯	◯	◯	◯	◯
10	◯	◯	◯	◯	◯	◯

10. Please rank the strategies reffered to the fourth recognised barrier for VC: Resistance of companies to change due to risk aversity *

Mark only one oval per row.

	Resources sharing	Continuous collaboration culture improvement	Cross-trained experienced managers	Managerial and employee support	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

11. Please rank the strategies reffered to the fifth recognised barrier for VC: Customer demand challenges *

Mark only one oval per row.

	Co-create with end-consumers	Early supplier and customer involvement	Effective use of pilot projects	Joint knowledge creation	Design for sustainability
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

Finnish pilot Horizontal Collaboration

12. Please rank the strategies reffered to the first recognised barrier for HC: Inadequate cost appraisal *

Mark only one oval per row.

	Costs/benefits allocation mechanism	Fair profit sharing	Collaborative planning across the supply chain
1	◯	◯	◯
2	◯	◯	◯
3	◯	◯	◯

13. Please rank the strategies reffered to the second recognised barrier for HC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

14. Please rank the strategies reffered to the third recognised barrier for HC: Lack of systems standardization *

Mark only one oval per row.

	Cross-functional collaboration	Effective use of pilot projects	Technology integration - Standardization	Use of systems for collaborative cooperation (ERP, CDSS)
1	◯	◯	◯	◯
2	◯	◯	◯	◯
3	◯	◯	◯	◯
4	◯	◯	◯	◯

15. Please rank the strategies reffered to the fourth recognised barrier for HC: Lack of clear operational goals and outcomes

Mark only one oval per row.

	Cross-functional collaboration	Joint product development	Multi-tier perspectives	Open innovation	Incentive alignment	Supplier alignment and rationalization
1	◯	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯	◯
6	◯	◯	◯	◯	◯	◯
7	◯	◯	◯	◯	◯	◯
8	◯	◯	◯	◯	◯	◯

Skip to question 16

Finnish pilot Vertical Collaboration

16. Please rank the strategies reffered to the first recognised barrier for VC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

17. Please rank the strategies reffered to the second recognised barrier for VC: Inadequate cost appraisal *

Mark only one oval per row.

	Costs/benefits allocation mechanism	Fair profit sharing	Collaborative planning across the supply chain
1	◯	◯	◯
2	◯	◯	◯
3	◯	◯	◯

18. Please rank the strategies reffered to the third recognised barrier for VC: Lack of systems standardization *

Mark only one oval per row.

	Cross-functional collaboration	Effective use of pilot projects	Technology integration - Standardization	Use of systems for collaborative cooperation (ERP, CDSS)
1	◯	◯	◯	◯
2	◯	◯	◯	◯
3	◯	◯	◯	◯
4	◯	◯	◯	◯

19. Please rank the strategies reffered to the fourth recognised barrier for VC: Unequal distribution of power and information sharing among partners

Mark only one oval per row.

	Co-create with end-consumers	Early supplier and customer involvement	Joint product development	Joint knowledge creation	Open information sharing culture	Centralized decision-making for effectiveness
1	◯	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯	◯
6	◯	◯	◯	◯	◯	◯
7	◯	◯	◯	◯	◯	◯
8	◯	◯	◯	◯	◯	◯
9	◯	◯	◯	◯	◯	◯
10	◯	◯	◯	◯	◯	◯

Portugal - Spain pilot Horizontal Collaboration

20. Please rank the strategies reffered to the first recognised barrier for HC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

21. Please rank the strategies reffered to the second recognised barrier for HC: Resistance of companies to change due to risk aversity *

Mark only one oval per row.

	Resources sharing	Continuous collaboration culture improvement	Cross-trained experienced managers	Managerial and employee support	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

22. Please rank the strategies reffered to the third recognised barrier for HC: Individual competitive advantage protection *

Mark only one oval per row.

	Co-create with end-consumers	Effective use of pilot projects	Anti-competitive laws compliance mechanism	Data privacy	Trust-based alliances
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

23. Please rank the strategies reffered to the fourth recognised barrier for HC: Unequal distribution of power and information sharing among partners

Mark only one oval per row.

