Chapter 7
Applications of Cross-Chain Collaboration

Having introduced a broad typology of horizontal collaboration projects and practical guidelines for its management in the previous chapter, again it is time to take a step from theory to practice and study some empirical evidence. Generally, empirical papers on horizontal collaboration either focus on survey results on the (perceived) opportunities of impediments, or discuss one or a few practical cases in detail. We start with the survey papers and then continue with descriptions of collaborative projects found in academic literature. Then, we focus our attention to relevant European Union policies and projects, and we conclude this chapter with an overview of some recent commercial initiatives that foster collaboration in logistics.

7.1 Surveys

The benefits and difficulties of horizontal collaboration have been studied in several empirical papers based on surveys. Cruijssen et al. (2007b) surveyed 155 LSPs in Flanders and based on the responses ranked the importance of proposed opportunities and impediments of horizontal collaboration.

According to Table 7.1 the most severe impediments for collaboration are the problems of finding a reliable party that can coordinate the collaboration in such a way that all participants are satisfied (I2) and the construction of fair allocation mechanisms for the attained savings (I5).

A comparable study was conducted by Eye for transport (2010). The results are presented in Figs. 7.1 and 7.2.

The findings regarding the opportunities are well in line with Cruijssen et al. (2007b). The most important opportunity is a reduction of operational cost, here split into two categories, transport and distribution. Maybe the most striking obser-

F. Cruijssen, *Cross-Chain Collaboration in Logistics*, International Series in Operations Research & Management Science 297,
https://doi.org/10.1007/978-3-030-57093-4_7

Table 7.1 Opportunities and impediments surveyed by Cruijssen et al. (2007b)

	Opportunities	Score (1–5)
O1	Horizontal collaboration increases the company's productivity for core activities, e.g. decrease in empty hauling, better usage of storage facilities, etc.	4.17
O2	Horizontal collaboration reduces the costs of non-core activities, e.g. organizing safety trainings, joint fuel facilities, etc.	3.65
O3	Partnerships reduce purchasing costs, e.g. vehicles, onboard computers, fuel, etc.	3.42
O4	LSPs can specialize while at the same time broadening their services	3.74
O5	Tendering on larger contracts with large shippers becomes possible	3.60
O6	LSPs can offer better quality of service at lower costs, e.g. in terms of speed, frequency of deliveries, geographical coverage, reliability of delivery times, etc.	3.56
O7	Forming partnerships helps to protect market share	3.24
	Impediments	
I1	It is hard to find commensurable LSPs with whom it is possible to cooperate for (non-)core activities	3.84
I2	It is hard to find a reliable party that can coordinate the collaboration in such a way that all participants are satisfied	4.00
I3	When an LSP cooperates with commensurable companies, it becomes harder to distinguish itself	3.52
I4	It is hard to determine the benefits or operational savings due to horizontal collaboration beforehand	3.54
I5	It is hard to ensure a fair allocation of the shared workload in advance	3.73
I6	A fair allocation of the benefits is essential for a successful collaboration	4.11
I7	Smaller companies in the partnership may lose clients or get pushed out of the market completely	3.95
I8	Collaboration is greatly hampered by the required indispensable ICT-investments	3.43
I9	Benefits cannot be shared in a fair way; the larger players will always benefit most	3.60

vation is that respondents do not consider modal shift as an important opportunity for horizontal collaboration. For the impediments, the study paints a somewhat different image. The most important impediment is the fear of sharing information with competitors. Following that, there is a group of impediments that has to do with finding trustworthy partners to collaborate with. They can be covered by getting a comprehensive legal and contractual framework in place and by having a clear approach for partner selection (see Sect. 5.7.1).

In another study, Pateman et al. (2016) surveyed 32 senior logistics managers about the enablers for logistics collaboration in Australia. Being questioned on the top factors for successful collaboration, the respondents were to choose three critical factors, which they ranked. The weighted index that was derived from the responses can be found in Table 7.2. The authors conclude that collaboration is a natural consequence of the competitive dynamics of logistics activities in Australia. The number of collaborations in Australia is expected to grow over the next 10 years.

