A survey on obstacles and difficulties of practical implementation of horizontal collaboration in logistics

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Abstract

During recent years, horizontal collaboration in logistics has gained attention because of achieved potential benefits such as cost reduction, an increase in fulfillment rates, and a decrease in CO2 emissions owing to reductions in traveled distances. Successful real-world cases, however, are rare since horizontal cooperation in logistics is not usually sustainable. This paper pays attention to this paradox of the lack of cases and discusses 16 identified practical issues that could explain this phenomenon. We propose a taxonomy composed of four categories categorizing the practical issues according to a value chain approach: design, planning and operations, market/business, and behaviors. Furthermore, we propose and discuss some measures to mitigate these problems.

Keywords: Collaborative logistics, horizontal collaboration, transportation, supply chain

1. Introduction

Horizontal collaboration in logistics has received increasing attention in past years, often driven by the large potential in cost reduction, reduction of uncertainty, and environmental concerns (Verdonck et al., 2013; Du et al., 2016). Many articles deal with new methods in sharing principles and joint planning in literature, though few articles report on successful implementation in practice. In this article, we focus on practical issues in horizontal collaboration. We define horizontal collaboration as cooperation between companies at the same level of a supply chain, e.g. carrier companies. Practical issues are meant to describe real-world problems stakeholders face when they try to implement such collaboration.

The main goal of collaborative logistics is to achieve an improved logistic chain, ensuring that the

total fulfillment costs are smaller than the sum of the companies' individual costs without collaboration. Examples of horizontal cooperation in logistics include group purchasing, use of a common inventory location to share fixed costs, collaborative transportation (Quintero-Araujo et al., 2017), and production lines sharing. Horizontal collaboration in logistics has been studied in the maritime shipping (Sheppard and Seidman, 2001), disaster relief (Schulz and Blecken, 2010; Ergun et al., 2014; Garrido et al., 2015) , and airline fields (Oum et al., 2004; Garrette et al., 2009; Weng and Xu, 2014) . However, collaborative ground transportation is quite an unexplored area.

In theory, many benefits can be achieved with collaboration, chief among them are cost reduction and increasing fulfillment rate. On the social side, collaboration usually decreases the traveled distance by carriers, which implies fewer emissions. In that way, collaboration encourages green logistics and reduces negative environmental impacts. These benefits have been shown in methodological and case study scientific papers, but few applications have been reported and captured expected benefits. For instance, in Audy et al. (2011), a collaborative transportation agreement is studied for the furniture industry. Even though theoretically important savings could be perceived by collaboration, the negotiation to establish how benefits were shared was impossible to carry out. One of the most important challenges in horizontal collaboration has been to agree on the sharing principles. Recently, Guajardo and Rönnqvist (2016) published an extensive survey in cost allocation methods in transportation collaboration. In Frisk et al. (2010), eight companies analyzed the potential to collaborate with Swedish forest transportation authorities to obtain an expected saving up to 14%. Nowadays, this agreement is no longer in operation. Suzuki and Lu (2017) state that "two real-world cases in which collaborations were attempted based on the idea similar to that of our concept, their results may not be used to assess the cost-saving potential of the concept, because in neither of these two cases, the idea was fully implemented".

This raises a need for a better understanding of the underlying reasons of this phenomenon. We would like to better comprehend why collaboration has so many advantages in theory, but is rarely successful in practice. We have conducted an extensive literature review enhanced with expert knowledge. We have identified what we have called practical issues in logistics collaboration. To the best of our knowledge, no specific papers deal with practical issues in horizontal logistics collaboration.

The literature is rich in vertical cooperation (Liu et al., 2018; Huang et al., 2018), but the environment is quite different. A recurrent example of vertical collaboration is found in the Collaborative Planning Forecasting and Replenishment (CPFR), where manufacturers and retailers share information and make common forecasting to improve demand visibility, thereby improving supply chain efficiency. We can anticipate that some practical issues in vertical collaboration apply also to horizontal collaboration. For a complete review of supply chain collaboration, including some practical issues, we refer the reader to Kanda et al. (2008).

Following a supply chain perspective, we propose a taxonomy for the practical issues with categories: design, planning and operations, business/market, and behaviors. Design practical issues are described as challenges of building efficient, stable, sustainable, and fair collaborations. The planning and operational practical issues are related to the difficulties arising from the implementation of such

collaboration. The business/market practical issues comprise the collaborative impact on the firms' strategical level and explain how agreements impact the whole market. Finally, we understand the behaviors practical issues as the human relationships challenges.

This classification is organized from a macro to micro perspective with a supply chain point of view. We first focused on practical issues coming from the design process, i.e., issues caused by structuring the collaboration. At this stage, problems are linked to the coalition formation, the benefits sharing policy, and the establishment of a proper coordination mechanism (Chen and Tan, 2018). Cooperation must be implemented with a high-level management standard. Practical issues linked to planning and operations tackle the challenges of implementing the collaboration structure designed previously. At this point, the key concept of information sharing scares managers. Coordination mechanisms are usually based on Decision Support Systems and advanced management techniques. Indeed, the various operational firm cultures should be considered. In third term, we focused on practical issues coming from the difficulties of explaining this novel procedure inside (business) and outside (market) the company. Many fears could be experienced at this juncture. For example, one could be considered as a cartel or lose autonomy. Finally, we have defined the behaviors practical issues by assembling potential problems linked to human relationships. This is crucial in horizontal collaboration, for partners are usually also competitors, and building a trustful partnership is the main challenge to face.

Two main contributions are valued in this article. First, we initially survey practical issues behind implementing horizontal collaboration, providing other researchers and practitioners with an overview of examples where methods and processes are developed, but never applied. Second, we propose a categorization to facilitate research into similar issues and search for practical approaches for future use.

In Section 2, we briefly describe multiple types of collaboration in logistics. In Section 3, we define a taxonomy for practical issues. Finally, in Section 4, we conclude with some remarks and further research directions.

2. Collaboration in logistics

In this section, we will analyze multiple types of collaboration. More specifically, we will explain differences between horizontal and vertical collaboration. Horizontal collaboration is defined as cooperation between competitor firms at the same supply chain level. Practical issues could vary dramatically depending on the type of collaboration established. This motivates a clear understanding and description of various logistics collaboration schemes.

To reduce cost, increase market conditions, reduce variability, increase fulfillment, respect operational and environmental constraints, and access new markets, companies establish collaborations with other enterprises. In contrast with vertical collaboration, where cooperation is done in the same supply chain, horizontal collaboration is established by companies at the same level in different supply chains. For example, forestry companies could share a unique terminal to split the fixed costs. Such a terminal often has large investments and requires a set of machines to function. In addition, it can easily handle