	Co-create with end-consumers	Early supplier and customer involvement	Joint product development	Joint knowledge creation	Open information sharing culture	Centralized decision-making for effectiveness
1	◯	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯	◯
6	◯	◯	◯	◯	◯	◯
7	◯	◯	◯	◯	◯	◯
8	◯	◯	◯	◯	◯	◯
9	◯	◯	◯	◯	◯	◯
10	◯	◯	◯	◯	◯	◯

Skip to question 24

Portugal - Spain pilot Vertical Collaboration

24. Please rank the strategies reffered to the first recognised barrier for VC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

25. Please rank the strategies reffered to the second recognised barrier for VC: Resistance of companies to change due to risk aversity *

Mark only one oval per row.

	Resources sharing	Continuous collaboration culture improvement	Cross-trained experienced managers	Managerial and employee support	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

26. Please rank the strategies reffered to the third recognised barrier for VC: Inadequate cost appraisal *

Mark only one oval per row.

	Costs/benefits allocation mechanism	Fair profit sharing	Collaborative planning across the supply chain
1	◯	◯	◯
2	◯	◯	◯
3	◯	◯	◯

27. Please rank the strategies reffered to the fourth recognised barrier for VC: Individual competitive advantage protection *

Mark only one oval per row.

	Co-create with end-consumers	Effective use of pilot projects	Anti-competitive laws compliance mechanism	Data privacy	Trust-based alliances
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

Lithuanian pilot Horizontal Collaboration

28. Please rank the strategies reffered to the first recognised barrier for HC: Unequal distribution of power and information sharing among partners

Mark only one oval per row.

	Co-create with end-consumers	Early supplier and customer involvement	Joint product development	Joint knowledge creation	Open information sharing culture	Centralized decision-making for effectiveness
1	◯	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯	◯
6	◯	◯	◯	◯	◯	◯
7	◯	◯	◯	◯	◯	◯
8	◯	◯	◯	◯	◯	◯
9	◯	◯	◯	◯	◯	◯
10	◯	◯	◯	◯	◯	◯

29. Please rank the strategies reffered to the second recognised barrier for HC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1					
2					
3					
4					
5					

30. Please rank the strategies reffered to the third recognised barrier for HC: Lack of Commitment

Mark only one oval per row.

	Centralized decision-making for effectiveness	Clearly defined entry and exit rules/setting limits	Using chain advisory councils	Incentive alignment	Ownership clarity	Cooperation feedback ratings	[dili pa sel
1							
2							
3							
4							
5							
6							
7							
8							

31. Please rank the strategies reffered to the fourth recognised barrier for HC: Conflict over differing needs between partners

Mark only one oval per row.

	Incentive alignment	Ownership clarity	Strategic alignment around joint objectives	Supplier alignment and rationalization	Due diligence in partner selection	Prior collaborative history with a partner	con me su
1							
2							
3							
4							
5							
6							
7							
8							
9							

Skip to question 32

Lithuanian pilot Vertical Collaboration

32. Please rank the strategies reffered to the first recognised barrier for VC: Resistance to information sharing *

Mark only one oval per row.

	Industry-university partnerships	Joint knowledge creation	Open information sharing culture	Continuous collaboration culture improvement	Supply chain education and training
1	◯	◯	◯	◯	◯
2	◯	◯	◯	◯	◯
3	◯	◯	◯	◯	◯
4	◯	◯	◯	◯	◯
5	◯	◯	◯	◯	◯

33. Please rank the strategies reffered to the second recognised barrier for VC: Unequal distribution of power and information sharing among partners

Mark only one oval per row.

	Co-create with end-consumers	Early supplier and customer involvement	Joint product development	Joint knowledge creation	Open information sharing culture	Centralized decision-making for effectiveness
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

34. Please rank the strategies reffered to the third recognised barrier for VC: Inadequate cost appraisal *

Mark only one oval per row.

