Deliverable 3.1 (V1.0)

Horizontal collaboration business models

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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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Content

Abbreviations **5**

Executive Summary **7**

1 Introduction **8**
1.1 Methodologies 8

2 Horizontal collaboration **11**
2.1 Introduction to collaborative business models 11
1.2 Horizontal collaboration models 12
1.3 Platform ecosystem-based approach 15

3 Awake.AI's platform and ADMIRAL marketplace **16**
2.1 Background 16
2.2 Awake.AI's Marketplace - current state 17
2.3 Next steps in ADMIRAL project 19
2.4 Competitors analysis 20

4 Horizontal collaboration models in other industry sectors **22**
3.1 Infrastructure sharing in mobile telecommunication 22
3.2 Global Distribution Systems in airline industry 26
3.3 AMEX GBT Neo travel platform integrates carbon emissions 31

5 Horizontal collaboration in transport and logistics **35**
4.1 Overview of horizontal collaboration models in transport and logistics 35
4.1.1 Alliances (example: shipping alliances) 37
4.1.2 Joint ventures (example: tramp shipping pools) 39
4.1.3 Associations (example: ports) 39
4.1.4 Single carrier collaboration 40
4.1.5 Transport marketplace 40
4.1.6 Shipper or logistics service provider collaboration 40
4.1.7 Logistics pooling 41
4.1.8 Physical internet 41
4.1.9 On-demand logistics 42
4.2 Real case examples of business models in transport and logistics 42
4.2.1 Load carrier sharing in transports 42
4.2.2 Digital solution for shipping value chain – Case Tradelens 46
4.2.3 Transport sharing between Procter & Gamble and Tupperware 51
4.2.4 Europe's first Smart Logistics System – TIMOCOM 54
4.2.5 B2B containers exchange digital platform - XChange 59
4.2.6 Freight consolidation network - System Alliance Europe 62
4.2.7 DHB-logistiek freight consolidation network 65
4.2.8 Warehouse space management and optimization 67
4.2.9 Vehicles capacity utilization in urban logistics 70

4.2.10 Federated architecture for data sharing in transport & logistics 73
4.2.11 Shared urban consolidation micro-hubs 77
4.2.12 Cargo Owners for Zero Emission Vessels (coZEV) 79

Summary and key conclusions to ADMIRAL development 82

References 85

List of Figures

Figure 1. Horizontal collaboration model (Jesus Saenz et al., 2015) 12
Figure 2. Most important barriers to HC (Schamschula et al., 2022) 15
Figure 3. AWAKE.AI's marketplace stakeholders (current state) 18
Figure 4. AWAKE.AI's marketplace platform canvas (current state) 19
Figure 5. Mobile network sharing options (Frisanco et al, 2008) 24
Figure 6. Suppliers GDSs distribution channels (Vinod, 2009). 29
Figure 7. Business network diagram of the airline reservation system with emissions calculation service. 33
Figure 8. Desired outcomes of transport process redesign or HC (Schamschula et al., 2022) 35
Figure 9. Ally decision framework (Martin et al., 2018) 36
Figure 10. Main incentives for carriers to be involved in the alliance (Notteboom et al., 2022) 37
Figure 11. Market shares in container shipping (Choi, 2023) 38
Figure 12. Examples of returnable load carriers. 43
Figure 13. Ekopullo pooling concept for beverage packages. 45
Figure 14. TradeLens Architecture (Source: IBM). 47
Figure 15. Timeline of TradeLens development path (Jensen et al, 2019). 48
Figure 16. Tradelense stakeholder diagram. 48
Figure 17. Procter & Gamble and Tupperware stakeholder diagram. 52
Figure 18. TIMOCOM stakeholder diagram. 56
Figure 19. The FENIX pilot sites and FENIX Federated Network as multi-stakeholder CBEs 74

List of Tables

Table 1. Classification of horizontal collaboration (Pan, 2017a). 9
Table 2. Drivers or horizontal collaboration as seen by senior executives (Jesus Saenz et al., 2015) .. 13
Table 3. Barriers for horizontal collaboration as seen by senior executives (Jesus Saenz et al., 2015) 14
Table 4. Some competitors for the ADMIRAL marketplace. 20
Table 5. Summary of mobile telecommunication case. 25
Table 6. Airline GDS in the market (Satalkar, 2017). 27

Table 7. Summary of the airline GDS case. 29
Table 8. Summary of travel platform emissions calculation. 33
Table 9. Summary of the shared load carriers case. 45
Table 10. Summary of the Tradelens case. 50
Table 11. Summary of the transport sharing case. 53
Table 12. Summary of the transport marketplace TIMOCOM case. 57
Table 13. Summary of the container exchange platform case. 60
Table 14. Summary of the System Alliance Europe freight consolidation network case. 63
Table 15. Summary of the freight consolidation network case DHB-logistiek. 65
Table 16. Warehouse space management and optimization case summary. 68
Table 17. Vehicles capacity utilization in urban logistics case summary. 71
Table 18. Federated architecture for data sharing in transport & logistics case summary. 74
Table 19. Summary of the shared urban consolidation micro-hub case. 78
Table 20. Cargo Owners for Zero Emission Vessels case summary 80
Table 21. Summary of the cases regarding type of collaboration and key takeaways for ADMIRAL development 82

Abbreviations

AI	Artificial Intelligence
Amex GBT	American Express Global Business Travel
API	Application Programming Interface
ARS	Airline Reservation System
ASTRE	European Carrier Association
CRS	Computer Reservation Systems
3PL	Third Party Logistics
EC	European Commission
BCO	Beneficial Cargo Owner
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ADEME2	The French Agency for Ecological Transition
GDS	Global Distribution System
GSBN	Global Shipping Business Network
HC	Horizontal Collaboration
HCT	Horizontal Collaborative Transport
ICAO	International Civil Aviation Organization

IATA	International Air Transport Association
LCC	Low-Cost Carrier
LSP	Logistics Service Provider
MNO	Mobile Network Operator
MVP	Minimum Viable Product
NDC	New Distribution Capability
PT	Paperless Trade
SC	Supply Chain
SIP	Shipping Information Pipeline
UK BEIS	UK Department for Business, Energy, and Industrial Strategy
US EPA	US Environmental Protection Agency
VC	Vertical collaboration
VFC	Virtual Freight Center
WP	Work Package
WPL	Work Package Leader

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 3.1 - Horizontal collaboration business model State-of-the-Art and reference studies - carried out in the project's work package 3 - Business models for sustainable transports.

Two approaches were used to carry out the studies for this deliverable: literature study to explore the key findings from recent literature and logistics development cases, and a case study with semi-structured interviews to gather data about the Awake.AI's – the ADMIRAL marketplace technology developer - platform development.

One aim for the task was to discover key learnings from the case studies to consider while developing the ADMIRAL marketplace. Following conclusions can be made from the case study findings regarding the governance and business model development:

- In global operations, global standards are essential foundation that enable seamless operations between stakeholders.
- If standards are not available, it is essential to have rules, guidelines and methods that are as broadly accepted as possible by the industry stakeholders.
- Control over the marketplace may have significant impact on the market acceptance of the marketplace. Broad key stakeholder control (e.g., joint venture, association) is one approach, completely independent third-party marketplace operator another. Control by only one or two stakeholders may hinder the market uptake.
- All stakeholders in the collaboration should have clear benefit out of it.
- Trust is essential component, many collaborations are formed after doing business together in long-term.
- Regarding door-to-door digitalization vision the cases cover only parts of the whole process. Only Tradelens case had the full logistics chain integration vision but failed. Integrating whole chain is a serious challenge.
- No developer community building services were identified in the marketplace cases.

1 Introduction

ADMIRAL seeks to develop and pilot AI-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, 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.

This deliverable reports the results of the task 3.1 - Horizontal collaboration business model State-of-the-Art and reference studies - carried out in the project's work package 3 - Business models for sustainable transports. 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. The purpose of the task 3.1 was to study recent development cases in the collaborative businesses in logistics and relevant other industry sectors to provide references and insights to support ADMIRAL development work.

The deliverable is structured as follows. Chapter 1 introduces the deliverable and the methodologies used. Chapter 2 reports the findings from the literature studies on horizontal collaboration in business context. Chapter 3 presents the background, current state and future vision of Awake.AI's platform, which forms the core of the ADMIRAL marketplace. In chapter 4 some relevant horizontal collaboration cases from other industries outside logistics are presented. Airline case is naturally logistics, but because air cargo is outside ADMIRAL scope, it's classified under other industries. Chapter 5 presents wide variety of recent cases that represent horizontal collaboration in logistics and transport sector. Finally, key findings are concluded in the chapter 6.

1.1 Methodologies

Two approaches were used to carry out the studies for this deliverable: literature study to explore the key findings from recent literature and logistics development cases, and a case study with semi-structured interviews to gather data about the Awake platform development.

As the main objective of T3.1 was to provide literature insights to ADMIRAL development, and due to relatively short time to carry out the task, the researchers chose to search for illustrative case studies on the subject instead of full scope literature review. The researchers relied on their expert judgement to collect relevant article sources and development case descriptions. As ADMIRAL aims for total

logistics chain transparency, the cases were selected to represent development activities in different phases of the logistics chain, from maritime shipping to last-mile deliveries.

Because the case description material was quite heterogeneous in level of details and availability of data, the descriptions in this document vary accordingly. To get a unified view of the cases, a framework with a set of questions was created to summarize each case. The framework was structured in table format and consisted of the following questions:

- Focus of collaboration and sharing
  - How the case/solution supports company business collaboration activities?
  - Key stakeholders
  - How the case/solution supports sharing of data/information
  - Does the case/solution handle emissions data?
- Use of platform technologies
  - How the case/solution uses platform technologies
- Motivation and barriers
  - What are the motivations/incentives for collaboration / sharing
  - What are the regulatory drivers/limitations/barriers?
- Implementation challenges
  - Identified challenges/ requirements/enablers for implementation / market uptake
- Learnings for ADMIRAL
  - Key takeaways to ADMIRAL development
- Theoretical positioning (logistics cases)
  - article of Pan (2017a) classification of horizontal collaboration
  - Type of collaboration?

A short description and summary of the Pan (2017a) classification of horizontal collaboration models is presented in the Table 1.

Table 1. Classification of horizontal collaboration (Pan, 2017a).

Horizontal collaborative transport (HCT) solutions	
Single carrier collaboration (S1)	An autonomous and independent carrier who collaborates with one or more other carriers bilaterally
Carrier Alliance/Coalition (S2)	In contrast to bilateral exchange, a number of collaborating carriers may form a group for more stable and efficient collaboration

Transport Marketplace (S3)	A place where shippers (or receivers) procure transport services from carriers or LSPs.
Shipper or LSP collaboration (S4)	Collaborating shippers can collectively and mutually define or revise logistics and transport constraints (e.g., lane, volume, lead time, delivery time windows), for the sake of transport synergy.
Logistics pooling (S5)	A solution for co-designing and sharing a common logistics network by partners (suppliers, retailers, carriers, LSP, etc.) with a common objective.
Physical Internet (S6)	A shared, highly modularised, standardised, and interoperable collaborative transport network of which the aim is to interconnect currently independent transport networks.
Implementation issues of HCT solutions	
Collaborative network design (I1)	Collaborative network design aims at reorganising or designing a common, shared collaborative logistics and transport network for SC stakeholders.
Transport planning optimisation (I2)	Collaborative transport planning optimisation issue consists of all collaborating actors (e.g., shippers, carriers) establishing optimal transport plans collectively and mutually.
Mechanism for exchanging requests (I3)	Deals with incentives and methods to exchange requests.
Coalition formation and Gain sharing (I4)	Concerns how to fairly allocate the common gain (or cost) to collaborating players.
Information and communications technology (I5)	How partners effectively and efficiently communicate with others to share information becomes an issue and impediment of HCT.
Organisation (I6)	Concerns the organisation, motives, and organisational concepts (facilitators) of HCT.
Management and governance (I7)	How to manage and maintain an HCT solution including business issues between collaborating companies, e.g., organisational culture, managers and employees' behaviour, conflict of interest.
Collaborative and Distributed Inventory Management (I8)	Collaborative inventory control strategiesor models based on HCT.

The semistructured interviews with Awake.AI consisted of the following activities. The researchers (3-5 researchers, one acting as the main interviewer and the others supplementing with questions and documenting the interview) had three focused 1-1,5-hour semi-structured interviews with the Vice President of Product from Awake.AI. The interviews were documented through video recordings and

meeting notes. Furthermore, there were two project meetings where Awake.AI presented its development plan to the whole project consortium. The interviewee also provided researchers with some earlier platform development-related documents.

2 Horizontal collaboration

2.1 Introduction to collaborative business models

The overall objective of the ADMIRAL project is to develop a multimodal low emission marketplace, called Admiral marketplace, on top of an existing platform developed and maintained by Awake.AI. Admiral marketplace will consist of applications that provide services – *transaction exchange* - and share information between platform users – *collaboration exchange* (Zhang et al., 2008).

Logistics marketplaces integrate collaboration features into their platforms, yet there has been no comprehensive systematic examination of the concept of collaboration within the context of logistics marketplaces. Previous research on logistics marketplaces is largerly focused on transactional exchange (services and products).

Collaboration can be characterized as a collective effort undertaken by companies, whether from the same industry or different sectors, to establish closer working relationships aimed at generating synergistic advantages that are unattainable when operating independently.

Business models founded on collaboration facilitate cost reduction and enhanced customer service by leveraging shared information and assets while improving the coordination of collaborative endeavors. In such collaborative arrangements, companies are motivated to work together to unlock greater value in their partnership, ensuring its sustained success, and aligning their efforts to achieve shared business objectives (Alarcón, 2005, Osório et al., 2013).

Collaboration becomes feasible when a minimum of two companies pool their resources, data, and/or assets to pursue a common goal (Gonzalez-Feliu and Salanova, 2012). Collaboration is when two or more independent companies work together to plan and execute operations with greater success than when they act in isolation (Jesus Saenz et al., 2015, Saenz et al., 2015).

Collaboration within the freight industry has not gained widespread acceptance primarily because of perceived obstacles related to competition, which has led to a deficiency in trust among fleet operators. Nonetheless, engaging in collaborative efforts within this sector offers substantial advantages. These include diminishing instances of empty running, lowering operating costs and others (Vargas et al., 2018).

Collaboration within the supply chain is a well-established practice, extensively employed among various supply chain partners. When companies effectively collaborate across the supply chain, it leads to reductions in inventory levels and costs, enhancements in speed, service quality, and customer satisfaction. Historically, most collaborative endeavors in the realm of supply chain management have

centered on partnerships between suppliers and manufacturers, as well as suppliers and retailers, particularly in areas like demand forecasting, sourcing, merchandising, and optimizing the flow of goods (Cao and Zhang, 2011, Liao and Kuo, 2014).

A growing variety of collaborative network structures have come into existence, encompassing vertical, horizontal, and lateral configurations. Within these structures, horizontal collaboration involves the cooperation of two or more unrelated or competitive organizations operating at the same logistical level. They collaborate by sharing confidential information or resources, such as transportation services. Vertical collaboration, on the other hand, entails the partnership of two or more organizations situated at different stages of the logistics chain, such as receivers, shippers, carriers, and freight forwarders. In this scenario, they share responsibilities, resources, and data to serve similar end customers within a specific supply chain. Lateral collaboration represents a fusion of both vertical and horizontal collaboration, where capabilities are combined and shared across various dimensions. (Cleophas et al., 2019).

1.2 Horizontal collaboration models

Horizontal collaboration (HC) models refer to collaborative relationships between companies operating at the same level in the industry or supply chain. Cooperation is of a "horizontal nature" if an agreement is entered into between actual or potential competitors

The idea for collaboration can come from the company itself or from its environment. In either case, there must be several interested companies that recognize the value of the potential interactions, assimilate it, and then use it for commercial purposes (Figure 1).

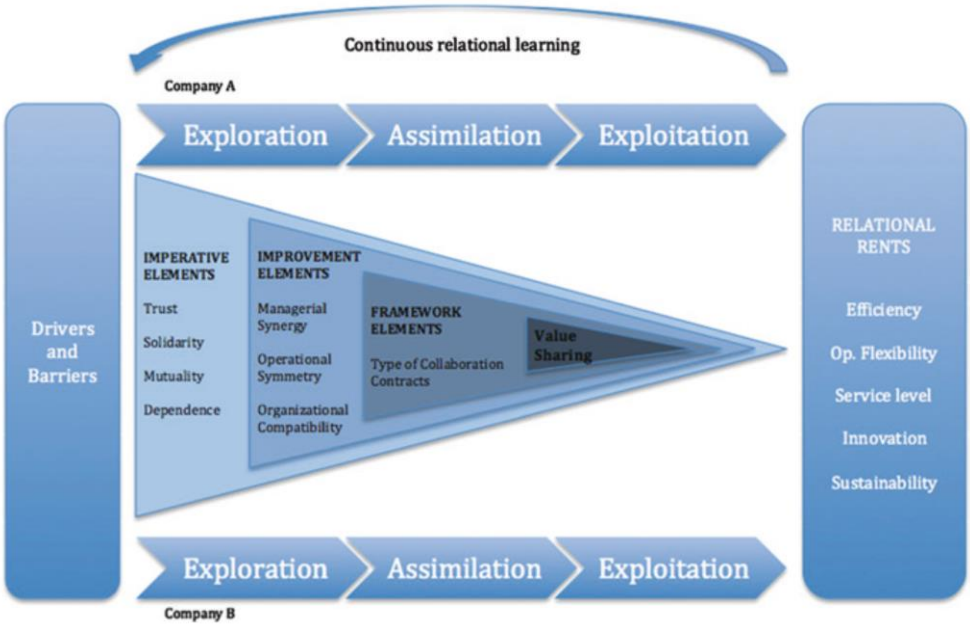


Figure 1. Horizontal collaboration model (Jesus Saenz et al., 2015)

HC models can take various forms, and the type of collaboration between companies must be clearly defined as the critical issue in collaboration is related to determination of shares of collaborators in outcomes, costs, and resources (Amiri and Farvaresh, 2023).

The reasons why companies enter HC depend on individual resource endowments and industries(Schmoltzi and Wallenburg, 2011); however, when companies enter into a horizontal partnership, they hope to gain benefits through knowledge transfer and information sharing. The main idea behind such cooperation models is therefore to achieve common goals and mutual benefits (e.g., resource sharing, cost savings, improved productivity and competitiveness, access to new markets, etc.) and to reduce risks.

The following table presents main motivations for horizontal collaboration as perceived by managers from five companies. A scale from 1 to 5 was applied for the assessment.

Table 2. Drivers or horizontal collaboration as seen by senior executives (Jesus Saenz et al., 2015)

Motivations	**Assessment**
Cost reduction	4.6
Allowing easier response to demand fluctuations	4.4
Improvement of the service level	4.2
Improvement of the vehicle fill utilization	4.2
Lower carbon emissions	3.2
Access new markets	3.0

Success of horizontal collaborative relationships relies on actors having a similar mindset and being able to decouple the commercial and sustainability agendas, especially when direct competitors are involved (Benstead et al., 2018). The entire company, from management to those actually responsible for the operations, must be involved in the collaboration. The organizational culture must be open for innovation within the company (Jesus Saenz et al., 2015).

For example, Soysal et al. (2018) report about huge benefits for two suppliers in the food production sector, which reduced their total transport costs and carbon emissions by almost 30% after starting HC. Similarly, some convenience stores reduced their total travelling distance by almost 25% (Montoya-Torres et al., 2016). More examples can be find in Pomponi et al. (2013).

As can be seen in Table 3, there are several barriers for horizontal cooperating; nevertheless, it seems that cooperating with other firms that operate at the same level is an ideal framework for better

operation and joint innovation since common risks and opportunities are shared (Jesus Saenz et al., 2015).

Table 3. Barriers for horizontal collaboration as seen by senior executives (Jesus Saenz et al., 2015)

Barriers	**Assessment**
Organizational culture	4.2
Lack of trust	4.0
Difficulty finding collaboration	3.6
Lack of common processes	3.6
Competitors acquiring information	3.2
Difficulty agreeing to HC terms	3.2
Difficulty distributing the benefits in a balanced manner	2.4

In another study (Schamschula et al., 2022) different barriers were emphasized; poorly integrated IT systems among partners and misaligned objectives were selected as key issues (indicated by 58% of interviewees who had the chance to select two options), closely followed by lack of data sharing (54%). In this study lack of trust, which is usually highly important (Islam et al., 2019), was not perceived as too problematic. Karam et al. (2021) identified 30 barriers in Danish transport sector and divided them into five categories. Then they applied AHP method and determined that Behaviours and attitudes has the highest weight among the barrier categories (this category includes Lack of trust among partners, Lack of trust in the methodologies and coordinator, and failing to keep commitments), followed by the Information quality (this category includes Low information accuracy, Lack of timely information updates, Lack of real-time information, and Shared information lack important details).