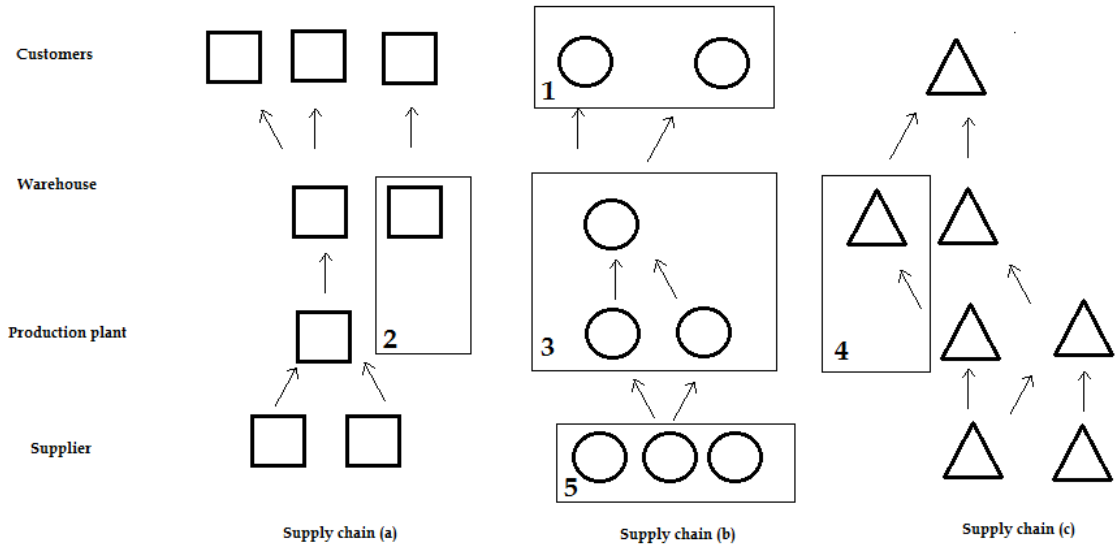

Figure 1: Dimensions of the collaboration, revised figure based on Audy et al. (2012b)

volumes for several companies. Examples of such terminals abound: truck – train or truck – vessel or truck – train – vessel. Competitors often use this type of collaboration.

Figure 1 shows multiple forms of collaboration with graphics. One has a vertical collaboration when business units cooperate within the same supply chain. For example, delimited area 5 considers a horizontal collaboration with three suppliers. Delimited area 3 considers horizontal and vertical collaboration. Finally, we can consider the horizontal collaboration among business units within the delimited area 2 and 4. In this case, we can see that cooperation is not between competitors; collaboration is key for practical issues. Vertical collaboration has been studied extensively: we can mention cooperation to mitigate the bullwhip effect, where information is shared within the supply chain to reduce the variability of the demand. For further information about horizontal and vertical collaboration, we refer readers to Caputo and Mininno (1996), where these concepts are exemplified with the Italian grocery industry.

Collaboration can be achieved at many levels, starting from a simple interchange of information to a common strategic vision. The more complex the collaboration is, the more key practical issues will arise.

In Figure 2, the first stage called *transactional relationship* considers all the information exchanges including sometimes a limited amount of operational or tactical data. At this level, the information exchanged is the minimum necessary to accomplish the objective of the collaboration. In the second stage called *information exchange relationship*, partners exchange more important information such as production plans, demand forecasting models etc. In the third stage called *joint planning relationship*,

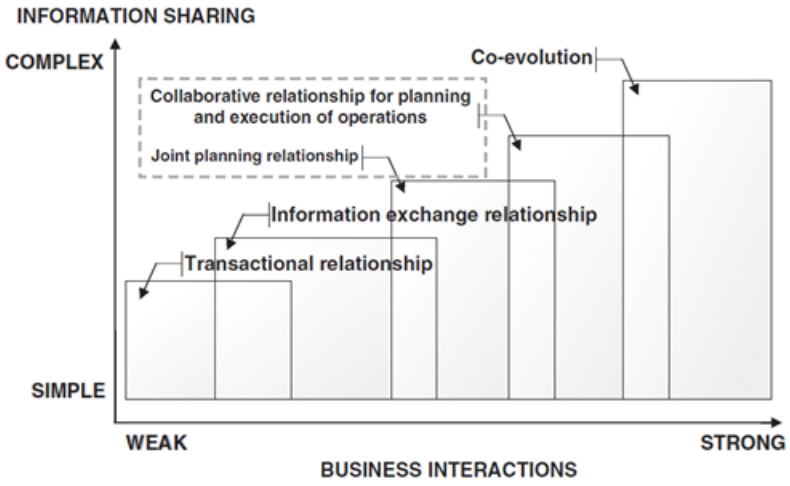

Figure 2: Forms of collaborative relationships (Frayret et al., 2003)

partners share information but also partial planning, ideas, and objectives in order to make some joint decisions. The fourth level is called *collaborative relationship for planning and execution of operations*. This level involves joint implementation of operations and joint contingency management in a spirit of mutual aid. The last stage called *co-evolution* implies cooperation on the strategic level of the firms which implies a long-term relationship. The practical issues are highly depended on the level of cooperation.

Various frameworks have been proposed in collaborative logistics (Simatupang and Sridharan, 2005; Verstrepen et al., 2009; Leitner et al., 2011; Pomponi et al., 2013; Gonzalez-Feliu et al., 2013) usually involving the followings steps: activities planning, computation of the benefits, and the decision of how to distribute them. Some new mechanisms are presented in Audy et al. (2012b) including the presence of a third party which could help avoiding some practical issues.

Decision Support Systems (DSS) are fundamental to plan and execute the collaborative plans. In this respect, Dahl and Derigs (2011) present a real time DSS for cooperative planning in carriers networks in Belgium. In the case presented by Frisk et al. (2010), a DSS called FlowOpt is used (Forsberg et al., 2005) to identify the potential of collaboration.

3. A Taxonomy for the practical issues

The articles reviewed in this survey have been obtained in three steps. In the first, we proceeded with a structured search on the Institute for Scientific Information website (2017). For a topic search, we used the word collaborative with *logistics*, *transportation*, or *inventory*. The second step involved a careful

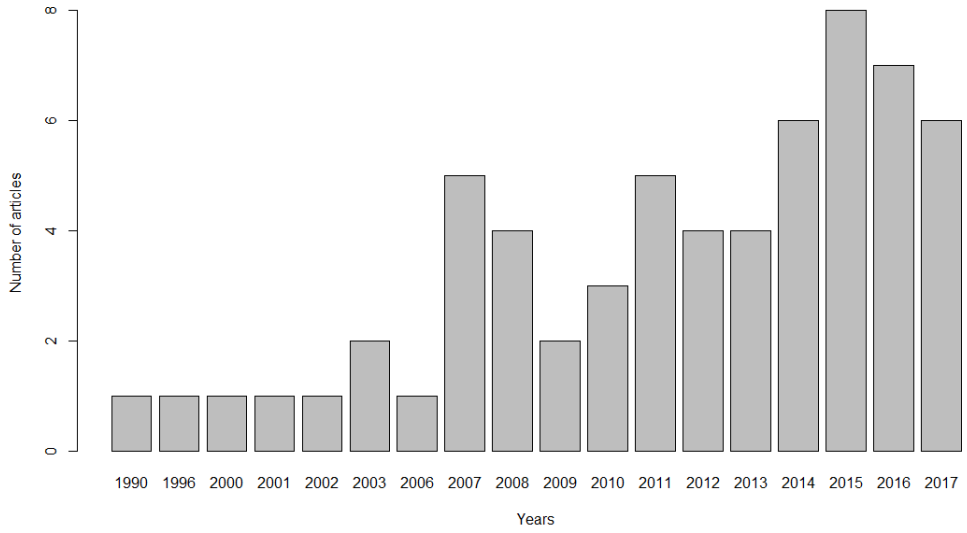

Figure 3: Number of articles per year

selection of each article. In fact, we aimed to identify articles that discussed practical issues. As we were conducting the review, our list was complemented with other articles we spontaneously noticed in the third step, either because they were frequently cited in the previously selected articles or we tracked references to them. Overall, we have identified 62 published articles published in journals (Table 1), especially in the past five years (Figure 3).