	Costs/benefits allocation mechanism	Fair profit sharing	Collaborative planning across the supply chain
1			
2			
3			

ANNEX V Hierarchies of Barriers and Drivers

AHP – HC barriers hierarchy with weights at the first and second levels and total weights

HC Barriers 1. level	1.Level weights	HC Barriers 2. level	2.Level weights	Total weights
1 Technology and Innovation	0.034	Lack of systems standardisation	0.635	0.021
		Technological incompatibility	0.238	0.008
		Knowledge and innovation asymmetry	0.084	0.003
		Lack of Skills. knowledge. training	0.043	0.001
		CR		0.261
2 Economic and efficiency	0.247	Inadequate cost appraisal	1.000	0.247
		CR		0
3 Governance and regulation	0.146	Lack of clear operational goals and outcomes	0.188	0.028
		Lack of governance planning	0.097	0.014
		Inconsistency in performance measurement	0.037	0.005
		Lack of intellectual property protection	0.045	0.007
		Lack of trust	0.103	0.015
		Cultural and language difficulties	0.015	0.002
		Conflict over differing needs between partners	0.056	0.008
		Complex legislation and regulation compliance	0.137	0.020
		Lack of Commitment	0.322	0.047
		CR		0.263
4 Market and business model	0.072	Resistance of companies to change due to risk aversity	0.637	0.046
		Individual competitive advantage protection	0.190	0.014
		Customer demand challenges	0.042	0.003
		Disparate operational practices and routines	0.131	0.010
		CR		0.520
5 Information sharing	0.501	Resistance to information sharing	0.900	0.451
		Unequal distribution of power and information sharing among partners	0.100	0.050
		CR		0
CR	0.479			

HC barriers final priority ranking, based on overall repsonses

1.Level	2.Level	Final Ranking
5 Information sharing	Resistance to information sharing	0.451
2 Economic and efficiency	Inadequate cost appraisal	0.247
5 Information sharing	Unequal distribution of power and information sharing among partners	0.050
3 Governance and regulation	Lack of Commitment	0.047
4 Market and business model	Resistance of companies to change due to risk adversity	0.046
3 Governance and regulation	Lack of clear operational goals and outcomes	0.028

1.Level	2.Level	Final Ranking
1 Technology and Innovation	Lack of systems standardisation	0.021
3 Governance and regulation	Complex legislation and regulation compliance	0.020
3 Governance and regulation	Lack of trust	0.015
3 Governance and regulation	Lack of governance planning	0.014
4 Market and business model	Individual competitive advantage protection	0.014
4 Market and business model	Disparate operational practices and routines	0.010
3 Governance and regulation	Conflict over differing needs between partners	0.008
1 Technology and Innovation	Technological incompatibility	0.008
3 Governance and regulation	Lack of intellectual property protection	0.007
3 Governance and regulation	Inconsistency in performance measurement	0.005
4 Market and business model	Customer demand challenges	0.003
1 Technology and Innovation	Knowledge and innovation asymmetry	0.003
3 Governance and regulation	Cultural and language difficulties	0.002
1 Technology and Innovation	Lack of Skills, knowledge, training	0.001

VC barriers hierarchy with weights at the first and second levels and total weights

VC Barriers 1. level	1.Level weights	VC Barriers 2. level	2.Level weights	Total weights
1 Technology and Innovation	0.120	Lack of systems standardization	0.621	0.075
		Technological incompatibility	0.202	0.024
		Knowledge and innovation asymmetry	0.132	0.016
		Lack of Skills. knowledge. training	0.045	0.005
		CR		0.512
2 Economic and efficiency	0.191	Inadequate cost appraisal	1.000	0.191
	CR		0	
3 Governance and regulation	0.033	Lack of clear operational goals and outcomes	0.212	0.007
		Lack of governance planning	0.071	0.002
		Inconsistency in performance measurement	0.066	0.002
		Lack of intellectual property protection	0.024	0.001
		Lack of trust	0.177	0.006
		Cultural and language difficulties	0.017	0.001
		Conflict over differing needs between partners	0.114	0.004
		Complex legislation and regulation compliance	0.106	0.003
		Lack of Commitment	0.212	0.007
		CR		0.337
4 Market and business model	0.081	Resistance of companies to change due to risk aversity	0.197	0.016
		Individual competitive advantage protection	0.116	0.009
		Customer demand challenges	0.056	0.005
		Disparate operational practices and routines	0.630	0.051
		CR		0.558
5 Information sharing	0.576	Resistance to information sharing	0.900	0.518
		Unequal distribution of power and information sharing among partners	0.100	0.058

VC Barriers 1. level	1.Level weights	VC Barriers 2. level	2.Level weights	Total weights
		CR		0
CR	0.278			

