# MECHANISMS FOR FREIGHT TRANSPORTATION SERVICE PROCUREMENT: A LITERATURE-BASED ANALYSIS

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## ABSTRACT

In last years, freight transportation has undergone a rapid evolution and an emerging of new markets that probably entail the need for innovative mechanisms. Considering this remark, this paper presents a literature review on procurement mechanisms of freight transportation services, in order to conduct an up-to-date and comprehensive study of the existing mechanisms in literature. The aim of this work is to identify the trends and gaps from the points of view of practitioners and researchers. A total of 65 articles published within 1997–2016 period in reputed peer-review academic journals have been reviewed. A framework of 5 classification criteria is developed to have a systemic literature review. Some essential findings include a big focus on the reverse auction mechanism for transportation service procurement in literature, the limited number of empirical studies, a less focus on multimodal transportation and a less focus on subjective outcomes. This first reviewing step, deemed worthy of attention, offers a way to reach a clearer understanding of freight transportation service procurement mechanisms and to describe the new future perspectives.

**Keywords**: Freight transportation, service procurement, market, mechanisms, literature review

## 1 INTRODUCTION

Freight transportation service procurement (FTSP) is the problem of matching shippers' transportation needs and carriers' capacities. This problem could be seen from different standpoints. From a shipper (carrier) standpoint, the problem is the selection (supply) of services and the choice of the proper methods of buying (selling) them. From a market standpoint, it is the determination of methods and settings that incite shippers (carriers) buying (selling) services efficiently and effectively. These methods, which specify how the transportation market operates and the admissible behaviors of its participants are called the FTSP mechanisms, see [1, 2].

The paper pays attention to FTSP mechanisms for several reasons. First, freight transportation is a large component of the economy, it is the largest logistics cost for most shippers; 60% of the total logistics costs of a firm, as stated in Wilson [3]. Second, it is clear that the current

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state of freight transportation, the backbone of a logistics network, is not optimized and is characterized by economic, social and environmental inefficiency and unsustainability. Despite efforts from transportation companies, empty trip frequency remains high and average loads of trucks are low: in Europe, trucks use just 56% of the weight capacity and 25% of trips are empty, see EuroStat [4]. Moreover, freight transportation, in developed countries, is responsible for nearly 15% of greenhouse gas emission: and this ratio has been increasing while there are significant reduction goals, see International-Energy-Agnecy [5]. Third, the variety of procurement mechanisms available in today's freight transportation markets (combinatorial auctions, private/public exchanges and electronic catalogs [2, 6]), shows that there exists no single best solution for all FTSP problems. In other words, a given mechanism may be very successful for one situation and may fail wholly for another. The selection of the appropriate transportation procurement mechanism is complicated; applying the "well-known mechanism" which worked for one situation to a second one may not provide the same expected successful outcomes and may have unintended repercussions. Finally, the rapid evolution of freight transportation market requires a guideline of mechanism design. For example, in freight spot market, more and more shippers are looking for short-term or one-shot service for their on-demand transportation requests (see some online platforms like *Click&Truck* for exemple). Another example can refer to horizontal cooperation among carriers that relies on carrier-carrier market instead of the traditional shipper-carrier market. These emerging freight markets probably entails innovative FTSP mechanisms.

Motivated by these reasons, our research aims to investigate FTSP mechanisms in theory and practice. This first paper aims to depict how far researchers have considered the different elements mentioned in the framework proposed to better understand the current status of research and identify fruitful avenues for research to follow. This paper is different from other articles published in the same field of study and focusing on the same problem. For example, Jothi Basu, et al. [7] publish a literature review of full truckload transportation service procurement. However, their review is focusing only in auction mechanisms for truckload transportation, contrarily to this paper, which dealing with all the existing FTSP mechanisms for different transportation modes (not limited to truckload only). In addition to Jothi Basu Subramanian, et al. [7] article, other articles and theses have been found in this context, for example, Nandiraju and Regan [8] who provide a survey of market mechanisms for online freight transportation marketplaces and Collignon [6] who provides a survey of mechanisms used by practitioners in the online transportation markets. These works do not focus on literature review but on a survey of existing (online) electronic transportation markets (from practitioners point of view). Moreover, they do not classify and compare the mechanisms according to a framework of criteria. The contribution of this work is thus different and complementary to the studies discussed.

The paper is organized as follows. Section 2 describes the methodological approach used in the literature review and the efforts made to select articles for the review. Section 3 puts forward a conceptual framework to analyze the FTSP mechanisms identified from the literature. Section 4 discusses the implications of the framework developed and the perspectives. Finally, section 5 concludes this work.

## 2 METHODOLOGY

The technique and methodology of Denyer and Tranfield [9] have been used in this work to locate and select existing studies, assess contributions, analyze articles and report results of analysis. This approach is based on five principles and steps: (1) Question formulation, (2)

locating studies, (3) study selection and evaluation, (4) analysis and synthesis, (5) reporting and using the results.

### 2.1 Problem and question formation

In order to address the initial review questions, and before beginning the systemic review, significant grounding and exploratory reviews have been made in this field to define relevant concepts and significant notions of the existing FTSP mechanisms. This paper puts forward to address the following research questions: What are the dominant mechanisms currently used in the field of FTSP? How have they influenced the behaviors of institutions? What are the promising lines for the future development of procurement mechanisms?