Saenz et al. (2017) provide some empirical evidence about horizontal collaboration based on several case studies. They state that horizontal collaboration is diffi-

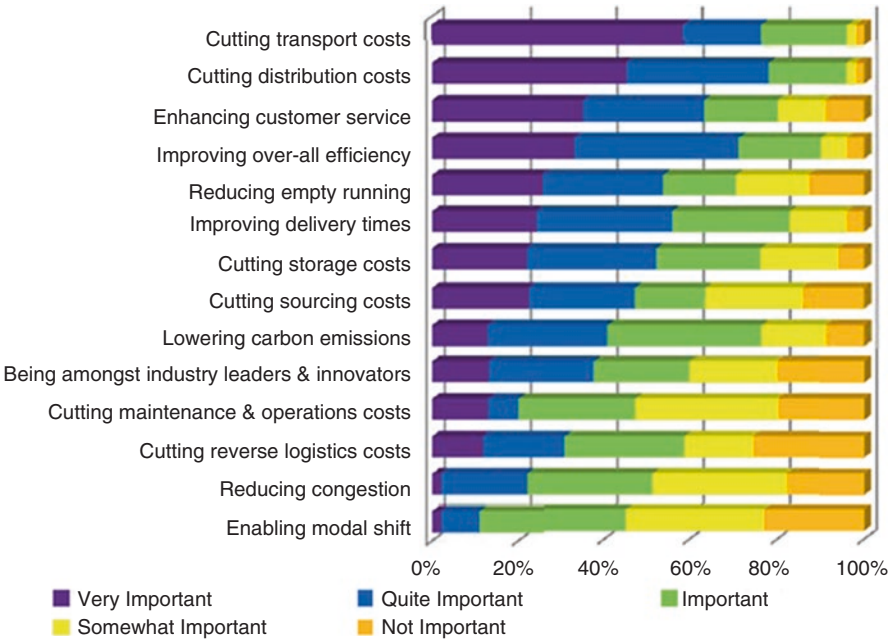

Fig. 7.1 Opportunities for horizontal collaboration (Eye for transport 2010)

cult to accomplish but hugely rewarding for those companies that do it successfully. They observe several drivers of horizontal collaboration, ranging from the demands of globalization to a marketing advantage (Fig. 7.3). Despite these potential gains, horizontal collaboration adoption is not widely practiced, for several reasons listed in Fig. 7.4. These include human fallibilities, primarily a lack of trust and a fear of failure and the effort required to implement new ideas, as well as operational difficulties.

Karam et al. (2019) also observe that although horizontal collaboration has gained an increasing attention in literature as an efficient practice for sustainable freight transport, successful applications are rarely reported. Therefore, they conducted an empirical study to find the main barriers to the implementation of collaborative freight transport in practice. A set of barriers was identified by an extensive literature review, and is grouped into six categories, i.e. "Design of the collaboration process," "Information sharing and collection," " Partners' behaviors and their relationships," "Decision making algorithm," "Web-based information system," and "Market structure and regulating laws." Then, a DEMATEL method is used to develop causality and prominence relations among these categories, starting with the question: "Why do implementations of collaborative transport fail?". The results are summarized in Fig. 7.5. They show that "Market structure and regulating laws" and "Partners' behaviors and their relations" are the most critical barriers to the success of collaboration process. "Web-based information system" has the lowest contribution to the success of the collaboration process. Therefore, guidelines

