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Platforms and digital transformation in logistics (PLATO)

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PLATFORMS AND DIGITAL TRANSFORMATION IN LOGISTICS (PLATO)

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Management summary

Digitization has the potential to transform the logistics sector, and digital platforms are accelerating this transformation. This is closely linked to other major trends: digitalization, automation, and energy transition. The logistics sector must therefore embrace this digital transformation and act to add value, remain competitive, improve sustainability, and build resilience to deal with disruptive forces.
This project aims to help the sector with this, by identifying the strengths, weaknesses, opportunities, and threats of platformisation, and providing the logistics sector with a perspective for action.
Ultimately, this project aims to help the sector formulate an appropriate response to platformisation and digital transformation.

Approach
The PLATO (Platforms and digital transformation in logistics) project is undertaken by a diverse group of consortium members consisting of industry organizations of shippers and carriers, three digital platforms active in the field of logistics, a knowledge hub, a knowledge institute, two universities and two ecosystem orchestrators. The project is co-sponsored by TKI Dinalog. Two digital ecosystems form the backbone of this project: Royal FloraHolland with its digital auction platform Floriday and Port of Rotterdam with multiple platforms active in their community.

The project consisted of three work packages, all with specific objectives:

- **Gap analysis** (*work package 2*) of supply and demand of value-adding information services to pinpoint opportunities for the logistic sector by establishing value adding information services descriptions that are relevant to shippers, transport operators, LSPs and freight forwarders.
- Development of a **taxonomy** of digital platform types and a **decision support tool** (*work package 3*) which helps to accelerate digitization in the logistic sector by informing the logistic sector about digital opportunities.
- Scenario mapping of **digital ecosystem developments** (*work package 4*) to establish insights for further developing digital strategies for (digital) ecosystem orchestrators.

17 Semi-structured interviews and two workshops have been conducted to map the supply and demand of value-adding information services. Those interviews are used throughout all the work packages.
For the development of the decision support tool and the ecosystem development scenarios two additional literature studies have been conducted. The decision support tool developed for SME carriers and shippers is validated in two validation sessions with several carriers and shippers.

Results and value

- ***Platform users have limited attention for data standards and data sovereignty.*** *Work package 2* showed that digital platforms provide all kind of different value-adding services, categorized in four categories: administration, insight, matching and visibility. Implementing and following data standards and focus on data sovereignty is key to make use of most of those platforms. Shippers and carriers have a limited focus on this, especially when compared to academics and policy makers.

- ***Smaller shippers and carriers are not being considered by the larger (visibility) platforms***. This is due to the lack of digital maturity of shippers and carriers**,** but also because of the relative high costs for larger platforms to integrate smaller organizations.

- ***Digital platforms can increase their added value by offering new digital services***. Work package 2 showed that smaller platforms in particular are reluctant to offer new services because they prioritize building and maintaining trust among users.

- ***SMEs have a limited view on the benefits of digital platforms.*** There is a lack of knowledge, but they also find it difficult to assess what value digital platforms can deliver. Therefore, platforms should have a clear added value for companies to consider them.

- ***Logistics platforms typically begin with a core service and expand to additional services to continue to add value to B2B customers***. *Work package 3* was focused on SME carriers and shippers who find it difficult to see the added value of digital platforms and who do not know where to start. First, a comprehensive taxonomy of digital platforms for business-to-business services was developed to give an overview of potential platforms. This taxonomy consists of three main aspects: service type, revenue model, value creation type. Based on the literature review and the conducted interviews it can be concluded that logistics platforms typically begin with a core service and expand to additional services to continue to add value to B2B customers. Connected to the developed taxonomy, it has been shown that a set of service-revenue model combinations have emerged with successful digital logistics platforms. Partly based on the taxonomy, a decision support tool has been developed to help SMEs assess whether digital platforms can adequately meet their needs and identify areas where further support or investment is needed. This tool can be used to guide SME shippers and carrier in discussions about digital platforms in logistics.

- ***Scenario thinking is a useful tool for eco system orchestrator to determine strategy of the digital platforms***. *Work package 4* developed four possible scenarios for digital ecosystem developments on which an orchestrator can adjust his strategy. Those scenarios are based on two key dimensions: (a) Trade Network, and (b) Ecosystem Organization. These two dimensions lead to four distinct scenarios: (1) Collaborative Green, (2) Digital Spores, (3) Hyper-competitive market, (4) Protective Market.

- ***To thrive on possible scenarios in the future, orchestrators must prioritize universal access to digital technologies to stimulate sustainable growth and prevent digital divide***. Therefore, two no-regret orchestrator strategies have been proposed. First, advocating for digital market regulation, including antitrust measures and data protection policies, is essential to prevent monopolistic practices and ensure equitable opportunities for all participants. Second, orchestrators should also promote global standards while diversifying networks and building bilateral trust to enhance resilience in the face of geopolitical and operational uncertainty. An ecosystem orchestrator can adjust its strategy based on the proposed ecosystem development scenarios.

Based on the entire PLATO study, it can be concluded that digital platforms already offer value to the logistics sector to some extent. However, these (especially larger) digital platforms are mainly aimed at large shippers. SMEs lag behind in this and struggle to firstly see the value of digital platforms and secondly to determine the starting point for digitalization. This project provides a clear overview of the different types of digital platforms active in logistics which are linked to concrete logistics problems. In addition, the decision support tool provides tools for discussions on digital platforms with SMEs. Finally, the scenario analysis provides insights for ecosystem orchestrators to facilitate developments around digital platforms through their strategy.

Discussion and recommendations

Several conclusions emerge from the study. First, there is a lack of overview of the specific digital platforms available and the value they provide. Second, tools to assess digital readiness and identify next steps would be very useful for logistics companies. Third, there is a lack of standardization and in some cases divergence rather than convergence. More standardization and avoidance of divergence is needed to avoid companies spending a lot of time and money translating data from one format to another.

Further research should focus on a quantitative analysis of the costs and benefits of digitization. A clear understanding of the value to logistics companies is needed to generate interest. In addition, an impact analysis of different orchestrator strategies in different scenarios could help orchestrators to develop their strategies. By analyzing the potential impact of ecosystem orchestrator strategies under circumstances, the effectiveness of their strategies can be assessed.

Finally, the interaction between the physical platform (enabling the physical movement of goods) and digital platform (enabling the exchange of information and coordination of activities) and the extension of services should be explored. For both use cases the ecosystem orchestrator has both a physical and digital platform role. However, the span of the digital role should be well aligned with their physical role to prevent frictions in their ecosystems.

Key words

Digital platforms; Logistics; Digitalization; Case study; Value-adding information services (VAIS)

Content

1 Introduction

1.1 Motivation of the study

Digitization has the potential to transform the logistics sector, and digital platforms are accelerating this transformation. This is closely linked to other major trends: digitalization, automation, and energy transition. The logistics sector must therefore embrace this digital transformation to add value, remain competitive, improve sustainability, and build resilience to deal with disruptive forces. This project helps the sector to embrace digital transformation, identify the strengths, weaknesses, opportunities, and threats of platformisation, and act accordingly. This project aims to help the sector formulate an appropriate response to platformisation and digital transformation. Previous research highlighted the disruptive potential of platformisation in logistics and the pace of digital transformation demands for a quick and adequate response in logistics (Zomer et al., 2021). However, the previous research also identified reluctance and difficulties to articulate this adequate response in platform implementation, corporate digital policies, and business process redesign (Van der Keijl & Moonen, 2022). This project aims to help the sector to formulate such an adequate response to platformisation and digital transformation.

In the project, we address two matters: (1) the logistics function is facing platformisation, which is an irreversible and (potentially) disruptive development; and (2) platformisation has potential to radically improve the logistics function. Question is whether benefits as in (2) can be achieved while avoiding unintended consequences as in (1). This calls for a proper understanding of value adding services for the users and providers of the logistics function, the shippers, freight forwarders, and LSPs, and provide logistic ecosystem orchestrators with the measures to manage the disruptive character of platformisation in their communities.

1.2 Relation to TKI Dinalog´s innovation themes

The project is at the heart of the roadmap towards data driven logistics. Platforms fulfil a crucial role in digitized business processes and the essence of most logistics platform business models is to deliver scalable data driven logistics services. Platformisation impacts all three main application domains of the Topsector Logistics, though the focus of this research is on supply chain management and multimodal freight corridors and hubs. The supply chain management theme is addressed in the shipper digital requirements activities and the activities aimed at integrating supply chain visibility, digital forwarding, and advanced data analytics. The digital strategy orientation in port and flower ecosystems puts a focus on the port of Rotterdam as the main hub in maritime logistics and the flower auctions of Royal FloraHolland as the hub in flower logistics. Moreover, the digital ecosystem strategic analysis recognizes the power of data platforms but also fully aligns with federated data sharing ideas, such as Basis Data Infrastructuur (BDI) and data space approaches such as International Data Spaces Association (IDSA). It shows how platforms, point-to-point interfaces and federated data sharing infrastructures complement each other in a digital ecosystem. As such, this comprehensive digital ecosystem approach applied in typical logistics ecosystems is highly innovative and at the same time very powerful in terms of valorization and realizing impact.

With the involvement of companies optimizing and reporting multimodal transport related carbon emissions, we explore how platform integration contributes to Digital Green policies, through data driven logistics sustainability services that contribute to data driven environmental footprint analysis of planned and alternative supply chain choices. This is also a distinctive innovative approach towards digital green policies in logistics.

1.3 Objectives

The project has the following objectives:

1. Pinpoint opportunities for the logistic sector by establishing value adding services descriptions that are relevant to shippers, transport operators, LSPs and freight forwarders that can (in the future) be provided by digital platforms.
2. Support acceleration of digitization in the logistic sector by informing the logistic sector about opportunities of digital platforms.
3. Establish guidance for further developing digital strategies for (digital) ecosystem orchestrators.

For this project and the described objectives, a digital platform is defined as follows:

A digital platform for logistics is a platform where digital data from several companies is combined, processed, and delivered in a digital way to other companies with the purpose to improve the performance of the logistics chain of the users of the platform.

Shippers, transport operators, LSPs and freight forwarders progressively see enhanced sustainability performance as part of their value creation and as a competitive edge. Value-adding information services (VAIS) on digital platforms will contribute to such value creation and will also help these users to monitor, report and enhance their sustainability performance, for example carbon emission reduction. For port authorities, managing the digital platform ecosystem through their digital strategy will help to make the logistics system in their port area and hinterland inclusive towards the Dutch logistics sector, which also includes many small and medium –sized enterprises (SMEs) that experience platformisation as a threat.

1.4 Approach and results

In a first step the digital services offered by IT companies with digital platforms and the digital services used and requested by logistics companies (e.g., shippers, LSPs, freight forwarders, transport operators) have been investigated. All findings of this analysis – such as the provided digital services and the requirements and barriers regarding platforms – have been discussed in detail with several companies in multiple workshops and semi-structured interviews. The results of the discussions have been used to get a better understanding of the current landscape of digital platforms and to identify the gaps between the demand and the supply of digital services.

Outcomes of this first step have been used as a basis for the next step to develop a taxonomy of digital platforms. Besides, a literature study has been carried out to develop the design of the most relevant taxonomy for this study. The taxonomy has been developed to provide a structured overview of types of digital platforms based on a variety of different characteristics of these platforms. Based on the taxonomy a decision support tool has been developed that will support logistics companies to get a better understanding of the available types of digital platforms, the requirements to use them and the added value they offer. By using this tool, the logistics companies can make better decisions about whether, how and what digital platform they can use for their specific needs.

In a third step, the landscape of digital platforms has been analyzed from the perspective of the two ecosystem orchestrators in the project: the Port of Rotterdam authority dealing with the freight transport and logistics going through the port of Rotterdam and FloraHolland dealing with supply and demand of flowers at the flower auction. Based on current and expected technological advancements, general trends, and geopolitical changes a set of probable future scenarios has been developed. These scenarios have been further used to describe changes in the landscape of digital platforms and how these could affect the strategic position and the digital strategies of the ecosystem orchestrators.

The results of the project are presented to and shared with companies and governments through presentations and publications. Specifically, the decision support tool has been provided to sectoral organizations who can use this tool in discussions with SME carriers and shippers to make them aware of all digital platform related considerations.

Summarizing, the study delivers the following deliverables:

- Gap analyses between current and future supply and demand of digital platforms.
- Decision support tool digital platforms to support companies to decide whether, how and what digital platform to use for their specific logistics needs.
- A set of likely future scenarios for logistic ecosystems and impact on digital strategies of ecosystem orchestrators.
- Increased knowledge of the logistic sector regarding digital platforms.

Research paper reporting on the main findings of the project.

1.5 Structure of the report

In chapter 2 an overview is given of the approach and the results of the gap analysis between supply and demand of digital platforms. Chapter 3 explains the design and outcome of the taxonomy of digital platforms and the decision support tool to support logistics companies in their decisions about the use of digital platforms. Chapter 4 gives an overview of the relevant developments for the landscape of digital platforms for the ecosystem orchestrators and the impact this will have on their digital strategies.
In chapter 5 it is explained how the results of this study are valorized and disseminated. Finally, chapter 6 describes the most important conclusions and recommendations.

1.6 References

Van der Keijl, N. & Moonen, H. (2022). *The what, how and why of data sharing: Port logistics more efficient, reliable and sustainable* [White paper]. Retrieved from: https://smartport.nl/wp-content/uploads/2023/03/SmartPort_White-paper_Data-Sharing_EN_final.pdf

Zomer, G., Hoesen, M. & Zuidwijk, R. (2021). *A Wolf in Sheep's Clothing or a Blessing in Disguise? Booking Platforms as a Disruptor and Enabler in the Logistics Industry*. Retrieved from: https://smartport.nl/wp-content/uploads/2021/01/SmPo_TNO-Booking-platforms_final.pdf

2 WP2: Gap analysis

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2.1 Goal and Approach

2.1.1 Goal

As previous research highlighted the disruptive potential of platformisation in logistics and the pace of digital transformation demands for a quick and adequate response in logistics. However, the previous research also identified reluctance and difficulties to articulate this adequate response in platform implementation, corporate digital policies, and business process redesign.

The goal of the gap analysis is to identify the gaps between the demand and the supply of digital services and also to map the current digital services that are being offered. Those digital services should be ready to use for logistics companies to improve the performance of several indicators in the logistics chain. The relevant success and failure factors will also be analyzed. This gap analysis is conducted in order to get a better understanding of the current landscape of digital platforms. The outcomes will support the sector to formulate an adequate and fast response to platformisation and digital transformation.

Finally, the results of this analysis will be input for and used by the succeeding activities in this study to determine the taxonomy of digital platforms and the decision support tool for logistics companies (chapter 3) and analysis of the changing logistics ecosystems (chapter 4).

2.1.2 Approach

The gap analysis is based on the results of several interviews and workshops with both suppliers of digital platforms (IT companies and consultants) and users of digital platforms in logistics (shippers, logistics service providers and transport companies). For this analysis, a digital platform in logistics has been defined as follows:

A digital platform for logistics is a platform where digital data from several companies is combined, processed and delivered in a digital way to other companies with the purpose to improve the performance of the logistics chain of the users of the platform.

Under this definition, the following types of digital platforms for logistics have been identified and have been further analyzed:

- Matching platform: matching supply (transport services) and demand (transport orders) of transportation.
- Visibility platform: providing visibility in the logistics chain/supply chain to know the status and the progress of the transportation.
- Administration platform: document handling and compliance to fulfil administrative requirements of the transportation.
- Insights platform: providing insights based on shared data adding information and analytics.

In Table 2.1 a further elaboration of these types of digital platforms is given including the expected added value of these digital platforms.

Table 2.1: Overview different types of digital platforms for logistics

Type	Matching	Visibility	Administration	Insights
Concept	Matching supply and demand of transportation	Visibility in the logistics chain	Document handling and compliance in the logistics chain	Information about the performance of the logistics chain
Examples	UTurn, Transporeon, Flexport, Nextlogic, Floriday*	Fourkites, Shippeo, MyTerminal	Portbase, Cargonaut	Bigmile
Added value	Fast and easy way to match supply and demand, reach of large number of companies, optimal pricing	Better organization and alignment of activities in the logistics chain based on insights in status and progress of transport	Smooth document handling and compliance, one-time delivery of data, unburdening activities	Additional information on current process and/or predicted futures to improve the performance of the logistics chain

(*) Floriday is a matchings platform matching supply and demand of flowers (not of transport)

The scope of the analysis covers hinterland transport by road, rail, and barge with the focus on national transport. This means that intercontinental transport and transport by sea and air are not covered in this analysis. Furthermore, the analysis focusses on two major hubs in the Netherlands with very different characteristics: the port of Rotterdam and FloraHolland. The landscape of digital platforms around the port of Rotterdam can be characterized as a scattered landscape with different digital transport platforms for different purposes supplied by and used by many different companies. FloraHolland has a monopoly position with the Floriday platform matching supply and demand of flowers. It is stressed that all platforms considered in the analyses are related to transport in the logistics chain, besides the Floriday platform that matches supply and demand of goods. Because of these clear differences between the digital platform landscapes around these hubs, it is interesting to analyze and compare them with each other.

Given the definition of digital platforms, the types of platforms, the scope of the analysis and the focus on the two major hubs a number of platforms have been selected for the interviews to cover the different types of platforms relevant for the major hubs.

It is mentioned that altogether there are many digital platforms in logistics. Together with the consortium partners a number of the more well-known platforms that are relevant for this study (by definition, type, scope and hub) and that cover the most relevant segments have been selected. Both from the supplier side and from the user side, the group of interviewed organizations does not give a complete nor a full representative view on the digital platform landscape. Results of this analysis should be interpretated and used as the outcome of the interviews with this specific group of organizations. Table 2.2 gives an overview of interviews and workshops (organizations, type of digital platforms and persons). It is mentioned that for several digital platforms more than one type of digital platform is valid (for instance both matching and visibility). In the table the main type of platform is mentioned.

Table 2.2: Overview interviews and workshops

Organization [type of platform]	Interviewee
Port of Rotterdam	
Port of Rotterdam *Port authority*	Martijn Thijsen & Pieter de Waard
Flexport [Matching] *Digital freight forwarder*	Daniël Hölzer Mathijs Slangen
Nextlogic [Matching] *Barge scheduling platform*	Sijbrand Pot
Transporeon [Matching] *Booking and information platform*	Serge Schamschula
UTurn [Matching] *Matching platform*	Daan Meboer
Four Kites [Visibility] *Visibility platform*	Marc Boileau
Shippeo [Visibility] *Visibility platform*	Vincent Huissen & Bram Borgman
Poort8 [Visibility] *Information platform*	Bart van Riessen
Portbase [Administration] *Port community system port of Rotterdam*	Dennis Dortland & Erik Fortgens
Cargonaut [Administration] *Port community system Schiphol airport*	Luc Scheidel
Big Mile [Insights] *Sustainability platform*	Jan Pronk
My Terminal [Insights] *Digital platform developed by ECT container terminal*	Ana Duskov & Willemien Akerboom
Evofenedex – workshop *[users of digital platforms]* *Association of shippers*	Nanne Schriek Supply Chain Community Event (~30 attendees)
TLN – workshop *[users of digital platforms]* *Association for road transportation*	Tom van der Schelde & Cees Pille Board meeting floriculture transport (7 attendees)
FloraHolland	
Royal FloraHolland [Matching – flowers] *Flower auction*	Andre van der Linden & Leendert-Jan Plaisier
Vilosa [user Floriday, supplier of flowers] *Grower of flowers*	Rick van Luijk
J&P ten Have [user Floriday, supplier of flowers] *Grower of flowers*	Jos ten Have
Van der Plas [user Floriday, buyer of flowers] *Exporter of flowers*	Frits Liefde
Hilverda de Boer [user Floriday, buyer of flowers] *Exporter of flowers*	Harold van Rijn

The interviews have been conducted following an interview protocol (see Appendix A). Minutes of all interviews have been checked by the interviewees and are available for the researchers in the PLATO project. Due to confidentiality agreements, the minutes are not public and therefore they are no part of this report. The interviews follow the research questions to address the added value of the (current and expected) services offered by the platforms, the requirements and the barriers to use the platforms. These topics are explained in the next results paragraph together with an overarching and summarizing paragraph about the identified gaps between the supply and demand of digital platforms for logistics.

2.2 Results

2.2.1 Value-adding information services (VAIS)

This section discusses the value-adding services that are being offered or that are in development by digital platforms.

By having various interviews with both providers and users of digital services, the following research questions as listed in the proposal will be answered in this paragraph:

1. What VAIS do logistics actors currently use?

2. What VAIS provide logistics actors with a competitive edge?

3. What VAIS desired by logistics actors are currently not available?

When looking at the services that are currently being used by logistics parties, various services came across. Table 2.3 shows the digital services divided in four categories: administrative, insight, matching and visibility. From left to right, digital services are based on more static (left) or dynamic (right) data. All value-adding services of digital platforms that were mentioned in the interviews are also mentioned in this table. The services are also combined in categories if applicable. Then the combined services which are related to each other are connected to a specific platform type.

Administration services can be divided into facilitating data-sharing between different parties (data sharing services) and administration of both financial and transport related information. This could be long term agreements, but also short-term shipment information, for example an eCMR. Administration in logistics entails all the transactional information that must be shared to make transport of the shipment possible, for example information regarding payment and customs.

Other digital services are related to giving insight in how, for example, the supply chain is performing depending on specific Key Performance Indicators (KPIs). Especially in the Royal FloraHolland case, Floriday made it possible for growers to keep track of real-time stock statuses and share these with buyers. For emissions but also transport performance, benchmarking makes it possible to compare results of (competitive) logistics companies. Also forecasts of transport demand or demand for products is also offered by digital platforms. Overall, digital services related to insights make it possible to steer supply chains in a strategic way based on their performance.

Bringing supply and demand together of transport or asset capacities is offered by matching platforms. This varies from full digital forwarding services to bringing shippers and carriers together on shipment basis. Other matching platforms bring supply and demand of products together and offer logistics services to that. Planning of different assets, e.g., modalities, terminals and warehouses, can also be offered by digital platforms. Some visibility platforms also add these services to their platforms, because visibility data is crucial for these kinds of services.

Table 2.3: Overview value-adding services of digital platforms

Data type	Static data → Dynamic data			
Platform type	Administration *Static information with an administrative nature*	Insight *Information about performance and statuses*	Matching *Bringing supply and demand of products or assets together*	Visibility *Event based, dynamic data*
Value adding services *mentioned in the interviews*	Transport administration (e.g., bill of lading, eCMR) *Financial services* Billing Settlement solutions Price negotiations Audit Port fare handling ***Data sharing services*** Broker Customs and compliance data Sticker information (flowers) Information about connected parties (flowers)	*Real-time statuses* Stocks Terminals *Benchmarking* Transport fares Emissions *Dashboarding* Transport fares Emissions Forecasts	Forwarding *Matching supply and demand* Transport Flowers ***Planning services*** Time slot management Modalities Terminals Warehouses	Real-time visibility Containers ETA of flowers Forecasting discharging time ***Communicative services*** Between shippers and carriers Between growers and wholesale

Lastly, visibility in the complete transport chain is offered mostly to the larger, tech-savvy companies. This also follows the demand for real-time visibility services in supply chains. The focus of these services is answering the question: "where is my shipment?". Sometimes (automated) customer service is added to this to reduce the high amount of re-quired employees for call centers. Those services are event driven and are based on the real-time statuses of physical assets, such as: modalities (ships, trucks, and trains), terminals and warehouses.

Many different companies offer digital services. Traditional logistics companies have added those digital services to their own company to improve their total services to clients. New incumbents are fully focused on a technology push and mainly provide visibility services to larger shippers. Those different digital services have been discussed in an ordered way; however, many digital platforms provide multiple digital services in other categories. Therefore, platforms could initially be started by providing visibility services, but now also offer scheduling services. Other smaller platforms focus on a particular niche market and provide for example only insights on emission level. Platforms can be competitors of each other but can also be complementary to each other. For example, visibility platforms adding emission services of another platform to their own platform.

When looking at the offered digital services, sometimes digital platforms are ahead of the demand for digital services of logistics parties and sometimes lacking behind. If platforms have more data available, it becomes easier to develop new services.

Sometimes new regulation makes that digital services may lack behind, for example the Corporate Sustainability Reporting Directive (CSRD) mandating companies to report their emissions.

2.2.2 Showcases of digital platforms in logistics

During the interviews and discussions during this project it was difficult for SME shippers and carriers to come up with examples of very successful digital platforms which have a big impact on the performance of logistics. Especially during the sessions with members of TLN and Evofenedex almost no examples were given, except for business to consumer platforms such as Marktplaats. The members also made limited use of digital platforms. Note: the attendees of the two sessions with TLN and Evofenedex were mostly small to medium enterprises. Because of the difficulties regarding the discussion about successful platforms, the digital platforms of the consortium have been asked to come up with practical showcases which are discussed in this section. These showcases are meant as examples of a number of digital platforms to make clear what added value the digital platforms can bring for logistics companies to improve the performance of their logistic activities. Again, these are examples of digital platforms and the added value they bring, it is not intended to give a complete overview of all relevant digital platforms.

Visibility platforms

The main idea behind visibility platforms is that supply chains can be better managed by having a complete view of locations, statuses and events of all shipments and modes of transport. Depending on the application of those insights, supply chain performance can be improved on several fronts.

In general, the use of visibility platforms could help parties to improve KPI's related to logistics and supply chain management:

- Increasing customer satisfaction
- Optimize personnel efficiency
- Digitalize transport processes and therefore increase productivity
- Reducing freight costs
- Optimization of cash flows
- Improve supply chain planning and reduce the effect of disruption
- Minimize CO_2 emissions

Showcase 1: Elevating customer experience (FourKites)

General description

This showcase is about improving visibility of a multinational manufacturer of adhesive materials with an overall revenue of around 9.6 billion euros. The main clients of this company are covering a wide range of industries. They collaborate with several logistics service providers to ship the products to their clients. Almost 1 million shipments are to be tracked in this application.