### 2.2 Locating studies

The second step is to locate relevant literature by picking out search strings and search databases. This paper used well-known databases such as Springer, Emerald, ScienceDirect, Informs, Wiley online library and Taylor & Francis, to search the set of publications of interest. This set of databases has been completed by Google scholar. The main keywords such as “mechanism”, “procurement”, “markets”, “freight”, “transport(ation)” are used for searching the relevant literature. In addition, their equivalent and grouping keywords such as “transportation purchasing services”, “Freight transportation procurement service mechanisms”, “transportation market mechanisms”, are used for completing the researches from the main keywords. Besides, the three keywords, “negotiations”, “auctions” and “catalogs” representing the three major mechanisms implemented in the transportation markets, coming from the prior literature review studies are added to include the literature that deals with these specific mechanisms. We apply multiple combinations of the keywords in an attempt to exhaustively find out all the relevant literature.

### 2.3 Study selection and evaluation

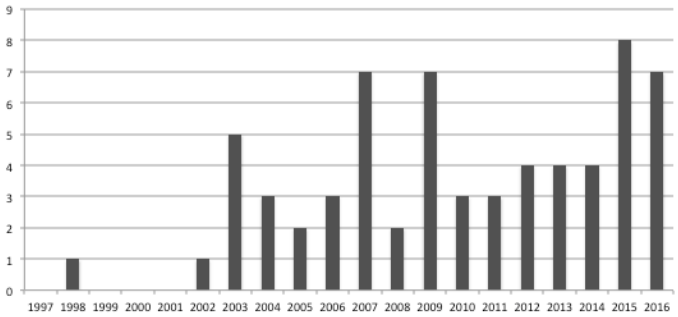
By using the keywords mentioned above and the set of databases chosen, 634 articles have been located. Then the next question faced is how to determine the scope of the survey and what articles to include. Based on a list of inclusion criteria, this survey classifies the literature in FTSP mechanisms published in the last 20 years, i.e. between 1997 and 2016, based on English papers published in peer-reviewed academic journals. By that, 409 articles have been remained. Other forms of publications such conference papers, books, reports, theses, have been discussed in this paper without being included in the review framework. All remaining articles have been saved in the reference management software “Endnote” in order to review titles, abstracts and contents to keep only articles that demonstrate the FTSP mechanisms as the clear focus/object of the research, including articles comparing and reviewing mechanisms. Finally, 65 articles are selected for reviewing and analyzing.

## 3 FRAMEWORK OF REVIEW

Based on the selected 65 articles, the first observation is that there is an increase in the number of publications especially in 2015 and in 2016 (see Figure 1). One of the reasons is the recently rapid evolution of freight transportation markets and the emerging of new freight markets that require innovative mechanisms and a guideline of mechanism design.

All papers selected were positioned according to 5 criteria of classification: The mechanism(s) studied, the articles’ methodology, the modes of procurement, the transportation modes and the outcomes, as shown in Table 1.

**Figure 1: Number of artciles published per year**




### 3.1 The procurement mechanisms

Several articles [2, 6, 8] have classified FTSP mechanisms that are implemented in trading institutions into three major categories: (a) **catalogs** (posted prices), wherein carriers' offers are posted and the sole choice of the shipper consists in picking the carrier that best fits with his own needs. This mechanism is used in several markets or platforms such as *Ishipp*, *Freightquote* and *Smartship*. (b) **Auctions,** wherein one party (most often the shipper) posts its requirements and several players of the other party (most often the carriers) place bids. It includes forward auctions, reverse auctions, double auctions (currently, more than thirty different auction mechanisms can be identified). These automated on-line mechanisms are widely used in the transportation service procurement problem, like *Ushipp.com*, *anyvan.com*, etc. (c) **Post and search** (negotiations), wherein players at both sides of the market, shippers and carriers, bargain over the conditions of an exchange. This mechanism is used in several transportation procurement services like *DAT Load Boards*, *The Internet Truckstop* and *getloaded.com*.

### 3.2 The modes of procurement

In this paper, the mode of procurement stands for the nature of contract used in the transportation market. According to the purpose of service, there exists summarily two modes: (a) **spot market**, wherein shippers are looking for one-time (one-shot) service for their on-demand transportation requests, and (b) the **contract market**, wherein shippers are seeking to transport their requests for a specific time horizon.

### 3.3 The Articles' Methodology

From the 65 reviewed articles, 5 categories of methodology can be observed. (a) **Conceptual analysis** that is the theoretical studies that report issues and challenges, or give definitions without any numerical or empirical studies, (b) **case study** in which data from practitioners are used to test and analyze the results, (c) **literature review** that is an evaluative report of information found in the literature related to a specific area of study, (d) **empirical study** that is based on observed and measured phenomena and derives knowledge from actual experience rather than from theory or belief and (e) **numerical experiment** that is the study of approximation techniques for solving a problem, taking into account the extent of possible errors.

### 3.4 The transportation modes

Transportation systems proliferated in last years in different configurations and catered to different transportation modes. The major one is road transportation, divided into two types: Full Truckload (FTL), wherein carriers operate over irregular routes and move from origin to

destination without any intermediate stops and Less than truckload (LTL), wherein carriers require the use of terminals and scheduled routes to collect small-sized shipments and consolidate them into larger loads. Moreover, other transportation modes also exist to transport freight, for example, railway transportation, airline transportation and maritime transportation. Some freight marketplaces like *GoCargo.com* (ocean shipping) and *Global freight exchange* (GFX) came into existence in last years.