When companies work together as global economy players, a value chain-based approach is required to reflect these business models (Martinez-Olvera and Shunk, 2006). Consequently, we have classified the practical issues using a value chain-based approach. This classification divides the practical issues into four categories: design, planning and operations, business/market, and behaviors. The first outlines the partnership configuration and the strategies to keep it sustainable. The second is devoted to practical issues from developing and implementing this partnership, particularly the operation and planning process. The third is related to practical issues that threaten the core business of a company and its impact on the whole market. Practical issues belonging to this category are usually caused by a misunderstanding of what horizontal collaboration or cooperation between competitors really means. The fourth is about human behavior and its implications for the partnership. Each practical issue is supported by our expert knowledge or quotation of some of the 62 reviewed articles.

Journal	Number of articles
Transportation Research Part E: Logistics and Transportation Review	7
European Journal of Operational Research	5
Supply Chain Management: An International Journal	5
International Journal of Industrial Organization	3
OR Spectrum	3
International Transactions in Operational Research	2
Computers & Industrial Engineering	2
Expert System with Applications	2
International Journal of Production Research	2
Applied Soft Computing	2
Operations Research Letter	1
Transportmetrica A: Transport Science	1
Computers & Operations Research	1
Energy	1
European Journal of Industrial Engineering	1
Decision Support Systems	1
International Journal of Transport Economics	1
Manufacturing & Service Operations Management	1
International Journal of Production Economics	1
Journal of Operational Research Society	1
Strategy: Critical Perspectives on Business and Management	1
Journal of Physical Distribution & Logistics Management	1
Production and Operations Management	1
Production Planning and Control	1
Strategic Management Journal	1
International Journal of Procurement Management	1
Journal of Science and Technology	1
Transportation Science	1
The Review of Economics Studies	1
Research in Logistics and Production	1
Journal of Studies on Manufacturing	1
The Journal of Economic Perspectives	1
International Journal of Logistics Systems and Management	1
Journal of Business Logistics	1
Accounting, organizations and Society	1
Flexible Services and Manufacturing Journal	1
Omega	1
Conference Papers	2
Total	62

Table 1: Number of articles per journal

3.1. Design

The design process is defined as the problem of collaboration stemming from the structure of such a partnership. How is it possible to find an agreement between partners to be engaged in a collaboration scheme? This is one of many fundamental questions in logistics collaboration. This section we will shed light on some of them.

This topic is usually called ***coalition formation*** in the related literature. For Dahl and Derigs (2011) "on the strategical level the choice of the right set of partners yielding enough consolidation potential as well as mutual trust is a cardinal point". Cruijssen et al. (2007) said to this respect that "according to the respondents the most severe impediments for cooperation are the problems of finding a reliable party that can coordinate the cooperation in such a way that all participants are satisfied". Mathematically, we can identify the coalition formation to a well-known problem called the partitioning problem, where we must split a set into disjoint subsets (Aumann and Dreze, 1974). The collaboration literature usually tackles the coalition formation problem from a cost reduction point of view using OR/Game Theory tools (Lozano et al., 2013; Guajardo and Rönnqvist, 2015; Jouida et al., 2017; Xu et al., 2017). Game theory is used to describe how different partners would act depending on other people's actions. Dao et al. (2014) study the Virtual Enterprise (VE), defined as a temporary alliance of enterprises that can share core competencies and resources together to better respond to business opportunities. The consultancy area usually uses this kind of procedure. According to the authors, "the working principle of VE indicates that one of the critical issues to establish a successful VE is to select the right partners—the so-called partner selection problem". Recently, Defryn et al. (2017) propose a multi-objective optimization model to integrate the partner objective in horizontal logistics collaboration. This framework distinguishes between the coalition objective and the player objectives. Additionally, the coalition formation problem does not usually include all the "transactional costs" (Williamson, 1981), estimated to be high, thereby hindering any positive upside of a collaboration.

Some recent research and practical experiences have shown that big coalitions are more likely to fail. Guajardo and Rönnqvist (2015) state that "adding a cost on the coalition cardinality might be useful for reflecting the issues of managing large coalitions". We define this as the ***coalition size*** issue. To mitigate this effect, new models limit the quantity of players per coalition or consider a cost per size in the objective function. Flisberg et al. (2015) states that "clearly, there are many companies involved in each of the integrated instances that make such collaboration more difficult". The right number of partners depends on the industrial context but is rarely higher than two or three, even though some exceptions apply. For example, Frisk et al. (2010) show a real case study of eight forest companies that initially agreed on a collaboration scheme obtaining savings up to 14.2%. Despite the large potential savings, such a collaboration was never implemented. However, three of the companies agreed to test the collaboration and it was successfully implemented for a short period. This experiment worked because a third-party partner was involved, having no interest in any of the companies. This partner represented a research and development organization; when experimenters were searching for a new independent partner, none could be found, putting an end to the three-company collaboration. Some companies worked together following the experiment, though savings were lower. But this collaboration continued because a pairwise collaboration was easier to coordinate (no financial flows are necessary

when only volumes were exchanged).

Who will lead the collaboration? This can become a potential source of conflicts. We called this the ***leadership and conflict of interest*** issue. Depending on how the collaboration is structured, a subset of the players (leading companies) performs collaborative planning on behalf of the others. As we will see later, this may cause a conflict of interest, affecting the whole market in some cases. In this section, we face the leadership issue from a design point of view. To avoid major problems, we need to think about and answer the following questions: How is the coalition led? Should there be a third party? What is the value of being a leading player? How do you trust the leader? How can one avoid the leader taking advantage of their position? Audy et al. (2012a) analyze the second question with a real case study in Sweden using four leadership scenarios. Depending on how agreements are made, the leading companies obtained a total 1.1–10.6% additional payoff. For Verstrepen et al. (2009), the leading practical issue is the most important: "Finding a reliable party to lead the cooperation and constructing a fair allocation mechanism for the benefits are the impediments that respondents agree with most". This statement is based on a survey presented in the article by Cruijssen et al. (2007). Montoya-Torres et al. (2016) state that "the diverse and (very often) conflicting interests of stakeholders have to be taken into account".

Once the coalition is formed, how are costs and benefits shared? We call this the ***cost allocation*** practical issue. According to Kevin Lynch, CEO for Nistevo Network, "The key to understanding collaborative logistics lies in recognizing how costs are distributed in a logistics network". Academicians have published an significant number of articles on this topic (Özener and Ergun, 2008; Frisk et al., 2010; Audy et al., 2011; Dai and Chen, 2012; Lozano et al., 2013; Sun et al., 2015; Dai and Chen, 2015; Li et al., 2016). For a complete survey on cost allocation in transportation, please see Guajardo and Rönnqvist (2016). Most articles use game theory to propose a solution to this issue using famous methods such as the Shapley Value (Shapley, 1953) and the Nucleolus (Schmeidler, 1969). Moreover, game theory and profit allocation methods have been used in cooperative inventory problems (Triqui Sari and Hennet, 2016; Guajardo and Rönnqvist, 2015). The literature has focused a lot on the problem of sharing the benefits/costs but dividing failure risks when unexpected problems arise has been rarely studied.