Logistics problem

Manufactures rely on many different logistics service providers. This makes it often difficult to keep track of all in-transit shipments. Therefore, this manufacturer wanted to improve visibility in order to increase the overall efficiency and eliminate manual processes. This could help their customers to better manage their own deadlines and operations. The main goal was to elevate the experience of their customers.

Solution

Further improvement of the availability and accuracy of Estimated Time of Arrival (ETA) and Actual Time of Arrival (ATA) data in minutes versus hours. Visibility included the whole end-to-end chain between company warehouse and customer site. ETAs are also made visible for customers on the eShop platform of the company itself.

Implementation

LSP's were actively involved in the development of this Track & Trace program, because it was mainly relying on their data. The collective team consisting of the company representatives and the partner platform monitored the coverage and quality of shipment visibility during the implementation phase.

Impact

In this showcase improved visibility had an impact on three particular KPIs:

- Time and cost savings
  By providing Track & Trace information to customers, customer service could save time and costs because manually tracking shipments was not necessary anymore. Productivity of customer service teams can be improved by 30-40% due to faster treatment of accidents.
- LSP performance accountability and improvements
  Performance of LSP's can be better monitored with the right information. It also becomes possible to reward well performing LSP's and address issues related to LSP performance. By improving carrier management, the On Time, In Full (OTIF) performance can be improved by 20-30%.
- Equitable dispute resolution
  By having all information available about shipments, shippers can verify if a shipment arrived late or on time. This could help if a customer claims that a shipment has arrived too late. By doing so a potential of 30-50% reduction of penalties related to late arrivals can be achieved.

Showcase 2: Increased competitiveness (Shippeo)

General description

In this showcase visibility is provided to a Logistics Service Provider who is active in 14 European countries and transports over 1 million transport orders a year with 3,400 trucks.

Logistics problem

The focus of this showcase is to remain competitive with other LSP's. Especially in times where logistics costs are increasing due to disrupting event in supply chains. Because this LSP is working with many subcontractors it is difficult to monitor performance and to develop 100% visibility. As main driver, customers' satisfaction is chosen by this client.

Solution

A visibility platform which provides clients with real-time information and insights regarding their shipments consisting of its statis, position and ETA. The platform should also be scalable and therefore the onboarding process of carriers was automated.

Implementation

Connection with carriers was based on API-integrations with Transport Management Systems (TMS) and telematics. The visibility platform itself was provided by the platform developers.

Impact

Customers' satisfaction was improved because they had access to real-time information about their shipments. It also became easier to monitor carrier performance on a real-time basis, for example on delays and dwell times. Therefore, the retention rate of customers can be improved by 3-5%, but also dwell time fees can be reduced by 20-40% by increased visibility of shipment ETAs.

Matching platforms

Matching platforms bring supply and demand of transport or goods together. This results in direct value for both supply and demand parties in the form of:

- Increase market reach
- Improve efficiency of (logistics) assets
- Optimize pricing

Showcase 1: Digital marketplace (Floriday)

General description

This matching platform brings supply and demand of producers and buyers together and is active in the sector of agriculture. Besides the main service of providing a digital auction, also other services are provided such as logistics and administrative services.

Logistics problem

There was no overview of stock statuses accessible for buyers, which resulted in products that were sold twice. Especially with living products this was a big problem. Besides this, administration was time consuming.

Solution

An open and international network of buyers and sellers on a single platform where goods are auctioned, and further processes are handled. Also, real-time stock statuses are provided via this platform.

Implementation

Both producers and buyers can connect to this platform via APIs. However, this is also dependent of the ERP system used. The platform offers services to connect to those third-party software companies.

Impact

Foremost, this digital platform provided producers with new sales opportunities via various sales channels on this single platform. Besides, it also resulted in 80% reduction of administrative work which saves time and costs.

Insight platforms

Insight platforms provide shippers or carriers with information that helps them improving the performance of logistics. By having those insights, it becomes easier to make better decisions in the supply chain regarding efficiency or effectiveness. Insights could result in:

- Deepen overview of supply chain performance
- Improve anticipation in the supply chain
- Reduce CO_2-emissions

Of course, giving insights does not have a direct impact on supply chain performance. However, by giving insights in current performance, companies can come up with strategies which can have a direct impact.

Showcase 1: Insights in CO_2-emissions (BigMile)

General description

The supply chain department of this multinational is active in Europe Middle East and Africa and produces office equipment. They provide their customers with new configurations (around 140 thousand per year) of their systems but also service parts (around 4.7 million a year) and have an overall turnover of 1.7 billion euro.

Logistics problem

The company wanted to get insights in their CO_2-emissions per modality to reduce those emissions.

Solution

The platform provided this company with a CO_2-monitoring tool which is also capable to calculate the impact of 'what-if' scenarios. This helped the company to form a strategy for reducing CO_2-emissions to reach their goal of reducing 60% of greenhouse gas emissions by 2030 compared to 2015.

This resulted in several reduction strategies: implementing a hub-and-spoke network, using double deck trailers, shifting from air to rail and applying multi-modality by truck and rail.

Implementation

To get those insights data about the shipments (origin, destination, and modality) are required. Also, other approaches based on general, or vehicle fuel consumption are possible if more precise monitoring is required. The initial onboarding phase takes between 2 and 8 weeks dependent of the data availability and approach chosen.

Impact

The implementation of the CO_2-monitoring tool has led to more insights in the performance of the supply chain with respect to emissions. This made it possible to act on specific point in the supply chain which has led, in this particular case, to a reduction of 23% of the greenhouse gas emissions by 2020 already. This is mostly due to the shift from air and truck to rail.

2.2.3 Requirements

This paragraph addresses the following research question from the proposal:

4. What software, hardware and orgware are needed to provide these VAIS?

This section discusses the requirements for logistics companies to connect and use a digital platform. The requirements and possibilities to connect differ per platform and is also dependent of the market focus of the platform. Big logistics enterprises have an own IT-department, smaller ones do not even have a single IT-employee. Therefore, digital platforms adjust their connectivity to their clients to maximize the network effect of their platform.

One of the key success factors of digital platforms is the easiness to connect. Most of the platforms make use of API-connections to retrieve and send data between data-providers and data-users. However, due to a low digital maturity level of logistics parties, shippers, and growers and buyers of flowers it can be difficult to connect. Therefore, multiple connection options are available at some platforms, such as: web screens, input via an Excel and web-based applications. Especially for visibility platforms it is difficult to connect with all the different (smaller) subcontractors of logistics services. They retrieve location data of trucks via telematic connections, however there are many different formats and technologies available. The same holds for all the available ERP-systems in the Royal FloraHolland case. In this way all connections to different parties become tailor based and therefore a platform can be less scalable. Another important topic is data governance: who is the owner of the data and who is in control over the data? For what purposes can the data be used? For some party's clear data governance agreements are required to get them participating in digital initiatives. However, there are also examples of parties that do not bother about data governance issues, because the platform they are participating in delivers sufficient and direct added value. For some of the matching platforms, this is the case.

2.2.4 Barriers

And finally, the research question about the barriers will be answered:

5. What are the main barriers that logistics actors experience in using digital platforms?

There are also reasons that keep logistics parties from using digital platforms. Those experienced barriers that came across during the interviews and previous research are shown in table 2.4 below (Van Adrichem, 2022; van der Keijl & Moonen, 2022; Zomer et al., 2021).

Table 2.4: Overview barriers for logistics companies to use digital platforms

Category	Barrier
Competitive position	Risk for misuse data Risk for individual competitive position Confidentiality of data Loss of control Dominance of parties over data
Business model	High development costs Unclear costs and benefits Monetization of data Network underrepresented on platform Responsibility of data-platform Missing revenue model and success stories
Attitude	Resistance to change Unfamiliarity with platforms Missing urge Unclear added value Willingness to share data is lacking Wait-and-see attitude Lack of trust
Data-sharing standards	Privacy and security problems Accuracy and reliability of data Missing data-purpose, definitions and standards Conflicting data-sharing requirements Competition law problems
Requirements	Lack of time and (IT-)knowledge Software (connection) problems

Digitization could potentially have a positive impact on the performance of logistics. However, there could also be a downside of sharing data and information with parties in the chain. In those cases, the competitive position of a company or role in the chain could be at stake. If logistics becomes more transparent, the value of the middlemen could be of less importance. Data has also commercial value which make data commercially sensitive or confidential but also vulnerable for misuse by competitors or criminal organizations.

This is also connected to the loss of control when data is shared: companies should have an over-view of to what data other companies have access it and for what application. Lastly, sharing information by using digital platforms makes those parties also powerful and these parties could hereby play a dominant and leading role in supply chains in a winner-takes-all scenario.

Another category of experienced barriers is a lacking business model regarding the use of digital platforms. Both benefits and costs can be uncertain and the time when these benefits and costs will occur can be unclear. The magnitude of benefits of using a digital platform depends, among other things, on the network that is represented. The costs, in contrast, on the development costs which are dependent of the onboarding time and the digital maturity of a logistics company. Also, success stories, as discussed before, of well performing digital platforms in the field of logistics are lacking. Lastly, companies can lose their opportunity to build and sell digital services on their own (monetization of data) if they share information with others.

The attitude or culture of a company can also be leading when making decisions about digitalization or innovations in general. Resistance towards change, the willingness to share information and a wait-and-see attitude make that parties are hesitant in making use of digital platforms. Also, the urge to share information could be missing if the costs of sharing information outweigh the potential benefits. In other words, some parties in the chain can have more benefits as compared to others. Lastly, trust plays an important role with respect to collaboration and sharing information with others in the chain.

Besides the first three categories which are focused on the organizations and people side of digitalization, it is also important that parties can use these kinds of services. Data sharing standards are required when data or information is shared between different parties to speak the same language. This means that data-sharing should be, from a technological point of view, accurate, reliable, secure, and compliant to all privacy regulation. However, also definitions of attributes and the purpose of sharing information should be clear. Lastly, some parties are in doubt if data may be shared between all parties from a competition law perspective.

To make use of digital platforms the right requirements should be met. To connect to a platform time and IT-knowledge (internally or otherwise externally) should be there to make this possible. Not always is the current infrastructure sufficient to connect and software or connection problems will occur. In general, companies that are more mature regarding Digitization are easier to connect as compared to (smaller) companies that are completely new with Digitization. This also has an impact on the development costs of the implementation of these kind of digital services at logistics companies.

2.2.5 Gaps between demand and supply of digital platforms

Observations

Based on an analysis of the interview results a number of observations can be made that are directly linked to the different types of digital platforms. For each of these platform's observations are described for the topics value, data, and scale (number of companies reached by the platform) since the digital platforms differ substantially around these topics. Besides, several important developments are mentioned.

Matching platforms

Table 2.5: Observations matching platforms

Topic	Description
Value	These types of digital platforms have a clear added value for the users. Suppliers of transport services (transport companies) are looking for transport orders and shippers or logistics service providers have transport orders and are looking for transport services. Each match on the platform has direct value to the users, including in many cases additional services such as administrative and financial settlement. Besides, on several of the matching platforms, users only pay once a successful match has been made. The larger amount of platform users – both suppliers and demanders of transport services – the higher the chance of successful matches. Around the matching platforms for road transport, a number of similar platforms are available that compete with each other.
Data	In general, digital platform suppliers have the strategy to make access to their platforms as easy as possible for the users. As a result of this, the platform suppliers do not request specific data formats, they deal with any data format and standard that can be delivered by users. In practice this means that the platform suppliers put quite some effort in translating the received data into the formats and standards they use for their platform. Concerning issues around ownership and use of delivered data by the platform users, several platform suppliers mentioned that the platform users do not really bother about this. Their assumption is that the value of the platform – getting a match on a short notice according to their requirements – is that high that they do not really care about how their data is further being used by the platform suppliers. A possible disadvantage of digital matching platforms that has recently been mentioned in publications (not in the interviews) is that criminals can make use of it to get to know the interesting high value transport order including further transport details1.
Scale	The digital platforms focus on all companies, large and small. From the start shippers and logistics service providers use the platform for the more ad-hoc transport services. But platform providers mentioned that the platforms are more and more also used for larger sets of planned transport orders. The higher the number of users of the platform, the higher the chance of a good match. Therefore, the network effect of these digital platforms is very important. In the early phases of these platforms, onboarding as many users is possible is an important goal. Especially for matching platforms for road transport, there is quite some competition which makes onboarding many users a challenge since different platforms offer the users comparable platforms.
Development	Matching supply and demand is the main goal of the matching platforms. But several platform providers mentioned that step by step they are extending the services from making matches to also arranging administrative and financial settlements and providing (limited) visibility in the logistics chain. The matching platforms gather lots of data that can also be used for additional services such as benchmarking or making predictions. In general, the matching platforms do not offer these types of services (yet), but they are thinking about it and developing some first applications. Another development concerns the scope of the matching platforms, the road transport platforms do consider or are already working on extending their services towards rail and inland waterways transport as well.

[1] See: Verzekeraars zijn ladingdiefstal beu: 'Stop met de vrachtbeurzen' | NT

Visibility platforms

Table 2.6: Observations visibility platforms

Topic	Description
Value	Visibility platforms have a clear value to the users of the platform. Visibility is created in the full logistics chain that can be used by the logistics service providers and/or shippers to act according to the real-time information about the progress of the transport and further information about the milestones in the logistics chain.
Data	The challenge with a visibility platform is to get visibility in the complete logistics chain, or for the largest part of the logistics chain. Since, the logistic chain is normally organized by many different organizations this means that data is required from many different organizations. Because different organizations have different data formats and different levels of data completeness and quality, it takes a lot of time and effort to collect and process all the data to get it on the right level and to fill the logistics chain as complete as possible.
Scale	In general, the large visibility platforms focus on the larger logistics service providers and shippers. The reason for this lies in the data situation as mentioned above, only the large companies do have enough time, effort, and resources to spend on the process to collect and improve the data. Besides, large companies do have the 'power' to request from the companies they work with in the logistic chain the needed data in the right format with right level of detail. For smaller companies, this is not feasible. Therefore, the scale of these visibility platforms is still limited, focusing on the large companies, and more or less not being used by smaller companies.
Development	The visibility platforms are extending their scope from the logistics chain towards the full supply chain providing even more value for the shippers.

Administration platforms

Table 2.7: Observations administration platforms

Topic	Description
Value	The value of administrative platforms is a bit ambiguous. On the one hand companies are unburdened related to several administrative processes and compliance and in several cases, they only have to deliver data once (instead of many times in the same way). On the other hand, many of the users complain that it is an obligation to use the platform while they do not really see the added value.
Data	Since the large administrative platforms have a monopoly position, they can request data according to a specific format. For the platform itself this is very convenient, for the users of the platform this less convenient since they must comply to formats, they are not using themselves. And thus, they have to translate their own data in requested formats.
Scale	The large administrative platforms have many users since they have kind of a monopoly position which means that all relevant organizations are obliged to use it. Therefore, these platforms have very complete data about processes in the logistics chain.
Development	The last couple of years, administrative platforms started initiatives to develop applications based on the set of data they have available, besides their core activity of passing on data for logistics processes. Because of this, discussions started with the users about ownership of the data and about the issue that users had to pay for applications based on their own data. Currently, the administrative platforms changed their strategy – partly based on these discussions – and stopped developing additional applications and mainly focus on their core activity.

Insights platforms

Table 2.8: Observations insights platforms

Topic	Description
Value	In general, the analysis performed in this study showed specific insights platforms related to sustainability. Based on data provided by users, calculations are being made for sustainability indicators according to agreed calculation standards. Besides, benchmarks can be shown, and analysis of emission reduction measures can be made.
Data	Mainly data about own processes in the own format of users can be delivered.
Scale	Insights platforms such as the ones focusing on sustainability do not need large scale to make sustainability calculations. For benchmarking, large scale is important to make good comparisons with other relevant companies.
Development	Many analyses could be made providing insights for users of digital platforms such as benchmarks, performance monitoring and making predictions. The suppliers of matching and visibility platforms are considering and preparing these kinds of additional services, but it is not being offered at scale yet. One of these considerations concerns the issue that digital platform providers are wary of offering additional services based on data of the users for an additional price. They expect that users might be against these services related to ownership of data and the need to pay for analysis based on their own data. One other development is that matching, and visibility platforms want to extent their services by adding sustainability calculations to the services of their platform by cooperations with digital insights platforms.

Identified gaps

In this part the most important gaps are described between services offered and demanded through digital platforms based on the interviews, workshops and analyses of all results. Those gaps formulate the major highlights and discrepancies that came across during the analysis.

Gap 1: limited attention for data standards and data sovereignty

Data standards are not commonly used. This is due to the fact that everybody works with their own operational specific data and procedures. This leads to the situation that data formats are translated all the time. On the one hand, the large digital platforms that have a (near) monopoly position (large administrative platforms and Floriday) can prescribe the data standard that has to be used to join the platform. The users have to comply to this standard which means that all the companies are translating their digital dialect into the digital dialect that has been requested by the digital platform. There are even specific companies who offer this as a service: translating the data from the users towards the requested format of the digital platform. On the other hand, in a competitive market where each digital platform wants to have as much users as possible (mainly the matchings platforms for road transport), the digital platforms want to make the access for the users as easy as possible. In practice this means that users can deliver their data in any format, and that the platform providers translate all the received data into the format they are using themselves for the platform. One way or the other, by missing commonly used data standards, a lot of time and effort is used on simply translating data from one format to the other.

Concerning data sovereignty, which concerns the right of data ownership and control, there is a big difference between visibility platforms and administrative platforms where this is an important topic for users and the matching platforms where most of the users don't care about this topic. In the former case, companies are afraid data will be used for applications they don't want or they even want to avoid being developed.

In the latter case, it seems that – although there is a lot of attention for data sovereignty in research and development projects – the value of the matching platform is that high that they don't bother about the data. Besides, companies don't provide a complete overview of all their data on matching platforms.

Gap 2: (larger) visibility platforms focus on larger shippers and not SMEs

The visibility platforms offering full visibility in the complete logistics chain/supply chain have the larger logistics service providers and shippers as clients. The reason for this is straightforward: it takes a lot of time, effort and money to create visibility that can only be afforded by large companies who have people and budget to do this. As a consequence, in terms of visibility the larger companies create a big advantage over the smaller companies who are missing this level of visibility. With the risk that the gap between larger and smaller companies becomes larger and larger over time.

Gap 3: potential of new digital services versus building trust among users

The digital platforms collect lots of data which gives them the opportunity to use this data for all kind of additional services providing insights such as monitoring, evaluation, benchmarking, forecasting or specific sustainability reports. Of course, an important condition is that the platform suppliers are allowed to do this by the users. However, even when it is allowed, these kinds of services are only offered to a very limited extent. Reasons are that platforms notice reluctance amongst users that are afraid for unwanted applications and high tariffs of these applications. Therefore, they rather focus on the core service of their platform. Other platforms are developing new services, but in many cases, these are still in the early development stages. A specific additional service concerns the sustainability reporting. Although this reporting will be obligatory soon, it doesn't have the attention of all digital platform suppliers and users (yet).

Gap 4: limited view on benefits of digital platforms

In several interviews and the workshops logistics companies and also platform suppliers have been asked to mention successful digital platforms for logistics. In this case a successful platform is defined as a digital platform that they know about, they use themselves or they know it is being used by other logistics companies and that has a clear value related to the logistics activities of logistics companies. The platform suppliers of course mention their own platform and they also mention some other digital platforms. However, it was quite striking that the logistics companies – and especially the SME companies – were not able to mention a number or any successful digital platform for logistics. This means that the smaller logistics companies currently hardly use any digital platform, that they are not really aware of digital platforms used by others and that they don't have a clear view on the potential value and benefits a digital platform can bring for their logistics activities.

2.3 Conclusions

Digital platforms provide all kind of different value-adding services, which can be categorized in four categories: administration, insight, matching and visibility. Most of the platforms lean to one of these categories, but also provide a broader spectrum of services. SME carriers and shippers, however, limitedly use digital platforms. Those companies also find it difficult to come up with examples of successful digital platforms in logistics. Also, connectivity is one of the key challenges with digital platforms. Connectivity is also dependent of the digital maturity of the platform user. APIs are used more of-ten, but connections can still be based on web screens and/or Excel. The main barriers experienced by logistics actors to not connect to digital platforms are related to competitive position, business model, attitude, data-sharing standards, and requirements.

The gap analysis resulted in four gaps related to the supply and demand of value-adding information services. First, platforms users have limited attention to data standards and data sovereignty. Especially when compared to academics and policy makers. Second, smaller shippers and carriers are not being considered by the larger (visibility) platforms due to the lack of digital maturity of shippers and carriers.

Third, especially smaller platforms limitedly focus on developing new digital services besides their current core service provided. Fourth, SMEs have a limited view on the benefits of digital platforms. Platforms should have a clear added value for companies to consider them.

2.4 References

van Adrichem, M. (2022). *Mapping inter-organizational data governance mechanisms in the container supply chain: Case study for the Port of Rotterdam* [Master thesis, TU Delft]. Retrieved from: http://resolver.tudelft.nl/uuid:4c20ecd2-4404-4668-aa68-a72a3391e3c3

Van der Keijl, N. & Moonen, H. (2022). *The what, how and why of data sharing: Port logistics more efficient, reliable and sustainable* [White paper]. Retrieved from: https://smartport.nl/wp-content/uploads/2023/03/SmartPort_White-paper_Data-Sharing_EN_final.pdf

Zomer, G., Hoesen, M. & Zuidwijk, R. (2021). *A Wolf in Sheep's Clothing or a Blessing in Disguise? Booking Platforms as a Disruptor and Enabler in the Logistics Industry*. Retrieved from: https://smartport.nl/wp-content/uploads/2021/01/SmPo_TNO-Booking-platforms_final.pdf

3 WP3: Logistics Platform Taxonomy and Decision Support Tool

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Our research objective is twofold. First, to develop a framework (the "taxonomy") into which logistics platforms – both digital and "traditional" – fit, which identifies a set of features that broadly characterizes these platforms. Traditional logistics platforms refer to conventional logistics service providers (LSPs) that offers services such as warehousing, transportation, planning, payment, etc., through analog communication channels such as spreadsheets, pen-and-paper documentation, phone calls and emails, whereas digital platforms rely on digital technologies such as web-based systems and mobile applications. The taxonomy leads to a set of logistics services that are currently being offered by both traditional and digital logistics platforms, albeit in different ways.

Our second objective is to develop a decisions support tool (the "tool") based on this taxonomy which helps small and medium-sized enterprise (SME) logistics actors that are interested in exploring digitization and digital solutions identify which platform solution(s) may be available to address their logistics challenges. The tool follows directly from the set of logistics services identified by the taxonomy. Moreover, the tool is intended to *help facilitate discussions* to identify opportunities where digital logistics platforms may add value and where a traditional LSP solution is better suited because further investment may be needed before digital solutions can add value. The tool is not a full, online, or product-ready tool for users to assess readiness for digital logistics platform selection or integration. It requires facilitation by a logistics expert with knowledge of current existing platforms and the ecosystem.

To build the taxonomy, we rely on the existing, but limited, B2B (business-to-business) platforms literature as compared to that on B2C (business-to-consumer). We discuss the importance of this B2B vs. B2C distinction below. In addition, our research objective guides our decision not to focus solely on the *digital* platform literature but on physical platforms as well; we aim to create a taxonomy that describes platform owners that either are (new) digital logistics entrants or traditional LSPs. This is because users of the tool (i.e., SMEs) may be choosing between the two options.

From the literature, we categorize the relevant value creation mechanisms offered by logistics platforms and identify the critical success factors (CSFs) required for *digital* platforms to offer a successful, competitive solution. The taxonomy and CSFs are developed based on a review of current peer-reviewed literature, interviews from WP2 gap analysis, and feedback moments with the PLATO consortium partners.

The decision support tool is a flowchart of discussion questions. The tool guides users through these discussion questions, encourage users to consider their own digital maturity level, and whether a digital logistics platform may be able to add value. If the latter is not the case and a traditional LSP is a better option, the tool helps explore which areas need further investment or improvement in order for a digital platform to be a good fit in the future.

Contribution

As platforms have emerged in the business setting, classifications and frameworks have attempted to categorize them (e.g., De la Boulaye et al. (2019), Koenen and Heckler (2020), Abendroth et al. (2021)). However, while they may provide some use, "these different classifications are not grounded in theory and can be prone to ambiguities, because different states are not mutually exclusive and collectively exhaustive (MECE)" (Anderson et al., 2022, p.504). This is a critical consideration when developing and using these frameworks. As such, rather than building our own framework that is susceptible to these issues, we build from the work of Anderson et al. (2022). The authors overcome previous challenges and connect the sources of value creation to specific supply chain functions accounting for demand side economies of scale and network effects, which are the main driver of platform value (Parker et al., 2016).

We conduct primary research with logistics actors and apply this framework to the context to help users better make sense of the many value-added services available, how they can be used, and identify the source of challenges that may arise.

Literature review methodology

The taxonomy and tool are developed based on a combination of secondary research in the form of a systematic literature review on digital platforms and primary research in the form of interviews (as described in WP2). Our systematic literature review methodology has been laid out by Durach et al. (2017) and Short (2009), which has been suggested specifically for the supply chain management field or literature. The main steps include (1) define the purpose of the review, (2) determine the required characteristics of primary studies, (3) retrieve a sample of potentially relevant literature, (4) select pertinent literature, (5) synthesize the literature, and (6) report the results.

Our goal is to identify the frameworks – factors which should be considered – to describe (B2B) digital platforms (Step 1). We include top operations, supply chain, logistics, and transportation peer-reviewed journals (see Acocella and Caplice, 2023) to ensure quality research and ensure the work is grounded in justifiable theory, less prone to ambiguity, and offers a better chance of a resulting taxonomy that is MECE (Anderson et al., 2022) (Step 2). We have conducted searches in Google Scholar by using keywords such as *B2B, (digital) platforms, digitization, logistics, transportation, warehousing,* etc. (Step 3) and from those that are topically relevant, we review the papers they also cite in order to conduct an iterative search process (Step 4). We synthesize the literature by developing the taxonomy (Step 5), and report the results in this document (Step 6).