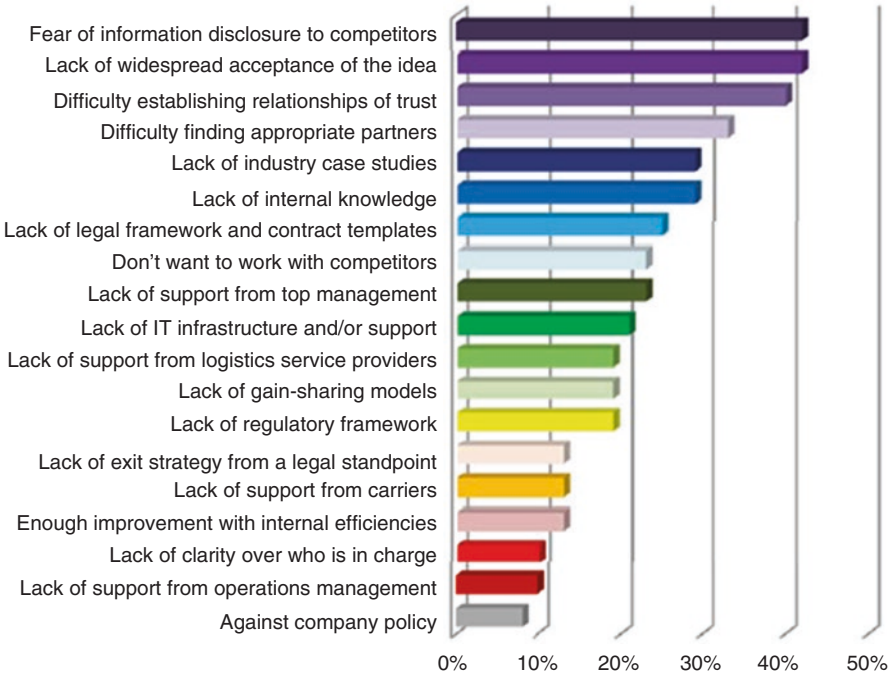

Fig. 7.2 Impediments for horizontal collaboration (Eye for transport 2010)

Table 7.2 Enablers for collaboration by Pateman et al. (2016)

Category	Theme	Weighted value
Mutual benefits	Business growth	9
	Enabling solutions	5
	Way of doing business	0
	Mutual benefits	11
	Other	9
Spirit of collaboration	Relationship building	36
	Interpersonal skills	46
	Business facilitation	58
	Other	8

for decision makers should put emphasis on the factors related to "Market structure and regulating laws" and "Partners' behaviors and their relations."

Nextrust (2018) conducted a survey in Germany about horizontal collaboration. A total of 121 representatives from the FMCG industry participated, most of which are representatives from large companies. Small and medium-sized companies represent 26 percent of participants. 5 percent of the study participants are employed in micro companies. The full results are shown in Figs. 7.6, 7.7, and 7.8, and the following are the main insights collected:

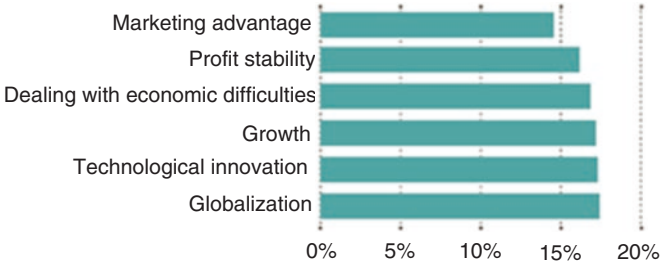

Fig. 7.3 Advantages of horizontal collaboration (Saenz et al. 2017)

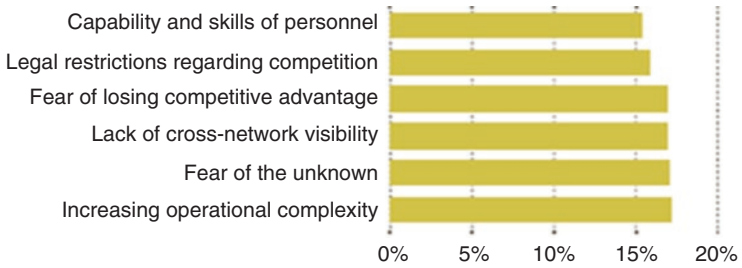

Fig. 7.4 Barriers to horizontal collaboration (Saenz et al. 2017)

- Companies from the FMCG sector express great interest in becoming involved in logistics collaboration in the future.
- Standards are a prerequisite for the successful implementation of collaborative networks.
- The motivation of the companies to collaborate is based on economic as well as ecological parameters.
- The saving potential that can be realized through efficiency gains from collaboration in logistics is underestimated by the market.

Next to the empirical studies we mentioned above, there are also some academic contributions that provide a list of opportunities and/or impediments for horizontal collaborations based on analysis and industry feedback, but without testing it on a wide scale with a questionnaire. Instead, they often use a case study approach, which is the topic of the next subsection.

7.2 Case Studies

The empirical literature on case studies is larger than the literature on surveys. One of the benefits of case studies is that they explain in detail how in a certain industry setting a collaboration was set up, what the difficulties were, where the benefits were found, and how these benefits could be quantified. Unfortunately though, in