### 3.5 The procurement mechanism outcomes

The scope of procurement mechanisms defined in this paper includes all types of mechanisms in transportation procurement that are impacting on numerous variables and outcomes, e.g., transaction process, on-time performance, transportation cost, relationship between agents, trust, goal achievements and satisfaction, ease of use and usefulness, perceived opportunism, etc. These outcomes could be aggregated at two levels: individual outcomes and market outcomes. The individual outcomes contain Objective Outcomes (referred by OO in Table 1, e.g. utility value, values of different attributes and time spent on the transaction and Subjective Outcomes (referred by SO in Table 1), e.g. trust, relationship between agents, goal achievements and different satisfactions, perceived opportunism etc. Market Outcomes (referred by MO in Table 1) include allocative efficiency and social welfare.

**Table 1: A framework of 5 criteria for the literature review**

| References | Mechanisms | Methodology | Modes of procurement | Transportation modes | Outcomes |
|---|---|---|---|---|---|
| Ağralı, et al. [10] | Reverse auction | Case study | Spot market | Road | OO/MO |
| Alp, et al. [11] | Auction | Numerical experiments | Contract | Road | OO |
| Andres Figliozzi, et al. [12] | Reverse auction | Numerical experiments | Spot market | Road | OO |
| Balasubramanian [13] | Catalog | Numerical experiments | Contract | Not specified | MO |
| Berger and Bierwirth [14] | Reverse auction | Numerical experiments | Spot market | Road | OO/MO |
| Buer and Kopfer [15] | Combinatorial auction | Numerical experiments | Contract | Not specified | MO |
| Buer and Pankratz [16] | Combinatorial auction | Numerical experiments | Contract | No specified | MO/SO |
| Caplice [2] | Auction, exchange, catalog | Conceptual analysis | Contract | Road | OO |
| Caplice and Sheffi [17] | Auction | Conceptual analysis | Contract | Road, Maritime, Air | OO |
| Carter, et al. [18] | Reverse auction, negotiation | Case study | Contract | Not specified | MO |
| Carter and Stevens [19] | Reverse auction | Empirical study | Contract | Not specified | SO |
| Chang [20] | Combinatorial auction | Empirical study | Spot market | Road | OO |
| Chen [21] | Combinatorial auction | Numerical experiments | Spot market | Road | OO |
| Chen, et al. [22] | Combinatorial auction | Numerical experiments | Spot market | Road | MO |
| Cheng [23] | Reverse auction, negotiation | Case study | Contract | Not specified | MO |
| Cheng, et al. [24] | Double auction | Numerical experiments | Spot market | Not specified | MO |
| Dahl and Derigs [25] | Empirical study | Empirical study | | Not specified | MO |
| Figliozzi, et al. [26] | Reverse auction | Numerical experiments | Spot market | Road | SO |
| Figliozzi, et al. [27] | Auction | Numerical experiments | Spot market | Road | OO |
| Figliozzi, et al. [28] | Auction | Numerical experiments | Spot market | Road | SO |
| Figliozzi, et al. [29] | Auction | Numerical experiments | Spot market | Road | OO |
| Gansterer and Hartl [30] | Auction | Numerical experiments | Contract | Road | MO |

| References | Mechanisms | Methodology | Modes of procurement | Transportation modes | Outcomes |
|---|---|---|---|---|---|
| Garrido [31] | Double auction | Conceptual analysis | Spot market | Road | MO |
| Gattiker, et al. [32] | Auction, negotiation | Numerical experiments | Contract | Not specified | SO |
| Goldsby and Eckert [33] | Reverse auction, negotiation | Conceptual analysis | Contract | Road | MO |
| Guo, et al. [34] | Auction | Numerical experiments | Contract | Road | OO |
| Handoko and Lau [35] | Double auction | Numerical experiments | Contract | Road | MO |
| Hu, et al. [36] | Auction, negotiation | Numerical experiments | Contract | Road, Rail, Maritime | MO |
| Huang and Xu [37] | Auction | Numerical experiments | Spot market | Road | OO |
| Jothi Basu, et al. [38] | Auction | Numerical experiments | Contract | Road | MO |
| Jothi Basu Subramanian, et al. [7] | Auction | Literature review | Spot market/Contract | Road | OO/SO/MO |
| Kersten [39] | Auction, negotiation | Numerical experiments | Contract | Not specified | MO |
| Kuo and Miller-Hooks [40] | Combinatorial auction | Numerical experiments | Spot market | Rail | OO |
| Kuo and Miller-Hooks [41] | Combinatorial auction | Numerical experiments | Spot market | Rail-Road | MO |
| Kuyzu, et al. [42] | Auction | Numerical experiments | Spot market/Contract | Road | OO |
| Ledyard, et al. [43] | Auction, negotiation | Case study | Contract | Road | OO |
| Lee, et al. [44] | Combinatorial auction | Numerical experiments | Contract | Road | OO |
| Li and Zhang [45] | Auction | Conceptual analysis | Contract | Maritime | MO |
| Lim, et al. [46] | Auction, negotiation | Numerical experiments | Contract | Not specified | MO |
| Lim, et al. [47] | Auction, negotiation | Numerical experiments | Contract | Road | MO |
| Ma, et al. [48] | Combinatorial auction | Numerical experiments | Contract | Road | OO |
| Mes, et al. [49] | Auction, negotiation | Numerical experiments | Spot market | Road | OO |
| Mesa-Arango and Ukkusuri [50] | Combinatorial auction | Numerical experiments | Contract | Road | MO |
| Özener, et al. [51] | Auction | Numerical experiments | Contract | Road | OO |
| Qiao, et al. [52] | Auction | Numerical experiments | Spot market | Road | OO |
| Qin, et al. [53] | Auction | Numerical experiments | Contract | Not specified | MO |
| Rekik and Mellouli [54] | Combinatorial auction | Conceptual analysis | Contract | Road | SO |
| Remli and Rekik [55] | Combinatorial auction, negotiation | Numerical experiments | Contract | Road | MO |
| Robu, et al. [56] | Auction, negotiation | Case study | Contract | Road | SO |
| Sandholm, et al. [57] | Reverse auction | Case study | Contract | Road | OO |
| Schwind, et al. [58] | Auction | Numerical experiments | Contract | Road | MO |
| Sheffi [59] | Combinatorial auction | Conceptual analysis | Contract | Not specified | MO |
| Song and Regan [60] | Combinatorial auction, negotiation | Numerical experiments | Contract | Road | OO |
| Song and Regan [61] | Combinatorial auction | Numerical experiments | Contract | Road | OO |
| Triki, et al. [62] | Auction | Numerical experiments | Contract | Not specified | OO |
| van Duin, et al. [63] | Auction, negotiation | Numerical experiments | Spot market/contract | Road | MO |
| Wang and Wang [64] | Combinatorial auction | Numerical experiments | Contract | Road | MO |
| Wang and Kopfer [65] | Auction | Numerical experiments | Contract | Road | MO |
| Xu, et al. [66] | Auction | Numerical experiments | Spot market/Contract | Intermodal transportation | MO |
| Xu and Huang [67] | Double auction | Numerical experiments | Spot market | Road | MO |

