Grant Agreement Number: 723265

Project acronym: Clusters 2.0

Project full title: Clusters 2.0 - Open network of hyper connected logistics clusters towards Physical Internet

D.2.1

SCOPING LOGISTICS CLUSTERS

Due delivery date: 12/07/2018 (first release)
Actual delivery date: 12/07/2018 (first release)

Organization name of lead participant for this deliverable:

<table>
<thead>
<tr>
<th>Dissemination level</th>
<th>PU</th>
<th>PP</th>
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<td></td>
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Project co-funded by the European Commission within Horizon 2020

Project funded by the European Union’s Horizon 2020 Research and Innovation Programme (2014 – 2020)
Document Control Sheet

<table>
<thead>
<tr>
<th>Deliverable number:</th>
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<tr>
<td>Deliverable responsible:</td>
<td>Consorzio IBI</td>
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<td>Work package:</td>
<td>2</td>
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<td>Editor:</td>
<td>Chiara Lepori</td>
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**Document Revision History**

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<th>Author(s)</th>
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<td>1.0</td>
<td>26/06/2017</td>
<td>Initial structure</td>
<td>Chiara Lepori</td>
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<tr>
<td>1.1</td>
<td>27/06/2017</td>
<td>Feedback and proposal on chapter 3 paragraphs</td>
<td>Valentin Carlan</td>
</tr>
<tr>
<td>1.2</td>
<td>30/06/2017</td>
<td>Feedback and proposal on chapter 2 content</td>
<td>Milos Milenkovic</td>
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<tr>
<td>2.0</td>
<td>07/08/2017</td>
<td>Version 2.0</td>
<td>Chiara Lepori</td>
</tr>
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<td>31/08/2017</td>
<td>Chapter 2 draft version</td>
<td>Milos Milenkovic, Jeannett Bolther</td>
</tr>
<tr>
<td>2.2</td>
<td>06/09/2017</td>
<td>Chapter 3 draft version</td>
<td>Valentin Carlan, Thierry Vaneislander, Christa Sys</td>
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<tr>
<td>3.0</td>
<td>22/09/2017</td>
<td>Updated input to chapters 2, 3 and 4</td>
<td>Milos Milenkovic, Jeannett Bolther</td>
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<td>25/09/2017</td>
<td>Consolidated version 4.0</td>
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<td>4.1</td>
<td>02/10/2017</td>
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<td>5.2</td>
<td>10/04/2018</td>
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<td>PO</td>
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Executive Summary
The present document is dedicated to design the concept of Cluster and define the framework conditions to enable its establishment. Also, advanced collaboration practices in the Cluster, the governance model and the steps towards its set-up are described.

The document is organized as follows.

Chapter 1 reports on the purpose of the document and the addressed audience.

Chapter 2 reviews of Clusters concept requirements, it describes and defines the main requirements of a successful logistic clusters. The chapter also shows the key stakeholder.

Afterwards, the chapter 3 gives an overview of the collaboration practices used in contemporary supply chain operations.

Chapter 4 defines the potential business model to be used in order to define a cooperative governance model which includes specific roles and responsibilities of actors in a cooperative business network, contractual and data governance.

The scope of the Chapter 5 is the increasing of added value for terminals and hubs in a region beyond transshipment, integrating manufacturing and resource sharing, thus targeting the full functional integration of all its components.
1 Introduction

1.1 Purpose of Document

The document explores the strategies to extend the role of hubs from the traditional node one – e.g. mainly storage, handling including transshipment and services to freight – towards central smart points for the formation of logistics clusters. The Cluster concept is designed, together with the path towards setting up well-established logistics Clusters able to leverage their full potentials in terms of competitiveness and sustainability for the European industry and society. Such Clusters will be also able to integrate manufacturing and advanced logistics services within the Cluster itself, which aspects will be fully developed in D 2.5.

The path towards Cluster establishment passes through the increase of coordination between the local actors, building also from the Proximity Terminal Network – PTN that are developed in D 2.2 – which drafting proceeds in parallel with the present document.

Basing on D 2.1 and D 2.2 main findings, a cluster management tool will be designed in D2.3 and fully developed as D2.4.

Therefore, D 2.1 defines the Cluster concept addressing collaboration and synchronisation of operations among stakeholders within the Cluster itself, taking into consideration the contemporary stakeholder functionalities and collaborative practices. On its turn, the coordination and synchronisation among actors enables the optimisation of the resource allocation at Cluster level, thus enabling the possibility of implementing upgraded transport and logistics services and offer added value services.

1.2 Intended audience

The document is addressed to the Clusters 2.0 project partners.

With regard to the functional aspects, the document aims to address:

- all the supply chain roles that can be involved in the definition of the Cluster concept;
- all the actors of the supply chain that could benefit from operational advantages and positive impacts from the Cluster definition and development.
2 Review of Cluster’s concept requirements

2.1 Logistics clusters: definitions and key stakeholders

Hence, logistics clusters can be defined as concentrations of several types of firms and operations:

- Firms providing logistic services – 4 PLs, 3PLs, carriers, forwarders, warehousing;
- Logistics operations of retailers, manufacturers and distributors;
- Operations of companies for whom logistics is a large part of their business.

Moreover, logistics clusters include also firms that service logistic companies such as maintenance operations, software providers, international financial service providers, law firms etc. All the actors within a logistic cluster can compete or cooperate with one another. Depending upon the development of a logistics cluster, vertical interdependencies by supplier-customer relations and horizontal interdependences by companies on the same level in the value chain can occur.

The Logistics clusters activities are:

- Cargo handling activities – loading, unloading, transshipment;
- Transport activities – the cluster is a part of a transport chain;
- Logistics activities - storage, re-packing, assembling;
- Manufacturing activities – assembling, customizing products for retail, repairing and refurbishing of return. Some firms are located in the cluster in order to reduce transport and logistics costs;
- Trading activities – commodity trade.

Cargo handling, logistics and transport firms are the most integrated in the cluster. There are numerous examples of horizontal cooperation between cargo handling, forwarding and transport firms in logistics clusters. Trading and storage are also closely connected.

According to Sheffi (2012), one possible classification of logistics clusters can be based on following aspects

Modal orientation

- Air logistics clusters, such as Schiphol Airport in The Netherlands, attract companies dealing with the time sensitive high value items. Serve as a mode transfer node to/from airplanes from/to trucks;
- Port logistics clusters, such as Rotterdam in The Netherlands, attract enterprises dealing with large volumes moved by maritime transport and rail. Serve as mode transfer nodes between ships and rail and/or trucks;
- Rail logistics clusters, such Duisburg in Germany, attract companies dealing with bulk and commodities. Serve as mode transfer nodes of containerized freight between trains and trucks.
- Trucking logistics clusters, serve urban areas or supplement industrial clusters.

Scope based classification

- International – most port and airport-based logistics parks.
- Regional – for regional distribution needs, such as the Zaragoza Logistics Park is serving the Iberian Peninsula and Southwest France.
- Urban – places outside large urban areas to manage the pickup and delivery of goods in and out of the urban area.
Functional classification

- Customs and taxation-advantaged places which include:
  - Free trade zones – areas with special customs procedures;
  - Bonded logistics clusters – set of warehouses where imported goods can be stored without duties paid until they are released into the country;
  - Export processing zones – provide a set of export subsidies provided by the government to exporting industries.
- Single commodity logistics clusters – support the relevant industry cluster and specialize in particular goods;
- Special services logistics clusters – specialize in temperature-controlled storage and distribution, bulk commodity distribution or hazardous material handling.

Besides the general advantages shared with industrial clusters, logistics clusters have some additional advantages, which can be classified into:
- Transportation advantages;
- Advantages related to resource sharing.

Both advantages lead to the reciprocal reinforcing feedback mechanism which makes the cluster more attractive as it grows, leading to further growth (Sheffi, 2012).

Transportation advantages include:
- Economics of scope by balancing freight demand between inbound and outbound flows and minimizing empty movements;
- Economics of scale by maximizing utilization of the capacity of transport assets and lowering transportation costs;
- Economics of density by increasing the efficiency of last mile transport through hub and spoke cluster concept;
- Economics of frequency by increasing volumes going in and out of the cluster.

Resource sharing advantages include:
- Shared assets. Sharing transportation, warehouse, management, administration, forklifts capacity among the service orders;
- Serving customers when providers change. Provision of good service by efficient coordination of the changes and smooth transition from one logistic provider to another.
- Expansion capabilities. Location within a cluster gives companies flexibility that can be used when the business expands or decreases (easier provision of additional space in a cluster, or leasing to others if its storage needs contract).
- Shared workforce. Sharing the human resources for operating the multiple distribution centers or sharing the pool of professionals with other 3PLs in a cluster.

Agglomeration of companies with logistics intensive operations in a given location contribute significantly to the economic growth in the regions where they are located (Sheffi, 2012). Companies located in the cluster benefit from the general cluster advantages and advantages specific to logistics intensive companies.

Logistics clusters contribution to regional development is reflected in:
- Job creation – Logistics clusters create a large number of jobs.
- Development of new and advanced logistics services (consulting, planning, network design, IT services).
- Diversification – Logistic cluster represents an efficient infrastructure for other sub-clusters of industries that require strong logistics services, such as Fashion design cluster in Amsterdam.
2.2 Main requirements of successful logistics clusters

Logistics clusters share many advantages with general industrial clusters. Porter (1998) states “the enduring competitive advantages in a global economy lie increasingly in local things – knowledge, relationships and motivation that distant rivals cannot match”.

A cluster affects competition on following ways:

- They improve the productivity of cluster companies;
- They increase their innovation capability;
- They stimulate the creation of new demand.

Porter’s concept of a cluster includes both horizontal relationships (local competition and complementary services) and vertical relationships (suppliers and buyers) (Porter, 1990). It also focuses on geographical proximity (ESCAP, 2008). Porter explains these effects with environmental influences that converge in six attributes that have the greatest influence on a company’s ability to innovate and upgrade (Elbert and Schonberger, 2009). These attributes, known as Porter Diamond shape the information firms have available to perceive opportunities, the pool of inputs, skills and knowledge they can draw on, the goals that condition investment and the pressures in firms to act (Porter, 1990). Porter’s diamond model includes following four interacting determinants of competitive advantage:

- **Factor conditions**: It refers to the factors of production, which can influence the industry's comparative advantage in the international market. Basic factors can provide the initial conditions like the natural resources, climate, location (Grant, 2001; Lau, 2009). Many logistics clusters have a history of being a trade junction throughout history. Main factor conditions are: location (proximity to main urban areas, ports and corridors), access to infrastructure (rail, highways, maritime, airports), educated workforce, price and access to land, health of related industry clusters;

- **Demand conditions**: describe the kind of regional demand for products or services of an industry. Developed regional demand represents one of the important prerequisites of successful clusters. The share of international trade is an important factor of logistics cluster competitiveness.

- **Related and supported logistics industries**: Regarded as complementary product or service providers. The close working relations and the ongoing coordination of related supporting logistics industries enhance the competitive advantage of the logistics (Porter, 1998; Chung, 2016). In case of logistics, there are many actors that participate in a regional logistics industry: freight forwarders, 3PLs, 4PLs, carriers etc. They can closely cooperate through the information technology. Co-located companies experience operational advantages resulting from the sharing of tangible resources such as logistics infrastructure and intangible assets such as tracking and tracing ability and efficiency of transport knowledge and innovation (Chung, 2016).

- **Firm strategy, structure and rivalry**: Determine the conditions of a cluster, how companies are organized and led, as they cooperate and how the regional competition looks like. The competition is an essential ingredient of the competitive advantage of the industry. Competition leads to the visible pressure on the firm to lower costs, improve quality and innovation. Therefore, it can upgrade the competitive advantage of the industry (Grant, 1991). The main indicators are the time, cost for starting a business and protecting minority investors from conflicts of interest (Chung, 2016).
Government and chance, additional two determinants that were later added, shape the regional competition sustainable and give at the same time important impulses for the cluster development. First, Government can play an important role in positioning the logistics cluster as an international cargo hub. Government measures can influence the four determinants indirectly and partially through a number of actions. Government regulations and policies play a crucial part in any logistics cluster’s operation and success. Secondly, the determinant ‘chance’ plays its role by altering the four main conditions in the diamond model. Chance events are largely outside of the control of firms (shifts in exchange rates or decisions taken by foreign governments).

![Figure 1: The Porter Diamond model [Porter, 1990]](image)

The development of a cluster is based on favorable conditions in one of the determinants of the diamond model or it can be released by acts of business, which cannot be traced to special local conditions.