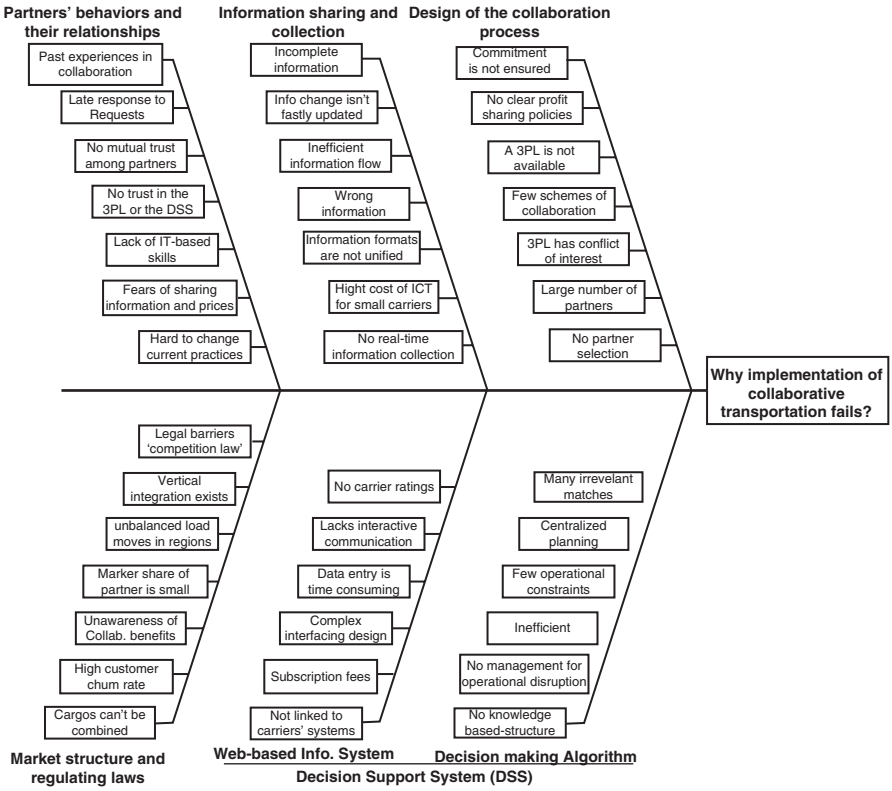

Fig. 7.5 Fishbone diagram indicating the barrier categories and their related barriers (Karam et al. 2019)

most papers collaboration is tested in a laboratory environment instead of in a real business setting.

According to Gansterer and Hartl (2018) the cost advantages of collaborations have been quantified in several studies. They observe that most of them find (potential) benefits of 20–30%. Also, ecological goals like reduction of emissions have been considered. However, most of these studies assume deterministic scenarios. Literature assessing collaboration potentials in the face of uncertainties is scarce. Also, collaboration gains in more complex, e.g. multi-modal, multi-depot transport systems, have yet to be widely investigated.

In their review paper on cost allocation methods for collaborative transport, Guajardo and Rönnqvist (2016) provide an overview of numerical results found in 55 academic papers. These numerical computations range from small illustrative examples to thorough case studies. For the publications using industrial data, they also listed the potential savings from collaboration, if reported. It shows that collaboration usually renders significant benefits, ranging from 4% to 46% cost savings, see Table 7.3.

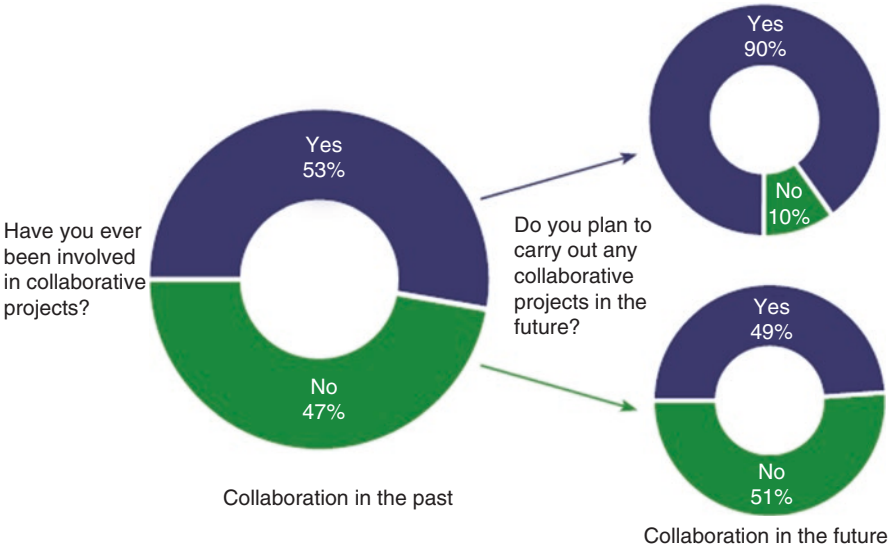

Fig. 7.6 Willingness to collaborate now and in the future (Nextrust 2018)

7.3 European Policy

Logistics project calls by the European Union through its funding schemes[1] are formulated by close consultation of industry stakeholders and experts through the so-called European Technology Platform, ALICE (Alliance for Logistics Innovation through collaboration in Europe).