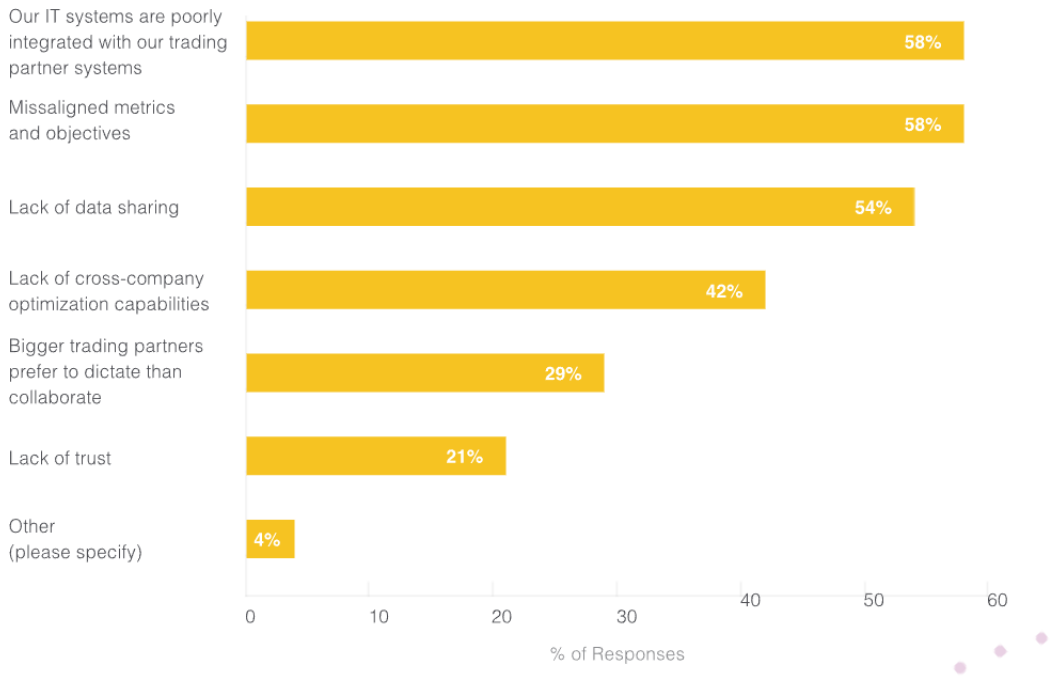


Figure 2. Most important barriers to HC (Schamschula et al., 2022)

1.3 Platform ecosystem-based approach

Nowadays, businesses use more and more platforms, challenging the traditional business models for collaboration (Shree et al., 2021). Platform based business aims to bring together different stakeholders, such as producers and consumers enabling value-creating interactions between them (Parker et al., 2016).

The rapid development in digitization has made it possible to use platforms in different sectors of society, such as industry, retail and services. Digitalization is also bringing together and enabling stakeholders in the interface of different societal and business sectors and ICT players to co-innovate new digital services and establish digital service ecosystems to support digitalized and automated interactions between different stakeholders within the sectors (Immonen et al., 2016).

Digital platforms enable time and place independent operation facilitated with smart software tools enabling easy and precise interaction (Parker et al., 2016). Platform types can be divided into transaction and innovation platforms (Koskinen et al., 2019, Cusumano et al., 2020). Transaction platform coordinates transactions between different parties by means of digital solutions. For instance, producers operating on digital marketplace platform create and offer complementary products or services and consumers purchase these products or services. Even though the product or service sale is the marketplace platforms' primary objective, digital platforms often also allow open exchange of information before the actual product and service sales occur. Innovation platforms

facilitate the development of complementary products and services on top of the platform (Cusumano et al., 2020), for instance smartphone apps.

The platforms can also be divided according to their operational context into C2C (Consumer-to-Consumer), B2C (Business-to-Consumer) and B2B (Business-to-Business) platforms. The operating contexts of these are different and, therefore, issue as information security are particularly important on B2B platform (Pauli et al., 2021). Furthermore, the development of complementary products requires more effort, as well as sales and marketing for industrial customers is different than for consumer customers (Pauli et al., 2021). Even though research related to B2B platforms is increasing, more empirically tested research on the topic is needed (Shree et al., 2021).

Platform-based business enables interactions between producers and users that create value for stakeholders and thus the digital platform is a participative infrastructure supporting these interactions and defining governance conditions for the participants (Hein et al., 2020). Platform ownership is an essential factor in the design and governance of digital platform ecosystems (Hein et al., 2020). Platform ownership is not just the legal entity owning the digital platform, but it relates to the distribution of power in the ecosystem (Hein et al., 2020). The owner of the platform has a key role in enabling and limiting operations in the platform (Hein et al., 2020). The owner aims to enable maximum value creation between the different parties of the platform and attract parties into the platform. However, the quality of the contributions is important as well, since low quality contributions may cause consumers abandon the platform (Parker et al., 2016). Therefore, the platform owner establishes governance mechanisms that define the ground rules for orchestrating interactions in the platform (Tiwana, 2013, Hein et al., 2020) like controlling who can access the platform and under what conditions, what kind of contributions are allowed in platform, etc.

Platform ecosystems have been studied for a long time and extensively, but the understanding of their emergence has received less attention (Pussinen et al., 2023, Valkokari et al., 2022). The literature focuses more on a snapshot at a given moment in time than on a longitudinal study when trying to understand the practical emergence and evolution of the ecosystem and platform (Valkokari et al., 2022, Pussinen et al., 2023) and the decisions that drive the ecosystem and platform emergence. Therefore, this is one avenue that will be considered in ADMIRAL project observing and understanding ADMIRAL marketplace ecosystem emergence.

3 Awake.AI's platform and ADMIRAL marketplace

2.1 Background

The company, Awake.AI, is founded 2018 to develop a software platform for digitizing ports and enabling Smart Ports to process remote controlled and autonomous maritime traffic. Before founding the company, the founders have participated in the development of the first commercial remote-

controlled and autonomous vessels. They have also been influential in working groups developing industry standardization.

Initially the Awake.AI data platform with Smart Port UI (Smart Port as a Service)[2] focused on enhancing and optimizing the ship-port-land transport logistics chain, such as predicting the arrival and departure of a vessel (Estimated Time of Arrival (ETA), estimated time of departure (ETD)). In the beginning the marketing communication was focused on ports, which as core actors enable contacts with the most important stakeholders (port authorities, shipping companies, terminal operators, etc.) in terms of port operations, as well as other ports. Solution contains web-application and native applications for Android and iOS. In addition, multiple APIs[3] are commercially available.

The key functionality of Awake.AI data platform and Smart Port is enriching data with the help of AI for various applications, for example, ETA for vessels and plan port operation tasks in a smarter way. The solution offers support in three main areas: situational awareness, port call planning, and optimization. The data providers and users of the data platform ecosystem are, for instance, shipping companies, ports, ground logistics and port operators. In addition to these, Awake.AI's ecosystem includes industrial companies, technology and software companies, product and service providers, research institutes and funding authorities. The Awake.AI's ecosystem works in cooperation with the Finnish One Sea ecosystem[4] that develops autonomous ships and the international Container 42 innovation ecosystem[5] that develops smart port operations and smart containers.

The benefits of the platform for the customer can be seen in the efficiency of operations, the elimination of surprises and delays, as well as the real-time transparency of information. Through this, better capacity utilization and environmental benefits are achieved, for example fuel savings are achieved by adjusting the vessel's speed according to optimal port arrival time. In terms of platform development, it is important to produce functionalities that are easy for different users to deploy and from which users immediately gain value for themselves.

2.2 Awake.AI's Marketplace - current state

At the end of 2020 Awake.AI received funding for COMMANDER project[6] (2020-2023, ESA ARTES 4.0 Demo project) the European Space Agency business applications demonstration project where Awake.AI is developing the first minimum viable product (MVP) of the marketplace for port services. The marketplace is built on the top of the existing data platform. The business logic and scaling of the marketplace is different from that of the data platform. Entering new customers to the data platform

[2] https://www.awake.ai/smart-port-as-a-service
[3] https://www.awake.ai/apis
[4] https://one-sea.org/
[5] https://weare42.io/
[6] https://www.awake.ai/post/awake-ai-collaborates-with-esa-to-develop-a-marketplace-for-sustainable-maritime-logistics

requires concrete help and support from Awake.AI, while entering the marketplace has been made as easy as possible. Onboarding is possible with simple registration and approval process.

The current state of Awake.AI's marketplace stakeholders is depicted in the following Figure 3.

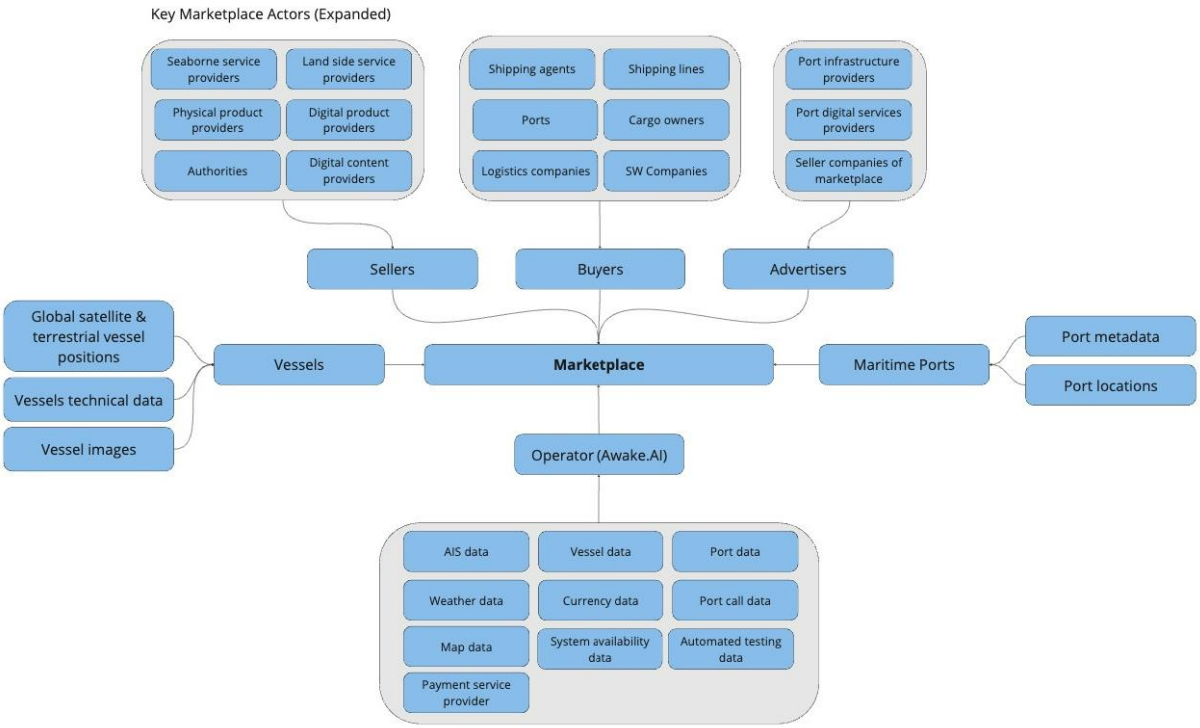


Figure 3. AWAKE.AI's marketplace stakeholders (current state)

The different stakeholders in the marketplace are divided into sellers, buyers and advertisers. An important part of the logic of the marketplace is to understand how ports work and how trading is performed in their context. The maritime ports with the necessary metadata and the vessels with their technical and location data provide the context for the sales and purchase transactions. With the help of the underlying data platform the stakeholders gain transparency into global vessel positions, vessel port ETA predictions and basic port call data that are important for efficient service delivery in marketplace.

The current state of Awake.AI's marketplace platform ecosystem description is depicted in the following Figure 4.

<table>
<tr><td colspan="2">Attract producers

Trial marketplace for free for 3-months</td><td>Entry smoothers

Step-by-step marketplace joining process (sellers, buyers) and approval decision</td><td colspan="2">Attract consumers</td></tr>
<tr><td colspan="2">Producers

Products / services:
• Seaborne service providers
• Land side service providers
• Physical product providers
• Digital product providers
• Authorities
• Digital content providers

Advertisers:
• Port infrastructure providers
• Port digital services providers
• Seller companies of platform</td><td>Interaction

Consumer finds and buys easily sellable items (physical and digital services and physical goods) provided by producers through one channel</td><td colspan="2">Consumers

Shipping agents
Shipping lines
Ports
Cargo owners
Logistics companies
SW companies</td></tr>
<tr><td>Substitutes

Other marketplaces</td><td>Value proposition

Sell faster & smarter
• Keep customers better aware what you sell, use customer specific prices when needed
• Approve purchases with 1-click, have all details always available
• Handle more buyers with less time</td><td>Facilitation

• Listings
• Very quick search with filters
• Subscriptions, buy listing automatically with recurrence
• Secondary currency, seller currency and your currency
• Multiple UI languages
• Online feedback and support tool
• Works on PCs, tablet & smartphones (web browsers, no installs)
• Work on multiple shopping carts at the same time
• Document and video files in the organisation profile page</td><td>Value proposition

Buy faster & with more transparency on delivery
• Buy from multiple sellers multiple items with one shopping cart
• Re-use shopping cart templates
• Negotiate via chat, get price quotes & availability faster
• Get rating information from sellers
• Save costs by doing more of the buying yourself</td><td>Substitutes

Finding product and service listings in producers web-pages and marketplaces</td></tr>
<tr><td colspan="2">Friction to be removed from producer side

Producers have to offer their services and products through own channels or diverse 3rd party channels.</td><td></td><td colspan="2">Friction to be removed from consumer side

Consumers have to find and buy sellable items from different channels with different usage logic and user experience.</td></tr>
<tr><td colspan="3">Boundary resources / practices

APIs, documentation, onboarding process guide (registration)
Onboarding approval decisions:
- AWAKE approval or port approval (organization really exists, is providing services they claim, can be contacted on their given contact information and so on)
- Some organizations that plan to provide services which require certificates and/or licenses must also be approved by the port authority. One relevant example of such an organization is bunkering service providers.</td><td colspan="2">Metrics

Get feedback from buyers where they want to see your company (e.g. ports)
Seller ratings provided by buyers</td></tr>
<tr><td colspan="2">Platform core

Marketplace
AWAKE Data Platform</td><td>3rd party platforms

AWS</td><td colspan="2">Other key resources

3rd party data providers:
- Vessel global positions
- Vessel technical particulars
- Weather
- Vessel images</td></tr>
<tr><td colspan="2">Cost model

Platform and marketplace cloud infrastructure
Data sources fees
External dev resources
Sales and marketing of marketplace
Onboarding of stakeholders
Support personnel and tools</td><td colspan="3">Monetization

Seller: Margin / commission take on sales
Seller: Monthly fixed marketplace fee
Buyers: Paid premium features
Sellers: Paid premium features, high value catalogue placement, advertisements</td></tr>
</table>

Figure 4. AWAKE.AI's marketplace platform canvas (current state)

Awake.AI's marketplace facilitates interaction between buyers and sellers enabling buyers to find and buy sellable items (physical and digital services and products) in the context of port and vessel through one channel. Furthermore, Awake.AI has enabled the advertising of products and services in marketplace. Awake.AI as an operator of the marketplace provides rules and guidance to participate in the marketplace. Marketplace has step-by-step registration process accompanied by an approval procedure and clear user guidelines. Marketplace utilises Awake.AI's data platform and provides transparency into data, such as vessel positions and vessel port ETA predictions to be utilised in marketplace transactions. Data platform enriches external data (e.g. weather data, vessel position data, port call data, etc.) with the support of artificial intelligence to create estimates for the marketplace e.g. vessel ETA.

2.3 Next steps in ADMIRAL project

In ADMIRAL project the multimodal marketplace is built on top of Awake.AI data platform and marketplace. The goal of the ADMIRAL project and WP4 is to expand the current version of the marketplace for

- multimodality,
- emissions awareness and
- optimizing logistics efficiency and
- scale the AI driven trading & routing to multiple logistic chains globally.

From collaboration point of view, the ADMIRAL marketplace will enable a reliable cooperation platform for emissions transparency in logistics. Furthermore, the project also builds the capability for application developers to build their own applications on top of the marketplace platform. Developers can also take a role where their application(s) feed data for the marketplace. This is related, for example, to the launch of the developer portal and other technical and cooperative practices to support participation to the marketplace.

2.4 Competitors analysis

There are almost no competitors that combine maritime port bound cargo flow platform with a marketplace that together allow even complex services to be traded on the marketplace, in addition to new digital products and traditional physical marine products. It is also hard to find detailed information from these partial identified competitors. Some freight visibility platform service providers such as Project44 and Shippeo may develop services towards ADMIRAL direction, e.g., regarding emissions intelligence, but based on Frost and Sullivan (2022) market analysis report the whole market of freight visibility platform services is still in initial stages. However, it is noteworthy that some logistics marketplaces (Transporeon, n.d.) have just lately announced that they are developing sustainability related services to their platforms. So, the market is emerging, and different players are approaching the opportunity from their current positions in the value network. Table 4 presents an analysis of some potential competitors for the ADMIRAL marketplace.

Table 4. Some competitors for the ADMIRAL marketplace.

Competitor	Shipeq[7]	Marine Online[8]	Maritime Marketplace	ShipServ[9]	NxtPort[10]	Kognifai[11]
Products / Services	Mainly physical products marketplace. Contains some services too.	Marketplace for physical products but also several service categories.	Connecting buyers and sellers with each other and marketing events and content. Not a	Selling and buying mostly physical products for whole of	Marine data based digital marketplace for data products and applications, extensions	Digital data sharing, application development and integrations with partners.

[7] https://shipeq.com/
[8] https://www.marineonline.com/
[9] https://www.shipserv.com/
[10] https://nxtport.com/
[11] https://kognifai.com/

			direct purchase of products or services marketplace.	maritime sector.	utilising the data. No physical services or products.	Simulation services.
Competitive advantage	Has been in business from 2016 and has built customer base.	Modern, capable website and mobile application. Ability to experience a modern marketplace without registration. Includes crediting facility for buyers.	Informa has been in the marine business domain at least 10+ years. Known brand and good existing connections.	In the business for a long time; established 260 shipping lines and 43.000 suppliers in their marketplace. Has recently upgraded their web marketplace.	2+ years' experience in developing and operating marketplace. Modern, large port Antwerp, Belgium as 1st enabled port.	Long history of working in maritime business domain. Making trust a big issue and how good Kognifai is on this aspect.
Target market	Shipping lines and offshore market.	Shipping lines and ship operators of all types.	Management and leadership of maritime organisations.	Whole maritime sector but shipping lines / operators as key focus.	Modern ports and port operating organizations willing to share data or use data-based collaboration tools.	Larger B2B ship operators and Off-shore companies. Maritime companies needing simulation services.
Marketing Strategy	Unknown.	Modern take on value and capable marketplace with social networks also used.	Marketing. Giving both buyer and seller type organizations a marketplace to find each other.	Modern multi-channel approach with online events and use of social media.	Multi- channel and online / offline events.	Online and offline events, online trade publication advertisements and sponsorship
Distribution channel	Online marketplace "Shipeq" and "DBluemart".	Online market-place with capable mobile application.	Online marketplace.	Online marketplace.	Online marketplace.	Online marketplace

Price and cost structure	Subscription based model.	Highlights no commission fee percentage for buyers. Sellers pay commission percentage.	Limited free company listing and then paid for more extensive listing.	Sellers pay % margin; additional premium listing and advertising possibilities.	Platform fees, indiv. APIs or application fees based on volume or fixed pricing tiers.	Unknown.
Business lifetime	Established 2016.	Est. 2017 in Singapore.	Unknown but fairly recent.	Established 1999.	Established 2018.	Established 2017.
Strategy	Unknown.	Many services besides physical products. Ship chartering, agent and crew services, insurance, finance crediting.	"LinkedIn" for maritime sector.	Best source of maritime physical products on a global basis. Trusted brand and catalogue.	To become leading European (now taking 1st steps to global capability) ports digital data and applications marketplace.	Partner driven marketplace for holistic applications utilising data from Kognifai platform and partner systems.

4 Horizontal collaboration models in other industry sectors

This chapter presents three examples of horizontal collaboration outside the ADMIRAL project's industry scope (land and marine logistics pilot cases). The purpose of these examples is to illustrate some relevant aspects and factors that may have notable influence on the how the horizontal collaboration is enabled. The first case is from infrastructure sharing in mobile telecommunications and two cases are from airline industry. The first airline case presents a historical story how the travel reservation systems were developed globally by different kind of collaboration constellations of the prominent airlines. The second airline case gives an advanced example of how the emissions data has been integrated to the travel reservation systems providing the customer an opportunity to compare flights by their emissions.

3.1 Infrastructure sharing in mobile telecommunication

Traditionally mobile network operators (MNOs) used to exhibit a high degree of vertical integration, where they handle various activities such as network planning, site acquisition, network implementation, operation and maintenance, service provision, and customer management. However, the rapid and complex technological advancements, competitive markets, and cost considerations have led operators to focus on differentiating themselves and outsourcing non-strategic functions. This has resulted in the disaggregation of the value chain, with specialized providers taking over specific

business segments. Additionally, the sharing of platforms and assets among multiple operators has emerged as a viable option through horizontal partnerships. Infrastructure sharing is a crucial topic being explored in this context, encompassing both growth and consolidation scenarios. Some operators have started sharing sites and passive infrastructure, and there is a shift towards optimizing costs and technology through joint ventures and shared leased lines and microwave links.

Infrastructure sharing characteristics

Infrastructure sharing transactions in mobile network context can be characterized by three dimensions: the business model, the geographic model, and the technology model. These dimensions are interrelated, as choices made in one dimension will influence options available in the others.

The decision on the business model and geographic model depends on the conditions, installed bases, and future plans of the operators involved. Incumbent operators with similar roll-out cycles may prefer mutual service provision agreements or establish a joint venture to operate the shared network. In cases involving both incumbent and new entrant operators, unilateral service provisioning may be a suitable choice. Alternatively, operators looking to focus on service development and sales may consider delegating network provisioning to a third-party network provider that owns and operates the assets.

Operations outsourcing can reduce costs for operators in various collaboration schemes: standalone, unilateral and mutual service provision agreements, and joint ventures. However, outsourcing becomes particularly appealing in collaboration scenarios because it allows for higher synergies through alignment of services, facilitates the sharing process, provides neutral governance models, and ensures confidentiality of operator-specific data, such as customer traffic and service configurations.

Network sharing options

The generic models for network sharing is shown in Figure 5 and explained shortly after. Base case is so called standalone case, where each operator provides full service coverage for the entire geographic area using its own network.