It is expected that logistics clusters will become relevant players in the supply chain. From the aspect of supply chain, logistics clusters have acceleration potential reflected through lead time reductions and agile and quick responses (Elbert and Schonberger, 2009). Logistics clusters can make it easier for companies to gain an increase in innovation ability and productivity and so enable higher reactivity. This increase results from a time advantage due to better product–market position, a connection of resources, core competencies and knowledge and declining transaction costs within the cluster. According to the market based view, value chains in clusters allow on the one hand bundling of existing regional product-market positions and on the other hand the development of new product market positions. By pooling of already developed markets, actors within the cluster can profit among themselves of the market positions of the cooperative partners and develop new markets on their own. Cooperation with already established competitors can reduce existing rivalry. The bundling of existing and the generation of new knowledge is based on the confidence between the actors. Cost advantage arises in cluster as a result of scale effects which cannot be realized individually by a single company. From the transaction cost theory view, the costs per transaction can be reduced by investments in relational capital, since repetitive transactions between a set of cluster’s network actors are reducing initiation and arrangement costs. Extensive exchange of information leads to reduction of the information asymmetries and reduces control costs. On the other hand, inter organizational cooperation may require a stronger coordination and organization of activities. The lack of confidence and reputation of actors may lead to opportunistic behaviors in the cluster’s network and require thus higher safety precautions. In these cases higher transaction costs arise from cooperation within the cluster’s network.

The following figure shows how clusters can be a source of innovation and productivity through cooperation, in combination with an activating cluster management. The Porter diamond reinforces the underlying sources of competitive advantages leading to superior productivity.
and enhanced innovation capability of actors. Time as determining factor is being added as additional advantage.

Elbert and Schonberger (2009) made a research to find out what logistics clusters in Germany think about their own acceleration potential in achieving innovations and higher productivity. Most clusters reference on:

- Infrastructure and the possibilities on working on an improvement together within the cluster to achieve faster movements;
- Cooperation with customs to reduce latency and to increase the passage;
- Local traffic jams warning systems to reduce waiting times and to reduce energy usage, environment pollution and traffic transport and the negative effects of traffic;
- Increase of transparency to reduce contact times;
- Building up a freight exchange to increase the productivity of all carriers;
- Reducing throughput times through area-wide, intelligent, traffic control systems to reduce the risk of traffic jams in the region;
- Connecting the regional players through regional networking and formulation and implementation of joint logistics projects to speed up the ability to react within the cluster and the region;
- Making it easier to adduce logistics services by special infrastructural offers and to be able to innovate;
- Capturing, structuring and operationalization of the term flexibility to create the basis for advantages for small and medium sized businesses and increasing their productivity;
- Knowledge exchange in several ways to accelerate the knowledge spill-over;
- Establishing ideas on how to segment customers by lead-times to increase the reactivity;
- Promotion and acceleration of research and development to transfer creative impulses

Figure 2: Time advantages of logistics clusters [Elbert and Schoneberger, 2009]
From the analysis of determinants of competitive advantage, it is obvious that one of the crucial factors for raising up the competitiveness of logistics clusters is increasing the cooperation between the actors (in vertical as well in horizontal linkages) within the cluster. Logistics clusters provide a good basis for eliminating two main reasons for the lack of cooperative skills: Lack of confidence in other logistics providers and lack of availability of IT applications capable for cooperation. Logistics clusters as regional logistics associations can act as a suitable forms on which social relations can grow and trust among the partners can be strengthened. Next section summarizes potential forms of cooperation between actors in a logistics cluster.

Chung (2016) presents 20 assessment criteria for the logistics clusters evaluation categorized in Porter’s diamond model dimensions:

1) Factor conditions:
   - Institutions – legal and administrative framework within which individuals, firms and governments interact to generate wealth;
   - Industrial added value (% of GDP) – contribution of a private industry or government sector to overall GDP;
   - FDI inflow (% of GDP) – Foreign direct investment inflow;
   - Customs service index – the quality, transparency and efficiency of customs administration of a country;
   - Labor Market Efficiency – Degree that workers are allocated to their most effective use in the economy and provided with incentives to give their best effort in their jobs;

2) Demand conditions:
   - Market size;
   - GDP ( Billion EUR)
   - Population (Million)
   - GDP per Capita (Population/GDP)
   - Share of world trade (%) – Percentage of the country of world trade.

3) Related and supported industries
   - Quality of air transport infrastructure – the quality of air transport infrastructure of a country;
   - Quality of rail transport infrastructure – the quality of rail transport infrastructure of a country;
   - Quality of port infrastructure – the quality of port transport infrastructure of a country;
   - Quality of road – the quality of road transport infrastructure of a country;
   - Tracking and traceability – the availability and quality of information technologies.

4) International firm strategy, structure and rivalry
   - Starting business – all procedures required for an entrepreneur to start up and formally operate and industrial business;
   - Pay taxes – the taxes and mandatory contributions that a medium size company must pay in a given year as well as paying taxes and contributions;
   - Protecting minority – the protection of minority investors from conflicts of interests through one set of indicators and stakeholder’s rights in corporate governance through another.

Presented indicators can be used for benchmarking competitiveness between logistics
2.3 Key stakeholders in a logistics cluster

Logistics clusters involve the activity and interaction of a wide variety of stakeholders. This interaction is centered around the services they exchange. A generic categorization for stakeholders is usually based on the ownership of the goods. The key roles and functions of each category are presented below.

First, the stakeholders group with a direct link to the good ownership is formed by: suppliers, manufacturers, wholesalers, distributors, retailers and users. Suppliers include a wide array of supply chain stakeholders that provide essential inputs to the production process of a manufacturer. This broad category of organizations includes raw material extractors and processors, parts producers, component assemblers, and similar entities that support the creation of finished goods. Manufacturers transform raw materials, parts, and components into products that are beneficial to end users. Wholesalers and distributors are intermediaries that take inventory in bulk from manufacturers and deliver a bundle of related product lines to end users. They may be considered as ‘middlemen’ between manufacturers and industrial buyers. Wholesalers and distributors create smaller selling units from large quantities of materials or parts from a manufacture and then, fulfill orders to end users. Wholesalers may also provide storage facilities to manufacturers for holding large inventories, and offer delivery services to retailers. With respect to distribution, retailers play a critical role in the supply chain, acting as an intermediary between end consumers and product manufacturers. Retailers stock inventory from multiple sources and sell in smaller quantities to the general public. They provide manufacturers with shelf space for their product and visibility of demand from point-of-sale data. End users are the drivers in the supply chain network. They may be the final end users of a product or any organization that purchases and uses a product. In an industrial setting, the end user is a company that buys materials, goods, and services to support its operations.

Secondly, the stakeholders which have an indirect link with the ownership of goods and act as facilitators are: logistics service providers, ICT developers, authorities, financing institutes and consultancy agencies. More specifically, the logistics service providers group includes freight carriers and logistics companies - transport operators, terminal operators, infrastructure managers, freight forwarders, third-party logistics (3PL) and Fourth Party logistics (4PL). The logistics service providers plan and execute the flow of goods from multiple points of origin points to multiple destinations. They go beyond simply transporting goods, and are responsible, among others, for providing additional services covering planning, warehousing, maintenance, insurance, customs management and inventory finance. A further group is identified with regard to ICT developers that include technology and data analytics providers. ICT providers facilitate rapid flow of critical information across the supply chain. They usually provide software tools and solutions for supply chain planning, execution, and event management in order to support decision-making and increase supply chain control and visibility. The authorities are represented by government regulatory agencies that mandate product standards, labor laws, equipment requirements, and transportation regulations to promote supply chain safety. The value of these services are intermediated by financial institutions who facilitate trade through payment and cash management, capital management, and support on contract execution.

Table focuses only on the role of the different stakeholders, and it gives a general indication of the data they have under their control.

Table 1. Relevant stakeholders: role and key functions in further integration

<table>
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<th>Supply chain role</th>
<th>Function</th>
<th>Data/information over</th>
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<td>Suppliers,</td>
<td>Shipper</td>
<td></td>
<td>The characteristics of</td>
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<td>Logistics Service Providers</td>
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<td>---</td>
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<td>manufacturers, wholesaler, distributors, retailers and users</td>
<td>manufacturers, wholesaler, distributors, retailers and users</td>
<td>goods</td>
<td>The origin and destination of goods etc.</td>
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<td></td>
<td>Transport operations organization, bundling</td>
<td>Goods movement rates, consolidation possibilities and goods movement along the supply chain</td>
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<td>Carrier</td>
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<td>Carrier</td>
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</tr>
<tr>
<td>Hinterland</td>
<td>Provide on-land transport capacities (sometimes pursues cargo bundling operations)</td>
<td>Own transport capacities and incoming transport orders</td>
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</tr>
<tr>
<td>Maritime</td>
<td>Deep-sea/short-sea carriage services</td>
<td>Own transport capacities, rates and ports of call</td>
<td></td>
</tr>
<tr>
<td>Terminal operator</td>
<td>Cargo handling (loading/unloading) operations in ports</td>
<td>Volumes of handled goods/ own handling capacities</td>
<td></td>
</tr>
<tr>
<td>Depot/warehouse</td>
<td>Cargo handling (loading/unloading) operations in hinterland</td>
<td>Volumes of incoming/out-going goods</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 provides a typical overview of stakeholders in a port cluster (Antwerp port in concrete case). Financial interactions are represented by the arrows [Van De Voorde and Vaneslander, 2008]. The figure highlights the significance of forwarders. Of course, the role and number of other port related players should not be underestimated either. From the aspect of value added generated by smaller players, fuel trading, forwarding and hinterland transport take the biggest share next to terminal operating activities.

![Figure 3: Interactions between port cluster related players](image)

Figure 3: Interactions between port cluster related players [Coppens, 2007]

---

2.4 Logistics cluster interfirm relationships

The concentration of firms in the same industry with their similar needs and concerns gives natural rise to joint activities. Increased competitiveness through cost reductions can be achieved if firms in a cluster collaborate in order to balance their request portfolios.

Main objectives of the process of cooperation are:

- Improving costs, productivity and flexibility;
- Improved communication and information sharing,
- Balanced operations and lower stocks;
- More accurate forecasts and better planning;
- Meeting the customers’ expectations, with shorter lead times and faster deliveries;
- Generating synergies:
  - Pooling the resources;
  - Sharing specific strengths and capabilities;
  - Sharing Know-How.
- Gaining of stability and sustainability of SC (more flexible organizations reacting faster to changing conditions).

Development of cooperative business relationships within the logistics cluster is characterized by utilizing of both mono-dimensional (horizontal and vertical cooperation) and bi-dimensional strategies (diagonal cooperation) as well as their simultaneous and interactive application. It can be a powerful way for satisfying the interests of stakeholders in cluster and improving their competitive position. Therefore, in this context the following relationships are possible:

- Horizontal cooperation as cooperation between a number of shippers or a number of 3PLs may lead to cost reduction, strengthened market position, improved productivity, service quality, enhanced innovation and supply chain responsiveness and increased social relevance. From the aspect of rail transport it leads to reaching required critical mass for establishing a rail freight service;

- Vertical cooperation as a cooperative relationship between shippers and 3PLs and/or rail operators can enhance synchronization between supply and demand and on that way reduce bullwhip effect. From the aspect of rail service, economy of scale and scope may lead to improved reliability and flexibility of service;

- Diagonal cooperation as a bi-dimensional cooperative strategy between a number of horizontally connected shippers or 3PLs and rail operators aims to additional enhancing of supply chain flexibility. Diagonal cooperation models would further enhance the position of rail freight sector and on that way additionally improve customer’s satisfaction;

- Combining three basic forms of cooperation at various levels and in various modes simultaneously leads to creating interconnected logistics networks. Interconnected logistics network leads to improved efficiency of matching between shipment demand and available transport and logistics services as well as high level of synchronization and dynamic update of logistics and transport plans across modes and actors.
Figure 4: Figure 2 - 4 Typical cooperative forms

It should be noted that in all these types of collaboration, there is a third party involved. Many examples include a neutral trustee (e.g. 4PL) to manage the collaborative operation. In some cases, the collaboration was mandated by a local government.

Main characteristics of horizontal, vertical and diagonal cooperation forms are given below.

**Horizontal cooperation**

Horizontal cooperation is active cooperation between two or more firms that operate at the same level of the supply chain and perform a comparable logistics function. These firms can be either competing or unrelated companies that share business information, facilities or resources to reduce costs and/or improve service. The advantages of horizontal collaboration are [Smart Rail, 2017]:

- Decreased costs due to decreased empty hailing and increased used of capacities;
- Increased productivity due to knowledge sharing and better ability to control costs and reduce the costs of supply chain;
- Better transparency of the service to the users;
- Better estimation of ETA;
- Broadening customer service though improving service quality and specializing while broadening service offerings;
- Opportunity to access new markets and customer acquisition.
- Environmental impact resulting from lower cost and higher productivity.