ALICE was launched on June 11, 2013 and received official recognition from the EC in July 2013. ALICE has been set up to develop a comprehensive strategy for research, innovation, and market deployment of logistics and SCM innovation in Europe with the mission "to contribute to a 30% improvement of end to end logistics efficiency by 2030."

One of the key elements identified by ALICE to achieve this improvement is the Physical Internet (PI) concept. PI is pursuing an open global logistic system founded on physical, digital, and operational interconnectivity, aiming to move, store, realize, supply, and use physical objects throughout the world in a manner that is economically, environmentally, and socially efficient and sustainable (see Sect. 3.7). On its journey to achieve the PI, ALICE has identified five different areas that need to be specifically analyzed and addressed in future research projects. These areas are:

1. Sustainable and Secure Supply Chains.
2. Corridors, Hubs, and Synchromodality.

[1] FP7, Horizon2020, Horizon Europe (https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en)

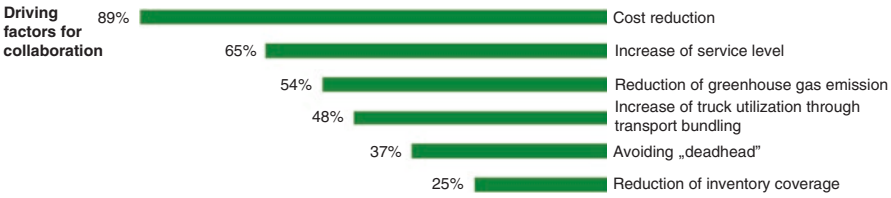

Fig. 7.7 Opportunities for collaboration (Nextrust 2018)

3. Information Systems for Interconnected Logistics.
4. Global Supply Network Coordination and Collaboration.
5. Urban Logistics.

Five different Thematic Groups have been launched, one in each of these areas, to further analyze and define research and innovation strategies, roadmaps, and priorities agreed by all stakeholders. For the purpose of this report on cross-chain consolidation centers, the research roadmap in the field of Global Supply Network Coordination and Collaboration is most relevant. ALICE notes that coordination and collaboration can enable synergistic use of resources in global supply networks, with significant gains in terms of both efficiency and sustainability. This will be a big step towards the PI, ultimately leading to open global supply networks that are operated as a whole, meaning with full vertical coordination and horizontal collaboration along and across currently individually managed supply chains.

ALICE provides a network for interdisciplinary collaborative research involving industry, academia, and public institutions. And using this network it defines its research and innovation strategies, roadmaps, and priorities to achieve its vision. These items will then assist the European Commission in the definition of Research and Innovation Programs, the most recent framework program being HORIZON Europe.

Out of industry consultation through ALICE came several innovation and coordination project calls that have been awarded to European consortia of companies, research institutes, and sometimes governments. The projects that are most intricately connected to horizontal collaboration are briefly discussed[2] in the following subsections.

7.3.1 CO3

The EU-funded project "Collaboration Concepts for Co-modality," or "CO3" in short, is a project that aimed to develop, professionalize, and disseminate information on the business strategy of logistics collaboration in Europe. The consortium ambitioned to deliver a concrete contribution to increasing load factors, reducing

[2] Based on https://ec.europa.eu/inea/en/horizon-2020/h2020-transport/projects-by-field/399

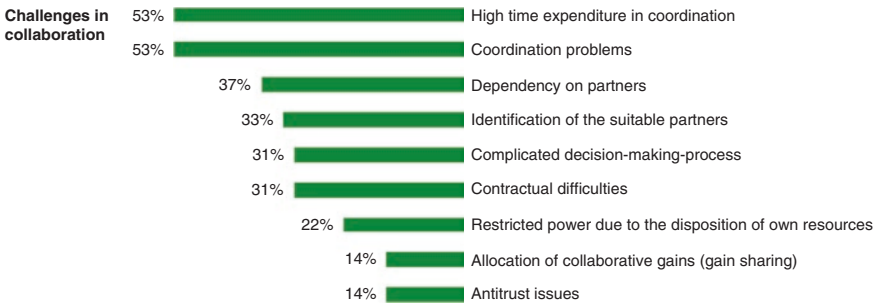

Fig. 7.8 Impediments for collaboration (Nextrust 2018)