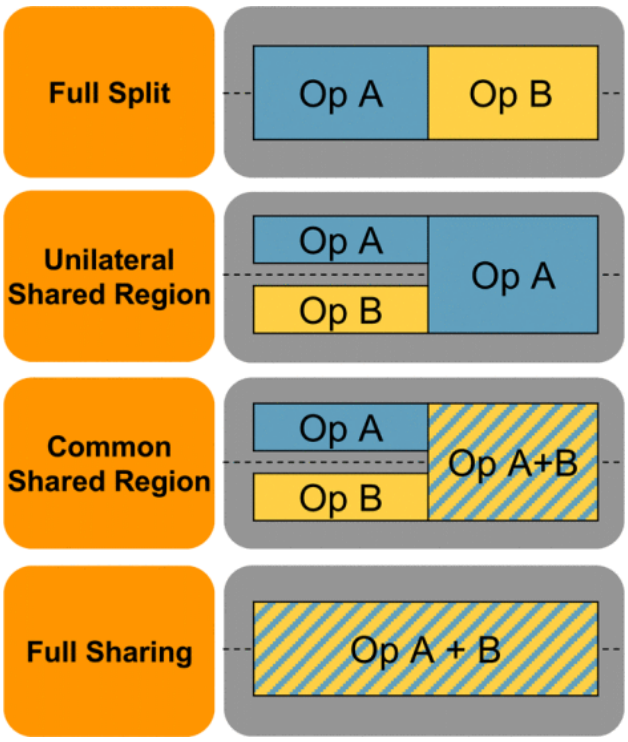


Figure 5. Mobile network sharing options (Frisanco et al, 2008).

In the **full split** case, operators cover separate and complementary areas. This approach is suitable for operators of similar strength who want to enter a mutual service agreement, such as roaming. It allows for extended coverage or the introduction of new technology at the lowest combined cost.

Unilateral sharing is a model that combines the rollout requirements of incumbent and new entrant operators. It enables the operator with a larger installed base to leverage it for additional volume and revenues while relieving the greenfield operator from investing in a full-coverage infrastructure. Roaming is the corresponding technical solution in this case.

Operators of similar scale establish a **common shared region** when they both want to be physically present in an area but aim to share infrastructure or sites to reduce capital and operating expenses. No roaming is required, and technical features allow both operators to use their individual network identifiers without subscribers necessarily noticing the infrastructure sharing.

In **full sharing**, operators combine all sites or their entire radio or core networks (depending on the technical solution). They may retain only a part of the core network related to subscriber ownership. Full geographical sharing is more efficient than partial sharing with the same technical approach. The difference between full split and full sharing, in a roaming-based solution, lies in the regional selection criterion for the former and a case-by-case decision for the latter. Full sharing requires optimal joint

network planning in a growth environment, while in a consolidation environment, operating costs are reduced by concentrating sites and retiring unnecessary equipment.

Table 5 summarizes the key learnings from the mobile telecommunication case to ADMIRAL development.

Table 5. Summary of mobile telecommunication case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Key aim to lower network investment costs by sharing infrastructure. Basic models roaming or joint network investments. Enables cost-efficient increase of service coverage for customers. Shared infrastructure enables cost-efficiency.
Key stakeholders	Mobile network operators
How the case/solution supports sharing of data/information	Network infrastructure shared, mobile network data not shared.
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Sharing technologies part of the mobile network technology infrastructure.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Enhanced customer service and improved capacity utilization.
What are the regulatory drivers/limitations/barriers?	Global standards enable/drive market development. Collaboration enabled within the limit of competitive market regulation.
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	No challenges identified in the case source materials.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	• global standards development to enable globally interoperable systems

Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration (Note, this classification does not comply with the mobile network industry, so the analysis is only figurative)	• HCT solutions:
	  ○ **Single carrier collaboration (S1)**
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ Transport Marketplace (S3)
	  ○ Shipper or LSP collaboration (S4)
	  ○ **Logistics pooling (S5)**
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ **Collaborative network design (I1)**
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• horizontal

3.2 Global Distribution Systems in airline industry

Airline industry, and particularly the evolution of flight reservation systems, provides one example of developing industry-wide solutions in horizontal collaboration. It also provides a development story how the relationships of key stakeholders change over time as new technologies enable new kind of relationship arrangements. Bingemer (2018) has identified several key turning points in the development of Airline reservation and distribution systems, which are briefly presented in the following chapters.

American Airlines collaborated with IBM to create the first Airline Reservation System (ARS), known as Sabre, in 1964 (Bingemer, 2018). Sabre aimed to automate processes such as passenger sales, seat inventory control, and passenger record retrieval. This system built using IBM mainframes, automated reservation processes while still requiring personal customer contact. The development of ARS laid the foundation for the Global Distribution System (GDS).

Airlines modified their ARS in the 1970s to allow travel agents access while restricting certain data and functionalities. This led to the birth of Computer Reservation Systems (CRS), which enabled travel agents to access information on flight schedules, fares, seat availability, make reservations, and issue

tickets. Each airline developed its own CRS, resulting in complexity and lack of consistency in the industry (Bingemer, 2018).

The formation of GDS marked a turning point in the airline industry in the 1980s. The transition from CRS to GDS was driven by commercial rather than technological factors. The GDS emerged when CRS technology services became independent from airline structures. The key focus of GDS was to provide a common base for displaying offers from different airlines, using parameters such as travel time, schedule, and net fare. However, limitations within the GDS environment still exist today due to its historical design (Bingemer, 2018).

In Europe, the evolution of GDS began in the mid-1980s and became operational in the 1990s. Amadeus Global Travel Distribution and Galileo were formed by airlines such as Lufthansa, SAS Scandinavian Air Services, Air France, Iberia, British Airways, Swiss Air, KLM, and Alitalia. This geographical focus explains why Sabre dominates the Americas, while Amadeus dominates Europe. Recent market positions of different GDSs are presented in Table 6.

Table 6. Airline GDS in the market (Satalkar, 2017).

Name of GDS	Founded In	Founders	Area Of Strong Operations
WorldSpan	1990	Delta, TWA and North West Airlines	USA and Europe
Sabre	1976	American Airlines (Now AMR Corporations)	US and Asia Pacific
Galileo	1993	11 North American and European airlines, conducted by United Airlines. Currently owned by Cendant Corporation.	US and Western Europe
Amadeus	1987	Iberia, Air France, SAS and Lufthansa	Europe, Middle East, N. Africa and Asia

The birth of the internet in 1989 had a profound impact on airline distribution. It provided a new direct sales channel that reduced costs for airlines and offered a superior customer experience. Airlines gained control over their distribution processes and started creating offers tailored to online channels. The internet also challenged the centralized nature of GDS by introducing a distributed network paradigm (Bingemer, 2018).

The rise of Low-Cost Carriers (LCC) and their adoption of internet-only distribution further transformed the airline distribution landscape. LCCs operated independently from GDS and offered low-cost fares

exclusively through their websites. This challenged the dominant role of GDS as a one-stop-shop for airline sales. Technology providers developed aggregation solutions through Application Programming Interfaces (APIs) to integrate LCC fares and offer a coherent search display. Direct bookings through airline websites allowed airlines to gather customer-specific data and offer personalized deals (Bingemer, 2018).

Cloud computing emerged as another crucial turning point in airline distribution. It lowered the entry barriers for distribution technology, enabling innovative startups and digital giants to enter the field more easily. Cloud-based services offered scalable computing power and eliminated the need for proprietary hardware, making it more convenient for travel agencies to access airline services and connect with distribution partners (Bingemer, 2018).

In 2011, American Airlines introduced "AA Direct Connect," a competing ticket delivery system aimed at reducing GDS fees. It allowed travel agents to connect directly to American Airlines' servers through Farelogix, bypassing traditional GDS distribution. This move led to reactions in the market, with Expedia and Orbitz stopping the display of American Airlines fares, and Sabre, the largest GDS in the US, displaying American Airlines fares unfavorably. American Airlines filed a lawsuit against Expedia, Orbitz, and Sabre, which was settled outside court in favor of American Airlines. This legal success did not settle the technological and commercial debates surrounding Direct Connect (Bingemer, 2018).

In 2012, the International Air Transport Association (IATA) formally adopted the New Distribution Capability (NDC) initiative. NDC aimed to enhance airline distribution by providing a new shopping experience across all distribution channels. It shifted the offer creation process from GDS providers to airlines, allowing airlines to combine all product elements into an airline offer and distribute it. NDC also facilitated the shift towards dynamic pricing and the selling of ancillary services. The standardization and implementation of NDC were seen as essential for harmonizing messaging and reducing complexity in the distribution landscape (Bingemer, 2018).

In 2015, the Direct Connect development seen in the USA reached Europe, starting with Lufthansa Group's announcement of a Distribution Cost Charge and the implementation of a Direct Connect API exempt from this charge. This move created market pressure and sparked discussions between Lufthansa Group and travel agencies. British Airways also announced the provision of an NDC API. Unlike the US market, where major competitors did not join the Direct Connect approach, in Europe, British Airways and Air France leveraged GDS fees to compensate for distribution costs while offering an NDC API. The growing importance of the NDC standard provided travel agencies with the possibility of connecting multiple Direct Connects through a single plug, although challenges in its coherent implementation persisted (Bingemer, 2018). Figure 6 from Vinod (2009) illustrates the different distribution channels for GDSs.

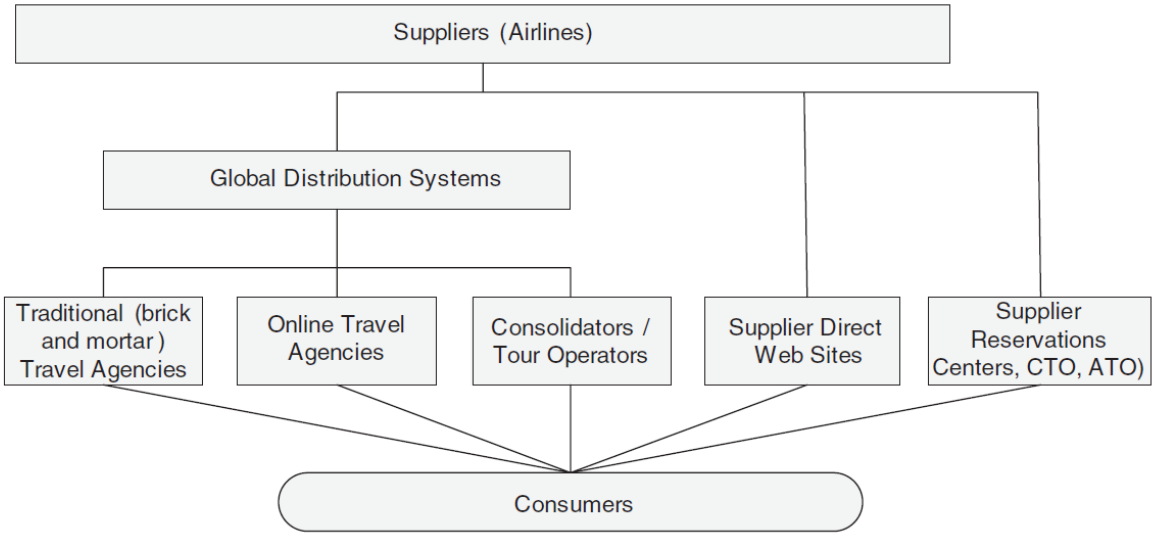


Figure 6. Suppliers GDSs distribution channels (Vinod, 2009).

Currently, Direct Connect implementations are individualized per airline, leading to a lack of diffusion among travel agencies. The adoption of Direct Connect distribution into the solution portfolio of GDS providers is seen as a crucial turning point for reach and diffusion of NDC-based Direct Connects. This development would require a change in the established GDS business model, and cloud-based aggregators could emerge to provide travel agencies with content and booking capability from multiple sources. While tendencies in this direction exist, broader diffusion of such technologies faces technological and commercial hindrances. NDC-based blockchain technologies and AI are also expected to play significant roles in the future of airline distribution.

Table 7 presents the key findings from the GDS development case with regards to ADMIRAL development.

Table 7. Summary of the airline GDS case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Key aim to provide platform for airline reservation data sharing between travel industry stakeholders. Initiated typically by several airline carriers (several similar systems that have their own ecosystems around them, different market leaders in different geographical locations).
Key stakeholders	• Airlines (joint ventures) • Platform technology developer • Travel agencies

How the case/solution supports sharing of data/information	Stakeholders have access to airline schedules and reservation data.
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Centralized GDS system provider, challenged lately by cloud-based solutions, and direct sales models by certain airlines.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Enhanced customer service and improved capacity utilization.
What are the regulatory drivers/limitations/barriers?	Not by authorities but industry association (IATA New Distribution Capability (NDC) initiative)
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Broad ownership collaboration of the airlines supported uptake in industry. This challenged by competitors with specific competitive strategy (low cost carriers and direct customer contacts), and cloud-based service providers.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	• platform developed and owned by joint venture of users (airlines) supports market uptake (less doubts of competitor interests) • horizontal collaboration relationships between the stakeholders change over time due to e.g., development of technologies and changes in competitive landscape.
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ **Single carrier collaboration (S1)**
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ **Transport Marketplace (S3)**
	  ○ Shipper or LSP collaboration (S4)
	  ○ **Logistics pooling (S5)**
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ **Collaborative network design (I1)**
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ **Coalition formation and Gain sharing (I4)**

	○ **Information and communications technology (I5)** ○ Organisation (I6) ○ **Management and governance (I7)** ○ Collaborative and Distributed Inventory Management (I8)
Type of collaboration?	• horizontal

3.3 AMEX GBT Neo travel platform integrates carbon emissions

American Express Global Business Travel (Amex GBT) has partnered with climate tech company CHOOOSE to integrate carbon emissions calculations into its travel booking and reporting tools (GBT, 2023). The collaboration aims to enhance Amex GBT's sustainability efforts by improving the accuracy and consistency of greenhouse gas emissions data and preparing for future carbon compensation strategies. The integration with CHOOOSE will offer clients more calculation options, detailed CO2 data, and a unified approach across their suite of tools for booking, tracking, and reporting travel (GBT, 2023).

Amex GBT's online booking tool, Neo, will display CHOOOSE-powered carbon emission data to help travelers make eco-conscious decisions. The integration will replace existing calculation methods with CHOOOSE's seamless emissions calculations. Travel managers will have the ability to choose preferred calculation methodologies for consistent application across online booking, mobile app, and itinerary solutions. The new system will enable travel managers to retroactively apply CHOOOSE's emissions calculations to trips booked since 2019, facilitating tracking, analysis, and management of carbon footprints.

For travelers, this integration means uniform emissions data will be displayed in search results, itineraries, and the Amex GBT Mobile app, offering clearer insights into individual carbon footprints and encouraging sustainable booking choices. The integration also grants Amex GBT access to recognized air emissions methodologies, including ICAO (International Civil Aviation Organization), UK BEIS, US EPA, and France ADEME2, enhancing accuracy through criteria like distance, fuel burn, occupancy, and cabin class. Amex GBT also integrates with additional data sources such as IATA CO2 Connect based on IATA RECOMMENDED PRACTICE-RP 1726. Preferences for radiative forcing and well-to-wake assessments will also be accommodated where applicable, particularly for measuring sustainable aviation fuel benefits. Emissions data for other travel segments such as rail, car, and hotel will be added in the future, along with additional features and methodologies.

This integration sets the foundation for further carbon compensation solutions within Amex GBT's offerings. Clients will have options to offset their business travel emissions through a range of climate solutions, seamlessly integrated into booking and reporting tools. CHOOOSE data will support

sustainable meeting and events solutions, ensuring consistent and reliable information across Amex GBT's services. The Amex GBT case stakeholder constellation is illustrated in the Figure 7.

CHOOOSE emissions calculation method – Air Canada example

To allocate the GHG emissions[12] of an Air Canada flight to an individual passenger, CHOOOSE uses the latest version of the IATA Recommended Practice Per-Passenger CO2 Calculation Methodology.

This allocation is obtained by dividing the average jet fuel consumption of the flight by the average load (passengers and cargo). Allocation to an individual passenger is weighted based on the selected class of travel (business, premium economy or and economy) and size of aircraft (narrow or wide body).

If the journey includes connecting flights operated by other airlines, the allocation of GHG emissions for those flights is obtained based on average GHG emissions as provided by the ICAO Carbon Emissions Calculator Methodology (Version 11).

The calculation methodology used by CHOOOSE provides an estimate only of the GHG emissions associated with your flight(s) and the cost to compensate for such GHG emissions and should not be relied upon as an accurate record of the actual emissions. Calculation results show GHG emissions in kgCO2e.

[12] GHG emissions from jet fuel combustion include CO2, CH4 and N2O emissions. The global warming potentials from IPCC Fourth Assessment Report (AR4) were used to convert the CO2, CH4 and N2O emissions to tonnes of CO2 equivalent (tCO2e). However, other GHG emissions sources such as upstream GHG emissions from jet fuel production (i.e., extraction, refining and transportation) and the non-CO2 terms (e.g., contrails) have not been included.

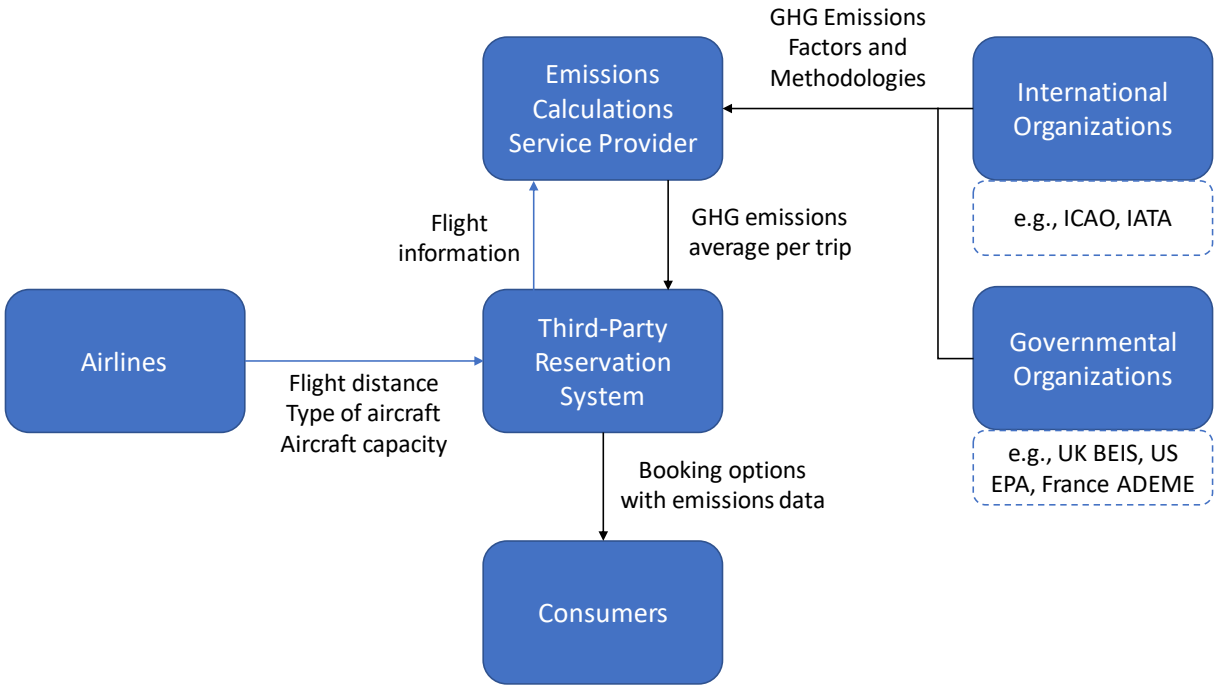


Figure 7. Business network diagram of the airline reservation system with emissions calculation service.

Table 8 presents the key findings from the GDS development case with regards to ADMIRAL development.

Table 8. Summary of travel platform emissions calculation.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Key aim to provide emissions data for airline reservation data sharing service between travel industry stakeholders. Third party centralized and outsourced emissions calculations provider serving the reservation systems operators (GDS, airlines, travel agents)
Key stakeholders	• Airlines (joint ventures) • Platform technology developer • Travel agencies • Emissions calculations service provider • Industry associations (IATA, ICAO)
How the case/solution supports sharing of data/information	Stakeholders have access to airline schedules and reservation data together with emissions data
Does the case/solution handle emissions data?	Yes

Use of platform technologies	
How the case/solution uses platform technologies	Centralized emissions calculations system provider, connected to GDS systems and airlines' private systems
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Enhanced customer service (emissions aware customers) and enable emissions compensation. Jointly defined methodology for emissions calculations by industry associations.
What are the regulatory drivers/limitations/barriers?	Not by authorities but industry association (IATA)
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Broad ownership collaboration of the airlines supported uptake in industry. This challenged by competitors with specific competitive strategy (low cost carriers and direct customer contacts), and cloud-based service providers.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	• focused third party service provider to implement emissions calculation service
Theoretical positioning (logistics cases)	
Pan 2017 article classification of horizontal collaboration	• HCT solutions: ○ **Single carrier collaboration (S1)** ○ **Carrier Alliance/Coalition (S2)** ○ **Transport Marketplace (S3)** ○ Shipper or LSP collaboration (S4) ○ **Logistics pooling (S5)** ○ Physical Internet (S6) • Implementation issues of HCT solutions: ○ Collaborative network design (I1) ○ Transport planning optimisation (I2) ○ Mechanism for exchanging requests (I3) ○ Coalition formation and Gain sharing (I4) ○ Information and communications technology (I5) ○ Organisation (I6) ○ Management and governance (I7) ○ Collaborative and Distributed Inventory Management (I8)
Type of collaboration?	• horizontal

5 Horizontal collaboration in transport and logistics

4.1 Overview of horizontal collaboration models in transport and logistics

Freight transport is gearing the economic growth; however, the global supply network is full of inefficiencies, which are shown in a high number of empty miles, wasted costs, congestion and a significant amount of carbon dioxide (CO2) emissions, etc. In fact, 25% freight vehicles in Europe run empty and 50% run with partial load, resulting in overall efficiency of only 43%. In addition, heavy-duty vehicles (trucks, city buses and long-distance buses), are responsible for more than 25% of GHG emissions from road transport in the EU and account for more than 6% of total EU GHG emissions (European Comission, 2023). The total cost of road freight transport inefficiency is estimated at €160 billion per year (Schamschula et al., 2022).