The literature usually approaches horizontal collaboration from a static point of view. In other words, it does not matter what will happen when situations go awry, information is missing, or other situations occur. What could possibly go wrong? Some examples include a player leaving the coalition, companies not accomplishing their tasks (e.g., some deliveries are unfinished), data change, or incomplete information. Such examples are defined as ***dynamic*** practical issues. This collaboration is highly unexplored. In Regan and Song (2003), a coalition of mid-sized carriers fulfilling a full truckload pickup and delivery requests is studied. According to Leitner et al. (2011), collaboration "requires a huge effort of coordination and dynamic planning within the network". Hernández et al. (2011) study the deterministic dynamic single carrier collaboration problem fort in the small-to medium-sized less-than-truckload (LTL) industry. Wang and Kopfer (2013) investigate a full truckload pickup and delivery transportation problem with deterministic information and requests to be fulfilled. Wang and Kopfer (2015) study a rolling horizon planning for a dynamic collaborative routing problem with full-truckload pickup. This is an interesting topic for further research.

Another key practical issue to be considered from a structural point of view is the process of ***negotiation*** that must be performed to form the coalition. Firms engaging in alliances incur transaction costs in negotiating, monitoring, and enforcing the contract (Garrette et al., 2009). Bleeke and Ernst (2002) explain how developing the relative negotiation power of the coalition members is key in understanding if an alliance is likely to be successful. These authors consider three factors: partners' initial strengths and weaknesses, change of these strengths and weaknesses, potential for competitive conflict. In the same way, Audy et al. (2012a) state that "we should expect that the player with higher negotiation power receives a larger payoff than its weaker counterpart". This idea suggests that the cost allocation must consider the firms' negotiation power. In the Frisk et al. (2010) case study, "the results reported rely on the fact that all forest companies agree in advance to accept a cost allocation computed in any of the suggested approaches". In this case, the negotiation was successful. In the transportation planning context, on the one hand, companies with high negotiation power are usually centrally located. On the other hand, peripheral companies have less negotiation power. In the article "Constructive and blocking power in collaborative transportation" by Guajardo et al. (2016), they empirically focus on the negotiation power for companies using game theory models. They concluded that some cost allocation models, such as the modiclus or SM-nucleolus, could help to maintain the coalition sustainable once they consider negotiation power. Wang et al. (2017) propose a profit allocation method to improve negotiation power for logistics network optimization. The proposed approach, in opposition to most previous efforts, regards the willingness of logistics participants to participate.

3.2. Planning and operations

Planning and operations practical issues are understood as the challenges that arise from implementing the collaboration. We focus on the operational drawbacks that could appear.

From an operational perspective, it is vital to establish good connections for the ***information flow*** and establish proper ***coordination mechanisms***. In other words, proper and known means of communicating within the coalition need to be provided; they must be secured and trustful. Web-based software has become a promising tool to enhance communication among companies (Kale et al., 2007; Chow et al., 2007; Gonzalez-Feliu et al., 2013; Ilie-Zudor et al., 2015). Ergun et al. (2007) explain in their papers how the three companies "Nistevo, Elogex, and Transplace use the Internet as a common computing platform to give shippers and carriers visibility to hidden costs". Information must be trustful since errors in data could imply higher or lower revenues for the companies. This could be eventually used as a tool to improve archly incomes, meaning that data validation is recommended. Consequently, information compatibility must be a central point. Firms often have many ways to keep information: collaboration involves data homogenization; managing costs should be incorporated into company cost. Planning the collaboration typically requires large amounts of information, and disaggregated data could be necessary for planning calculation. According to Prakash and Deshmukh (2010), "Both the flexibility and collaboration requires high communication between various information systems at one hand and on the other hand the compatibility of their practices". The authors not only focused on information compatibility but also focused on practice compatibility. Stefansson and Russell (2008)

define the place where the information and physical goods are exchanged as "interface". They believe that what works today may not work tomorrow. Hence, establishing a fruitful collaborative scheme with the "interface" must be constantly supervised to take fast actions if things are going wrong. For Stefansson and Russell (2008), the bottlenecks tend to be at the interfaces. Recently, Zhang et al. (2017) discussed a collaborative transportation model using an e-commerce platform (e.g., Tmall) for suppliers and retailers to share operational information with multiple logistics service providers (LSPs) forming a collaborative alliance in an e-commerce logistics network.

One of the main issues in implementing collaboration in logistics is the high level required by practitioners since companies must have a qualified human resources team. One idea to partially mitigate this issue is to outsource some technical decisions to a transparent expert or academician. This is called a ***practitioner knowledge*** practical issue. The expert should be respected by all the members and their expertise should be recognized in the industry and academia. For Cruijssen et al. (2010), "transportation is a hands-on and low-tech sector and practical cases have shown that practitioners often regard the problem of constructing a fair gain sharing mechanism as too difficult or academic".

Enterprises could have various accuracy rates, making the collaboration more difficult since companies with the best fulfillment may not be interested in collaborating with those in worse situations, even though a cost reduction could be obtained in theory. Moreover, operational standards must be similar for the collaboration to be successful. This is known as a ***fulfillment and standards*** practical issue. According to Caputo and Mininno (1996), in the collaborative inventory management, "branded industries have to adopt the same standard for bar-coding consumer units, cartons and pallets and they have to respect the chosen standards". To palliate this practical issue, the collaboration contract must stipulate what must be done if a company fails to live up to its commitments. For example, some payments should be made to repair the damages. Determining the amount of those payments is not an easy task, though. In the Wang and Kopfer (2014)article "Collaborative transportation planning of less-than-truckload freight," the authors state that "the calculation of the potential fulfillment costs for all bundles of less-than-truckload pickup and delivery requests with time windows constitutes a very difficult problem, which they do not consider". This practical issue is especially important for horizontal collaboration since all coalition members perform the same activities. In some areas (e.g., retailers), companies place such a value on service levels that it is difficult to envisage any collaboration (Hingley et al., 2011). Further, the partners may have different productivity levels.

Successful cases of horizontal collaboration usually use advanced Enterprise Resource Planning (ERP) or Decision Support System (DSS) for cooperation operations (Buijs and Wortmann, 2014). We call this the ***high-tech*** practical issue. We can mention as an example the transportation collaboration between eight Swedish companies (Frisk et al., 2010) that use the FlowOpt tool to coordinate the exchange of wood between members. For details about this DSS, we refer the reader to Forsberg et al. (2005). This is a practical issue particularly for small- and medium-sized companies that cannot afford expensive computational tools or consultancies. Additionally, these companies benefit most from horizontal collaboration in logistics. Wang and Kopfer (2014) said that "for small and medium-sized freight carriers, horizontal collaboration is considered as a promising support". Unlike large companies that can accomplish requests to a high extent by exploiting the economy of scale, small-

and medium-sized carriers are in small surfaces. For Ergun et al. (2014), “Information technology (IT) tools can help facilitate collaboration, but cost and other barriers have limited their use”. For example, “the visibility of the transport operation has been greatly enhanced in recent years by the introduction of telematics (. . .) It was created for three leading grocery manufacturers who collaboratively united to commission the system and is due to go live during the spring of 2006” (Mason et al., 2007). For Hernández and Peeta (2014), collaboration in logistics has grown rapidly in past years because of “the affordability and the increased use of the Internet and information and communication technologies”. Montoya-Torres et al. (2016) state that “technological issues are of high relevance to ensure effective and efficient collaboration networks in urban goods transport”.