VC barriers final priority ranking, based on the overall responses

1.Level	2.Level	Final Ranking
5 Information sharing	Resistance to information sharing	0.518
2 Economic and efficiency	Inadequate cost appraisal	0.191
1 Technology and Innovation	Lack of systems standardization	0.075
5 Information sharing	Unequal distribution of power and information sharing among partners	0.058
4 Market and business model	Disparate operational practices and routines	0.051
1 Technology and Innovation	Technological incompatibility	0.024
4 Market and business model	Resistance of companies to change due to risk aversity	0.016
1 Technology and Innovation	Knowledge and innovation asymmetry	0.016
4 Market and business model	Individual competitive advantage protection	0.009
3 Governance and regulation	Lack of clear operational goals and outcomes	0.007
3 Governance and regulation	Lack of Commitment	0.007
3 Governance and regulation	Lack of trust	0.006
1 Technology and Innovation	Lack of Skills. knowledge. training	0.005
4 Market and business model	Customer demand challenges	0.005
3 Governance and regulation	Conflict over differing needs between partners	0.004
3 Governance and regulation	Complex legislation and regulation compliance	0.003
3 Governance and regulation	Lack of governance planning	0.002
3 Governance and regulation	Inconsistency in performance measurement	0.002
3 Governance and regulation	Lack of intellectual property protection	0.001
3 Governance and regulation	Cultural and language difficulties	0.001

AHP – HC drivers hierarchy with weights at the first and second levels and total weights

HC Drivers 1. level	1.Level weights	HC Drivers 2. level	2.Level weights	Total weights
1 Technology and Innovation	0.064	Technological advances or innovative tools	0.642	0.041
		Ability to foster innovation	0.068	0.004
		Access to expertise and knowledge	0.291	0.019
		CR		0.7
2 Economic and efficiency	0.557	Costs reduction	0.088	0.049
		Minimize delivery times	0.088	0.049
		Better use of assets and resources	0.071	0.039
		Improve operational efficiency and productivity	0.247	0.138
		Increased revenues	0.469	0.261
		Access to resources	0.037	0.02
		CR		0.329
3 Governance and regulation	0.225	Regulation and Legislation compliance	0.777	0.175

		Sustainability requirements (e.g. ESG. etc.)	0.155	0.035
		Faster conflict resolution	0.069	0.015
		CR		0.148
4 Market and business model	0.035	Increased customer demand and satisfaction	0.626	0.022
		Better market global positioning Competition	0.043	0.001
		Reliability/Resilience	0.249	0.009
		Developing strategic synergies	0.082	0.003
		CR		0.299
5 Sustainability	0.119	Reduce environmental impacts	0.9	0.107
		Ensuring social welfare	0.1	0.012
		CR		0
CR	0.298			

HC drivers final priority ranking. Based on the overall responses

1.Level	2.Level	Final Ranking
2 Economic and efficiency	Increased revenues	0.261
3 Governance and regulation	Regulation and Legislation compliance	0.175
2 Economic and efficiency	Improve operational efficiency and productivity	0.138
5 Sustainability	Reduce environmental impacts	0.107
2 Economic and efficiency	Costs reduction	0.049
2 Economic and efficiency	Minimize delivery times	0.049
1 Technology and Innovation	Technological advances or innovative tools	0.041
2 Economic and efficiency	Better use of assets and resources	0.039
3 Governance and regulation	Sustainability requirements (e.g. ESG, etc.)	0.035
4 Market and business model	Increased customer demand and satisfaction	0.022
2 Economic and efficiency	Access to resources	0.020
1 Technology and Innovation	Access to expertise and knowledge	0.019
3 Governance and regulation	Faster conflict resolution	0.015
5 Sustainability	Ensuring social welfare	0.012
4 Market and business model	Reliability/Resilience	0.009
1 Technology and Innovation	Ability to foster innovation	0.004
4 Market and business model	Developing strategic synergies	0.003
4 Market and business model	Better market global positioning Competition	0.001

AHP – VC drivers hierarchy with weights at the first and second levels and total weights.

