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.3.4

# Collaboration Methodology in Between Logistics Clusters

**Due delivery date: 30/06/2019**
**Actual delivery date: 11/11/2019**
Organization name of lead participant for this deliverable: PGBS

| Project co-funded by the European Commission within Horizon 2020 | | |
|---|---|---|
| Dissemination level | | |
| PU | Public | x |
| PP | Restricted to other programme participants | |
| RE | Restricted to a group specified by the consortium | |
| CO | Confidential, only for members of the consortium | |

Project funded by the European Union's Horizon 2020 Research and Innovation Programme (2014 – 2020)

Clusters 2.0

Document Control Sheet

| | |
|---|---|
| Deliverable number: | 3.4 |
| Deliverable responsible: | PGBS |
| Work package: | 3 |
| Editor: | Seyed Abolfazl Mohseni |

| Author(s) – in alphabetical order | | |
|---|---|---|
| Name | Organisation | E-mail |
| Seyed Abolfazl Mohseni | University of Antwerp | seyedabolfazl.mohseni@uantwerp.be |
| Valentin Carlan | University of Antwerp | valentin.carlan@uantwerpen.be |
| Christa Sys | University of Antwerp | christa.sys@uantwerpen.be |
| Thierry Vanelslander | University of Antwerp | thierry.vanelslander@uantwerpen.be |
| Frans Cruijssen | ArgusI | f.cruijssen@argusi.org |
| Milos Milenkovic | ZLC | mimilenkovic@zlc.edu.es |
| Shenle Pan | Mines-ParisTech | shenle.pan@mines -paristech.fr |

| Document Revision History | | | |
|---|---|---|---|
| Version | Date | Modifications Introduced | |
| | | | |
| 0.1 | | First internal draft | |
| 0.2 | | Peer review version | |
| 0.3 | | Integration of comments of peer-review | |

## Legal Disclaimer

# Abbreviations and Acronyms

| Acronym | Definition |
|---|---|
| WP | Work Package |
| SOS | System of systems |
| LLC | Limited Liability Company |
| IS | Integrated System |
| ITN | Intermodal Transportation Network |
| ICT | Information and Communication Technology |
| DSS | Decision Support System |
| LTL | Less Than Truckload |
| FTL | Full Truckload |
| LSP | Logistics Service Provider |
| LP | Linear Programs |
| CO3 | Collaboration Concepts for Co-modality |
| TMS | Transport Management System |
| SCN | SELIS Community Node |
| P-S | Publish-Subscribe |
| WDP | Winner Determination Problem |
| BGP | Bid Generation Problem |
| RB | Request Bundles |

Clusters 2.0

# Table of Contents

## List of Tables

## List of Figures

## Executive Summary

WP3 aims to establish logistics clusters integration into a high performing synchromodal transportation network on a EU scale. WP3 addresses the shift towards low emission transport modes and consolidated freight management between logistics clusters. WP 3 will achieve this by means of :

• A massification framework for inter cluster cooperation along intermodal transport chains.

• Create network visibility across clusters on freight streams.

• Establish the basis for collaboration resulting in cargo pooling and optimising asset usage

• Establish new roles and governance models for logistics clusters including all stakeholders

WP 3 is linked to Symbiotic Network of Logistic Clusters Living Lab providing requirements, implementing and testing for massification and establishing the transfer of the massification concept to other clusters within and outside Clusters 2.0 scope.

In WP 3, the task 3.3 is about the Clusters 2.0 Massification governance model. This deliverable deals with the activities of task 3.3 as “Definition of governance body structure”. It aims to define a governance body structure and framework for the Massification concept. Moreover, it brings a strong review of gain sharing mechanisms with positive and negative elements of each method.

# 1. Problem Statement

Building further on Task 3.2 which is focused on data collection of shipper data and governance within clusters, Task 3.3 will focus on developing a governance framework in between clusters, ensuring consistency in process adherence and gain sharing in between supply chain stakeholders across the EU-28 member states. The activities of Task 3.3 will be focused firstly on the following area:

1) Definition of a governance body structure for the Massification platform:

The objective of this activity is to define the set-up and structure of a Massification governance board in the Clusters 2.0 set-up. It is indeed needed to have a governance board which is able to manage the relationships in between the different stakeholders with regards to overall conduct and gain sharing in the Massification community. The definition of member profiles and overall tasks for this governance board are part of this definition.

2) Definition of a code of conduct for all stakeholders of the Massification concept:

Once the Massification governance board structure is defined, a code of conduct needs to be developed which needs to be undersigned by all Massification stakeholders. The objective of the code of conduct is to ensure that relationships in between Massification stakeholders are taking place in accordance with legislation and ethical business principles. This should not only avoid that anti-trust issues arise through platform collaboration but also ensure that no free-rider behaviour takes place in the relationship between Massification stakeholders.

3) Definition of gain sharing mechanisms on the Massification platform:

As the Massification concept will generate benefits for the stakeholders it will be critical that these benefits are equally shared amongst all the Massification stakeholders. It is the objective to build further on the work done by the CO3 and Nextrust projects to drive these gain share mechanisms to a next, networked level... not only to share the gains, but also pains which may arise from collaboration through Massification in the Clusters 2.0 set-up.

Moreover, in order to be more efficient and competitive, companies have clearly focused on their internal organization and processes and through vertical collaboration with supply chain partners. As pressure to become ever more competitive continues, companies are now looking externally beyond the boundaries of their own organizations and value chains and transport as a mobile asset is arguably more versatile in being able to achieve this concept. Horizontal collaboration more fully exploits the conceptualization of supply chains as supply networks.

In addition, horizontal collaboration is different from the relationship between partners in regular chain and the value of the customer–supplier relationship is driven by transaction.

Management and governance issues deal with the question of how to manage and maintain horizontal collaboration. These two issues are considered the two main problems covered by the survey. It includes business issues between collaborating companies, e.g., organisational culture, managers and employees' behaviour, conflict of interest.

### 1.1. Document structure:

This deliverable deals with the first activity of Task 3.3 as “Definition of governance body structure”. It attempts to give a clear definition of a collaborative platform and horizontal collaboration.

This deliverable is structured as the following parts. In section 2, the Massification platform is defined with its main features and characteristics. Section 3 reports the literature review regarding federative, centralized and decentralized organizations. Besides that, in the following of this section, vertical and horizontal collaboration and different methods of gain sharing are discussed as well. Finally in section 4, some experiences of previous projects related to governance body and collaborative platform are reported.

## 2. Definition of Massification Platform

The Massification platform should be based on a goal-directed organizational network (Figure 1.) and an appropriate form of governance is needed to ensure that all participants involved (Clusters, LSPs, Transport operators, Infrastructure managers, Ports, etc.) engage in collective and mutually supportive action, that conflict is addressed and the available resources are acquired and utilized efficiently and effectively.

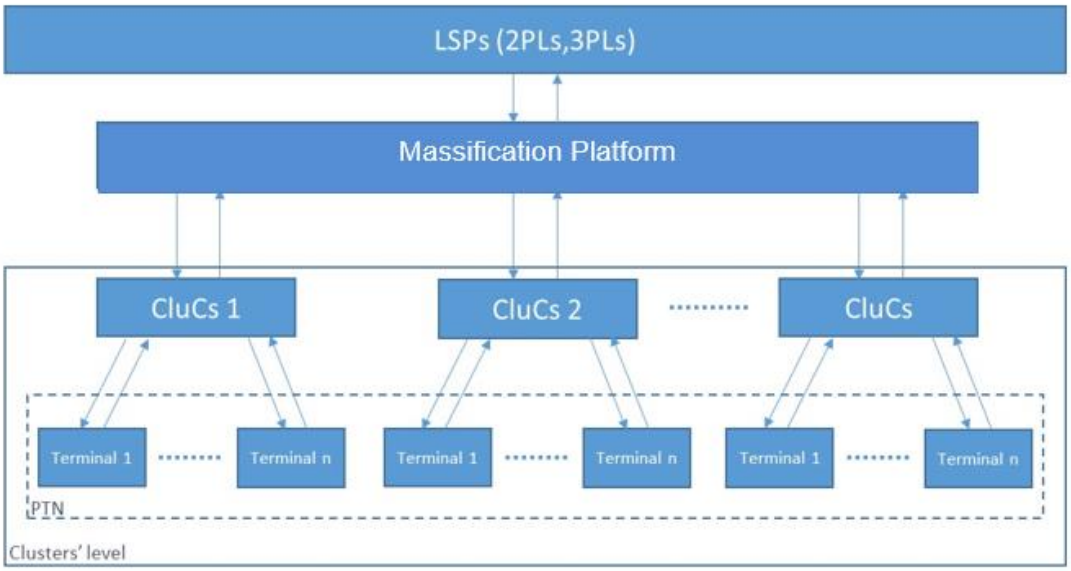


Figure 1: Organizational network of the Massification Platform

Integrating and coordinating different heterogeneous systems (CluCS, LPS’s proprietary solutions, Terminal Management Systems) leads to the SoS (System of Systems) Massification Platform perspective. In other words, there is a number of large scale integrated systems that are heterogeneous and independently operable on their own, but are networked together for a common goal. In the following table, three dimensions of platform governance are reported:

| Dimension | Definition |
|---|---|
| Decision rights | How decision rights are divided up between the platform orchestrator and stakeholders |
| Managing the network | What types of formal and informal control mechanisms are used by the platform owner (gatekeeping, performance metrics)<br>How a platform orchestrator controls the whole network |
| Pricing policies | Pricing structures, including decisions about which side gets subsidized. Pricing structure must be aligned with the platform business model, its stage in its lifestyle, and its architecture |

Table 1: Dimensions of platform governance

Depending on the kind of decision made and the structure implementing it, governance may be good or bad one. There are eight inter-related characteristics which define a good governance such as: Participatory; Rule of Law; Effective and Efficient; Transparent; Responsive; Equitable and Inclusive; Consensus-Oriented; and Accountable. In table 2, these eight features are defined with the most important parameters.

| Characteristic | Definition | Properties | Requirements / Demands |
|---|---|---|---|
| **Participation** | Active involvement of all affected and interested parties in the decision-making process | Participation may either be direct (is done through elections, initiatives) or indirect (participation is done through public consultations) | Participation of different sectors of the platform.<br>An enabling environment where relevant information is effectively published |
| **Rule of Law** | Through the law that actors express their request which means peace and order, absence of corruption, impartial and effective justice system, observance and protection of human rights, and clear, publicized, and stable laws | Absence of rule of law is anarchy (happens when actors act in absolute disregard of law and when the government act arbitrarily beyond their powers) | Actors give obedience to the law.<br>Laws are responsive to the needs of the platform |
| **Effectiveness and Efficiency** | Effectiveness means meeting the needs of the society by different actors. Efficiency means proper utilization of resources | Enhancement and standardization of the quality of public service delivery consistent with international standards, professionalization of bureaucracy, elimination of redundancies or overlaps in functions and operations, and an improved financial management system | Programs and objectives of the various government agencies are aligned with individual performance goals |

| | | | |
|---|---|---|---|
| **Transparency** | Actors are open to information regarding decision-making process and the implementation of it | Promotion and protection of democratic ideals<br>Information on matters of public concern are made available to the actors or those who will be directly affected | Transactions involving public interests must be fully disclosed and made accessible to the actors |
| **Responsiveness** | Institutions and processes serve all stakeholders in a timely and appropriate manner | Actors and structures of governance easily give clear expression | Demanded both from the private sector and public sector |
| **Equity and Inclusiveness** | All the members, especially the grassroots level, must be taken into consideration in policy-making | Refers to a kind of justice that gives more opportunity to the less fortunate members | |
| **Consensus Oriented** | Governance is consensus oriented when decisions are made after taking into consideration the different viewpoints of the actors | Decisions-making must entail recognition of their respective interests as well as their respective duties | Strong, impartial, and flexible mediation structure must be established |
| **Accountable*** | It means answerability or responsibility for one's action | Based on the principle that every person or group is responsible for their actions | |

Table 2: Inter-related characteristics of governance body structure
Source: Tamayao (2014)

* With respect to the feature 'accountability', there are various forms; first is hierarchical which refers to the ordered accountability of the various agencies and their respective officers and personnel in relation to their program objectives, and second is managerial which refers to employee accountability.