Table 7.3 Reported savings in industrial cases based on Guajardo and Rönnqvist (2016)

References	Reported savings (%)
Engevall et al. (2004)	46
Krajewska et al. (2008)	11.5
Cruijssen et al. (2010)	23.7
Frisk et al. (2010)	8.6, 9.3, 14.2
Massol and Tchung-Ming (2010)	10.5, 11.9, 12.9
Audy et al. (2011)	12.9
Dahl and Derigs (2011)	13.85
Lehoux et al. (2011)	4
Flisberg et al. (2015)	5.99; 22.18
Vanovermeire et al. (2014)	25.83, 41.81
Guajardo and Rönnqvist (2015)	8.6, 9.3, 14.2

empty movements, and stimulating co-modality, through collaboration between industry partners, thereby reducing transport externalities such as greenhouse gas emissions and costs. The project coordinated studies and expert group exchanges and built on existing methodologies to develop legal and operational frameworks for collaboration through freight flow bundling in Europe. Furthermore, the project consortium of knowledge institutes and industry partners developed joint business models for logistics collaboration. The developed tools, technologies, and business models are applied and validated in the market via case studies. Finally, the CO3 consortium promoted and facilitated matchmaking and knowledge-sharing through conferences and practical workshops to transfer knowledge and increase the market acceptance of collaboration.

Project period: April 2011–April 2014. **EU Funding received**: 2 million euro.

7.3.2 Nextrust

The objective of NEXTRUST was to increase efficiency and sustainability in logistics by developing interconnected trusted collaborative networks along the entire supply chain. These trusted networks, built horizontally and vertically, should fully integrate shippers, LSPs and intermodal operators as equal partners. To reach a high level of sustainability, focus is not only on bundling freight volumes, but also on shifting them off the road to intermodal rail and waterway. NEXTRUST focused on research activities that create stickiness for collaboration in the market, validated through pilot cases in live conditions. The action engages major shippers as partners (Beiersdorf, Borealis, Colruyt, Delhaize, KC, Mondelez, Panasonic, Philips, Unilever) owning freight volumes well over 1.000.000 annual truck movements across Europe, plus SME shippers, and LSPs with a good innovation track record. The pilot cases cover the entire scope of the call and cover a broad cross section of the entire supply chain (from raw material to end-consumers) for multiple industries. Nextrust expects its pilot cases to reduce deliveries by 20–40% and to reduce GHG 0emissions by 40–70% with modal shift.

Project period: May 2015–October 2018. **EU Funding received**: 18 million euro.

7.3.3 SELIS

Project SELIS (acronym for Shared European Logistics Intelligent Information Space) is aimed at delivering a "platform for pan-European logistics applications" by:

- Embracing a wide spectrum of logistics perspectives and creating a unifying operational and strategic business innovation agenda for pan-European Green Logistics.
- Establishing a strong consortium of logistics stakeholders and ICT providers that can leverage EU IP from over 40 projects so as to create proof of concept Common Communication and navigation platforms for pan-European logistics applications deployed in eight living labs representing the principal logistics communities.
- Establishing a research and innovation environment using living labs to provide data that can be used for discovery of new insights that will enable continuous value creation supporting the large-scale adoption of SELIS.

SELIS is a network of logistic communities' specific shared intelligent information spaces termed SELIS Community Nodes. SELIS Community Nodes are constructed by individual logistics communities to facilitate the next generation of collaborative, responsive, and agile green transport chains. SELIS Community Nodes link with their participants' existing systems through a secure infrastructure

and provide shared information and tools for data acquisition and use, according to a cooperation agreement. Connected nodes provide a distributed common communication and navigation platform for European-wide logistics applications. Each Node decides what information it wishes to publish and what information it wants to subscribe to. The principle of a SELIS Community Node is that it provides a "lightweight ICT structure" to enable information sharing for collaborative sustainable logistics for all logistics companies, from strategic to operational levels.

Project period: September 2016–August 2019. **EU Funding received**: 17.7 million euro.

7.3.4 AEOLIX

Supply chain visibility supported by easy access to, and exchange and use of relevant logistics information is an important prerequisite for the deployment of pan-European logistics solutions that are needed to increase efficiency and productivity, and to reduce environmental impact. Although there is a strong development of logistics-related data stores, information channels, information management systems, and data mining facilities, with both international and intermodal focus, this multitude of solutions exhibits a high degree of fragmentation, due to differences in user requirements, data models, system specification, and business models. This legacy situation severely hampers the use of logistics information.