B2B versus B2C

The logistics setting is one in which business enterprises interact with one another as service providers and customers to one another. This business-to-business (B2B) context differs significantly from that of the business-to-consumer (B2C) contexts in which platforms are typically discussed. Anderson et al. (2022) explain that the B2B context is more complex due to multiple supply chain levels at play, purchasing and organizational sophistication, competition, and value of data and associated risk in the case of breaches. The authors note differences between B2B versus B2C platforms. For example, B2B platforms choose a specific industry and type of value on which to focus (typically standalone or same side) at launch to get customers and users onboard. They then change their mix over time, offering cross-side value.

We observe this strategy in which platform companies evolve their mix of offerings over time to continue to add value in our primary research with logistics actors. We find that logistics platforms must continue to add value to users to keep them from moving off the platform and working together in a direct relationship.

3.1 Taxonomy

Value creation lens

There are a set of critical operational decisions that must be made by B2B platforms. These include the launch timing and version development decisions (Bhargava et al., 2013), whether to enter a market in which complementary technologies exhibit strong learning effects, making market penetration difficult (Anderson and Park, 2013). How platforms make these decisions may determine their success in creating value for customers.

Taking a value creation lens, Anderson et al. (2022) create a framework grounded in operations theory to explain the platform creation and growth. The authors identify three types of platform value: standalone, same-side, and cross-side from the information economics domain. Standalone value (V_{SA}) refers to a platform that uses data from a single user or set of users on one side of the platform to offer insights into their own operations.

Same-side value (V_{SS}) occurs when the platform creates value by aggregating data from many participants on one side of the platform and offers more advanced information services due to wider range of data access. Finally, cross-side value (V_{CS}) is created by a platform when data aggregated from one side creates value for the other side.

Total value created by a platform can be summarized in the following equation (Anderson et al., 2022):

$$User\ Value := V_{SA} + V_{SS} + V_{CS}$$

Value creation in the logistics sector requires helping customers improving efficiency, reduction cost and time, and removing operational challenges. The added value can come about from a range of services offered depending on the business need. A set of business models for online platforms have been identified by Chen et al. (2020), which include resource sharing (e.g., Deliveroo, B2C), matching (e.g., Tinder, C2C – customer to customer), crowdsourcing (e.g., InnoCentive, B2B), review (e.g., Yelp, C2C), crowdfunding (e.g., Kickstarter, B2C). We build from these business models by applying them to the B2B logistics setting (based on our interviews with logistics actors) and identify the complete set of logistics services offered.

Moreover, a set of revenue models for online platforms (Wen et al., 2001) can also be used to categorize the logistics platform setting. They include a brokerage, retail, mall, advertising, subscription, community, manufacturer, customization. Again, we identify the models which apply specifically to the logistics industry based on the existing framework.

Taxonomy development

We organize the taxonomy of such value-added services on a continuum from digitization of information to digitalization of information (Gradillas and Thomas, 2023). Digitization refers to the conversion of information and data into digital records that can be more easily accessed. Digitalization refers to using those digital data to develop processes and make decisions.

The taxonomy, depicted in Figure 3.1, depicts the value-added services available for the logistics industry and the typical revenue models that appear in this setting. The services (in order from digitization to greater digitalization) are data/information sharing, payment & finance, market/matching, and forwarding & planning (see Chen et al. (2020)). The relevant revenue models (in order of increasing frequency of interactions) are subscription, brokerage/commission, and transaction (see Wen et al. (2021).

Data sharing

Data sharing is a fundamental role of a digital platform, which requires basic digital infrastructure. As digitization refers to the collection of raw data and transforming into digital form (e.g., spreadsheets rather than hand-written forms), digital platforms can add value that can collect such raw historical data (see a comprehensive review of the definition of digitization and digitalization in Frenzel, et al., (2021)). Types of data that may be shared include transactional data, tracking data, inventory data, and transportation and warehouse performance metrics. The value created by data and information platforms include visibility in logistics and transportation activities which are typically very challenging to observe, greater efficiency, and assistance in process improvement.

Information sharing

While similar to data sharing, information sharing goes one step further along the digitization vs digitalization spectrum by using said digitized data to offer synthesized information that can help in decision making. This can include aggregating transportation tracking information to identify network segments that are bottlenecks, CO_2 emissions information and opportunities to reduce consumption, informed warehouse inventory ordering policies, price benchmarking, or supplier selection and procurement information. The value added by information sharing platforms begins to help users make strategic and operational business decisions.

Payment & finance

Digital logistics platforms may offer payment and financial services on their platform. This is typically done as an added service on top of the core service offered. Although this functionality technically may not go much beyond sharing data specifically in support of transactions, its commercial impact can be significant, justifying separate treatment. These platforms enable and facilitate secure, fast, and transparent payment for logistics services. For example, a platform may offer freight matching services (see below) and allow the shipper to pay the carrier directly through the platform. The platform may offer invoicing and documentation for services performed, financing and credit for warehouse operations, or even insurance solutions for cargo. The value added by payment and finance platforms include faster payment for service providers, which may lead to greater liquidity particularly for smaller players, security and risk reduction, and transaction transparency.

Market/matching

The digital platform is well suited for market and (freight) matching services. These two services focus on connecting shippers and carriers, aggregating capacity, streamlining booking processes, and enabling both parties to find a match for their needs. This can include load matching, dynamic pricing, booking and scheduling, procurement and contracting, review and rating, and communication tools. Some services solely propose matches and leave it to the users to settle the deal including finalizing booking and scheduling, pickup and drop-off operations, and payment. Other services establish the deal on the platform including payment and communications. The value added includes reduction in empty miles driven for carriers, fast capacity availability for shippers, transparency (though some argue matching platforms do the opposite and create artificial pricing), and flexibility for both sides. Freight transport is a highly fragmented market. These platforms attempt to aggregate information from both sides to add value.

Forwarding & planning

With the most digitalized services considered, forwarding and planning, we move to a set of platforms that offer predictive analytics and provide more automated solutions for users. These platforms ensure smooth flow of goods by simplifying and automating freight forwarding operations such as forecasting and warehouse inventory processing, shipment planning and booking, documentation, and route optimization. What sets these platforms apart is their ability to utilize data to offer predictive analytics, automation, and decision-making abilities. The digital platform aims to replace the end-to-end freight forwarder function. Value added for users includes efficiency, cost reduction, transparency, and flexibility.

Revenue models

In addition to the distinctions between the value-added services, there are key distinctions between the revenue models identified. The revenue models relate to how the value created can be translated to if and how the user is willing to pay for the services.

With a subscription model (e.g., paying for a service at fixed intervals such as annually), customers pay a recurring fee. This offers cost predictability, continued access to services, typically enhances customer retention, and often offers continued value creation for the customer to retain users and prevent churn. Examples in other industries include streaming services such as Netflix and Spotify, software-as-a-service (SaaS) such as Microsoft 365, and premium website memberships.

With a brokerage or commission-based model (e.g., platform or service provider takes a percentage of the transaction value as a fee for facilitating or brokering the transaction), customers only pay when a transaction is successful or specific service is rendered and they receive the value provided. Moreover, the customer can pick and choose when and how to use the platform's services. Examples include e-commerce platforms such as Amazon and eBay, real estate agents, and stock trading platforms.

Finally, with the direct sale model, (e.g., seller offers a product or service for a set price, the customer pays and receives the product or service in its entirety and the full value of the sale is collected upfront), again, the customer only pays for what it needs. There is no obligation to continue providing value to the customer expect for the potential benefit of future business. In the logistics setting, this type of revenue model exists when shippers directly pay carriers to haul individual shipments. Other industry settings include buying a standalone software package or paying for auto maintenance service.

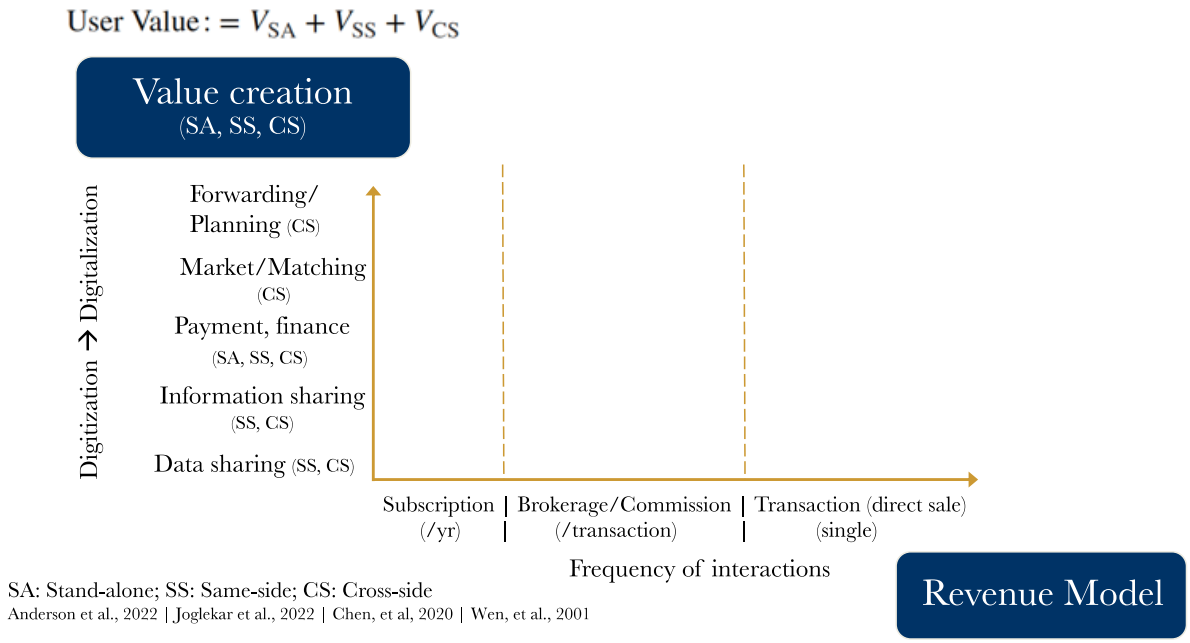

Figure 3.1: Taxonomy of digital platforms

Value Creation Type

Finally, taking the value creation lens, we draw from the framework developed by Anderson et al. (2022) and Joglekar et al. (2022) to explain how platforms create value, including the examples provided below. This value creation can be in the form of stand-alone (SA), single-side (SS), and cross-side (CS) value. SA value is created by the service the platform itself offers, for example, an airline company may use a platform which collects its maintenance data to improve maintenance scheduling. SS value is created when more players on the same side of the platform adds value to each user. For example, say the same example platform collects data from many airlines, aggregate it, and improve predictive power of its maintenance scheduling suggestions. Finally, CS value is created when complementary products from third-party players involved. For example, if parts suppliers can be integrated into the example platform, airlines can be alerted when maintenance is required and order new parts directly within the platform. Platforms can offer one or more types of value.

We demonstrate how such a taxonomy may be used by placing the set of platforms interviewed in WP2 within this matrix in Figure 3.2.

Company	Services offered					Revenue model			
	Data sharing	Information sharing	Payment, finance	Market, matching	Forwarding, planning	Subscription (/yr)	Brokerage/commission (/transaction)	Direct sale (single)	Value Creation type
Shippeo	X	X				X			SS, CS
UTurn			X	X			X		CS
Fourkites	X	X					X		SS, CS
BigMile	X	X	X			X	X		SS, CS
Flexport	X	X		X	X		X		SS, CS
Floriday	X	X	X	X			X		SS, CS
NextLogic					X		X		CS
Portbase	X					X			SS, CS
Cargonaut	X	X				X			SS, CS
Transporeon	X	X	X	X			X		SS, CS
Sennder			X	X	X			X	SA
DHL			X	X	X			X	SA
DB Schenker					X			X	SA
LKW Walter					X			X	SA

Figure 3.2 Demonstration of the taxonomy

With the taxonomy describing services, revenue models, and value creation offered by traditional (LSPs) and digital platforms, we have a complete picture of the types of services tool users (i.e., SMEs looking for external logistics support) may desire, the type of value created, and how the providers typically collect value (revenue) in return. The tool builds from this framework; it guides users to identify where within this taxonomy they may find a provider – traditional or digital – that adds value.

3.2 Tool development and use

Next, we move to the decision support tool. As noted earlier, the tool helps SME logistics actors (shippers and carriers) identify where within the taxonomy they may find providers that appropriately serve their logistics needs. It brings them through a set of discussion questions regarding their digital maturity and willingness to pay for the value created as well as functional considerations that must be in place for a digital logistics platform to add value as a solution. Moreover, it helps users identify which areas may need additional effort and/or investment before a digital platform becomes an appropriate solution for their specific problems. We suggest the tool be used as part of a discussion between logistics experts and SMEs that may be interested in digitization but require some direction. This may be in the form of a workshop between membership organizations and their members, for example. We describe the tool and its use with this context in mind: a workshop leader guiding users through the tool.

The tool itself is a flowchart (see Figure 3.3) which guides users through the set of questions (see Figure 3.4). First, a user must answer what is the business or logistics need that exists. This question places the user along the y-axis of the taxonomy. An example of potential answers to this question that lead to each one of the potential taxonomy services offered is indicated in Figure 3.3. For example, if a user is lacking visibility on where its trucks are because it is struggling with late deliveries, it will be directed to a data sharing service. If the company is looking to reduce CO_2 emissions to adhere to upcoming sustainability regulations, it will be directed to an information sharing platform. If it is struggling with auditing and payment processes that need to be streamlined, it will be directed to a payment/finance service. If it needs transportation capacity quickly and easily, it will be directed to a market/matching service. Finally, if the user is looking for an end-to-end inventory forecasting and ordering policy service that is hands off, it will be directed to a forwarding/planning service.

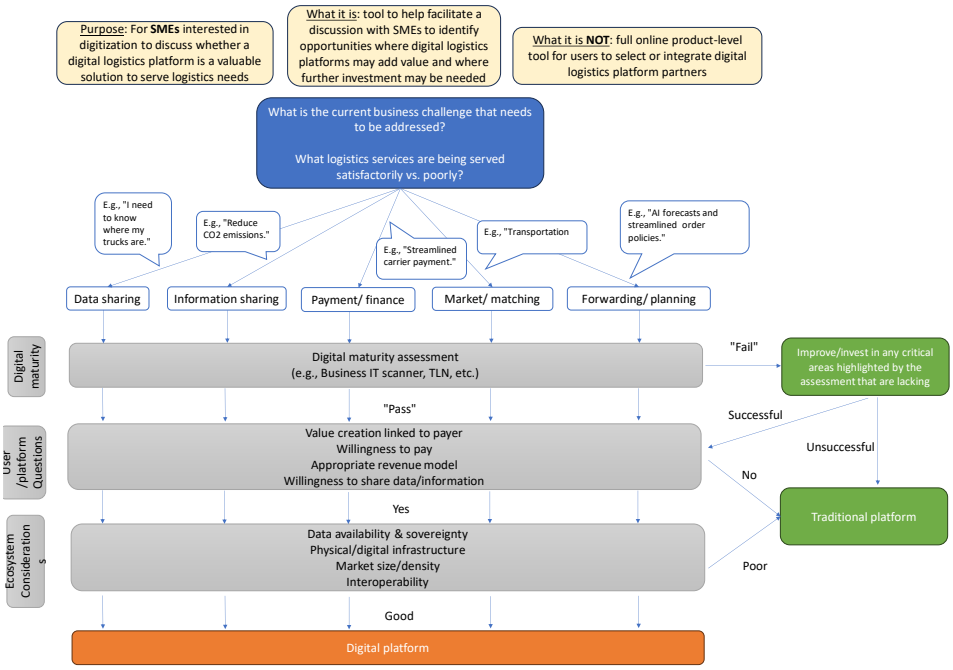

Figure 3.3 Decision support tool

A user's answer to the question regarding what their logistics issue is places the user in one of the categories of services offered from the taxonomy (i.e., data/information sharing, payment & finance, market/matching, and forwarding & planning). Then the user must answer a set of service-specific questions regarding critical success factors based on the literature (e.g., Anderson et al. (2022), and Joglekar et al. (2022) and interviews conducted as part of WP2) for a digital platform to be an appropriate solution. These questions are depicted in Figure 3.4.

This brings the user to the matrix of CSFs related to the user's digitization maturity, user and platform-specific questions, and functionality considerations depicted in Figure 3.4. Based on the answers to these questions, the user can move through the flowsheet in Figure 3.3, which determines whether a digital platform solution is appropriate.

The user is instructed to assess its digital maturity level. There are several off-the-shelf digital readiness assessments which are available for users. We neither promote nor renounce any in particular. Rather, we encourage users to use one that helps identify how ready their business is to explore digital tools. If the user appears to have a mature digital level, it can proceed to the next set of questions. If not, the user can choose to improve or invest in the areas identified by the assessment. If these are successful, the user can then move on to the next set of questions. If not, the user should continue to rely on traditional platform options (i.e., LSPs).

Next, the user is brought through a set of discussion questions related specifically to whether the value creation is clear and linked to whichever party is expected to pay, their willingness to indeed pay for the value added, whether the payment mechanism is appropriate for the specific value added services (i.e., is the user willing to participate in the revenue model that the platform has chosen) and the user's their willingness to share the required data and information. If the answers to these questions suggest the user (and required other parties) are adequately willing, the user can move to the next set of questions. If not, it may be better suited to continue with traditional platform options.

Finally, the user is directed through a set of functionality considerations regarding the platform ecosystem. These considerations are not specific questions the user can answers. Rather, they are discussion points where the workshop leader guiding the SME through the tool will need to bring in their expertise of currently available platforms and ecosystem. We refer the reader to this report's section regarding WP4 for further discussion.

These considerations relate to data availability (including where and how it is stored, how it can be shared, and how clean it is), data sovereignty (data security and privacy are protected), the physical and digital infrastructure that are either required or helpful for digital platforms to provide the intended value, characteristics of the market (e.g., size and density levels) that are typically needed for these types of digital platforms, and platform interoperability (its ability to readily connect and exchange information across a wide range of existing digital enterprise systems already implemented by users for complementary processes). Again, this set of considerations helps the user identify areas of strength and weakness in its given ecosystem that may require additional effort before a digital platform solution may be implemented.

As users progress through the tool questions and considerations, they are guided to discuss the status of their digital readiness, willingness to participate, and the logistics ecosystem. When a user's answer to a question suggests that one (or more) CSF is insufficient in their setting, the user can note this as an identified opportunity to invest further and given the status, should consider a "traditional" or more manual approach to solving its logistic need. This helps identify areas that need further investment from the user and/or platform ecosystem before such a digital solution is appropriate.

As the tool does not provide specific recommendations but rather is a guide for discussion, it cannot offer specific numeric values, thresholds, or requirements. For example, while a large, dense market on both supply and demand sides are important for a matching platform, our research does not offer a specific size (i.e., number of users) that is required for success. Moreover, some CSFs may apply more strictly in some settings than others. For example, regulations may help (or hinder) a digital platform. However, it is up to the workshop leader to assess the extent to which such regulations may impact the user's specific situation – in other words, it is meant as a suggestion for what a user may need to consider when considering digital logistics platforms and help workshop leaders guide the discussion.

		Digitization		---------->		Digitalization
		Data sharing	Information sharing	Payment/ finance	Market/matching	Forwarding/planning
	Digital maturity assessment	Select an external assessment tool of choice				
	Existing digitization level	Moderate	Moderate-High	High		
User/ platform Questions	Value creation linked to payer	Yes				
	Willingness to pay	Yes				
	Appropriate revenue model	Revenue model is linked appropriately to the type of value created (see taxonomy) and payer is willing to participate in this payment mechanism.				
	Willingness to share data/information	High on one side of platform.	High on one side of platform.	High on both sides of platform.		
Functionality Consideration	Data availability & sovereignty	> depending on information needed, data may need to be shared by one or both sides of platform.		> owned by user company. > pricing of current services digitally documented (e.g., digital transportation/ warehouse/ process management system).	> data from both sides of platform needed. > shipment (demand) information from buyer, capacity information from supplier.	> ownder by user. > digital shipment/materials flow data management system.
		> data cleaned, stored in accessible databases				
		> data can be legally shared by the parties that must share it, data owners' rights are protected, and all security efforts are in place to protect identity, business competitiveness, and financial records				
	Physical/digital infrastructure	> ability to share archival data (e.g., via email, shared storage, server access, etc.).	> EDI/API for real-time data for some servies (e.g., visibility), archival access such for others (e.g., price benchmarking).	> EDI/API systems implemented > digital payment processes in place	> analytics tools/softwares, easy UI > process to send/share data > warehouses, transport, ports	> real-time data communication. > EDI/API systems. > analytics tools/software, easy UI. > warehouses, transport, ports.
	Market size/density	> low-moderate on one side (side for which value is being created).	> moderate-high on one side (side for which information is needed) e.g., moderate on transport capacity side for visibility, high on transport capacity side for price benchmarking.	> high on both sides enough to warrant infrastructure investment. > typically goes hand-in-hand with other services (e.g., matching, forwarding), both needing high size/density.	> needs to be large (many players) and dense on both supply and demand side.	> high on both sides of platform for better predictive analytics.
	Platform interoperability	> moderate level of interoperability needed on the single side of platform to maintain customer base.	> high level of interoperability on single side of platform needed to ensure enough data are available.	> high level of interoperability needed to ensure users' systems on each side can make transactions.	> high level of interoperability needed to work with large number of players all with different systems.	> high level of interoperability needed to work with large number of players all with different systems.

Figure 3.4: Digital platform considerations of the decision support tool

3.2.1 Example of tool usage

In this section, we briefly discuss two illustrative cases of how a workshop leader may utilize the tool with a SME.

Example #1:
Setup: A shipper has a new customer location where goods need to be delivered. Therefore, it is facing new road transportation demand for a region with no current transportation service provider. The new lane is from Rotterdam to south Netherlands.

This puts the user in the market/matching service category.

Digital maturity: the shipper currently has high digitization; fully digital TMS, EDI capabilities, etc.

Value creation linked to payer and willingness to pay: with such a matching/market digital platform service, the shipper is the party looking for added value, thus it should be willing to pay for the service. Matching platforms typically offer a brokerage revenue model, which is appropriately matched to this type of service and value added.

Willingness to share data: user is willing to share any necessary data for service.

Based on these above user/platform factors, the user is well placed to use a digital platform. Next, the workshop leader should go through the ecosystem considerations that follow in the tool. These will be specific to the users' situation. For example, the potential platform should be able to demonstrate data security, have the appropriate digital and physical infrastructure for the user to upload shipment information and requirements, select from a set of carriers willing to participate (indicating a large enough pool of users on the supplier side of the platform – i.e., sufficiently large/dense markets), and be able to be operable for the users' current digital systems. If all of these are in place and given the answers for the user/platform questions above, this user is well positioned to utilize a digital platform.

Example #2:
Setup: Same setup as Example #1, with two differences. First, the new lane is in the north of the Netherlands. There is *very* little transport traffic in this lane.

The user is still in the market/matching service category.

Digital maturity: This is the second difference between the shipper in Example #1. This Example #2 shipper has low digital maturity. It currently uses phone or email to obtain capacity. Data storage is manual and messy.

Value creation linked to payer and willingness to pay: these factors are the same as the shipper in Example #1. The user is willing to pay, there is clear link between the value added the user, and the brokerage revenue model.

Willingness to share data: the user is willing to share data, however, as noted, data are messy and not digitally stored.

Based on the above user/platform factors, this user is not well suited for a digital platform solution at this time. These questions have identified a set of areas in which the user needs to invest and improve. Namely, the user's digital maturity is not currently sufficient. Moreover, a critical success factor has been identified to a logistics expert that may be running this discussion with the user that will be a challenge. That is, the lane of interest on which the user needs capacity has low volume. This means the market size and density of the supply side of a platform is low and likely insufficient. This challenge is not one the user can invest in to improve as it can with the digital maturity concerns. Therefore, even is the user can overcome these digitization issues, a digital platform may not be a good solution anyway and relying on traditional LSPs with relationships and expertise in finding capacity for these difficult lanes may be the best option.

With these simple examples, we demonstrate how the tool can help guide discussions necessary when SMEs are looking for (digital) logistics solutions.

Validation sessions

To test the use of our tool, we have conducted a set of validation sessions with real would-be users of such a tool. We form two workshops with SMEs – one workshop consists of three shippers and the other workshop consists of two carriers. A total of four workshop participants are already investing in digitization of their internal processes. This is important as we note earlier, the ideal tool user will need to have interest in moving toward digitization and need direction in doing so. It is not the intention of the tool to help those that have not yet begun their digitization journey.

Each validation workshop session is conducted by an expert in logistics and digitization from the PLATO project team. Users are brought through each step of the tool and – in addition to answering the specific questions about their businesses – they are asked to give feedback on the tool.

The validation session participants' main comments are summarized as follows. The users indeed find value on such a tool to conduct a self-assessment of their readiness for digital logistics platforms. The main value is in the discussions within the workshop. Users find listening to experience shared by other participants of particular value. However, for the discussion to help with specific company challenges, a more detailed, pointed discussion is required of the workshop leader who has knowledge of the digital platform landscape and logistics industry. Finally, the workshop participants note the importance of users' ability to not only clearly define the logistics challenge they face but also lay out their digitization process. That is, companies must be able to explicitly map which steps must be taken that will bring them to becoming digitally mature enough to participate in the digital logistics ecosystem.

From these validation sessions, several noteworthy points add valuable context to the discussion. For example, the participants note that while their own digital maturity is important, but to reduce their hesitancy of using digital platforms, the digital maturity of others in the ecosystem is important, say for example if there is potential for collaboration among platform users. Related to digital maturity requirements, users comment that if the tool identifies areas for digitization improvements, the additional development costs are factors that may limit their willingness to pay for services. When it comes to users' willingness to share data and information, participants discuss that this depends also on the platform owner and a level of trust that their data are going to be protected – and data ownership and sovereignty questions – the potential for custom development for that user's business needs, and data accessibility once it has been shared.