| References | Mechanisms | Methodology | Modes of procurement | Transportation modes | Outcomes |
|---|---|---|---|---|---|
| Xu and Huang [68] | Auction | Numerical experiments | Spot market/Contract | Road | MO |
| Xu, et al. [69] | Double auction | Numerical experiments | Spot market/Contract | Road | OO |
| Zhang, et al. [70] | Combinatorial auction | Numerical experiments | Spot market/Contract | Road | MO |
| Zhang, et al. [71] | Combinatorial auction | Numerical experiments | Spot market/Contract | Road | MO |
| Zhang, et al. [72] | Auction | Numerical experiments | Spot market/Contract | Road | MO |

## 4 COMMENTS AND PERSPECTIVES

Table 2 shows the distribution of the literature according to classification criteria considered.

**Table 2: Distribution of literature according to the classification criteria**

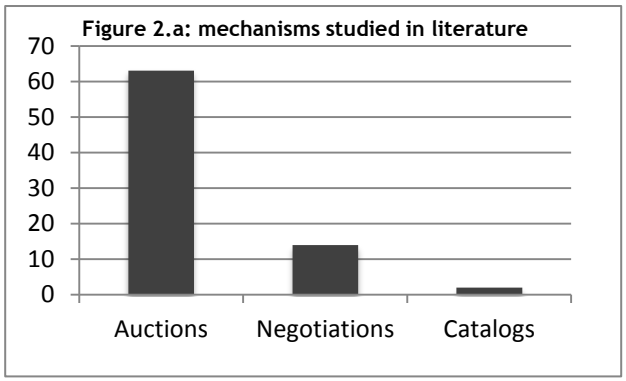
| Classifying criteria | Type | N° of papers | Classifying criteria | Type | N° of papers |
|---|---|---|---|---|---|
| Mechanism studied | Auction | 49 | Type of procurement | Contract | 42 |
| | Negotiation | 14 | | Spot market | 18 |
| | Catalog | 2 | Transportation mode | Truckload | 44 |
| Type of work | Conceptual studies | 7 | | Railway | 1 |
| | Empirical study | 3 | | Maritime | 1 |
| | Case study | 5 | | Multimodal | 4 |
| | Literature review | 1 | Outcomes | Individual objective outcomes | 26 |
| | Numerical experiments | 48 | | Individual subjective outcomes | 5 |
| | | | | Market outcomes | 33 |