Besides, the selection of a governance model depends also on the organisation model of horizontal collaboration. For carrier collaboration, for example, a corporate model is more suitable for carrier coalition, and a cooperative model for carrier alliance. Alliance and coalition are two distinct organisation models, though sometimes they are used interchangeably in the literature. In general, companies in alliance collaborate with each other but operate as independent units, while companies in coalition operate in a fully coordinated way and work like a single integrated company. For both, a limited liability company (LLC) is usually formed to organise and manage the alliance or the coalition (Albers and Klaas-Wissing 2012).

A LLC can be economically independent (owned by someone outside the alliance) or dependent (owned by the partners in the alliance). The former is more autocratic – members can either accept the board's decision or leave the alliance – while the latter is more democratic - members make strategic decisions together (Albers and Klaas-Wissing (2012)). Accordingly, governance model could be different for each organisation model.

Moreover, there are two types of complexity of the Massification platform such as structural and behavioural. The reason for rising complexity is the number of different subsystems whose interactions and interdependencies are difficult to describe and manage.

Architecture is the lever to tackle structural complexity, whereas, governance is the lever to tackle behavioural complexity. The architecture of Massification platform is inseparable from how it ought to be governed. This requires code signing and coevolving them as a Massification platform ecosystem processes through different stages in its lifecycle.

# 3. Literature Review

In this part, a literature review is done on the following topics:

3.1. Federated organization
3.2. Centralized structure
3.3. Decentralized structure
3.4. Collaborative Platform
3.5. Horizontal collaboration
3.6. Gain sharing methods

All the above mentioned sub-sections will be discussed in details in the below.

## 3.1. Definition of federated organization

A federative organization is an organizational framework within which independently-owned companies (member units or the entrenched organizations) gather together and form a mutually-owned unit (the central organization) which will perform some functions for and co-ordinate some activities of the funding organizations. The member units retain their ultimate right to decide whether or not to participate in the activities of the federative organization (Jonnergard et al, 1984).

Moreover, Jonnergard (1988) stated that participation in a federative organization is based on a long-term constitutional contract, which specifies the functions and roles of different parties of the organization. According to Svensson (1983), all member units participate in decision-making processes on issues that concern the federative organization as a whole. This demands both formal decision-making processes including all parts of the federative organization and somewhat equal power relationships between different parts of the organization.

Based on above definitions, the federative organizational is formed by emphasizing the character of voluntary, democratic cooperation between enterprises and sharing a common ideology. A federated architecture is expected to deliver high flexibility and agility among independently cooperating components and at the same time reduces complexity.

According to Houldsworth, Russo & Company, (2016), there are four main legal models of

federated organizations:

1. Single corporations:

The primary advantage of the single corporation model is that the founder generally retains control over activities. In this case, the founder is liable for out-of-state activities, so a successful claim exposes all the chapters to risk.

2. Separate corporations:

Independent corporations can be created in each state where the founder operates. Each state is liable for its own activities. The agreement with the founder governs use of trademarks, resources, etc. This type of setup gives individual chapters the most autonomy.

3. Separate subsidiary corporations:

One alternative is to create separate subsidiaries in each state where the founder operates an out-of-state program. The founder retains ultimate control but the subsidiaries are legally protected from liabilities of other subsidiaries.

4. Separate LLCs:

An emerging model is to form limited liability companies (LLCs) with the founder as the sole member. As single-member LLCs, the subsidiaries are treated as separate entities under state law for asset protection purposes.

Source: own compilation based on Russo & Company, 2016

## 3.2. Definition of Centralized structure

Surbhi (2015) states that, centralization and decentralization are the two types of structures that can be found in the organization, government and management.

According to literatures, Henry Fayol describes this definition as "*Everything that goes to increase the importance of the subordinate's role is decentralization; everything which goes to decrease it is centralization.*" While, L.D. White has another definition *as "The process of transfer of administrative authority from a lower to a higher level of government is called centralization; the converse, decentralization."*

Centralization of authority means the power of planning and decision making are exclusively in the hands of top management (Surbhi, 2015). Moreover, centralized organization can be defined as a hierarchy decision-making structure where all decisions and processes are handled strictly at the top or the executive level. Managers and employees lower in the chain of command are limited in the decision-making processes (Chantal 2012). It involves systematic and consistent reservation of authority and is best suited for small sized organization. (Surbhi, 2015).

### 3.2.1. Advantages and disadvantages of centralized structure

Based on literature, table 3 reports the main benefits and drawbacks of the centralized structures.

| ADVANTAGES | DISADVANTAGES |
|---|---|
| Responsibilities and duties are well defined within the central governing body | Decisions may be misled while passing on and lower position departments do not have decision making power. |
| Decision-making is very direct and clear | Attentions and support on each department may not be balanced |
| It provides the maximum control over the entire organization. | Delay of work information may result in inefficiency of the government |
| It ensures that all the work is performed in the same manner and in accordance with the same general policies and principles. | Discrepancies in economy and information resources between the centre and other places are significant |
| It ensures economy in administration by avoiding duplication of work. | It does not facilitate people's participation in administrative process |
| Centralization is implemented, when the organization has inadequate control over the management. | Decision takes time due to the concentration of powers in the hands of a single person |

Table 3: Advantages and disadvantages of centralized structure
Source: Marume & Jubenkanda (2016), Surbhi (2015) and Mukhtar (2010)

### 3.3. Definition of decentralized structure

On the other hand, decentralization refers to the dissemination of powers and assignment of authorities and responsibilities by the top management to the middle or low-level management. In addition, it is best suited for large-sized organization (Surbhi, 2015).

According to Marume & Jubenkanda (2016), decentralization means dispersal of authority among the lower levels of the administrative system. Thus, the issue of centralization versus decentralization revolves around the location of the decision making power in the administrative system.

Moreover, Chantal (2012) states that decentralization means executives or business owners assign tasks to management and employees and maintain a very open communication.

### 3.3.1. Advantages and disadvantages of decentralized structure

The table 4 gives an overview of the main benefits and drawbacks of the centralized structures:

| ADVANTAGES | DISADVANTAGES |
|---|---|
| It increases administrative efficiency by reducing delays and encouraging faster action | It complicates coordination and integration of the activities of various units due to decrease in the degree of central control over the total organization |
| It encourages competition and comparative standards of evaluation among several competing field units | It makes communication among various levels difficult and thereby reduces its effectiveness. |
| It facilitates people's participation in administrative process and thus strengthens democracy at the grassroots level | There might be different objectives and goals between lower-level managers and the organization |
| More flexible and open to change, it is possible for innovation and individual thought processes that could benefit the company as a whole. | Lower-level managers may make decisions without fully understanding the effects those decisions could have on the organization as a whole |
| It reduces the workload of the head office and thus enables the top echelons to concentrate on vital issues like policy formulation, examining major problems | It makes administration expensive due to duplication of work and lack of centralized services |
| It makes administration more responsive as the field units act with the knowledge of local conditions and requirements. | It is not suitable for dealing with emergencies and unanticipated matters |

Table 4: Advantages and disadvantages of decentralized structure
Source: Marume & Jubenkanda (2016), Surbhi (2015) and Mukhtar (2010)

## 3.4. Collaborative Platform

According to Miksa (2013), when the pooling collaboration involves multiple logistics players, freight exchange platforms are typically used "to match available vehicle space with available freight" in order to maximize resources utilization rates and minimize empty legs.

In general, these tools are web-based IT information hubs enabling data standardization, routes comparison and shipments consolidation. The mentioned functionalities are supported by various sector-specific e-platforms such as CargoX for air cargo, Teleroute for road transportation, etc. Typically, these e-platforms require the following decision technologies:

- "How to" questions: optimization techniques useful to answer "how-to" questions (i.e., to support collaboration members in optimizing the overall transportation network performance through shipments consolidation, pooled routes planning and vehicle capacity sharing)

- "What-if" analyses: simulation techniques to support decision makers by performing

  "what-if" analyses. Sometimes, one of the collaboration members is in charge to develop the shared IT platform. For example, Lufthansa has developed a Global Distribution System (i.e., Amadeus) enabling information sharing and logistics coordination among several Star Alliance members. In other cases, external entities provide technical guidelines, support and tools to collaboration members.

In addition, other communication support platforms are available in the literature. The following paragraphs report some of these systems.

Dullaert et al., (2009) developed an intelligent agent-based communication support platform for multimodal transport. The new expert communication platform put forward here (called MamMoeT) addresses these two issues by using a software agent-based approach. Software agents are pieces of software representing a single user. They are autonomous, communicative and intelligent. Moreover, the MamMoeT system developed can be described as a real-time decision support system in which intelligent software agents handle communicative tasks, exchange desired amounts of information among different users using common exchange protocols which act as translators between different systems.

Moreover, Boschian et al., (2011) specifies an Integrated System (IS) devoted to the management of Intermodal Transportation Networks (ITNs) to take both tactical decisions, i.e., in an offline mode, and operational decisions, i.e., in real-time. Both the resulting IS structures rely on a closed-loop approach that is able to tune the choices with the current system conditions. In either case, the core of the presented IS are a reference model and a simulation module. In particular, the reference model uses information from the real system, obtained by modern Information and Communication Technologies (ICTs) and the simulation module evaluates the impact of the management decisions. In order to obtain a systematic model suitable to describe a generic ITN, a metamodeling approach is proposed that describes in a thorough and detailed way the structure and the behaviour of ITNs.

