



Optimization of Collaborative Transport and Distribution Strategies: Trends and Research Opportunities

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Abstract. During the last two decades, global market competitiveness has reached higher levels between companies operating worldwide. A situation that results from the new growing trends of globalization, the effects of the COVID19 pandemic on the whole world, and sustainability challenges. So, to maintain a sustainable supply chain in the current context, many enterprises choose to invest in logistic collaborations with presumed partners. Hence, logistic collaboration seems to be an efficient solution for companies willing to share their resources in order to reduce transport costs, CO₂ emissions, congestion along with traffic accidents. 73 scientific articles have been collected and studied as part of a systematic literature review about optimization of collaborative transport and distribution strategies. So, this study aims to analyze the existing literature on this topic to find gaps and opportunities for future research. The results highlight the most to the less studied types of collaboration and trending resolution techniques used.

Keywords: Logistic collaboration · Optimization · Sustainable supply chain · Logistic strategy · Transport · Distribution

1 Introduction

In the last years, globalization is enhancing the development of new technologies, which both, have a huge impact on the worldwide economy. The transport and logistics sectors, playing an important role in the economic growth, are also affected. Since both enhance national and international trading, moreover uphold the economy's recovery specifically during and after global economic crises such as the one caused by COVID19 pandemic. In addition to struggles related to globalization and digitalization, sustainability challenges are becoming more and more intense to be unignorable due to the establishment of laws, by many countries, concerning, environmentally, the reduction of carbon prints and the reduction of greenhouse gases, to prevent more of the global warming consequences on the planet. Many solutions were advanced by multiple firms along with research of the field, solutions that aimed to increase a firm's profitability and its competitiveness, moreover sustain its development. As one of the solutions, many companies, particularly, choose to commit into collaborations.

Whether concerning freight transportation or passengers' transportation in normal daily life or in case of emergencies, many organizations choose to combine their efforts in order to gain advantages they struggled to achieve alone. These alliances that concern particularly the transport of goods and people, are technically referred to as logistic collaborations or logistic pooling.

Since the existing review articles aimed to find research gaps and most studied research topics based on a categorization decision making levels, this paper aims to examine recent studies conducted on the optimization of collaborative transport and distribution strategies in the last decade, to establish the existing state of the art of the subject and find the emerging trends used in solving issues related to collaboration between organizations under sustainability challenges, also to identify research gaps and future research opportunities.

The remainder of this paper shall be organized into 5 sections. **Research methodology**, Sect. 2, explains the methodology used while elaborating this review. Section 3 shows the **Results** of the systematic review conducted. As Sect. 4, **Discussion**, is dedicated to discuss the findings of this study. Finally, the last section summarizes the whole work.

2 Research Methodology

Since this work concerns a state of the art on the subject of the optimization of collaborative transport and distribution strategies, a Systematic Literature Review is conducted. It includes 5 major steps. The first step revolves about the formulation of the search question then fixing the appropriate keywords for the review. The second step concerns the definition of both inclusion and exclusion criteria. The third step is a search step applied upon eligible databases. Whereas, papers are selected in the fourth step, discussed then the results are analyzed. Finally, reporting the results comes as in the last step. [1].

2.1 Aim of the Research and Keywords

The aim of this research, as mentioned above, is to examine the existing literature on the logistics and transport field concerning the optimization of collaborative strategies of transport and distribution. Thus, this review article answers the following questions: What are the trending technological solutions used among collaborating organizations nowadays? And what are the issues related to logistic coalitions that are yet to be studied?

After formulating the search questions of the systematic review, the choice of the keywords remains the second most crucial step, since they enable to focus, localize and limit the study. In this case, two categories of keywords were established. The first category, referred to as the main category which is related to the field of the search, includes: "optimization", "logistics", "supply chain", "transport" and "distribution". And the second category contains the vocabulary related to collaboration, it includes: "collaborative", "cooperative", "coalition", "pooling" and "alliance".