VC Drivers 1. level	1.Level weights	VC Drivers 2. level	2.Level weights	Total weights
1 Technology and Innovation	0.085	Technological advances or innovative tools	0.684	0.058
		Ability to foster innovation	0.255	0.022
		Access to expertise and knowledge	0.061	0.005
		CR		0.938
2 Economic and efficiency	0.551	Costs reduction	0.104	0.057
		Minimize delivery times	0.22	0.121
		Better use of assets and resources	0.285	0.157

		Improve operational efficiency and productivity	0.285	0.157
		Increased revenues	0.077	0.042
		Access to resources	0.029	0.016
		CR		0.191
3 Governance and regulation	0.2	Regulation and Legislation compliance	0.76	0.152
		Sustainability requirements (e.g. ESG. etc.)	0.181	0.036
		Faster conflict resolution	0.059	0.012
		CR		0.472
4 Market and business model	0.132	Increased customer demand and satisfaction	0.659	0.087
		Better market global positioning Competition	0.042	0.006
		Reliability/Resilience	0.15	0.02
		Developing strategic synergies	0.15	0.02
		CR		0.069
5 Sustainability	0.033	Reduce environmental impacts	0.9	0.03
		Ensuring social welfare	0.1	0.003
		CR		0
CR	0.357			

VC drivers final priority ranking, based on the overall responses

1.Level	2.Level	Final Ranking
2 Economic and efficiency	Better use of assets and resources	0.157
2 Economic and efficiency	Improve operational efficiency and productivity	0.157
3 Governance and regulation	Regulation and Legislation compliance	0.152
2 Economic and efficiency	Minimize delivery times	0.121
4 Market and business model	Increased customer demand and satisfaction	0.087
1 Technology and Innovation	Technological advances or innovative tools	0.058
2 Economic and efficiency	Costs reduction	0.057
2 Economic and efficiency	Increased revenues	0.042
3 Governance and regulation	Sustainability requirements (e.g. ESG. etc.)	0.036
5 Sustainability	Reduce environmental impacts	0.030
1 Technology and Innovation	Ability to foster innovation	0.022
4 Market and business model	Reliability/Resilience	0.020
4 Market and business model	Developing strategic synergies	0.020
2 Economic and efficiency	Access to resources	0.016
3 Governance and regulation	Faster conflict resolution	0.012
4 Market and business model	Better market global positioning Competition	0.006
1 Technology and Innovation	Access to expertise and knowledge	0.005
5 Sustainability	Ensuring social welfare	0.003

HC barriers ranking per pilot

		1 (Slovenian-Croatian pilot.)	2 (Finnish pilot.)	3 (Portugal - Spain pilot.)	4 (Lithuanian pilot.)
1 Technology and Innovation	Lack of systems standardisation	0.040	0.070	0.044	0.089
	Technological incompatibility	0.065	0.004	0.016	0.016
	Knowledge and innovation asymmetry	0.005	0.004	0.007	0.032
	Lack of Skills, knowledge, training	0.011	0.004	0.003	0.007
2 Economic and efficiency	Inadequate cost appraisal	0.533	0.207	0.027	0.081
3 Governance and regulation	Lack of clear operational goals and outcomes	0.012	0.046	0.011	0.085
	Lack of governance planning	0.007	0.002	0.006	0.044
	Inconsistency in performance measurement	0.006	0.010	0.008	0.044
	Lack of intellectual property protection	0.002	0.006	0.011	0.012
	Lack of trust	0.024	0.010	0.040	0.018
	Cultural and language difficulties	0.001	0.002	0.002	0.018
	Conflict over differing needs between partners	0.004	0.016	0.004	0.119
	Complex legislation and regulation compliance	0.007	0.016	0.011	0.034
	Lack of Commitment	0.014	0.027	0.032	0.119
4 Market and business model	Resistance of companies to change due to risk aversion	0.024	0.007	0.160	0.011
	Individual competitive advantage protection	0.001	0.017	0.065	0.001
	Customer demand challenges	0.001	0.001	0.039	0.011
	Disparate operational practices and routines	0.001	0.001	0.010	0.001
5 Information sharing	Resistance to information sharing	0.215	0.496	0.455	0.129
	Unequal distribution of power and information sharing among partners	0.024	0.055	0.051	0.129