Demirkan and Delen (2013) define a list of requirements for service oriented DSS and proposed a conceptual framework for DSS in cloud. A unique contribution of the service is its perspective on how to servitize the product oriented DSS environment, and demonstrate the opportunities and challenges of engineering service oriented DSS in cloud. Organizations need to consider value of service level and quality in addition to the cost and duration of delivered services. As well, DSS in CLOUD enables scale, scope and speed economies.

Rusicz (2017) proposes a cloud-based collaborative platform supporting decision makers in planning and managing logistics and transportation processes in interconnected collaborative networks. In particular, the case of a Decision Support System (DSS) for the Trieste intermodal transportation network has been presented. The architecture of a cloud-based DSS that integrates cooperative logistics management and decision support for intermodal

transportation systems. In particular, the specified DSS focuses on the new paradigm of cooperative logistics: different stakeholders share information, historical and real-time data and decisions by pursuing shared objectives. In order to describe the main modules of the DSS, the cargo transport optimization, the intelligent truck parking and the $CO_2$ footprint estimation and monitoring services are introduced.

### 3.5. Horizontal collaboration

There are different types of business relationships in terms of the core company. In simple terms, relationships can be formed in one of two dimensions; either vertically or horizontally. Barratt (2004) presented this concept in a very useful model in which he identified the four different potential relationship partners, suppliers and customers on the vertical axis and competitors on the horizontal plain. He also noted that another form of collaboration can occur internally within the core company as departments, previously functionally orientated, break down barriers and work towards optimization from a process perspective (Figure 2). In addition, a form of combined relationship which links the benefits of vertical and horizontal collaboration has been identified known as lateral collaboration.

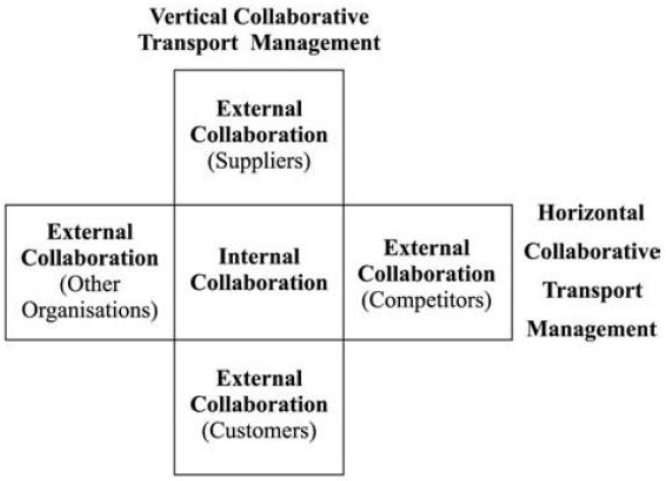


Figure 2: Horizontal vs. vertical collaboration
Source: Adapted from Barratt (2004)

In literatures, there are other definitions for horizontal collaboration. In the following part, some of the main definitions are reported.

Lambert et al. (1999) define a partnership as "*a tailored business relationship based on mutual trust, openness, shared risk, and shared rewards that yields a competitive advantage, resulting in business performance greater than would be achieved by the firms individually*."

Moreover, according to European Commission (2011), horizontal collaboration refers to a collaboration between two or more unrelated or competing companies active at the same level of the supply chain. Horizontal collaboration can be a means to share risk, save costs, increase investments, enhance product quality and variety and launch innovation faster.
By sharing available knowledge, resources, manufacturing capacities and etc, companies are able to create synergies which they could not exploit when working alone (Soosay, Hyland,

and Ferrer 2008). Lastly, Cruijssen (2006) defines horizontal collaboration in transport and logistics as "*active collaboration between two or more firms that operate on the same level of the supply chain and perform a comparable logistics function on the landside*."

Given the number of potential companies involved in this concept of multi-relations in a network, it is often managed not as a cohesive whole, but as a self-evolving system, Ritter et al. (2004) notes. This introduces also the ideas behind reducing the number of contact points so that they can be better managed and the segmentation of relationships to determine different levels of collaborative action. However, where they can be conceptualised as a complete network and a single point of control established there is considerable room for holistic gains to be made in the transport operation. This is recognised in the definition of combining horizontal and vertical forms of collaboration. Lateral collaboration aims to gain more flexibility by combining and sharing capabilities in both vertical and horizontal manners (Simatupang and Sridharan, 2002).

The example of the structure of supply chain Meersman et al. (2010) is reported here:

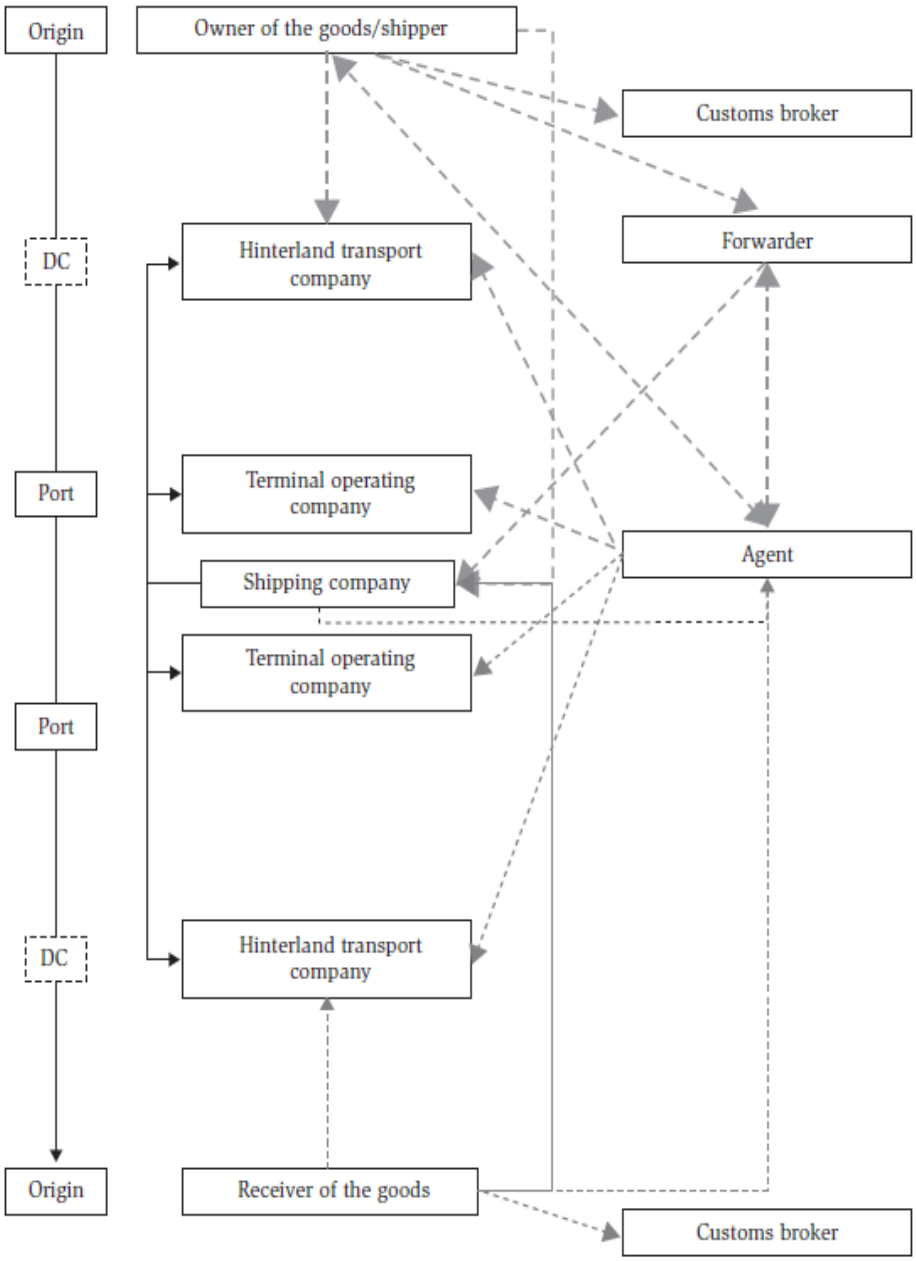


Figure 3: Structure of supply chain

As it is illustrated in Figure 3, dashed lines mean alternatives to the direct path that may be taken, thus involving one or more intermediaries. The owner or shipper of the goods will, with or without mediation of a forwarder, choose a certain shipping company. This is shown through the bold lines. In the reverse case, marked through the non-bold lines, the receiver of the goods will make that choice. In its turn, this shipping company will, in conjunction with the consignor or otherwise, opt for a specific route and thus for a port of call.

Regarding horizontal collaboration, management framework development and operational governance modes are the two main issues covered by the survey. A management framework for horizontal collaboration can be, for example, a stepwise framework to manage key decisions and influencing factors involved in horizontal collaboration (Verstrepen et al. 2009, Leitner et al. 2011, Audy et al. 2012, Brekalo et al. 2013). A stepwise framework can involve three stages:

- The first stage concerns partner selection (Cheikhrouhou et al. 2010, Raue and Wallenburg 2013) and developing trust between partners (Pomponi et al. 2015). The studies indicated that market position, common objectives and motives, structure, and similarity of flows influenced partner selection.
- The second stage is devoted to implementation, including defining the partner's responsibilities, leadership, and benefits (Audy et al. 2012).
- The third stage concerns the long-term evolution and growth of the collaboration (Verstrepen et al. 2009).

On the other hand, according to Verstrepen et al. (2009), operational governance mode relates to the selection of an adequate governance model for horizontal collaboration.
There are two major governance models commonly used in practice: corporate and cooperative. These models are compared in Klaas-Wissing and Albers (2010) who indicate that with the former model, partners act as one single integrated company, while with the latter partners act as independent collaborating companies based on an alliance agreement. In both models, conflict management is one of the most prominent issues, (Wallenburg and Raue (2011) and Verstrepen et al. (2009)).

The concept of horizontal collaboration requires a typology for horizontal collaboration to be defined. In literature, a number of structured descriptions of horizontal collaboration projects can be found, as discussed in the following part.

| Dimension | Based on |
|---|---|
| Intensity of the collaboration | Lambert et al. (1999) |
| Direction of consolidation | Industry consultation |
| Leadership | McKinsey (2010) |
| Scope and Intensity | Zinn and Parasuraman (1997) |
| Scope, competition, combined assets and objectives | Cruijssen (2006) |
| Shippers and/or carriers | Industry consultation |
| Number of partners | Industry consultation |

Table 5: Dimensions for typology of horizontal collaboration
Source: ArgusI

In the following subsection, a brief discussion of each dimension is reported.