2.2 Inclusion and Exclusion Criteria

In order to select the most appropriate articles related to the search questions, a list of inclusion and exclusion criteria is established. The following table, Table 1, identify those criteria distinctively for the purpose of limiting the literature search.

Table 1. Inclusion and exclusion criteria of the study

Inclusion criteria	Exclusion criteria
Article written in English	Non-English written article
Article published between 2012 and first trimester of 2022	Article published before 2012
Article dealing with logistic optimization and collaborative logistics	Article dealing with types of collaborations between organizations other than logistic collaboration

2.3 Databases

Before selecting papers for the study, it is important to identify the source databases that are selected for the search. So, in this paper, many electronic resources are chosen, including: Web of Science, ScienceDirect, Scopus, Emerald Insight, Taylor & Francis, Wiley Online Library, IEEE Xplore, Google Scholar and Springer.

2.4 Papers' Selection

The selection of papers for this review shall be done through the application of filters using inclusion and exclusion criteria after entering keywords of the search in the selected databases. Once the results are shown, it is important to identify the most relevant of the papers to focus on.

2.5 Results' Reporting

Once the papers for the study are selected, the next step is to read them thoroughly, analyze them, then discuss their results. Above all, a descriptive analysis should be conducted, papers need to be classified, and studies are yet to be categorized according to the research methodology used. After that, an in-depth conclusion is to be made about the conducted analysis of the literature identified. This conclusion will help in determining the current trends in the topic, identifying research gaps along with future research opportunities.

3 Results

First, in the preselection phase, a number of 122 articles were selected, including articles that mainly discussed urban traffic, public transport, in addition to vehicle routing problems. The first-hand chosen articles were analyzed to know about research advancements on those subjects and make comparison between collaborative and non-collaborative scenarios. These articles were eliminated from through the selection process, resulting in a total of 73 selected articles that are appropriate to the research theme.

3.1 Selected Papers

The Table 2 below contains research papers that were selected according to the research methodology described in the previous section. Information on the papers as per their title, their type, and the year of publishing are collected and presented.

Table 2. Informations about the selected papers for the review

Paper title	Year	Paper type	Resolution method category
An Integrated Fuzzy Approach for Strategic Alliance Partner Selection in Third-Party Logistics [18]	2012	Research article	Fuzzy AHP technique
An Intelligent Scheduling Strategy of Collaborative Logistics for Mass Customization [69]	2012	Research article	PSO heuristic algorithm & Simulation
How to anticipate the level of activity of a sustainable collaborative network: the case of urban freight delivery through logistics platforms [21]	2013	Conference paper	Modeling & Game theory
A Multi-Agent Distributed Framework for Collaborative Transportation Planning [44]	2013	Conference paper	Multi-Agent Modeling
Combined demand and capacity sharing with best matching decisions in enterprise collaboration [45]	2013	Research article	Fuzzy MIP model
Collaborative Logistics from the Perspective of Road Transportation Companies [63]	2013	Review article	Systematic Literature Review

(continued)

Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
A Collaborative Supply Chain Management System for a Maritime Port Logistics Chain [5]	2014	Research article	Modeling & Simulation
A Performance Evaluation Research on Collaborative Operation between Logistics Enterprise and Manufacturing Enterprise [12]	2014	Research article	Modeling based on AHP and fuzzy comprehensive analysis
Supply Chain Collaboration, Integration, and Relational Technology: How Complex Operant Resources Increase Performance Outcomes [23]	2014	Research article	Empirical Survey & Data Analysis
Collaborative Urban Logistics – Synchronizing the Last Mile [71]	2014	Research article	Modeling
Developing a Collaborative Planning Framework for Sustainable Transportation [72]	2014	Research article	Modified K-means clustering approach
Advanced predictive-analysis-based decision support for collaborative logistics networks [32]	2015	Research article	Modeling
Collaborative relationships between logistics service providers and humanitarian organizations during disaster relief operations [8]	2016	Research article	Survey & Data analysis
Effective logistics alliance design and management [9]	2016	Review article	Systematic Literature Review
Definition of a Collaborative Working Model to the Logistics Area using Design for Six Sigma [10]	2016	Research article	DMADV methodology
Determining collaborative profits in coalitions formed by two partners with varying characteristics [14]	2016	Research article	Simulation & Data Analysis