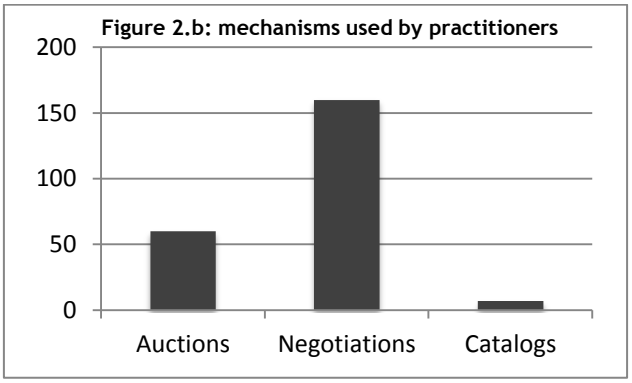
### 4.1 Mechanisms studied

It is clear from the table 2 and figure 2.a that auctions are more addressed by the academia than other mechanisms. The opposite findings are revealed from the practitioners' point of view. Collignon [6] shows in a survey of 206 online marketplaces that the most popular mechanism is negotiation, which is far ahead of auction (see Figure 2.b). One of the reasons of the gap between academia and practitioners could be the link between mechanism and fee structure. Negotiation mechanisms may be free but auction mechanisms tend to require a fee to participants because of charging transaction fees due to the existence of the auctioneer. Another reason could also be the added complexity required in auction mechanisms. The complexity of procurement could influence the seller's trust. As shown by Gattiker Huang, et al. [32], when negotiation is used, procurement complexity has no effect on seller trust. When reverse auctions are utilized, the greater the complexity of the purchase, the lesser is the seller trust. Another significant finding is that the most commonly used auction mechanisms are reverse auctions. Few papers deal with double auctions or exchanges. However, it is clear from [24, 67] that the use of double auctions is promising for transportation service procurement. It allows simultaneous bidding from both shippers and carriers, and clears the market one at a time based on the received asks and bids. In addition, double auctions are also more time efficient and practically attractive than reverse auction in a "thick" market. One of the reasons of this lack of double auctions could be the complexity to implement them in a

market, because of the necessity of a market broker. However, the emerging of horizontal cooperation and collaborative transportation systems may require more attention to unearth new ways and mechanisms of exchanging transportation services to reach effectiveness and efficiency.

**Figure 2: Number of mechanisms studied in literature Vs those used by practitioners**




### 4.2 The Articles' Methodology

One of the most important findings in this field is the limited number of real world cases - very few empirical studies or case studies have been conducted. Most of the articles have put a focus on computational and numerical experiments. Empirical studies are needed to explain the gap in term of FTSP mechanisms between academia and practitioners. Moreover, in this field, few works have empirically studied the comparison of different mechanisms, contrarily to other fields such (construction, economy etc.). This type of comparisons will help integrating research and practice.

### 4.3 The modes of procurement

Traditionally, shippers used long-term transportation service procurement contracts to transport their goods. These long-term plans may be disrupted by many uncertainties (e.g., road traffic, waiting time, entrance of new carriers or technology to the market, sudden fuel price changes, etc.), forcing shippers to improvise at the last minute, see Nandiraju and Regan [73]. It has been suggested that it is advisable to go on the spot market when demand is highly uncertain. On the other hand, short-term practices (spot markets) help eliminate some of the complexities of long-term contracts procurement and can be used when procurement criteria are clear, see Andersson and Norrman [74]. Researchers use different procurement mechanisms in both spot markets and long-term procurement plans. Sheffi [59] studying the long-term contracts shows that shippers choose long-term contracts to avoid volatility in future prices and to ensure capacity availability, and service quality. Carriers accept these contracts when shippers offer sufficient freight volume, acceptable regularity, and service compatibility.

In literature reviewed, contract market is widely considered by authors more than spot market. One of the reasons is both the period of agreement between the agents (shippers and carriers) is higher compared to spot market and the amount of load to be transported by the carrier are also considerably longer and higher. In contract market, the stakes are not only on establishing contract but also on sustaining it, contrarily to spot market where only one-time procurement of transportation service is provided. In this aspect, works may be done to include, in the contract market, a number of carrier/shipper attributes and performance measures during the

contract's period for the next allocation period – an engagement of performance improvement.

### 4.4 The transportation modes

Table 2 shows that the presence of truckload procurement process is dominant comparing to any other transportation modes. Indeed, many articles deal with the auction mechanism for truckload transportation service procurement problem, but the multimodal auction-based mechanism for FTSP still wait to be solved in the future.

### 4.5 The procurement mechanism outcomes

The procurement mechanism outcomes are very important from the operation perspective. Many articles focus on individual objective outcomes (OO); references [11, 12, 27, 43, 44] show that the use of reverse auctions minimize (maximize) the expected total cost (profits) for the shippers (carriers). Moreover, Kersten [39] shows that multi-attribute reverse auctions are efficient mechanisms producing efficient solutions that maximize the buyers' utility. While some articles focus on the individual subjective outcomes (SO), Carter and Stevens [19] show the benefits and drawbacks of using reverse auction in transportation procurement from different perspectives; it creates perceptions of opportunism among participating suppliers, however, from the buyer's perspective, reverse auctions can yield lower purchase prices. Moreover, Gattiker Huang, et al. [32] underlines that sellers who used negotiation, always reported higher trust in their buyer counterparts than did sellers using internet reverse auctions. Many other articles focus on the market outcomes (MO) and propose allocatively efficient mechanisms that minimize the global transportation costs, see [66-68].

Table 2 shows that any subjective outcomes are given a low importance and less attention comparing to objective outcomes and market outcomes. The literature addressing collaboration issues as a new way to procure transportation service needs more focus on non-financial outcomes such as on-time performance and pick-up performance, in order to maintain the collaboration. It needs also that researchers put more focus on the question of who will organize the auction mechanism, the shipper or the carrier.

## 5 CONCLUSION

This paper has discussed the state of existing mechanisms in freight transportation service procurement. A framework based on five classification criteria was developed to give a systemic literature review. A total of 65 journal articles have been reviewed and analyzed. Some essential findings from this work offer a way to reach a clearer understanding of existing freight transportation service procurement mechanisms. It is worth to note that the goal of this literature review is not necessarily to find a particular mechanism for a specific case, but to provide a comprehensive review to an understanding of mechanisms to guide practitioners and future researches. Since the literature focus of this work has been put on the field of freight transportation procurement, it could be possible that some studies from other fields (e.g. economic behavior, organization, etc.) are missing. This can be seen as a limit of this work.