3.3. Business/market

We define business practical issues as the challenges faced by the firms at the strategical level. As we mentioned in Section 2, collaboration could be established through various dimensions, from a transactional relationship or information exchange to a joint planning or strategic development. On the one hand, closer cooperation will have major implications on the company’s core business. On the other hand, the market practical issues are related to the interaction between the collaborators and the environment (government, competitors, consumers, etc.)

Some countries will allow a merger or a collaboration agreement only if consumers are not harmed. This is the case of Australia, the European Union, Indonesia, Mexico, the Netherlands, Norway, Portugal, the United Kingdom and the US. Some other countries have a more flexible stance and allow price increases as long as social welfare is not hurt, that is, that the increase in profits at the industry level is larger than the reduction of surplus for consumers, thus leaving space for a Pareto improving redistribution. This is the case of Canada, South Africa, Singapore, New Zealand and Korea. Anyways, ***collusion*** is a crucial topic in most countries because of recent cartel discoveries; however, it is not a new procedure. A well-known case study of collusion in first-price auctions is reported by Pesendorfer (2000), where the bidding for school milk contracts in Florida and Texas during the 1980s is studied. Collusion is a key practical topic in horizontal and vertical collaboration. The logistic collaboration must be carried out to in a way to ensure that it is not considered collusion. Achieving this task requires an in-depth study of anti-trust laws in each country. Many authors have studied the collusive implication of integration between two or more firms. Although this integration it is not focused on collaborative logistics, some of the first authors who studied horizontal integration are Shapiro and Willig (1990), who analyzed “the antitrust treatment of collaborative production activities among rival firms”. Chen and Ross (2003) studied the particular collaboration in which parent companies produce a critical input that they use to produce final goods. They have in part concluded that “the effect on market efficiency will depend on the extent to which savings in fixed costs compensate for the reduced level of competition between the partners”. Basso (2008) studied the effects on capacity and pricing in airports where no collusion regulation was introduced. For Frisk et al. (2010), horizontal cooperation is allowed if it does not interfere with the overall market prices in supply areas. In their case study, eight companies participated in a common transportation planning, but they still competed for buying harvest areas. Some additional precautions could be taken to avoid collusion risk. In the Frisk et al. (2010) case study,

an additional practical constraint has been added: the flow balance between any pair of companies should be equal. This implies that there is no need to invoice between companies. Some countries are promoting horizontal collaboration in logistics, implementing legal frameworks to support it. For instance, in Europe, a program called Collaboration Concepts for CO-Modality (CO3) has recently been launched (Vanovermeire and Sörensen, 2014). This framework suggests the use of a trustful third party to coordinate the cooperation. CO3 also offers a legal background describing the entry and exit clauses for collaboration. This program promotes the Shapley Value (Shapley, 1953) to split the benefits among companies. Hezarkhani (2016) study pairwise collusion in bipartite matching games with an application in collaborative logistics.

Depending on the productive area, some useful data to establish cooperation could be considered sensitive information for the companies. These data are referred to as ***sensitive information sharing*** issues. Chow et al. (2007) propose a strategic knowledge-based planning system for the freight forwarding industry in Hong Kong. According to the authors, "most freight forwarders are reluctant to share their secret information such as customer's transaction record to others". Clifton et al. (2008) examine the use of cryptographic techniques to perform collaborative logistics among potential competitors' carriers without a broker and with a strictly minimum share of information. To illustrate this approach, the authors focused on a problem faced by independent trucking companies with miscellaneous pick-up and delivery tasks. Cruijssen et al. (2010) defined the insinking phenomenon as a pull approach where the service provider initiates the shift of logistics activities selecting companies carefully. The authors think that this procedure is better than outsourcing since it facilitates the attainment of synergy without the difficulties arising from sharing sensitive information between the cooperating companies. According to Leitner et al. (2011), "collaboration entails much more than cooperation, especially in terms of sharing information, risks, knowledge and profit and in the required level of closeness". Wang and Kopfer (2014) talked about collaboration in less-than-truckload freight. In this case, customer payments and cost structure information are unexposed in the Carrier Transport Provider. Chen (2016) state, "because carriers are generally autonomous units or even competitors, they do not want to reveal their confidential business". The author proposes a combinatorial clock-proxy exchange to tackle this issue. Recently, Lai et al. (2017) stated that cooperation was "difficult to realize because each party is self-interested who may not share his private information that is necessary for the cooperation". They proposed an iterative auction scheme that facilitates successful collaboration among carriers.

Some companies do not want to appear related to another one for reasons of ***reputation***, even though the collaboration could be beneficial for them. To avoid this, the collaboration could be done privately. Some companies are suspicious about collaborating with others since they think this kind of procedure could reduce their ***autonomy***. Some papers have confronted this issue. For example, Ghosh and Morita (2012) focused on how collaboration between competitors reduced their product distinctiveness. At this point, it is important to clearly restrict the coalition's attributions so companies can decide whether or not to enter the partnership.

3.4. Behaviors

In this subsection, we focus on the behavioral practical issues. In this context, we define the behaviors issues as problems arising from human factors and relations that may impact the collaboration.

The first practical issue that we are going to describe is ***trust***. As we have partially mentioned in other sections, trust is essential for any collaboration. System, partners, and data—these are three areas where the trust could be broken. Trust in the system refers to confidence; there is hope that the collaborative partnership will be positive for the company. Here, a deep belief lies in procedures and methodologies of horizontal collaboration in logistics. Trust in the partners refers to the belief that coalition members will act ethically, responsibly, and diligently. Trust in the partners suggests that no stakeholder will take advantage of your company. Shapiro and Willig (1990) explain it like this: "the cooperation intrinsic to a production joint venture may foreclose opportunities that would otherwise arise for one venturer to expand profitably at the expense of another". Trust in the data refers to players' confidence in their data and in that of others. Tomkins (2001) studied the behavioral practical issue when accounting information had to be shared with others. He believed that all business relationships depended on trust to some extent. He says emphatically that "the role that developing more reliable forms of trust and the cost of doing that is rarely considered in the cost-benefit analysis". Simply put, there is a lack of behavioral analysis when the partnership contributions are studied. Lyons et al. (2006) focused on the preponderance that technologies have over socio-emotional cues. In the Pérez-Bernabeu et al. (2015) case study, the authors demonstrate that important savings in distances and greenhouse gas emissions could be made through collaboration in the vehicle routing problem. They think that "one of the many aspects to analyze in horizontal cooperation is trust between entities". Meanwhile, Özener and Ergun (2008) emphasize that trust in horizontal collaboration is somehow difficult to build since collaborators are usually competitors. This is a particularly important remark since it is in contrast with the vertical cooperation (partners are not usually direct competitors). This is where trust is simpler to build. Cruijssen et al. (2007) talked about partners' opportunistic behaviors. This fear of companies could be related to sensitive information that must be shared to perform the cooperation. A trust development evolutionary framework for horizontal collaboration in logistics is proposed by Pomponi et al. (2013), Pomponi et al. (2015), and Montoya-Torres et al. (2016). All authors state that "collaboration in urban logistics requires confidence, trust and information sharing between the actors involved in the process".