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Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
An Intelligent Multi-Agent Based Model for Collaborative Logistics Systems [37]	2016	Research article	Game Theory & LP & MOLP
Enterprises' Readiness to Establish and Develop Collaboration in the Area of Logistics [60]	2016	Research article	Data Analysis
Are People the Key to Enabling Collaborative Smart Logistics? [7]	2017	Conference paper	Data analysis
GoodsPooling: An Intelligent Approach for Urban Logistics [22]	2017	Conference paper	Modeling (UML)
Collaborative vehicle routing: a survey [25]	2017	Review article	Systematic Literature Review
Enabling sustainable energy futures: factors influencing green supply chain collaboration [33]	2017	Research article	Literature Review & Modeling
Collaborative shipping under different cost-sharing agreements [51]	2017	Research article	Modeling
Economies of Product Diversity in Collaborative Logistics [59]	2017	Research article	Integer Linear Program
Design optimization of resource combination for collaborative logistics network under uncertainty [67]	2017	Research article	Modeling & Simulation
Collaborative urban transportation: Recent advances in theory and practice [11]	2018	Review article	Narrative Literature Review
Centralized bundle generation in auction-based collaborative transportation [24]	2018	Research article	GA Heuristic Algorithm
Disagreement on the Gain Sharing Method in Supply Chain Collaborations [36]	2018	Research article	Quantitative Case Study Approach

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Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
Horizontal collaboration in logistics: decision framework and typology [43]	2018	Research article	Modeling
Centralised horizontal cooperation and profit sharing in a shipping pool [65]	2018	Research article	Game theory
Optimization of tuna fishing logistic routes through information sharing policies: A game theory-based approach [27]	2019	Research article	Game theory
Collaborative distribution: strategies to generate efficiencies in urban distribution - Results of two pilot tests in the city of Bogotá [30]	2019	Research article	Pilot tests
Cooperation of customers in traveling salesman problems with profits [49]	2019	Research article	Game Theory
Cooperative game-theoretic features of cost sharing in location-routing [50]	2019	Research article	Game Theory
A triple-win scenario for horizontal collaboration in logistics: Determining enabling and key success factors [52]	2019	Research article	Case study methodology
Horizontal collaborative transport: survey of solutions and practical implementation issues [53]	2019	Review article	Systematic Literature Review
Effect of strategic alliance based on port characteristic and integrated global supply chain for enhancing industrial port performance [58]	2019	Research article	Survey & Structural Equation Modeling
A GRASPxILS for the Shared Customer Collaboration Vehicle Routing Problem [62]	2019	Conference paper	Hybridized GRASPxILS metaheuristic

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Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
Environmental impact assessment in the case of pooling Moroccan Hydrocarbon supply chain resources [17]	2020	Conference paper	Simulation
City logistics: Towards a blockchain decision framework for collaborative parcel deliveries in micro-hubs [31]	2020	Research article	Modeling
Collaborative profit allocation schemes for logistics enterprise coalitions with incomplete information [34]	2020	Research article	Game Theory & Quadratic Programming Model
Allocating Cost to Freight Carriers in Horizontal Logistic Collaborative Transportation Planning on Leading Company Perspective [41]	2020	Research article	Modeling
The quality-driven vehicle routing problem: Model and application to a case of cooperative logistics [42]	2020	Research article	Modeling
A green lateral collaborative problem under different transportation strategies and profit allocation methods [55]	2020	Research article	Mathematical modeling
Collaboration of sustainability and digital supply chain management of achieving a successful company [56]	2020	Review article	Literature Review
A Multi-Layer Collaboration Framework for Industrial Parks with 5G Vehicle-to-Everything Networks [57]	2020	Research article	Modeling
A decision-making support system in logistics cooperation using a modified VIKOR method under an intuitionistic Fuzzy environment [61]	2020	Research article	Multi-criteria decision making & intuitionistic fuzzy set