HC drivers ranking per pilot

		1 (Slovenian-Croatian pilot.)	2 (Finnish pilot.)	3 (Portugal - Spain pilot.)	4 (Lithuanian pilot.)
1 Technology and Innovation	Technological advances or innovative tools	0.014	0.002	0.025	0.168
	Ability to foster innovation	0.014	0.002	0.009	0.168
	Access to expertise and knowledge	0.194	0.023	0.002	0.168
2 Economic and efficiency	Costs reduction	0.014	0.087	0.050	0.001
	Minimize delivery times	0.014	0.012	0.146	0.001
	Better use of assets and resources	0.080	0.049	0.146	0.007
	Improve operational efficiency and productivity	0.236	0.012	0.090	0.007
	Increased revenues	0.164	0.087	0.016	0.001
	Access to resources	0.053	0.012	0.016	0.007
3 Governance and regulation	Regulation and Legislation compliance	0.019	0.381	0.138	0.185
	Sustainability requirements (e.g. ESG. etc.)	0.007	0.092	0.033	0.055
	Faster conflict resolution	0.002	0.032	0.011	0.016
4 Market and business model	Increased customer demand and satisfaction	0.033	0.038	0.024	0.047
	Better market global positioning Competition	0.013	0.009	0.005	0.009
	Reliability/Resilience	0.064	0.019	0.012	0.003
	Developing strategic synergies	0.005	0.003	0.024	0.009
5 Sustainability	Reduce environmental impacts	0.067	0.127	0.227	0.130
	Ensuring social welfare	0.007	0.014	0.025	0.014

VC barriers ranking per pilot

		1 (Slovenian - Croatian pilot.)	2 (Finnish pilot.)	3 (Portugal - Spain pilot.)	4 (Lithuanian pilot.)
1 Technology and Innovation	Lack of systems standardisation	0.027	0.136	0.039	0.079
	Technological incompatibility	0.027	0.007	0.002	0.079
	Knowledge and innovation asymmetry	0.004	0.007	0.002	0.079

	Lack of Skills, knowledge, training	0.010	0.007	0.002	0.022
2 Economic and efficiency	Inadequate cost appraisal	0.258	0.158	0.182	0.081
3 Governance and regulation	Lack of clear operational goals and outcomes	0.007	0.002	0.006	0.022
	Lack of governance planning	0.001	0.001	0.004	0.022
	Inconsistency in performance measurement	0.003	0.002	0.004	0.007
	Lack of intellectual property protection	0.001	0.001	0.003	0.004
	Lack of trust	0.007	0.002	0.010	0.013
	Cultural and language difficulties	0.001	0.001	0.001	0.002
	Conflict over differing needs between partners	0.003	0.013	0.001	0.013
	Complex legislation and regulation compliance	0.001	0.002	0.001	0.052
	Lack of Commitment	0.003	0.002	0.016	0.007
4 Market and business model	Resistance of companies to change due to risk adversity	0.062	0.001	0.204	0.003
	Individual competitive advantage protection	0.008	0.001	0.102	0.003
	Customer demand challenges	0.062	0.016	0.015	0.001
	Disparate operational practices and routines	0.008	0.010	0.043	0.017
5 Information sharing	Resistance to information sharing	0.252	0.565	0.327	0.246
	Unequal distribution of power and information sharing among partners	0.252	0.063	0.036	0.246

VC drivers ranking per pilot

		1 (Slovenian - Croatian pilot.)	**2 (Finnish pilot.)**	**3 (Portugal - Spain pilot.)**	**4 (Lithuanian pilot.)**
1 Technology and Innovation	Technological advances or innovative tools	0.071	0.014	0.012	0.367
	Ability to foster innovation	0.005	0.014	0.002	0.026
	Access to expertise and knowledge	0.005	0.003	0.012	0.112
2 Economic and efficiency	Costs reduction	0.036	0.054	0.056	0.003
	Minimize delivery times	0.120	0.025	0.056	0.007
	Better use of assets and resources	0.120	0.054	0.056	0.007