We define ***cultural*** issues as the difficulties stemming from major differences between or within collaborators. This topic is huge in military and civilian environments. Lyons et al. (2006) explain it like this: "the military is facing novel demands in terms of peacekeeping, humanitarian, and disaster relief operations, which require instant and effective logistic collaboration between the local, state, and federal governments; military; and civilian organizations. This collaboration may also traverse cultural and geographic boundaries, which adds another degree of complexity to logistics teams". Military organizations have a vertical leadership that could collide with civilians ones (more horizontal). Some companies have informal procedures to communicate to others, which could be insurmountable for more organized companies. Ghaderi et al. (2012) explored the potential and impediment for group purchasing collaboration. They stated that "the success factors related to inter-organizational trust, the formality of the group and the uniformity of the group members" are important practical issues to care

about.

To perform a good collaboration, ***incentives*** must be offered intelligently. With a classical fulfillment rate scope, managers could be motivated to accomplish only their company's task, leaving aside partner requirements. For Hingley et al. (2011), "this resistance may reflect a lack of ability, interest or determination or could simply imply that powerful retail manager gatekeepers block its implementation due to their own self-interest".

3.5. Summary

We have identified and proposed a taxonomy to categorize 16 practical issues that limit the implementation of collaborative logistics (see Table 2). Some articles cover several issues. Clearly, problems surface and are described in various application areas and a variety of scientific articles.

4. Concluding remarks

In theory, many benefits could be achieved when implementing horizontal collaboration in logistics. In the last decade, literature in this area has grown rapidly, and many models, methods, and approaches have been suggested and tested in case studies and examples (Palander and Väätäinen, 2005). Real implementations are rare, however. As shown and described, many reasons abound that explain how collaboration is not implemented. Understanding these problems in depth is crucial to alleviate their consequences.

We have proposed a taxonomy for four main categories involving 16 identified issues. These categories are Design, Planning and Operations, Business and Market, and Behavior. They correspond to various parts of the value chain and time horizons. In the articles found, it has been shown that theoretical models are not usually able to capture all the real-world difficulties. This work highlights the main complications of such collaboration to encourage researchers to incorporate it into their models.
From a theoretical point of view, we have found that the cost allocation problem is the most studied practical issue. Researchers have solved it by using Game Theory, OR, and other ad-hoc techniques to split costs fairly. Despite the above techniques, trust and the coordination mechanism are huge obstacles to make the collaboration happen from a real-world point of view. The information must flow in defined and secured channels using sophisticated approaches to react when something unexpected happens. Anti-trust laws are another critical matter, as they directly relate to strict market regulations. Hence, it is important to study anti-trust laws in each country to avoid being taken for a cartel. The agreement must be made in a way that companies do not lose autonomy and maintain their enterprise philosophy. Moreover, there often will also be resistant from a legal side, as contracts involving horizontal collaboration may not be simple to process. There can be multiple complexities involved in the duties and rights of each party involved.

Table 2: Summary of the practical issues

Category	Practical Issue	Papers
Design	Coalition formation	Cruijssen et al. (2007) ,Dahl and Derigs (2011) Lozano et al. (2013) , Dao et al. (2014) Guajardo and Rönnqvist (2015),Triqui Sari and Hennet (2016) Jouida et al. (2017) , Xu et al. (2017) Defryn et al. (2017)
	Coalition size	Guajardo and Rönnqvist (2015), Flisberg et al. (2015) Frisk et al. (2010)
	Leadership and conflicts of interest	Cruijssen et al. (2007), Verstrepen et al. (2009) Audy et al. (2012a), Montoya-Torres et al. (2016)
	Cost allocation	Özener and Ergun (2008), Dai and Chen (2012) Audy et al. (2011), Lozano et al. (2013) Sun et al. (2015), Dai and Chen (2015) Guajardo and Rönnqvist (2016) , Li et al. (2016) Triqui Sari and Hennet (2016)
	Dynamic aspects	Regan and Song (2003),Hernández et al. (2011) Leitner et al. (2011), Wang and Kopfer (2013) Wang and Kopfer (2015)
	Negotiation	Bleeke and Ernst (2002), Frisk et al. (2010) Audy et al. (2012a), Guajardo et al. (2016) Wang et al. (2017)
Planning and Operations	Information flow and coordination mechanism	Chow et al. (2007) , Ergun et al. (2007) Kale et al. (2007) ,Stefansson and Russell (2008) Prakash and Deshmukh (2010) Gonzalez-Feliu et al. (2013), Ilie-Zudor et al. (2015), Zhang et al. (2017)
	Practitioner knowledge	Cruijssen et al. (2010)
	Fulfillment and Standards	Hingley et al. (2011), Wang and Kopfer (2014)
	High-tech	Mason et al. (2007) , Frisk et al. (2010) Wang and Kopfer (2014), Hernández and Peeta (2014) Ergun et al. (2014) , Buijs and Wortmann (2014) Montoya-Torres et al. (2016)
Business/Market	Collusion	Shapiro and Willig (1990), Pesendorfer (2000) Chen and Ross (2003), Basso (2008) Frisk et al. (2010), Vanovermeire and Sörensen (2014) Hezarkhani (2016)
	Sensitive information sharing	Clifton et al. (2008), Cruijssen et al. (2010) Leitner et al. (2011), Wang and Kopfer (2014) Chen (2016), Montoya-Torres et al. (2016) Lai et al. (2017)
	Reputation and autonomy	Ghosh and Morita (2012)
Behaviors	Trust	Shapiro and Willig (1990), Tomkins (2001) Lyons et al. (2006), Cruijssen et al. (2007) Özener and Ergun (2008), Pomponi et al. (2013) Pérez-Bernabeu et al. (2015),Pomponi et al. (2015) Montoya-Torres et al. (2016)
	Cultural	Lyons et al. (2006), Ghaderi et al. (2012)
	Incentives	Hingley et al. (2011)

The need for better DSS's to support the implementation of horizontal collaboration in logistics should motivate a better understanding of the problem. This paper provides a wave of opportunities to improve the modeling and the design of the DSS. The facts, for example, that horizontal logistics is planned and executed dynamically over time and that partners may express a different type of behaviors should be better recognized, modeled and considered in OR contributions to the field. This would increase the potential for implementation.

Acknowledgements

We gratefully acknowledge financial support from the Complex Engineering Systems Institute, ISCI (grant CONICYT FB0816) and a CONICYT-Chile doctoral grant (Franco Basso).

References

Audy, J.F., D'Amours, S., Rönnqvist, M., 2012a. An empirical study on coalition formation and cost/savings allocation. *International Journal of Production Economics* 136, 1, 13–27.

Audy, J.F., D'Amours, S., Rousseau, L.M., 2011. Cost allocation in the establishment of a collaborative transportation agreement—an application in the furniture industry. *Journal of the Operational Research Society* 62, 6, 960–970.

Audy, J.F., Lehoux, N., D'Amours, S., Rönnqvist, M., 2012b. A framework for an efficient implementation of logistics collaborations. *International transactions in operational research* 19, 5, 633–657.

Aumann, R.J., Dreze, J.H., 1974. Cooperative games with coalition structures. *International Journal of Game Theory* 3, 217–237.

Basso, L.J., 2008. Airport deregulation: Effects on pricing and capacity. *International Journal of Industrial Organization* 26, 4, 1015–1031.

Bleeke, J., Ernst, D., 2002. Is your strategic alliance really a sale. *Strategy: critical perspectives on business and management* 4, 4.

Buijs, P., Wortmann, J., 2014. Joint operational decision-making in collaborative transportation networks: the role of it. *Supply Chain Management: An International Journal* 19, 2, 200–210.