However, horizontal collaboration has also some impediments and possible pitfalls as the following (Holmberg and Orne, 2013):
• Profit sharing – dividing the benefits or sharing the profit. Problems in quantifying the operational savings are major obstacle to share the profit properly;
• Partner selection – it is hard to find reliable party that can coordinate the cooperation in such a way that all participants are satisfied. Possible transition of bad image as result of choosing “wrong partner” for long term cooperation.
• Information and communication technology – a lack of IT technology can be an issue for cooperation with high intensity of data exchange.
• Unequal bargaining power of partners – bargaining power depends on initial strengths and weaknesses of partners, how those strengths and weaknesses change over time and potential for competitive conflict. Relative bargaining power between the partners can be an issue and a key for fail of cooperation.
• Cooperation complexity - increasing complexity leads to increasing management challenges;
• Conflicts – conflict in horizontal cooperation have higher potential of opportunism and dysfunctional conflicts due to competitive nature. Dysfunctional conflicts (personal disagreements) are bad for performance and innovation.
• Risk of decreasing system efficiency – the system efficiency becomes more sensitive for interruptions (delays when loading/unloading or due to congestion). Complex backhaul networks containing additional journey legs have greater risk of delay.

According to Bengston and Kock (1999) there are four types of horizontal relationships:

• Coexistence: Relationship without commitments and no economic exchange, only information and social exchanges exist. Trust is regarded important and the companies’ goals are stipulated separately.
• Cooperation: partners in a cooperative relationship follow shared goals. They can also be competitors and do not need to trust each other, depending if the relationship has a formal or informal character, where informal relationship is built on norms and trust.
• Competition: it is an action-reaction relationship, where companies share or have similar suppliers and target the same customers.
• Coopetition: coopetition relationship can consist of both economic and non-economic bonds. Two companies cooperate in one area or with some activities while simultaneously competing in other areas or with other activities. It is best to have cooperation relationship in non-core activities far from customer, while a competition relationship is best for core activities that are near the customers.

Regarding the scale of cooperation there are two extremes, arm’s length on one side and integrated firms on the other (Figure 5.). In between these two extremes there are three following types [Cruijssen, 2006]:

• Type I cooperation includes mutually recognized partners that coordinate their activities and planning, though to a limited degree. The time horizon is short-term and the cooperation involves only a single activity.
• Type II is a cooperation in which the participants not only coordinate, but also integrate part of their business planning. The horizon is of a long though finite length and multiple divisions or functions of the companies are involved.
• Type III cooperation, the participants have integrated their operations to a significant level and each company regards the other(s) as an extension of itself. Typically, there is no fixed end date for such cooperation. Type III cooperation is often called ‘strategic alliance’. Usually the Type I and II cooperation are characterized by the absence of a
formal contract, whereas strategic alliance is defined as a long-term contractual agreement.

There are also logistics-based strategic alliances which are based on two dimensions, being the scope and the intensity of the relationship between the partners. Scope is defined as the range of services for which cooperation takes place, and intensity is defined as the extent of direct involvement that exists between partners. Possible indicators of intensity are the sum of assets invested and the number of working hours dedicated to maintaining the cooperation.

Many factors may play a crucial role in the success of cooperation of which the most important ones are [Smart Rail, 2017]:

- Information sharing;
- Relationship management;
- Contracts.

In horizontal cooperation, there is a clear need for the exchange of appropriate and reliable information. The sharing of logistics information is important from a costs perspective because it can replace unnecessary costs for transport or storage of goods. Generally, there are internal and shared information. Internal information is necessary for each company to manage its own activities and should only be accessible to a company’s own employees. The shared information should be available to all participants in cooperation. If partners do not share this information, they will lack knowledge about each other’s plan and intentions, and their activities will not be harmonized. This will cause no optimal benefit to the cooperation.

Other important factors for facilitation of horizontal cooperation are relationship management and contracts. Two manners of formal relationship management can be distinguished. They are a ‘strict’ contract, and a more ‘open’ contract structure. Open contract is more suitable in the pursuit of a collective goal, because this process typically depends on unanticipated future conditions that cannot explicitly and exhaustively be captured in formal contractual agreements. Therefore, an open contract is probably the best form to structure a horizontal cooperation. Sometimes the strongest cooperation generally has the shortest and least specific agreements or even no written agreement at all. The parties involved often consider the set-up of a binding juridical framework to be a burden instead of an aid or necessity. From other side sometimes the lack of a written agreement for cooperation can cause problems in the event of conflict situations, or even lead the cooperation to an end. In addition to contractual issues, it is very helpful for efficient relationship management if the companies engaged in a horizontal cooperation show a certain level of mutuality, symmetry, and strategic fit.

**Vertical cooperation**

The other type of cooperation between firms in a cluster is vertical cooperation [Smart Rail, 2017]. In vertical cooperation two or more stakeholders of different stages of the SC work
together with the aim to gain benefit out of their collaboration. This type of cooperation is often limited in time and during its term participating stakeholders stay legally and economically independent. Vertical cooperation is very often described as supply chain management. Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, in order to minimize system wide costs while satisfying service level requirements. Usually supply chain management is aimed at installing beneficial cooperation and linkages between stakeholders operating at different levels of the SC in order to avoid unnecessary logistics costs. The key drivers of such costs savings are inventory and transport reductions, logistics facilities or equipment rationalization, and better information usage.

Vertical cooperation usually has higher success rates than horizontal cooperation. Although in most cases contracts are used to govern vertical cooperation, trust between partners makes the alliance more effective. Managing horizontal cooperation alliances is more difficult, because partners are often competitors. The benefits of vertical cooperation come from the greater capacity it gives organizations to control access to inputs and to control the cost, quality and delivery times of those inputs.

Advantages of vertical cooperation are:

- Improvement of SC coordination;
- Higher control over inputs and the whole SC;
- Increasing the entry barriers to potential competitors;
- Firms remain independent and therefore flexible;
- No high capital investment required.

Vertical cooperation is a difficult strategy for companies to implement successfully. It is often expensive and hard to reverse. Vertical cooperation has the following, rather short list of disadvantages:

- Risk of know-how outflow;
- High dependency on strong partners;
- Higher coordination costs.

To ensure the long-term functioning of collaboration structures among independent supply chain partners, positive incentives for the partners should be generated in the collaboration process. An appropriate profit sharing scheme should guarantee a financial advantage for each freight carrier individually. The additional profit generated through the collaboration process is split among the coalition members according to predetermined rules.

One interesting case of vertical relationship is a virtual joint venture between a big shipper and LSP\(^2\). This relationship has been successfully realized by Jula (Swedish retailer which operates in DIY segment) and DB Schenker. Jula and DB Schenker have had a close collaboration for more than a decade before the discussions regarding a joint intermodal transport service started. Initial ideas came from the municipality in Falkoping who did a pre-study to analyse the possibilities of a rail shuttle between the port of Gothenborg and the intermodal terminal at Falkoping. The study showed that the intermodal transport solution could be competitive with around 10000 TEU per year. Around 2012, Jula increased volumes and achieved critical volume. However, it was needed a long time to coordinate all stakeholders and to develop the necessary intermodal terminal facilities. Figure 6 illustrates the complexity in terms of number of agreements and the fact that they had to be coordinated and synchronized. Furthermore, agreements preceded long process of trust building for stakeholders to establish enough confidence and willingness to invest.

Central agreement is between Jula and Schenker with a focus on defining how risks, investments and benefits are distributed. They operate on open-book agreement with a high level of transparency and both actors are involved in discussions covering aspects such as pricing, investments, service quality and tendering processes. Long-term contracts were signed with terminal operators to support him to invest in a new terminal adjacent to the old terminal. Hence, Schenker in the role as a control tower, has signed two year contract with the rail operator and a five year contract with the terminal operator (the terminal operator was appointed by the municipality of Falkoping through the process of public tendering. In the role as control tower, Schenker takes the responsibility for three main functions: booking, accounting and monitoring. Schenker also has the responsibility of marketing and sales of the intermodal service to attract other shippers besides Jula. Schenker and terminal operator focus on developing more agreements with shipping lines to increase the usage of container depot at the intermodal terminal.

**Diagonal cooperation**

From the practice, it evident that the horizontal cooperation within segments is very difficult, due to the strong pressure coming from competition, and thus produces limited advantages. Vertical cooperation, between different stakeholders providing different service is seen as possibly successful. But, hard challenges apply as well, such as differences in the cost and benefit distribution between the partners, the presence of a dominant company, the unwillingness to invest in future collaboration. Supply chain management as well as focusing on vertical coordination and process integration also needs to incorporate the potential considerable power of horizontal cooperation.

These difficulties/weak points could be avoided by the so called diagonal (or lateral/matrix) model of cooperation. The diagonal cooperation involves both different stakeholder/s of different stages (vertical) of the SC and few companies belonging to the same segment (horizontal). This, as a strategic component associated with a network strategy is the extension of cooperative processes with stakeholders operating on the same level of the supply chain (horizontal) but also who are upstream or downstream in the vertical network. This type of cooperation is also considered as an enabler of end-to-end integration. The aim
of such type of cooperation is to provide faster and more reliable supply and reduce physical and information disruptions. The interdependencies of networked supply chains means any disruption at a node/step radiates throughout the network. Hence, end-to-end integration turns out to be among the most important for the SC.

Diagonal cooperation represents potentially winning strategy for improving transport and supply chain performances of a cluster. It integrates the supply chain through vertical collaboration to reduce costs and to improve service levels as well as horizontally with industry partners to better utilize assets and to further reduce costs. Diagonal cooperation aims to gain more flexibility by combining and sharing capabilities in both vertical and horizontal manners.

In the diagonal cooperation, there is a need for a suitable decision support to facilitate the choice of an appropriate mode of relationship between the value chain partners. Prior to the development of such a strategy would be the identification of the critical variables which determine the choice of mode of relationship. The diagonal model of cooperation can facilitate the determination of the mode of value chain relationship leading to a more stable integration.

In recent years, characterized by globalization and increasing business complexity and enabled by information technology, work has become more "horizontal". Global customers now want a single point of communication. Supply chains cut across traditional functions and organizational boundaries to include suppliers, partners and customers beyond national boundaries, and more integrated business functions and common processes cut across business units and regions. IT systems became more cost-effective and efficient and enabled higher levels of integration and coordination. All these define the following key reasons for moving to a diagonal model of cooperation, namely [Hall, 2013]:

- To increase cooperation and communication across the traditional vertical silos and to unlock resources and talent that is currently inaccessible to the rest of the organization;
- To deliver "horizontal work" more effectively – to serve global customers, manage supply chains and run integrated business regions, functions and processes;
- To be able to respond more flexibly – to reflect the importance of both the global and the local, the business and the function in the structure and to respond quickly to changes in priorities;
- To develop broader capabilities – a matrix helps to improve perspectives and skills of partners who can deliver value across the business and manage in a more complex and interconnected environment.

The diagonal cooperation is not the ideal one and there are partners struggling to make the cooperation work. Some stakeholders even claim to have "abandoned the matrix" entirely (though in reality they usually just move to a simpler form of matrix). The disadvantages they indicate usually include:

- Lack of accountability;
- Unclear goals and roles;
- Delays in decision-making (too many partners getting involved);
- Increase in uncertainty and conflict.

A successful matrix implementation matches Structure, Strategy, Systems and Skills, and the integration of all these four S’s is required in order to have successful cooperation. A matrix succeeds when there is a collaborative culture, where information flows freely, where development of strong relationships and informal networks are supported. The decision of the mode of relationship between the value chain partners is strategic in nature and has the primary bearing on the success of the value chain. The mode of stakeholder’s cooperation or what mix of approaches will be applied in SCs depends on the capability and expertise they
need to best respond to customer demand.

An example of diagonal cooperation is the cooperation between one pre- and one -end hauler (vertical), intermodal terminals and rail transport companies (horizontal cooperation). In inland waterways, which is prone to horizontal competition a positive example of matrix cooperation comes from 4 inland Dutch terminals (Barge terminal Tilburg, Oosterhout Container Terminal, ROC Waalwijk and Inland Terminal Veghel), also offering pre/end haulage and waterway transport. The cooperation is based on optimizing the container freight flows (from/to Rotterdam, sharing equipment and employees. The result is cost reduction and better service for customers. The four terminals jointly own a company whose role is to administrate the cooperation.