## 6 REFERENCES

[1] **Bellantuono, N. Kersten, G. E., and Pontrandolfo, P. 2008**. Exchange Mechanisms in Logistics Services Markets.

[2] **Caplice, C. 2007**. Electronic Markets for Truckload Transportation, *Production and Operations Management*, **16**(4), pp. 423-436.

[3] **Wilson, R. 2005**. Security Report Card-Not Making the Grade, *16th State of Logistics Report presented at Washington Council of Supply Chain Management Professionals (CSMP). Washington*.

[4] **EuroStat 2007**. Average loads, distances and empty running in road freight transport, (117/2007).

[5] **International Energy Agnecy 2009**. CO2 emissions from fuel combustion., *Statistics, OECD/IEA, Paris*.

[6] **Collignon, S. E.** 2016. *Exploratory and Empirical Analysis of E-Marketplaces for Truck Transportation Services Procurement*, Virginia Tech.

[7] **Jothi Basu, R. Subramanian, N., and Cheikhrouhou, N. 2015**. Review of full truckload transportation service procurement, *Transport Reviews*, **35**(5), pp. 599-621.

[8] **Nandiraju, S. and Regan, A.** 2008. *Freight Transportation Electronic Marketplaces: A Survey of the Industry and Exploration of Important Research Issues*.

[9] **Denyer, D. and Tranfield, D.** 2009. *Producing a systematic review*, in *The Sage handbook of organizational research methods*, D.A.B.A. Bryman, Editor. 2009, Sage Publications Ltd: Thousand Oaks, CA. p. 671-689.

[10] **Ağralı, S. Tan, B., and Karaesmen, F. 2008**. Modeling and analysis of an auction-based logistics market, *European Journal of Operational Research*, **191**(1), pp. 272-294.

[11] **Alp, O. Erkip, N. K., and Güllü, R. 2003**. Outsourcing Logistics: Designing Transportation Contracts Between a Manufacturer and a Transporter, *Transportation Science*, **37**(1), pp. 23-39.

[12] **Andres Figliozzi, M. Mahmassani, H., and Jaillet, P. 2003**. Framework for study of carrier strategies in auction-based transportation marketplace, *Transportation Research Record: Journal of the Transportation Research Board*, (1854), pp. 162-170.

[13] **Balasubramanian, S. 1998**. Mail versus Mall: A Strategic Analysis of Competition between Direct Marketers and Conventional Retailers, *Marketing Science*, **17**(3), pp. 181-195.

[14] **Berger, S. and Bierwirth, C. 2010**. Solutions to the request reassignment problem in collaborative carrier networks, *Transportation Research Part E: Logistics and Transportation Review*, **46**(5), pp. 627-638.

[15] **Buer, T. and Kopfer, H. 2014**. A Pareto-metaheuristic for a bi-objective winner determination problem in a combinatorial reverse auction, *Computers & Operations Research*, **41**, pp. 208-220.

[16] **Buer, T. and Pankratz, G. 2010**. Solving a bi-objective winner determination problem in a transportation procurement auction, *Logistics Research*, **2**(2), pp. 65-78.

[17] **Caplice, C. and Sheffi, Y. 2003**. Optimization – based procurement for transportation services, *Journal of Business Logistics*, **24**(2), pp. 109-128.

[18] **Carter, C. R. Kaufmann, L. Beall, S. Carter, P. L. Hendrick, T. E., and Petersen, K. J. 2004**. Reverse auctions--grounded theory from the buyer and supplier perspective, *Transportation Research Part E: Logistics and Transportation Review*, **40**(3), pp. 229-254.

[19] **Carter, C. R. and Stevens, C. K. 2007**. Electronic reverse auction configuration and its impact on buyer price and supplier perceptions of opportunism: A laboratory experiment, *Journal of Operations Management*, **25**(5), pp. 1035-1054.

[20] **Chang, T.-S. 2009**. Decision support for truckload carriers in one-shot combinatorial auctions, *Transportation Research Part B: Methodological*, **43**(5), pp. 522-541.

[21] **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**, pp. 152-172.

[22] **Chen, R. L.-Y. AhmadBeygi, S. Cohn, A. Beil, D. R., and Sinha, A. 2009**. Solving Truckload Procurement Auctions Over an Exponential Number of Bundles, *Transportation Science*, **43**(4), pp. 493-510.

[23] **Cheng, C.-B. 2011**. Reverse auction with buyer–supplier negotiation using bi-level distributed programming, *European Journal of Operational Research*, **211**(3), pp. 601-611.

[24] **Cheng, M. Xu, S. X., and Huang, G. Q. 2016**. Truthful multi-unit multi-attribute double auctions for perishable supply chain trading, *Transportation Research Part E: Logistics and Transportation Review*, **93**, pp. 21-37.

[25] **Dahl, S. and 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), pp. 620-626.

[26] **Figliozzi, M. Mahmassani, H., and Jaillet, P. 2004**. Competitive performance assessment of dynamic vehicle routing technologies using sequential auctions, *Transportation Research Record: Journal of the Transportation Research Board*, (1882), pp. 10-18.