To overcome this fragmentation and lack of connectivity of ICT-based information systems for logistics decision making, AEOLIX established a cloud-based collaborative logistics ecosystem for configuring and managing (logistics-related) information pipelines. This digital business ecosystem creates visibility across the supply chain, enabling more sustainable and efficient transport of goods across Europe. An essential element of the approach is to ensure that for logistics actors connecting to and using the ecosystem has a low complexity barrier. The developed ecosystem enables the integration of transport processes through logistics software solutions for cloud-based connectivity and interaction, to support more efficient collaboration in the logistics supply chain than today.

Project period: September 2016–August 2019. **EU Funding received**: 16.2 million euro.

7.3.5 Clusters 2.0

Clusters 2.0 is a Horizon 2020 project leveraging the potential of European Logistics Clusters for a sustainable, efficient, and fully integrated transport system. It relies on an open network of logistics clusters operating in the frame of the Ten-T corridors and supporting local, regional, and European development, while keeping neutral the impacts such as congestion, noise, land use, and pollution levels. It enhances

coordination among logistics stakeholders within and among European logistics clusters. The project conducted the following activities to meet its objectives:

- Increase the engagement, performance, and coordination of terminals and hubs in the clusters.
- Achieve a significant step forward in the European transport performance through a hyper connected network of logistics hubs and clusters.
- Develop low-cost and low-capital material handling and transshipment solutions.

Project period: May 2017–April 2020. **EU Funding received**: 6 million euro.

7.3.6 LOGISTAR

The EU faces the challenge to maintain and increase its economic growth and cope with the problem of freight transport efficiency in Europe. Integration of transport volumes and modes, better use of capacity, flexibility, resource efficiency, and collaboration between all actors along the logistic chain are required.

Aligned with the European policies and the ALICE roadmap, LOGISTAR's objective is to allow effective planning and optimization of transport operations in the supply chain by taking advantage of horizontal collaboration, relying on the increasingly real-time data gathered from the interconnected digital environment. For this, a real-time decision making tool and a real-time visualization tool of freight transport will be developed, with the purpose of delivering information and services to the various agents involved in the logistic supply chain, i.e. freight transport operators, their clients, industries, and other stakeholders such as warehouse or infrastructure managers.

LOGISTAR will address several advances beyond the state of the art in the interdisciplinary field of smart algorithms for data processing: Artificial Intelligence focused on prediction, parallel hybrid metaheuristics for optimization, automated negotiation techniques, and constraint satisfaction problem solving techniques. The resulting platform will outperform more traditional market products and services such as Freight Exchange Systems, Collaborative Platforms, Transport Control Towers, or Routing Systems.

Project period: June 2018–May 2021. **EU Funding received**: 5 million euro.

7.3.7 Other Related EU Sponsored Projects

Some other project sponsored by the EU that touch the topic of horizontal collaboration are:

- Modulushka—standardized load carriers.
- ICONET—Physical Internet framework.

- iCargo—Open freight management ecosystem.
- Secure SCM—lowering data-sharing risks in SC Collaborative environments.
- Logicon—improving access to Logistic platforms to transport SMEs.
- DISCwise—digital integration of small and medium-sized LSPs.
- T-Scale—new business and operational models for vertical and horizontal cooperation.

7.3.8 Reflection on European Supply Chain Collaboration Projects

As can be concluded from the previous sections, a lot of applied research has been done on the topic of horizontal collaboration. ALICE (2015) drew some Important lessons from these past projects:

1. Collaboration can be successfully triggered and applied in almost any logistics environment, but it does not occur spontaneously with the existing market players.
2. The new function of the Neutral Trustee developed in CO3, in addition to the existing roles of shippers and LSPs (3/4PLs), is essential in triggering and creating sustainable and large-scale horizontal collaboration in the logistics market.
3. Horizontal collaboration among the right partners (shippers) can deliver double-digit improvements in logistics cost, transport carbon footprint, empty mileage, network/asset utilization, and in many cases it also improves customer service levels.
4. Anti-trust compliant, multilateral legal agreements will be key in the creation of sustainable and large-scale collaborations. However, in most companies, there still exists a large mental gap between logistics and legal professionals.
5. Along with legal solutions, information technology (ICT) plays a crucial role in collaboration, but mostly as an enabler, not as a driver.
6. To ensure stability and fairness of the collaboration gain sharing and good governance between the partners are essential.
7. Many LSPs in the market are still hesitant or defensive to actively support collaboration between shippers or to embrace collaboration among themselves.