Another example is the already mentioned ECT\(^3\) extended gate model. Despite being owned by a single company, its model of inland terminals (dry ports or deep sea terminals) including vertical service (railways, pre/end haulage, barges), demonstrates that planning, executing and exploiting horizontal + vertical cooperation is possible.

Interconnected cooperation model

Interconnected cooperative relationships represent a combination of already described cooperative types at various levels and in various modes simultaneously thus creating interconnected networks. These new (still not available) forms of business models, aligned with Physical Internet (PI) paradigm aim to reduce social, economic and environmental impacts of existing systems by designing an appropriate cooperative network (depending on the specific case) based on a combination of classic cooperation types at various levels and in various modes. Main principles of PI such as: openness, reliability, synchronization, sustainability and efficiency should be addressed by this cooperation type.

2.5 Main requirements for successful cooperative network in a cluster

Previous chapters described main characteristics of potential forms of cooperative relationships between the actors in the logistics cluster. Both horizontal and vertical cooperation, have their main purpose and disadvantages as well. Diagonal cooperation aims to gain more flexibility by combining and sharing capabilities in both vertical and horizontal manner. However, in this case it is necessary to take into account potential cooperation complexity reflected in a large number of actors involved. For this purpose, an information sharing platform (cloud based to enable the dynamics in the cooperative network) to support today’s planners in supply chain optimization and the fulfillment of the shipper’s requirements for supply chain visibility is required.

Additional difficulty for achieving an efficient inter-cluster collaboration is the lack of trust among the actors. Many organizations simply do not trust other members of the supply chain and they are reluctant to share information. Traditional business relationship, which have been built on open market negotiations need time to convert to a trust based win-win situation. Barriers to successful supply chain cooperation are in more detail described below.

Regarding development of any cooperative relationship in supply chain usually following barriers appear (Smart Rail, 2017; Yen and Thai, 2016):

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\(^3\)ECT is the operator of most of the container terminals in the Port of Rotterdam.
Soft barriers

- **Culture**: mental shift required.
- **Trust**: insufficient trust in partners to cooperate (make less decisions on your own, lose your exclusivity, share information) and to realize a (independent, neutral) coordinating function.
- **Knowledge**: no knowledge available.

Hard barriers

- **Cost-benefit**: unclear insight in the balance between cost (investments and operational costs) and the benefits that will result from the investments.
- **Critical mass**: insufficient partners and mass to realize impact in the market;
- **Redesign of processes/Organizational changes**: required changes in existing processes and in organization;
- **Investments**: investment, e.g. in additional activities and information exchange systems (see below).
- **Market engagement**: required activities to attract new customers (Shippers) and improve the customer interface.

In the above list, the barriers have been clustered into two categories: soft and hard barriers. Soft barriers are difficult to measure and overcoming these barriers will take most probably more time and effort but is crucial to be successful. Without overcoming the soft barriers no project will start or become profitable. The soft barriers are in place and an external push, some kind of motivation or ‘risk’, is needed to get out of the comfort zone. If than everything is running smoothly and there is success, the mind set will change. This is the positive way. In the negative way, the push will be some threat that can harm the existing business. In that case the only alternative will be some creative effort to find a new competitive position, otherwise parties are losing the business. If the parties will be successful the outcome in respect of the soft barriers is the same. The hard barriers are easier to measure but difficult to overcome as well. Cost-benefits, critical mass, organizational changes and investments can be seen and calculated.

Any initial push or driver will aim at the soft barriers in the first line. As long as the organization is not willing to accept the need for change, any other efforts will not be successful. On the other hand the outcome of any effort is crucial as well. Any failure – non-success - results in an even more stabilized mind-set and makes it even more difficult to overcome the soft barrier in the future.

The barrier ‘Trust’ might be the most difficult barrier to overcome. Culture, knowledge and perception in combination with the personal experience are resulting in trust. Even if the economic output of a project might be positive for all participants the trust barrier might not be overcome. The idea that other parties gain more for less effort and unfair profit sharing can only be overcome if trust between the partners is given. The lack of trust can be partly covered
The following intervention directions to realize the cooperative relationships in a logistics cluster:

- Interventions in **willingness to invest and cost benefit distribution** to support vertical cooperation, between different stakeholders;
- Interventions to **realize “mixed” vertical-horizontal cooperation** by sharing assets;
- Interventions to **realize an improved ICT solution like a shared virtual information platform is**, held by a third party, which gathers and provides shipment information from actor to actor.

Therefore, the factors that play a crucial role in the success of cooperation of which the most important ones are [Smart Rail, 2017]:

- Information sharing;
- Relationship management;
- Contracts.

In any kind of cooperative relationship, there is a clear need for the exchange of appropriate and reliable information. The sharing of logistics information is important from costs perspective because it can replace unnecessary costs for transport or storage of goods. Generally, there are internal and shared information. Internal information is necessary for each company to manage its own activities and should only be accessible to a company’s own employees. The shared information should be available to all participants in cooperation. If partners do not share this information, they will lack knowledge about each other’s plan and intentions, and their activities will not be harmonized. This will cause no optimal benefit to the cooperation.

Other important factors for facilitation of cooperation are relationship management and contracts. Contract design should be based on criteria that provide an environment of trust. Trust will contribute to overcoming initial suspiciousness about potential partner opportunism which may prevent effective implementation of cooperation. Imbalances in organisational power, indicated by disparities in the resources contributed and controlled by the partners can impede trust creation due to the partner’s unequal capacities to fulfil their obligations.

From these reasons a complementary governance mechanism characterized by a dynamic interplay between contractual and relational governance. In case of absence of previous experience (where trust and relational norms are not well developed) contracts should be more formal in order to complement relational governance by providing the confidence for each of the partners through safeguarding transaction specific investments (in case there are – IT infrastructure, freight wagons) and controlling opportunism. There are a ‘strict’ contract, and a more ‘open’ contract structure. Open contract is more suitable in the pursuit of a collective goal, because this process typically depends on unanticipated future conditions that cannot explicitly and exhaustively be captured in formal contractual agreements. After some time (or in case of previous experience between partners) the trust and relational norms will create more opportunities for cooperative parties to learn knowledge and contracting skills. Here, a dynamic process of interplay between two governance mechanisms arises. Proposed governance mechanism could be adapted to support long-term trusting relationship and to address necessary variations in internal and external transport chain environment.

Therefore, the key aspects needed to fulfill the aim of establishing a successful cooperative relationship are:
Clusters 2.0

- An independent party who will manage the cooperative business network established within the cluster;
- Information sharing platform (or cluster community system) managed by an independent party;
- A cooperative governance framework based on the established business network which will enforce the trust and commitment between the partners.
3 Definition of Shipper and Carriers advanced collaboration practices

3.1 Introduction

This chapter gives an overview of the collaboration practices used in contemporary supply chain operations. A look at existing business practices shows that the collaboration practices in the supply chain are influenced by factors such as the type of the contracts, the type of shipping agreements (door-to-door, door-to-port, door-to-depot, and so on), the type and form of information available (pre-announced orders with electronic data or not), or the information owner. The shipper-carrier advanced collaboration practices are shaped according to these factors.

To map out these advanced collaboration practices, both an in-depth desk research and interviews with logistics stakeholders were conducted. The desk research consists of a literature review collecting insights with regard to contemporary supply chains characteristics, functionalities and stakeholders’ roles. This literature overview covers sources from scientific journals with regard to state-of-the-art research results. Hence, the conceptual consideration with regard to shipper and carrier collaboration practices are identified. In parallel, interviews with supply chain stakeholders were set up to disclose and to analyse, from a practical perspective, the type of collaboration practices that are applied within logistics chains. This analysis was conducted by carrying out semi-structured interviews with supply chain stakeholders having their main activity within and around the port of Antwerp. In total, 19 companies were interviewed in the period of June-October 2017. As shown in Figure 8, the majority of the interviewees are representatives of road transport operators, while a smaller proportion are representatives of forwarders, shipping agents, and shippers. The duration of interviews depended on the role of the organization in the supply chain and varied between 45 minutes and two hours. The points addressed during these interviews were linked to issues covering the type of collaboration agreements, the scale and scope of these agreements, and the benefits and barriers met when trying to collaborate.

![Figure 8: Logistics stakeholders share involved in the surveys](image)

The following sub-chapters address the following factors. Firstly, a literature overview is given in sub-chapter 3.1 to understand the main supply chain functionalities and the factors
contributing to further integration of the supply chain. Secondly, the stakeholders’ roles and strategies in integration initiatives are detailed in sub-chapter 3.2. Finally, sub-chapter 3.3 focuses on the contemporary business practices seen at the interaction between shippers and carriers, but also the needs of the other supply chain stakeholders.

3.2 Overview of the supply chain key functional needs

Supply chains involve the activity and interaction of a wide variety of stakeholders. The main functionalities brought up in a supply chain depend on the flows that it addresses and on the level of integration of its stakeholders. Supply chain integration has been previously studied by Lee and Whang (2001) or Flynn, Huo, and Zhao (2010). Among others, these studies in literature that define the supply chain refer either to the flow of goods, information, financials, or a combination of the aforementioned (Mentzer et al., 2001). Hence, supply chain stakeholders integrate their operational activities with regard to these elements. In practice, stakeholders or communities of stakeholders, have developed advanced tools to assist and, in some cases, to optimize these flows. Figure 9 represents a schematic view on the goods, information and financial flows. In an integrated supply chain, these flows are interconnected and dependences are automated.

![Figure 9: Main supply chain flows [based on Kasilingam, 1998]](image)

More specifically, the customer-supplier relation is intermediated by a range of additional stakeholders. The cargo flow is handled by carriage service providers, while the information flow is enabled by ICT solution providers. The financial flow is supported through means offered by financial institutes. The level of integration between these stakeholders allows differentiating between the level of services for the end customer. Subsequently, the following paragraphs present a non-exhaustive literature overview with regard to each of these flows to better understand the functional needs of a supply chain.

3.3 Goods flow
Frohlich and Westbrook (2001) prove that the integration of suppliers and customers has a positive effect on the performance of a supply chain, while Fawcett and Magnan (2002) bring evidence of the integration difficulties faced by the supply chain stakeholders. The latter authors conclude that often managers have difficulties to measure the trade-off between their competitive potential and the collaboration benefits. This factor hampers the engagement in further extensive supply chain integration. Hesse and Rodrigue (2004) raised the problem of transport integration from a geographical perspective. They conclude that logistics and freight distribution are often fragmented. From a supply-demand perspective, significant gains are possible due to integration and goods consolidation. Yet, fragmentation is most of the time caused by geographical and/or infrastructure constraints. The same authors suggest that both dimensions, supply-demand and geography should be considered for a stronger supply chain integration. Flynn et al. (2010) indicate that supply chain integration is equally related to both operational and business performance. Moreover, their study indicates that internal and customer integration are more strongly related to improving performance than supplier integration. Their proposal for integration steps are: integrate first internally, then with customers and then with suppliers.

Bosona and Gebresenbet (2011) investigate local food supply chain characteristics and develop a coordinated distribution system to improve logistics efficiency, reduce environmental impact, increase potential market for local food producers and improve traceability of food origin for consumers. They prove that, by creating collaborative clusters and establishing collection centres in a distribution network, the number of routes, driving distances and product delivery times can be significantly reduced.

More recent research by Durach and Wiengarten (2017) assesses whether contingency factors at the country level (i.e., institutional and cultural factors), need to be considered when setting up supply chains. Moreover, they point out that firms situated in countries with low levels of national institutional uncertainty experience less operational difficulties as well.

The research of Yuen and Thai (2017) puts forward five main difficulties faced by maritime supply chain stakeholders when trying to integrate their operations:

- Lack of trust and commitment because of the display of scepticism and opportunistic behaviour.
- Resistance to change, which is a result of complacency and individualism.
- Incompatibility of operating and strategic goals, which is caused by inadequate supply chain leadership and poor partner selection.
- Lack of resources.
- Inability to accurately measure and assign cost to the activities necessary for the completion of a maritime logistics services.

Baldwin and Lopez-Gonzalez (2015) seek global patterns in the supply chain. They analyse the import-export interdependence at country level. They appoint US, Germany, China, Korea and Japan as headquarters economies having very diverse patterns in the sourcing and sales side, while other, factory economies, tend to be heavily reliant on the closest high-technology manufacturing giant. They conclude that, in the contemporary economic scene, it is difficult to find an authentic scenario. This conclusion indicates that future supply chains have to be flexible and need a very open governance structure in order to be successful.