[27] **Figliozzi, M. Mahmassani, H., and Jaillet, P. 2005**. Impacts of auction settings on the performance of truckload transportation marketplaces, *Transportation Research Record: Journal of the Transportation Research Board*, (1906), pp. 89-96.

[28] **Figliozzi, M. Mahmassani, H., and Jaillet, P. 2006**. Quantifying opportunity costs in sequential transportation auctions for truckload acquisition, *Transportation Research Record: Journal of the Transportation Research Board*, (1964), pp. 247-252.

[29] **Figliozzi, M. A. Mahmassani, H. S., and Jaillet, P. 2007**. Pricing in Dynamic Vehicle Routing Problems, *Transportation Science*, **41**(3), pp. 302-318.

[30] **Gansterer, M. and Hartl, R. F. 2016**. Request evaluation strategies for carriers in auction-based collaborations, *OR Spectrum*, **38**(1), pp. 3-23.

[31] **Garrido, R. A. 2007**. Procurement of transportation services in spot markets under a double-auction scheme with elastic demand, *Transportation Research Part B: Methodological*, **41**(9), pp. 1067-1078.

[32] **Gattiker, T. F. Huang, X., and Schwarz, J. L. 2007**. Negotiation, email, and Internet reverse auctions: How sourcing mechanisms deployed by buyers affect suppliers' trust, *Journal of Operations Management*, **25**(1), pp. 184-202.

[33] **Goldsby, T. J. and Eckert, J. A. 2003**. Electronic transportation marketplaces: a transaction cost perspective, *Industrial Marketing Management*, **32**(3), pp. 187-198.

[34] **Guo, Y. Lim, A. Rodrigues, B., and Zhu, Y. 2006**. Carrier assignment models in transportation procurement, *Journal of the Operational Research Society*, **57**(12), pp. 1472-1481.

[35] **Handoko, S. D. and Lau, H. C. 2016**. Enabling Carrier Collaboration via Order Sharing Double Auction: A Singapore Urban Logistics Perspective, *Transportation Research Procedia*, **12**, pp. 777-786.

[36] **Hu, Q. Zhang, Z., and Lim, A. 2016**. Transportation service procurement problem with transit time, *Transportation Research Part B: Methodological*, **86**, pp. 19-36.

[37] **Huang, G. Q. and Xu, S. X. 2013**. Truthful multi-unit transportation procurement auctions for logistics e-marketplaces, *Transportation Research Part B: Methodological*, **47**, pp. 127-148.

[38] **Jothi Basu, R. Bai, R., and Palaniappan, P. K. 2015**. A strategic approach to improve sustainability in transportation service procurement, *Transportation Research Part E: Logistics and Transportation Review*, **74**, pp. 152-168.

[39] **Kersten, G. E. 2009**. Multiattribute Procurement Auctions: Efficiency and Social Welfare in Theory and Practice, *Decision Analysis*, **11**(4), pp. 215-232.

[40] **Kuo, A. and Miller-Hooks, E. 2012**. Developing Responsive Rail Services through collaboration, *Transportation Research Part B: Methodological*, **46**(3), pp. 424-439.

[41] **Kuo, A. and Miller-Hooks, E. 2015**. Combinatorial auctions of railway track capacity in vertically separated freight transport markets, *Journal of Rail Transport Planning & Management*, **5**(1), pp. 1-11.

[42] **Kuyzu, G. Akyol, Ç. G. Ergun, Ö., and Savelsbergh, M. 2015**. Bid price optimization for truckload carriers in simultaneous transportation procurement auctions, *Transportation Research Part B: Methodological*, **73**, pp. 34-58.

[43] **Ledyard, J. O. Olson, M. Porter, D. Swanson, J. A., and Torma, D. P. 2002**. The First Use of a Combined-Value Auction for Transportation Services, *Interfaces*, **32**(5), pp. 4-12.

[44] **Lee, C.-G. Kwon, R. H., and Ma, Z. 2007**. A carrier's optimal bid generation problem in combinatorial auctions for transportation procurement, *Transportation Research Part E: Logistics and Transportation Review*, **43**(2), pp. 173-191.

[45] **Li, L. and Zhang, R. Q. 2015**. Cooperation through capacity sharing between competing forwarders, *Transportation Research Part E: Logistics and Transportation Review*, **75**, pp. 115-131.

[46] **Lim, A. Qin, H., and Xu, Z. 2012**. The freight allocation problem with lane cost balancing constraint, *European Journal of Operational Research*, **217**(1), pp. 26-35.

[47] **Lim, A. Rodrigues, B., and Xu, Z. 2008**. Transportation Procurement with Seasonally Varying Shipper Demand and Volume Guarantees, *Operations Research*, **56**(3), pp. 758-771.

[48] **Ma, Z. Kwon, R. H., and Lee, C.-G. 2010**. A stochastic programming winner determination model for truckload procurement under shipment uncertainty, *Transportation Research Part E: Logistics and Transportation Review*, **46**(1), pp. 49-60.

[49] **Mes, M. van der Heijden, M., and Schuur, P. 2009**. Dynamic threshold policy for delaying and breaking commitments in transportation auctions, *Transportation Research Part C: Emerging Technologies*, **17**(2), pp. 208-223.

[50] **Mesa-Arango, R. and Ukkusuri, S. V. 2013**. Benefits of in-vehicle consolidation in less than truckload freight transportation operations, *Transportation Research Part E: Logistics and Transportation Review*, **60**, pp. 113-125.