### 3.5.1. Intensity of collaboration

Lambert et al. (1999) identify three types of collaboration depending on the level of integration of partners (Figure 4).

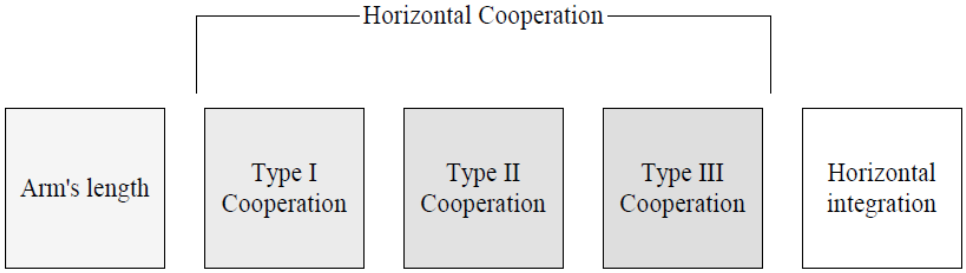


Figure 4: Horizontal collaboration and the level of integration (Inspired by Lambert et al., 1999)

In an arm's length collaboration, communication is of an incidental nature and companies may collaborate over a short period of time, involving only a limited number of exchanges. There is no strong sense of joint commitment or joint operations

As illustrated in Figure 4, horizontal collaboration can be subdivided into three types. Table 6 defines the three types identified by Lambert et al. (1999).

| Relationship | Description | Example |
|---|---|---|
| Type I | The organizations involved recognize each other as partners and, on a limited basis, coordinate activities and planning. The partnership usually has a short-term focus and involves one division or functional area within each organization. | Data exchange,<br>Joint distribution or line haul,<br>Back loading,<br>Purchasing/tendering group,<br>Maintenance group |
| Type II | The organizations involved progress beyond coordination of activities to integration of activities. Although not expected to last "forever," the partnership has a long-term horizon. Multiple divisions and functions within the firm are involved in the partnership. | Synchronized planning,<br>Multimodal collaboration,<br>Warehouse/cross dock sharing |
| Type III | The organizations share a significant level of integration. Each party views the other as an extension of their own firm.<br>Typically no "end date" for the partnership exists. | Network integration<br>Joint investments |

Table 6: Types of relationships (Lambert et al., 1999)

### 3.5.2. Direction of consolidation

Cap Gemini and the Consumer Goods Forum (2011) argue that traditional bilateral supply chain relations are developing into new multi-lateral supply network relations. As such, a new integrated supply chain model is taking shape that takes into account sustainability, reduced energy consumption, better traceability and reduced traffic congestion, as well as traditional measures like on-shelf availability, cost reduction and financial performance.

To do so, this concept can be supported by reducing the number of relations in the overall supply network by means of transport bundling. From a high level, there are three possible transport bundling strategies. First, less than truckload (LTL) flows can be combined into one better utilized milkrun. Secondly, two LTL or preferable two full truckload (FTL) routes travelling in opposite directions can be glued together to reduce empty repositioning kilometers. Finally, LTL or FTL shipments travelling in the same direction can be combined into one long haul on a vehicle with a bigger capacity. Typically, this third form is concerned with a modal shift from road to either rail, inland waterways or shortsea shipping

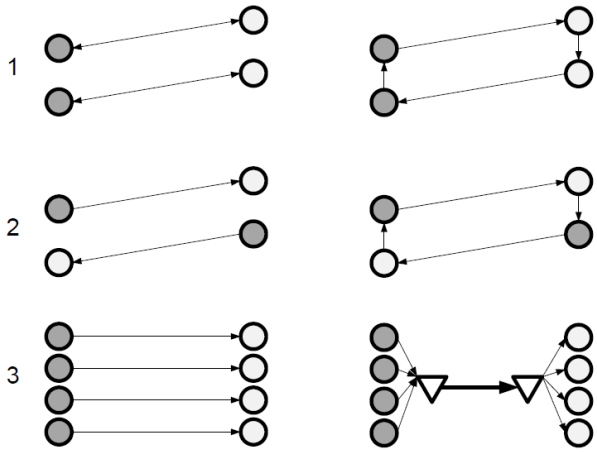


Figure 5: Three possible directions of flow consolidation

### 3.5.3. Leadership

McKinsey (2010) presents a segmentation of horizontal partnership by means of the governance or leadership that is observed within the collaboration. It includes three types as convened collaborations, primus inter pares collaborations and inter pares collaborations. The following table, discusses the features of each of these three setups.

| Typology | Advantages | Disadvantages |
|---|---|---|
| **Convened collaboration** | No disclosure of confidential information to competitors (3PL acts as neutral intermediary)<br>Less effort for shipper in organizing and carrying out collaboration (clear governance of convener)<br>No laborious partner search | Potentially limited transparency on direct cost efficiency gains (closed book)<br>Additional financing of 3PL margin<br>Little opportunity to influence the collaboration model/governance |
| **Primus inter pares collaboration** | Clear alignment on who is in charge to make collaboration successful<br>Potentially large gains for smaller shippers | Little opportunity for smaller shippers to influence the collaboration model<br>Potentially limited transparency on improvements and no guarantee for "small" shipper to capture the full benefit<br>High dependency on "primus" for all smaller shippers to make collaboration work |
| **Inter pares collaboration** | Full transparency on cost improvements<br>Opportunity to draft fair gain sharing model providing the full collaboration benefit to each participant | Disclosure of potentially confident information to partners<br>Calls for relatively high expertise on bundling and implementation of collaborations<br>Buildup of proper governance requires substantial resources |

Table 7: Leadership collaboration typology (McKinsey, 2010)

### 3.5.4. Scope and Intensity

Zinn and Parasuraman (1997) state that *"strategic alliances are at the forefront of current management practice" and that "in these alliances, buyers, sellers, and third-party service providers in the distribution channel engage in business relationships designed to reduce the*

*joint cost of two or more firms".*

Moreover, they propose a typology that classifies logistics-based strategic alliances along two dimensions, 1) scope (broad versus narrow), and 2) intensity (high versus low). In this typology scope is defined as "the range of services to be included in the alliance" and intensity as "the extent of direct involvement between partners" (Zinn and Parasuramen, 1997).

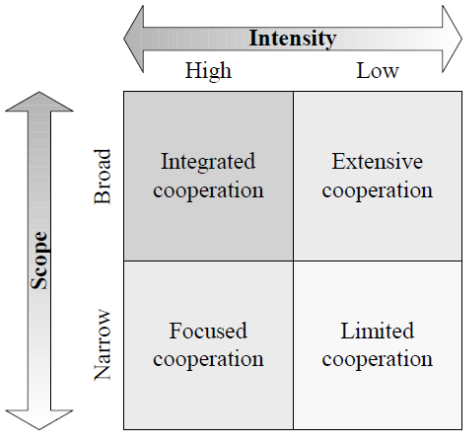


Figure 6: Typology of logistics-based strategic alliances (Zinn and Parasuraman, 1997)

### 3.5.5. Scope, Competition, Combined assets and Objectives

Another typology of horizontal collaboration is given by Cruijssen (2006) and is designed especially for horizontal collaboration in practice. It classifies horizontal collaboration in practice using four different dimensions:

1) Decision level (operational, tactical or strategic),
2) Competition (competitive or non-competitive),
3) Combined Assets (orders, logistics facilities, rolling stock, market power, supporting processes, and/or expertise), and
4) Objectives (cost reduction, growth, innovation, quick response, and/or social relevance).

In the below, it is discussed the elements of this typology.

#### 3.5.5.1. Decision level (Operational/Tactical/Strategic)

The first dimension refers to the decision level which is explained in the below:

- Operational collaboration relates to the daily operations within the logistics company. It can be described as "joint execution" or "sharing operational information".
- Tactical collaboration relates to achieving mid-term objectives and involves more intensive planning and more substantial investments. Tactical collaboration can be described as "joint organizing", "servicing a market together" and "sharing logistic resources".
- Strategic collaboration is aimed at achieving long-term company objectives. It is characterized by intensive planning and is closely related to the mission statement, core activities and core competences of the company.

In most cases of horizontal collaboration that is observed in practice, strategic collaboration cannot be achieved without preceding collaboration at the tactical level. Similarly, tactical collaboration seems to require a well-established collaboration at the operational level.

3.5.5.2. Competition (competitive or non-competitive)

The second dimension is competition. Horizontal logistics collaboration can either be competitive or non-competitive. Non-competitive horizontal collaboration occurs when collaborators that are not active in the same market work together. If the partners are servicing the same industries, they are direct competitors and the collaboration is referred to as competitive horizontal collaboration.

3.5.5.3. Combined Assets

Combined assets is the third dimension. All collaboration projects are based on the sharing of some kind of assets. The following six groups of assets that can be combined to the benefit of all participants: 1) orders, 2) logistics facilities, 3) vehicle fleet, 4) market power, 5) supporting processes and 6) expertise.

3.5.5.4. Objectives

The last dimension for horizontal collaboration in the typology of Cruijssen (2006) is based on the objectives of horizontal collaboration such as (cost reduction, growth, innovation, quick response, and/or social relevance). Over the last years since 2006, a number of additional objectives have emerged in the transport industry, notably supply chain security, supply chain robustness, and reduced carbon footprints.

Cost reduction: Most short-term collaboration initiatives from practice have cost reduction as their primary goal.

Growth: Through collaboration, especially logistics service providers can establish financial growth (increased turnover or profit) or geographically extend their coverage by combining the networks of all partners.

Innovation: Innovative service concepts, the introduction of new systems and technology (e.g., RF tags) and inter-organizational learning can increase the quality of the services offered by cooperating

Information and quick response: Technological progress in information and communication technology supports cheap and efficient communication between the partners in a network. Moreover, response times can also be shortened by introducing innovative cooperative logistics concepts or by benefiting from partners' distribution or storage networks

Social relevance: Horizontal collaboration can be an effective way to achieve a higher capacity utilization by exchanging loads and equipment between the geographically dispersed partners, load exchanges, central planning, shared distribution centres and etc.

### 3.5.6. Carrier and/or shipper

Collaboration can take place between shippers, between carriers or between multiple carriers and multiple shippers. In collaboration terms however, shippers are taking active control to consolidate their flows and offer them to LSPs in a bundled manner.