These lessons stress the promise of horizontal collaboration to contribute significantly to the vision of the EU and ALICE to improve logistics efficiency in Europe by 30% by 2030. However, despite the recent European projects on horizontal collaboration summarized in the previous section, a strong move of the logistics industry towards collaborative logistics is yet to be seen. Many projects have trouble gathering representative (real-time) company data to test their collaborative solutions. As a result, some projects remain technical or conceptual, whereas the ambition was to bring about many industry test cases. An example is the project Nextrust, which was a direct successor of the CO3 project. The claim of Nextrust was that the

tools and concepts gathered and developed in CO3 are ready and the challenge is to apply it in as many industry sectors and with as many companies as possible. Although the budget of the project was 9 times bigger than CO3 (18 vs 2 million euro) and despite several temporarily successful pilot projects, Nextrust did not deliver the industry mind shift and the market take-up that it promised. This again illustrates the paradox also noted by Basso et al. (2018) that a logistics concept that is widely regarded as a necessary condition for achieving the policy and company goals of increased efficiency is applied in practice only in very few situations. We will come back to this inconvenient truth when we discuss the Dutch collaboration projects in Chaps. 8 and 9.

It seems that the actual problem with horizontal collaboration in logistics lies more on governance and scalability side of the solutions than on the envisioned savings. The required knowledge and insights are there and most of the shippers and LSPs are aware of this. But still companies are waiting for the "golden" support model for horizontal collaboration to appear.

One problem is that usually companies must base their decision to participate in a collaboration on calculations based on static, historic data that is gathered for all the potential consortium partners. Currently, these data are not centrally stored and only available in companies' internal systems in company-specific formats. The process of data gathering and harmonization usually takes a few weeks or even months, and by that time the situation has usually changed, and the calculations made do not fully apply anymore. Note that the mentioned Secure SCM and iCargo projects aim to solve this problem. But currently this still tedious process may explain why the current model of collaboration is not scalable, flexible, or sustainable.

There is a growing conviction also in the ALICE group that the attainable cost reduction through collaboration is apparently less than the perceived cost of the needed transition. This may change if the EU's green deal[3] goes ahead, if some other unavoidable external force comes to the stage, or if a specialized trustee or software company finds a silver bullet collaboration model. But until then, collaboration will probably stay a tough nut to crack.

7.4 Some Recent Commercial Initiatives

Despite the somewhat disappointing message of the section above, still there is a growing industry of companies specializing in horizontal collaboration support, trustee functions, collaboration software, etc. (Table 7.4)

Next to these commercial companies that have collaboration as their main business model, also an increasing number of LSPs are investing in proprietary control towers to connect internally and with their suppliers (i.e., carriers). All the major transport integrators (FedEx, UPS, DHL, etc.) have this in place, but also some

[3] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Table 7.4 Commercial collaboration initiatives

Trustees	Collaboration software	Focused consortium	Control tower
Digitrust	AX4	Fjordfrende	IDS
MixMove	Haulistix	Transmission	Informore
TriVizor	Mix-Move-Match	Netwerk Benelux	Shareship
	Nistevo	Spring Platform	Smartway Logistics
	Quicargo	Greenway Logistics	C6/King Netherlands
	Stockbooking	Construction Hub Utrecht	
	Stockspots	Greenport Logistics	
	TGmatrix		
	Uturn		
	ChainCargo		
	Cargonexx		

smaller innovative LSPs are such Ahlers, FM Logistic, Geodis, and LINEAS are moving in this direction.

Some other companies are also making good efforts to enable collaboration. For example, CHEP, the pallet pool company, is actively promoting and setting up collaborations between their customers. With their scale and access to transport flow data based on the tracked positions of its pallets, CHEP enables its customers to bundle their flows and reduce empty miles, fuel, $C0_2$ emissions, and costs.

So, there are some interesting commercial initiatives fostering horizontal collaboration in Europe. In the next chapter, we turn our attention to the Netherlands, a frontrunner on the topic of horizontal collaboration. The Netherlands has stimulated it financially via a government program that ran from 2010 until 2020. It is instructive to see the experiences in the Netherlands, both its successes and its disappointments. The lessons learned are useful for commercial companies as well as for European and national policy makers.