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Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
Closed loop location routing supply chain network design in the end-of-life pharmaceutical products [73]	2020	Research article	MILP
Hybridization of game theory and ridesharing to optimize reverse logistics of healthcare textiles [74]	2020	Conference Paper	Game Theory
Towards a collaborative and integrated optimization approach in sustainable freight transportation [4]	2021	Conference paper	MILP
Systematic literature review on collaborative sustainable transportation: overview, analysis and perspectives [6]	2021	Review article	Systematic Literature Review
An investigation on the effect of inter-organizational collaboration on reverse logistics [13]	2021	Research article	Data Analysis
An algorithmic approach for sustainable and collaborative logistics: A case study in Greece [15]	2021	Research article	TONN heuristic algorithm
Public-private collaborations in emergency logistics: A framework based on logistical and game-theoretical concepts [16]	2021	Research article	Game theory
Leadership strategies, management decisions and safety culture in road transport organizations [26]	2021	Research article	Interviews & Braun & Clarke thematic analysis
Environmental benefits from shared-fleet logistics: lessons from a public-private sector collaboration [28]	2021	Research article	Survey & Data Analysis

(continued)

Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
Lateral collaboration with cost-sharing in sustainable supply chain optimisation: A combinatorial framework [29]	2021	Research article	MILP
Cooperation between Sea Ports and Carriers in the Logistics Chain [38]	2021	Research article	Game Theory
Towards learning behavior modeling of military logistics agent utilizing profit sharing reinforcement learning algorithm [39]	2021	Research article	Multi-agent model & profit-sharing reinforcement learning algorithm
Analysis of an evolutionary game of pallet pooling with participation of third-party platform [40]	2021	Research article	Game Theory
Genetic Algorithm Based on Clark & Wright's Savings Algorithm for Reducing the Transportation Cost in a Pooled Logistic System [47]	2021	Research article	Heuristic algorithm GA and Clark & Wright's algorithm
Impact of operational constraints in city logistics pooling efficiency [48]	2021	Research article	Mathematical model & SA & VNS methods
Blockchain-Empowered Digital Twins Collaboration: Smart Transportation Use Case [54]	2021	Research article	Modeling
A Blockchain-IoT Platform for the Smart Pallet Pooling Management [66]	2021	Research article	Modeling and Case study methodology
Collaborative logistics network: a new business mode in the platform economy [68]	2021	Research article	5W1H method
Collaborative Vehicle Routing Problem in the Urban Ring Logistics Network under the COVID-19 Epidemic [70]	2021	Research article	MILP & metaheuristic VNS algorithm

(continued)

Table 2. (continued)

Paper title	Year	Paper type	Resolution method category
Demonstration of a blockchain-based framework using smart contracts for supply chain collaboration [2]	2022	Research article	Modeling
The “Lateral Transshipment” is a Cooperative Tool for Optimizing the Profitability of a Distribution System [19]	2022	Book Chapter	Modeling & Simulation
Cooperation and competition among retailers third party logistics providers alliances under different risk behaviors, uncertainty demand and environmental considerations [20]	2022	Research article	Non-Linear Program
Design of Supply Chain Transportation Pooling Strategy for Reducing CO ₂ Emissions Using a Simulation-Based Methodology: A Case Study [35]	2022	Research article	Discrete-Event Simulation-based methodology
Introducing CRISTAL: A model of collaborative, informed, strategic trade agents with logistics [46]	2022	Research article	Modeling
Towards intelligent public transport systems in Smart Cities; Collaborative decisions to be made [64]	2022	Research article	Modeling

3.2 Statistical Descriptive Analysis

After collecting all necessary data about the selected works for this review, the number of papers, dealing with the subject of the study “Optimization of Shared transport and distribution strategies”, is quantified per year in the time frame chosen between 2012 and the first trimester of 2022. This is shown in the Fig. 1 below.