Caputo, M., Mininno, V., 1996. Internal, vertical and horizontal logistics integration in italian grocery distribution. *International Journal of Physical Distribution & Logistics Management* 26, 9, 64–90.

Chen, H., 2016. Combinatorial clock-proxy exchange for carrier collaboration in less than truck load transportation. *Transportation Research Part E: Logistics and Transportation Review* 91, 152–172.

Chen, Q., Tan, Z., 2018. Mixed coordination mechanisms for scheduling games on hierarchical machines. *International Transactions in Operational Research*

Chen, Z., Ross, T.W., 2003. Cooperating upstream while competing downstream: a theory of input joint ventures. *International Journal of Industrial Organization* 21, 3, 381–397.

Chow, H.K., Choy, K.L., Lee, W., 2007. A strategic knowledge-based planning system for freight forwarding industry. *Expert Systems with Applications* 33, 4, 936–954.

Clifton, C., Iyer, A., Cho, R., Jiang, W., Kantarcıoğlu, M., Vaidya, J., 2008. An approach to securely identifying beneficial collaboration in decentralized logistics systems. *Manufacturing & Service Operations Management* 10, 1, 108–125.

Cruijssen, F., Borm, P., Fleuren, H., Hamers, H., 2010. Supplier-initiated outsourcing: A methodology to exploit synergy in transportation. *European Journal of Operational Research* 207, 2, 763–774.

Cruijssen, F., Cools, M., Dullaert, W., 2007. Horizontal cooperation in logistics: opportunities and impediments. *Transportation Research Part E: Logistics and Transportation Review* 43, 2, 129–142.

Dahl, S., Derigs, U., 2011. Cooperative planning in express carrier networks—an empirical study on the effectiveness of a real-time decision support system. *Decision Support Systems* 51, 3, 620–626.

Dai, B., Chen, H., 2012. Profit allocation mechanisms for carrier collaboration in pickup and delivery service. *Computers & Industrial Engineering* 62, 2, 633–643.

Dai, B., Chen, H., 2015. Proportional egalitarian core solution for profit allocation games with an application to collaborative transportation planning. *European Journal of Industrial Engineering* 9, 1, 53–76.

Dao, S.D., Abhary, K., Marian, R., 2014. Optimisation of partner selection and collaborative transportation scheduling in virtual enterprises using ga. *Expert Systems with Applications* 41, 15, 6701–6717.

Defryn, C., Sörensen, K., Dullaert, W., 2017. Integrating partner objectives in horizontal logistics optimisation models. *Omega*

Du, G., Sun, C., Weng, J., 2016. Liner shipping fleet deployment with sustainable collaborative transportation. *Sustainability* 8, 2, 165.

Ergun, Ö., Gui, L., Heier Stamm, J.L., Keskinocak, P., Swann, J., 2014. Improving humanitarian operations through technology-enabled collaboration. *Production and Operations Management* 23, 6, 1002–1014.

Ergun, Ö., Kuyzu, G., Savelsbergh, M., 2007. Shipper collaboration. *Computers & Operations Research* 34, 6, 1551–1560.

Flisberg, P., Frisk, M., Rönnqvist, M., Guajardo, M., 2015. Potential savings and cost allocations for forest fuel transportation in sweden: A country-wide study. *Energy* 85, 353–365.

Forsberg, M., Frisk, M., Rönnqvisty, M., 2005. Flowopt–a decision support tool for strategic and tactical transportation planning in forestry. *International Journal of Forest Engineering* 16, 2, 101–114.

Frayret, J., D'Amours, F., D'Amours, S., 2003. Collaboration et outils collaboratifs pour la PME Manufacturière [Collaboration

and collaborative tools for manufacturing SMEs]. Technical report, CEFRIO Technical Report, Canada.

Frisk, M., Göthe-Lundgren, M., Jörnsten, K., Rönnqvist, M., 2010. Cost allocation in collaborative forest transportation. *European Journal of Operational Research* 205, 2, 448–458.

Garrette, B., Castañer, X., Dussauge, P., 2009. Horizontal alliances as an alternative to autonomous production: Product expansion mode choice in the worldwide aircraft industry 1945–2000. *Strategic Management Journal* 30, 8, 885–894.

Garrido, R.A., Lamas, P., Pino, F.J., 2015. A stochastic programming approach for floods emergency logistics. *Transportation research part E: logistics and transportation review* 75, 18–31.

Ghaderi, H., Darestani, S.A., Leman, Z., Ismail, M.Y., 2012. Horizontal collaboration in logistics: a feasible task for group purchasing. *International Journal of Procurement Management* 5, 1, 43–54.

Ghosh, A., Morita, H., 2012. Competitor collaboration and product distinctiveness. *International Journal of Industrial Organization* 30, 2, 137–152.

Gonzalez-Feliu, J., Morana, J., Grau, J.M.S., Ma, T.Y., 2013. Design and scenario assessment for collaborative logistics and freight transport systems. *International Journal of Transport Economics*

Guajardo, M., Jörnsten, K., Rönnqvist, M., 2016. Constructive and blocking power in collaborative transportation. *OR spectrum* 38, 1, 25–50.

Guajardo, M., Rönnqvist, M., 2015. Operations research models for coalition structure in collaborative logistics. *European Journal of Operational Research* 240, 1, 147–159.

Guajardo, M., Rönnqvist, M., 2016. A review on cost allocation methods in collaborative transportation. *International Transactions in Operational Research* 23, 3, 371–392.

Hernández, S., Peeta, S., 2014. A carrier collaboration problem for less-than-truckload carriers: characteristics and carrier collaboration model. *Transportmetrica A: Transport Science* 10, 4, 327–349.

Hernández, S., Peeta, S., Kalafatas, G., 2011. A less-than-truckload carrier collaboration planning problem under dynamic capacities. *Transportation Research Part E: Logistics and Transportation Review* 47, 6, 933–946.

Hezarkhani, B., 2016. Pairwise mergers in bipartite matching games with an application in collaborative logistics. *Operations Research Letters* 44, 6, 818–822.

Hingley, M., Lindgreen, A., Grant, D.B., Kane, C., 2011. Using fourth-party logistics management to improve horizontal collaboration among grocery retailers. *Supply Chain Management: An International Journal* 16, 5, 316–327.

Huang, F., He, J., Lei, Q., 2018. Coordination in a retailer-dominated supply chain with a risk-averse manufacturer under marketing dependency. *International Transactions in Operational Research*

Ilie-Zudor, E., Ekárt, A., Kemeny, Z., Buckingham, C., Welch, P., Monostori, L., 2015. Advanced predictive-analysis-based decision support for collaborative logistics networks. *Supply Chain Management: An International Journal* 20, 4, 369–388.

Jouida, S.B., Krichen, S., Klibi, W., 2017. Coalition-formation problem for sourcing contract design in supply networks. *European Journal of Operational Research* 257, 2, 539–558.

Kale, R., Evers, P.T., Dresner, M.E., 2007. Analyzing private communities on internet-based collaborative transportation networks. *Transportation Research Part E: Logistics and Transportation Review* 43, 1, 21–38.

Kanda, A., Deshmukh, S., et al., 2008. Supply chain coordination: perspectives, empirical studies and research directions. *International journal of production Economics* 115, 2, 316–335.

Lai, M., Cai, X., Hu, Q., 2017. An iterative auction for carrier collaboration in truckload pickup and delivery. *Transportation Research Part E: Logistics and Transportation Review* 107, 60–80.