		1 (Slovenian - Croatian pilot.)	2 (Finnish pilot.)	3 (Portugal - Spain pilot.)	4 (Lithuanian pilot.)
	Improve operational efficiency and productivity	0.120	0.054	0.056	0.007
	Increased revenues	0.120	0.054	0.017	0.001
	Access to resources	0.036	0.017	0.017	0.002
3 Governance and regulation	Regulation and Legislation compliance	0.012	0.353	0.105	0.186
	Sustainability requirements (e.g. ESG. etc.)	0.002	0.104	0.032	0.013
	Faster conflict resolution	0.012	0.028	0.007	0.056
4 Market and business model	Increased customer demand and satisfaction	0.116	0.052	0.187	0.003
	Better market global positioning Competition	0.058	0.011	0.187	0.003
	Reliability/Resilience	0.024	0.052	0.093	0.003
	Developing strategic synergies	0.008	0.026	0.038	0.060
5 Sustainability	Reduce environmental impacts	0.121	0.077	0.063	0.130
	Ensuring social welfare	0.013	0.009	0.007	0.014

ANNEX VI Ranking of Strategies per Pilot Site

1. Slovenian - Croatian pilot

Ranking of strategies to overcome HC & VC barriers by the Slovenian-Croatian pilot

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
Inadequate cost appraisal	1. Collaborative planning across the supply chain 2. Costs/benefits allocation mechanism - Fair profit sharing	1. Fair profit sharing 2. Costs/benefits allocation mechanism 3. Collaborative planning across the supply chain
Resistance to information sharing	1. Open information sharing culture 2. Continuous collaboration culture improvement 3. Joint knowledge creation 4. Supply chain education and training 5. Industry-university partnerships	1. Open information sharing culture 2. Continuous collaboration culture improvement 3. Joint knowledge creation 4. Supply chain education and training 5. Industry-university partnerships
Technological incompatibility	1. Technology integration – standardisation 2. Use of systems for collaborative cooperation 3. Cross-functional collaboration 4. Effective use of pilot projects	N/A
Unequal distribution of power and information sharing among partners	N/A	1. Open information sharing culture 2. Co-create with end-consumers 3. Early supplier and customer involvement 4. Joint product development 5. Centralized decision-making for effectiveness 6. Joint knowledge creation 7. Neutral leadership 8. Command-and-control-based relationships 9. Using chain advisory councils 10. Servant leadership & enlightened despotism
Resistance of companies to change due to risk aversion	1. Resources sharing 2. Continuous collaboration culture improvement 3. Managerial and employee support 4. Supply chain education and training 5. Cross-trained experienced managers	1. Continuous collaboration culture improvement 2. Managerial and employee support 3. Resources sharing 4. Cross-trained experienced managers 5. Supply chain education and training
Lack of trust	1. Data privacy 2. Trust-based alliances 3. Anti-competitive laws compliance mechanism 4. Understanding of the elements that constitute effective collaboration 5. Neutral leadership 6. Servant leadership & enlightened	N/A

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
	despotism 7. Strategic SC vision 8. Using chain advisory councils 9. Prior collaborative history with a partner	
Customer demand challenges		1. Joint knowledge creation 2. Early supplier and customer involvement 3. Effective use of pilot projects 4. Co-create with end consumers 5. Design for sustainability

2. Finnish pilot

Ranking of strategies to overcome HC & VC barriers by the Finish pilot

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
Inadequate cost appraisal	1. Costs/benefits allocation mechanism 2. Fair profit sharing 3. Collaborative planning across the supply chain	1. Costs/benefits allocation mechanism 2. Fair profit sharing 3. Collaborative planning across the supply chain
Resistance to information sharing	1. Continuous collaboration culture improvement 2. Joint knowledge creation 3. Open information sharing culture 4. Industry-university partnerships 5. Supply chain education and training	1. Open information sharing culture 1. Continuous collaboration culture improvement 2. Industry-university partnerships 3. Joint knowledge creation 4. Supply chain education and training
Lack of systems standardization	1. Cross-functional collaboration 2. Technology integration – standardisation 3. Use of systems for collaborative cooperation 4. Effective use of pilot projects	1. Technology integration – standardisation 2. Use of systems for collaborative cooperation 3. Cross-functional collaboration 4. Effective use of pilot projects
Lack of clear operational goals and outcomes	1. Supplier alignment and rationalization 2. Multi-tier perspectives 3. Joint product development 4. Incentive alignment 5. Process documentation 6. Process integration 7. Cross-functional collaboration 8. Open innovation	N/A
Unequal distribution of power and information sharing among partners	N/A	1. Open information sharing culture 2. Co-create with end-consumers 3. Joint knowledge creation 4. Joint product development 5. Early supplier and customer involvement