3.3.1 Information flow

Focusing on the ICT aspect, Gunasekaran & Ngai (2004) gives a broad classification of IT products that are used in the activity of a supply chain. The five categories and their definitions are presented in Table 1. Moreover, they state that, although the successful implementation of ICT solutions leads to further integration of the supply chain operation, the decisive role depends on the organizations, on the approach and on the human resources (Gunasekaran
Similarly, as among others Baldwin (2011) or Carlan et al. (2016) indicate that further supply chain integration can be achieved due to new ICT solutions.

In the new technology era, supply chain stakeholders introduce relatively cheap but reliable solutions to win the quest for success. The study of Wamba and Chatfield (2009) discusses the added-value potential created from RFID supply chain network projects. Among (well known) benefits derived from the use of ICT solutions, they point out that local firms and upstream manufacturers represent the main barrier to up-scaling the RFID benefits to the supply chain network level. Resource poverty (financial capabilities) is mentioned as the main factor. These issues have been addressed by integrative solutions such as ICT innovation and data sharing platforms. In contemporary business, the focus has switched to problems that address data ownership and/or security issues. According to Flynn et al. (2010), the collaboration practices in a supply chain that focus on product manufacturing are grouped in three categories: customer, supplier and internal integration. The former two are referred as external integration, while the latter has an internal scope.

Table 1: Types of ICT usability in the supply chain management [Gunasekaran & Ngai, 2004]

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic planning</td>
<td>ICT with a critical implication on the long-time performance of the supply chain.</td>
</tr>
<tr>
<td>Virtual enterprise</td>
<td>Companies integrate various links of the supply chain and their supporting information systems that are driven by the need to streamline operations.</td>
</tr>
<tr>
<td>E-commerce</td>
<td>With the development of Internet-based technologies, integration of e-commerce with SCM systems is becoming a necessity. It can support various activities along the supply chain.</td>
</tr>
<tr>
<td>Infrastructure management</td>
<td>The infrastructure includes the hardware and software and the nature and type of systems required for an IT-system in a supply chain environment.</td>
</tr>
<tr>
<td>Knowledge (and IT) management</td>
<td>Knowledge (and IT) management requires a systemic approach or framework for educating and training workers in teamwork and being innovative. Management of technology requires planning, developing and implementing decisions based on the characteristics of business processes and organizational objectives.</td>
</tr>
<tr>
<td>Implementation of IT</td>
<td>Implementation of IT in SCM that requires a project management approach for the planning and implementation of (IT) projects.</td>
</tr>
</tbody>
</table>

Specifically for the information flow, Baldwin (2011) also exposes the difficulties in integrating supply chains. This author mentions the contribution of the ICT revolution to reducing the cost of coordinating complex activities at a distance made the geographical dispersion of supply chains feasible and profitable. Moreover, he points out that the key development struggle is to continue to reach new equilibria, thus deepening the exploitation of external economies. New developments would have to implement solutions that would reduce inter-company inconsistencies. The research of Carlan, et al. (2016) shows that these type of issues still persist.

3.3.2 Financial flows

The topic of financial flows in supply chain operations did not receive similar attention as the other flows. In this respect, Hofmann (2005) has stressed the need of further analysis of financial flows in supply chain. Hence, Wuttke, Blome, and Henke (2013) have presented an empirical investigation to strengthen the managerial decisions concerning financial flows in supply chains. Their study reveals that the pre-shipment financial supply chain management encourages upstream working capital, while the post-shipment capital strengthens the buying firms’ position.

Electronic means that integrate financial information are the electronic versions of the Airway
bill, the CMR or the Bill of Lading. Moreover, different ICT solutions have been developed and implemented to support also the financial flows in the supply chain. In this context, the EssDocs is a solution that provides a paperless approach towards digital trade and the Bolero software aims at improving the cash flows in the supply chain.

3.3.3 Supply chain resilience and integration needs

Clusters depend on the global supply chains and establish new collaboration on operational side at micro level. An overview of global supply chain management shows that to achieve integration, supply chain partners collaboratively need to manage intra- and inter-organizational processes. This type of micro-level management is applied to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer (Flynn et al., 2010).

Jüttner and Maklan (2011) conduct an empirical study and seek the supply chain resilience. They investigate the relationship between supply chain vulnerability and supply chain risk management. Their findings suggest that supply chain risk enhances the supply chain resilience by positively affecting elements like flexibility, visibility, velocity, and collaboration capabilities. This proves that management structures in the supply chain are governed by a reactive, rather than a preventive, drive.

Table 2 puts forward the needs addressed by the supply chain integrators. A division with regard to each flow is made.

Table 2: Integrated supply chain needs

<table>
<thead>
<tr>
<th>Supply chain key functional need</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For cargo flow</strong></td>
<td></td>
</tr>
<tr>
<td>Allow goods consolidation</td>
<td>Hesse &amp; Rodrigue (2004)</td>
</tr>
<tr>
<td>Coordinate the goods distribution mechanism</td>
<td>(Bosona &amp; Gebresenbet (2011)</td>
</tr>
<tr>
<td><strong>For information flow</strong></td>
<td></td>
</tr>
<tr>
<td>Implement common ICT systems that integrate both customers’ and suppliers’ needs</td>
<td>Stanley E. Fawcett &amp; Gregory M. Magnan, (2002; Schrauf &amp; Bertram(2016)</td>
</tr>
<tr>
<td>Reduce the cost of information</td>
<td>Baldwin (2011)</td>
</tr>
<tr>
<td><strong>For financial flow</strong></td>
<td></td>
</tr>
<tr>
<td>Provide a trusted solution</td>
<td>Daudi, Hauge, &amp; Thoben (2017; Yuen &amp; Thai (2017)</td>
</tr>
<tr>
<td>Integrate data ownership rules and protection mechanisms</td>
<td>Jagadish et al. (2014)</td>
</tr>
</tbody>
</table>

Supply chain integration is successful if stakeholders collaborate. These collaboration practices are centred on each of the previously mentioned flows. Seen from an organisational point of view, these practices can have an individual one-with-one scope or involve groups of stakeholders. In order regard to further understand the collaboration practices established between these supply chain stakeholders, the next section puts forward their key roles in operations’ integration.
3.4 Key roles of supply chain stakeholders in operations’ integration

A formal way of collaboration is forming alliances. Heaver, Meersman, Moglia and Voorde (2000) focus on alliances in the framework of European shipping and port competition. They conclude that the role of the port and the port authorities have to redefine their tactics. Later on, Heaver, Meersman and Van de Voorde (2001) put into discussion these port strategies. They point out that maritime shipping companies arrange consortia agreements and alliances to gain better negotiation power over other logistics stakeholders such as port authorities, terminal management companies and land transport firms. This strategy points rather towards a supply chain where little integration is possible and where the stakeholders outside these alliances are forced to practice low prices in order to maintain their businesses. Another option for these stakeholders is to form, on the other side, own cooperation agreements, joint ventures and financial stakes. These early forms of collaboration are the basis of contemporary community systems and clusters collaboration.

Barratt (2004) criticizes the collaboration practices within the supply chain and suggests a supply chain segmentation approach. This approach would be shaped by the customer buying behavior and service needs. Similarly, Lee, Kwon and Severance (2007) study the supply chain linkages and the achieved performance. They indicate that internal integration contributes to cost-containment. The cost-containment approach is a cost-management strategy that aims at keeping the costs down to only necessary and intended expenses (Chang Won Lee et al., 2007). By following this approach, the buyer-supplier integration increases the supply chain reliability. In this perspective, inventory information creates a transparent environment for easy internal integration and a reliable ordering system is supported by a direct link with the suppliers.

Hoshino (2010) discusses the collaboration strategies of ports located in East Asia. He argues that smaller ports close to regional hub ports are seeking for collaboration with other (similar-sized) ports, rather to compete against each other. It is also pointed out that this collaboration is important to be considered in future master plans of regional development as it will influence the hinterland infrastructure and cargo flows.

An overview of the competitive behavior of the maritime stakeholders is given by Sys (2010), in the context of container liner shipping. Five years later, Meersman, Sys, Van de Voorde and Vaneelslander (2015) explore the competition issues in container liner shipping setting the pricing strategy as a main indicator. Similar to the studies that focus on port competition, they state that lower rates force small operators to focus on niche markets. Short-term effects are seen in increasing collaboration and specialization (with no immediate need for further regulation), but in the long term, this might lead to fragmentation and inefficiencies. Van Hassel, Meersman, Van de Voorde and Vaneelslander (2016) shed light on the impact brought by two environmental policies on port competitiveness. They demonstrate that the effect on the theoretical captive hinterland of ports in the Hamburg-Le Havre range and the Mediterranean ports is not significant.

Till present date, limited research has pursued the collaboration practices of supply chain stakeholders at the operational level for which data is a key need. From a maritime supply chain perspective, this interaction expands from the origin of the goods (the shipper) till the port (the terminal operators), including stakeholders such as freight forwarders, hinterland and maritime carrier, shipping agents, depots or warehouses. Hence, data in the supply chain is spread across these multiple stakeholders, being linked also to flows detailed in the previous section. Few initiatives have pursued its centralization and bundling. In a digital era, information influences the competitive position of different stakeholders, and thus of entire supply chains. Table 4 puts forward the role that different supply chain stakeholders can have.

Table 3. Role of supply chain stakeholders in operation integration.
SC stakeholder                              Roles
(Port) Authorities                      Facilitators
Logistics Service Providers              Integrators
Suppliers, manufacturers, wholesaler, distributors, retailers and users Beneficiaries

Yet, the decision with regard to transport operations is taken by the logistics service providers based on the transport characteristics of the goods. As put forward in table 4, the beneficiaries of operations integrations are enjoyed either by the suppliers, manufacturers, wholesaler, distributors, retailers or users which, in the supply chain, take the shipper’s role. In this context the authorities plays the facilitator role and the LSP, including the carriers, are the actual integrators. The details with regard to shipper and carrier interactions in the supply chain are put forward in the following section.

3.5 Focus on the shipper and carrier interactions/collaboration

This sub-chapter focuses on the shipper-carrier collaboration practices. Here, an exhaustive overview of collaborative practices between those types of stakeholders is given including both from a literature review and industry survey perspective. Furthermore, it identifies the success and failure factors for further collaboration. Hence, solutions to overcome integration barrier are identified.

3.5.1 Literature review with regard to shipper-carrier collaboration practices

Knaak, Kruse and Page (2006) explore the applicability of an agent-based simulation on analysing a hub-orientated approach for fixed exchange points in bike carriage. They found that, in this type of service, all couriers involved in the processing should agree upon an appropriate work-sharing before an order gets attributed. If one would try to use such a system, technical means for orchestrating and negotiating this activity are needed.

Krajewska, et al. (2008) present cost-reducing practices among carriers. This type of horizontal collaboration brings benefits from a reinforced market position. Features such as routing, scheduling, and pick-up/delivery time windows sharing are discussed as collaboration practices. Equally, possibilities of profit sharing are analysed.

Zhang, Yu, and Liu (2008) point out that electronic logistics marketplaces (ELMs) support collaboration practices. The parties with the most benefits from this type of collaboration are shippers and carriers.

Table 4: Benefits for shippers and carriers derived from ELMs [Zhang et al., 2008]

<table>
<thead>
<tr>
<th>Benefits to individual partners</th>
<th>Shippers</th>
<th>ELMs help shippers gain better visibility of all consignments regardless of which carrier does the deliveries. It leads to more reliable delivery and improved customer service level, as well as better management of carriers’ performance.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carriers</td>
<td>ELMs help carriers achieve better fleet and labour utilisation</td>
</tr>
</tbody>
</table>

ELMs are ICT systems that link shippers, carriers and customers together for the purpose of information sharing and long-term collaborative activities. Importantly, they involve pre-defined contracts and rates. They can be in-house or hosted by an outside party.
through better scheduling, and be more responsive to shippers’ requests through improved visibility. Affordable ICT infrastructures have lowered the perceived entry barriers and smaller carriers can now compete successfully with larger ones.

Customers

ELMs encourage “buy-in” to the logistics process and generates a better understanding of the inherent constraints and opportunities. Tracking and tracing functions also lead to greater confidence in both the shipper and carrier.

The core benefit achieved by the use of ELMs is streamlining the processes, as shown by Wang, Potter, Naim and Beevor (2011) in Figure 10.

Fugate, Davis-Sramek and Thomas J. Goldsby (2009) point out that collaboration agreements between shipper and carriers are mostly driven by managerial decisions. Such collaboration usually regards the allocation, sharing, and management of resources at operational level.