An additional comment related to willingness to share data and information relates who decides to use the digital platform. In many cases, one party may force its customer (or supplier) to use a specific

platform to continue doing business with them. In such cases, it is not a matter of willingness toward or against digital platforms, it is a necessary condition for ongoing business. This is a concern for many small players, that they may be forced into situations they are not ready or willing to be in. This highlights the importance of SMEs in the logistics space to become prepared for digital transformation rather than later. This also leads to a discussion on data-sharing standards that would be helpful in the digitization transition. While outside the scope of this Work Package, it is important to note that the digital ecosystem may be limited without such a standard.

The conclusion of this project, SMEs are still quite skeptical of digital platforms in the logistics space. This stems from data and privacy concerns as well as mistrust that digital platform companies are solely interested in making profit off them. Some SMEs may even choose to develop their own digital platform to ease their concerns while still reaping some of the benefits. We acknowledge these users' concerns of the risks of using digital logistics platforms.

3.3 Conclusion

As digital logistics platforms have emerged there has yet to be a comprehensive framework that organizes their value-added services in a meaningful way for logistics actors. According to our interviews, SMEs have had a difficult time identifying whether and how to engage with digital logistics platforms. We develop a taxonomy and decisions support tool aimed specifically to SMEs to explore the potential benefits digital logistics platforms may offer and where barriers remain. In this section, we take a value creation lens and the perspective of the potential platform users solely focused on identifying options for serving their logistics challenges. In the next section, we take the ecosystem perspective and explore – among other things – the risks of implementation.

It is important to note the distinctions between the taxonomy developed in this WP3 and the classification described in WP2. WP2 makes an initial inventory of platform types while identifying the gap between platform functionalities and user requirements. WP3 builds and expands on this and based on a more specific and thorough analysis of the literature and a broad-ranging description of logistics platforms (rather than the small sample of those in WP2 interviews) while identifying a viable taxonomy. Moreover, in WP3 (and WP4) we choose two distinct lenses to view platforms; in WP3 we focus on value creating services and value creation through network effect on the platform, while in WP4 we focus on the embedding of platforms in their logistics ecosystem e.g., through their complementing or competing roles. We discuss this further in the synthesis section.

Main takeaways

1. This is the first comprehensive taxonomy of B2B logistics services developed.
2. There are three main aspects of the taxonomy: service type, revenue model, value creation type.
3. Logistics platforms typically begin with a core service and expand to additional services to continue to add value to B2B customers.
4. A set of service-revenue model combinations have emerged with successful digital logistics platforms.
5. A decision support tool can help SMEs interested in digitization of logistics services identify whether digital platforms can appropriately service their needs and identify areas where further support or investment is needed.

3.4 References

Abendroth, J., Riefle, L., & Benz, C. (2021). "Opening the black box of digital B2B co-creation platforms: A taxonomy." *Presented at the 16th International Conference on Wirtschaftsinformatik,* Essen, Germany.

Acocella, A., & Caplice, C. (2023). "Research on truckload transportation procurement: A review, framework, and future research agenda." *Journal of Business Logistics*, 44, 228–256. https://doi.org/10.1111/jbl.12333

Anderson, E. G., & Parker, G. G. (2013). "Integration and cospecialization of emerging complementary technologies by startups." *Production and Operations Management*, 22, 1356–1373.

Anderson, E., Lopez, J., Parker, G., (2022), "Leveraging value creation to drive the growth of B2B platforms," *Production and Operations Management*.

Bhargava, H. K., Kim, B. C., & Sun, D. (2013). "Commercialization of platform technologies: Launch timing and versioning strategy." *Production and Operations Management*, 22, 1374–1388.

Chen, Y., Dai, T., Korpeoglu, C. G., Körpeoğlu, E., Sahin, O., Tang, C. S., & Xiao, S. (2020). "Innovative Online Platforms: Research Opportunities." *Manufacturing & Service Operations Management*, *22*(3), 430–445. https://doi.org/10.1287/msom.2018.0757.

de la Boulaye, P., Erriquez, M., Gener Bago, M., Jiménez Iribarren, A., & Russo, F. (2019). "How B2B online marketplaces could transform indirect procurement." *McKinsey Online*, https://www.mckinsey.com/businessfunctions/operations/our-insights/how-b2b-online-marketplaces-couldtransform-indirect-procurement.

Durach, C. F., Kembro, J., & Wieland, A. (2017). "A new paradigm for systematic literature reviews in supply chain management." *Journal of Supply Chain Managemen*t, 53(4), 67–85.

Frenzel, A, Muench, J.C., Bruckner, M, and Veit, Daniel, "Digitization or digitalization? – Toward an understanding of definitions, use and application in IS research" (2021). AMCIS 2021 Proceedings. 18. https://aisel.aisnet.org/amcis2021/adv_info_systems_general_track/adv_info_systems_general_track/18

Gradillas, M, &Llewellyn TDW. "Distinguishing digitization and digitalization: A systematic review and conceptual framework." *Journal of Product Innovation Management* (2023). https://onlinelibrary.wiley.com/doi/full/10.1111/jpim.12690.

Joglekar, N., Anderson, E.G., Lee, K., Parker, G., Settanni, E., & Srai, J. S. (2022). "Configuration of digital and physical infrastructure platforms: Private and public perspectives." *Production and Operations Management*, 31, 4515–4528. https://doi.org/10.1111/poms.13865.

Koenen, T., & Heckler, S. (2020). "German digital B2B platforms." *Federation of German Industries (BDI),* Berlin, Germany, Jul.

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*.

Short, J. (2009). "The art of writing a review article." *Journal of Management*, 35(6), 1312–1317.

Wen, H. J., Chen, H., & Hwang, H. (2001). "E-commerce Web site design: strategies and models." *Information Management & Computer Security*, *9*(1), 5–12.

4 WP4: Orchestrating Digital Platforms in Logistics Ecosystems

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4.1 Introduction

Collaboration in logistics ecosystem, both horizontally and vertically, offers the potential to achieve operational excellence and improve sustainability performance. These opportunities have triggered organizations to effectively collaborate by sharing data, resources, and synchronizing activities. In this internet era, the data-sharing efforts often involve *interorganizational systems* (IOS) which have evolved into what are currently known as "digital platforms".
A *digital platform* is a software-based business model that generates new value-added services by facilitating digital interactions among multiple distinct groups of participants[2]. In contrast to traditional IOS, which primarily focus on data sharing and communication, digital platforms expand IOS functionality by creating new services through information exchange between stakeholders (Hein et al., 2020). Digital platforms are also characterized by their openness, scalability, and the potential for third-party engagement and innovation (Mann et al., 2022). In the logistics sector, such a platform empowers companies to collaborate and significantly enhances the supply chain, particularly in terms of growing networks, improving visibility, efficiency, and sustainability performance. This value-adding is especially noticeable in major global trade and logistics hubs where numerous businesses converge. Within these hubs, the responsibility for shipments often transitions between various entities, presenting numerous opportunities for value creation through both vertical and horizontal collaborations.
The digital platform often emerges as a group initiative led by first-movers from within the ecosystems. A prominent example of this is the development of Port Community Systems (PCS) such as PortBase, which facilitate data sharing, enhance operational efficiency at ports, and are built upon collaborative efforts from actors in the Port of Rotterdam. Another example is the development of Floriday which is an online platform developed by Royal FloraHolland to facilitate the digital trading of flowers and plants within the horticultural sector. Some actors within the ecosystem can also establish their own digital platforms, such as MyTerminal by ECT and NxtPort by Vopak.

Nonetheless, the provision of digital platforms in an ecosystem are not exclusively initiated or owned by the incumbents in the logistics ecosystem. New entrants from outside of the community may also offer digital platforms (such as: FlexPort, FourKites, Shippeo, and BigMile), which can be utilized by incumbent actors directly. Note that these platforms, although helpful in achieving the ecosystem objective, may not represent the collective action of the stakeholders within the ecosystem. These "platformization" trends result in the emergence of a *digital ecosystem* where multiple platforms co-exist within an ecosystem providing diverse range of value-adding services (Gawer & Cusumano, 2014).

The co-existence of multiple digital platforms within a logistics ecosystem can introduce *cross-platform effects* that can enhance system performance and accelerate technology adoption (Joglekar et al., 2022). Digital platforms can introduce new value-adding services that can be used by incumbent and traditional actors to enhance their services and competitiveness. The diversity of services from multiple platforms accommodates a wide range of functionalities, offering flexibility for users to select platforms aligning with their needs. These diverse services can also evolve into *complementary services* and reinforcing overall ecosystem competitiveness (Hein et al., 2020). Moreover, competition among digital platforms can lead stimulate innovations within the ecosystem and reduce the average costs (Acs et al., 2021). Along with digitization, the platformization is also closely linked to the green transformation of logistics function (George et al., 2021).

[2] Digital platforms are explained in: Van Alstyne, M. W., Parker, G. G., & Choudary, S. P. (2016). Pipelines, platforms, and the new rules of strategy. *Harvard business review*, *94*(4), 54-62.

This connection is rooted in the improved visibility and transparency that digital platforms provide which serve as a foundation for enhancing sustainability efforts within the logistics ecosystem.

However, the *fragmentation* of digital platforms within an ecosystem also presents some challenges that can create negative externalities. Firstly, there is the risk of redundancy/duplicates among platforms. When multiple digital platforms offer similar services, it can lead to inefficiencies, as users may find themselves divided among different platforms, diluting the potential for collaboration and counteract the efficiency objectives of the ecosystem (Belleflamme & Peitz, 2019). Interoperability issues are another concern. Different digital platforms may use multiple data standards and not seamlessly integrate with each other, hindering the efficient flow of data and collaboration among ecosystem members (Noura et al., 2019).

Furthermore, motivating incumbent companies to adopt digital platforms can present some challenges. Given the varying levels of digital maturity and technology adoption among companies, there may be a need for substantial investments in training and change management initiatives to fully capitalize on the advantages offered by these platforms (Joglekar et al., 2022). Moreover, as logistics companies gather and exchange sensitive information, the risk of data security escalates. Unauthorized access to this data can result in financial losses and reputational damage. Finally, managing the governance of multiple digital platforms can also be complex. Ensuring fair and equitable participation, resolving conflicts, and establishing standards for data sharing require clear governance structures and rules (Addo, 2022; Mann et al., 2022).

Considering the potential advantages and risks associated with platformization, the role of the orchestrator is increasingly important in shaping the future of the ecosystem and formulating strategies to accomplish ecosystem objectives. This study aims to investigate the strategic roles of orchestrators given potential developments in logistics ecosystems. By understanding and addressing the complexities of platformization, this research seeks to contribute valuable insights to the future developments of logistics ecosystems.

4.1.1 Objective and Methodology

The objective of our study is two-folds. Firstly, it aims to discern the strategic role of orchestrators within the digital logistics ecosystem and explore their (digital) strategies to realize their objectives. Secondly, the study seeks to analyze how the strategic priorities of orchestrators changes given the diverse possible scenarios, drawing on key developments in technology, business, and geopolitics.

To achieve these objectives, we conducted semi-structured interviews with orchestrators in the ecosystems of both the Port of Rotterdam and Royal FloraHolland. Some questions were derived as follow-ups from insights obtained in previous interviews conducted in Work Package #2. The interview process consisted of two rounds for each representative. The first round delved into the roles and strategies of orchestrators in navigating challenges within digital logistics ecosystems. The second focused on identifying key drivers that influence the future development of these ecosystems. Subsequently, we conducted a literature review to identify key concepts recognized in the literature and further contextualize our findings.

In the scenario development phase, we extracted key trends from the interviews that can significantly impact the development of digital logistics ecosystems in the future. We then introduced a diverging trend with two extremes to represent uncertainties in trend direction. To simplify scenario development, we grouped strongly correlated trends into a simple 2x2 scenario matrix. These matrix forms a foundation for developing strategies that are robust across multiple scenarios.

To refine and validate our scenarios, we engaged in a review session with representative actors from the ecosystems. This collaborative effort ensured that the developed scenarios remain relevant and represent the dynamics within the logistics ecosystems. This multi-step process combines empirical insights, literature reviews, and stakeholder feedback to enhance the comprehensiveness and significance of the study.

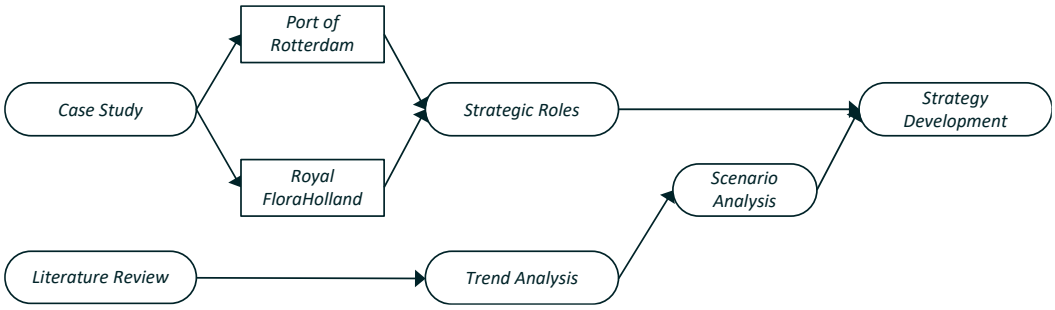


Figure 4.1: Methodological Framework

4.1.2 Contributions

- The study provides a detailed evaluation of platformization trend within logistics ecosystems. This understanding is crucial for academics, practitioners, and policymakers seeking to navigate the dynamic nature of logistics landscape.
- This study seeks to identify possible scenarios for digital ecosystems based on key trends in technology, business, and geopolitics. This forward-looking approach sheds a light on the potential challenges and opportunities in the future, enabling stakeholders to prepare for and adapt to changes in the digital landscape.
- This study sheds light on the role of orchestrators and their respective strategies in achieving ecosystem objectives. It provides insights for companies and policymakers to formulate strategies that align with the dynamic nature of digital platforms and address challenges effectively.

4.1.3 Structure of Report

As the concept of the digital logistics ecosystem is relatively new and complex, we begin by providing key terms used to describe the digital logistics ecosystem in Section 2. This includes basic definitions derived from the literature, complemented by examples obtained from interviews. In Section 3, we present two case studies highlighting the roles of orchestrators and their strategies for achieving ecosystem objectives. Moving to Section 4, we explore key trends in technology, business, and geopolitics that may impact the development of the digital logistics ecosystem. Subsequently, in Section 5, we introduce probable scenarios and strategies to navigate uncertainties in the evolving logistics landscape. Finally, Section 6 summarizes the study findings, acknowledges limitations, and outlines key takeaways from our study.

4.2 Key Terms and Examples

4.2.1 Logistics Ecosystems

A logistics ecosystem is a network of interdependent actors that jointly enable logistics and supply chain activities to function effectively. The actors are traditionally co-located in a specific area providing diverse roles in the logistics chain. An ecosystem emerges when synergies among different actors are strong enough to require coordination, but not strong enough to result in a single, integrated corporate hierarchy that controls all activities (de Langen, 2023). This ecosystem typically exhibits two key characteristics. Firstly, they have *system level objectives*, often related to performance or efficiency. Secondly, achieving this system objective relies on *a network of interdependent actors,* where the performance of an actor is affected by the performance of their partners (Eriksson et al., 2019).
To illustrate, consider a logistics ecosystem at a seaport. In the seaport ecosystem, various actors come together to facilitate the smooth operation of logistics and supply chain activities. These actors can include terminal operators, logistics service providers (LSPs), shipping lines, freight forwarders, customs and border control agencies, and financial and technology providers.

Each actor may focus on efficiency of itself. However, since they are inter-connected, their performance is affected by actions of their counterpart. Therefore, to achieve overall efficiency of the system, the actors need to have a better coordination and collaboration. Terminal operators must efficiently handle cargo, while shipping lines need the port to minimize turnaround times. Freight forwarders require smooth customs procedures, and customs and border control agencies depend on accurate information from logistics service providers. Financial and technology providers play a role in facilitating and optimizing transactions and data sharing.

In global supply chain networks, logistics ecosystems typically serve as *physical hubs,* representing interconnection between geographical, political, and commercial boundaries. They enable the transshipment of interregional good flows to more distributed smaller networks chain and vice versa. The development of information and communication technology (ICT) also has enables logistics ecosystems to extend their role as *digital hubs*, enabling them to coordinate with diverse stakeholders and execute geographically dispersed logistics and production chains (van Baalen et al., 2008). Due to these roles, the viability of logistics ecosystems is important in facilitating global trade, enhancing resiliency, and fostering economic development.

4.2.2 Physical and Digital Platforms

Traditionally, logistics ecosystems are organized around a *physical platform*, which is a set of tangible assets that enables the movement of goods within a supply chain. These physical platforms encompass various elements, including warehouses, distribution centers, transportation networks, handling equipment, and storage facilities which can belong to different actors in the ecosystem. Therefore, coordination among actors is necessary to achieve efficiency in the logistics operations. The auction center of Royal FloraHolland serves as an example of a physical platform in the logistics ecosystem. It provides a centralized location where growers, buyers, and logistics providers can gather, connect, and transact the exchange of flower and plant products.
The integration of ICT has further enhanced logistics ecosystems with the introduction of **d***igital platforms.* The platforms act as inter-organizational systems that facilitate the exchange of information between different users within the logistics network. They enable communication, data sharing, and coordination among related stakeholders that can significantly enhance operational efficiency and expand possibilities such as new services creation and new market expansion. The Floriday of Royal FloraHolland serves as an exemplary digital platform within a logistics ecosystem. It seamlessly integrates with the physical auction center, extending its reach beyond the physical marketplace and transforming the floricultural supply chain into a fully interconnected digital network.

Nonetheless, unlike their physical counterparts, digital platforms are not constrained by a physical presence or geographical boundaries within the ecosystem. They facilitate the exchange of information across different users, even at distant locations, thereby blurring the boundaries of digital platforms in the global supply chain. On one hand, digital platforms help users cater their various needs and enhance market outreach globally. On another hand, global external platforms may enter into an ecosystem and coexist with existing platforms that have been available. These may operate with either complementary or competitive interests, further complicating the orchestration required to achieve ecosystem objectives.

4.2.3 The Ecosystem Orchestrator

The view of logistics ecosystem emphasizes the need for *orchestration* between actors in the ecosystem to achieve its objectives. The logistics ecosystems gain a competitive advantage by effectively orchestrating these interconnected processes to create higher efficiency and more opportunities for customers (Thomas et al., 2014). The ecosystem sustainability is determined by their ability to remain competitive and not be overtaken by other ecosystems (Eriksson et al., 2019). Therefore, the role of an orchestrator within an ecosystem holds significant importance in achieving both efficiency and competitiveness objectives.

The orchestrator of an ecosystem can take on various forms, ranging from formal organizational structures to informal leadership roles. However, what remains consistent is the orchestrator's *undisputed role* in coordinating the activities within the ecosystem as often expected by the participating entities[3].

For example, within the context of a seaport ecosystem, the port authority typically assumes the orchestrator role. It acts as the central authority responsible for facilitating the smooth and efficient functioning of all activities within the port, from cargo handling to customs procedures, aiming to enhance the competitiveness of their ecosystem in the global supply chain. Similarly, Royal FloraHolland, a cooperative of Dutch flower growers, takes on the orchestrating role in coordinating the actors within the Netherlands to strengthen the market position of Dutch growers in the international market. In both cases, the orchestrator serves as a central and important figure responsible for harmonizing the diverse activities taking place within the ecosystem. This coordination is essential for achieving the common objectives of the ecosystem, such as operational efficiency, sustainability, and competitive position in the global market.

4.2.4 Orchestration Challenges

To achieve their objectives, the orchestrators commonly sponsor the adoption of digital platforms by organizations within the ecosystem. According to van Baalen et al. (2008), the orchestrator typically faces three key challenges in digitalizing the logistics ecosystem: (1) recognizing the needs for a digital platform, (2) providing the suitable digital platform architecture, and (3) coordinating interests in the network.

Due to the dynamic changes in the business landscape, the *functional requirements* of a digital platform within the ecosystem may evolve over time. Besides, the diverse interests among actors may not always align with the ecosystem objectives, leading to hesitancy in sharing information across the network. Therefore, the success of digitalization relies on the orchestrator's ability to recognize and reevaluate platform functionalities over time (van Baalen et al., 2008). This involves identifying features that benefit all stakeholders, align with evolving needs, and convincing them to adopt the digital platform.

However, convincing actors to adopt digital platforms is inherently complex. One reason is the *awareness gap* regarding the value of digital platforms (van Baalen & van Oosterhout, 2008). The orchestrator in the logistics ecosystem is typically a large and more digitally mature organization that has a more optimistic and holistic view on the value of digital platform. Due to this reason, they are willing to make sufficient investment to reap the long-term benefit. Conversely, the potential adopters of digital platforms are often small and medium enterprises that typically possess a lower awareness of the potential value and often expect immediate benefit. This gap contributes to their resistance towards adopting the platform, leading to a fragmented digital landscape within the logistics ecosystem. This fragmentation may compromise the efficiency gains expected from the digitalization.

Moreover, the efficiency of data sharing relies on the *adoption of standards* to ensure interoperability across network. Although organizations have their own information systems, they heavily depend on data from others, requiring participation in various information systems. Standard setting within an ecosystem helps to formalize procedures, enhance interoperability, and limit technology options (Lyytinen, 2001). Despite the well-recognized benefits of standards, organizations often hesitate to adopt them. Concerns stem from the fear that reliance on a single standard might reduce autonomy and that long-term benefits might not outweigh short-term gains (van Baalen & van Oosterhout, 2008). Recent research suggests that standardization might have adverse effects on organizations' competitive positions, especially in highly competitive environments where complementary technologies for the chosen standard are lacking (Toh & Pyun, 2023).

[3] Our definition on ecosystem orchestrator is closely related to "ecosystem leader" and "ecosystem developer" in the literature. See for example: (Autio, 2022; Jacobides et al., 2018; Kapoor et al., 2021)

To address these challenges, fostering a collaborative environment and building trust among ecosystem actors are essential for successful digitalization. The orchestrator's ability to navigate these complexities will be instrumental in realizing the full potential of an integrated logistics ecosystem.

4.2.5 Orchestration Strategies

The orchestration strategy refers to strategies adopted by the orchestrator to convince organizations within an ecosystem to make voluntary inputs that are consistent with the ecosystem objectives (Autio, 2022). Van Baalen et al. (2008) outline three required capabilities to successfully orchestrate a logistics ecosystem. Firstly, there is the need for the capability to recognize and *reinvent* platform requirements within the ecosystem dynamically. The second capability involves *negotiating* with network participants to determine the design and implementation of the platform, with options for both a bottom-up approach, as exemplified by the Port of Rotterdam, and a top-down approach, as seen in the Port of Singapore. The third requisite capability is the *modularization* of platform implementation into relatively independent modules. This approach allows potential adopters to observe short-term benefits, fostering gradual progression towards the grand design of the platform over time.
Autio (2022) provides more details on the strategy to negotiate with network participants within the ecosystem. He argues that the messy reality of ecosystem creation appears to call for a more bottom-up approach. In order to be successful an orchestrator needs to consider four layers in ecosystem orchestration: (1) the *technological layer* which involve a set of shared standards for the network architecture, (2) the *economic layer* which involve driving network effects, (3) the *institutional layer* involving role definition and regulatory embedding, and (4) the *behavioral layer* involving dynamic control of network participants.

De Langen (2023) identified four potential strategic roles for orchestrator in developing their ecosystem: (1) minimalist; (2) integrator; (3) platform provider; and (4) ambidextrous integrator and platform provider (See Figure 2). These roles are developed based on two axes: the availability of synergy services, and the provision of in-house services for users. In the *integrator* role, the orchestrator acts as a central position within the ecosystem, controlling commercial interactions with buyers directly by integrating various activities in the value chain. In contrast, a *platform provider* focuses on providing a platform to facilitate the growth of actors within the ecosystem. Unlike the integrator, the platform provider does not seek control over commercial services but prioritizes developing infrastructure that enable third parties in the ecosystem to grow by promoting synergy and collaboration. The fusion of these two roles has given rise to a unique "ambidextrous integrator and platform provider" role wherein the orchestrator not only developing a platform for actors to offer services but also actively participates in integrating essential services for buyers/end-users.

4.3 Case Studies on Logistics Ecosystems

The logistics ecosystem comprises of network of interdependent actors, meaning that there is no structured hierarchy to controls all activities. Since actors within an ecosystem have diverse interests, an orchestration is needed to ensure the attainment of ecosystem objectives. The orchestration itself refers to the set of strategies that the ecosystem orchestrator takes to persuade actors within the ecosystem to make contribution on the attainment of the ecosystem objectives.
In this study, we provide two cases of the Dutch logistics ecosystems to illustrate the empirical roles and strategies taken by the orchestrators to achieve ecosystem objectives. The cases are developed based interviews with key representatives, discussion with experts, and secondary information from credible sources such as official webpages and study reports.

The case study aims to address the following main questions:

- Which roles does the orchestrator assume in the digital logistics ecosystem?
- How the digital platforms compete, collaborate, and synergize in the logistics ecosystem?
- What are the objectives and strategies taken by the orchestrator in orchestrating the digital logistics ecosystem?

4.3.1 Port of Rotterdam (PoR)

As the largest seaport in Europe, the Port of Rotterdam (PoR) hosts a logistics ecosystem comprising several actors, including the port authority, shippers, terminals, freight forwarders, transport companies, and shipping lines. The port capacity and efficiency are very important for the competitive position of the port in the global network. However, due to the limited space, capacity expansion is expensive and not always feasible. Therefore, maximizing port efficiency through digitalization and collaboration has been seen as an opportunity to improve port competitiveness.
The PoR has helped to establish a range of digital platforms within the port ecosystem, such as PortBase, Navigate, PortXchange, and RouteScanner, to improve efficiency in logistics chain[4]. There are also digital platforms that are developed by actors within the ecosystem, such as MyTerminal by ECT and NxtPort by Vopak. Besides, global technology players such as Fourkites, Flexport, Transporeon, and Shippeo have also offered their platforms in the Port of Rotterdam to help companies increase their efficiency and market outreach.