[51] **Özener, O. Ö. Ergun, Ö., and Savelsbergh, M. 2009**. Lane-Exchange Mechanisms for Truckload Carrier Collaboration, *Transportation Science*, **45**(1), pp. 1-17.

[52] **Qiao, B. Pan, S., and Ballot, E. 2016**. Dynamic pricing model for less-than-truckload carriers in the Physical Internet, *Journal of Intelligent Manufacturing*, pp. 1-13.

[53] **Qin, H. Luo, M. F. Gao, X., and Lim, A. 2012**. The freight allocation problem with all-units quantity-based discount: A heuristic algorithm, *Omega-International Journal of Management Science*, **40**(4), pp. 415-423.

[54] **Rekik, M. and Mellouli, S. 2012**. Reputation-based winner determination problem for combinatorial transportation procurement auctions, *Journal of the Operational Research Society*, **63**(10), pp. 1400-1409.

[55] **Remli, N. and Rekik, M. 2013**. A robust winner determination problem for combinatorial transportation auctions under uncertain shipment volumes, *Transportation Research Part C: Emerging Technologies*, **35**, pp. 204-217.

[56] **Robu, V. Noot, H. La Poutré, H., and van Schijndel, W.-J. 2011**. A multi-agent platform for auction-based allocation of loads in transportation logistics, *Expert Systems with Applications*, **38**(4), pp. 3483-3491.

[57] **Sandholm, T. Levine, D. Concordia, M. Martyn, P. Hughes, R. Jacobs, J., and Begg, D. 2006**. Changing the game in strategic sourcing at Procter & Gamble: Expressive competition enabled by optimization, *Interfaces*, **36**(1), pp. 55-68.

[58] **Schwind, M. Gujo, O., and Vykoukal, J. 2009**. A combinatorial intra-enterprise exchange for logistics services, *Information Systems and e-Business Management*, **7**(4), pp. 447-471.

[59] **Sheffi, Y. 2004**. Combinatorial Auctions in the Procurement of Transportation Services, *Interfaces*, **34**(4), pp. 245-252.

[60] **Song, J. and Regan, A. 2003**. Combinatorial auctions for transportation service procurement: The carrier perspective, *Transportation Research Record: Journal of the Transportation Research Board*, (1833), pp. 40-46.

[61] **Song, J. and Regan, A. 2005**. Approximation algorithms for the bid construction problem in combinatorial auctions for the procurement of freight transportation contracts, *Transportation Research Part B: Methodological*, **39**(10), pp. 914-933.

[62] **Triki, C. Mirmohammadsadeghi, S., and Piya, S. 2017**. Heuristic methods for the periodic Shipper Lane Selection Problem in transportation auctions, *Computers & Industrial Engineering*, **106**, pp. 182-191.

[63] **van Duin, J. H. R. Tavasszy, L. A., and Taniguchi, E. 2007**. Real time simulation of auctioning and re-scheduling processes in hybrid freight markets, *Transportation Research Part B: Methodological*, **41**(9), pp. 1050-1066.

[64] **Wang, D. and Wang, N. 2015**. Quantum computation based bundling optimization for combinatorial auction in freight service procurements, *Computers & Industrial Engineering*, **89**, pp. 186-193.

[65] **Wang, X. and Kopfer, H. 2014**. Collaborative transportation planning of less-than-truckload freight, *OR Spectrum*, **36**(2), pp. 357-380.

[66] **Xu, S. X. Cheng, M., and Huang, G. Q. 2015**. Efficient intermodal transportation auctions for B2B e-commerce logistics with transaction costs, *Transportation Research Part B: Methodological*, **80**, pp. 322-337.

[67] **Xu, S. X. and Huang, G. Q. 2013**. Transportation service procurement in periodic sealed double auctions with stochastic demand and supply, *Transportation Research Part B: Methodological*, **56**, pp. 136-160.

[68] **Xu, S. X. and Huang, G. Q. 2014**. Efficient auctions for distributed transportation procurement, *Transportation Research Part B: Methodological*, **65**, pp. 47-64.

[69] **Xu, S. X. Huang, G. Q., and Cheng, M. 2009**. Truthful, Budget-Balanced Bundle Double Auctions for Carrier Collaboration, *Transportation Science*.

[70] **Zhang, B. Ding, H. Li, H. Wang, W., and Yao, T. 2014**. A Sampling-Based Stochastic Winner Determination Model for Truckload Service Procurement, *Networks and Spatial Economics*, **14**(2), pp. 159-181.

[71] **Zhang, B. Yao, T. Friesz, T. L., and Sun, Y. 2015**. A tractable two-stage robust winner determination model for truckload service procurement via combinatorial auctions, *Transportation Research Part B: Methodological*, **78**, pp. 16-31.

[72] **Zhang, M. Huang, G. Q. Xu, S. X., and Zhao, Z. 2016**. Optimization based transportation service trading in B2B e-commerce logistics, *Journal of Intelligent Manufacturing*, pp. 1-17.

[73] **Nandiraju, S. and Regan, A. 2008**. Freight transportation electronic marketplaces: a survey of the industry and exploration of important research issues, *University of California Transportation Center*.

[74] **Andersson, D. and Norrman, A. 2002**. Procurement of logistics services—a minutes work or a multi-year project?, *European Journal of Purchasing & Supply Management*, **8**(1), pp. 3-14.