Agarwal, Ergun, Houghtalen and Ozener (2009) discuss three forms of collaboration in cargo transportation: carrier alliances in sea and air cargo, and shipper collaborations in trucking.

- **In the liner shipping alliance setting**, carriers bring their fleets into a collaborative association to operate them together and seek answers for the tactical and operational questions described previously. The service network is designed by creating the ship routes, i.e., the sequence of port visits by a given fleet and the assignment of ships to these routes. Ships move in cycles, referred to as service routes, from one port to another following the same port rotation for the entire planning horizon. The determination of service routes must take into account a minimum frequency, which is desired in order to achieve a high market share. Further, carriers decide which cargo to accept or reject for servicing and which path(s) to use to deliver the selected cargo. Once a set of service routes is decided on, members of the alliance assign their ships for operating the chosen routes and allocate each ship’s capacity among the alliance members.
Similar to code sharing in the passenger setting, air carriers collaborate in the cargo setting by sharing capacity. Decisions about how much space to assign to each member and how to distribute revenue among the members are both applicable. A key difference between passengers and cargo, however, is the relatively low sensitiveness of cargo to route selection. Because of this flexibility, the decision of how to route cargo becomes a relevant factor in considering collaboration among air cargo carriers, and is an important justification for the independent analysis of collaboration in the air cargo industry.

In the road multicarrier-shipper collaboration, there are problems such as the pricing decision of carriers, collaboration among carriers, different types of contractual agreements between shippers and carriers, carrier preferences or commitments to shippers.

Dai and Chen (2009, 2012) set their focus of research on multiple carriers and shippers interaction. They claim that partnerships arise to optimise transportation operations. The means used by these stakeholders are vehicle capacity sharing. They propose a mixed integer programming model to find solutions for less than truckload with pickup and delivery tasks across multiple carriers and shippers. This model suits also for simulation of distinct shipper or carrier collaboration practices.

Yilmaz and Savasaneril (2012) analyse the decisions taken by the coalition and study the effect of shipper characteristics on the benefit of collaboration. The analysis shows that the shippers always benefit from the coalition, but when the benefits are to be allocated, the coalition may not always guarantee the budget balance, which is elementary for the sustainability of any coalition.

3.5.2 Survey results with regard to shipper-carrier collaboration practices

This sub-section presents an overview of contemporary business practices related to shipper and carrier activity. Firstly, the collaborative relations that resemble with principles used inside clusters networks are put forward. Secondly, an outline with regard to common barriers and own solutions are given. And finally, the most used communication means for operative purposes in relation with the type of information are summarized.

3.5.3 Collaborative relations

In pursuit of economic returns, shippers and carriers have formed collaborative relationships of a greater strategic focus. Collaboration among stakeholders are made on the following areas: decision making, capacity procurement, inbound management, sharing capacities or capabilities expansion.

Collaborative decision making refers to a process where supply chain actors synchronize their decision making process, with the purpose of optimizing the chain’s performance. Examples of collaboration practices by carriers include among others synchronization of transportation and production, standardization of trailer sizes, dock exchange expertise, driver training. In addition, collaboration practices by shippers may include dock unload/load redesign, palletization/containerization redesign, increase of dock doors in facilities, sharing of production schedules, synchronization of transportation and production.

Shipper/crrier information sharing: is an essential element of inter-organizational relationships among the members of the supply chain. Information sharing determines the way and magnitude of the material flow such as finished product from suppliers to end users and also the product return and repairs from the end user. The information flow may include of the
exchange of data, coming from product manufacturing to customer feedback.

**Capacity procurement** represents the interaction between the shipper and the carrier to arrange freight capacity. Through collaborative planning, carriers usually benefit from higher demand while shippers might anticipate load consolidation opportunities and increased volume commitment.

**Inbound management** is defined as the proactive control of inbound flow and management of transportation by the receiver of the freight. Focusing on outbound shipments alone to reduce costs and increase efficiency is not simply enough for optimizing the supply chain performance. By exhibiting better control of inbound freight, carriers benefit from inbound consolidation and thus, reduced transportation costs. In addition, shippers benefit from reduced administrative expenses and shipment refusals.

While companies operating distribution centers may not always share resources directly in a horizontal collaboration, they do it through their 3PL or another external body. As customer needs fluctuate and distribution among cluster members varies, trained warehouse workers can be moved from one facility to the next. Similarly, cluster members may share local IT infrastructure and trained personnel using the capabilities offered by virtualization and cloud technologies. Moreover, facility maintenance personnel can be shared and managed by the cluster facilitator or a collaborative body.

As mentioned above, the flows over a logistics network are not predictable in many cases. The reason is that most strategic changes a company makes, such as spinning-off a division, acquisition of other companies, entering new markets, launching new products, or offering new services, manifest themselves immediately in the product flows and the need for storage space. These changes are related to the **expansion capabilities** of each company. When a company locates its warehousing facilities in a logistics cluster, whether it owns its facilities or using a public warehouse space, there will be other facilities in the area when there is a need for more space, and its own space may be easier to lease to others if its storage needs contract. Thus, a location within a cluster gives companies flexibility that can be used when the business expands or contracts. Such flexibility obviates the immediate need to move to a new location, which may be costly due to the need to change the supply chain network.

### 3.5.4 Common barriers, own solutions and communication means for operative purposes

From the interviews, it was specified that the collaboration practices between shipper-carrier are stipulated in the contracts or agreements framing the business relations. There, the use of specific platforms for data communication, the type of data shared and their tariffs are predefined. Yet, it is interesting to observe that, with regard to carriage contracts, differences between the hinterland and the maritime practices exist. The main elements that differ are the length of the agreements, the volumes and the penalties. While in the maritime carriage, the contract lengths can run up to 3-5 years (with annual re-negotiation), in the hinterland, these contracts are mostly limited to a yearly basis. Moreover, the volumes in maritime carriage, their geographical scope and penalties are most of the time pre-defined. With this regard, the hinterland carriers agree only on the tariffs having limited overview with regard to volumes.

From an operational perspective, the visibility over the supply chain operations is claimed as a main issue in contemporary operations. Shippers are interfaced by other supply chain stakeholders (with or without the use of ICT data platforms) such as agents, freight forwarders or carriers to get real-time information with regard to the status of their shipment. Carriers have set up advanced track & trace solutions that allow them to retrieve information with regard to the location, status and foreseen activities of their equipment. Yet, there are limited solutions that link these elements with the cargo handled and further bring this information and serve
the shippers’ needs. Further operational barriers and challenges together with the solutions set in place are given in Table 5.

Table 5: Contemporary supply chain barriers, challenges and own solution to information retrieval

<table>
<thead>
<tr>
<th>Supply chain stakeholder</th>
<th>Barriers and challenges</th>
<th>Own solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipper</td>
<td>Low visibility over the supply chain operations</td>
<td>Own operational check-points to track the goods flow</td>
</tr>
<tr>
<td>Carrier</td>
<td>Retrieve information over the transport dues payment</td>
<td>Clients working with credits and electronic confirmation</td>
</tr>
<tr>
<td>Maritime</td>
<td>Fragmentation of data sources</td>
<td>Manual data bundling</td>
</tr>
<tr>
<td>Hinterland</td>
<td>Unpredictable driving time due to congestion</td>
<td>Take into account extra buffer time based on own experience</td>
</tr>
<tr>
<td></td>
<td>Delay at terminals/destinations</td>
<td>Investments in own depots on concessioner grounds within the port for off-peak deliveries</td>
</tr>
<tr>
<td></td>
<td>Limited opening hours of some of the terminals</td>
<td>Manual operational planning and checking of the available time slots</td>
</tr>
<tr>
<td>Freight forwarder</td>
<td>Information spread/scarcity</td>
<td>Manual data entry and information retrieval over orders and goods flows</td>
</tr>
<tr>
<td></td>
<td>Limited area/ground capacity</td>
<td>Investments with limited forecasting coverage Gate appointment system</td>
</tr>
<tr>
<td>Terminal operator</td>
<td>Non-uniform truck arrivals</td>
<td>Gate appointment system</td>
</tr>
<tr>
<td></td>
<td>Unpredictable own equipment planning due to late arrivals of trucks</td>
<td>Overbooking of the equipment and working with long reserves</td>
</tr>
<tr>
<td>Depot/warehouse</td>
<td>Update the available capacity</td>
<td>Manual up-date into own systems</td>
</tr>
</tbody>
</table>

The range of solutions set in place by supply chain stakeholders to respond to the operational challenges are presented in Table 5. It is obvious that many operational tasks with regard to data bundling are still done manually by an operator, planner or dispatcher. Hence, retrieving real-time information is time-consuming, and thus costly. Full track & trace services are currently available only in closed distribution chains, operated by the shipper itself or urban and last mile distributors. Completing information retrieval tasks requires optimally the close collaboration of carriers with the other stakeholders. Table 6 presents the means of communication used by the supply chain stakeholders and the type of data that is communicated.

Table 6: Supply chain stakeholders operational collaboration

<table>
<thead>
<tr>
<th>Supply chain stakeholder</th>
<th>Type of collaboration (order placing/IT management tools)</th>
<th>Operational communication</th>
<th>Main data primarily communicated</th>
</tr>
</thead>
</table>
From an order placing perspective, evidence from industry has shown that in some cases, the shippers use web platforms opened by carriers to place their orders. Yet, in most of the cases, order placing mechanisms are lacking and non-standardised electronic means such as email are used. For these cases, manual processing or OCR systems are set in place. Recommendation with further development of data integration platforms would serve, in principle, supply chain clusters. These clusters’ data communication platforms can offer more visibility over the supply chain operations as a result of increased collaboration between shippers and carriers.

Even though collaborative practices between shippers and carriers promise significant cost savings and carbon emissions reductions, many industry players have hesitated to adopt collaborative distribution. Most prominently, shippers hesitate to engage in any operations that require data sharing with competitors. Data sharing can be a sensitive area for shippers, as shippers fear they would reveal strategic insights into markets relevant to their operations. A secondary perceived risk among shippers is that sometimes common points of operation cannot be easily found in order to justify initial investments into collaborative distribution. Even if shippers agree to share data and collaborate on distribution plans, common points of operation are simply not discoverable. Lastly, the information systems technology required to implement new ideas in the context of shipper-carrier collaboration, can be considerable. Despite the fact that technology is available, operational changes can require substantial planning and negotiation.

Opportunities should be identified that will extend the role of hubs beyond transshipment (e.g. storage, handling, packaging, bundling and cleaning) to serve as of logistics clusters. Such clusters could integrate current activities with more advanced logistics services. The development of governance and business models for such logistics clusters, is crucial for meeting the challenge of efficient and sustainable transport. Table 7 puts forward the claimed benefit that would be generated.

**Table 7: Benefits of integrated ICT clusters platforms**

<table>
<thead>
<tr>
<th>Supply chain stakeholder</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipper</td>
<td>Higher visibility over the supply chain operations</td>
</tr>
<tr>
<td>Carrier</td>
<td></td>
</tr>
</tbody>
</table>

Table 7 puts forward the claimed benefit that would be generated.
Benefits from general data sharing platforms are estimated to be gained by any of the supply chain stakeholders. Yet, to achieve these benefits, issues with regard to monetary valuation of data and property rights are still to be solved. The following sections puts forwards the partial conclusions with regard to supper-carrier collaboration practices.

<table>
<thead>
<tr>
<th>Hinterland</th>
<th>Higher accuracy of operations planning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maritime</strong></td>
<td>Better administration handling</td>
</tr>
<tr>
<td>Freight forwarder</td>
<td>Increased visibility over the supply chain operations</td>
</tr>
<tr>
<td>Terminal operator</td>
<td>Better equipment and labour planning</td>
</tr>
<tr>
<td>Depot/warehouse</td>
<td>Better overview of incoming-outgoing goods/containers</td>
</tr>
</tbody>
</table>

- **Clusters 2.0**
- **CLUSTERS 2.0**
4 Definition of Cluster governance model

4.1 Potential Cluster business model

In order to define a cooperative governance model which includes specific roles and responsibilities of actors in a cooperative business network, contractual and data governance we first need to define a potential business model.

Based on existing business models of relevant stakeholders in the Cluster and CluCS concept design we may conclude that for building a synergy of transport and logistics activities at the Cluster level a collaborative business model is needed, it will be developed in the D1.1.