The sustainability of freight transport has become a major issue in the field of logistics in the past decades (Pan, 2017a). HC is considered as one of the innovative solutions to effectively address the growing challenges in transport and logistics from both environmental and economic perspectives (Pomponi et al., 2013). In fact, HC can enable synergistic use of resources in global supply networks, with significant gains in terms of efficiency and sustainability (Schamschula et al., 2022). Through horizontal transport collaboration (HTC), companies can consolidate their freight into fewer numbers of trucks, leading to cost and environmental savings (Pan et al., 2019). Other desired outcomes of transport process redesign can be seen in the following figure.

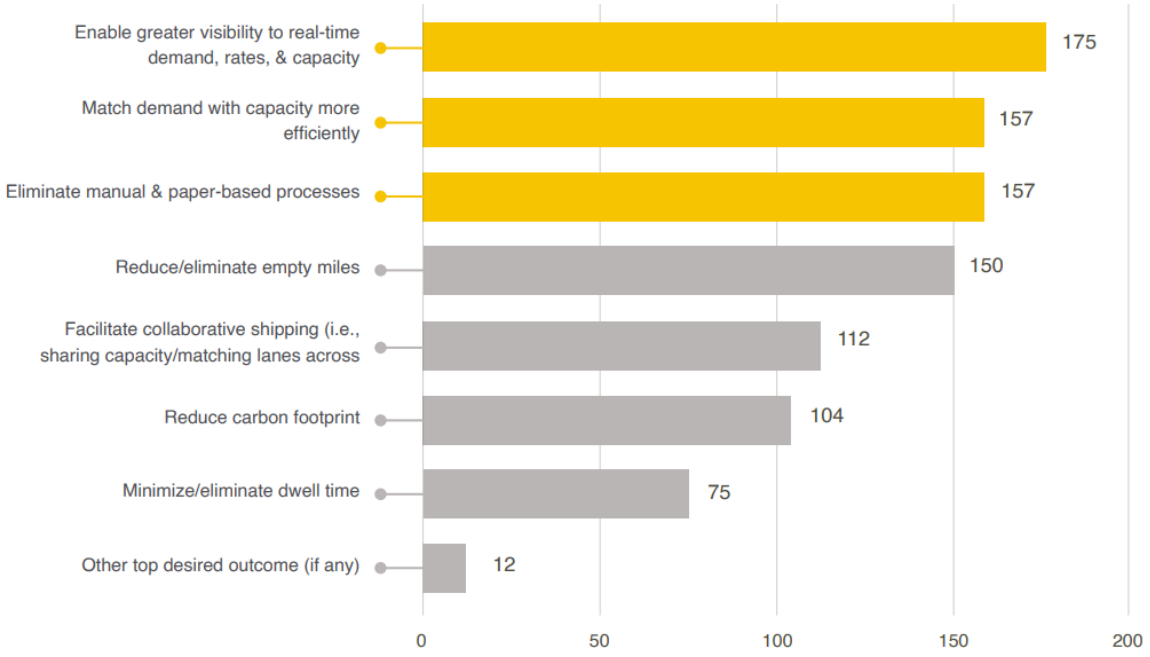


Figure 8. Desired outcomes of transport process redesign or HC (Schamschula et al., 2022)

When redesigning logistics processes, one of the most essential choices that companies face is whether to a) keep logistics execution in-house, b) outsource, or c) seek cooperation with comparable

companies to exploit synergies (make/buy/ally decision) (Cruijssen, 2006). To meet the need for shorter, more sustainable, and more cost-efficient supply chains, greater HC between transportation companies and logistics service providers is required (Notteboom et al., 2022).

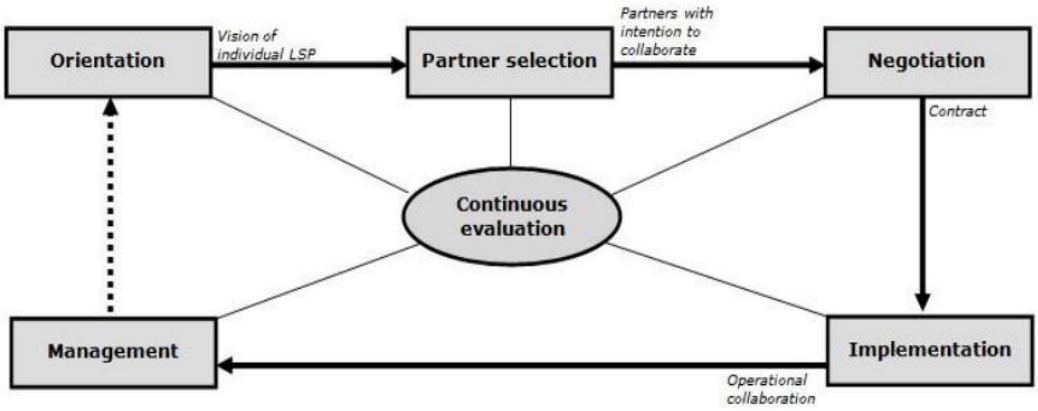


Figure 9. Ally decision framework (Martin et al., 2018)

HC usually occurs between two or more manufacturers, shippers, or logistics service providers (LSP). It can take place between companies at the same level within a given supply chain, e.g., between two manufacturers in the same industry, or between companies in different value chains, e.g., between two manufacturers in different industries (Saenz et al., 2017), as the horizontal cooperation is about identifying and exploiting win-win situations between companies active at the same level of the supply chain in order to increase performance (Cruijssen, 2006).

HC can be formed on either strategic (agreements and investments) or operational (execution) level (Figure 9).

Strategic horizontal collaboration in transport allows (Schamschula et al., 2022):

- use of alternative transport modes (shuttle-service by road, intermodal instead of road, etc.),
- existing transport corridors to become more attractive (such as ferry-routes with more frequent sailings),
- investment in new equipment such as high cube trailers or special boxes,
- construction of new terminals or similar infrastructure.

The horizontal partnership should therefore result in load optimization and load consolidation, asset sharing, empty moves reduction, joint storage and warehouses, etc.

On the other hand, horizontal collaboration on operational level does not allow any investments or last minute changes, but allows (Schamschula et al., 2022):

- to do the “matchmaking” just in-time via platforms by using a digital handshake,
- all parties to freely consider a specific bid, load, truck or offering.

To ensure stability and fairness of the collaboration, it is essential that a neutral body (a trustee) distributes wins and gains accordingly among the participants (Schamschula et al., 2022).

In research by Cruijssen et al. (2017) half of the surveyed companies consider horizontal collaboration in logistics useful for improving cost, productivity, customer service and market position. Horizontal cooperation in logistics is mainly gaining momentum in Western Europe. Sub-chapters 5.1.1 - 5.1.8 present one by one different HC models.

4.1.1 Alliances (example: shipping alliances)

In the container shipping industry, low prices and a wide coverage are two important elements that carriers must offer to make their business profitable. With limited resources this is barely possible, therefore the shipping companies found the solution in cooperation. Operational cooperation between container shipping companies comes in many forms ranging from slot-chartering and vessel-sharing agreements to multi-trade strategic alliances (Notteboom et al., 2022).

A shipping alliance, often referred to as an ocean alliance, is a group of ocean carriers that jointly enter into a cooperative agreement. The main incentives for shipping companies to engage in strategic alliances are the need for critical mass in the scale of operation, improving global reach, improving fleet deployment, and spreading the risks associated with investing in large container ships (Figure 10) (Notteboom et al., 2022).

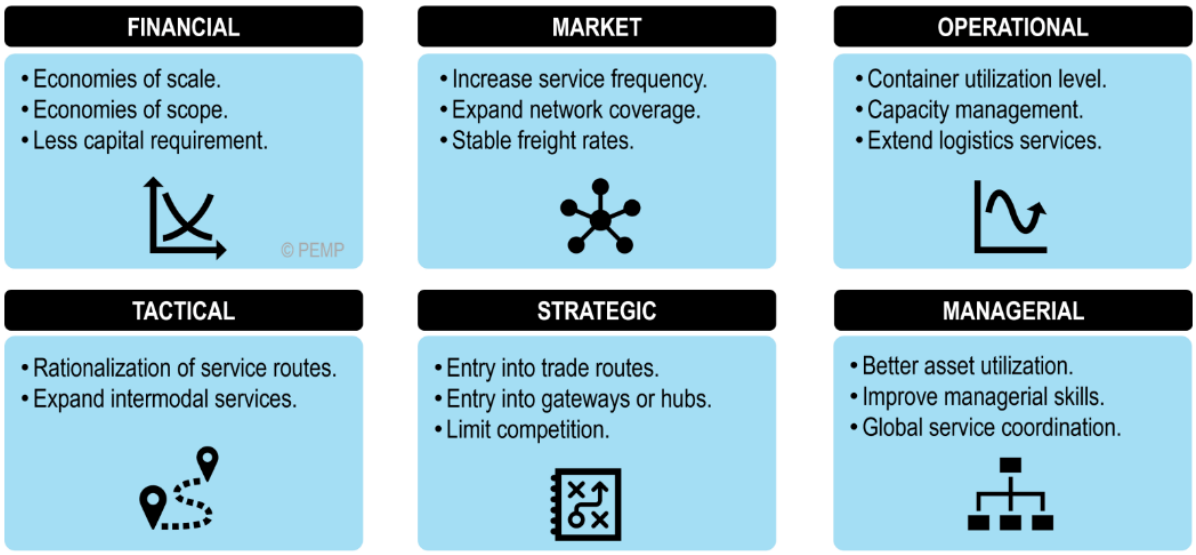


Figure 10. Main incentives for carriers to be involved in the alliance (Notteboom et al., 2022)

Alliances entail a loss of operational independence for their members as well as some other hitches. In particular, negotiations between alliance members on the design of joint liner services and the selection of ports of call can be very difficult, especially when one or more alliance members operate their own global container terminal network (Notteboom et al., 2022).

The main areas of communication and information sharing between the companies are stowage plans, vessel assignment, scheduling, and problem solving. However, alliances do not involve joint sales, marketing, pricing, or joint ownership of assets, which distinguishes them from other forms of partnership (Choi, 2023).

The first strategic alliances between shipping lines date back to the mid-1990s. In the beginning of 2023, three alliances were operational globally: 2M (MSC, Maersk), Ocean Alliance (CMA CGM, COSCO, Evergreen) and THE Alliance (Hapag-Lloyd, ONE, HMM, Yang Ming) (Figure 11). Together they had the largest impact on the shipping market, as they were controlling more than 83% of the entire container ships (Choi, 2023).

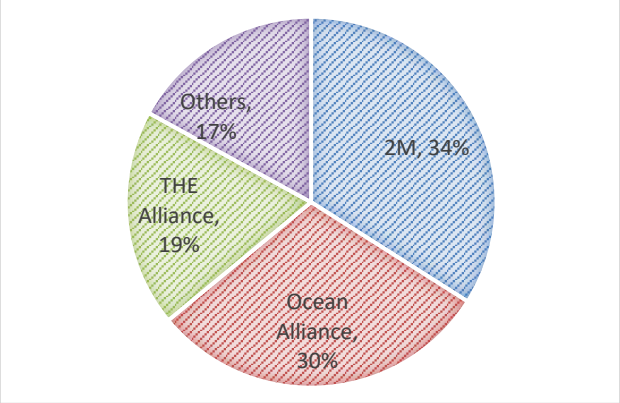


Figure 11. Market shares in container shipping (Choi, 2023)

For example, the European carrier association, ASTRE, was created to help independent carriers exchange transport requests (Pan et al., 2019). The system allows to find tailored, scalable and environmentally responsible transport and logistics solutions at every stage in the supply chain (ASTRE, n.d.). ASTRE was founded in 1992 by 19 partner companies and it grew to become the leading and the only European transport and logistics group with a range of products and services offered across the EU. ASTRE nowadays comprises around 160 middle-sized companies and independent freight forwarders, as well as hauliers from various European countries. ASTRE has its headquarters in France. The companies are independent of one another in equity terms, operating within their regions, with more than 400 sites. These companies together generate a turnover of more than €3.3 billion and employ almost 20,000 people (ASTRE, n.d.).

All ASTRE members have regular customers with whom they do most of their business. The rest they do with their partners in ASTRE. The main idea is to serve shippers who demand onestop shops for their logistics services in Europe, and they mostly compete to the major pan-European logistics concerns like Danzas, Geodis, Schenker etc. (Parcel, 2002).

4.1.2 Joint ventures (example: tramp shipping pools)

A joint venture is a short-term or long-term business arrangement in which two or more parties agree to pool their resources to accomplish a specific task or project. Each of the participants in a joint venture is responsible for the profits, losses, and costs associated with the joint venture. However, the joint venture is an entity which is separate from the other business interests of the participants (Hargrave, 2023b).

A pool is a joint venture of vessel owners for the pool of vessels of similar type and size with centralised commercial management (joint marketing, negotiation of freight rates and centralisation of incomes and voyage costs) and commercial operations (planning vessel movements and instructing vessels, nominating agents in ports, keeping customers updated, issuing freight invoices, ordering bunkers, collecting the vessels' earnings and distributing them under a prearranged weighting system), (Woolich, 2015a, Chartering, 2015). The technical operation of vessels (safety, crew, repairs, maintenance) is still usually the responsibility of each owner (Woolich, 2015a).

Joining a pool allows owner to achieve economies of scope, diversification and spread of risk, bargaining power, less ballast legs and idle times, and secure cashflow even when vessel is unemployed. However, shipowners can't control the tonnage and they rely on a 3rd party to secure employment of the ship. Shipowners become detached from the market and their own operational mechanism (e.g., insurance policy) (Hargrave, 2023a, Woolich, 2015b, Chartering, 2015).

4.1.3 Associations (example: ports)

Traditional port associations try to defend the interests of their members at bodies, generally supranational, acting as a lobby and representing their members in a collegiate manner (eg., ESPO). Recently, however, new types of associations are developing, which in many cases do not even adopt a legal structure, acting more like a "club of friends" with common interests, more focused on sharing knowledge and experience than on the traditional representation or lobbying function (PierNext, 2022).

Ports join the associations to easier face demanding environment in which they operate. Port associations have a common goal, usually to promote the region and attract more traffic to it.

For example, the European carrier association, ASTRE, was created to help independent carriers exchange transport requests (Pan et al., 2019). The system allows to find tailored, scalable and environmentally responsible transport and logistics solutions at every stage in the supply chain. All ASTRE members have regular customers with whom they do most of their business. The rest they do with their partners in ASTRE. The main idea is to serve shippers who demand onestop shops for their logistics services in Europe, and they mostly compete to the major pan-European logistics concerns like Danzas, Geodis, Schenker etc.

4.1.4 Single carrier collaboration

Single carrier collaboration is a term used to describe an HCT solution for an autonomous and independent carrier who collaborates with one or more other carriers. For such companies, horizontal cooperation increases efficiency and competitiveness by raising economies of scale, increasing sales, lowering costs, and sharing information and resources (Parcel, 2002). This HCT solution is based on a bilateral carrier-carrier agreement and not multilateral alliance agreement as alliance HCT model.

4.1.5 Transport marketplace

Transport marketplace facilitates the connection of shippers with carriers/logistics professionals. It can manifest as an online platform. Traditionally, within the transport marketplace, shippers assume the role of buyers seeking transport services, while carriers act as sellers offering their services. In this context, competition typically prevails, particularly in terms of bidding prices among carriers. However, in certain instances, carriers may play a dual role, functioning as both buyers and sellers. This occurs in marketplaces that allow carriers to exchange service requests. Consequently, these marketplaces evolve into collaborative transport platforms for carriers (Parcel, 2002).

A collaborative marketplace approach distinguishes itself from single carrier collaboration, joint venture and associations by its exchange system's inherent openness. Here, a carrier has the option to submit their request into the system without actively searching for partners. Subsequently, any carrier that proposes an appealing price can react to the request directly through the system (Pan et al., 2019).

Transport marketplace facilitates the connection of shippers with carriers/logistics professionals. For example, TimoCom is a digital marketplace featuring a freight exchange which supports trade and industry companies, freight forwarders and road hauliers to assign and find transport orders for road transport. Their goal is to optimise the customer’s logistics processes and save them time and money. TimoCom revolutionized Europe’s transport sector by creating an electronic marketplace for freight and vehicle exchange (Pan et al., 2019, TimoCom, 2023).

4.1.6 Shipper or logistics service provider collaboration

Collaboration can also manifest among distinct shippers embedded within a supply chain. In this scenario, cooperating shippers jointly and reciprocally establish or amend logistics and transportation parameters (such as routes, shipment quantities, lead times, or delivery windows) with the objective of achieving transportation synergies. For instance, two shippers can engage in collaboration through a shared logistics service provider. This intermediary entity facilitates the creation of joint transportation plans for the shippers and, when necessary (in cases where the logistics provider lacks its own transportation capabilities), forwards transportation requests to carriers (Pan et al., 2019)

Collaborative distribution (last mile)

Collaborative distribution brings together different shipments from different companies that are going to the same location. A third-party transport company that acts as a matchmaker can identify which

shipments are going to the same location so these shipments can all be loaded onto a single truck. This not only fills that truck's space is not wasted, but it also cuts down on the number of trucks required to move goods. So, instead of thousands of products travelling separately to the same end point, this concept foresees their combination them into highly utilized units, thus taking numerous trucks off the road, reducing greenhouse gas (GHG) emissions and cutting distribution costs for as much as 35% (Munholland, 2015).

4.1.7 Logistics pooling

Logistics pooling, sometimes referred to as supply chain pooling, can be defined as a strategy aimed at leveraging synergies among supply chains through the amalgamation of both vertical and horizontal collaborative efforts. This approach to logistics pooling involves the collaborative design and utilization of a unified logistics network by various partners, including suppliers, manufacturers, retailers, and carriers, all sharing a common goal. The resources that are commonly pooled and shared among these partners encompass warehouses, platforms, and transportation assets. Contrasting this with the traditional shipper or logistic service provider collaboration model, which primarily involves shippers, logistics pooling takes a more expansive approach by orchestrating the coordination of a broader spectrum of supply chain stakeholders and integrating their shared interests into the overall solution (Pan et al., 2019).

Shared warehousing

A shared warehouse (public warehouse or multi-client warehouse) is a single warehouse that operates as a distribution centre supporting multiple businesses. In this way the users share the costs of space, labour, and technology which can help rationalize their supply chain operations and provide quicker delivery at lower costs. In addition, the users of shared warehouses can test new markets for their business without having huge investments. Shared warehousing is becoming a popular solution for online retailers with (currently) only one downside visible; the warehouse is managed and run by the third-party logistics (3PL).

Largest European warehouse complex is located in Sipoo, Finland. It streatched over 195,000 sq m. The Finnish logistics service provider INEX Partners introduced this grocery distribution centre in 2018. It can store over 300,000 goods, receive about 1,000 delivery vehicles as well as supply more than 1,500 stores daily. Most importantly, advanced automated systems handle 80% of containers with dry goods; there's just one manual phase (Pan et al., 2019).

4.1.8 Physical internet

Within the framework of the physical internet's horizontal collaboration business model, carriers have the capability to exchange transport requests by utilizing an open physical internet hub. This exchange aims to enhance the efficiency of truck load rates and minimize empty trips. Consequently, each time a transport request reaches a physical internet hub, it can be reassigned to the most competitive

carrier, with each reassignment serving as a localized optimization step. The distinct feature of the physical internet lies in its decentralized approach to organizing and optimizing transportation. This implies that the optimal route for a specific request, from its point of origin to the final destination, is dynamically adjusted in real-time at a physical internet-hub based on locally available information. To effectively manage such decentralized systems, the implementation of transport protocols and collaborative protocols becomes essential. These protocols play a pivotal role in ensuring the level of service and global optimization across the network (Pan et al., 2019).

4.1.9 On-demand logistics

On-demand logistics, known also as Uber-like business model for freight transportation, is one form of HC beginning to emerge in recent years. The on-demand logistics market is becoming more popular because it is more efficient, convenient, and cost-effective to transport products by truck. It is also possible to track the products in real time. The market is expected to be worth $75 billion by 2030 (Arbuzova, 2019).

On-demand logistics focuses on increasing asset utilisation and operating flexibility by allowing last-minute matching between providers and customers, often via an app. With on-demand logistics, manufacturers secure transportation and storage for their goods as-needed from a pool of available resources utilised by the entire supply chain. Agreements between the on-demand transportation provider and the customer are typically contract-free, with the price charged to customers based on the amount of goods shipped and the customer's delivery window (Pan et al., 2019).

On-demand logistics companies offer a range of services, from last-mile delivery to same-day delivery. These services allow retailers to get products to customers quickly and efficiently without investing in their own delivery infrastructure. On-demand logistics thus enables brands to expand their customer reach and fulfil orders as soon as they are placed (Silitonga, 2022). Such logistics is more flexible; however, it is also more costly.

4.2 Real case examples of business models in transport and logistics

4.2.1 Load carrier sharing in transports

A load carrier is typically a wheel mounted pallet, cage or container designed to transport and support parcels, products, objects, or materials. They are specifically designed to handle the weight and dimensions of the load and ensure its safe transportation. Load carriers play a crucial role in different industries like parcel logistics, car manufacturing, dairy and warehousing, where moving loads efficiently is necessary (Figure 12). In Finland, sharing of returnable load carriers has been reality for decades between dairy industry operators.

Figure 12. Examples of returnable load carriers[13].