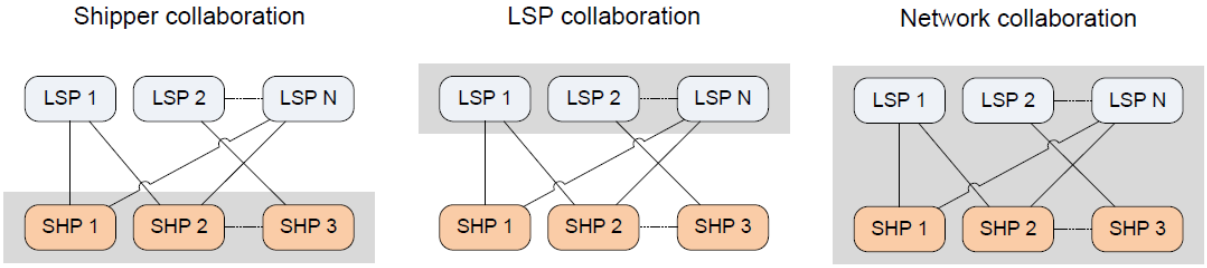


Figure 7: Collaboration between shippers and/or LSPs

The best setup however is the case where a group of both LSPs and shippers work actively together. Although arguably more difficult to organize and maintain, such a collaboration offers most opportunities to improve efficiency.

### 3.5.7. Number of partners

As a general rule of thumb, adding more partners will increase the operational synergy, for example in terms of the number of ton-kilometers that can be avoided. Simultaneously however, the coordination costs will increase if the number of partners increases.
As the number of partners grows, also the number of potential contact points increases. This introduces also the ideas behind reducing the number of active contact points so that they can be better managed and the segmentation of relationships to determine different levels of collaborative action (Ritter et al., 2004). This can be established by means of a trustee.

#### 3.5.7.1. Trustee

By definition, a trustee is a person or firm that holds and administers property or assets for the benefit of a third party. A trustee is supposed to make profitable decision for the entity under its authorization. It is a legal relationship between the trustee and the party, where the trustee is totally responsible for the maintenance, performance, and profitability of the trust under his guidance. Usually the trustee is not to make any profits, for itself, using the resources of the trust. (Coleman & Co. 2018).

Trustees must interpret and understand the trust agreement and be able to administer the distribution of any trust assets to the proper parties or beneficiaries. All trustees are considered the decision-makers for all matters of the trust and make those decisions based on the provisions outlined in the trust agreement.

In the context of horizontal collaboration in transport and logistics, the trustee is responsible for collecting and analysing data and for the management of the collaboration between a number of different shippers, logistic service providers and/or horizontal communities.

#### 3.5.7.2. Types of trustee

Typically, there are two separate types of collaboration support activities carried out by a trustee. These types are categorize as ‘offline’ and ‘online’ activities.

The offline function requires the trustee to play an external, supporting role and as such will not take part in the day-to-day operations, activities or processes of the collaboration.
The online function in turn requires a trustee to be a pivotal actor in the horizontal community and to be responsible for the harmonious organization of daily processes, activities and operations

It is regarded logical that the offline services are charged on a consultancy basis, while the online services can be paid for by transferring for example a percentage of the synergy savings to the trustee.

The main keywords for both the online and the offline functions of a trustee are *neutrality*, *transparency* and *safeguarded confidentiality of data provided*. In particular, these three elements distinguish a trustee from a 4PL. The main concrete tasks of a trustee are listed in the below categorized in the online and offline functions.

##### 3.5.7.2.1. Online functions

Online functions can be defined with the following tasks.

Triple bottom line: A trustee should manage the collaboration from the perspective of the company-specific objectives of the partners

Loads combination: From a supply chain efficiency perspective, a trustee should be able to fully support a company’s drive to reduce inventory and work to a tighter just in time system shipping regular small quantities on fairly tight lead times (Mason et al., 2007)

Prioritization: The trustee should be completely neutral in its handling and prioritization of jobs coming from the various partners

Synchronization: It must act a signalling function that makes shippers aware that cost reduction through bundling can be achieved if some of their shipments are somewhat delayed or released earlier.

Contact person: The trustee is always available as a contact person for all collaborators, both for logistics service providers and shippers. It also provides a neutral platform and safe location for meetings, brainstorms and discussions.

Interfaces: The trustee is responsible for the definition and implementation of interfaces between the IT systems of the various partners

Maximize gain: On a high level, the trustee is responsible to creating the maximum gains from the collaboration in whatever way allowed by the partners, for example by bundling or avoiding transport flows.

Matching: The trustee makes sure that LSPs are selected that correctly match the transport needs of participating shippers.

Improvement: The trustee is the mandated to continuously improve the community by making suggestions based on the realized consolidation results and their experiences in the partnership.

#### 3.5.7.2.2. Offline functions

With respect to offline functions, the following tasks are defined.

Critical mass: The trustee is always on a quest for the best transport flows and capacities to further extend and improve the collaboration.

Stability and fairness: The trustee safeguards stability of the collaboration by ensuring correct gain sharing.

Legal compliance: Trustee makes sure that the collaboration is fully legally compliant.

Entry and exit: By putting in place clear guidelines on for example volume bandwidths and entry rules, the trustee makes sure that the collaboration is flexible enough to cope with changes in the composition of its partners.

Conflict resolution: In cases of conflict, the trustee will be the first to act as a referee

Satisfaction: Trustee makes sure that all partners are satisfied with the course of the collaboration

Confidentiality: The trustee prevents potential partners from having to share market related data directly with each other.

## 3.6. Gain sharing

When costs and gains are generated as a result of a cooperation between different partners, it is not trivial to determine which partner has a right to which fraction of these gains and which partner should pay what part of the coalition cost. To properly divide these costs or profits among all the collaborating partners a gain sharing method to be selected. (*Defryn et al., 2017).*

Mistrust about the fairness of the applied allocation rule for savings has caused many horizontal logistics collaboration initiatives between shippers, and/or LSPs to marginalize or disintegrate.

### 3.6.1. Methods for gain sharing

According to Defryn et al. (2017) among numerous methods regarding gain sharing in the literature, the most important and commonly used ones are reported in the following section. The methods based on the fundamentals of cooperative game theory are Shapley value and Nucleolus, while, Equal profit method, Alternative cost avoided method and Volume-based allocation are considered as rules of thumb.

### 3.6.2. Principle of cooperative game theory

Lambertini (2011) states that cooperative game theory is the field of research that studies the strategic interactions between multiple agents. Moreover, cooperative game theory is about how to create benefits for the group, rather than focusing only on your personal profit, and how to share these benefits among all players. (Shubik 1984).

#### 3.6.2.1. Shapley value

According to Tjid and Driessen (1986), the formation of the grand coalition is a sequential process, where the partners enter one by one. By repeating this for any possible permutation of the order of entering and averaging the obtained marginal profits in a uniform manner, the Shapley value cost allocation method is obtained. This method is based on a partner's cooperative productivity since it takes into account the marginal effect of a partner on all sub-coalitions. The need of information is the main drawback of this method. The calculation of the Shapley value requires at least an estimation of the total cost or benefit of every possible sub-coalition.

#### 3.6.2.2. Nucleolus

As defined by Schmeidler (1969), nucleolus is an allocation mechanism based on the idea of minimizing the maximum unhappiness of each individual partner. Unhappiness is measured by the excess of the proposed allocation and is interpreted as the gain that the partners in a sub-coalition *S* would obtain if they withdraw from the grand coalition *N*. Thus, it can be seen as an incentive for these partners to leave the grand coalition. By minimizing this incentive, the stability of the grand coalition can be maximised.
Moreover, to evaluate different allocations based on the excess, a sequence of Linear Programs (LPs) should be solved.

The nucleolus is more difficult to compute than the Shapley value and for larger groups of collaborators though, this calculation becomes very time-intensive.

#### 3.6.2.3. Equal Profit Method

Frisk et al. (2010) present this method based on the idea of obtaining relative savings as equal as possible for the partners. The calculation is done by solving a straightforward linear programs that minimises the largest relative savings difference between any pair of partners. By doing so, a stable solution is guaranteed and therefore the EPM can only be calculated if the core is non-empty.

It can be mentioned that, it might seem fair to offer the same relative savings to every partner in the coalition. However, the profit allocated to each partner strongly depends on its stand-alone cost. As a result. Companies with a higher stand-alone cost will receive a larger absolute part of the coalition gain.

#### 3.6.2.4. Alternative cost avoided method

According to Tjid and Driessen (1986), an allocation method is based on the principle of first dividing the total coalition gain in a separable and a non-separable part. The first part linked to one specific partner, is defined as the marginal cost when that partner enters the coalition consisting of all other partners (Vanovermeire, Vercruysse, and Sorensen, 2014). The non-separable can be divided in various ways. The Alternative cost avoided method defines a set of weights that can be used to divide the non-separable costs based on the individual contributions of each partner. These weights are based on the difference between the stand-alone cost and the marginal cost of a partner.

#### 3.6.2.5. Volume based allocation

According to Frisk et al. (2010), companies mostly stick to the more straightforward allocation methods that can be easily interpreted and offer a certain transparency.
In these kinds of proportional allocation methods, the total coalition costs is divided by calculating a weight for each partner and when a volume-based allocation is used, the weights are based on the volume shipped by the partner with respect to the total coalition volume.

### 3.6.3. Properties of gain sharing methods

Tjid and Driessen (1986) mention that, in order to evaluate an allocation mechanism, the field of cooperative game theory provides a number of properties with the aim of guaranteeing the fairness of the results. These features are reported in the below:

- ✓ Efficiency: the allocation method should be efficient, which means that exactly the entire benefit is divided among the partners.
- ✓ Individual rationality: this property ensures that situation of a partner does not worsen by joining the coalition, which means that, when applying a profit allocation method, each partner should be assigned a positive profit otherwise the grand coalition will tend to break up as the affected partner will have an incentive to leave.
- ✓ Stability: If the allocation method ensures individual rationality for every sub-coalition, the result is said to be stable. Therefore, when choosing a stable allocation method, none of the partners can improve their situation by leaving the grand coalition to form a sub-coalition.
- ✓ Additivity: this property ensures that the allocation cannot be influenced by making larger coalitions in advance.
- ✓ Dummy player: it states that a partner that neither helps nor harms any sub-coalition is allocated a zero-profit or a cost equal to its stand-alone cost.
- ✓ Symmetry: it means that partners that are identical (generate the same cost in each coalition), should be allocated the same cost.

The relevant features for each method of gain sharing is summarized in table 8.

| | *Shapley value* | *Nucleolus* | *Alternative cost avoided method* | *Equal Profit Method* | *Volume based allocation* |
|---|---|---|---|---|---|
| Efficiency | Yes | Yes | Yes | Yes | Yes |
| Individual Rationality | Yes | Yes | Yes | - | - |
| Stability | - | Yes | - | - | - |
| Additivity | Yes | - | - | - | - |
| Dummy Player | Yes | Yes | - | - | - |
| Symmetry | Yes | Yes | Yes | Yes | - |

Table 8: Properties of gain sharing methods

It can be concluded that the Shapley value and the Alternative cost avoided methods are in fact preferential. The Shapley value should be used for smaller, coherent groups. The Alternative cost avoided method is very suitable for collaborations of changing partners.