Collaborative business model should be based on designing a Proximity Terminal Network (PTN) that can efficiently address the need for logistics cost decreasing and improving logistics service level by shifting consolidated cargo to rail (or barge) so that economies of scale can be obtained. Depending on the available infrastructure (railway lines, road or inland waterway network) within the network of terminals in Cluster's proximity (PTN - Proximity Terminal Network) through collaboration the necessary synchronization between road transport service (first/last mile transport) and more environmentally friendly transport services (rail or barge) can be combined in intermodal cluster network. In general, the focus of collaborative business network within the Cluster is a strong rationalisation of business processes that leads to economy of scale and scope and on that way to justifying rail intermodal flows from/to Cluster.

Collaborative cluster's network is in essence a two-layered network composed from:
- Upper level subnetwork that connects terminals;
- Lower level subnetwork that includes first/last mile flows from/to terminals.

Local road carriers are subcontracted for this activity (in case of absence of rail industrial sidings). On the upper level consolidated shipments in terminals have been sent to the main terminal in PTN. In this terminal, which represents a Cluster's gateway, consolidation of freight will be performed in order to generate enough volumes for establishing a train service from Cluster. Freight bundling can be performed by long haul truck service or rail/barge service. This also depends on the market segment. Figure 11 compares flow pattern in existing situation and in case of collaborative network with consolidated flows via PTN.
In existing situation, the flows are highly fragmented - shipments from different shippers are sent mostly by trucks without a system of flow consolidation. In this situation the cost efficiency is under pressure. In proposed business network freight flows of different shippers are consolidated and shipped through a PTN. The extra costs generated by freight flows bundling (extra handling, transportation) will be compensated by the economies of scale of the inter-cluster transportation.

Consolidation at Cluster level allows more efficient and more frequent transportation by concentrating large flows onto relatively few links between hubs.

PTN design problem in general form includes:
- Finding an optimal location for PTN terminal facilities and establishing a gateway terminal;
- Assigning origins/destinations to PTN terminals;
- Determining connections between PTN terminals;
- Routing flows through the network.

Based on established PTN design we can look for collaboration between stakeholders involved in PTN in order to achieve economies of scale and scope. Combination of activities of different stakeholders may lead to cost sharing, exchanging of relevant information leads to avoiding sub-optimisation (when stakeholders act independently) and acting as one organisation the stakeholders that collaborate can operate more efficiently and more effective.

For initialisation of collaboration based on the designed PTN, two structures are suggested:

**Coalition of terminals coordinated by a neutral trustee.** This is in essence a horizontal collaborative PTN model with vertical character. This model establishes a synergy through forming a coalition between terminals currently competing to each other. Coalition is coordinated by a neutral party equipped with CluCs. Considering its expertise, 4PL represents the most competent party for building and maintaining this collaborative network. Formation of this collaborative network could yield to following advantages:
• Improved and optimized services;
• Better utilisation of transport capacities;
• Market power - with the formation of network, terminals will gain market power. Also, lower costs for terminal operators due to combined purchasing power;
• Shifting cargo from road transport for out of Cluster routes (also within the Cluster in case the rail infrastructure is available);
• Better utilisation of combined capacity - synergy between capacities of terminal will increase capacity compared to capacity of individual terminals. This will lead to improved reliability and flexibility within the Cluster.
• Utilisation of storage facilities: increasing of efficiency and reduction in total cost by sharing the storage facilities.

4PL will also combine the activities of 3PLs in order to reduce costs, optimise load factors and avoid empty running and coordinates transport requests in order to establish a PTN with improved service, better capacity utilization and lower CO2 emissions. So, the 3PLs are charged for last/first mile haulage. Between terminals, a number of options are available: long haul road option toward main terminal or in case of availability rail option (block/shuttle trains) or inland waterways operators can be subcontracted by 4PL. CluCs should enable joint operational planning. Cooperative structure with links within the coalition and with other actors looks like on Figure 2. RU/RO represents Railway Undertakings (RU) or Railway Operators (RO) subcontracted for PTN rail transport service provision in case the network is available. LSPs are in essence 3PLs or road hauliers subcontracted for the first/last mile or long haul transportation between terminals.

Vertical collaborative PTN model. Previous collaborative PTN business model may evolve in a vertical business network by establishing a strong relationship with one or more shippers, 3PLs and rail operators (Figure 3). Again, the network is coordinated by 4PL empowered by CluCs. Having rail operator in strategic collaboration may enhance the coordination between
terminal and transport operations within PTN in case the flows within PTN are performed by rail. Also, establishing a strategic relationship with rail transport provider will contribute to efficient interlinking between Clusters. This will be the subject of 4.2.3 section.

![Vertical collaborative PTN model](image)

Additional benefits comparing to previous business model are:

- Long term business network sustainability - one big or a number of shippers give sustaining capability to business network.
- Smooth visible, reliable and environmentally improved intermodal rail transport service. Efficient synchronization of transport demand and transport supply through joint timetable planning, warehousing derived terminalisation function.

This intra-cluster models (which will be further elaborated in next Deliverables) should also be aligned with the inter-cluster model. The aim of business framework on inter-Cluster level is to establish a "network of networks". Therefore, this requires an efficient and bi-directional link between local networks or logistics clusters and global network. This idea is illustrated on the following figure. Orchestrator of intra cluster network acts as a regional manager, manages the flows on one Cluster's level. On inter cluster level cross chain integration is achieved by connecting individual intra cluster networks into a global inter cluster collaborating network. On this way a globally optimal transport chain optimal solution could be obtained.
This "orgware" innovation must be followed by adequate "software" innovation. That means that the network of networks must be empowered by system of systems concept. In other words, CargoStream platform should act as a system of Cluster Community Systems (CluCss). Besides this, from a "software" innovation point of view it is needed for platform to be open/synchronized with existing systems of individual stakeholders (Port Community Systems, Control Towers of LSPs, transport management systems or terminal operation systems). Therefore, the need for CargoStream platform as a federative platform surely exists. Also, in order to satisfy the aim of shifting the flows to rail intermodal (and establishing strong railway links by using the existing TEN-T corridor network) this federative platform must include the links to rail related information systems - Raildata, Rail net Europe (RNE), and existing collaborative platforms like the platform of X-Rail alliance is for example. Also very important is that in order to enable a long term sustainability of the platform it also have to be open for actual disruptive innovations - blockchain, software as a service (SaaS) and other.

4.2 Cluster governance model

4.2.1 General considerations

Logistics clusters are characterized by intensive interaction and coordination. Cluster governance represents a coordination of activities between stakeholders in a cluster. Cluster governance has two main functions Bijman et al., 2013):

- Maintaining partners’ commitment and aligning interests;
- Aligning and adjusting partners actions.

There are six different modes of coordination play a role in a cluster: markets, hierarchies, hybrids (alliances, joint ventures, networks, etc.), public-private bodies (innovation centers,
labor pools) and public bodies (educational organizations, custom activities, port authority in seaport logistics clusters). Figure 15 explains the relation between complexity and governance structure chosen.

Figure 15: Modes of coordination in a logistics cluster

The different modes of coordination have different advantages and disadvantages. All these different modes have a specific domain and play a different role in a regime.

- Market relates to high-powered incentives and the capacity of coordinating action with minimal communication.
- Hybrid modes of coordination, whatever form they take, they are systematically oriented towards organizing activities through inter-firm coordination and cooperation, so that the key investment decisions must be joined ones.
- Hierarchy relates to the use of formal authority and implies predictability, transparency and accountability through rules, procedures and evaluation systems.
- Public-Private Partnership (PPP) sets a framework for the public and the private sectors to join forces in areas where they have complementary interests but cannot act as efficiently alone. Private-public system of governance of major airports and ports is actual. The airports and ports are leased to locally managed non-profit corporations that have to operate the facilities commercially, without access to public funds. Surpluses are reinvested.
- Public ownership and operations have been important in many modes because of the strategic importance of transport and the long-term investments required that the private sector may be incapable or unwilling to make. In this way the terminals can be owned and operated as public goods, and can be integrated with public regional and national economic policies. Public-private organizations and public organisations can be regarded as elements of the infrastructure for collective action (of a cluster) if they are established to generate cluster specific collective benefits.

Companies do not have the incentive to change a governance regime. Therefore relatively inefficient regimes can exist. The differences in regimes are central in the competition between clusters\(^5\).

The **quality of governance** is determined by two factors\(^6\):

- Level of coordination costs or transaction costs (costs of searching for partners, the costs of specifying contracts);
- The scope of coordination beyond price (cooperation in innovation projects and information sharing).

Four variables of cluster governance quality exist (Figure 16):

---

\(^5\) Hollingsworth et al., 1994
\(^6\) De Langen, 2004; De Langen and Van der Horst, 2008
• Trust – high level of trust in a cluster implies low transaction costs and lower risk of opportunistic behavior. It is also important for enabling cooperation within and with stakeholders outside the logistics cluster;

• Intermediaries – forwarders, 4PLs, commodity traders. Existence of intermediaries in a cluster increases the quality of governance through decreasing coordination costs, enabling cooperation and expanding the scope of coordination beyond price due to:
  • A bridging tie between non-connected partners;
  • Reduced coordination costs because intermediaries can bridge cognitive differences between actors that operate in different market environments;
  • Intermediaries reduce the costs of starting and disentangling relationships (Notteboom, 2000).

• Leader firms - The presence of leader firms increases the quality of governance in a logistics cluster. Have the ability and incentive to invest in the competitiveness of a cluster. Three investments of leader firms with positive effects on all actors within the cluster:
  • Internationalization;
  • Innovation – ECT main container operator develops inland networks and new technologies for reducing congestion in a terminal;
  • Contribution to solving collective action problems (Olson, 1971).

• Collective action problems (CAP) in clusters (innovation, training, education, internationalization, marketing and promotion, hinterland access): Even in cases where collective benefits exceed collective costs various collective action problems may appear. In these cases, collective action regime (CAR) is applied to solve CAP. A regime is path dependent and relatively stable over time because energy and capital have been invested in a regime and these investments are sunk costs that prevent adaptations of a regime (Westlund, 1992). The quality of solutions to CAPs greatly determines the performance of the logistics cluster. Cooperation between stakeholders within the cluster is seen as a mean for solving the CAPs. Also, for the sake of solving collective action problems the role of a logistics cluster manager (a non-profit organization that generates income through cluster tax and re-invest it to improve the performances of a logistics cluster) should be planned.

It should be noted that collective action regimes greatly affect the performance of a cluster.
CARs differ substantially between countries, industries and clusters and their differences are central in the competition between clusters (Hollingsworth et al., 1994). Regarding the relationship with different modes of governance, associations, PPPs, and public organizations have better capabilities to deal with CAPs.

Five factors that influence the quality of the CAR are the presence of an infrastructure for collective action, the role of public organizations, the voice of firms, a sense of community and the involvement of leader firms. De Langen and Chouly (2004) suggested the concept of hinterland access regime in seaports in which hinterland access was identified as a governance issue because firms face a CAP. The authors defined the hinterland access regime as the set of collaborative initiatives taken by the relevant actors in the port cluster with the aim to improve the quality of hinterland access. In Rotterdam port cluster for example, rail has only a small modal share (4% and 14% in container transport). Improving hinterland access regime in Rotterdam may be reached by the joint development of intermodal transport system through collaboration of multiple actors (terminal – train, barge-train).

The influence of all four variables of cluster governance is positive: more trust, more intermediaries, and more leader firm behavior will raise the quality of the governance of a cluster. The same holds for the quality of the regimes: more infrastructure for collective action, more leader firms behavior, more involvement of public actors, more sense of community and more voice lead to better collective action regimes (De Langen, 2004).

4.2.2 Cooperative intra-cluster governance mechanism

Based on proposed intra-cluster cooperative business relationships a cooperative governance models need to be established. Actually, proposed goal directed business networks must be governed in order to be effective. Efficient governance is crucial for involved stakeholders to gain competitive advantage and create value from this business model. Governance structure should explain the network organization structure in the sense of which actors are involved, how chain is managed, how roles and responsibilities are distributed, how decision making and change processes are organized.

Regarding contractual governance, contract design should be based on criteria that provide an environment of trust. Two types of governance mechanisms exist in inter-organizational governance: contractual and relational governance mechanisms. Contractual governance is considered as formal governance strategy and refers to explicit, formal and usually written contracts which are detailed, legally binding agreements that specify the obligations and roles of parties in a relationship. However, contracts may be incomplete. Because human being’s bounded rationality, it is impossible to write a complete contract that anticipates all possible events and clarifies the appropriate actions of each party. On the other side, relational governance refers to the social relations and shared norms. Relational governance relies on informal structure and self-enforcement of each party. [47] Relational governance emphasizes the role of developing trust. Relationships based on relational governance are governed by social processes that promote norms of flexibility, solidarity and information exchange. However, the development and maintenance of relational governance may be time and resource consuming. Therefore, reliance on single governance mechanism is not sufficient. From these reasons we suggest a complementary governance mechanism characterized by a dynamic interplay between contractual and relational governance.