Load carriers are vital material handling equipment and essential part of transportation systems, that are widely used in various industries to facilitate the movement and transportation of goods and materials. By adding a sensor, a load carrier becomes an intelligent asset that can produce data from the whole cycle of its use. With the data it is possible the improve the efficiency of the load carrier fleet, e.g., transportation of empty units can be minimized, cycle time improved, and asset losses minimized. Additionally, intelligent load carriers extend data collection to the entire process, generating much richer data that can be analyzed and turned into efficiency improvements and shorter throughput times and to prevent process errors as well.

In Nordic countries there are two rather exceptional load carrier pooling concepts between food and beverage industry together with producers, wholesalers, shops and restaurants. Finnish origin example is Ekopulloyhdistys (Ekopullo association), managing a deposit-based return system that includes refillable deposit glass bottles, deposit transport units for beverage containers, such as plastic trays, dollies, and PAN pallets, owned by its member companies. Ekopullo's transport units are primarily used to deliver packages belonging to return systems administrated by Suomen Palautuspakkaus Oy (Palpa); aluminium cans, plastic and glass bottles that are subject to a deposit and are recyclable as material. Ekopullo's and Palpa's deposit-refund systems offer a functional and resource-efficient overall solution for beverage deliveries for the beverage industry and wholesalers.

Ekopulloyhdistys ry is a non-profit association established in 2004. The operation of the association is funded by the entrance and membership fees paid by its members. Ekopullo acquires the required human resources and other services from Suomen Palautuspakkaus Oy (Palpa), in whose premises the association operates.

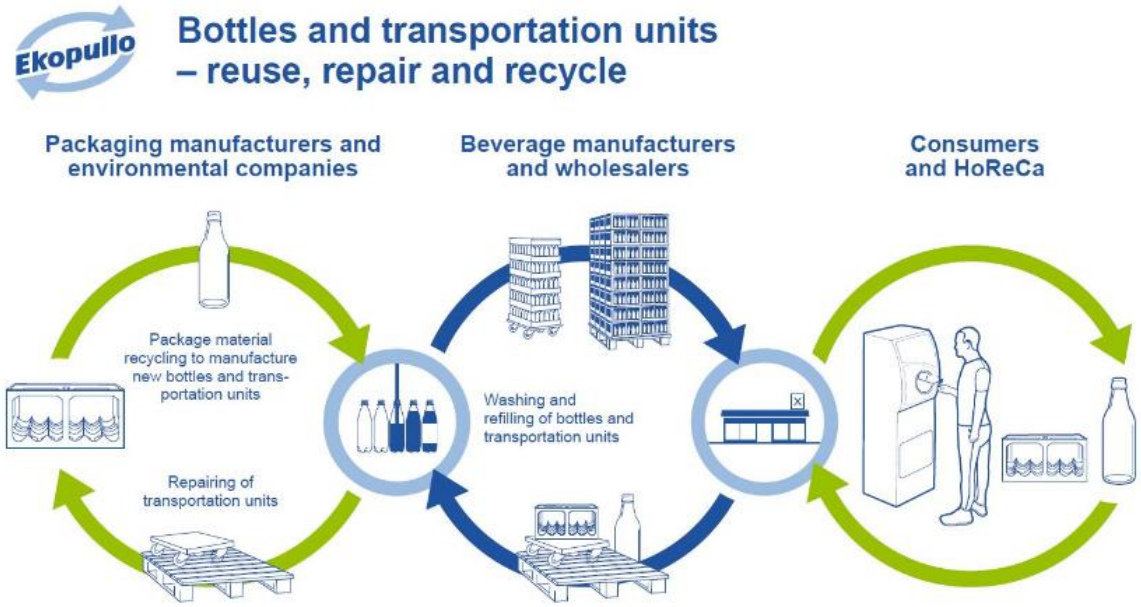
Ekopulloyhdistys association develops and promotes the reuse, repair and recycling of beverage packages and transport units subject to a deposit in cooperation with its member companies. The deposit-based system for beverage packages together with the reuse of transport units considerably

[13] K. Hartwall Ltd., 2023, https://k-hartwall.com/products/

reduces the amount of package waste and environmental impact. The deposit system also ensures that transport units damaged in use are returned into the system.

The service life of reusable transport units can be considerably extended by repairing damaged units with new or recyclable spare parts. The bottles and transport units are manufactured using standard raw materials, which ensures that the materials obtained from them after use are high-quality recyclable raw materials.

The return rate of Ekopullo's refillable glass bottles has remained very high in Finland for years. Consumers return approximately 97% of glass bottles placed on the market. Glass bottles are washed and inspected every time they are refilled. Glass bottles can be refilled 33 times on average. Second Nordic example is Swedish Returnsystem[14].



[14] https://www.retursystem.se/sv/vart-retursystem

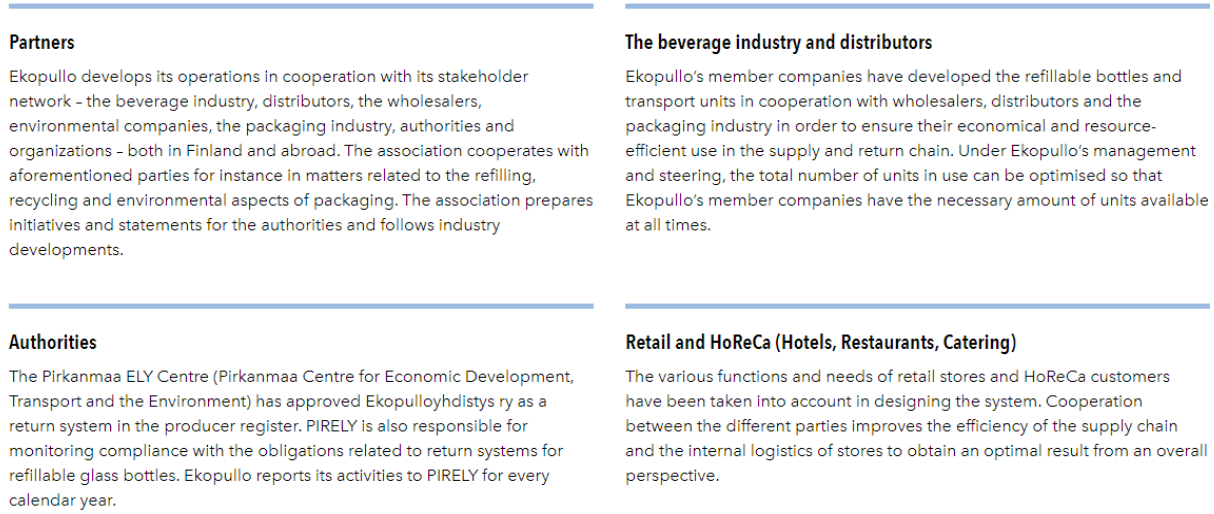


Figure 13. Ekopullo pooling concept for beverage packages[15].

The key learnings from the load carrier sharing case to support the ADMIRAL development work are summarized in the Table 9.

Table 9. Summary of the shared load carriers case.

Key elements of the case analysis	Key findings (load carriers)
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Supports mainly local scale Supports globally if integrated to container logistics
Key stakeholders	•
How the case/solution supports sharing of data/information	Supports if load carriers tracked
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Potential integration to platform through sensors etc.
Motivation and barriers	

[15] https://www.ekopullo.fi/en/

What are the motivations/incentives for collaboration / sharing	Time and asset savings
What are the regulatory drivers/limitations/barriers?	Not identified
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Not identified
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Stakeholder association as a governance model for collaboration
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ **Single carrier collaboration (S1)**
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ Transport Marketplace (S3)
	  ○ Shipper or LSP collaboration (S4)
	  ○ **Logistics pooling (S5)**
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ Collaborative network design (I1)
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• horizontal

4.2.2 Digital solution for shipping value chain – Case Tradelens

TradeLens is a collaborative platform developed by Maersk and IBM with the aim of digitalizing inter-organizational collaboration in the containerized shipping industry. It utilizes blockchain technology to enable the trusted exchange of information among industry participants. The solution provides

authorized actors with access to relevant shipping information throughout the supply chain, helping them comply with regulations, reduce administrative costs, decrease lead times, and mitigate risks through improved monitoring capabilities. The core components of TradeLens include the Shipping Information Pipeline (SIP) platform for event tracking and information, the Paperless Trade (PT) Blockchain Network as a document repository, and the blockchain network for access control. Figure 14 illustrates the Tradelens architecture.

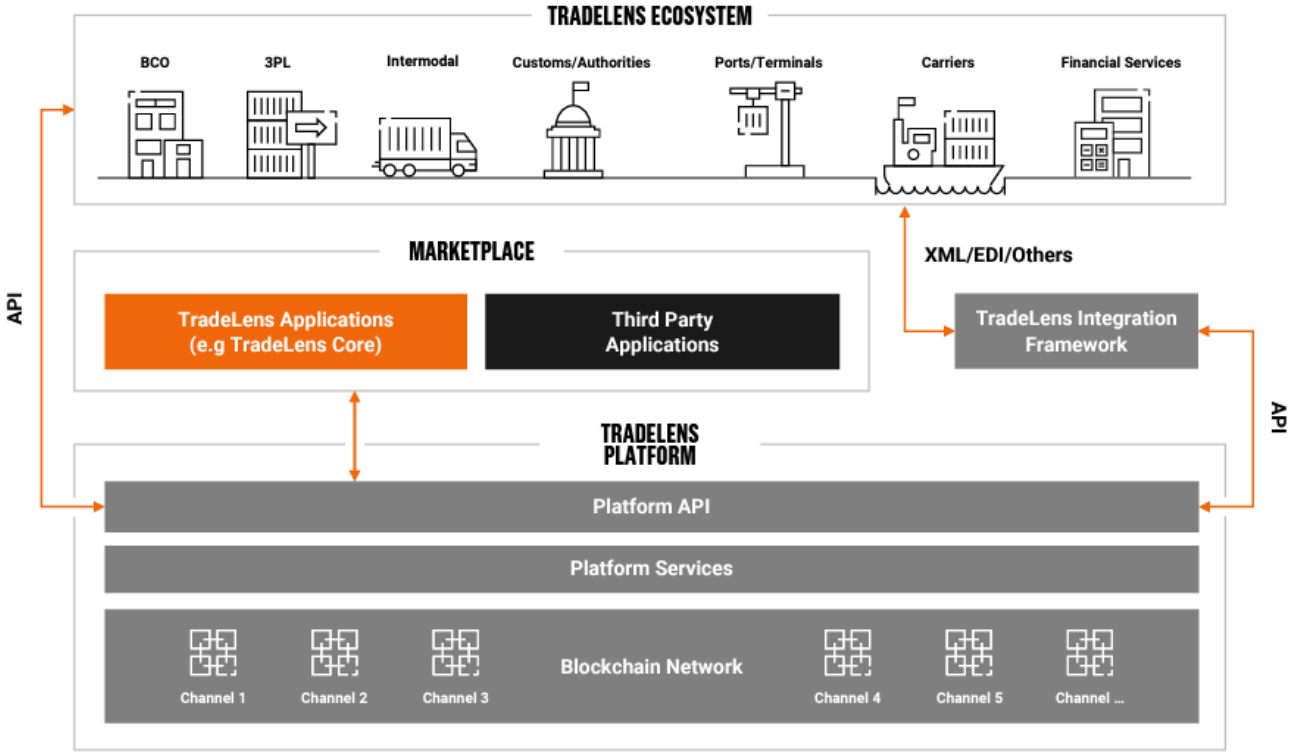


Figure 14. TradeLens Architecture (Source: IBM).

The development of TradeLens faced challenges, including the complexity of exploring a new technology and the distributed nature of the development team, with members located in different countries. The organizational structure of TradeLens went through several transformations, starting as separate initiatives sponsored by Maersk and IBM. Initially, plans for a joint venture were made, but due to prolonged approval processes in some countries, the ownership structure shifted to Maersk forming a subsidiary company. TradeLens established an advisory board with industry leaders to ensure an open platform. Timeline of TradeLens development path (Jensen et al, 2019) is presented in the Figure 15 and a simple stakeholder diagram in the Figure 16.

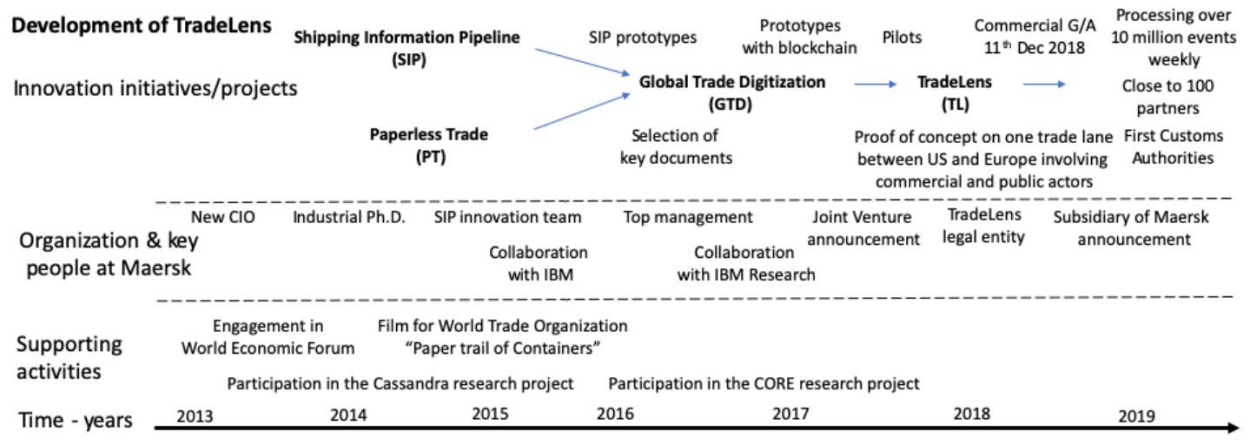


Figure 15. Timeline of TradeLens development path (Jensen et al, 2019).

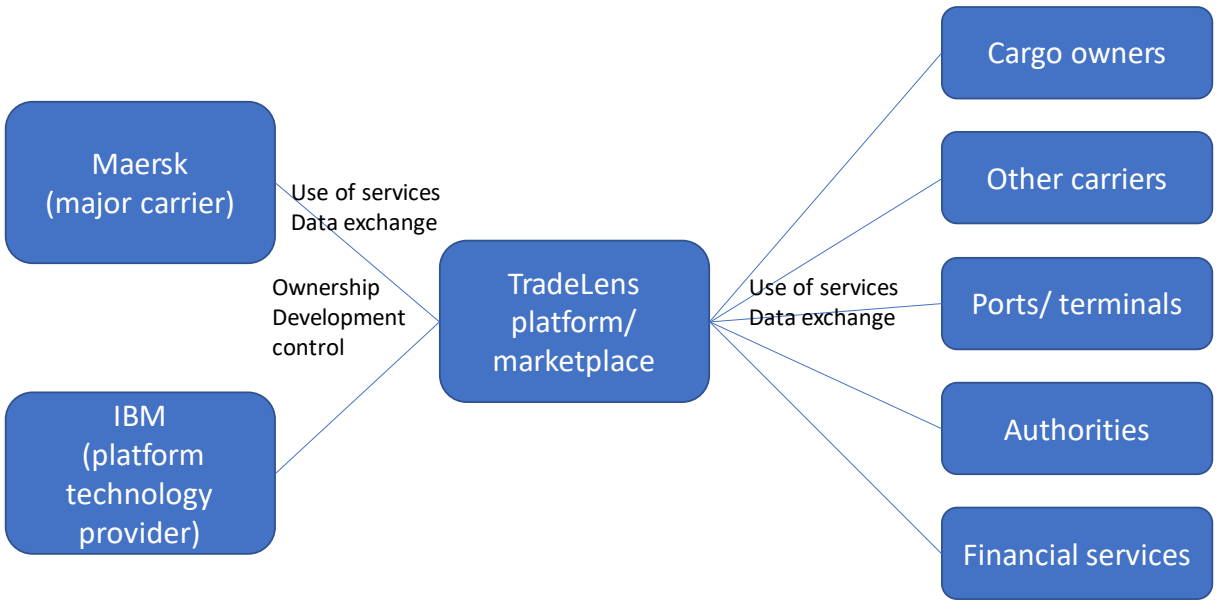


Figure 16. Tradelense stakeholder diagram.

Lessons from the Tradelens development process

Based on their research of TradeLens development process, Jensen et al (2019) identify seven key lessons. Firstly, blockchain solutions require a shift in corporate strategy towards uplifting the entire ecosystem rather than focusing solely on individual organizations. Secondly, the focus should be on the vision rather than return on investment (ROI), as blockchain aims to disrupt and create value through disruption. Thirdly, blockchains address trust issues in inter-organizational contexts by providing distributed control through technical solutions. Fourthly, partnership trust is crucial for the success of inter-organizational blockchains, as it establishes credibility and enables unbiased competition. Fifthly, the starting point for blockchain implementation should consider legitimacy and political feasibility, focusing on areas where acceptance and adoption are more likely. Sixthly,

governance models for blockchain need to evolve as adoption expands, with the need for decision-making structures and adaptability. Finally, blockchain interoperability is a strategic consideration as digital platforms and technologies evolve within the industry.

Discontinuation of TradeLens

At the end of 2022 Maersk and IBM decided to shut down the TradeLens service. In their web page Rotem Hershko, Head of Business Platforms at A.P. Moller – Maersk, stated that "TradeLens was founded on the bold vision to make a leap in global supply chain digitization as an open and neutral industry platform. Unfortunately, while we successfully developed a viable platform, the need for full global industry collaboration has not been achieved. As a result, TradeLens has not reached the level of commercial viability necessary to continue work and meet the financial expectations as an independent business."

As the decision is quite recent, more detailed analysis of the discontinuation is yet not available. Following explanations have been given in different media outlets:

The adoption of TradeLens was limited, with only a small portion of participants in the global shipping industry joining the project. Notably, Asian/Chinese container shipping firms did not become part of TradeLens, and a major European shipper chose to join a competing permissioned blockchain supply chain ledger called Global Shipping Business Network (GSBN) (Mearian, 2022).

Various challenges contributed to the platform's failure, including the difficulty of digitizing documents that span multiple jurisdictions. While electronic bills of lading have been used for decades, insufficient effort was made to understand the key obstacles to digitizing shipping documents before employing blockchain technology (Mearian, 2022).

The search for a viable, commercial model for an electronic shipping ledger remains an issue for all blockchain networks, including TradeLens. Additionally, technical issues were compounded by concerns surrounding Maersk, the shipping giant driving the TradeLens initiative. The involvement of Maersk raised skepticism among potential participants, and the inclusion of IBM in the project was not sufficient, particularly as IBM itself scaled back its focus on blockchain technology. The original plan for a joint venture between Maersk and IBM also fell through due to legal and regulatory reasons (Mearian, 2022).

Maersk's objective was to create a trading platform similar to Sabre for airline booking (also developed by IBM), with the goal of facilitating collaboration among ocean shippers. However, the fragmented and volatile nature of the ocean shipping market posed significant barriers to achieving this vision (Cecere, 2022).

Table 10 presents the key findings from Tradelens case with regards to ADMIRAL development.

Table 10. Summary of the Tradelens case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Horizontal collaboration between Maersk and IBM. Horizontal and vertical collaboration support for container logistics stakeholders. Blockchain based platform solution enables trusted data exchanged between logistics stakeholders.
Key stakeholders	• Maersk • IBM (platform technology developer)
How the case/solution supports sharing of data/information	Key aim to provide platform for data sharing in logistics process. Initiated by one major logistics player, challenges to get others onboard.
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Blockchain based platform solution
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Business process efficiency through digitalization of processes.
What are the regulatory drivers/limitations/barriers?	Not identified
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Initiated by one major logistics player, challenges to get others onboard (competitors suspicious), slow uptake by other players (if not at all). System developer and logistics player had challenges to agree on the governance model of the platform.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	• Collaboration governance model may turn away potential partners (large competitor in key role)
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ **Single carrier collaboration (S1)**
	  ○ Carrier Alliance/Coalition (S2)
	  ○ **Transport Marketplace (S3)**
	  ○ Shipper or LSP collaboration (S4)
	  ○ Logistics pooling (S5)
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ **Collaborative network design (I1)**
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ **Coalition formation and Gain sharing (I4)**
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ **Management and governance (I7)**
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• horizontal • vertical

4.2.3 Transport sharing between Procter & Gamble and Tupperware

The horizontal collaboration was focused on incorporating the Tupperware freight flows in the P&G supply chain – sharing means of transport and warehouse. Which was the reason (Protector & Gamble, 2016)?

In the early 2010s, P&G identified a low load factor problem in its transport operations between its production facilities in Belgium and its warehouses in Greece. P&G shipments of detergents consisted in an intermodal solution of road and railway transport that was using a 95% of the maximum weight capacity of the vehicles but only 50% of the volume capacity. The frequency of the shipments was three times per week resulting in approximately 300 loads per year with transit times between 6 and 7 days. The company realized that increasing the use of the volume capacity of its vehicles was an opportunity to reduce logistics costs and increase the overall efficiency of its supply chain (Protector & Gamble, 2016).

The Tupperware also had manufacturing facilities and distribution centres in Belgium, more precisely in Aalst. Tupperware was sending plastics boxes to Thiva, 100 km away from Athens, by road using 120 m3 combi-trailers. The shipments had a frequency of one trip a week, with transit times between 3 and 5 days, which resulted in approximately 80 loads per year. The bulk cargo had a load preparation of 27 man-hours and filled around 80% of the maximum volume of the vehicles but only 30% of its weight capacity (Protector & Gamble, 2016).

The solution consisted in the elimination of all direct Tupperware truck shipments to Greece, which were being loaded as bulk in the vehicles. Instead, the Tupperware products were shipped to the P&G distribution centre in Mechelen. In this distribution centre, P&G detergents were being palletized and loaded in containers. The horizontal collaboration required that the Tupperware plastic cases were top-loaded on the detergents pallets and transported to Greece using the 45 feet containers carried by road and railway (Protector & Gamble, 2016).