Those digital platforms co-exist within the Port of Rotterdam, providing a diverse array of value-adding services for their respective users. The fragmentation of digital platforms within the port ecosystem present both positive and negative aspects. On one hand, the fragmentation can increase competition, fostering innovation and accelerating the digitalization rate among companies. On the other hand, it may lead to lower collaboration, visibility, and efficiency due to the presence of multiple systems within the ecosystem.

Nonetheless, despite the rapid development of digital platforms, the adoption rate in port ecosystem is slower than other industry. Numerous smaller logistics companies still work using traditional means, relying on phone, spreadsheet, and email as primary resources for information exchange and data management. These companies often have limited capability in IT development, hindering the adoption of digital platforms that often requires API to connect. Besides, due to the limited resources and small business size, these companies often lack motivation to participate in digital platforms. They may also be not fully aware of the value that digital platforms can bring to their companies, making them hesitant to invest in digital capability.

Within this complex digital landscape, PoR serves as the orchestrator of the port ecosystem. The mission of PoR is to create economic and social value by achieving sustainable growth in the world-class port, in collaboration with clients and stakeholders[5]. From the mission statement, it is clear that the sustainability and collaboration are at the heart of the port development. As the Port of Rotterdam navigates these complexities, finding a balance between fostering innovation and ensuring seamless collaboration will be crucial in sustaining its position as a leading global seaport.

4.3.1.1 The roles of PoR in the digital ecosystem

The ecosystem governance at port can be seen as two interconnected layers of physical and digital realms. In the physical realm, PoR takes a role as a "landlord", having relinquished in-house operation of its terminals. This operational model empowers PoR to outsource a significant portion of port operations — such as terminal operations, warehousing, shipping, and cargo handling — to third-party logistics providers. It enables PoR to focus on enhancing the port as a "platform" where private companies act as the main service providers and PoR concentrates on providing basic infrastructure that cater to the needs of the general port users such as maintaining depth of water, developing pipeline, and expanding port areas (e.g., Maasvlakte project). Sometimes, PoR also engage in basic specific services within the port such as providing rail transport (e.g., PortShuttle), inter-terminal transport (e.g., Container Exchange Route), and parking facility.

Along with the trend of digitalization, PoR also starts to explore their strategic roles in the digital realm. The initial attempt was to provide digital services like a Booking.com for the port community.

[4] Some of these digital platforms now have become independent entities
[5] https://www.portofrotterdam.com/en/about-port-authority/purpose-mission-vision-and-strategy

However, this initiative encountered significant resistance due to competing interests with private entities in the port community. Since then, the digital strategy of PoR has shifted, by aligning more with its role in the physical realm. It now takes a similar landlord role in the digital realm, providing digital infrastructures and basic services through various joint ventures, such as data sharing services (e.g., PortBase), digital planning services (e.g., Nextlogic, PortXChange), and innovation acceleration service (e.g., SmartPort, PortXL).

In the digital ecosystem, PoR established itself as *"smart partner in logistics chain"* [6]. PoR has refrained from delivering commercial services that might pose competition with private entities within the port community. Instead of becoming the main player in the digital ecosystem, PoR focuses on providing digital infrastructure to support collaboration between actors in the port community. It only involves on a relatively tiny portion of basic digital services which are mainly related to customs and dues. PoR believes that the market itself knows better on what they need in term of digital services and PoR's role is to act as an enabler for such creation by enabling data-sharing and collaboration within the port ecosystem.

A concrete example of this role can be seen in the partnership between PortBase and Nextlogic. Nextlogic provides comprehensive planning services aimed at optimizing asset utilization in the inland container shipping chain. In this collaboration, PortBase shares essential data gathered from multiple sources, including Estimated Times of Arrival (ETAs) and docking times, with Nextlogic. Nextlogic, in turn, leverages this data to enhance the value it delivers to its customers. It is important to note that Portbase conforms to the authentication protocol, requiring explicit authorization from its customers before sharing data with other parties or platforms.

4.3.1.2 Competition and Collaboration between platforms

PoR acknowledged that the current digital ecosystem in the Port of Rotterdam is largely fragmented with various global and local platforms offering similar or competing digital services. Rather than becoming an integrator or a direct competitor to these platforms, PoR through PortBase positions itself as a neutral digital hub that make data universally available for all potential users including local platforms (e.g., Nextlogic), global platforms (e.g., Amazon, Maerks, Project44), and other port community systems. This inclusivity also extends to digital entrepreneurs such as software developers in area of blockchain and supply chain finance, regardless of their size.
In the pursuit of fulfilling its role as a neutral digital hub, PortBase has embraced a non-profit organizational model. This strategic decision is anchored in the commitment to maintaining a neutral stance, fostering an environment conducive to collaboration among diverse stakeholders. The revenue model employed by PortBase is relying on user fees to cover the operational costs.

PortBase also extends its commitment to neutrality by refraining from expressing opinions on the data collected from their users such as making ranking, indexing, or comparing performance. This approach underscores PortBase's dedication to providing an unbiased and impartial platform for data exchange. By avoiding any subjective judgment, PortBase ensures that the data shared within its ecosystem remains objective and reliable, fostering trust among the participating users to collaborate in the network.

By upholding such a neutral position, PoR focuses on facilitating role for collaboration and let the market to create innovations and commercial digital services. While this approach has its merits, it is not without risks. The market mechanism is not always efficient and sometimes failure can occur. One potential downside is the intensification of competition between organizations, potentially leading to "race-to-the-bottom" scenario, where prices are slashed and profit margins are reduced, making smaller companies struggle to compete against their larger counterparts. In such circumstances, market consolidation becomes a possibility, resulting in a "winner-takes-all" scenario, where a few dominant alliances monopolize the entire market. This situation may lead to monopolistic behaviors, resulting in higher prices and hindering innovations, ultimately eroding port competitiveness.

[6] https://www.portofrotterdam.com/en/about-port-authority/purpose-mission-vision-and-strategy

Consistent with its role, PoR plans to become more involved in value-adding services only in the event of market failure. This involvement arises if the innovation rate within the ecosystem falls behind the global competition or if there is sufficient indication that the market will not take up key digital services. In such cases, PoR will cautiously take the initiative to develop the necessary services, aiming to maintain port competitiveness in the global supply chain.

To prevent market failure, PoR is committed to ensuring that the digital infrastructure remains inclusive and accessible to all organizations, regardless of their size. This effort is to minimize the risk of a monopoly emerging within the market. By fostering inclusivity, PoR seeks to create an environment that encourages fair competition and innovation, promoting equal opportunities for organizations to participate and contribute to commercial digital services.

4.3.1.3 Strategic Initiatives

To fill the role as a smarter partner in logistics chain, PoR intends to provide *network infrastructure* and *standardization.* This strategic plan aims to guarantee the accessibility and interoperability of data among users in the ecosystem**.** However, within the complex port ecosystem, where diverse stakeholders coexist, concerns related to data ownership and confidentiality frequently emerge. Each participant possesses a significant interest in maintaining control due to the potential value and sensitive nature of the data.
Acknowledging this challenge, PoR consider the option to establish a *federated data-sharing network.* Such a network implies a decentralized approach to data collaboration. In this model, each participating organization maintain ownership and control over its own data, rather than relying on a centralized repository. Even though the structure is decentralized, organizations within the network can collaborate and access data as needed. This process is facilitated through authorization and authentication protocols, ensuring the security of data exchange.

The federated data-sharing network presents several advantages over the existing centralized network. Firstly, it enhances security and privacy by keeping data within the control of its owner, minimizing the risks of unauthorized access, data breaches, and a single point of failure. Additionally, this network fosters innovation through collaboration, given the absence of central control. It also provides flexibility to adapt to changing needs, as participants can tailor their systems to meet specific preferences, allowing for a higher degree of customization.

However, a federated data-sharing network comes with certain risks. Without centralized control, organizations may retain data within their preferred networks, limiting overall data visibility and resulting in information silos. This situation can hamper collaboration, as the willingness to share data depends on negotiations and agreements among organizations. Furthermore, the effectiveness of federated networks relies on data harmonization and standards to ensure seamless data exchange and interoperability. Establishing and adhering to these standards are essential for realizing the full potential of a federated data-sharing network within a complex organizational landscape.

Recognizing the importance of standard in improving efficiency, PoR aims to promote the adoption of European Union (EU) and *global standards* within its digital ecosystem. PoR strive to provide a "north-star" or guidelines for semantics, key data events, data model, API, and principles for interoperability. This approach aims to enhance the efficiency of information exchange and promote collaboration among the diverse stakeholders in the port ecosystem. By adhering to widely accepted standards, PoR expects that the data will follows a consistent standard, promoting interoperability and mitigating complexities associated with diverse standards.

The PoR commitment to implement global standards within its ecosystem is evident through *partnerships with major consortia*. One notable example is the European Digital Infrastructure Consortium (EDIC), led by the Directorate General for Communications Networks, Content, and Technology (DG CONNECT). This commitment is reinforced by well-defined Key Performance Indicators (KPIs) that prioritize the standardization of the top 20 most exchanged data within the port.

This standardization process is not without a challenge. Implementing global standards at the firm level often involves substantial financial investments. Companies may need to upgrade their infrastructure, modify existing systems, or even adopt entirely new systems to comply with these standards. These adjustments can be costly in terms of both time and resources. Meanwhile, as many companies still relies on legacy systems, data received from these companies comes in various formats and standards, creating interoperability issues. To address this issue, PortBase conducts extensive *data processing and translation* to ensure that the data adheres to the required standards and interoperable across networks.

PoR also acknowledges that the network effects of its digital ecosystem stem from the reinforcement between digital and physical platforms. The core function of PoR is to attract and facilitate global trade via Rotterdam. The digital platforms are intended to enhance the seaport core function by improving the operational excellence and sustainability. Currently, the value proposition of digital platforms to the physical platform lies primarily in the improved visibility of the logistics chain. With the rise of artificial intelligence, the value proposition should evolve from *visibility* to *predictability*. This evolution aims to make the logistics chain more adaptive, and resilient against disruptions.

Furthermore, PoR recognizes the importance of the "network bridging" in enhancing the network effects. PoR considers that its digital hub should not only connect with local organizations but also establish connection with major global ports. This strategic option can position the Port of Rotterdam as a key player in a global supply chain network and attract more international partnerships and business opportunities to the port. Besides, the diversified connections created through this strategy can contribute to the resilience of the port ecosystem. In the face of disruptions or challenges in one region, the interconnected nature of the network may facilitate the sharing of resources and information to mitigate negative effects.

Despite the efforts to accelerate digitalization, the primary challenge in the short term remains in the slow adoption rate among ecosystem players. To tackle this issue, POR is actively working to create an innovative ecosystem, through initiatives such as PortXL and SmartPort. Additionally, PoR, through PortBase, provides an incentive for smaller companies to join by offering the first two years of user fees free of charge. This approach allows these companies to experience the benefits of digitalization without immediate financial commitments.

4.3.2 Royal FloraHolland

The Netherlands is the world's largest trade hub of flowers and plants, commanding most of flower transport in the world, from growers to retailers and ultimately to end customers. The 2021World Floriculture Map shows a fairly stable pattern in the floriculture global supply chain[7]. The trade hub for flower market in the Netherlands is centered in Aalsmeer, facilitated through an auction that serves as a *physical hub* for the flower industry, as it provides a (physical) platform for growers and buyers to trade their products.

The flower auction in the Netherlands is managed by Royal FloraHolland (RFH) which is a cooperative of Dutch growers that operates under a non-profit model. With over a century of experience in the floriculture industry, RFH has successfully developed a robust ecosystem encompassing growers, exporters, wholesalers, retailers, and logistics service providers. The auction process itself has undergone substantial digitization, with the majority of bidding now taking place through computer.

Recognizing the opportunity from digitalization, RFH has introduced Floriday, a digital platform designed to increase its capacity and capacity in serving global trade. Floriday is an online marketplace serving as a *digital hub* in floriculture industry that bring together growers, buyers, logistics service providers, financial service entities, and software developers.

[7] https://research.rabobank.com/far/en/sectors/fresh-produce/a-mixed-bouquet-of-developments-in-floriculture-world-floriculture-map-2021.html

The main users of Floriday are the growers and the buyers. Growers use Floriday to exhibit and sell a diverse range of flowers and plants. This platform empowers growers by expanding their market reach, optimizing sales processes, and fostering meaningful connections with potential buyers. Conversely, buyers, including wholesalers, retailers, and florists rely on Floriday to efficiently source high-quality products from a variety of growers. The platform provides buyers with an extensive selection, transparent information on product availability and pricing, and a streamlined ordering process. Besides, Floriday's ecosystem is also enriched by several complementors such as transport companies, software developers, and financial institutions, who provide complementary service that enhance the user experience and the overall value proposition of the platform.

However, RFH's leadership in the global flower market is not immune to challenges. Over the past two decades, the organization has observed notable shifts in the market, including changes in buyer behaviors, escalating competition from low-cost producers in Africa and Latin America, and a decline in auction participation in favor of direct sales. Besides, Floriday is not the only digital platform available in the global floricultural market. Several companies have also introduced their own platform and auction market for growers and buyers worldwide.

4.3.2.1 The roles of PoR in the digital ecosystem

In this complex digital landscape, RFH consider itself as a platform organization that mediate growers and buyers in floriculture industry with the Netherlands as its global hub. The interviews highlight that the objective of RFH is to sustain long-term growth and profitability for the Dutch growers both in the regional and international market. To achieve this, RFH aims to establish *a future-proof international floriculture marketplace* with a single digital platform and physical hubs, a marketplace where supply and demand come together digitally and physically[8].
From the statement above it is clear that RFH takes a more active role as an *integrator* within its digital ecosystem. It has developed a single digital platform, Floriday, that connect with its physical platforms and works closely with its members to deliver all identified value-adding services essential to the users. It is important to note that Floriday was initially a separate independent entity before being acquired and subsequently integrated into Royal FloraHolland.

To provide such integrated services, RFH collaborates with several providers such as trading agents, transport companies, financial institution, and software developers to complement value proposition of its platform. For example, RFH opens its platform to connect with existing information systems used by growers and buyers through the Floriday API link. This feature facilitates a seamless integration of diverse information systems used by its users. Furthermore, RFH has expanded its operational scope by acquiring three transport companies — De Winter, Van Zaal, and Wematrans — to provide customized logistics solutions for the floriculture market, leading to the establishment of an independent entity, called *Floriway*.

This integrator role was taken since RFH is a representative of the Dutch growers, thus the provision of a centralized digital platform will help its member to be more efficient and compete in global market. Such an integrator role is feasible as the provision of such services aligns with RFH's role in physical realm without introducing significant conflict of interest with its participating members. Instead, the development of a single digital platform helps to safeguarding the interest of the Dutch growers in strengthening their position and the Netherlands as the central hub in global floriculture industry. To ensure careful decision-making in its role in digital realm, RFH relies on extensive consultation with its members council and supervisory board, nurturing a collaborative approach in representing the interest of the Dutch growers.

4.3.2.2 Competition and Collaboration between platforms

Despite being a single digital platform promoted by the cooperatives, RFH does not restrict its members to exclusively use Floriday or Floriway as their service providers.

[8] https://www.royalfloraholland.com/en/about-us/who-we-are/ambition

Growers retain the autonomy to establish direct contacts and transactions with buyers independently. Floriday even provide multiple sales channels within its digital platform, including direct sales, direct bidding, auction sales, and contracts, providing flexibility for its users in making transactions. The report from ACM outlines that only 40% of import volumes were facilitated through Floriday[9]. It means that the majority of import volumes between growers and buyers were traded without using RFH's platforms. Since the growers and buyers have a freedom to choose their preferred channels and service providers, there is a risk that they may not use Floriday for transactions. Without high participation, the network effect may not occur, limiting the efficiency and growth of the Floriday as a global digital marketplace. It also can negatively affect the future competitiveness of the Dutch growers and the Netherlands as global hub in the global digital landscape.

However, during the initial implementation phase, there was indeed substantial resistance from growers, particularly smaller firms, for adopting Floriday as the main digital platform. This resistance is partly due to the fact that many of small growers are not aware of the value-adding from digital platforms in the long term, making them hesitant to participate. Some of them had not yet reached a level of digital maturity required to connect seamlessly with a digital platform. Besides, digitalization often requires growers to change the way they work, which takes a lot of effort and investment.

In light of these challenges, RFH must ensure that its platform offers tangible benefits for growers and is appealing to international buyers. This is particularly crucial given the presence of global competitors, including low-cost producers and emerging tech companies. Besides, there are the challenges related to the energy transition and growing consumer demands. By emphasizing the value proposition of digital platform and addressing the concerns of growers, RFH can raise participation, increase the digital maturity of the growers, and strengthen the competitive position of Dutch growers and the Netherlands as the leading hub for international floriculture market.

4.3.2.3 Strategic Initiative

In order to facilitate the successful adoption of Floriday, RFH has established a dedicated team committed to assisting these businesses in their journey toward digitalization, especially for the SMEs. This specialized team works collaboratively with SMEs, offering guidance, training, and support to ensure that they are well-prepared to leverage the benefits of Floriday.

To fulfill the role as an integrator in the ecosystem, RFH through Floriday intends to attract more buyers and growers in its digital ecosystem by continuously seek and create digital services that give value-adding for its users, such as simplify the dealmaking, tailoring logistics services, and providing consultancy for smarter business[10]. The objective is to provide the best possible market price at the lowest possible cost.

RFH realizes that to foster business growth, there should be reinforcement between digital and physical platform (i.e., auction hubs). The value-adding services from digital platform can increase participation in the auction hubs, and the improvement in the capacity of physical hub can attract more participation in the digital platform. At the moment, there is an initiative to improve efficiency by bringing together auction hubs on one national digital clock auction and enhancement in logistics service, such as order picking, track-and-trace, and delivery consolidation[11]. RFH also recognizes that the share of foreign floriculture products on Floriday has been growing for years. As of 2022, 17% of the floriculture products available originate from international producers. Within the auction setting, this percentage increases to 28%. Additionally, Floriday manages 24% of international transactions in direct flows[12].

[9] https://www.acm.nl/sites/default/files/documents/royal-floraholland-krijgt-vergunning-voor-overname-gebr-de-winter-holding-van-marrewijk-holding-en-van-zaal-concentratiebesluit.pdf
[10] https://www.royalfloraholland.com/en/about-us/strategy-and-service
[11] https://www.royalfloraholland.com/en/customized-logistics
[12] https://www.royalfloraholland.com/en/news-2022/week-08/management-board-column-international-growers-and-buyers-strengthen-the-marketplace

However, RFH realized that the digitalization should be done at an appropriate pace with the capacity of physical hubs to create a balanced growth[13]. Ongoing discussions are in progress regarding the internationalization of Floriday, including considerations about serving international trades that do not pass through their physical hubs. Although this presents opportunities for market expansion and establishing a global presence, serving international trades outside their physical hubs may introduce additional complexity, logistical challenges, and dependency on external networks.

Recognizing the crucial role of logistics, RFH has introduced Floriway to streamline the transportation of floriculture products efficiently, whether for clock auction or direct sales. Linking Floriway with Floriday ensures that growers and buyers can soon organize transport for floriculture products reliably and with optimal efficiency, irrespective of the sales channels and the density of the supply network[14]. Importantly, RFH ensures that growers and buyers retain the autonomy to use their preferred carrier or provide their own transport.

Table 4.1: Characteristics summary of Digital Logistics Ecosystem in PoR and RFH

	Port of Rotterdam	Royal FloraHolland
Role of Orchestrator	Smart Partner ("Platform provider")	Central Hub ("Integrator")
Main Digital Platform	PortBase	Floriday
Type of Platform	Innovation Platform (B2B)	Transaction Platform (B2B)
Main Users	Port Community	Growers, Buyers
Complementors	Tech Companies, Software Developers, Global Ports	Transport companies, Financial Service Providers, Software Developers
Platform Objective	Improve collaboration and foster innovation within the port community	Improve competitiveness of growers and increase market efficiency
Value Proposition	A neutral digital hub that provides essential data for users to generate value-adding services.	A global digital marketplace that provides broad quality products and efficient commercial and logistics services.
Value Capture	Subscription fees Indirect benefits via future volume growth	Selective service fees Profit split with complementors
Platform Architecture	Centralized data-sharing network that aimed at facilitating the easy and efficient exchange of data in the logistics chain.	Centralized platform with multiple interfaces for different user groups connected through API.
Orchestration Strategy	Ensuring platform neutrality and let the market creates the value-adding services. Promote collaboration with local and global players through a federated data-sharing network. Focus on providing essential data and make it universally accessible for port community. Encourage the use of global standard to improve efficiency in data collaboration with local and global actors. Intervene only in the event of market failure. Helps port community to embrace digitalization through smart initiatives.	Attract more users by continuously invent and add new services that give value-adding for their users. Collaborate with potential complementors to support global service excellence (e.g., linking Floriday and Floriway). Improve the efficiency of physical hubs through one national digital clock auction. Strengthen network effect through reinforcement between digital and physical platform at an appropriate pace. Helps growers to be more competitive in digital world through consultancy and supports.

[13] https://www.royalfloraholland.com/en/simplify-dealmaking
[14] https://www.royalfloraholland.com/en/customized-logistics

4.3.3 Summary

Based on the two case studies presented earlier, we can extract valuable insights into how the ecosystem leader orchestrates its network in the logistics ecosystems.

1. **Continuity of Orchestrator's Role.** The case studies affirm that the orchestrator's role in the digital realm typically resemble its role in the physical realm. For instance, PoR assumes the role of platform provider, acting like a "landlord" in both the physical and digital domains. It focuses on providing digital infrastructure and basic services for the port community, facilitating private entities to collaborate and create more sophisticated value-adding services. POR refrains from engaging in commercial services and only intervenes in cases of market failure. On another side, RFH assumes an integrator role in the digital ecosystem, consistent with its historical role as a cooperative for growers in the physical realm. It was established to represent the interests of Dutch growers, leading to more direct interactions with buyers through the integration of various services in the value chain. This consistency in role is likely due to expectations established in the physical world, where orchestrators have proven their indispensable role within the ecosystem. Maintaining a familiar role in the digital realm enables orchestrators to build trust with participants, laying a solid foundation for smooth collaboration.
2. **Trust Building and Stakeholder Engagement**. Building trust requires active involvement and consultation with related stakeholders. The orchestrator must interact and engage with network actors to identify common interests, align expectations, and ensure that the digital platform aligns with the evolving needs of the members. For instance, the resistance encountered by the Port of Rotterdam (PoR) when introducing commercial services, leading to a realization of their ideal role within the port community as a neutral digital hub. To preserve trust, PoR abstains from applying subjective judgment to the collected data. Similarly, Royal FloraHolland (RFH) consistently consults with its board council to ensure that the development of Floriday aligns with the interests of its stakeholders. This collaborative approach fosters a sense of ownership among stakeholders, encouraging their active participation and ensuring that the digital platform aligns with their needs and expectations.
3. **Enabling Interoperability and Collaboration.** Effective digitalization demands seamless integration between existing information systems used by network members. Standardization and translation services are crucial to facilitate interoperability and enable seamless collaboration across the ecosystem. For instance, RFH offers a dedicated team to assist users in connecting their existing information systems and aligning with the standards used by Floriday. PoR plans to provide guideline in data standards to allow smooth data exchange. Recognizing the diverse array of standards within its ecosystem, PoR, through PortBase, also provides translation services to ensure data interoperability across networks. Without such standardization, the digital platform becomes an isolated entity, hindering collaboration and value creation within the network.
4. **Reinforcement between Digital and Physical Platforms.** Both case studies highlight that the digitalization should enhance and complement the core values that have made the physical platform successful. The new digital layer should not replace or undermine the traditional strengths of the network but rather amplify them. For instance, PoR highlights that the value proposition of digital platforms should progress beyond visibility to predictability. This shift aims to enhance anticipation and resilience within the port ecosystem. RFH, on another hand, emphasizes the digitalization should be done at an appropriate pace with the capacity of physical hubs to create a balanced growth.
5. **Scope Ambiguity in the Digital Realm.** Since the digital platform is not limited to geographical and physical boundary, orchestrators are still exploring the scope of their role in the digital world. But how far should they go? This is a still a question for orchestrators as they move into the digital realm.

Both orchestrators recognize the potential benefits of global expansion, such as increasing market share, securing market leadership, and increasing resiliency during uncertain times. However, there are also potential challenges, such as managing physical capacity and flow complexity, which potentially can dilute their focus on their core network members. Therefore, orchestrators may need to carefully consider the trade-offs from global expansion. Striking the right balance is crucial for sustainable growth and success in the dynamic market.

4.4 External Trend and Developments

The digital logistics ecosystem is a rapidly growing and evolving industry that is being shaped by a number of trends and external developments in technology, operations, ecosystems, and geopolitics. In this section, we discuss key trends affecting logistics ecosystems and their relations with digital platforms. The identified trends will later be used in scenario analysis.

4.4.1 Technological Trend

Coordinating logistics activities can be particularly challenging, especially with the growing globalization and interconnectivity of supply chains. Historically, logistics coordination relied heavily on manual and paper-based methods, which hindered the ability to track the movement of goods and maintain transparency in the supply chain. The introduction of information technology has brought about a transformative shift in the logistics industry, offering numerous advantages and opportunities to enhance efficiency and competitiveness within the ecosystem. We distinguish the impact of this technological development into two key dimensions: (1) from digitized to digital platform and (2) from data-sharing to data analytics.