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
		6. Centralized decision-making for effectiveness 7. Neutral leadership 8. Command-and-control-based relationships 9. Servant leadership & enlightened despotism 10. Using chain advisory councils

3. Portugal – Spain pilot

Ranking of strategies to overcome HC & VC barriers by the Portugal – Spain pilot

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
Resistance to information sharing	1. Joint knowledge creation 2. Open information sharing culture 3. Continuous collaboration culture improvement 4. Industry-university partnerships Supply chain education and training	1. Joint knowledge creation 2. Continuous collaboration culture improvement 3. Open information sharing culture 4. Industry-university partnerships Supply chain education and training
Resistance of companies to change due to risk aversion	1. Resources sharing 2. Cross-trained experienced managers 3. Continuous collaboration culture improvement 4. Managerial and employee support 5. Supply chain education and training	1. Resources sharing 2. Cross-trained experienced managers 3. Managerial and employee support 4. Continuous collaboration culture improvement 5. Supply chain education and training
Individual competitive advantage protection	1. Trust-based alliances 2. Effective use of pilot projects 3. Co-create with end consumers 4. Anti-competitive laws compliance mechanism Data privacy	1. Trust-based alliances 2. Anti-competitive laws compliance mechanism 3. Effective use of pilot projects 4. Co-create with end consumers Data privacy
Unequal distribution of power and information sharing among partners	1. Open information sharing culture 2. Early supplier and customer involvement 3. Joint knowledge creation 4. Co-create with end-consumers 5. Joint product development 6. Centralized decision-making for effectiveness 7. Neutral leadership 8. Command-and-control-based relationships 9. Servant leadership & enlightened despotism Using chain advisory councils	N/A

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
Inadequate cost appraisal	N/A	1. Collaborative planning across the supply chain 2. Fair profit sharing Costs/benefits allocation mechanism

4. Lithuanian pilot

Ranking of strategies to overcome HC & VC barriers by the Lithuanian pilot

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
Resistance to information sharing	1. Joint knowledge creation 2. Open information sharing culture 3. Industry-university partnerships 4. Supply chain education and training 5. Continuous collaboration culture improvement	1. Open information sharing culture 2. Industry-university partnerships 3. Joint knowledge creation 4. Supply chain education and training 5. Continuous collaboration culture improvement
Lack of Commitment	1. Ownership clarity 2. Prior collaborative history with a partner 3. Centralized decision-making for effectiveness 4. Using chain advisory councils 5. Incentive alignment 6. Clearly defined entry and exit rules/setting limits 7. Due diligence in partner selection 8. Cooperation feedback ratings	N/A
Conflict over differing needs between partners	1. Ownership clarity 2. Strategic alignment around joint objectives 3. Incentive alignment 4. Supplier alignment and rationalization 5. Collaborative communication for sustainability 6. Due diligence in partner selection 7. Design for sustainability 8. Prior collaborative history with a partner 9. Accurate comprehensive measures for sustainability	N/A
Unequal distribution of power and information sharing among partners	1. Joint product development 2. Open information sharing culture 3. Early supplier and customer involvement 4. Using chain advisory councils 5. Centralized decision-making for effectiveness 6. Co-create with end-consumers	1. Co-create with end-consumers 2. Early supplier and customer involvement 3. Open information sharing culture 4. Centralized decision-making for effectiveness 5. Using chain advisory councils 6. Joint knowledge creation

	HORIZONTAL COLLABORATION	VERTICAL COLLABORATION
Most significant barriers	**Ranking of Strategies**	**Ranking of Strategies**
	7. Servant leadership & enlightened despotism 8. Joint knowledge creation 9. Neutral leadership 10. Command-and-control-based relationships	7. Joint product development 8. Neutral leadership 9. Command-and-control-based relationships 10. Servant leadership & enlightened despotism
Inadequate cost appraisal	N/A	1. Costs/benefits allocation mechanism 2. Collaborative planning across the supply chain 3. Fair profit sharing