Outcomes of the collaboration:

- Transport costs reduction (17%).
- Raise of the load factor from around 50% to 85%.
- Use of more sustainable transport mode.
- Reduction of congestion.
- Reduction of CO2 emissions in more than 200 tons of CO2.

Companies involved in the collaboration:

- Procter & Gamble is an American multinational consumer goods company specialised in the following sectors: beauty care, baby, feminine and family care, fabric and home care and health and grooming.
- Tupperware, one of the world's leading manufacturers and sellers of plastic food serving, storage, and preparation products (Protector & Gamble, 2016).

Type of collaboration within a case study:

- Horizontal collaboration. A simple stakeholder diagram of the case presented in the Figure 17.

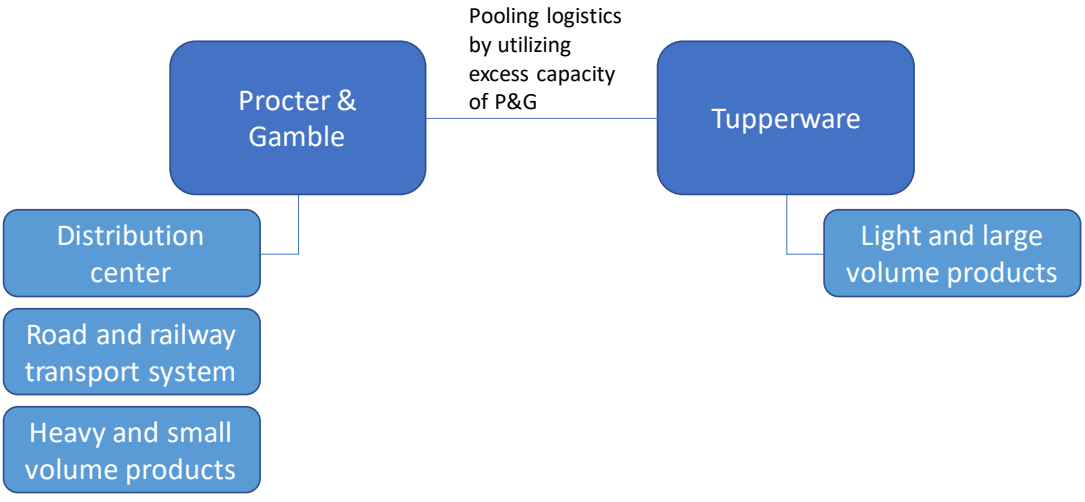


Figure 17. Procter & Gamble and Tupperware stakeholder diagram.

Identified challenges are as follows:

- Finding right partners (open-minded in terms of innovative solutions and willing to set up collaboration with an external company) --> this task is meant to be performed by a neutral third party (trustee). The third party is responsible for gathering the information from potential partners, avoiding them to directly share sensitive information. The role of the trustee is to reduce uncertainty by increasing trust among companies.
- Addressing challenges related to some important differences in terms of speed, frequency between both companies, matching lanes, coordinating loads, a shift to an intermodal solution, optimizing container fill and thinking "outside the box" to get a creative solution: collaborative pallets.
- Building trust between the two companies.
- Coordination of information systems of both companies.

Table 11 presents the key findings from P&G and Tupperware case with regards to ADMIRAL development.

Table 11. Summary of the transport sharing case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Sharing transport assets (services) / pooling logistics between two cargo owners.
Key stakeholders	• Procter & Gamble • Tupperware
How the case/solution supports sharing of data/information	Logistics scheduling data shared (sharing lanes, loades).
Does the case/solution handle emissions data?	No
Use of platform technologies	No.
How the case/solution uses platform technologies	IT solution knowledge not available.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Increasing transport capacity utilization, cost and emissions reduction. Combining heavy and small volume cargo with light and large volume cargo to fill up containers.
What are the regulatory drivers/limitations/barriers?	Anti-trust law.
Implementation challenges	

Identified challenges/ requirements/enablers for implementation / market uptake	Finding right partners, Addressing challenges related to some important differences, Building trust between the two companies, Coordination of information systems of both companies, sharing the gains, how to collaborate and not violate the anti-trust law.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Find a legal formula (competition law) which is in accordance with EU and third countries). Transport sharing service could be a potential offering on the ADMIRAL marketplace.
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ **Single carrier collaboration (S1)**
	  ○ Carrier Alliance/Coalition (S2)
	  ○ Transport Marketplace (S3)
	  ○ Shipper or LSP collaboration (S4)
	  ○ **Logistics pooling (S5)**
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ **Collaborative network design (I1)**
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ **Coalition formation and Gain sharing (I4)**
	  ○ **Information and communications technology (I5)**
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• horizontal

4.2.4 Europe's first Smart Logistics System – TIMOCOM

TIMOCOM GmbH – freight and warehouse space marketplace – a mid-sized IT and data specialist, with more than 500 employees from over 40 countries, and representative offices in Poland, the Czech Republic and Hungary (TimoCom, 2023).

Services offered by TIMOCOM are:

- B2B freight and vehicle exchange.
- B2B network offering varied storage space.
- Tenders.
- Goods transport insurance.
- Routes planning & Costs calculating (TimoCom, 2023).

B2B freight and vehicle exchange: Owner drivers and haulage companies can search for a cargo space from over 147,000 members across Europe using our intuitive multi-search tool and place offers. With up to 1 million international freight offers and cargo spaces available daily for carriers and forwarders, a customer can narrow a search by radius, vehicle location, and more to find the ideal space, or secure interesting offers with a freight quote (TimoCom, 2023).

B2B network offering varied storage space: TIMOCOM it is by far the largest B2B network offering the most and most varied storage space in Europe. The system user automatically has access to more than 9,000 warehousing and logistics spaces across 46 European countries or can offer a free storage space to other customers. Depending on needs, a customer can submit or view storage space offers and connect directly to potential business partners (TimoCom, 2023).

Tenders: As a transport and logistics company, you can find the perfect business partner and make optimal long-term use of your vehicle fleet. Take part in national and European tenders and expand your network with attractive transport customers from the manufacturing, commercial and logistics (TimoCom, 2023).

Companies involved in TIMOCOM:

- Owners of goods.
- Owners of storage space.
- Logistics providers (road transport companies).
- Freight forwarders
- TIMOCOM

A simple stakeholder diagram is presented in the Figure 18.

TIMOCOM GmbH is offering Europe's first Smart Logistics System – **a digital marketplace** featuring a freight and warehouse space exchange which supports trade and industry companies, freight forwarders and road haulers to assign and find transport orders for road transport and warehouse space. TIMOCOM's Smart Logistics System connects customers, transport and warehouse service providers throughout Europe. Their neutral network consists of over 50,000 verified companies. Transactions are concluded directly between the contract partners (TimoCom, 2023).

Type of collaboration within a TIMOCOM:

- Vertical collaboration (freight owners & road carriers).
- Horizontal collaboration (road carriers that have excess cargo).

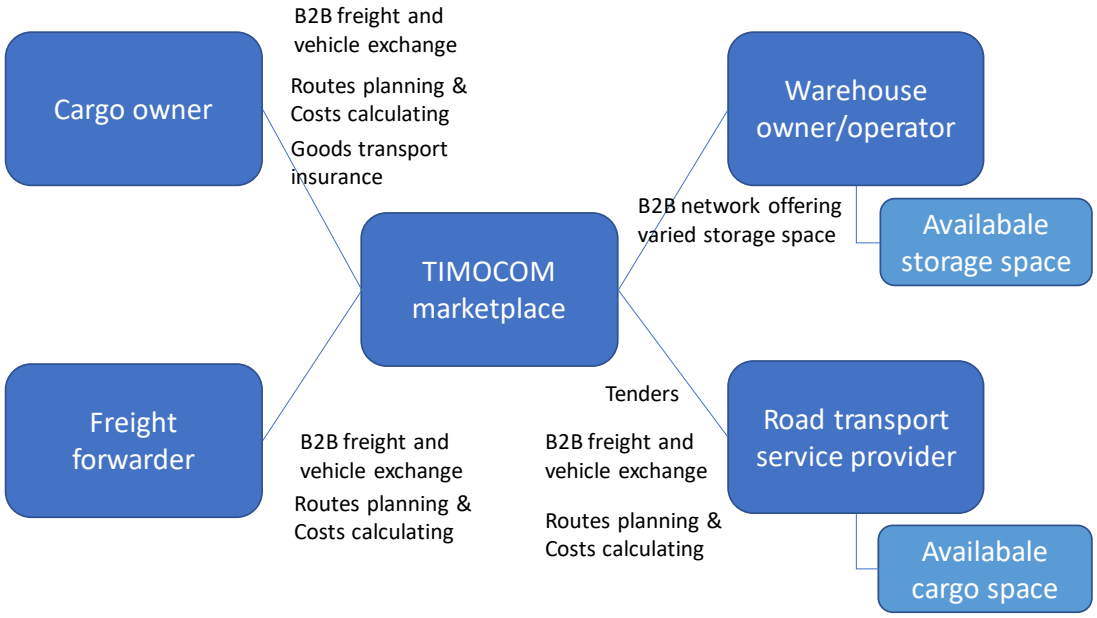


Figure 18. TIMOCOM stakeholder diagram.

Requirements/enablers for the implementation of services within a TIMOCOM are as follows:

Security: There is a whole package of security measures, all with a single goal: optimally protecting customers' business:

- New customer verification.
- Identity verification.
- Access software.
- Technologies.
- International debt collection service (TimoCom, 2023).

New customer verification: All customers interact within TIMOCOM solely with verified business partners. TIMOCOM thoroughly vet customers before approving their applications, to ensure only trustworthy partners can access the platform. Companies that wish to work with TIMOCOM have to meet specific requirements and strict access protocols:

- Access to the exchange is generally permitted after 6 months corporate existence.
- Authentication of important business documents before conclusion of a contract.
- Verification of every new customer.
- Permanent customer monitoring even after conclusion of a contract (TimoCom, 2023).

Identity verification: Since transactions are carried out directly between the parties involved, commercial due diligence must be exercised by everyone:

- Partners can check other business partner's identity.
- Partners can request that other business partner send a print-out of the relevant offer from the Smart Logistics System. They can also immediately check whether they have legitimate access to the Smart Logistics System.

- Partners can have a look at other potential business partner's company profile. With the document feature, frequently requested documents should have been uploaded to the profile for identification purposes.
- Partners can compare the information in the uploaded documents with the company's information in their company profile.
- Partners can compare the contact person's details, for example, whether name, phone number and e-mail address are identical to the data in the company profile (TimoCom, 2023).

Access software: A secure access to the System is granted to TIMOCOM customers, via an individual security access key. Once customers' account is activated, they will always have simple, authorised, secure access to the Smart Logistics System (TimoCom, 2023).

The same high security standards apply even when accessing the Smart Logistics System via mobile app. An individual PIN grants access to customers' personal Smart Logistics System account and allows them to work with all System applications (TimoCom, 2023).

Technologies: As an IT specialist, TIMOCOM offers: (1) Certified and energy efficient data centres. (2) Secure transmission of data thanks to the encrypted SSL connection. (3) 24/7 monitoring and operating with customer's IT department. (3) Multiple redundant internet connections. (3) Powerful firewall and multi-layer anti-virus systems (TimoCom, 2023).

International debt collection service: International debt collection service is an efficient accounts receivables management partner. The service acts as an intermediary across Europe in 27 languages. If someone's business partner has defaulted on a payment, a customer can count on competent and reliable help from debt collection team. They take action quickly and without complications and find out whether or not a customeer can expect to receive money (TimoCom, 2023).

Table 12 presents the key findings from the TIMOCOM case with regards to ADMIRAL development.

Table 12. Summary of the transport marketplace TIMOCOM case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	**A digital marketplace** featuring a freight and warehouse space exchange which supports trade and industry companies, freight forwarders and road hauliers to assign and find transport orders for road transport and warehouse space.
Key stakeholders	• Owners of goods. • Owners of storage space. • Logistics providers (road transport companies). • TIMOCOM (marketplace provider)

How the case/solution supports sharing of data/information	TIMOCOM provides marketplace for following services: • B2B freight and vehicle exchange. • B2B network offering varied storage space. • Tenders. • Goods transport insurance. • Routes planning & Costs calculating. • Tracking.
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	• Routes planning & Costs calculating. • Tracking. Archive and tracking transport orders. Smart Logistics System. Transport barometer.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Reduction of empty runs, biding on national and European tenders, optimisation of warehouse and truck space use, reduction of CO_2 emissions.
What are the regulatory drivers/limitations/barriers?	Not identified.
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Misues of identity. Fantasy companies.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	• New customers access check. • A personal security key when downloading Login.
Theoretical positioning (logistics cases)	
Pan 2017 article classification of horizontal collaboration	• HCT solutions: ○ Single carrier collaboration (S1) ○ Carrier Alliance/Coalition (S2) ○ **Transport Marketplace (S3)** ○ Shipper or LSP collaboration (S4) ○ **Logistics pooling (S5)**

	○ Physical Internet (S6) • Implementation issues of HCT solutions: ○ Collaborative network design (I1) ○ Transport planning optimisation (I2) ○ Mechanism for exchanging requests (I3) ○ Coalition formation and Gain sharing (I4) ○ Information and communications technology (I5) ○ Organisation (I6) ○ Management and governance (I7) ○ Collaborative and Distributed Inventory Management (I8)
Type of collaboration?	• Vertical collaboration (freight owners & road carriers). • Horizontal collaboration (road carriers that have excess cargo).

4.2.5 B2B containers exchange digital platform - XChange

xChange Solutions GmbH offered the following services:

- B2B containers exchange (leasing, trading).
- Container control.
- Container tracking.
- Container insurance (xChange, 2023).

B2B containers leasing: A company can use a platform to make a container more visible by specifying the location, container type and quantity and setting terms. A company that is searching free container space can check the desired locations among 2500+ around the world and quickly find new suppliers, that they can trust. Customers can find containers for any type of goods from dry cargo to wood logs and metal scrapes (xChange, 2023).

Container control: A company can get a clear overview of all the containers they are moving and monitor their journey in near real-time. They also get notified on latest container movements and each container's status and can use this information to minimize future charges (xChange, 2023).

Following companies are involved in the platform:

- Freight owners.
- Port agents.
- Logistics service providers.
- NVOs.
- Shipping lines.
- Railways operators.

- Xchange marketplace (xChange, 2023).

XChange is the world's first neutral container trading marketplace – making xChange the 1-stop shop for all things container-related. For example, if someone needs to move a container to Egypt, then by using XChange can see who she/he can do business with (xChange, 2023).

Requirements/enablers for the implementation of services offered by xChange:

Security:

- Owner of the platform does background checks on every member (any sanctions alert on a company in international watch lists and government records, negative news on a company e.g., fraud, crime, arrests, etc., any criminal activity) so companies can safely do business on xChange with confidence.
- xChange also ensures that containers are safe, guarantees payments, and credits them to a customer in real time.
- xChange also ensures that companies get the containers they need and verifies release references with depots to avoid pick-up issues.
- Access and use of the Platform is conditional upon receipt of the necessary Login Details from xChange Solutions GmbH which may grant or restrict the Login Details in its absolute discretion and restrict access to all or any part of the Platform.
- Participants are required to treat information received from or via the Platform as confidential and will not disclose it to any other person not entitled to receive such information except as may be necessary to fulfil their respective obligations in the conduct of their business and except as may be required by law or regulatory authority.
- xChange Solutions GmbH processes and transfers personal data in accordance with the Privacy Policy and the Participant confirms it has read and understands the Privacy Policy and consents to any collection, use, processing, disclosure and transfer of personal data carried out by xChange Solutions GmbH in accordance with the Privacy Policy.
- The Platform offers two models to settle payments between the Participants. The first alternative is a bilateral payment settlement (The parties to the transactions are contract partners in the transaction and directly address invoices including related charges and applicable taxes to the other party.). The alternative consists of a payment settlement via xChange Solutions GmbH acting on behalf of the Supplier as commercial agent (xChange, 2023).

Table 13 presents the key findings from xChange container exchange platform case with regards to ADMIRAL development.

Table 13. Summary of the container exchange platform case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	

How the case/solution supports company business collaboration activities?	Platform provides container location and exchange service for container providers and customers.
Key stakeholders	• Freight owners. • Port agents. • Logistics service providers. • NVOs. • Shipping lines. • Railways operators. • X-Change (marketplace platform provider). • Leasing companies.
How the case/solution supports sharing of data/information	• A company can get a clear overview of all the containers they are moving and monitor their journey in near real-time. • Catalogue of container offerings
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Slot booking directly from shipping lines and feeders. Tracking. Container insurance.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	• More efficient container utilization. • Reduction of depot costs, as well as demurrage and detention charges. • Learning the latest global and region-specific trends and future developments forecasts. • Receiving auto alerts in case of delays, discharge, rollovers or lengthy wait times. • xChange takes care of following up on open invoices or calculating per-diem charges.
What are the regulatory drivers/limitations/barriers?	Not available
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Not available
Learnings for ADMIRAL	

Key takeaways to ADMIRAL development	Potential service for the ADMIRAL marketplace?
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ Single carrier collaboration (S1)
	  ○ Carrier Alliance/Coalition (S2)
	  ○ **Transport Marketplace (S3)**
	  ○ Shipper or LSP collaboration (S4)
	  ○ Logistics pooling (S5)
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ Collaborative network design (I1)
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• Vertical collaboration • Horizontal collaboration

4.2.6 Freight consolidation network - System Alliance Europe

System Alliance Europe offers delivery of various types of goods through the Europe (they are offering 9 different types of deliveries regarding the time of delivery, information offered to recipients of goods, documentation sent with the shipment and payment of delivery) (Martin et al., 2018).

48 partners belonging to 24 mediumsized logistics service providers are involved in the alliance. Allinace enables horizontal collaboration (Martin et al., 2018).

Requirements/enablers for implementation of the alliance are as follows:

Security:

- "Regarding partner selection, the initial alliance formation was not accompanied by extensive formal activities as bilateral agreements already existed among the 13 initial partners. Formal partner screening seemed to have limited added value since sufficient insights in, among others, operational procedures was gained by cooperating for many years. Moreover, collaboration experiences evoked a sense of trust and commitment.
- Statutes were formulated in 2004 containing the guiding principles of the alliance.

- The alliance has operational and financial agreement, with KPIs defined and selection criteria for future partners established.
- Regarding the alliance's management structure, a two-tier structure was established. The steering committee, composed of ten electable representatives of the partners, determines the strategic policy, while the System Alliance Europe Agency is responsible for policy implementation and day-to-day management.
- The establishment of the required management structures and adaptations at an ICT-level is required to enable, among others, the transmission of confidential order data and the development of an integrated track-and-trace system.
- In the management phase, alliance activity monitoring is an essential step. Performance assessment at System Alliance Europe is based on KPIs established during negotiations. The achievements of alliance members are evaluated on a monthly basis, after which a bonus-malus system is applied: non-complying logistics service provider has to pay a penalty that is distributed among complying logistics service providers. This practice encourages partners to improve their performance.
- Individual alliance members retain complete autonomy on several key issues such as specifying tariffs charged to partners" (Martin et al., 2018).

Table 14 presents the key findings from System Alliance Europe freight consolidation network case with regards to ADMIRAL development.

Table 14. Summary of the System Alliance Europe freight consolidation network case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Alliance combines the capacity (transport) of the partners to expand service offering. The core competence of the cooperation is a shipping of groupage freight.
Key stakeholders	• 48 partners belonging to 24 mediumsized logistics service providers. CEVA Logistics Italia
How the case/solution supports sharing of data/information	• adaptations at an ICT-level is required to enable, among others, the transmission of confidential order data and the development of an integrated track-and-trace system • Operative KPIs agreed to each partner, bonus-malus system to encourage performance improvement
Does the case/solution handle emissions data?	No
Use of platform technologies	

How the case/solution uses platform technologies	• Tracking system CargoTrack.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	• Enhancing competitiveness of individual partner through alliance collaboration (offer our customers a broader range of transport solutions) • Better utilization of cargo space. • Reduction of empty kilometers. • Emissions reduction. • Know-how consolidation (https://www.systemallianceeurope.net/en/media-center/news.html).
What are the regulatory drivers/limitations/barriers?	• The legal basis for data protection can be found in the Federal Data Protection Act (DSGVIO new) and the Telemedia Act (TMG) as well as in Regulation 2016/679 (EU-DSGVO).
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	• Building trust. • Coordination of the network partners in the various countries for the procurement logistics. • Data and information flow between all companies involved in the transport (Martin et al., 2017).
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	• Operational and financial agreement, with KPIs defined and selection criteria for future partners established. • Performance assessment based on KPIs established during negotiations.
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ Single carrier collaboration (S1)
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ Transport Marketplace (S3)
	  ○ Shipper or LSP collaboration (S4)
	  ○ Logistics pooling (S5)
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ **Collaborative network design (I1)**
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)

	○ Coalition formation and Gain sharing (I4) ○ **Information and communications technology (I5)** ○ Organisation (I6) ○ Management and governance (I7) ○ Collaborative and Distributed Inventory Management (I8)
Type of collaboration?	• Horizontal collaboration

4.2.7 DHB-logistiek freight consolidation network

Freight consolidation (DHB-logistiek is a freight consolidation network in the Benelux. In 2007, four Dutch LSPs joined forces to offer nationwide distribution services in the Netherlands. Two years later, two Belgian LSPs joined the alliance such that one-day delivery services in the Benelux could be offered.). The network also offers warehousing (Martin et al., 2018).

Four logistics service providers offering transport and warehousing services (Martin et al., 2018).