# 4. Projects

The previous works and experiences regarding governance model is reported here. Firstly, the smart rail project from ZLC is discussed and then Collaboration Concepts for Co-modality (CO3) from ArgusI is reported and research works from Mines-ParisTech are brought up lastly.

## 4.1. Smart Rail project: Governance models enabling cooperation in the supply chain

Smart-Rail, (2016) sets out an innovative governance framework which is problem driven, market oriented and corridor based. Development of the framework followed a multidisciplinary approach taking into account network governance theory, supply chain management as well as geographical terms such as corridors and networks.

The motivation for this task it to understand the intra- and inter- network relations between all potential partners in cooperative business network developed in previous task and to assess the potential for its successful implementation. Existing drivers and barriers as well as policy guidelines and legal actions at the European level have been taken into account.

It represents a vertical highly relational inter organizational governance network in which 4PL or LSP empowered by an information sharing platform acts as intermediary and governs the relationships between all partners in the network – one or more shippers, one or more logistic service providers, terminal operator and railway freight operator.

Smart-Rail project generated a Logistical Control tower for long distance rail freight transport. It is an operational Logistical Control Tower including rail information in operation from August 2017. For door-to-door operational corridor management, LSP Seacon has developed a monitoring dashboard and an integrated module for its transport management system (TMS). For event management a work flow applies for the corridor, so required corrective actions can be taken and monitored.

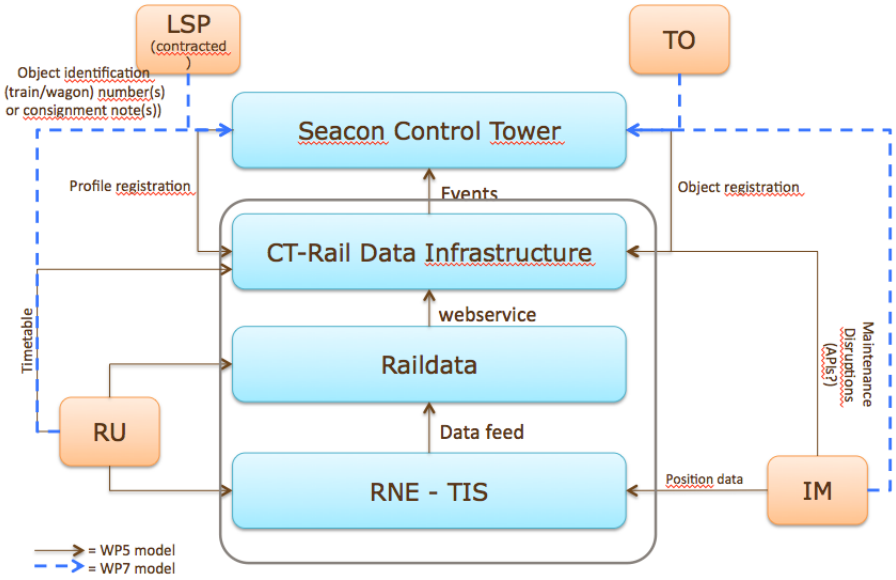


Figure 8: Integration of multiple models of data exchange into the Control Tower

The implemented Control Tower Rail at Seacon Logistics is fed by information exchanges from the infrastructure manager, railway undertaking, terminal operator, as well as the (contracted) LSP which is directly using the particular railway leg.

Information from IM to Control Tower takes the form of either TIS/RailData, or services based on current business practice and communication directly provided to the Control Tower by the IM. TIS/RailData. This structure, as one of multiple legs on which the Control Tower is based, is projected to be built and implemented during the fourth quarter of 2017. Information directly provided to the Control Tower by the IM, on the other hand, includes planned maintenance and actual disruptions. Also, a combination of the two forms may be used.

More information regarding this project is discussed in appendix A.

## 4.2. AEOLIX project

AEOLIX project (2016) project aims to develop a cloud-based collaborative logistics ecosystem for configuring and managing (logistics-related) information pipelines thus creating visibility across the supply chain and enabling more sustainable and efficient transport of goods across Europe. AEOLIX project exploits the results of CO-GISTICS and will address new Trieste intermodal transportation network challenges. In particular, the cargo transport optimization service deployed in CO-GISTICS will be integrated with further functionalities concerning the pre-clearing paperless procedures in export.

## 4.3. SELIS project

This project produces a governance framework for the use of APIs, protocols etc., taking into account organizational aspects within ‘cooperation agreements’. A key advantage will be eliminating the need for centralized infrastructure with complex governance. SELIS will link private-sector platforms and public-sector platforms, promoting customs-business

cooperation and supporting the seamless movement of goods through secure trade chains. The SELIS Customs Node will be designed for both e-compliance and voluntary information sharing.

The concept of smart collaborative spaces in the domain of transport logistics has been explored in previous FP7 Projects (e-Freight, eMAR, EcoHubs and iCargo). SELIS takes this one step further, by highly enhancing the technologies basis, including strong analytics and knowledge graphs, and by lowering the barriers to forming, managing and participating in virtual transportation chain communities, providing tools to support the semiautomatic configuration of collaborative nodes in the cloud, and by providing ready to be configured solution sets to support innovative business models.

In appendix B, more detailed of this project is reported.

### 4.4. Collaboration Concepts for Co-modality (CO3)

It is a project that aims to develop, professionalize and disseminate information on the business strategy of logistics collaboration in Europe. The goal of the project is to deliver a concrete contribution to increasing load factors, reducing empty movements and stimulate co-modality, through collaboration between industry partners, thereby reducing transport externalities such as greenhouse gas emissions and costs. The project will coordinate studies and expert group exchanges and build on existing methodologies to develop legal and operational frameworks for collaboration via freight flow bundling in Europe.

The CO3 project aims at finding, developing and managing co-modality projects that are made possible by horizontal collaboration between at least three companies, being either logistics service providers or shippers. Individually these companies might not have the scale to make the shift from road to rail, inland navigation or short sea shipping, but the idea is that by bundling companies can accumulate enough transport volume to fill a train or ship, thereby reducing cost and decreasing total emissions of the transport industry in Europe.

The developed tools, technologies and business models will be applied and validated in the market via case studies.

Finally, the CO3 consortium will promote and facilitate matchmaking and knowledge-sharing through conferences and practical workshops to transfer knowledge and increase the market acceptance of collaboration.

There are three main results of this project:

1. When creating these consortia of companies working together, quite some aspects play a role. For example, a consortium is only economically viable if enough synergy exists among it. Furthermore, there is the aspect of trust, fair gain sharing and competition. Usually it is easier to collaborate with companies outside one's own industry than with direct competitors, although obviously the overlap and synergy with competitors is promising by its nature. Whether between competitors or non-competitors, a fair gain sharing mechanism is essential. Therefore, fair gain sharing is the first key message of CO3.

2. The CO3 project aims to develop, describe and implement the ideal setup of a logistics collaboration project. This should be generic enough to fit most practical cases. It

explicitly does not ambition to guide all individual cases in their development process towards true collaboration. That is impossible because there are just too many possible routes towards this, which depend on the specifics of the companies involved, the pace of development, impact etc. It is very important to stick to a structured development process, for example including all legal contracts required.

3. There is a need for a specialized entity to setup, manage and develop a collaboration. If such a neutral, transparent and trusted party is not present, there is a severe risk that not all parties will efficiently work together in the long run on a fair give and take basis. Typically, there are two separate types of collaboration support activities carried out by a trustee. These types are 'offline' and 'online' activities. The main keywords for both the online and the offline functions of a trustee are neutrality, transparency and safeguarded confidentiality of data provided. These can never be compromised in any of the tasks performed by the trustee. Given the importance of a trustee, CO3 states that in a true horizontal collaboration project, a neutral trustee must be in place.

## 4.5. Research works from Mines-ParisTech:

In this part, some of research works that could be useful to the platform governance model development are presented. In this research, both centralised and decentralised horizontal collaboration are considered.

### 4.5.1. Centralised and corporate model

Here, corporate governance model is assumed adequate for centralised organisations, in which all partners act as one single integrated company to make decisions collectively. The key issue is to form the coalition and fix the collaborative terms. It is proposed a general model which is illustrated in Figure 9.

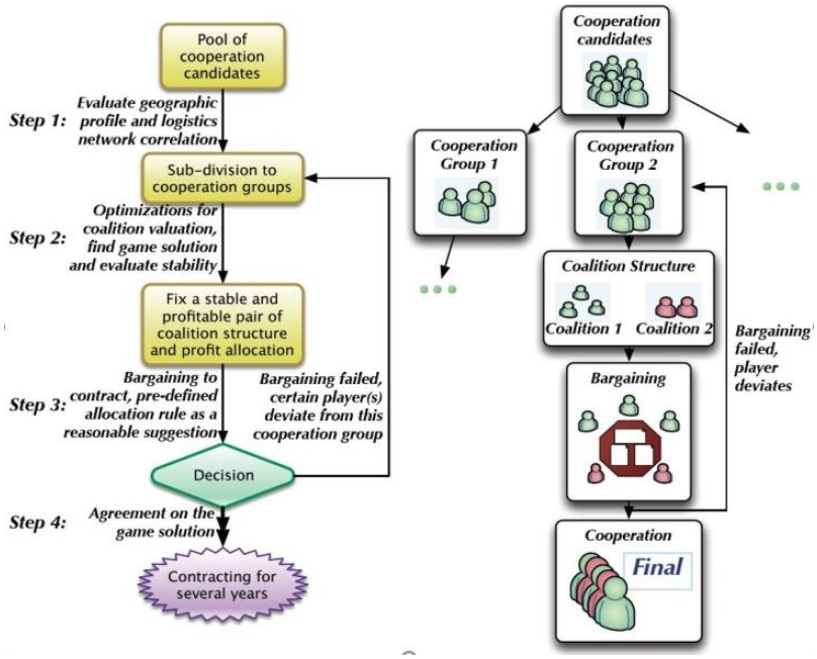


Figure 9: General cooperation model for centralised organisations

At the beginning of the cooperation procedure, it is got a set of cooperation candidates who have incentive to cooperate with others. Then it is evaluated the cooperation possibilities among all candidates to select some of them into several "cooperation groups", for example groups of companies in the same region.