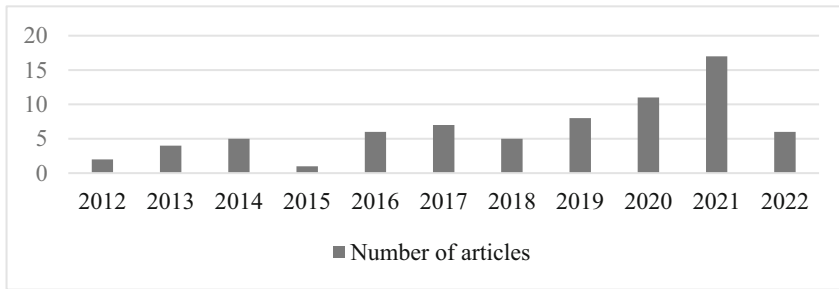


Fig. 1. Number of papers published in the last decade about the study subject

As it is seen, the number of works that deals with Collaboration transport and distribution strategies and their optimization has been growing over the last decade, which proves the importance of the subject between the researchers and the scholars' community. As per the type of the papers selected, it is remarked that a majority of 58 paper works tend to be research articles which is slightly less than 80% of the whole. While more than 20% of the remaining works are divided between: 8 conference papers, 7 review articles and one book chapter.

3.3 Categorization and Content Analysis

Since the statistical data analysis has been done, the next step of the systematic literature review needs to be conducted. It consists of a classification and categorization of the papers selected in Table 1. This categorization mainly distinguishes between papers based on the types of collaborations studied depending on the stakeholders engaging in, and the characteristics of those collaborations. In addition to that, another classification differentiates between these papers depending on the resolution techniques used in these studies.

3.3.1 Types of Collaboration

Business-to-business collaborations

Many researchers got interested in logistic collaborations between firms and collaborative supply chain, whether it being a vertical collaboration, a horizontal or a lateral one. Among those researchers, in this work [4], authors were interested in quantifying the benefits of implementing a collaborative strategy economically, socially and environmentally in integrated inventory, location and routing decisions. While in [67] the problem of selection of the optimal network design scheme for Collaborative Logistic Networks under uncertainty was studied. Others were interested in collaboration between firms operating in the food industry [42], where researchers quantified the effects of multi-stop transportation on food quality while taking in consideration the

unloading time, both internal and external temperature for the transportation vehicles, driving speed and cooling rate.

Public-private collaborations

Some researchers got rather interested in logistic collaboration forms between public and private organizations. This work [16] shed light on this kind of collaborations under an emergency context. Based on game theory and logistical concepts, a framework is developed for public-private emergency collaborations. The developed framework unraveled the constraints of partnership for each of the public organizations and the firms, and its effects on both, especially the reputational ones. While in [8], authors got interested in the collaboration that can be formed during disaster cases, between humanitarian organizations and logistics service providers. It identified the benefits of such collaboration and the challenges that it faces. It also shows how crucial and efficient of a collaboration it is in saving human lives in case of disasters.

City logistics collaborations

The majority of researches done on collaborative logistics focused on city logistic collaborations and last-mile freight transport. Researchers studied Courier, Express and Parcel (CEP) carriers engaging in horizontal collaboration, and developed a blockchain decision framework for last-mile distribution in the context of micro-hubs [31]. Others proposed a new architecture for the management of Cooperative Intelligent public Transport Systems (C-ITS) in Smart cities. An architecture that enhances collaboration between participants to the eco-system' mobility, that is constantly updated and that is sustainable [64].

3.3.2 Trending Resolution Techniques

Blockchain technology

Since its appearance in 2009, blockchain technology has been used in different field others than the environment where it was initially developed, that is cryptocurrency. It showed its benefits in the logistic and transport field for enabling safe tracking of goods and vehicles and many other advantages. It is now mainly used between firms committing in horizontal coalitions, as it keeps transparency of transactions and ensures that the shared informations between different stakeholders remain confidential supporting by then the trust among them. In this work [2], authors modeled a framework used in collaborative resource sharing context based on blockchain. Models were designed through UML diagrams and BPMN models, while smart contracts are to be verified and validated through an algorithm developed simultaneously. In this paper [54], authors explored the combination of Digital Twins and Blockchains as two highly useful technology in the Industry 4.0 era, and they proposed a framework applied for collaborative smart transportation.