Requirements/enablers for the implementation of offered services are as follows:

Security:

- "The four founding logistics service providers did not cooperate prior to alliance formation. A common supplier of ICT-solutions established the initial contact and subsequent personal contacts created sufficient confidence to start negotiations.
- Partners have agreements in order to develop of broad support for the alliance.
- Besides a general contract, a service level agreement was developed. This one-page document included, among others, KPIs.
- A decision was made to hand over alliance control and strategic policy definition to an autonomous management. Other points on the negotiation agenda related to partner selection criteria and service region definition for individual logistics service provider.
- DHB-logistiek evaluates alliance performance using the KPIs defined in the service levelagreement. In contrast to System Alliance Europe, DHBlogistiek refrains from using a bonus-malus system as the interdependence between a limited number of partners results in a strong intrinsic motivation to improve performance. When the predefined goals are not met, a partner is assisted by a DHB-logistiek quality team.
- Strong connections are present among partners (significant joint investments are made to develop an integrated track-and-trace system and comprehensive smart phone applications" (Martin et al., 2018).

Table 15 presents the key findings from DHB-logistiek freight consolidation network case with regards to ADMIRAL development.

Table 15. Summary of the freight consolidation network case DHB-logistiek.

Key elements of the case analysis	Key findings

Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Alliance combines the capacity (transport, warehouse) of the partners to expand service offering. Alliance control and strategic policy definition turned over to an autonomous management organization
Key stakeholders	• Four logistics service providers offering transport and warehousing services (ABN Amro, TLN and FENEX). • Common ICT-solutions supplier
How the case/solution supports sharing of data/information	• Service level agreement for each partner, no bonus system • joint investments to integrated track-and-trace system and smart phone applications
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Integrated track-and-trace system between partners.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Enhancing competitiveness of individual partner through alliance collaboration (better rates, costs savings, more sustainable logistics chain, load factor optimization, geographical coverage, sharing costs) Improved customer service by one day deliveries in the operations region.
What are the regulatory drivers/limitations/barriers?	Not identified
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Building trust (common ICT supplier helped).
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Potential service offering on/via ADMIRAL marketplace.
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ Single carrier collaboration (S1)
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ Transport Marketplace (S3)
	  ○ Shipper or LSP collaboration (S4)
	  ○ Logistics pooling (S5)
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ Collaborative network design (I1)
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• Horizontal collaboration

4.2.8 Warehouse space management and optimization

A brief description of the solution offered:

The WareM&O Virtual Freight Center (VFC) is the first on-demand warehousing platform in Greece. The WareM&O Marketplace provides to the relevant ecosystem a comprehensive observatory of warehouses, optimizes the utilization of the unused storage facilities and increases their visibility in the market. All of these are achieved through a single access point and the users can participate in collaborative storage schemes, in order to have information for both real-time space availability in warehouses, as well as their specifications and products' requirements.

The WareM&O Marketplace provides an automatic "intelligent matching" of supply and demand using real-time matching algorithms. This service facilitates the process of finding storage spaces for short-term rental in the Thessaloniki area that meet the criteria of the prospective renter without any effort on their part (Parodos et al, 2022).

The marketplace offers an innovative pricing model to enhance transparency and fairness between stakeholders. More specifically, through the development of specialized pricing algorithms and the analysis/modeling of supply and demand data, the user is provided with a specialized tool for calculating the "fairest" price to assist in the costing of the storage service (Xenou et al., 2020).

Companies involved: The ecosystem of the e-marketplace is constituted by industrial partners and logistics service providers (LSPs).

Aknowledgments: The VFC has been developed in the frame of aresearch project under the name Warehouse Match & Optimize (WareM&O), co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation. The Hellenic Institute of Transport CERTH/ HIT is the technical coordinator of the project and the private company TREDIT S.A. acts as general coordinator.

Requirements/enablers for implementation:

- The on-demand warehousing platform enhances the short-term leasing of a space, providing a flexible "pay-as-you-use" pricing policy. Based on that, both the supply and demand side will be benefit as both of them can better plan their needs and activities in short and long term.
- The platform supports horizontal collaboration in order to increase the warehouse capacity utilization.
- The platform supports customers to store overstock products to cope with exceptional warehouse overstocking conditions or to meet seasonal needs.
- Increase the users' willingness to cooperate in sharing warehouse capacity schemes, as for some of them it is difficult to conceptualize the benefits for using the VFC in their daily business routine (Xenou et al., 2020, Parodos et al., 2022).

Table 16 presents the key findings from the VFC warehouse space management case with regards to ADMIRAL development.

Table 16. Warehouse space management and optimization case summary.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	A digital marketplace providing a digital observatory of warehouses in order for the businesses to have real-time information about the space availability in warehouses and their specification.
Key stakeholders	• Industrial partners • Third Party Logistics - 3PL, freight forwarder, shipper • Warehouse owners/ operators • Cargo owners • Individuals (for temporary storage in case of moving)

How the case/solution supports sharing of data/information	• The interested warehouse operators insert the required information to the marketplace platform and any company can have a clear real-time knowledge about the space availability and specifications. • The uses of the platform pay a monthly subscription, having bonus months. The platform receives a commission on transactions split to seller kai buyer users.
Does the case/ solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	track-and-trace system, specialized pricing algorithms, real-time matching algorithms
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Increasing warehouse capacity utilization, enhance short-term leasing with transparent and flexible fair pricing model. Offering of an innovative pricing model to enhance transparency and fairness between stakeholders. Supporting customers to store overstock products to cope with exceptional warehouse overstocking conditions or to meet seasonal needs. Reduced distribution costs in last mile.
What are the regulatory drivers/limitations/barriers?	Not identified
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Lack of strong and organized competition, as there is not in Greece other similar platform operated by a company knows the local conditions. Increase trust among seller and buyer, as the financial process is not concluded via the platform. Increase the users' willingness to cooperate in sharing warehouse capacity schemes, as for some of them it is difficult to conceptualize the benefits for using the VFC in their daily business routine.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Potential service to be offered on/via ADMIRAL marketplace?
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ Single carrier collaboration (S1)
	  ○ Carrier Alliance/Coalition (S2)
	  ○ **Transport Marketplace (S3)**
	  ○ **Shipper or LSP collaboration (S4)**
	  ○ **Logistics pooling (S5)**
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ **Collaborative network design (I1)**
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• Horizontal collaboration

4.2.9 Vehicles capacity utilization in urban logistics

Introduction

Globalization is a common term in recent years, and it is expected by 2050, around 70% of the global population to live in urban areas (United Nations, 2018). This increased population causes expansion of urban areas and generates new types of cities with more functions and complexity (Parodos et al., 2022). Based on that trend that shapes overcrowded urban areas, the utilization of city logistics operation is vital for the quality of life for more and more people.

Additionally, technological advancements such as e-commerce have changed the retail sector in the previous decades (Dais et al., 2023). More specifically, the e-commerce rate has been extended and it is estimated to represent 20% of the total global retail share (World Economic Forum, 2022). The Covid-19 pandemic acts as a driver to the increase of the e-commerce share, with parallel increasing of electronic transactions and seamless payments (OECD, 2022, UNCTAD, 2022). All of them stress the supply chains and new innovative customers-based solutions are emerging for increasing the capacity utilization of supply chains.

A brief description of the solution offered:

The purpose of DeliNet is to address market gaps by offering quality distribution solutions through reducing delivery times, increasing order visibility, eliminating the possibility of unsuccessful deliveries, and minimizing the environmental footprint of distribution. DeliNet aims to comprehensively cover

the last-mile distribution needs of online stores and enhance the shopping experience of e-commerce and food distribution consumers by providing services:

- Express delivery with direct communication for on-demand delivery by professional distributors.
- More efficient product delivery to customers.
- Stock replenishment from store to store.
- Immediate returns at a scheduled time and location.

The Delinet offers ships from Store, from Hub, Store-to-Store, Hub-to-Store, Business Collections, as well as customer returns.

Acknowledgement:

The project Delinet was implemented under the framework of the Action «Investment Plans of Innovation» of the Operational Program «Central Macedonia 2014 2020», that is co-funded by the European Regional Development Fund and Greece.

Table 17 presents the key findings from vehicles capacity utilization in urban logistics case with regards to ADMIRAL development.

Table 17. Vehicles capacity utilization in urban logistics case summary.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	An on-demand courier application that connects businesses and customers to professional drivers in order to facilitate their goods delivery requirements efficiently, reliably and sustainably. Delinet aims to provide to the customers with a seamless shopping experience, the business partners with end-to-end transport solutions, and the cities with a brighter future.
Key stakeholders	• Customers • Businesses, cargo owners • Professional Drivers • DeliNet dashboard administrators Potential markets: e-commerce, retail, pharmacies and banking
How the case/solution supports sharing of data/information	The core problem of on-demand services is that they must handle dynamic and usually stochastic vehicle routing problems. The main aspects that may have to be otimized are the time to deliver, the waiting and relocation tradeoffs and the numbers of customers that will be served. In general, the platform will provide real time services, route optimization, estimated time

	of arrival, batch processing services, demand forecasting, pricing models, emissions calculation
Does the case/ solution handle emissions data?	The platform estimates/ calculates the CO2 emissions for delivering each delivery
Use of platform technologies	
How the case/solution uses platform technologies	Requests from all types of users are coordinated by an HAProxy high availability load balancer, which has the ability to distribute multiple requests to multiple servers. The Delinet API integrates DeliNet directly with the company website for easy transfer of data that enables a seamless delivery experience for their customers. Through the DeliNet Admin Panel the company getsreal-time visibility over all their shipments and customer returns in one panel.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Urban freight transport contributes significantly not only to climate change, but also to traffic congestion in cities and the deterioration of the quality of life of citizens. To achieve economic and social prosperity in cities, mitigating the side effects caused by urban freight transport is the goal for the relevant stakeholders. Last mile delivery costs are considered as the highest cost and most value-added part of the supply chain and for that reason the companies involved are looking for ways to collaborate in order to improve their customers' experience. Towards logistics optimization the role of technology has been recognized in literature.
What are the regulatory drivers/limitations/barriers?	
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Find companies for collaboration, combination of parcels in order to better utilize the vehicle capacity.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	

Theoretical positioning (logistics cases)	
Pan 2017 article classification of horizontal collaboration	• HCT solutions: ○ Single carrier collaboration (S1) ○ Carrier Alliance/Coalition (S2) ○ Transport Marketplace (S3) ○ **Shipper or LSP collaboration (S4)** ○ **Logistics pooling (S5)** ○ Physical Internet (S6) • Implementation issues of HCT solutions: ○ Collaborative network design (I1) ○ **Transport planning optimisation (I2)** ○ Mechanism for exchanging requests (I3) ○ Coalition formation and Gain sharing (I4) ○ Information and communications technology (I5) ○ Organisation (I6) ○ Management and governance (I7) ○ Collaborative and Distributed Inventory Management (I8)
Type of collaboration?	• Horizontal collaboration

4.2.10 Federated architecture for data sharing in transport & logistics

A brief description of the solution offered:

The FENIX Federated Network (FENIX Network) is the first pan-European federated architecture for data sharing serving the European logistics community. The main vision of FENIX is to develop a Collaborative Business Environment of federated T&L platforms in Europe in which the involved stakeholders can share and use logistics services (Figure 19). Collaborative Business Environments are communities of autonomous, heterogeneous and geographically distributed interacting actors that create value to their customers based on their products and services (Ayfantopoulou et al., 2021). The FENIX Network acts as an enabler of B2B and B2A decentralized data sharing and exchange among T&L platforms in Europe, similarly to a data space (Reiberg et al., 2021). Data Federation has emerged as the enabler of interoperability and seamless data exchange in transport and logistics, under the guidance of the Digital Transport & Logistics Forum (DTLF).

Across the 11 pilot sites in Europe and all corridors of TEN-T, FENIX Federation has been tested through 66 real-environment cases (2019-2023). The tested services were more than 90, with the majority of them (99.97%) being at TRL ≥7, classified in 12 inclusive and comprehensive service types. The services cover several operations: cargo monitoring, catalogues and KPIs, customs services optimization,

dangerous goods management, emissions monitoring, transport and cargo e-documentation, track and trace, traffic management, slot management, gate management, parking management and trip and capacity planning (Ayfantopoulou et. al, 2022).

Companies involved:

Collaboration included all forms of vertical and horizontal combined interactions among different actors from all steps of the transport and logistics process. Among others shippers, freight forwarders, 3PLs, 4 PLs, 5 PLs, and operators (warehouse, rail, road, port and airport), academia, public administration. In general, organizations invest in inter-organizational global collaborations to get access to assets, capabilities and expertise that are global dispersed.

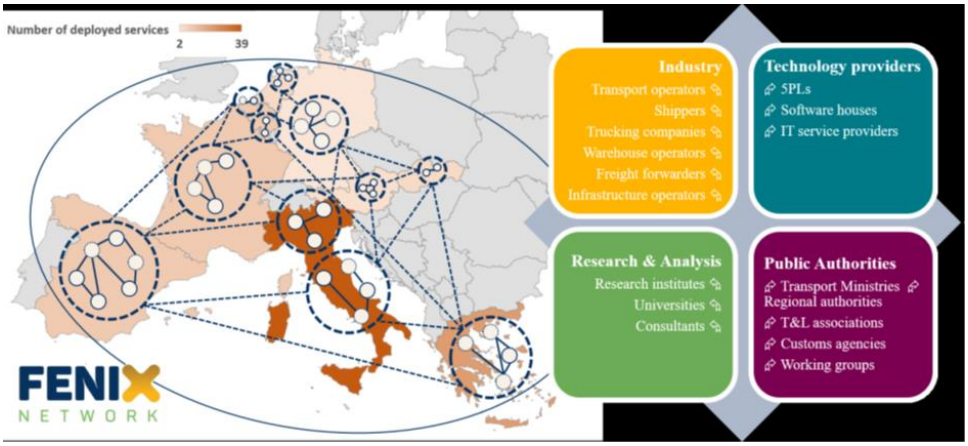


Figure 19. The FENIX pilot sites and FENIX Federated Network as multi-stakeholder CBEs.

Acknowledgments: FENIX Project (A European Federated Network of Information eXchange in LogistiX) is an action under the Grant Agreement number INEA/CEF/TRAN/M2018/1793401, with the Innovation and Networks Executive Agency (INEA) under the powers delegated by the European Commission.

Table 18. presents the key findings from the FENIX case with regards to ADMIRAL development.

Table 18. Federated architecture for data sharing in transport & logistics case summary.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Federation is a promising concept that aims to create a collaborative business environment of interconnected and interoperable platforms through which European T&L actors could share and use services.

	FENIX foresees to enable sharing of information and services needed to optimize TEN-T corridors from economic, environmental and social perspectives, support total supply chain visibility and predictive; feedback-driven, flexible collaborative planning including sourcing, manufacturing, delivering, and returning goods; reduce the time needed to complete the freight transport procedures from and to large logistics hubs (ports, airports, distribution centers); as well as. optimize end-to-end visibility along supply chains based on real-time data availability to influence the financial side of operations, allowing monitoring financial performance. It does so in a decentralized manner, as well.
Key stakeholders	Data & services providers & users of the 4-Helix such as: • Industry (manufacturers, transport operators, services providers, etc.) • Technology providers • Research and Analysis • Public Authorities
How the case/solution supports sharing of data/information	The FENIX Federated Network is fundamentally based on the FENIX Connector, an integral element of the network architecture developed for every federated platform, that enables seamless communication between the platforms of the network members. It serves as a key component, offering functionalities such as (1) identity management, (2) brokering, and (3) data exchange to facilitate interaction between the various network platforms.
Does the case/ solution handle emissions data?	Primarily, the FENIX Federated Network facilitates interoperability, connectivity and seamless communication among T&L systems. The impact of the Federation on the performance of supply chains has been quantified through the FENIX Operational Performance Measurement Framework (OPMF) (Ayfantopoulou et al., 2022; Dais et al., 2022). The application of FENIX Federation resulted to reductions, although indirect, accounting to 7.32% for NOx and 16% for CO_2 emissions. In general, CO2 data could be handled through the FENIX Federation as the actual message (semantics interoperability level) was not is scope of the project.
Use of platform technologies	
How the case/solution uses platform technologies	At the system-to-system connectivity/ communication layer. The FENIX Connector enables the sharing and use of services

	across Europe with minimum adaptations in involved stakeholders' operational platforms. At the same time, the data is keeping under their owners' control.
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	It has been proved through pilot testing in more than 90 cases that the use of the FENIX Federations bears important gains to stakeholders in the form of reduced costs, improved operations efficiency, and reduced emissions. It is easy to be developed, requiring minimum adaptations in involved stakeholders' operational platforms and minimum costs. It is decentralized, the data is kept under their owners' control. It provides easy access to a network of more than 60 organizations across Europe. FENIX2.0, the organization that has been created to sustain and scale-up FENIX's outcomes continues to build upon what has already been done.
What are the regulatory drivers/limitations/barriers?	Lack of harmonization of legal processes. Governance requirements may hinder collaboration.
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Five macro-areas and related gaps in the development of FENIX services has been identified. The most identified gaps are related to the lack of communication and standardization, lack of data and digitalization, low stakeholders' involvement, management problems such as bottlenecks and queue. Based on gap analysis, the stakeholders were able to overcome the vast majority of these gaps by implementing the FENIX Federation to their systems.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Data sharing architecture specifications to consider in ADMIRAL marketplace development to support interoperability and seamless system-to-system communication. Access to an already vibrant society of T&L stakeholders across Europe.

Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ **Single carrier collaboration (S1)**
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ Transport Marketplace (S3)
	  ○ **Shipper or LSP collaboration (S4)**
	  ○ **Logistics pooling (S5)**
	  ○ **Physical Internet (S6)**
	• Implementation issues of HCT solutions:
	  ○ Collaborative network design (I1)
	  ○ Transport planning optimisation (I2)
	  ○ **Mechanism for exchanging requests (I3)**
	  ○ **Coalition formation and Gain sharing (I4)**
	  ○ **Information and communications technology (I5)**
	  ○ **Organisation (I6)**
	  ○ **Management and governance (I7)**
	  ○ **Collaborative and Distributed Inventory Management (I8)**

Type of collaboration?	• Horizontal and vertical collaboration • 4-Helix collaboration / private-public collaboration

4.2.11 Shared urban consolidation micro-hubs

A micro-hub is a logistics facility usually located close an urban area, in which a logistics service provider (LSP) can store, sort, load and unload parcels that have to be delivered to final receivers. It can be owned or operated by one LSP, but due to high costs and limited space in the urban area, it can also be shared with other LSP. Sometimes micro-hubs are also owned by an external partner, for example municipality.

In Helsinki, one strategically located micro-hub was shared by five business partners: 24/7 parcel locker company, a magazine publisher that had its daily magazines delivered by cargo bikes by a third-party LSP, a large LSP using the micro-hub as a transshipment point, delivering from its depot to the micro-hub by either a van or a truck and from the micro-hub to the customers by cargo bikes; and a startup providing crowd-sourced deliveries.

Types of collaboration offered are as follows:

- Horizontal (different LSP sharing same warehouse location, potentially also same means of transport (bikes, e-bikes).
- Vertical (crowdsdshipping platform provider, magazine publisher, LSP).

Partners identified following challenges:

- Lack of trust.
- The right business partnership.
- Difficulties to share data among partners.
- The need for a common system.

Table 19 presents the key findings from the shared urban consolidation micro-hub case with regards to ADMIRAL development.

Table 19. Summary of the shared urban consolidation micro-hub case.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	B2B collaboration by sharing the same micro-hub or/and parcel lockers in urban area.
Key stakeholders	• 24/7 parcel locker company • A magazine publisher that had its daily magazines delivered by cargo bikes by a third-party LSP • A large LSP using a micro-hub as a transshipment point, delivering from its depot to the micro-hub by either a van or a truck and from the micro-hub to the customers by cargo bikes • A startup providing crowd-sourced deliveries
How the case/solution supports sharing of data/information	• Asset sharing, no data sharing (?) / perhaps warehouse capacity situation (?)
Does the case/solution handle emissions data?	No
Use of platform technologies	
How the case/solution uses platform technologies	Not available
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	• Efficient use of warehouse resource (lower fixed costs). • Shorter distances to end customers --> delivery time reduction. • Emissions reduction. • Better productivity of couriers.
What are the regulatory drivers/limitations/barriers?	Not identified
Implementation challenges	

Identified challenges/ requirements/enablers for implementation / market uptake	• Lack of trust. • The right business partnership. • Difficulties to sharing data among partners. • The need for a common system.
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Having a third party to sustainability in the long term.
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ Single carrier collaboration (S1)
	  ○ **Carrier Alliance/Coalition (S2)**
	  ○ Transport Marketplace (S3)
	  ○ Shipper or LSP collaboration (S4)
	  ○ Logistics pooling (S5)
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ Collaborative network design (I1)
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• Horizontal collaboration

4.2.12 Cargo Owners for Zero Emission Vessels (coZEV)

CoZEV, or Cargo Owners for Zero Emission Vessels, is a platform aimed at climate-leading customers in the shipping industry. Its primary goal is to facilitate collaboration among cargo owners to accelerate the transition to zero-emission (ZE) maritime shipping. Through coZEV, cargo owners can:

- Communicate and Advocate: Cargo owners have the opportunity to speak with a unified voice regarding their ambition levels and policy concerns related to zero-emission shipping.
- Influence the Transition: By working together, cargo owners can help shape the pace of the transition by contributing to market development and taking concrete actions to reduce their supply chain emissions (Scope 3 emissions).

CoZEV's Vision and mission

CoZEV's mission is to achieve an international maritime shipping sector that provides economically viable freight services powered by zero-emission fuels and technologies on a scale that allows cargo owners to decarbonize their maritime shipping by 2040. The aim is to eliminate virtually all greenhouse gas emissions from the entire sector by 2050 in alignment with the Paris Agreement's climate goals.