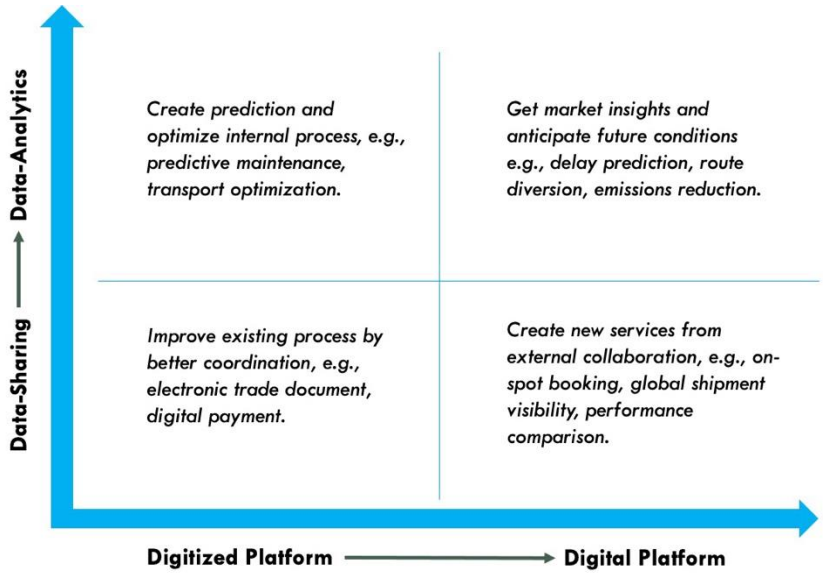


Figure 4.2: Technological Development

While the term of digitization and digitalization are often used interchangeably in the literature, we distinguish them by using the following definition. We define a digitized platform as a framework that leverages information and communication technology to convert or represent existing analog or physical services into digital versions in order to gain efficiency.

An example of digitized platform is the conversion of traditional bill of lading into the electronic version which can save 10-30% of total trade documentation cost in global logistics[15].

[15] https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/the-multi-billion-dollar-paper-jam-unlocking-trade-by-digitalizing-documentation

Another example is the digitization of financial transactions that have enhanced accessibility, security, and speed of payment in logistics. On the other hand, the digital platform is a framework that leverages information and communication technology to create new value-adding services often by facilitating interaction or collaboration across organizations[16]. An example of digital platform is the freight matchmaking platform that utilize online application to intermediate shippers and carriers in the freight market.

Based on the interviews, we observed that several logistics firms embark on their digital journey by first digitizing their existing physical operations. Subsequently, they may either develop their own digital platforms or become part of existing ones. This initial digitization step allows these firms to actively monitor, control, and coordinate their processes in real time, resulting in enhanced operational efficiency. Furthermore, it provides the necessary infrastructure for establishing connections and communication with other organizations. This connectivity serves as the foundation for digitalization, that unlock market opportunities for the creation of new value-added services through collaborations with external parties. Thus, in summary, the digitalization trend shifts firms focus from inward looking (e.g., process optimization) to outward looking (e.g., business growth).

The second dimension involves a technological shift, progressing from data-sharing to data-analytics. From interviews, we observed that many digital platforms in logistics are currently focus on providing visibility as the main value proposition, such as shipment tracking, price insights, inventory visibility, and emission estimate. This kind of value-adding services are dominantly emerging from data sharing with a low level of analytics. However, over time, they began to recognize the untapped value of data when it is processed more extensively. For instance, transaction data can be further analyzed to provide market price insights[17] and estimate carbon footprints[18]. There is still untapped potential use of data that has not been leveraged from high level of analytics such as predicting delay and disruption, adaptive route optimization, which can give valuable benefit for shippers and logistics companies.

4.4.2 Sustainability Trend

The growing awareness of sustainability issues has led to a noticeable trend where customers are increasingly favoring companies that support sustainable practices. In responses to this trend, shippers are now leaning towards logistics providers that can offer more sustainable services. The move towards sustainability is a crucial factor for shippers when they look for partners who share their commitment to sustainability.

Governments worldwide are amplifying this trend by introducing target and regulations to foster sustainable practices. For example, in 2023, European law requires all large companies and all listed companies to report sustainability information according to European Sustainability Reporting Standards (ESRS)[19]. The information will help users and investors to compares company based on their sustainability performance in a standard reporting format.

However, aggressive sustainability regulations also introduce new costs and compliance challenges for logistics providers. They may need to redesign their business process, and investing in sustainable technologies, as electric vehicles, and renewable energy, which can be highly expensive since logistics is a capital-intensive industry. Another challenge is that the sustainability pressure may precede the green infrastructure readiness. For instance, transport companies were asked to transition to electric vehicles, but they face a shortage of accessible charging stations. This may lead to slower adoption for sustainable operations and result in less competitive pricing compared to companies using conventional vehicles. We illustrate the uncertainty in sustainability development into two opposite scenarios with conservative and aggressive regulations at its extremes. Both scenarios provide risks and opportunities.

[16] https://hbr.org/2016/04/pipelines-platforms-and-the-new-rules-of-strategy
[17] https://container-news.com/uturn-introduces-container-price-calculator-tool/
[18] https://maritime-executive.com/article/facing-scrutiny-on-co2-rotterdam-starts-tracking-vessel-emissions
[19] https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

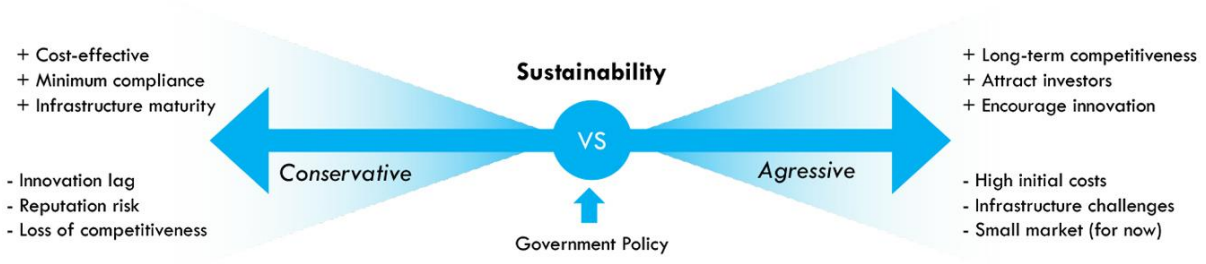


Figure 4.3: Sustainability Trend

In the *aggressive scenario,* governments put greater pressure to achieve sustainability target as soon as possible with minimum infrastructure readiness. Logistics companies were required to comply and embrace commitment toward sustainability goals. They would make substantial investments in sustainable operations and renewable energy, even before the infrastructure is fully matured. The aggressive scenarios will also push the adoption of digital technologies aimed to monitor and report the sustainability performance. A strong commitment to sustainability can enhance companies brand image, attracting investors and partners who share their vision. They can also charge a premium for their commitment, attracting a niche market of socially responsible consumers. With the investment, these companies can seize the opportunity to expand their market and become pioneers in sustainable solutions in global market. Notably, the pressure to meet sustainability requirements has been especially intense for large transportation companies operating in international markets (Jazairy & von Haartman, 2020).

Nonetheless, the aggressive scenario also requires companies to put significant investments in green technologies and infrastructure, which can be costly and affect their pricing. Early adoption may outpace the readiness of the green infrastructure, potentially resulting in operational disruptions and a slower integration of sustainable practices. It is important to note that the demand for sustainable logistics, while on the rise, still remains a relatively niche sector globally. Companies that overcommit to sustainability may unintendedly limit their market, exposing themselves to risks if the demand does not grow as expected.

Conversely, in the *conservative scenario*, the government opts for a more cautious approach towards achieving sustainability targets, allowing time for the market and infrastructure to align. In response, logistics companies adopt a "wait-and-see" stance, giving priority to cost-effectiveness and implementing only the minimum sustainable practices required by regulations. By waiting for the green infrastructure to mature, these companies minimize potential disruptions linked to infrastructure gaps, resulting in a smoother transition to sustainable practices.

Adopting a conservative approach may lead to quicker profitability and help avoid the high initial costs associated with the aggressive scenario, but it also poses certain risks. Companies may risk losing customers to more aggressive competitors who are catering to the growing market of sustainability-focused clients. Waiting for sustainability practices to become mainstream could lead to falling behind in terms of innovation, missing opportunities to create proprietary, cost-effective sustainable solutions. Furthermore, companies perceived as slow to embrace sustainability may damage their reputation, particularly in the current market when consumers are increasingly concerned about sustainability issues.

4.4.3 Ecosystem Trend

The current state of the logistics ecosystem has been marked by a significant degree of *fragmentation.* There are many different logistics providers, carriers, shippers, and intermediaries, each operating independently or within specific niches.

This fragmentation can lead to a lack of standardization and coordination across regions and industry, making it more difficult to offer efficient solutions for global supply chain.

The introduction of digital platforms helps to *integrate* players in the ecosystem. Digital platforms make it easier for companies to connect and coordinate with external parties. They also help to streamline complex administration process by introducing standardization which improve efficiency across the supply chain. Besides, digital platforms reduce the barriers to market, making it easier for businesses to reach global markets, even if they are small or new. They allow business to scale their operations quickly and easily through the network effect.

Due to this advantage, many businesses start to develop their own digital platforms to enjoy the benefit of being the first movers. Similar digital platforms are competing to attract potential users and complementors to join their ecosystems and create network effect. As the global competition between platforms intensifies, market consolidation might occur. Larger, well-established platforms are likely to acquire smaller platforms or form exclusive partnerships with complementors to dominate the global market.

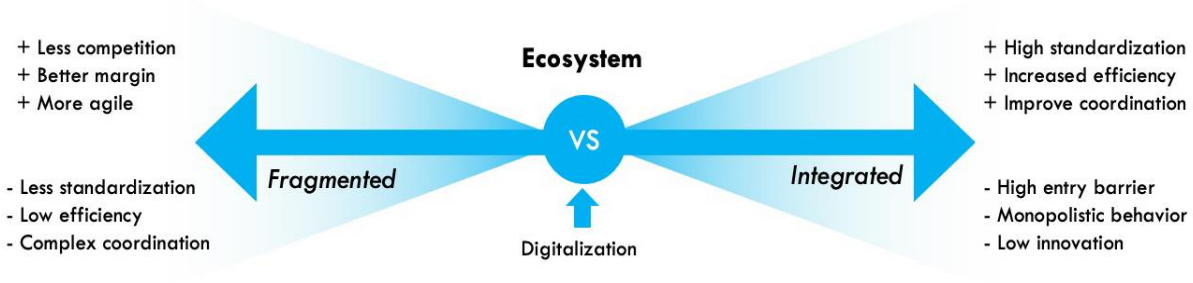


Figure 4.4: Ecosystem Trend

The consolidation can lead to a "winner-takes-all" scenario, where only a few dominant players end up controlling a significant portion of the global logistics market. This can make it difficult for new entrants to compete with established platforms, as they already have a large and engaged user base. Big platforms could use their resources to monopolize users and data, putting smaller platforms at a disadvantage when it came to competing. When these big platforms lack of competitor, they may have less incentive to innovate and compete. This can lead to higher prices and lower quality services for consumers.

Governments and policymakers are increasingly concerned about the potential negative consequences of winner-takes-all markets. They are exploring a variety of policy options to address this issue, such as antitrust enforcement and regulation, like the Digital Market Act and the Digital Service Act to make sure the market remains open and fair. Community and association also provide in-house services to help small businesses make a smoother transition into the digital economy.

However, it is important to note that consolidated platform is not always bad. In some cases, they can lead to significant efficiency gains that benefits the ecosystem. Dominant players in the logistics market may establish standards and technology frameworks that enhance coordination and consistency. This can reduce complexities in supply chain operations, making it easier for different stakeholders to collaborate seamlessly.

4.5 Operational Trend

In the last decades, businesses have adopted a lean approach to supply chain operations, emphasizing efficiency and cost reduction. They embraced a more globalized approach, relocating manufacturing operations to regions with lower labor costs, outsourcing non-core activities to specialized providers, and employing lean inventory management practices to optimize resources and minimize waste.
The globalization trend has also opened-up new opportunities for companies to source labor and materials from countries with lower costs. This practice, known as offshoring, has been particularly

prevalent in the manufacturing industry, where companies have moved production to countries like China, Mexico, and Southeast Asia. By locating manufacturing operations to lower-cost countries, companies can significantly reduce labor costs and improve profitability.

The provision of digital platforms facilitates seamless communication and collaboration between companies and their global network of suppliers. This ensures better coordination, faster issue resolution, and improved overall efficiency in the supply chain. With the aid of digital platforms, companies can optimize transportation routes, choose the best carriers, and consolidate shipments to minimize costs and transit times. This optimization is vital when dealing with goods produced in different parts of the world. Digital platforms also facilitate traceability, allowing companies to ensure ethical sourcing practices and monitor sustainability goals across their global supply chains.

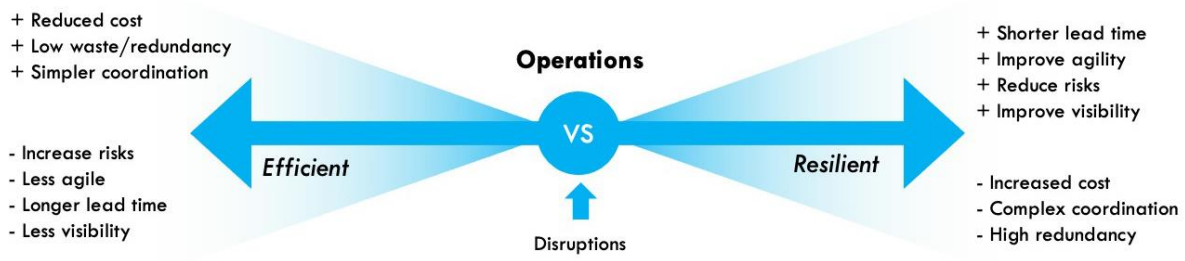


Figure 4.5: Operational Trend

However, in the last couple decades, the risk of disruption has risen significantly due to natural disasters, pandemics, trade disputes, and political instability. The supply chain operations are undergoing a transformation, marked by a shift from its focus on efficiency to a more emphasis on resilience. Businesses that rely on outsourcing and offshoring has high dependency on external parties which can introduce potential risks associated with quality control, supplier disruptions, and communication breakdowns. Considering this, companies realize that resilience is a critical safeguard against the unforeseen disruptions.

To strengthen the resilience, companies are proactively introducing redundancy into their supplier networks (Kamalahmadi et al., 2022). Collaborative partnerships with multiple suppliers mitigate the risks associated with an overdependence on a singular source (Namdar et al., 2018). Enhancing resilience can also be done by incorporating spot markets into the freight industry and diversification of transport modes (Wang et al., 2021). This strategy introduces flexibility, enabling companies to secure transportation capacity promptly, particularly in the face of unforeseen disruptions. This approach ensures a smoother flow of goods even when regular channels might encounter hindrances.

The logistics operations are also witnessing a trend towards nearshoring, where companies are relocating production and sourcing closer to their main markets (Fernández-Miguel et al., 2022). This strategic shift enhances agility and responsiveness, addressing vulnerabilities highlighted by the pandemic and other disruptions associated with global supply chains. By minimizing geographical gaps, nearshoring contributes to the resilience objectives and adaptive strategies embraced by the logistics ecosystem.

This resilient trend has brought some implications to logistics digital platforms especially on visibility and risk management. Companies requires end-to-end visibility across the supply chain to be more resilient. This includes real-time tracking, monitoring, and sharing insights with stakeholders to quickly identify disruptions and implement necessary adjustments. Besides, there are greater needs for digital platforms to provide risk assessment and management tools that help businesses identify vulnerabilities, quantify risks, and implement contingency plans to minimize potential disruptions.

4.6 Geopolitical Uncertainty

In recent years, there has been a notable trend in the realm of geopolitics, transitioning from a longstanding emphasis on globalization to a more pronounced trend of regionalization. This trend is marked by a departure from the traditional open-market approach, where nations seek to promote global trade and economic integration, to a more inward-looking stance, characterized by safeguarding domestic industries, securing national interests, and mitigating perceived vulnerabilities[20].
The surge of nationalism has sparked a countermovement against free trade in various countries. Notable examples include the United States withdrawing from the Trans-Pacific Partnership in 2017 and the UK's Brexit decision in 2020, along with the rise of protective policies in numerous other countries. The US-China trade war has also led to tariffs being imposed on goods traded between the two countries. The Russia-Ukraine war in 2022 has further exacerbated these trends The war has disrupted global energy and food markets, leading to higher prices and shortages. It has also disrupted supply chains, making it more difficult and expensive to move goods around the world (Sheth & Uslay, 2023). This has led to calls for increased protectionism in some countries, as governments seek to protect their own industries from the impact of the war.

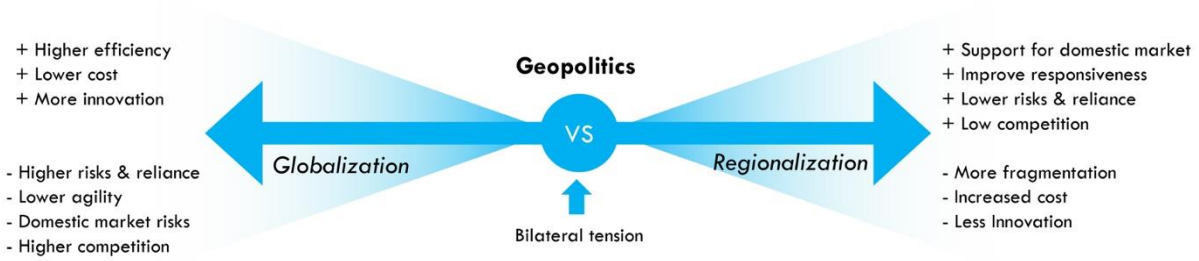


Figure 4.6: Geopolitical Trend

The surge in regionalization have triggered several implications for global supply chain. To begin, protectionism often result in the imposition of tariffs, quotas, and stricter customs regulations. These actions establish higher entry barriers for global players attempting to access regional markets. For instance, the geopolitical tensions between India and China have impacted the access of Chinese digital platforms to the Indian market[21]. Although local players might gain an advantage through their familiarity with domestic regulations, these barriers can hinder operational efficiency, dampen competitive dynamics, and restrict market expansion.

Besides, governments may also view digital platforms from other countries as a security threat and take steps to restrict their access to their citizens' data. For example, the United States has accused Huawei, a Chinese telecommunications company, of posing a security threat[22]. This has led to the company being banned from providing equipment to telecommunications networks in many countries.

Moreover, the trend of regionalization can extend to data localization, obliging that data generated within a country's borders be stored locally. This poses challenges for digital platforms that rely on cloud computing and data sharing across borders. Conflicts between countries might result in stringent data localization requirements, forcing digital platforms to adhere with a specific local standard. This can add complexity and cost to their operations, affecting how they manage and process user data.

[20] Charan, R. & McGrath, R. (2023) The Radical Reshaping of Global Trade. Harvard Business Review. https://hbr.org/2023/11/the-radical-reshaping-of-global-trade
[21] CNN. November 2020. India bans more Chinese apps as tensions remain high. https://edition.cnn.com/2020/11/25/tech/india-bans-chinese-apps-hnk-intl/index.html
[22] BBC. November 2022. US bans sale of Huawei, ZTE tech amid security fears.. https://www.bbc.com/news/world-us-canada-63764450

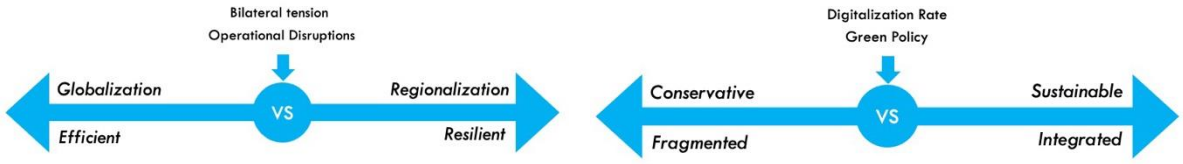
For example, Russia has a data localization law that requires that all personal data collected from Russian citizens be stored within the country[23]. This law has made it more difficult for global platforms like Facebook and Google to operate in Russia.

4.7 Scenario Analysis and Strategy Development

4.7.1 Scenario Analysis

The scenario analysis can help organizations to prepare for environmental uncertainty in the logistics ecosystem. First, it can help organizations to identify and prioritize risks and develop contingency plans. By understanding the range of potential outcomes that an organization may face, organizations can better allocate resources to mitigate risks. Second, scenario analysis can help organizations to identify new opportunities. By exploring the range of possible outcomes, organizations may identify strategic priority that they should pursue.
In this study, the scenario analysis functions as a strategic tool aimed at investigating potential developments. This involves a detailed examination of core uncertainties spanning various domains, including technology, market dynamics, operational paradigms, geopolitics, and sustainability issues. Given the complexity of deriving scenarios from five key trends, we opted for a simplification strategy. Through this approach, we observed that the key trends could be effectively categorized, providing a clearer and more manageable framework for scenario analysis.

By identifying strongly correlated trends, we organized the trends into a streamlined 2x2 scenario matrix. This matrix simplifies the scenario development process by grouping related trends into two distinct dimensions (see Figure 10).



Dimension #1: Geopolitical Uncertainty

Dimension #2: Ecosystem Uncertainty

Figure 4.7: Trend Grouping

- *Dimension #1(Geopolitical Uncertainty)* intertwines geopolitics and operational trends, influenced by bilateral tensions and operational disruptions. We group these two trends together due to their tendency to exhibit correlated movements. The escalation of global uncertainty, including major disasters and pandemics, is prompting companies to adopt resilient operations through nearshoring and a heightened focus on regional development. This operational trend aligns with geopolitical dynamics, particularly those driven by bilateral tensions. The degree of bilateral tension plays a pivotal role in shaping these trends. Increased bilateral tension strengthens the drive toward regionalization, leading to the emergence of diverse standards and regulations. Conversely, in periods of low bilateral tension, achieving global standards becomes more feasible, fostering efficiency and promoting international collaborations. This interplay between geopolitical factors and operational trends underscores how the level of bilateral tension shapes the path toward either regionalization or global standardization, influencing the dynamics of international collaborations and regulatory frameworks.

[23]Sherman, J. 2022. Brookings. https://www.brookings.edu/articles/russia-is-weaponizing-its-data-laws-against-foreign-organizations/

- *Dimension #2 (Ecosystem Uncertainty)* combines ecosystem and sustainability trend driven by the digitalization rate and government policy. An aggressive sustainability measures compels companies to adopt digital solutions, fostering transparency and visibility in their operations. In environments where the digitalization rate is high, ecosystem players are more likely to integrate, laying the groundwork for improved chain visibility and the development of sophisticated services. These advantages contribute to enhancing operational efficiency, reducing carbon footprint, and fostering the adoption of more sustainable strategies by companies. Conversely, a conservative approach to sustainability may lead companies to cautiously embrace digital solutions due to the associated high investment. In less digitalized environments, companies often operate in silos with limited connectivity, resulting in a fragmented ecosystem. This fragmentation hinders the potential benefits derived from comprehensive integration, restricting operational efficiency improvements and sustainability strategies. The digitalization rate and sustainability measures thus intertwine, influencing the level of integration and connectivity within the ecosystem.

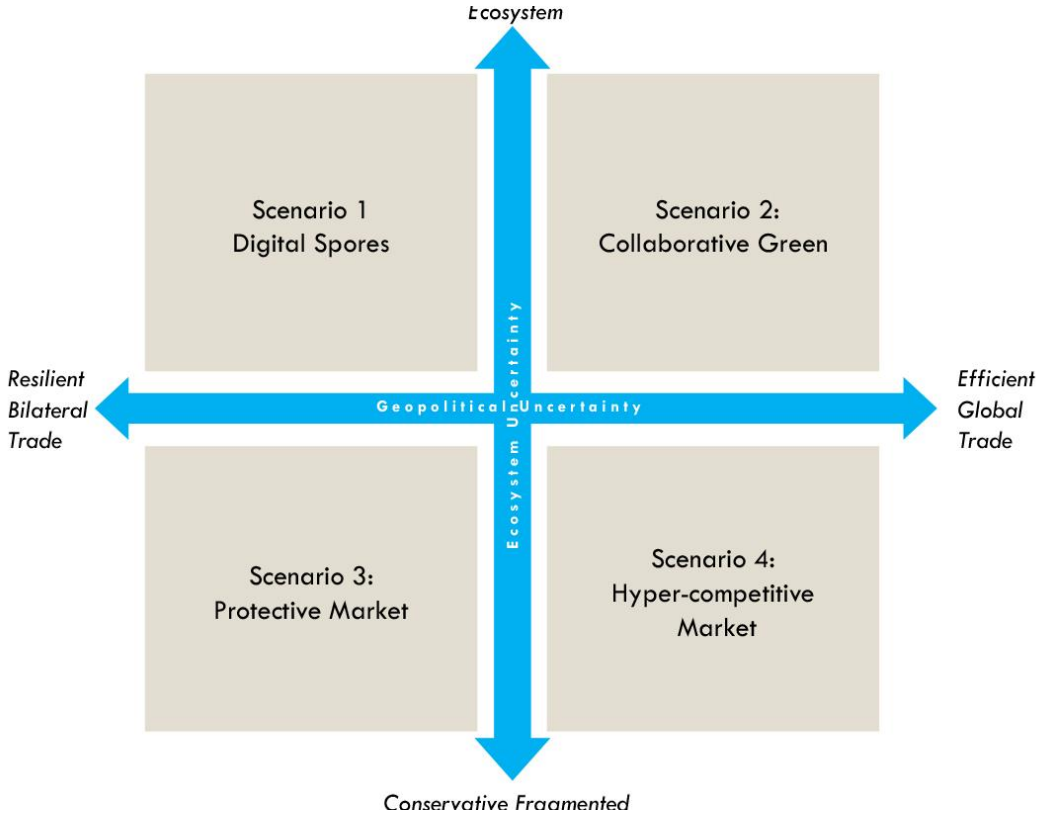


Figure 4.8: Cross-matrix scenario based on geopolitical and ecosystem uncertainty in digital logistics ecosystem

We developed four scenarios based on the two main dimensions (see Figure 11). The short description of each scenario is as follow:

- *Collaborative Green:* this scenario is driven by the high digitalization rate, pressure to adopt sustainable practices, and stable international relationship. In this scenario, most players in the logistics ecosystem actively embrace digitalization and collaboration to create value-adding services. With stable international relations, the collaboration between players may extend beyond regional level and lead to global market consolidation, resulting in the emergence of few dominant platforms. These major platforms provide greater efficiency, transparency, and visibility for its users, helping companies to adopt more sustainable practices.

  Nonetheless, they may also have significant market power, potentially influencing pricing, competition, market dynamics. This issue can raise concern about monopolistic practices,

platform dependency, and data sovereignty in the ecosystem.