Multi-agent-based frameworks

Another highly adopted resolution method consists of adopting multi-agent-based frameworks. In this work [39], researchers explore a new way for simulating combat along

with military logistics effectiveness during times of peace. They propose a model for military logistics based on multi-agent model and profit-sharing reinforcement learning algorithm. Both the developed model and the proposed algorithm show their feasibility and validity through simulation experiments. The algorithm gives more accurate results for a high number of simulations, and the simulation results are proved to be highly consistent with actual war experiments according to military experts. Another work investigates the issue related to collaboration planning in logistics and proposes an agent-based approach embettering the management of collaborative logistics [37].

4 Discussion

Hence, after reporting the literature contents on the subject of “Optimization of collaborative transport and distribution strategies”, here we state the research gaps and the topics of literature on the subject had remained scarce, and consequently identify. First, we remark that collaboration strategies, in the literature, mainly focus on city logistics and road freight transport. However, a combination of transport means under a collaborative strategy is yet to be addressed. Due to the importance given to the multimodal transport for people and goods, it is necessary to study its effect while combined with a horizontal or lateral collaborative strategy especially in the industrial context. Second, the majority of research articles studying organizations engaging in logistic collaborations opt for optimizing routing planning under constant variables of the environment, making the obtained solutions less accurate to reality. Thus, it is necessary to solve the routing planning related problems in the real context under changing variables related to road conditions and uncertain demand variation. A benchmark realized on the non-cooperative cases in the literature may be helpful since more researches have been elaborated in this context. Third, little the problem of finding the most stable coalition is studied. It is hard to maintain coalitions under nowadays context, which makes it hard for organizations depending on it. Consequently, it is so important to be able to identify the most suitable formation and configuration of collaboration to engage in, whether it is a large one or rather a sub-coalition. Fourth, among the existent forms of logistic collaboration in literature, almost in all of them, partners consider collaborations under their mutual objectives. Nevertheless, the effect of their different strategies and opposite interests on the collaborations formed should be studied thoroughly. Fifth, practically all of the recent research on logistic collaborations propose blockchain frameworks that are supposed to alleviate issues mainly regarding informations’ privacy and confidentiality, to support trust among stakeholders. However, the developed framework architectures and models are yet to be technically applied in the industrial context. Sixth, the technological advancements have been proved to be theoretically very useful regarding resolution of issues faced among collaborating organizations, yet the existing literature has poorly explored if investments in acquiring those technologies is profitable on the medium and long terms. Since it is difficult to deal with consequential changes of digitalization, private organizations always prefer to invest on those that allow them the maximum benefits. It is crucial, then, to investigate their profitability on the long run. Lastly, public-private collaborations received less attention in the literature, which make this kind of collaborations a good research opportunity, since this collaboration can be

very important in contexts of not only emergencies, but also in context of city logistics management, and others.

5 Conclusion

In this paper, we explored the existing literature dealing with “Optimization of collaborative transport and distribution strategies”. Under a systematic literature review, we were able to collect data about the most studied topics and the recent advancements in this research field. Topics of city logistics and last mile urban freight collaborations are the most studied amongst others. Also, horizontal collaboration and lateral collaboration have gained much more attention in the last decade being the new forms of collaboration mitigated to. And while recent applied laws on firms taxed their carbon prints, most of logistic collaboration solutions were addressed under a green or sustainable perspective. Hence, the resolution methods consisted majorly on modeling multi-agent-based frameworks or modeling decision making blockchain frameworks. In the end, it is concluded that blockchain technology should not only be studied theoretically but rather be put into use in real industrial context to better know its effects. Also, logistic collaborations between public and private organizations should be more studied in the future.

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