Transport Collaboration Mechanisms for Autonomous Carriers

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Small and medium sized enterprises (SME) face problems of strong competition in the transport sector. Larger enterprises can provide better service and lower prices due to economies of scale and scope. Economies of scale may be achieved by delivering several less-than-truckload (LTL) cargo in one tour and economies of scope by the combination of various tours which might decrease the number of empty returns. One solution for improving the efficiency of SME discussed in theory and found in practice is cooperation between several enterprises on an operational level.

In the German road transportation sector several horizontal cooperations for LTL cargo are found. The oldest and probably most successful cooperation is IDS. In terms of revenue, the second and third largest transport coalitions are System Alliance and CargoLine, respectively. What these examples have in common is that they started as independent companies cooperating only in parts of their business and then developed towards joint organizational structures over time with the individual companies strongly integrated today. Nowadays, they even act like one organizational entity towards the customer. They offer specific products and have a central organizational unit in contact with the customer also assigning customers' transportation requests to the participating road haulage contractors.

In contrast to this trend of concentration and unification, most SME want to stay autonomous and are looking for collaborative concepts without building a centralized organizational unit. Thus, they want to cooperate within a Groupage System [2] which provides occasions for the leveling of transportation capacities across voluntarily cooperating companies who remain legally and economically independent. Operational transport collaboration within Groupage Systems can create competitive advantages for the participating companies. In order to be successful a common exchange mechanism between those companies has to be found. The idea discussed for Groupage systems is mainly based on a mutual adjustment of the operational planning of the partners of a coalition. This means, transportation requests are exchanged between the cooperating partners in order to improve profitability and service performance. Collaborative planning then refers to the planning done jointly for all involved partners in the cooperation. Common to the considered approaches is the assumption of independent road haulage contractors entering only a certain share of their transportation requests to the collaborative planning. The remaining share of their requests is planned autonomously by each partner and this planning might even go further and include vertical cooperation with subcontractors. Including both fulfillment modes into a road haulage contractor's operational decisions leads to at least three modes of different related cost structures since subcontracting might be subject to more than one type of cost structure. The planning situation for the entire system is then unlike the global approach for collaborative planning where plans are completely decided upon centrally. Rather, decentralized planning has to be installed where partners conduct their planning autonomously and only exchange limited information on a certain share of their customers' requests. These shared requests are to be planned following the global objectives of the total coalition.

The decentralized approach retains a higher degree of autonomy for the cooperating partners than the practical examples for horizontal cooperations mentioned before. The underlying

assumption is that SMEs have the desire to remain economically and organizationally autonomous and may be competitors when entering the cooperation. For collaborative planning this situation implies that not all information will be voluntarily provided and that it cannot be excluded that partners might act strategically and provide incorrect information despite their desire to cooperate.

In order to find and select suitable exchange mechanisms it is necessary to define meaningful and significant criteria for their evaluation [1]. General criteria can be derived from microeconomic theory. These criteria are intended for the evaluation of the efficiency of a system distributing bundled goods in an economy. The situation of planning in Groupage Systems is an extension of the theoretical case of perfect information towards asymmetric information and decentralized planning. Therefore, the criteria for the planning situation of autonomous partners in transport collaboration must be extended by the requirements of incentive and decentralized planning compatibility.

Additionally, all payments related to the exchange need to be specified, distributing the costs and financial benefits of the request exchange among the partners. Our contribution is a general analysis of such mechanisms and payment structures, including the investigation of conditions to be fulfilled by an exchange mechanism in order to be acceptable to the partners and further the investigation of criteria for defining the rules for a successful cooperation. This analysis is based on insights from microeconomics and game theory. The results are not necessarily limited to operational transport collaboration but can also hold for cargo exchange in electronic markets or for long-term assignment of transportation routes. In the first part of our contribution, an overview of research on operational transport collaboration systems is provided. Then the general properties of operational transport collaboration and the reallocation mechanism as well as criteria for its efficiency are discussed. This is followed by a discussion of practicability issues for such mechanisms and conclusions for efficient collaboration mechanisms.

The major challenge for future research on transport collaboration mechanisms lies in the computational complexity of the underlying problems to be solved for evaluating transportation requests and reallocating them between the collaborating partners. Further, the situation of sellers has not been considered so far but needs to be addressed. Every participant may take the position of seller and buyer at the same time. It is rational for the seller to attempt to create additional profit by selling transportation requests. However, if this additional profit becomes too large it may contradict an efficient solution. Additionally, sellers might not necessarily provide correct information on transportation requests and thus endanger the calculation of efficient transfer prices. Mechanisms of profit sharing as introduced in [3] deal with an incentive compatible compensation of sellers and should be included into transport collaboration mechanisms.

References

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