- *Digital Spores: t*his scenario is driven by the high digitalization rate, aggressive green policy, but with high geopolitical uncertainty. In this scenario, most players in logistics ecosystem embrace digital platforms to improve efficiency and help them adopt sustainable practices. However, the high geopolitical tension prompts companies to prioritize local sourcing. Unfortunately, not all goods can be served locally. Global trade is still needed to serve local demand. Under uncertain geopolitical environment, countries may prefer to engage in bilateral agreements rather than relying on broader multilateral arrangements[24]. As a consequence, the global supply chain might be fragmented into a number of regional hubs. Each regional hub may embrace their own system and standard, limiting the interoperability at global scale. Thus, in order to facilitate sustainable global supply chain, logistics players dependent on their connections across regions and capability to navigate the complex regulatory/standard compliance. An ecosystem that does not have this regional network capability may risk falling behind and lose competitiveness in the global supply chain.

- *Hyper-competitive market: th*is scenario is driven by the low digitalization rate, low enforcement of sustainability targets, and stable international relations. In this context, market players operate within a highly competitive landscape with little incentive to collaborate through open platforms. This competitiveness is partly driven by the resource constraints and limited capabilities of smaller players, while larger entities opt for private information systems to directly engage with their global customer base. Consequently, the ecosystem becomes highly competitive and fragmented. While some logistics players may thrive and become dominant, the services provided may not be as efficient as those offered through an open platform, leading to higher prices and a reduced variety of quality choices. Furthermore, this scenario has the potential to widen the digital divide, exacerbating disparities between those with and without access to technology. Additionally, the lower pressure to adopt sustainability practices may impede innovation, causing the ecosystem to miss out on opportunities in sustainable technologies and hindering progress toward a more sustainable future.

- *Protective market:* this scenario is driven by the low rate of digitalization, low enforcement on sustainability targets, and high geopolitical uncertainty. Within this context, players in the ecosystem are highly competitive but face restrictions to regional markets due to limited access to global trade caused by geopolitical issues. The limited adoption of digital technologies impedes collaboration, leading to a fragmented ecosystem where players operate independently. The absence of stringent sustainability targets diminishes incentives for cooperation and innovation. In navigating this complex landscape, companies may prioritize self-sufficiency, resilience, and defensive strategies, resulting in constrained market expansion and low economic growth.

Based on the scenario development, we further identified risks and opportunities, associated with each scenario to establish relevant strategies. The results are shown in Table 4.2.

[24] Charan, R. & McGrath, R. (2023) The Radical Reshaping of Global Trade. Harvard Business Review. https://hbr.org/2023/11/the-radical-reshaping-of-global-trade

Table 4.2: Opportunity and risks in each scenario

Scenario	Opportunity	Risk
Collaborative Green	Digitalization and globalization drive market efficiency and innovation. Improved transparency and visibility on a global scale, supporting sustainability practices. Establishment of standardized procedures and technological frameworks led by major platforms.	Market consolidation may limit competition and dynamics. Potential monopolistic practices and market power concerns Issues of platform dependency and data sovereignty arise.
Digital Spores	Digital platforms improve ecosystem efficiency and supply chain transparency. Enhanced supply chain resilience through strategic local sourcing of main goods. Secure reciprocal digital connections mediate global trade.	Multiple standards limit interoperability and global collaboration. Complex regulatory and standard compliance Risk of losing competitiveness without bridging capability
Hyper-competitive market	Secure profitability due to low pressure in sustainability and digitalization. Thrive in the market that values economic advantage rather than long-term sustainability.	Risk of a digital divide that poses a threat to traditional companies. Lack of collaboration between players hinders efficiency and sustainable innovation.
Protective Market	Human-centric services emerges to navigate complex challenge global supply chain.	Limited access to the global supply chain due to geopolitical issues. Lack of collaboration and innovation. Emphasis on self-sufficiency may hinder market expansion and economic growth.

4.7.2 Strategy Development

Strategy development is an integral part of scenario analysis, serving as the bridge between understanding the potential scenarios and developing proactive plans to navigate these possibilities. By aligning strategies with the identified scenarios, organizations can enhance their agility, resilience, and preparedness to adapt to changing market conditions and external factors.
For each identified scenario, we provide trigger points that can help to detect the likelihood of a specific scenario unfolding. We then proposed strategic priority for orchestrator to seize the opportunity and minimize the associated risks in each scenario. The results are outlined in Table 4.3.

Table 4.3: Trigger points and strategic priority

Scenario	Trigger points	Strategic Priority
Collaborative Green	• Increased investment and implementation of digital platforms, IoT, and automation • Diplomatic statements, trade agreements, and geopolitical analyses suggesting stable international relations. • Widespread adoption of industry-wide sustainability standards and certifications	• Establish partnerships with key players to contribute to the development of global platforms. • Invest in advanced digitalization technologies to enhance efficiency and sustainability. • Proactively address concerns of market power by implementing transparent governance and regulatory compliance
Digital Spores	• Political developments, trade disputes, and international relations suggesting increased uncertainty. • Government regulations, industry guidelines, and corporate strategies promoting local supply chains and sustainability. • Investments and infrastructure development focused on creating regional standard and regulatory to enhance data sovereignty.	• Develop digital presence across regions by building local platforms or partnering with local players. • Invest in translation capability to deal with diverse standards in global supply chain.
Hyper-competitive market	• Limited investment in digital platforms, IoT, and automation • Corporate and government priorities emphasizing economic growth without significant emphasis on sustainability targets. • Price wars, aggressive marketing, and efforts to gain global market share through traditional platform.	• Support the development of data-sharing platforms accessible for large and small players. • Advocate for global collaboration and standardization to improve resilience. • Invest in educational supports and technology to minimize digital divide
Protective Market	• Lack of investments in digital platforms, IoT, and automation • Political instability, trade restrictions, and international relations creating a heightened geopolitical tension. • Regulatory changes emphasizing protectionist measures and self-sufficiency with less emphasis on sustainability.	• Establish self-sufficiency through strong regional supply-chain networks. • Create open platform that facilitate knowledge exchange on navigating cross-border regulations.

Building resilient or no-regret strategies is crucial in scenario analysis as it prepares companies to effectively navigate the uncertainties of the future and achieve long-term success. These strategies focus on building capabilities and competencies that can withstand various challenges and emerging trends, regardless of the specific scenario that unfolds.

Based on the analysis, we propose the following strategies for orchestrator to thrive in the uncertain environments:

- *Improve digital accessibility:* as observed in the scenarios, low access to digital technology can pose several threats such as non-competitive environment, low innovation, and "digital divide". Therefore, it is important for orchestrators to ensure that all players in the ecosystem, regardless of their size and resources, can actively participate in the digital transformation.

One of the ways is by the provision of digital platforms accessible to every participant in the logistics ecosystem. This initiative significantly reduces entry barriers and initial costs associated with adopting advanced technologies. The goal is to democratize access, preventing the concentration of technological capabilities in the hands of a select few. Orchestrator can also put emphasis on capacity building. This can be done by training programs to enhance digital literacy and capabilities of small companies to leverage digital tools for improved efficiency and competitiveness. Additionally, consultancy services can also be offered to assist companies through the complexities of digital integration.

- *Promote global standard:* global standards facilitate efficiency and interoperability in the digital ecosystems. It helps to reduce cost, cross-border barriers, and improve collaboration between players globally. The latter is especially important to build resilient network during disruption and improve visibility and transparency to support sustainable practices. Global standards can also help to establish a common framework for data security and privacy between regions within uncertain geopolitical environment. This can help to build trust in digital platforms and facilitate the exchange of data between businesses.
- *Diversify Network: o*rchestrator should encourage companies to diversify their network so that they are less reliant on any single market or supplier. The provision of digital platforms could help to achieve this diversification. It can help to mitigate the impact of trade disruptions and supply chain bottlenecks**.** For example, if a supplier in one market is unable to deliver goods, a company with a diversified network may be able to source the goods from another supplier. It is also important when geopolitical tensions are heightened. In this case, having a good bilateral relationship with other regional hubs can help players to improve trust and facilitate global trade and logistics. For example, Port of Rotterdam and Port of Singapore can develop a "bridge" that connect the two port communities together. This bridge can help players to connect, share data, and navigate potential solution in global supply chain amid the uncertainty in geopolitics.
- *Advocate for digital market regulation: p*latformization and globalization can lead to market consolidation, monopoly practices, and platform dependency. Therefore, it is important for orchestrators to ensure fair competition where all participants in the market have an equal opportunity to compete. It may be necessary to work with regulatory bodies to establish guidelines that prevent monopolistic practices and clarify the legal frameworks for data storage, processing, and transfer such as those in EU Digital Market Act and Digital Governance Act. This may involve measures such as antitrust regulations and data protection policy.
- *Continuous Risk Monitoring:* continuously monitoring risks allows for proactive identification of potential disruptions, whether they are environmental, economic, geopolitical, or technological. This early awareness enables swift action to mitigate these risks before they significantly impact logistics operations. By actively monitoring risks, logistics companies can adapt their strategies and responses based on the specific scenario unfolding. Data-driven insights such as from sentiment analysis can help companies to become more aware regarding changes in the environment. Companies can leverage sentiment analysis of news articles, social media posts, and official government statements to gauge public sentiment and anticipate potential political instability, trade conflicts, or war. This allows for proactive measures to be taken, such as diversifying supply chains, relocating operations, or modifying marketing campaigns.

4.7.3 Summary

The scenario analysis brings to light two pivotal driving forces that have the potential to significantly shape the digital logistics landscape. First and foremost is the geopolitical uncertainty, an external force that molds the relationships between logistics hubs on a global scale, leading to either globalization or regionalization. On the other hand, the ecosystem uncertainty serves as an internal force, influencing the relationships between organizations within an ecosystem, which can evolve towards integration or fragmentation. These two dimensions intricately interplay to configure the digital logistics landscape into four distinctive scenarios: collaborative green, digital spores, hyper-competitive market, and protective market.

One key takeaway from this analysis is the identification of trigger points that act as indicators for the likely unfolding of a particular scenario. These trigger points not only serve as early warning signals but also empower organizations to strategically prioritize their actions. Each scenario presents unique opportunities and associated risks, and recognizing these trigger points allows organizations, especially orchestrators, to navigate the dynamic landscape with informed decisions.

It is essential to note, however, that the scenarios and strategic priorities outlined in this study are intended as tools to assist organizations in preparing for potential future developments within the logistics ecosystem. They provide a structured framework for anticipating changes and making strategic decisions aligned with the identified scenarios. As the logistics landscape evolves, organizations, particularly orchestrators, can leverage these insights to adapt and proactively position themselves in response to emerging trends and uncertainties.

4.8 Conclusions

The findings from the study can be summarized as follows:

1. Orchestrators in the digital realm maintain roles consistent with their physical-world counterparts, providing digital infrastructure and basic services. PoR acts as a platform provider, akin to a "landlord" role, focusing on facilitating collaboration without engaging in commercial services. RFH assumes an integrator role, aligning with its historical role as a cooperative for growers.

2. Engagement with stakeholders is essential for building trust and ensuring that the digital platform aligns with the needs of the community. Both PoR and RFH recognized the importance of consulting with stakeholders throughout the digitalization process. This active engagement helped to ensure that the platforms were designed to address the real needs of the users and build trust in the digital ecosystem.

3. Effective digitalization requires seamless integration and data standardization. The study highlights the need for digital platforms to be seamlessly integrated with existing legacy systems and to adopt common standards. This will enable organizations to share information more easily and effectively, which is essential for collaboration and data-driven decision-making.

4. Digitalization should enhance and complement the strengths of physical platforms, not undermine them. Organizations should focus on leveraging digital tools to improve efficiency, visibility, and responsiveness, while maintaining the strengths of their physical assets and networks.

5. Orchestrators need to carefully consider the extent of their role in the digital world. The study highlights the challenges faced by orchestrators in defining the right balance between global expansion and managing physical capacity and flow complexity. Organizations need to carefully consider their capabilities and resources before expanding their digital footprint too quickly.

6. Geopolitical and ecosystem uncertainties are identified as driving forces shaping the digital logistics landscape. The study identifies four potential scenarios for the digital logistics landscape: collaborative green, digital spores, hyper-competitive market, and protective market. Orchestrators should actively monitor geopolitical and ecosystem uncertainties that shape the digital logistics landscape to anticipate potential shifts and adjust their strategies accordingly. The trigger points can serve as early warning signals for organizations, particularly orchestrators, to navigate the evolving landscape.

4.9 References

Acocella, A., Caplice, C., & Sheffi, Y. (2020). Elephants or goldfish?: An empirical analysis of carrier reciprocity in dynamic freight markets. *Transportation Research Part E: Logistics and Transportation Review*, *142*, 102073. https://doi.org/10.1016/j.tre.2020.102073

Acs, Z. J., Song, A. K., Szerb, L., Audretsch, D. B., & Komlósi, É. (2021). The evolution of the global digital platform economy: 1971–2021. *Small Business Economics*, *57*(4), 1629–1659. https://doi.org/10.1007/s11187-021-00561-x

Addo, A. (2022). Orchestrating a digital platform ecosystem to address societal challenges: A robust action perspective. *Journal of Information Technology*, *37*(4), 359–386. https://doi.org/10.1177/02683962221088333

Anderson, E. G., Lopez, J., & Parker, G. G. (2022). Leveraging value creation to drive the growth of B2B platforms. *Production and Operations Management*, *31*(12), 4501–4514. https://doi.org/10.1111/poms.13866

Autio, E. (2022). Orchestrating ecosystems: a multi-layered framework. *Innovation: Organization and Management*, *24*(1), 96–109. https://doi.org/10.1080/14479338.2021.1919120

Belleflamme, P., & Peitz, M. (2019). Platform competition: Who benefits from multihoming? *International Journal of Industrial Organization*, *64*, 1–26. https://doi.org/10.1016/j.ijindorg.2018.03.014

de Langen, P. W. (2023). The strategy of the port development company; a framework based on the business ecosystems perspective and an application to the case of Port of Rotterdam. *Maritime Transport Research*, *4*. https://doi.org/10.1016/j.martra.2023.100089

Eriksson, K., Wikström, K., Hellström, M., & Levitt, R. E. (2019). Projects in the Business Ecosystem: The Case of Short Sea Shipping and Logistics. *Project Management Journal*, *50*(2), 195–209. https://doi.org/10.1177/8756972818820191

Evans, P., & Gawer, A. (2016). *The Center for Global Enterprise The Rise of the Platform Enterprise*. https://www.thecge.net/wp-content/uploads/2016/01/PDF-WEB-Platform-Survey_01_12.pdf

Fernández-Miguel, A., Riccardi, M. P., Veglio, V., García-Muiña, F. E., Fernández del Hoyo, A. P., & Settembre-Blundo, D. (2022). Disruption in Resource-Intensive Supply Chains: Reshoring and Nearshoring as Strategies to Enable Them to Become More Resilient and Sustainable. *Sustainability*, *14*(17), 10909. https://doi.org/10.3390/su141710909

Gawer, A. (2021). Digital platforms' boundaries: The interplay of firm scope, platform sides, and digital interfaces. *Long Range Planning*, *54*(5). https://doi.org/10.1016/j.lrp.2020.102045

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417–433. https://doi.org/10.1111/jpim.12105

George, G., Merrill, R. K., & Schillebeeckx, S. J. D. (2021). Digital Sustainability and Entrepreneurship: How Digital Innovations Are Helping Tackle Climate Change and Sustainable Development. *Entrepreneurship Theory and Practice*, *45*(5), 999–1027. https://doi.org/10.1177/1042258719899425

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic Markets*, *30*(1), 87–98. https://doi.org/10.1007/s12525-019-00377-4

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal*, *39*(8), 2255–2276. https://doi.org/10.1002/smj.2904

Jazairy, A., & von Haartman, R. (2020). Analysing the institutional pressures on shippers and logistics service providers to implement green supply chain management practices. *International Journal of Logistics Research and Applications*, *23*(1), 44–84. https://doi.org/10.1080/13675567.2019.1584163

Joglekar, N., Anderson, E. G., Lee, K., Parker, G., Settanni, E., & Srai, J. S. (2022). Configuration of digital and physical infrastructure platforms: Private and public perspectives. *Production and Operations Management*, *31*(12), 4515–4528. https://doi.org/10.1111/poms.13865

Kamalahmadi, M., Shekarian, M., & Mellat Parast, M. (2022). The impact of flexibility and redundancy on improving supply chain resilience to disruptions. *International Journal of Production Research*, *60*(6), 1992–2020. https://doi.org/10.1080/00207543.2021.1883759

Kapoor, K., Ziaee Bigdeli, A., Dwivedi, Y. K., Schroeder, A., Beltagui, A., & Baines, T. (2021). A socio-technical view of platform ecosystems: Systematic review and research agenda. *Journal of Business Research*, *128*, 94–108. https://doi.org/10.1016/j.jbusres.2021.01.060

Lyytinen, J. D. K. (2001). The Role of Intermediating Institutions in the Diffusion of Electronic Data Interchange (EDI): How Industry Associations Intervened in Denmark, Finland, and Hong Kong. *The Information Society*, *17*(3), 195–210. https://doi.org/10.1080/01972240120907

Mann, G., Karanasios, S., & Breidbach, C. F. (2022). Orchestrating the digital transformation of a business ecosystem. *The Journal of Strategic Information Systems*, *31*(3), 101733. https://doi.org/10.1016/j.jsis.2022.101733

Namdar, J., Li, X., Sawhney, R., & Pradhan, N. (2018). Supply chain resilience for single and multiple sourcing in the presence of disruption risks. *International Journal of Production Research*, *56*(6), 2339–2360. https://doi.org/10.1080/00207543.2017.1370149

Noura, M., Atiquzzaman, M., & Gaedke, M. (2019). Interoperability in Internet of Things: Taxonomies and Open Challenges. *Mobile Networks and Applications*, *24*(3), 796–809. https://doi.org/10.1007/s11036-018-1089-9

Sheth, J. N., & Uslay, C. (2023). The geopolitics of supply chains: Assessing the consequences of the Russo-Ukrainian war for B2B relationships. *Journal of Business Research*, *166*, 114120. https://doi.org/10.1016/j.jbusres.2023.114120

Thomas, L. D. W., Autio, E., & Gann, D. M. (2014). Architectural Leverage: Putting Platforms in Context. *Academy of Management Perspectives*, *28*(2), 198–219. https://doi.org/10.5465/amp.2011.0105

Toh, P. K., & Pyun, E. (2023). Risky business: How standardization as coordination tool in ecosystems impacts firm-level uncertainty. *Strategic Management Journal*. https://doi.org/10.1002/smj.3562

van Baalen, P., & van Oosterhout, M. (2008). IOS Adoption and Implementation in Global Port Communities. In *Port Inter-Organizational Information Systems: Capabilities to Service Global Supply Chains* (pp. 140–155).

van Baalen, P., Zuidwijk, R., & van Nunen, J. (2008). Port Inter-Organizational Information Systems: Capabilities to Service Global Supply Chains. *Foundations and Trends in Technology, Information and Operations Management*, *2*(2–;3), 81–241. https://doi.org/10.1561/0200000008

Wang, K. Y., Wen, Y., Yip, T. L., & Fan, Z. (2021). Carrier-shipper risk management and coordination in the presence of spot freight market. *Transportation Research Part E: Logistics and Transportation Review*, *149*, 102287. https://doi.org/10.1016/j.tre.2021.102287

Wu, Y., Huang, J., & Chen, X. (2024). The information value of logistics platforms in a freight matching market. *European Journal of Operational Research*, *312*(1), 227–239. https://doi.org/10.1016/j.ejor.2023.06.043

5 Conclusions and Recommendations

This project report has the following three objectives:

1) Pinpoint opportunities for the logistic sector by establishing value adding information services descriptions that are relevant to shippers, transport operators, LSPs and freight forwarders that can (in the future) be provided by digital platforms. Descriptions are functional, not algorithms that quantify the value adding information services on a platform;
2) Accelerate digitization in the logistic sector by informing the logistic sector about digital opportunities; and
3) Establish guidance for further developing digital strategies for (digital) ecosystem orchestrators. This objective also incorporates the fact that digital platforms may disrupt the logistics ecosystems in which they operate in an unintended way. An orchestrator should consider this when developing its strategy.

To reach the objectives indicated above, the project takes two main perspectives: (1) the platform perspective; and (2) the logistics ecosystem perspective.

Work Package 2 aims at the first objective by considering the gap between demand for and supply of value adding information services on platforms. Based on this gap analysis, the following conclusions can be drawn.

From the supply side, digital platforms provide a variety of different value-adding services, which can be sorted into four categories: administration, insight, matching, and visibility. Most of the platforms lean to one of these categories, but some also provide a broader spectrum of services. Such more advanced value adding services have not always been developed in response to requests by customers but usually anticipate their future needs. Digital platforms also tactically launch those services to avoid overwhelming the potential users. Given the available amount of data, there are many potential new services that can be developed in the future. However, digital platforms are also hesitant to add services that are beyond their scope.

From the demand side, SME carriers and shippers use digital platforms to a limited extent, and they seldom have clear examples of successful digital platforms in logistics. Drivers for using digital platforms are either coercive or intrinsically motivated. Coercion can originate from public authorities, from a specific powerful business partner (a large shipper), or from the logistics community as a whole. For example, data sharing is mandated through Portbase for containers that are being handled by the deep sea terminals.

Intrinsic motivation can come when the value added by the platform is clear to the users. For example, the use of visibility platforms can (but not always) be motivated intrinsically by the many disruptions in global supply chains. Benefits of visibility are often captured by advanced supply chain planning systems. As such, the value is more often observed by larger shippers than SMEs. Matching platforms are also used by smaller shippers and carriers because of the immediate value they bring. Many administrative tasks in logistics are still done manually. However, the handling of paperwork can be outsourced to an administrative digital platform. In connection with the increased attention on transparency and new legislation (e.g. the Corporate Sustainability Reporting Directive), insight platforms are also progressively being used.

To explain the gap between demand and supply, several factors come into play. Connectivity is one of the key challenges while using digital platforms. Connectivity is dependent on the digital maturity of the platform user. Advanced connectivity tools such as APIs are used more often, but connections can still be based on manual data input via web screens and Excel. Other barriers experienced by logistics actors with respect to the use of digital platforms are related to competitive position, business model, attitude, data-sharing standards, and requirements.

Based on the interviews with users and platform owners, four gaps are defined: (1) Platforms users do not experience the same sense of urgency with regard to employing data standards and data sovereignty as academics and policy makers; (2) Smaller shippers and carriers are not being considered by the larger (visibility) platforms due to their lack of digital maturity; (3) Platforms, especially smaller ones, focus to a limited extent on developing new digital services besides their current core service provided, which differs from the expansion of services observed by larger platforms; and (4) SMEs have a limited view of the benefits of digital platforms. Platforms should have a well-articulated added value for companies to consider them.

Based on the findings of this work package it can be concluded that the supply of value adding digital services is broad and diverse and that this supply may surpass the demand for those services. To some extent, this can be explained by the absence of concrete show cases that demonstrate the value add of digital platforms in specific situations. This makes it difficult for smaller shippers and carriers to recognize the value add of digital platforms and where to start to reap the low hanging fruit of digitalization. Some guidance in this discussion for SMEs around digital platforms could definitely help, and we explore this in the next work package.

Work Package 3 considers demand and supply of value adding services in the following way: How could a prospective user of logistics services decide what type of platform to use – digital or otherwise? This question comes up particularly for SME users that do not have a clear overview of the variety of platforms available to them. According to our interviews, SMEs have had a difficult time identifying whether and how to engage with digital logistics platforms. Therefore, this work package develops a comprehensive taxonomy of B2B logistics services, which seems to be the first in its kind, to support SMEs identifying platforms that are of value to them.

This work package takes a value creation lens to develop the taxonomy. The taxonomy is built around three main aspects: service type, revenue model, and value creation type. As digital logistics platforms develop and grow over time, they typically start with a core set of services and expand to additional services to continue to add value to their B2B customers. The platforms also need to fit their value adding services with a proper revenue model. The research identifies a set of service-revenue model combinations that have emerged with successful digital logistics platforms. Platforms – digital and more traditional – can each be positioned within this taxonomy, as it is designed to be all-inclusive. Some platforms occupy multiple positions within the taxonomy because they have developed services in multiple categories. The taxonomy helps prospective users of logistics platforms understand the wide range of value-added services that may be available to them from platforms and ways in which the platforms typically extract value in return (i.e., their revenue models).

The research has inspired the design of a decision support tool that can help SMEs interested in digitization of logistics services, to identify whether digital platforms can appropriately service their needs and identify areas where further support or investment on their part is required. The taxonomy is the foundation of the decision support tool – ultimately, the tool helps users identify which position within the taxonomy a (digital) logistics platform should take that would help serve the user's logistics needs. The decision support tool guides a discussion for SMEs interested in digitization of their logistics services to (1) identify specific logistics needs that require value-added services, (2) self-assess whether a digital logistics platform would be well suited to serve the logistics needs, and (3) if a digital logistics platform is not a good fit currently, which specific aspects of the user's business operations, platform availability, and functionality need further improvement or investment before a digital option is suitable.

The decision support tool is validated by a set of potential users: SME shippers and carriers interested in digitization of their logistics needs. The participants confirm the value of the decision support tool for guiding discussion, particularly in learning from each other and from leaders of the working sessions that are experts in the field of logistics and the digital platform space.

As such, the research has helped to establish the second research objective of the project.

Work Package 4 does not take the perspective of the value adding services of an individual platform but considers the positioning of platforms in a logistics ecosystem. Focus is on logistics ecosystems that feature an undisputed orchestrator. The aim is to guide the orchestrator in establishing a strategy to manage the logistics ecosystem while considering the impact of digital platforms.

To understand this impact, the work package provides a detailed evaluation of platformization trends within logistics ecosystems. This helps stakeholders, including the orchestrator, to navigate through the dynamics of the logistics ecosystem under platformization.