- Depending on the cooperation content, a consensus specifying related cooperation organization, coordination details and profit sharing scheme should be identified in the step 2 as the basis of cooperation.
- Based on the framework thus defined, there will always be some indefinite area left to bargaining. So in the step 3, cooperating companies try to establish an explicit contract by bargaining.
- In step 4, there are two possibilities: agreement being made, cooperation relationship contracted; or bargaining failed, someone in the cooperation group deviates, the others move back to step 2.

In this cooperation model, the most important part is how to construct a feasible cooperation mechanism. Cooperative game theory is fit for the investigation of such problems. In particular, gain sharing is important part of such mechanism. For more information, readers are invited to read the paper (Xu et al. 2012) and the or the PhD thesis (Xu 2013).

### 4.5.2. Decentralized and cooperative model

The main idea is to reach the collaborative organisation performance level but in a more dynamic manner. The mechanism design theory is a theoretical framework to favour collaborative solution without collaboration by the design of a mechanism that aligns the objectives of the players to a global objective with the help of an organizer (an auctioneer, a web platform…). To that regard, the platform should follow several principles, for example: Neutrality, fair mechanism and respect of business/data privacy.

In our research, it is proposed that intermediary (platforms, organizers, etc.) can use auction-based model to match dynamically transport demands and offers in real-time. In particular, to respect business and data privacy, we suggest to use proxy agent in the model. The proposed model can be simplified and presented in three steps as follows.

- **Step 1**: All the requests are submitted to the proxy auctioning agent to create a pool of requests. At the same time, each carrier also submits the required private information to his private bidding agent (e.g. capacity, expected margin rate, and cost rate). Then, the information of pool is sent to carriers' bidding agents, as shown in Figure 10.

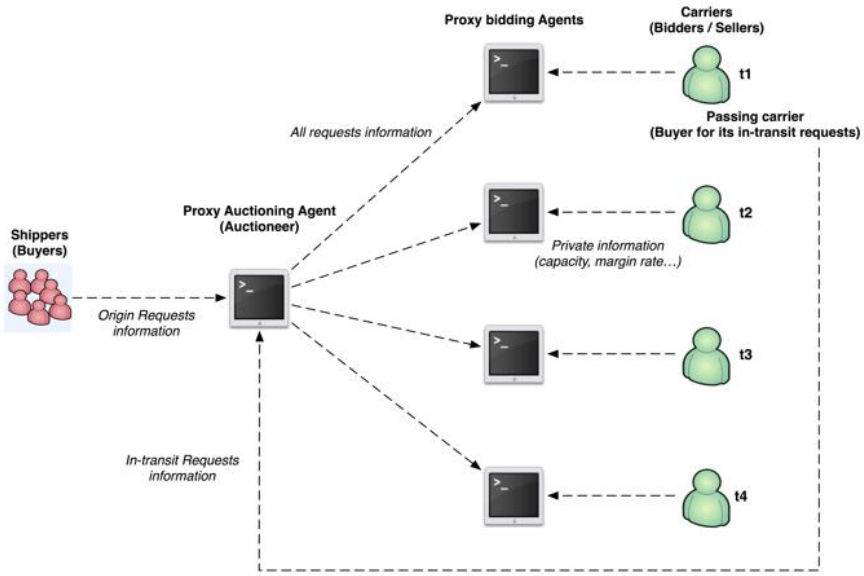


Figure 10: Collecting information of requests and carriers (Step 1)

- **Step 2**. Once the bidding agents have received the requests' and carriers' information, they will compute the request bundles to be proposed to their client, as well as the cost and bidding price.

It is the process for the bid generation problem (BGP). As example,
Figure 11 11 gives all compatible groups and feasible request bundles (RBs). In this case, we have three compatible groups and sixteen feasible RBs. To assure that none of the RBs will be missed, the agents will compute bidding price for each RB for their own client. Thus, for each carrier we have a vector of bids for all RBs; and a $|T|\times|RB|$ matrix of bids in the auction, specifically 4×16 in this case. Each element is a bid. Once the matrix bidding proposals have been validated by carriers, they will be submitted to the proxy auctioning agent.

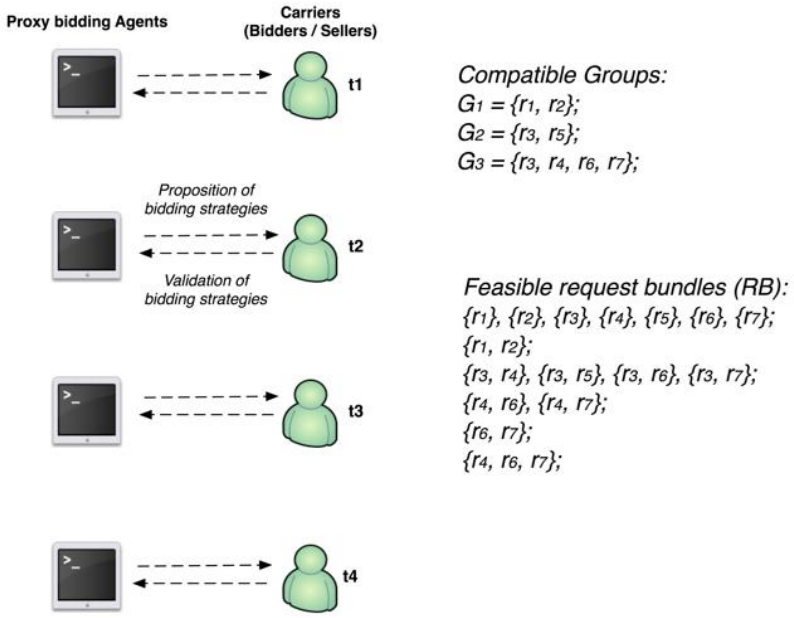


Figure 11: Bidding generation (Step 2)

- **Step 3:** As displayed in Figure 12, at the beginning of this step all bids have been submitted to the auctioneer proxy agent then the winner determination problem (WDP) – an optimisation problem will be executed. Once the auction finished, the payment of each request in the bundles will be computed by the model, and then proposed to the shippers and carriers. The process will be finished by validating the payment of shippers to carriers, or in-between carriers for in-transit request, so that the shipments begin.

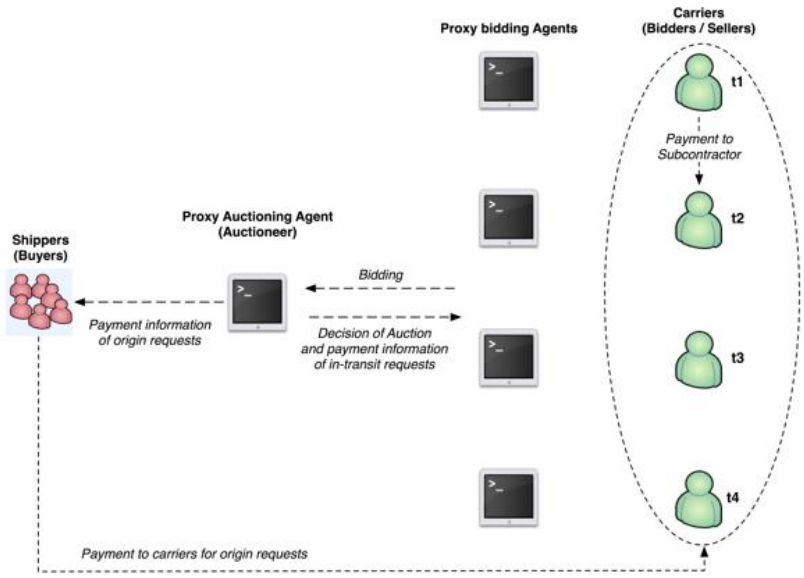


Figure 12: Determination of auction and payment (Step 3)

The ideas of the proposed model are presented in this section. For more details or mathematical models, readers are invited to read the paper (Pan et al. 2014) or the PhD thesis (Xu 2013).

## 5. Conclusion

Within Task 3.3 of the Clusters 2.0 project the concept of horizontal collaboration, which has been defined and tested by the CO3 and Nextrust consortia, has been further expanded from a dimension perspective into multidimensial collaboration, combining the value and benefits of both horizontal and vertical collaboration.

This expansion of horizontal collaboration into multidimensional collaboration was needed, as the Clusters 2.0 project does not aim to drive horizontal collaboration in between two shippers on a single transportation lane, but wants to expand this into collaboration within and in between logistics clusters involving multiple stakeholders, like shippers, LSPs, railway operators and railway terminals.

This approach also implies that the role of the cluster coordinator, which can be considered as a "super trustee" needs to be implemented at cluster level to drive massification. Indeed, this Cluster coordinator will need to massifiy the flows within a logistics cluster for all involved stakeholders and will also need to connect massified flows of the logistics cluster towards the other logistics clusters. In this way the cluster coordinator becomes the

business developer, governance gatekeeper, logistics coordinator and value distributor for the logistics cluster in scope.

The concept of massification through cluster coordination will be tested in Living Lab 2 through massification workshops at the different railway terminals, maritime ports and airports with the aim to promote intermodal transportation and multidimensional collaboration with the aim to drive a modal shift for the shippers which are active in the cluster. These massification workshops will be supported by the Quickcheck Tool and the X-Intermodal Tool which are developed as part of Task 3.5 and Task 3.6 respectively in Work Package 3.

# 6. References


- AEOLIX (2016). Architecture for European Logistics Information Exchange (AEOLIX), Horizon 2020, European Commission.
- Agrell, P. J., J. Lundin and A. Norrman (2017). "Supply Chain Management: Horizontal carrier coordination through cooperative governance structures." International Journal of Production Economics **194**: 59-72. DOI: http://dx.doi.org/10.1016/j.ijpe.2016.10.025.
- Albers, S. and T. Klaas-Wissing (2012). "Organisation of multilateral LTL alliances." International Journal of Logistics Research and Applications **15**(3): 181-198. DOI: 10.1080/13675567.2012.709836.
- Audy, J. F., N. Lehoux, S. D'Amours and M. Rönnqvist (2012). "A framework for an efficient implementation of logistics collaborations." International transactions in operational research **19**(5): 633-657.
- Barratt, M. (2004) Understanding the meaning of collaboration in the supply chain, Supply Chain Management: An International Journal **9**(1): 30-42.
- Boschian et al., (2011) Boschian, V., Dotoli, M., Fanti, M. P., Iacobellis, G., and Ukovich, W. (2011). A metamodeling approach to the management of intermodal transportation networks. *IEEE Transactions on Automation Science and Engineering*, 8(3): 457-469.
- Brekalo, L., S. Albers and W. Delfmann (2013). "Logistics alliance management capabilities: where are they?" International Journal of Physical Distribution & Logistics Management **43**(7): 529-543. DOI: doi:10.1108/IJPDLM-06-2012-0194.
- Chantal. (2012). Centralized Organization vs. Decentralized Organization. Retrieved from https://blog.ordoro.com/2012/07/19/centralized-organization/
- Cheikhrouhou, N., G. Piot and M. Pouly (2010). "A multi-criteria model for the evaluation of business benefits in horizontal collaborative networks." Journal of Intelligent Manufacturing **21**(3): 301-309. DOI: 10.1007/s10845-008-0181-6.
- Consumer Goods Forum, Cap Gemini (2011) 'Future Value Chain 2020 - Building strategies for the new decade'.