Leitner, R., Meizer, F., Prochazka, M., Sihn, W., 2011. Structural concepts for horizontal cooperation to increase efficiency in logistics. *CIRP Journal of Manufacturing Science and Technology* 4, 3, 332–337.

Li, J., Cai, X., Zeng, Y., 2016. Cost allocation for less-than-truckload collaboration among perishable product retailers. *OR spectrum* 38, 1, 81–117.

Liu, J., Xiao, T., Tian, C., Wang, H., 2018. Ordering and returns handling decisions and coordination in a supply chain with demand uncertainty. *International Transactions in Operational Research*

Lozano, S., Moreno, P., Adenso-Díaz, B., Algaba, E., 2013. Cooperative game theory approach to allocating benefits of horizontal cooperation. *European Journal of Operational Research* 229, 2, 444–452.

Lyons, J., Ritter, J., Thomas, K., Militello, L., Vincent, P., 2006. Collaborative logistics: Developing a framework to evaluate socio-technical issues in logistic-based networks. In *Collaborative Technologies and Systems, 2006. CTS 2006. International Symposium on*, IEEE, pp. 208–214.

Martinez-Olvera, C., Shunk, D., 2006. Comprehensive framework for the development of a supply chain strategy. *International*

Journal of Production Research 44, 21, 4511–4528.

Mason, R., Lalwani, C., Boughton, R., 2007. Combining vertical and horizontal collaboration for transport optimisation. *Supply Chain Management: An International Journal* 12, 3, 187–199.

Montoya-Torres, J.R., Muñoz-Villamizar, A., Vega-Mejía, C.A., 2016. On the impact of collaborative strategies for goods delivery in city logistics. *Production Planning & Control* 27, 6, 443–455.

Oum, T.H., Park, J.H., Kim, K., Yu, C., 2004. The effect of horizontal alliances on firm productivity and profitability: evidence from the global airline industry. *Journal of Business Research* 57, 8, 844–853.

Özener, O.Ö., Ergun, Ö., 2008. Allocating costs in a collaborative transportation procurement network. *Transportation Science* 42, 2, 146–165.

Palander, T., Väätäinen, J., 2005. Impacts of interenterprise collaboration and backhauling on wood procurement in finland. *Scandinavian Journal of Forest Research* 20, 2, 177–183.

Pérez-Bernabeu, E., Juan, A.A., Faulin, J., Barrios, B.B., 2015. Horizontal cooperation in road transportation: a case illustrating savings in distances and greenhouse gas emissions. *International Transactions in Operational Research* 22, 3, 585–606.

Pesendorfer, M., 2000. A study of collusion in first-price auctions. *The Review of Economic Studies* 67, 3, 381–411.

Pomponi, F., Fratocchi, L., Rossi Tafuri, S., 2015. Trust development and horizontal collaboration in logistics: a theory based evolutionary framework. *Supply Chain Management: An International Journal* 20, 1, 83–97.

Pomponi, F., Fratocchi, L., Tafuri, S.R., Palumbo, M., 2013. Horizontal collaboration in logistics: a comprehensive framework. *Research in Logistics & Production* 3.

Prakash, A., Deshmukh, S., 2010. Horizontal collaboration in flexible supply chains: a simulation study. *Journal of Studies on Manufacturing* 1, 1, 54–58.

Quintero-Araujo, C.L., Gruler, A., Juan, A.A., Faulin, J., 2017. Using horizontal cooperation concepts in integrated routing and facility-location decisions. *International Transactions in Operational Research*

Regan, A., Song, J., 2003. An auction based collaborative carrier network. *Transportation Research Part E: Logistics and Transportation Review* 2.

Schmeidler, D., 1969. The nucleolus of a characteristic function game. *SIAM Journal on Applied Mathematics* 17, 6, 1163–1170.

Schulz, S.F., Blecken, A., 2010. Horizontal cooperation in disaster relief logistics: benefits and impediments. *International Journal of Physical Distribution & Logistics Management* 40, 8/9, 636–656.

Shapiro, C., Willig, R.D., 1990. On the antitrust treatment of production joint ventures. *The Journal of Economic Perspectives* 4, 3, 113–130.

Shapley, L.S., 1953. A value for n-person games. *Contributions to the Theory of Games* 2, 28, 307–317.

Sheppard, E.J., Seidman, D., 2001. Ocean shipping alliances: the wave of the future? *International Journal of Maritime Economics* 3, 4, 351–367.

Simatupang, T.M., Sridharan, R., 2005. An integrative framework for supply chain collaboration. *The International Journal of Logistics Management* 16, 2, 257–274.

Stefansson, G., Russell, D.M., 2008. Supply chain interfaces: defining attributes and attribute values for collaborative logistics management. *Journal of Business Logistics* 29, 1, 347–359.

Sun, L., Rangarajan, A., Karwan, M.H., Pinto, J.M., 2015. Transportation cost allocation on a fixed route. *Computers & Industrial Engineering* 83, 61–73.

Suzuki, Y., Lu, S.H., 2017. Economies of product diversity in collaborative logistics. *Journal of Business Logistics*

Tomkins, C., 2001. Interdependencies, trust and information in relationships, alliances and networks. *Accounting, organizations and society* 26, 2, 161–191.

Triqui Sari, L., Hennet, J.C., 2016. Cooperative inventory planning in a distribution network. *International Journal of Production Research* 54, 19, 5916–5931.

Vanovermeire, C., Sörensen, K., 2014. Integration of the cost allocation in the optimization of collaborative bundling. *Transportation Research Part E: Logistics and Transportation Review* 72, 125–143.

Verdonck, L., Caris, A., Ramaekers, K., Janssens, G.K., 2013. Collaborative logistics from the perspective of road transportation companies. *Transport Reviews* 33, 6, 700–719.

Verstrepen, S., Cools, M., Cruijssen, F., Dullaert, W., 2009. A dynamic framework for managing horizontal cooperation in logistics. *International Journal of Logistics Systems and Management* 5, 3-4, 228–248.

Wang, X., Kopfer, H., 2013. Dynamic collaborative transportation planning: A rolling horizon planning approach. In

International Conference on Computational Logistics, Springer, pp. 128–142.

Wang, X., Kopfer, H., 2014. Collaborative transportation planning of less-than-truckload freight. *OR spectrum* 36, 2, 357–380.

Wang, X., Kopfer, H., 2015. Rolling horizon planning for a dynamic collaborative routing problem with full-truckload pickup and delivery requests. *Flexible Services and Manufacturing Journal* 27, 4, 509–533.

Wang, Y., Ma, X., Liu, M., Gong, K., Liu, Y., Xu, M., Wang, Y., 2017. Cooperation and profit allocation in two-echelon logistics joint distribution network optimization. *Applied Soft Computing* 56, 143–157.

Weng, K., Xu, Z.h., 2014. Flow merging and hub route optimization in collaborative transportation. *Journal of Applied Mathematics* 2014.

Williamson, O.E., 1981. The economics of organization: The transaction cost approach. *American journal of sociology* 87, 3, 548–577.

Xu, X.F., Hao, J., Deng, Y.R., Wang, Y., 2017. Design optimization of resource combination for collaborative logistics network under uncertainty. *Applied Soft Computing* 56, 684–691.

Zhang, M., Pratap, S., Huang, G.Q., Zhao, Z., 2017. Optimal collaborative transportation service trading in b2b e-commerce logistics. *International Journal of Production Research*