The identified trends encompass a range of factors, including emerging developments and uncertainties in technology, sustainability, operations, ecosystem dynamics, and geopolitical considerations. The work package identifies the trend toward digitalization and advanced analytics. It also recognizes the shift from efficiency toward more resilient operations. There is also stronger demand for sustainability, especially for large transportation companies operating in international markets. Furthermore, the uncertainty in geopolitics has the potential to lead to regionalization and increased fragmentation, adding complexity to global supply chains

The work package also identifies probable scenarios for digital ecosystems based on developments and uncertainties in the logistics landscape. This forward-looking approach contributes to a proactive understanding of potential challenges and opportunities, enabling stakeholders to prepare for and adapt to changes in the digital landscape.

The work package identifies four potential scenarios in which the observed trends are consolidated, for the digital logistics landscape: “collaborative green”, “digital spores”, “hyper-competitive market”, and “protective market”. The scenario analysis suggests that orchestrators should actively monitor geopolitical uncertainty and ecosystem dynamics that shape the digital logistics landscape to anticipate potential shifts and adjust their strategies accordingly. The identified trigger points can serve as early warning signals for organizations, particularly orchestrators, to navigate the evolving landscape.

Finally, the work package sheds light on the role of orchestrators and their respective strategies in achieving logistics ecosystem objectives. This provides actionable insights for companies and policymakers to formulate strategies that align with the dynamic nature of digital platforms and address challenges effectively.

Building resilient or no-regret strategies is crucial in scenario analysis as it prepares companies to effectively navigate the uncertainties of the future and achieve long-term success. These strategies focus on building capabilities and competencies that can withstand various challenges and emerging trends, regardless of the specific scenario that unfolds.

Based on the analysis, we propose the following strategies for orchestrator to thrive in the uncertain environments:

1) **Improve digital accessibility.** Low access to digital technology should trigger orchestrators to ensure that all players in the ecosystem, regardless of their size and resources, can actively participate in the digital transformation. The provision of a basic digital infrastructure would support this. The orchestrator can also put an emphasis on capacity building.
2) **Promote global standard**. Orchestrators can promote global standards that help facilitate efficiency and interoperability in the digital ecosystems.
3) **Diversify Network.** Orchestrator should encourage companies to diversify their network so that they are less reliant on any single market or supplier, which is of particular importance in an uncertain environment with geopolitical tensions and trade barriers. Digital platforms could help to achieve this diversification.

4) **Advocate for digital market regulation**. Platformization and globalization can lead to market consolidation, monopoly practices, and platform dependency. Orchestrators could help establishing regulatory guidelines that prevent this.
5) **Continuous Risk Monitoring.** The orchestrator could help creating early awareness, enabling swift action to mitigate environmental, economic, geopolitical, or technological risks before they significantly have impact on the logistics ecosystem.

In the digital ecosystems, orchestrators maintain roles consistent with their physical counterparts. Maintaining a familiar role in the digital realm enables orchestrators to build trust with participants, laying a solid foundation for smooth collaboration. Trust is further enhanced through active engagement with ecosystem members, fostering a sense of ownership and ensuring alignment of the digital platform with their needs and expectations. Additionally, the strategies involve facilitating seamless integration among existing information systems used by network members. A critical aspect of this strategy is the implementation of standardization and translation services to ensure interoperability as a groundwork for collaboration. The strategies also emphasize that digitalization should reinforce the core values that make physical platforms successful.

The above provides guidance for further developing digital strategies for ecosystem orchestrators

To explain the differences between the various typologies used in the various work packages, first note that WP2 makes an initial inventory of platform types while identifying the gap between platform functionalities and user requirements. WP3 builds and expands on this. This work package performs a thorough analysis of the literature and provides a broad-ranging description of logistics platforms, rather than a sample of those in the WP2 interviews, while identifying a viable taxonomy. Second, WP3 and WP4 use two distinct lenses to view platforms. In WP3, we focus on value creation through services offered on platforms, and value extraction by the same platforms while employing revenue models. In WP4, we focus on strategies of the platform ecosystem orchestrator based on how platforms complement and compete with one another. A detailed overview of the platform types as explained in the various work packages is provided in Table 5.1.

From the three work packages, we conclude the following. Digital platforms create a variety of value adding digital services that may surpass the needs for those services as currently experienced by the (potential) users of the platforms. This can be explained, for instance, by the lack of concrete show cases that demonstrate the value add of digital platforms in specific situations. Some guidance is needed, and a decision support tool has been developed and validated in this project that forms the basis for an instrument that can be used in practice. Next to the perspective of the value adding services of an individual platform, we also consider the positioning of platforms in logistics ecosystems that feature an undisputed orchestrator. Based on a four scenarios with different levels of geopolitical uncertainty and ecosystem uncertainty, we propose a number of strategic priorities: Improve digital accessibility, promote global standards, diversify network, advocate for digital market regulation, and perform continuous risk monitoring. The scenarios inform the order of these strategic priorities.

Although this research project addresses a number of critical aspects of the development and success of digital logistics platforms, there are still many areas which require further development or investigation.

Sample points for further development:

1) An overview of available digital platforms and the value they offer is missing. Such an overview would be very beneficial, especially for smaller logistics companies. Importantly, such an overview would need to be dynamic and maintained by a neutral third-party; platforms and the set of services they offer are constantly changing;
2) Many smaller logistics companies are not digitally mature. Tools to determine digital readiness and identify what next steps can be taken would be very useful for logistics companies. An overview of these digital maturity assessment tools could help these SME logistics actors;

3) Standardization is lacking and, in some cases, diverging rather than converging. More standardization is required to will help prevent companies from spending excessive time and money translating data from one format to another.

Further research could embark on:
1) A quantitative analysis of costs and benefits of digitalization and in particular the use of digital platforms. Clear insight in the value for logistics companies is needed to create more interest;
2) An impact analysis of different orchestrator strategies in different scenarios;
3) The interaction between the physical and digital platform and how this could enable the extension of services.

Table 5.1: Platform types as explained in the various work packages

Work package	Platform types			
*Platform types WP2: focus on **main activity*** (based on interviews)	**Administration** *Static information with an administrative nature*	**Insight** *Information about performance and statuses*	**Matching** *Bringing supply and demand of products or assets together*	**Visibility** *Event based, dynamic data*
*Platform types WP3: focus on **combination of services offered** (based on literature)*	**Data sharing** *Collection of raw data and transforming into digital form* **Payment/finance** *Facilitating secure, fast and transparent payment (mostly an add-on to other digital services)*	**Information sharing** *Transformation of data into useful insights*	**Market/Matching** *Connecting shippers and carriers* **Forwarding/planning** *Ensuring smooth flow of goods by simplifying and automating freight forwarding operations*	**Information sharing** *Transformation of data into useful insights*
*Platform types WP4: focus on **nature of the platform** (based on literature)*	**Transaction platform** *Facilitating and enabling commercial transactions between users*	**Innovation platforms** *Facilitating collaboration and innovation among various stakeholders, especially focused on new technologies and solutions*	**Transaction platform** *Facilitating and enabling commercial transactions between users* **Innovation platforms** *Facilitating collaboration and innovation among various stakeholders, especially focused on new technologies and solutions*	**Innovation platforms** *Facilitating collaboration and innovation among various stakeholders, especially focused on new technologies and solutions*

Appendix A

Appendix A.1 – Interview details

Table A.1.1: Interviewees and round sessions during the case study

Organization	Round	Interviewees
Port of Rotterdam Authority	1(60 minutes)	Paul Walter
	2 (60 minutes)	Paul Walter, Pieter de Waard
Royal FloraHolland	1(60 minutes)	Nanne van der Burg
	2 (60 minutes)	Nanne van der Burg

Appendix A.2 - Digital Ecosystems

The presence of multiple digital platforms within a logistics ecosystem triggers the development of a digital ecosystem. A digital ecosystem typically consists of four types of organizations that make up the platform economy (Acs et al., 2021) including (1) digital platforms, (2) digital users, (3) digital entrepreneurs, and (4) digital infrastructures (see Figure 3). These components interact with each other creating a digital ecosystem that complement and enhance the traditional values created by the physical platform.

Digital Platforms

In a digital ecosystem, digital platforms serve as intermediaries, facilitating exchanges of values and information between different parties within the ecosystem through an IOS. There are two main types of digital platforms: (1) transaction platforms; and (2) innovation platforms (Evans & Gawer, 2016)
The transaction platforms are built to facilitate and enable commercial transactions between users by facilitating the exchange of goods, services, or information. The objective is to create efficient marketplaces for buyers and sellers to connect. They create value by streamlining the buying and selling process often by reducing search and information costs (Acs et al., 2021). Users on transaction platforms include organizations looking to purchase goods or services and suppliers looking to sell their products or service. For example, transaction platforms include matching platforms[25], such as UTurn or Transporeon, that connects shippers with carriers on a spot market. Shippers can post their cargo requirements, and carriers can bid on shipping contracts, leading to an efficient and transparent market for logistics services.

The innovation platforms are designed to facilitate collaboration and innovation among various users, such as individuals, businesses, and developers, in the ecosystem (Gawer, 2021). They typically connect established companies with developers or innovators that are creating new technologies or solutions. The platforms typically collect and analyze large amounts of data which can be used to identify new opportunities and develop new value-adding services. The platform may provide access, tools, resources, and APIs (Application Programming Interfaces) for innovators to experiment and create new solutions from the data.

In our study sample, we did not find a pure example of innovation platform in the logistics ecosystem. This absence could be attributed to the fact that platforms are primarily designed with a direct focus on providing value-adding services. Consequently, the idea of establishing a purely innovative platform that operates behind the scenes, contributing to value creation, may not be perceived as a feasible starting point.

A close example within the logistics ecosystems we investigate is PortBase. While PortBase currently functions as an administrative platform[26], it is envisioned to develop into an innovation platform,

[25] See more detailed explanation on matching platforms in Work Package #2
[26] See more detailed explanation on administration platforms in Work Package #2

facilitating companies in data sharing and collaboration. This collaborative effort is expected to encourage the development of new commercial services within the ecosystems, such as capacity booking, voyage planning, and emissions optimization. It is worth noting that these services might not be directly hosted by PortBase. Instead, PortBase could support by providing data to platforms that host these specific services.

As digital platforms continue to develop, they often expand by introducing additional user groups and even combining transaction and innovation functionalities into hybrid platforms (Gawer, 2021). Nowadays, many big transaction platforms such as Amazon, Facebook, and Alibaba have evolved into hybrid platforms. The main motivation behind adding an innovation aspect is to enhance the overall user experience by offering a broader range of applications and features to sustain network effects. This expansion also creates new opportunities for revenue streams, such as new market channels and data monetization.

Digital Users

Digital platforms often involve two or more distinct users that can be categorized as the demand-side and supply-side groups. Demand-side users are customers who require a service or product and are looking for providers to fulfil their needs, while supply-side users are organizations that uses digital platforms to provide the services or products that the demand-side users are seeking. It is important to acknowledge that there are two types of supply-side users in the digital platform. The first one is "producers" that offers their products/services to the demand-side users through the platform, and the second one is "complementor" that provide product/services which complement or enhance the value offerings of the platform.
For instance, consider the users of PortBase, a data-sharing platform within the Port of Rotterdam that aggregate operational data from various entities engaged in port activities. In this platform, demand-side users are the organizations or developers that seek access to operational data to support their services. Conversely, the producers are the organizations that contribute their data to PortBase. It is worth noting that in this platform, similar organizations may function as both demand-side and supply-side users. The complementors in this platform are the software developers that creates applications from the data collected in the platform.

Another example is Floriday, which serves as a transaction platform primarily functioning as a digital marketplace for the global floricultural market. In this ecosystem, demand-side users represent the international buyers, such as wholesalers and florists, who seek flowers and plants for purchase. On the other side, supply-side users are the growers who list their products for sale. The complementors in this platform are the software developers and financial and logistics service providers.

Digital Entrepreneurs

Digital entrepreneurs in digital ecosystems refer to individuals or organizations that develop software, applications, or innovative solutions that extend the values of digital platforms. Typically, when digital platforms interact with these developers, they provide one or more APIs along with SDKs (Software Development Kits) and reference documentation of their platforms. By granting access to APIs and SDKs, platform owners empower developer community to be part of the platforms. In return, these entrepreneurs contribute to the platform growth and competitiveness by developing new services that cater a wide range of user needs.

There are two distinct categories of digital entrepreneurs: those who concentrate on product innovations and those who specialize in process innovations. Product innovators focus on developing new applications that extend or complement the core value proposition of the platforms to their digital users.
This includes payment services, data analytics, customer services, etc. On the other hand, process innovators work to improve the underlying infrastructure, data handling, and security protocols to ensure the seamless functioning and safety of the digital platforms. This includes developing data-sharing architecture, improving interoperability, and enhancing data security measures of the platforms.

Because of their crucial role in supporting the growth of the digital ecosystem, several big platform owners prioritize the development of these entrepreneur communities. The platform owners foster this community through various means, such as organizing developer events, hackathons, and sharing SDKs. This creates an environment that not only inspires innovation but also provides incentives for it. These efforts make sure that developers have the necessary tools and resources to bring creative solutions, add value to the platform, and improve the user experience. For example, in Port of Rotterdam, developers' community is nurtured through the PortXL[27], World Port Hackathon and the SmartPort Summit.

Digital Infrastructure

Digital infrastructure comprises information technology and telecommunications service providers, including internet service providers (ISPs), telecommunications companies, data centers, and cloud service providers. These entities are responsible for both establishing and upkeeping the physical and logical network infrastructure that serves as the fundamental framework of the digital economy. Their primary function is to ensure that the essential network infrastructure is readily available to connect individuals, businesses, and devices to the digital network.
The examples for companies with digital infrastructure roles in the ecosystem includes Amazon Web Services and Microsoft Azure that facilitates businesses and individuals to store and access data remotely, deploy applications, and leverage scalable computing resources without the need for on-premises hardware. Traditional telecommunications companies, such as AT&T, Verizon, and Vodafone, play a pivotal role in digital infrastructure by providing the necessary connectivity services, including broadband and mobile networks, essential for the functioning of various digital applications.

By providing these essential services, digital infrastructure providers empower businesses and individuals to leverage the potential of digital technologies. They enable activities such as e-commerce, seamless information access, and collaborative efforts within an interconnected world. The reliability, security, and scalability that they offer are pivotal factors for the triumph of digital enterprises and services.

Appendix A.3 - Evolution of Digital Platforms

Based on interviews conducted as part of Work Package #2, we identified three key stages in the platforms within a logistics ecosystem: (1) Forming Collaborative Networks, (2) Managing Value Exchanges, and (3) Sustaining Innovation. This evolution has also been observed in the Work Package #3 where logistics platforms begin with a core service and expand to additional services to continue to add value to B2B customers.

The initial stage involves the establishment of a digital platform that brings together various stakeholders within the logistics ecosystem to identify or communicate how new value-adding services can be incorporated[28]. These stakeholders can include shippers, carriers, freight forwarders, manufacturers, warehouses, and more. Once the collaborative network is established, the platform's focus shifts to managing value exchanges between different participants. This stage is crucial for ensuring that the platform remains viable and beneficial for all parties involved. As the platform matures, sustaining innovation becomes a focal point. This stage involves continuously evolving the platform's capabilities, services, and technologies to meet the evolving needs of the logistics ecosystem.

[27] https://www.portofrotterdam.com/en/port-future/innovation
[28] The tool from WP3 provides a framework how to identify and communicate

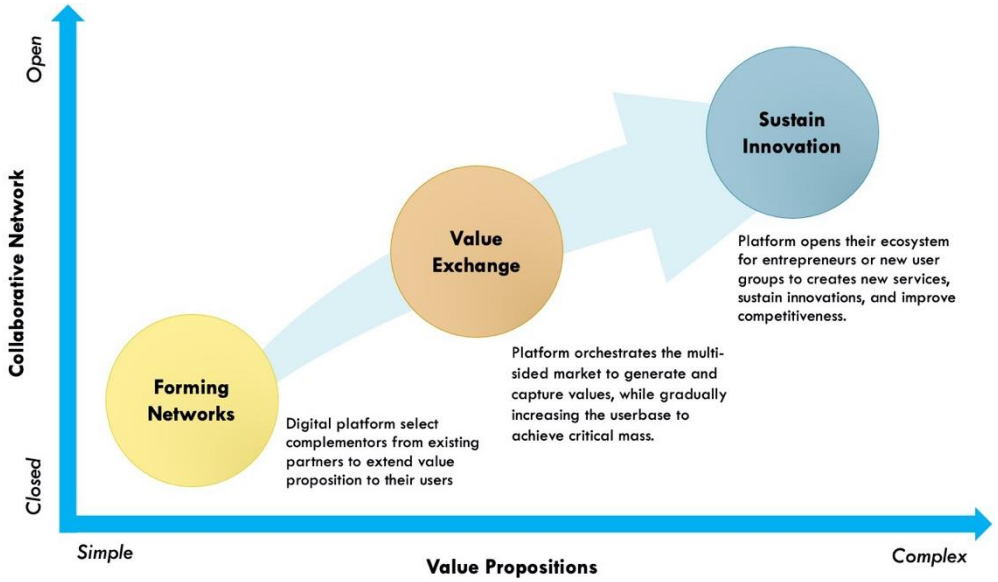


Figure A.3.1: Observed Platform Development

A. Forming Collaborative Networks

Forming collaborative networks in Business-to-Business (B2B) logistics platforms possess distinct characteristics compared to popular Business-to-Customer (B2C) platforms like Amazon or Uber. Based on interviews, we observed that logistics platform owners are often taking selective approach when it comes to partnering with complementors. This approach contrasts with B2C platforms, which often prioritize openness to potential complementors to expedite network effects (Anderson et al., 2022).

The selective approach in logistics platform development can be attributed to several factors:

- **Trust**: To create new services, logistics platforms often require complementors to share data, which may contain sensitive information that, if mishandled, could harm their competitiveness Therefore, there is a need for assurance that platform owners will handle the data responsibly and not exploit it only for their advantage. This trust factor drives a demand for neutrality and fair competition within the platform. On the other hand, the platform owners also need to trust that complementors will fulfil their commitments and align with the platform's vision. This to make sure the sustainability of the value proposition in the long run.
- **Quality:** Logistics platforms need to be able to ensure the quality and reliability of their services. Given that responsibilities for shipments can transition among various entities within logistics, there are inherent risks in the chain, such as fraud, damages, and no shows. Therefore, platform owners often screen the quality and capability of potential complementors. This can result in a higher overall quality of services offered within the platform's ecosystem.
- **Compatibility:** Logistics platforms favor complementors with a certain level of digital maturity. This preference ensures that partnerships will be technologically compatible and that complementors can adapt to digital processes efficiently, contributing to the overall effectiveness of the platform. For example, building supply chain visibility services often requires deeper technological integration with complementors. Therefore, to enable such a service, it is necessary to possess a certain level of digital maturity to connect with the platforms (e.g., via EDI or API).
- **Simplicity**. To expedite network effects, logistics platforms must quickly demonstrate the benefits they offer to both users and complementors. To achieve this, both complementors and platform owners often start by focusing on simple or basic services. These are services that can be easily harnessed from a collaboration, such as by reinforcing and extending traditional services from existing networks. For example, the services provided by Port Community Systems such as Portbase are basic data exchange services, and the initial value offering from visibility platforms such as Fourkites and Shippeo are tracking capability.

The selective approach adopted by platform owners in logistics tends to yield slower network growth. As a result, the ecosystem may become fragmented, with different groups or players operating in silos rather than in a cohesive manner, limiting the network effects. Besides, slower network growth can limit innovation within the ecosystem since there are fewer interactions and collaborations happening, which can prevent the development of new and creative solutions. It is important to note that the varying digital maturity levels among companies also contribute to the slow network growth observed by the logistics platforms.

B. Managing Value Exchanges

Digital platforms often serve as intermediaries, facilitating value exchanges between different parties within an ecosystem (multi-sided platforms). For example, in logistics, these exchanges can involve shippers, carriers, and other service providers. The digital platform's role is to enable and increase these value exchanges to stimulate network effects[29] that benefit all users.
As discussed in WP3, the value exchanges and be categorized into two main types: same-side values and cross-side values (Anderson et al., 2022). In multi-sided platforms, stimulating cross-side value exchanges can be a challenging task, especially when certain conditions such as market dynamics affect the collective behavior of user groups (Acocella et al., 2020). We demonstrate the challenges associated with value exchanges within platforms through three examples gathered from our interviews.

The first example pertains to the visibility platforms that offer real-time tracking services for shippers. These platforms gain significant popularity during uncertain times as they enhance visibility and responsiveness in case of disruptions. To provide this service, the platforms must establish connections with a wide range of carriers and service providers. Based on the interviews, we discovered that carriers are not autonomously interested to join visibility platforms, as it does not give direct values from them, given the extra efforts to connect and integrate with the platforms. But since many carriers are under contractual agreements, the platforms can ask shippers to push carriers to join the platforms. The problem is that when market conditions become more stable and the need for visibility decreases, shippers are less interested in using the platform. This decreased interest among shippers also means that carriers are less motivated to invest in the platform. This can have negative effects on the platform business, as exemplified by the challenges faced by the visibility platform leader, in 2023[30].

The second example we found is in the matching platforms that connect shippers and carriers in the freight market. Shippers value the convenience and efficiency to book shipments on the spot and get better prices from carriers, while carriers value the ability to access a large pool of shippers and find more loads and to reduce empty miles. As more shippers join, more carriers are attracted, creating network effects, especially in high-demand or uncertain times. In high-demand situations, shippers compete for carrier services, potentially leading to higher prices. At the same time, carriers become more selective, prioritizing higher-paying jobs. From interviews, we observed that shippers indeed often receive higher prices from the spot market. This is possibly due to double margins (carrier and platform fees) and carriers' stronger bargaining power (Acocella et al., 2020; Wu et al., 2024). Conversely, in low-demand periods, shippers find it easier to secure carriers, reducing platform dependence. Carriers may have excess capacity, becoming more open to less profitable jobs. Joining platforms may even make the price lower due to high competition with other carriers. Hence, during periods of low demand, both shippers and carriers may become less inclined to utilize the platform, potentially impacting the platform's growth over time.

An interesting example come from a matching platform such as Floriday that connect growers and buyers in B2B floricultural market. This platform traditionally operates on a Dutch auction model, where growers input product details—such as type, quantity, quality— and buyers participate in the auction by placing bids on the listed products. In a Dutch auction, the grower begins with a high asking price, which is gradually lowered until a buyer accepts the price or the bidding reaches a predetermined minimum.

[29] Network effects in digital platforms refer to the phenomenon where the value of the platform increases as more users join and use it.
[30] https://www.freightwaves.com/news/freighttech-industry-isnt-what-it-was-a-year-ago

Such an auction creates a market mechanism that efficiently determines prices for perishable goods in a transparent and competitive manner. While generally efficient, Dutch auctions can pose higher risks for growers during low seasons. Decreased demand may lead to unexpectedly low prices due to the descending auction mechanism. Moreover, low participation from buyers during these periods heightens risk and uncertainty for growers. Recognizing these challenges, Floriday has devised a system enabling growers to sell their products through various channels, including direct sales, direct bidding, auction sales, and contracts, each with distinct value capture mechanisms[31]. This multi-channel provision offers flexibility for both growers and buyers to choose the most convenient approach to interact depending on the market conditions.

From these three examples, we can observe that managing value exchanges in a digital platform is a challenging task that requires an active role from platform owner. Platform owners need to ensure that value is balanced between different participants to maintain a healthy ecosystem across different times. If one group consistently receives a disproportionately high share of the value, it can create dissatisfaction and lead to imbalances. To encourage participation and engagement from different parties, platform owner may use power dynamics across users strategically to attract cross-side groups to join or become more active on the platform. Besides, platforms may need to expand and diversify their services to remain relevant to shippers and carriers across market conditions. This might include services related to new services/features (e.g., automation, advanced analytics), new revenue streams (e.g., data monetization, market channels), service performance (e.g., on-time payment, load acceptance rate), and user experience.

C. Sustaining Innovation

The platformization trend in a logistics ecosystem generates multiple platforms that may provide similar services. This situation may heighten the competition within the ecosystem that may lead to a "winner takes all" scenario where a single platform dominates the ecosystem leaving little or nothing for the remaining competitors. To stay competitive and maintain the preserved networks, platform owners need to sustain the platform attractiveness in the digital market. Platforms that are able to successfully differentiate themselves from the competition will be well-positioned to succeed in the long term. However, those that fail to innovate and adapt to the changing market landscape may find themselves struggling to survive.

From interviews, we found that many logistics platforms plan to carefully open the platform to other complementors and digital entrepreneurs to sustain the innovations and serve the evolving needs of the logistics ecosystem. For instance, Floriday plan to open their platform to more potential complementors such as financial service providers, transportation companies, and developers to continuously creates value-adding services for their users and be more competitive in global market. PortBase also plan to open their platform to digital entrepreneurs by supporting essential data for new commercial services that can give value-adding to the port efficiency and competitiveness.

Opening up a platform and integrating it with external developers is a common approach for platform owners to expedite growth of a digital ecosystem (Mann et al., 2022). As an analogous example, this strategy has a major contribution in the success of large digital platforms such as: Google Playstore, Apple App Store, and Amazon Web Service. The provision of external developers allows the platform to grow and evolve more quickly. By opening up the platform to external developers, the platform owner can tap into a much larger pool of talent and creativity. This can lead to the development of new and innovative applications and new revenue streams that the platform owner may not have been able to develop on their own. Moreover, it has the potential to bolster the platform's adoption rates, giving rise to positive network effects.

[31] https://www.floriday.io/en/solutions-for-growers-in-floriday

Nonetheless, there are also risks associated with becoming an open platform. Firstly, it may lead to a lack of control over the quality of contributed content or applications, creating challenges in ensuring consistency and reliability due to varying developer skill levels and standards. Poorly managed integration of external applications can negatively impact the platform's user experience, causing dissatisfaction and reduced engagement. Compatibility issues may arise as developers employ different frameworks and standards, hindering seamless platform operation. Additionally, there is a risk of introducing security vulnerabilities, with malicious actors exploiting weaknesses and posing threats to data integrity and user privacy.

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