- CO3 project
- Cruijssen, F. (2006) Horizontal Collaboration in Transport and Logistics. CentER Dissertation Series No. 176. Tilburg University, Tilburg. ISBN 90 5668 176 1. (ISBN 2007: 978 90 5668 176 1).
- Demirkan, H. and Delen, D. (2013). Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud. *Decision Support Systems*, 55(1):412-421.
- Dullaert, W., Neutens, T., Berghe, G. V., Vermeulen, T., Vernimmen, B., and Witlox, F. (2009). Mammoet: An intelligent agent-based communication support platform for multimodal transport. *Expert Systems with Applications*, 36(7): 10280-10287.
- Frisk, M., M. Göthe-Lundgren, K. Jörnsten, M. Rönnqvist (2010) Cost allocation in collaborative forest transport, European Journal of Operational Research **205** (2): 448– 458.
- Hilde Meersman, Eddy van de voorde, Thierry Vanelslander, (2010): Port competition revisited. University of Antwerp
- Houldsworth, Russo & Company, P.C. Certified Public Accountants. (2016). The Pros and Cons of Federated Organizations. Retrieved from http://trusthrc.com/the-pros-and-cons-of-federated-organizations/
- Jonnergard, K. (1988). THE LIFE AND DEATH OF THE FEDERATI'W ORGANIZATION. School of Economics University of Lund.
- Jonnergard, K, Lagnevik, M, Svensson, C, & Wijk, G. (1984). Decision-making in Cooperative Organizations.
- Klaas-Wissing, T. and S. Albers (2010). "Cooperative versus corporate governance of LTL networks." International Journal of Logistics Research and Applications **13**(6): 493-506.
- Leitner, R., F. Meizer, M. Prochazka and W. Sihn (2011). "Structural concepts for horizontal cooperation to increase efficiency in logistics." CIRP Journal of Manufacturing Science and Technology **4**(3): 332-337. DOI: http://dx.doi.org/10.1016/j.cirpj.2011.01.009.
- Marume, S. B. M., & Jubenkanda, R. R. (2016). Centralization and Decentralization. Retrieved from http://www.questjournals.org/jrhss/papers/vol4-issue6/Q46106110.pdf
- McKinsey (2010) Identifying and assessing horizontal collaboration partnerships. Paper presented at the Eye for transport conference of 1 June 2010 in Brussels.
- Miksa, (2013). Air-cargo e-platform. *Prace Instytutu Lotnictwa*, 1 (228): 37-53.
- Mukhtar. (2010). Centralization & Decentralization. Retrieved from http://management4best.blogspot.com/2010/02/centralization-decentralization.html
- Pan, S., D. Trentesaux, E. Ballot and G. Q. Huang (2018). "Horizontal Collaborative Transport: survey of solutions and implementation issues." (under review).
- Pan, S., X. Xu and E. Ballot (2014). Auction-based transport services allocation in Physical Internet: a simulation framework. 5th International Conference on Information Systems, Logistics and Supply Chain.
- Pomponi, F., L. Fratocchi and S. R. Tafuri (2015). "Trust development and horizontal collaboration in logistics: a theory based evolutionary framework." Supply Chain Management: An International Journal **20**(1): 83-97. DOI: doi:10.1108/SCM-02-2014-0078.

- Raue, J. S. and C. Wallenburg (2013). "Alike or not? Partner similarity and its outcome in horizontal cooperations between logistics service providers." Logistics Research **6**(4): 217-230. DOI: 10.1007/s12159-013-0106-4.
- Robert Mason, Chandra Lalwani, Roger Boughton, (2007) Combining vertical and horizontal collaboration for transport optimisation: Supply Chain Management: An International Journal Volume 12 · Number 3 · pp 187–199
- Rusizc, (2017). Collaborative Logistics Networks. PhD Dissertation, CIRRELT, 2017.
- Schmeidler, D. (1969) The nucleolus of a characteristic function game. SIAM Journal of Applied Mathematics, **17**(6), 1163-1170.
- Schmoltzi, C. and C. M. Wallenburg (2012). "Operational Governance in Horizontal Cooperations of Logistics Service Providers: Performance Effects and the Moderating Role of Cooperation Complexity." Journal of Supply Chain Management **48**(2): 53-74. DOI: 10.1111/j.1745-493X.2011.03262.x.
- SMART-RAIL, (2016). SMART-RAIL: Smart Supply Chain Oriented Rail Freight Services. Deliverable 7.6: Progress report on updates of CIT 2 monitoring results and adjustments made to the concept. Available at: http://www.smartrail-project.eu/downloads/.
- SMART-RAIL, (2016). SMART-RAIL: Smart Supply Chain Oriented Rail Freight Services. Deliverable 4.3: Governance models enabling cooperation in the supply chain. Available at: http://www.smartrail-project.eu/downloads/.
- SMART-RAIL, (2016). SMART-RAIL: Smart Supply Chain Oriented Rail Freight Services. Deliverable 5.5: Roadmap for the implementation of the interoperability architecture. Available at: http://www.smartrail-project.eu/downloads/.
- Surbhi, S. (2015). Difference Between Centralization and Decentralization. Retrieved from https://keydifferences.com/difference-between-centralization-and-decentralization.html
- Svensson, C. (1983). Federative Processes and Administrative Development, A study of Federative Cooperative Organizations. Lund Studies in Economics and Management 3, Lund University Press, Lund.
- Tijs, S., Driessen, T. (1986) Game theory and cost allocation problems, Management Science **32** (8): 1015–1028.
- Verstrepen, S., M. Cools, F. Cruijssen and W. Dullaert (2009). "A dynamic framework for managing horizontal cooperation in logistics." International Journal of Logistics Systems and Management **5**(3): 228-248.
- Wallenburg, C. M. and J. S. Raue (2011). "Conflict and its governance in horizontal cooperations of logistics service providers." International Journal of Physical Distribution & Logistics Management **41**(4): 385-400.
- Xu, X. (2013). Collaboration Mechanism in the Horizontal Logistics Collaboration. Ph.D., MINES ParisTech.
- Xu, X., S. Pan and E. Ballot (2012). Game theoretic contribution to horizontal cooperation in logistics. Proceedings of the 4th international conference on information systems, logistics and supply chain-ILS 2012

- Zinn, W. and A. Parasuraman (1997) Scope and intensity of logistics-based strategic alliances. Industrial Marketing Management, **26**(2), 137-147.

# 7. Appendix

## 7.1. Appendix A: Smart-Rail Project

Smart-Rail, 2016 presents an implementation plan (roadmap) for data sharing based on requirements of the Smart-Rail Continuous Improvement Tracks. The roadmaps consider the construction of a so-called “System-of-systems” or “Federative Infrastructure”. The solution is transformed to a specific implementable structure with its harmonised services, federation protocol, plug-and-play approach, and the governance and adoption models. Standardization factors are stressed as well, as these define success or failure of any widespread solution. The implementation roadmap combines different viewpoints: the functional, geographical/corridor, logistics chain, and rail freight view.

Developed model is corridor based and strategically oriented toward more integrated organizational forms between involved partners which will further improve its performances from the aspect of transactional cost and resource based view. Developed model also provides benefits in more efficient coordination through better planning at all nodes of this vertical governance network, reliable, visible and flexible flows on links within and out of the network, better planning of transport services and better utilization of transport equipment through scope and scale economy.

It is also recommended that the rail freight stakeholders actively collaborate and participate at European (e.g. Digital Transport and Logistics Forum) level to develop this federative infrastructure with its standards.

Adoption and implementation of such an innovative concept is complex, including aspects like standardization, EU policy, IT innovations, and various barriers. To address these aspects innovation of legacy IT systems is, amongst others, required. Not only rail freight stakeholders, but most logistics stakeholders, face difficulties to change legacy IT into innovative systems. New entrants in logistics operations with a greenfield solution are thus a threat to existing stakeholders. To overcome this barrier, logistics stakeholders should be able to construct a greenfield federative infrastructure, where data is stored in the infrastructure and legacy IT systems are integrated with the infrastructure. There are conditions to this type of development to prevent investment of central systems: a peer-to-peer solution should be developed where only access to data is shared. The solutions should be extendible, flexible, and integrate with similar solutions based on clearly specified protocols, minimal governance by the sector itself, integrate with IT back office systems, support development of innovative IT applications, and utilize state of the art IT technology.

## 7.2. Appendix B: SELIS project

The breakthrough technology that will be developed and tested in the Living Labs is the *SELIS Community Node (SCN)*: A smart collaborative space for virtual transport logistics communities that is easy to setup and deploy in the Cloud. SCN performs as a virtual data pipeline connecting information providers to information users of a Logistics Community, can be networked with other SCNs, and is designed so that interconnected SCNs can scale up and enable disruptive innovation models in Supply Chain to apply at a European scale. The SCN operation is enforcing governance and trust to the Supply Chain actors connected.

The main SELIS subsystems are:
1. A Logistics Information Connectivity, Communications and Navigation Sub-System:

a) A highly scalable and distributed Cloud based Publish-Subscribe (P-S) platform, enhanced with security/privacy preserving and content-based routing features.
b) Communication gateways and adaptors: Provides connectivity to GPS and sensor inputs and allows mobile & satellite systems to divert communication and navigation data through the Platform. Also connectivity through SOAP, REST and other intelligent connectors equipped with semantic translation services allows external systems to publish information to the Platform.
c) A distributed Cloud based subscriber registry with cooperation agreements about who is entitled to send what information to whom, and who is entitled to view content communicated. This is utilized by the P-S platform to manage routing in line with subscriber agreements.

2. The Shared Knowledge Graph (SKG): a knowledge sharing environment for transportation chains, establishing graphs based (“social-like”) logistics and transportation networks, enabling context analysis and reasoning for decision making.

3. A Big Data analytics platform with a library of analytics techniques and algorithms, designed for logistics applications (e.g. collaborative planning and forecasting, transportation planning, risk management and compliance), cloud-enabled, ready to deploy and manage in a fully automated way.

4. The SELIS intelligent logistics Applications Suite that act as information subscribers to the Platform with access rights determined from cooperation agreements.

5. Deployment and Implementation Accelerators tooling to enable logistics stakeholders set up and manage their own SCNs expediently and efficiently with minimum expertise, enabling rapid development of new SELIS applications and solutions, and the integration with existing systems.