Close cooperation of actors in proposed governance framework assumes an efficient information sharing framework which will contribute to an improved decision making process. Therefore, it is needed to design a data governance framework. More specifically, we need to investigate how and to what extent data framework in proposed governance model can be explained by the adopted governance structure. The answers should be provided on “what” – which information to share and “how” – the mechanism facilitating the information sharing.
All these aspects of governance will be clearly defined in following tasks.

4.2.3 **Enabling collaboration practices in the nodes**

Potential key enablers towards effective implementation of collaboration practices include:

- **Build a network of trust**: The generation of a supply chain network based on mutual trust and collaboration is a key enabler for increasing collaboration practices among various nodes in the logistics network.

- **Information, data and technology**: Data from various stakeholders in the supply chain have to be available in a way that all stakeholders integrated into the transport chain are able to properly use them. Therefore, it is essential to use ITS and ICT systems for dynamically sharing data and optimizing operations.

- **Optimal planning solutions**: Sophisticated solutions for transport optimization will enable collaboration practices. Customer preferences, often frequented routes and available resources of hubs and transport modes have to be evaluated and examined for achieving efficient operations.

- **Legal and Political Issues**: Harmonized transport regulations for data sharing are key enablers for supporting collaboration practices.

4.3 **Case studies perspective: development (approach)**

Collaborative relationships there are uni-dimensional models - between the actors operating on the same level of supply chain (horizontal collaboration) or on different levels (vertical collaboration). Recently, bi-dimensional collaborative network have emerged in order to enhance supply chain flexibility.

Horizontal collaboration practices refer to agreements established between logistics stakeholders of the same type and used by shippers, transporters, terminal operators, and/or forwarders.

According to the literature review several elements must be considered when describing the business process. According to their nature, these elements can be classified to: area characteristics, network characteristics and quantitative (financial) aspects. These elements
are further seen as assessment blocks to establish the clusters’ characteristics. These assessment block offer further input to define the business model(s). The elements necessary to define the characteristics of each business model have been defined in D2.2.

Business model definition necessary elements:

Table 8: Business model necessary elements

<table>
<thead>
<tr>
<th>A. Area characteristics</th>
<th>Descriptive, qualitative analysis</th>
<th>Quantitative evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>User catchment area. Potential partners identification (description)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Partners size (scalability)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Coalition size</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Geographical characteristics</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Shipments necessities: fixed dimensions (size and/or weight; time)</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Network characteristics (design)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements linked to the loading/unloading of units</td>
<td>X</td>
</tr>
<tr>
<td>The type of storage of units on the yard</td>
<td>X</td>
</tr>
<tr>
<td>The arrival and departure process of units by truck; train; other</td>
<td>X</td>
</tr>
<tr>
<td>The network structure</td>
<td>X</td>
</tr>
<tr>
<td>Trusted party to ensure the neutrality</td>
<td>X</td>
</tr>
<tr>
<td>Transparency</td>
<td>X</td>
</tr>
<tr>
<td>Safeguarded confidentiality of data provided</td>
<td>X</td>
</tr>
<tr>
<td>Nodes location</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Quantitative and financial</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The storage capacity</td>
<td>X</td>
</tr>
<tr>
<td>The demand</td>
<td>X</td>
</tr>
<tr>
<td>The operational costs per unit for loading/unloading; storage; transport etc.</td>
<td>X</td>
</tr>
<tr>
<td>Late deliveries penalties</td>
<td>X</td>
</tr>
<tr>
<td>Routes length</td>
<td>X</td>
</tr>
</tbody>
</table>

*base on the desk research and interviews presented in D2.2.*
5 Design of Cluster concept and establishment path

Clusters’ scope is the increasing of added value for terminals and hubs in a region beyond transshipment, integrating manufacturing and resource sharing, thus targeting the full functional integration of all its components. In order to be able to act in this way, Clusters have to be designed targeting also the extension of the roles of involved parties and stakeholders.

5.1 Cluster target

Logistics operations may locate in a logistics cluster due to the cluster’s role in supporting:

- economies of scope, mainly for direct operations transport modes;
- economies of density, mainly for consolidated transportation modes.

Clusters can then provide spill-over capacity for warehousing and transportation; and the ability to cooperate between providers when dealing with demand fluctuations.

In the Clusters2.0 vision and scope, Clusters have then to focus on establishing a platform for logistics services providers, such as transportation carriers, warehousemen, forwarders, third party logistics companies (3PLs), customs brokers, workforce and utility providers; all the actors in the territorial economy should then progressively join the Cluster concept functioning and integrate with it to exploit Cluster capacity at its best.

Indeed, Clusters are in charge to provide two main functionalities:

a) to facilitate the most efficient matching of supply chain stakeholders demand and supply and;

b) to enable the resource sharing, infrastructure and utilities as a means to minimize costs and maximize efficiency.

Basing on this, the main Cluster features can be identified to serve the involved parties and the territorial context.

5.2 Cluster concept

Clusters have to provide the freight transport actors with functionalities to exploit their full potential.

The various steps of freight supply chain have to be considered to serve the parties’ needs. Indeed, in the first phase (task 2.5 will enlarge the cluster use/exploitation to industry/manufacturing), the transport needs are basically targeted.

The transport chain can be broke down in three main phases:

A. planning;
B. execution;
C. monitoring.

On their turn, all these phases have specific components, that are detailed in the below paragraphs.

Furthermore, Clusters interact with under and above –standing supply chain sections, thus including the Proximity Network Terminal and the synchronization tools that could harmonize the clusters functioning. This can be summarized in a initial concept for a Cluster management tool, named “Cluster Community System” – CluCS for short, which is schematized in Figure 17.
In the Clusters2.0 phase, enhanced functionalities able to involve industry and manufacturing sectors within the Cluster would be considered through specific services to be offered by CluCS as well.

5.2.1 Planning
Building up on and extending the concept of PTN, planning functionalities should cover the possibility for the customers to visualize / find the needed transport services and book them; on the other side, the transport service providers (thus including LSPs, terminal and warehouse managers, etc.) have the interest to publish their services and make them available to the widest audience potential and then to receive bookings from customers.

It is also interest of all actors to have the possibility to plan the transport chain in the best potential shape, to exploit the resources at their best and perform the needed activities and/or receive the wished services with no delays or extra costs.

The transport chain planning should also be done in compliance with under and above-standing transport chain sections, thus implying the need of coordinating Clusters with PTNs and / or Cluster of Clusters.

Therefore, for the planning phase the following features are needed in a functioning Cluster environment:

- service publishing;
- service booking;
- service planning and coordination with under/above-standing transport chain sections.

5.2.2 Execution
The Execution phase has to be considered as a dynamic process, able to take into account the possibility of enhancing the services offered through real time adaption to supply chain conditions. This means it has to interact constantly with the Monitoring phase, which on its turn has also to be linked to the Planning phase to keep updated the status of published services.

The Execution functionalities would then involve the proper exploitation of the cargo bundling at cluster level, the terminal operations and the logistics services, thus offering the following features:

- road transport cargo bundling;
- terminal operations;
- logistics services;
- real time adaptation.
5.2.3 Monitoring
Monitoring in the Clusters2.0 perspective is a dynamic phase able to interact with both Planning and Execution to: (i) keep the status of services within the Cluster constantly up-to-date; (ii) suggest the needed adaptations to react promptly to unexpected events that could delay a supply chain or cause costs.

Therefore, Monitoring has to be linked to both the Planning and Execution phases to keep updated the status of published services and to allow a real-time adaptation of services offered to changing environmental conditions.

Basic functions for Monitoring are then:

- real time monitoring;
- iterative link with Planning and Execution;
- full visibility of under and above -standing supply chain sections monitoring tools.

In order to answer the above detailed needs, the Cluster can be designed as a bundle of functions and managed through a tool built with modular approach. Such tool is developed under task 2.3, where the CluCS scheme is defined considering the above identified basic functionalities.

5.3 Cluster establishment path

Basing on the above detailed concept, Clusters can be established with an incremental approach.

Basic building blocks can be identified as territorial entities with a specific hinterland, where clusters themselves can play a functional and systemic role to increase the added value for the region itself.

Such building blocks can be terminals, hubs, PTNs: they are in principle able to play a territorial role and target the integration of various actors and economic components combining basic freight transport functions (such as transhipment, resource sharing for maintenance and handling, etc.) and advanced integration services to extend the roles of involved parties and stakeholders and enlarge the Cluster caption/influence area/zone.

Cluster establishment could then start from identified building blocks through the adoption of CluCS basic functionalities: this would allow the integration of offered/desired services for joining actors. Progressive publishing of service provider offers would then build the basis to apply the Cluster approach; as soon as customers start interacting with the Cluster, the enlargement of the basis of actors would give the Cluster the strength to grow up further by integrating new services, thus establishing a virtuous circle.
6 Conclusion

This research gives an overview of the supply chain interactions and the engagement of supply chain stakeholders in collaboration practices. Both a desk research and a survey with relevant stakeholders have been pursued. The supply chain flows overview shows that despite the fact that different levels of integration were already achieved in supply chains yet, further more comprehensive collaboration practices are pursued. An in-depth approach with regard to research and business practices on the topic of shipper and carrier interaction is taken. The type of data/information that each of these stakeholders control is identified, their contemporary barriers to integrate this data are mentioned and benefits with regard to further integration benefits are acknowledged.

A first conclusion of this research is made with regard to the initiatives that were already taken by supply chain stakeholders to integrate. This integration has a cross-supply chain flows approach. Within this regard, cargo consolidation practices are an example of collaboration in the goods flow. If data with regard to the goods characteristics or the dues payment is considered, then a cross-supply chain flow collaboration is achieved. Electronic B/L or AWB are contemporary achievements that pursue those goals. Furthermore, comprehensive collaboration is then pursued in using new technologies such as blockchain or IoT.

Secondly, a more in-depth literature overview centered on the supply chain stakeholders is conducted. This overview shows their key role in achieving this type of integration and further collaboration needs on operational level through data sharing. Few initiatives have been taken to integrate and coordinate data sharing related to real-time operations. This type of collaboration would chance the competitiveness of supply chains.

Finally, the results retrieved though interviews with supply chain stakeholders (shippers and carriers) show that most of the communication with regard to operational needs is done via phone/email or even fax. The later integration of data related to the transport operation would increase the shippers’ visibility over the supply chain operations and would enable carriers to better plan their operations.

This research is relevant for industry as well as for initiators of collaboration practices in the supply chain. The presented literature review, interviews results and their interpretation represent a basic foundation on which the scope of different collaboration practices in the supply chain is defined. Nonetheless, research can be initiated to further validate the findings of this study more in depth. The expansion of interviewees list that cover other geographical regions, may offer more interesting results. Equally, researchers might pursue the calculation of cost-effectiveness of integrating these collaborative activities in central ICT platforms or clusters formation.
Annexe 1. Guiding questions to seek the shipper-carrier contemporary collaboration practices

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have collaboration agreements with other logistics stakeholders? Which type of collaboration</td>
</tr>
<tr>
<td>agreements do you have? Please indicate the type of stakeholders.</td>
</tr>
<tr>
<td>What is the scale/scope of those agreements? (Ex. geographical and type of cargo or other)</td>
</tr>
<tr>
<td>Which value added benefits can be further obtained based on collaboration practices in your sector?</td>
</tr>
<tr>
<td>Give some examples from your daily operations.</td>
</tr>
<tr>
<td>Which barriers you often meet when trying to collaborate? Or when trying to build a cooperation</td>
</tr>
<tr>
<td>agreement with another stakeholder(s)?</td>
</tr>
<tr>
<td>Which barriers/challenges do you meet on an operational level? Which solutions have you implemented</td>
</tr>
<tr>
<td>or will implement to overcome these barriers?</td>
</tr>
<tr>
<td>Which methods/tools do you use for communication on operational level? (within the company and</td>
</tr>
<tr>
<td>external)</td>
</tr>
<tr>
<td>Does your company’s strategy looked/looks into mergers or acquisition? Could you list a few reasons</td>
</tr>
<tr>
<td>for that?</td>
</tr>
</tbody>
</table>
References


Economic impact of port activity: a disaggregate analysis: the case of Antwerp

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Full text (open access): https://repository.uantwerpen.be/docman/irua/183795/62516.pdf