CoZEV's Mission is to provide opportunities for cargo owner companies to lead, innovate, and set ambitious goals for decarbonizing the maritime sector. This is achieved through an action-focused platform that fosters collaboration among climate-forward companies and others in the maritime supply chain. Concrete initiatives are undertaken to accelerate shipping decarbonization, scale zero-emission solutions, and influence policy and demand signals for zero-emission solutions.

CoZEV's Origin and partners

CoZEV was developed by the Aspen Institute Energy & Environment Program in collaboration with a network of cargo owner companies. Founding partners include Clean Air Task Force, Environmental Defense Fund, Ocean Conservancy, and University College London/UMAS. Expert partners such as Neoteric Energy & Climate, Lloyd's Register, Global Maritime Forum, C40 Cities, Pillsbury Winthrop Shaw Pittman, Smart Freight Buyers Alliance, and Stephenson Harwood are involved. The Aspen Institute Energy and Environment Program serves as the facilitator and secretariat for coZEV.

Table 20 presents the key findings from the coZEV case with regards to ADMIRAL development.

Table 20. Cargo Owners for Zero Emission Vessels case summary.

Key elements of the case analysis	Key findings
Focus of collaboration and sharing	
How the case/solution supports company business collaboration activities?	Provides a platform for companies to combine their forces to support the development of zero emissions maritime shipping
Key stakeholders	• Cargo owners • Environmental expert organizations • Aspen Institute Energy and Environment facilitates collaboration
How the case/solution supports sharing of data/information	• ZEMBA program (Zero Emission Maritime Buyers Alliance) drives zero emission fuels use by aggregating demand of different cargo owners that have the same goal.
Does the case/solution handle emissions data?	No

Use of platform technologies	
How the case/solution uses platform technologies	No information available/found
Motivation and barriers	
What are the motivations/incentives for collaboration / sharing	Pooling demand to drive supply
What are the regulatory drivers/limitations/barriers?	No regulatory drivers/barriers for collaboration identified
Implementation challenges	
Identified challenges/ requirements/enablers for implementation / market uptake	Collaboration started very recently, no information available
Learnings for ADMIRAL	
Key takeaways to ADMIRAL development	Marketplace could potentially have demand aggregation (purchase pooling) for services (low/zero emission)
Theoretical positioning (logistics cases)	

Pan 2017 article classification of horizontal collaboration	• HCT solutions:
	  ○ Single carrier collaboration (S1)
	  ○ Carrier Alliance/Coalition (S2)
	  ○ Transport Marketplace (S3)
	  ○ **Shipper or LSP collaboration (S4)**
	  ○ **Logistics pooling (S5)**
	  ○ Physical Internet (S6)
	• Implementation issues of HCT solutions:
	  ○ Collaborative network design (I1)
	  ○ Transport planning optimisation (I2)
	  ○ Mechanism for exchanging requests (I3)
	  ○ Coalition formation and Gain sharing (I4)
	  ○ Information and communications technology (I5)
	  ○ Organisation (I6)
	  ○ Management and governance (I7)
	  ○ Collaborative and Distributed Inventory Management (I8)

Type of collaboration?	• horizontal • vertical

Summary and key conclusions to ADMIRAL development

The collection of recent logistics collaboration cases presented in this deliverable cover all the different horizontal collaboration categories of Pan et al (2017), see Table 21. Many of the cases cover several types of collaboration, giving a hint that in practice companies often need to combine many models to implement viable solutions. Regarding the share of different collaboration categories our cases covered, following observations can be made towards the academic discussion on horizontal collaboration in logistics:

- Collaboration between the core stakeholders in the logistics chain is typically approached from transportation offering side (carriers collaborating) or from the demand side (shippers collaborating).
- Transport marketplaces and logistics pooling collaborations often introduce an external stakeholder to the collaboration, e.g., marketplace operator or pooling services provider.
- From the transportation offering side single carrier collaboration or carrier alliances occur in most of the cases. They often form one key partner in other types of collaboration, e.g., transport marketplace or logistics pooling.
- From the transportation demand side, shipper or LSP collaboration forms similarly a key partner for marketplace collaboration and carrier alliance collaboration.
- Physical internet type of collaboration seems to be just emerging, only one of logistics cases had that characteristic. Being the most advanced or modern collaboration form, this may not be a surprise.
- Trust essential component, many collaborations are formed after doing business together in long-term.
- Regarding door-to-door digitalization vision the cases cover only parts of the whole process. Only Tradelens case had the full logistics chain integration vision but failed.
- Having global standards or broadly accepted and agreed industry practices is often a fundamental enabler of horizontal collaboration and widely interoperable systems.

Table 21. Summary of the cases regarding type of collaboration and key takeaways for ADMIRAL development

Case	HC categories included	Key takeaways
Mobile telecom	Single carrier collaboration (S1) Carrier Alliance/Coalition (S2)	global standards development to enable globally interoperable systems
Global Distribution Systems in airline industry	Single carrier collaboration (S1) Carrier Alliance/Coalition (S2) Transport Marketplace (S3) Physical Internet (S6)	platform developed and owned by joint venture of users (airlines) supports market uptake (less doubts of competitor interests)
Travel platform integrates carbon emissions	Single carrier collaboration (S1) Carrier Alliance/Coalition (S2) Transport Marketplace (S3)	focused third party service provider to implement emissions calculation service

Load carrier sharing	Single carrier collaboration (S1) Carrier Alliance/Coalition (S2) Logistics pooling (S5)	Stakeholder association as a governance model for collaboration.
Tradelens	Single carrier collaboration (S1) Transport Marketplace (S3)	Collaboration governance model may turn away potential partners.
Transport sharing P&G and Tupperware	Single carrier collaboration (S1) Logistics pooling (S5)	Importance to match regulations of different countries of operation. Transport sharing service a potential offering on the ADMIRAL marketplace.
System Alliance Europe (Freight consolidation network)	Carrier Alliance/Coalition (S2)	Potential service to be offered on/via ADMIRAL marketplace?
TIMOCOM – transport marketplace	Transport Marketplace (S3) Logistics pooling (S5) Physical Internet (S6)	Technical solution to manage large network of stakeholders. Potential platform to collaborate with ADMIRAL marketplace?
B2B container exchange platform XChange	Transport Marketplace (S3)	Potential service for the ADMIRAL marketplace?
WareM&O Virtual Freight Center	Transport Marketplace (S3) Shipper or LSP collaboration (S4)	Potential service to be offered on/via ADMIRAL marketplace?
DHB-logistiek freight consolidation network	Carrier Alliance/Coalition (S2) Shipper or LSP collaboration (S4)	Potential service offering on/via ADMIRAL marketplace.
Demand – supply matching in transport (FENIX)	Single carrier collaboration (S1) Carrier Alliance/Coalition (S2) Transport Marketplace (S3) Shipper or LSP collaboration (S4) Logistics pooling (S5) Physical Internet (S6)	Data sharing architecture specifications to consider in ADMIRAL marketplace development
Shared urban consolidation micro-hub	Carrier Alliance/Coalition (S2)	Having a third party to sustainability in the long term
Cargo Owners for Zero Emission Vessels	Shipper or LSP collaboration (S4)	Marketplace could potentially have demand aggregation (purchase pooling) for services (low/zero emission)

For the ADMIRAL marketplace development, following conclusions can be made for the governance and business model aspects:

- In global operations, global standards are essential foundation that enable seamless operations between stakeholders (mobile telecom).
- If standards are not available, it is essential to have rules, guidelines and methods that are as broadly accepted as possible by the industry stakeholders (airlines, FENIX).

  - ISO 14083 standard Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from transport chain operations has been just published. EU commission is promoting its use through CountEmissionsEU framework. Global Logistics Emissions Council promotes the same methodology with its GLEC Framework 3.0.
- Who has the control over the marketplace may have significant impact on the market acceptance of the marketplace. Broad key stakeholder control (joint venture, association) is one approach (airlines), completely independent third-party marketplace operator another (TIMOCOM, CHOOOSE).
- All stakeholders in the collaboration should have clear benefit out of it.
- Trust is essential component, many collaborations are formed after doing business together in long-term.
- Regarding door-to-door digitalization vision the cases cover only parts of the whole process. Only Tradelens case had the full logistics chain integration vision, but failed. Integrating whole chain is a serious challenge.
- No developer community building or services were identified in the marketplace cases.

Following potential service offerings for the ADMIRAL marketplace could be identified from the cases:

- Logistics pooling service (P&G and Tupperware transport sharing)
- Demand aggregation/purchase pooling service for shippers/cargo owners (Zero Emission Maritime Buyers Alliance)
- Free storage and cargo space search and matching service (WareM&O)
- Carrier alliance partner search service (DHB-Logistiek, System Alliance Europe)
- Micro-hub (last mile warehouse) operation service
- Potential marketplace to collaborate with (TIMOCOM), i.e., instead of own service offering, partnering with other marketplace that offers the service.

References

ALARCÓN, F. 2005. Desarrollo de una Arquitectura para la definición del proceso de Comprometer Pedidos en contextos de Redes de Suministro Colaborativas. Aplicación a una Red compuesta por Cadenas de Suministro en los Sectores Cerámico y del Mueble. Universidad Politecnica de Valencia Valencia, Spain.

AMIRI, M. & FARVARESH, H. 2023. Carrier collaboration with the simultaneous presence of transferable and non-transferable utilities. European Journal of Operational Research, 304, 296-617.

ARBUZOVA, L. 2019. 10 Largest Warehouse Complexes in Europe. EuroSender.

ASTRE. n.d. Together for a European supply chain. [Online]. Available: https://www.astre.fr/en/ [Accessed July 2023].

AYFANTOPOULOU G., D. S., PARODOS L., RENZI G. 2021. Achieving efficient collaborative business environment in logistics: service classification and deployment gaps in FENIX project. 27th ITS World Congress. Hamburg, Germany.

AYFANTOPOULOU G., D. S., PARODOS L., RENZI G. 2022. Operational evaluation of digital logistics services: A methodological framework. 14th ITS European Congress. Toulouse, France.

BENSTEAD, A. V., HENDRY, L. C. & STEVENSON, M. 2018. Horizontal collaboration in response to modern slavery legislation: An action research project. International Journal of Operations & Production Management, 38.

BINGEMER, S. 2018. "Back to the future with IATA NDC? Critical turning points in the history of airline distribution". Journal of Tourism Futures, 4, 205-2017.

CAO, M. & ZHANG, Q. 2011. Supply chain collaboration: Impact on collaborative advantage and firm performance. Journal of operations management, 29, 163-180.

CECERE, L. 2022. TradeLens discontinues operations. Why you should care., Forbes. Forbes Magazine.

CHARTERING, H. 2015. Pooling in shipping [Online]. Available: https://hanseatic-chartering.com/pooling-in-shipping/ [Accessed June 2023].

CHOI, G. 2023. Significance and impact of dissolution of 2M Alliance. Cello Square.

CLEOPHAS, C., COTTRILL, C., EHMKE, J. F. & TIERNEY, K. 2019. Collaborative urban transportation: Recent advances in theory and practice. European Journal of Operational Research, 273, 801-816.

CRUIJSSEN 2006. Horizontal cooperation in transport and logistics (Doctoral thesis). Tilburg: CentER, Center for Economic Research.

CRUIJSSEN, F., COOLS, M. & DULLAERT, W. 2007. Horizontal cooperation in logistics: opportunities and impediments. Transportation Research Part E: Logistics and Transportation Review, 43, 129-142.

CUSUMANO, M. A., YOFFIE, D. B. & GAWER, A. 2020. The future of platforms. MIT Sloan Management Review, 61, 26-34.

DAIS, S., MALEAS, Z., Ayfantopoulou, A. Customer and retailer expectations from city logistics: A comparative analysis of the market in Thessaloniki, Greece. 11th International Congress on Transportation research, 20-22 September 2023, Heraklion, Crete.

WORLD ECONOMIC FORUM, W. E. 2020. The Future of Last Mile Logistics [Online]. Available: https://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf [Accessed].

GBT, A. 2023. American Express Global Business Travel integrates with CHOOOSE to accelerate sustainable business travel. .

GONZALEZ-FELIU, J. & SALANOVA, J.-M. 2012. Defining and evaluating collaborative urban freight transportation systems. Procedia-Social and Behavioral Sciences, 39, 172-183.

HARGRAVE. 2023a. Joint Venture (JV): What Is It and Why Do Companies Form One? [Online]. Available: https://www.investopedia.com/terms/j/jointventure.asp [Accessed June 2023].

HARGRAVE, M. 2023b. Joint Venture (JV): What Is It and Why Do Companies Form One? : Investopedia.

HEIN, A., SCHREIECK, M., RIASANOW, T., SETZKE, D. S., WIESCHE, M., BÖHM, M. & KRCMAR, H. 2020. Digital platform ecosystems. Electronic markets, 30, 87-98.

IMMONEN, A., OVASKA, E., KALAOJA, J. & PAKKALA, D. 2016. A service requirements engineering method for a digital service ecosystem. Service Oriented Computing and Applications, 10, 151-172.

ISLAM, S., SHI, Y., AHMED, J. U. & UDDIN, M. J. 2019. Minimization of empty container truck trips: insights into truck-sharing constraints. The International Journal of Logistics Management, 30, 641-662.

JESUS SAENZ, M., UBAGHS, E. & CUEVAS, A. I. 2015. Enabling horizontal collaboration through continuos relational learning, New York, Dordrecht, London, Springer.

KARAM, A., REINAU, K. H. & ØSTERGAARD, C. R. 2021. Horizontal collaboration in the freight transport sector: barrier and decision-making frameworks. European Transport Research Review, 13.

KOSKINEN, K., BONINA, C. & EATON, B. Digital platforms in the global south: foundations and research agenda. Information and Communication Technologies for Development. Strengthening Southern-Driven Cooperation as a Catalyst for ICT4D: 15th IFIP WG 9.4 International Conference on Social

Implications of Computers in Developing Countries, ICT4D 2019, Dar es Salaam, Tanzania, May 1–3, 2019, Proceedings, Part I 15, 2019. Springer, 319-330.

LIAO, S.-H. & KUO, F.-I. 2014. The study of relationships between the collaboration for supply chain, supply chain capabilities and firm performance: A case of the Taiwan' s TFT-LCD industry. International journal of production economics, 156, 295-304.

MARTIN, N., VERDONCK, L., CARIS, A. & DEPAIRE, B. 2018. Horizontal collaboration in logistics: decision framework and typology. Operations Management Research, 11, 32-50.

MEAREAN, L. 2022. Maersk's TradeLens demise likely a death knell for blockchain consortiums. [Online]. Available: https://www.computerworld.com/article/3682128/maersks-tradelens-demise-likely-a-death-knell-for-blockchain-consortiums.html [Accessed Dec 2 2022].

MONTOYA-TORRES, J. R., MUÑOZ-VILLAMIZAR, A. & VEGA-MEJÍA, C. A. 2016. On the impact of collaborative strategies for goods delivery in city logistics. Production Planning & Control, 27, 443-455.

NATIONS, U. 2018. World Urbanization Prospects:. In: AFFAIRS, D. O. E. A. S. (ed.). New York, USA.

NOTTEBOOM, T., PALLIS, A. & RODRIGUE, J.-P. 2022. Port economics, management and policy, Routledge.

OECD. 2020. COVID-19 and the Retail Sector: Impact and Policy Responses, OECD Policy Responses to Coronavirus (COVID-19); [Online]. Available: https://www.oecd.org/coronavirus/policy-responses/covid-19-and-the-retail-sector[1]impact-and-policy-responses-371d7599/. [Accessed].

OSÓRIO, A. L., CAMARINHA-MATOS, L. M. & AFSARMANESH, H. Enterprise collaboration network for transport and logistics services. Collaborative Systems for Reindustrialization: 14th IFIP WG 5.5 Working Conference on Virtual Enterprises, PRO-VE 2013, Dresden, Germany, September 30–October 2, 2013, Proceedings 14, 2013. Springer, 267-278.

PAN, S. 2017a. Horizontal collaboration for sustainable transport and logistics. Business administration. Universite de Valenciennes et du Hainaut-Cambresis.

PAN, S., TRENTESAUX, D., BALLOT, E. & HUANG, G. Q. 2019. Horizontal collaborative transport: survey of solutions and practical implementation issues. International Journal of Production Research, 57, 5340-5361.

PARCEL, P. 2002. Profile of ASTRE, a European haulier network [Online]. Available: https://postandparcel.info/5744/news/profile-of-astre-a-european-haulier-network/ [Accessed July 2023].

PARKER, G. G., VAN ALSTYNE, M. W. & CHOUDARY, S. P. 2016. Platform revolution: How networked markets are transforming the economy and how to make them work for you, WW Norton & Company.

PARODOS, L. T., O.; TSOUKOS, G.; XENOU, E.; AYFANTOPOULOU, G. 2022. Business Model Analysis of Smart City Logistics Solutions Using the Business Model Canvas: The Case of an On-Demand Warehousing E-Marketplace. Future Transp., 2, 467–481.

PAULI, T., FIELT, E. & MATZNER, M. 2021. Digital industrial platforms. Business & Information Systems Engineering, 63, 181-190.

PIERNEXT. 2022. Collaboration between ports: strength through unity [Online]. Available: https://piernext.portdebarcelona.cat/en/governance/collaboration-between-ports-strength-through-unity/ [Accessed June 2023].

POMPONI, F., FRATOCCHI, L., ROSSI TAFURI, S. & PALUMBO, M. 2013. Horizontal collaboration in logistics: A comprenhensive framework. Research in logistics an produciton, 3, 243-254.

POMPONI, F., FRATOCCHI, L., TAFURI, S. R. & PALUMBO, M. Horizontal collaboration in logistics: A comprehensive framework.

PROTECTOR & GAMBLEP. 2016. Horizontal collaboration - case study [Online]. Available: https://www.cpcarregadores.pt/wp-content/uploads/2016/10/Horizontal-Collaboration-Case-Study.pdf [Accessed].

PUSSINEN, P., WALLIN, A. & HEMILÄ, J. 2023. The hope of exponential growth–Systems mapping perspective on birth of platform business. Digital Business, 3, 100060.

REIBERG, A., NIEBEL, C. & KRAEMER, P. 2022. What is a Data Space? Definition of the concept Data Space. White Paper 1/2022. In: TECHNIKWISSENSCHAFTEN, B. F. W. U. K. D. B. D. A. A. D. A. D. (ed.).

SAENZ, M. J., UBAGHS, E. & CUEVAS, A. I. 2015. Enabling horizontal collaboration through continuous relational learning, Springer.

SAENZ, J.M., GUPTA, R. & MAKOWSKI, C. 2017. Finding profit in horizonral collaboration. Supply Chain Management Review, 16-22.

SCHAMSCHULA, S., VAN GEVEREN, P. & KUHLMANN, K. 2022. Horizontal collaboration by collaborative sourcing. Transporeon.

SCHMOLTZI, C. & WALLENBURG, C. M. 2011. Horizontal cooperations between logistics service providers: motives, structure, performance. International Journal of Physical Distribution & Logistics Management, 41, 552-576.

SHREE, D., SINGH, R. K., PAUL, J., HAO, A. & XU, S. 2021. Digital platforms for business-to-business markets: A systematic review and future research agenda. Journal of Business Research, 137, 354-365.

SILITONGA, N. 2022. On-Demand Logistics 101: A Comprehensive Guide. Dropoff.

SOYSAL, M., BLOEMHOF-RUWAARD, J. M., HAIJEMA, R. & VAN DER VORST, J. G. A. J. 2018. Modeling a green inventory routing problem for perishable products with horizontal collaboration. Computers & Operations Research, 89, 168-182.

SULLIVAN, F. 2023. Global Freight Visibility Growth Opportunities [Online]. Available: https://store.frost.com/global-freight-visibility-growth-opportunities.html#section6 [Accessed 2023].

TIMOCOM. 2023. Available: https://www.timocom.co.uk/ [Accessed 2023 August].

TIWANA, A. 2013. Platform ecosystems: Aligning architecture, governance, and strategy, Newnes.

TRANSPOREON. n.d. Transport Execution Hub. [Online]. Available: https://www.transporeon.com/en/platform/transport-execution-hub [Accessed 2023 August].

UNCTAD. COVID-19 and e-Commerce: A Global Review. 2021. Available online: https://unctad.org/system/files/official-document/dtlstict2020d13_en_0.pdf (accessed on September 2023).

VALKOKARI, K., HEMILÄ, J. & KÄÄRIÄINEN, J. 2022. Digital Transformation—Cocreating a Platform-Based Business Within an Innovation Ecosystem. International Journal of Innovation Management, 26, 2240016.

VARGAS, A., PATEL, S. & PATEL, D. 2018. Towards a business model framework to increase collaboration in the freight industry. Logistics, 2, 22.

VINOD, B. 2009. Distribution and revenue management: Origins and value proposition. Journal of Revenue Pricing Management 8, 117–133 (2009). https://doi.org/10.1057/rpm.2008.62

WOOLICH, A. 2015. Shipping pools: A competition law perspective - sink or swim? London: Holman Fenwick Willan.

WORLD ECONOMIC FORUM, W. E. 2020. The Future of Last Mile Logistics [Online]. Available: https://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf [Accessed].

XCHANGE. 2023. Container xChange [Online]. Available: https://www.container [Accessed 2023 July].

XENOU E., Parodos L., Tsoukos G., Ayfantopoulou G. and Maleas Z. (2020). The rise of the on-demand warehousing. Is the Greek Market Ready for This Change? Advances in Mobility-as-a-Service Systems Proceedings of 5th Conference on Sustainable Urban Mobility, Virtual CSUM2020, June 17–19, 2020, Greece.

ZHANG, C., YU, H. & LIU, Z. Logistics collaboration supported by electronic logistics marketplaces. 2008 IEEE Symposium on Advanced Management of Information for Globalized Enterprises (AMIGE), 2008. IEEE, 1-5.