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A Holistic Approach to Identify Collaborative Shipping Opportunities

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Abstract

Horizontal collaboration between companies has been recognized as beneficial, although implementing horizontal collaboration has proven to be challenging. In this paper, we zoom in on the largest challenges and present a holistic approach to foster horizontal collaboration. Specifically, we present quantitative methods for computing synergies and at the same time draw on social psychological insights and legal considerations. Next, we present how this approach was used to construct and implement a matching tool that allowed members of a huge shipping entrepreneur organization to find and support a horizontal collaboration partner.

Keywords: strategic horizontal collaboration; logistics; matching

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1. Introduction

A growing trend in improving logistics efficiency is to set up logistics partnerships with other companies (Creemers, 2017). One can distinguish between vertical and horizontal supply chain collaborations. Vertical collaborations are established between suppliers and buyers. An example is sharing information on customer orders upstream of the supply chain to reduce demand uncertainty for the suppliers. Horizontal collaborations are established between companies that operate at the same level in different supply chains (e.g., between suppliers or between buyers). A furniture boulevard, where stores competing on furniture are clustered, is a typical example of horizontal collaboration. Cooperation between airlines in alliances, such as SkyTeam and Star Alliance, is another example. Similarly, there are various examples of horizontal collaboration between competitors in logistics, such as between logistic service providers and between consumer goods manufacturers (Leitner, 2011).

Horizontal partnerships in logistics have the potential to generate substantial gains for the partners by leveraging the overlaps in transport networks (Cruijssen, 2007, Leitner, 2011). This is not only related to cost efficiency and reducing the CO₂-footprint, but it can be much broader, like service improvements, increasing the product and proposition value, and the openings of new market channels (Compose, 2020). In the World Economic Forum report of 2015, collaborative shipping was identified as one of the processes in driving shared value (World Economic Forum, 2015). Vertical collaborations have been successfully established for many years; however, horizontal collaboration initiatives seem to be much more challenging to create and sustain (Cruijssen, 2020). Even companies that are willing to cooperate may encounter practical impediments.

In this paper, we zoom in at the largest impediments, after which we present a holistic approach to identify and create collaboration between shippers. We do not restrict ourselves to quantitative aspects, but we also consider the social-psychology perspective. The focus is not restricted to cost savings, but also on improving customer value. This holistic approach is the foundation of the R&D-project Compose¹, where researchers from

¹ See <https://www.tilburguniversity.edu/research/impact/creating-value-data/strategiclogisticalcollaboration> for an introduction of Compose.

different disciplines have established a matching platform together with the organization *evofenedex*, representing the shippers in the Netherlands. This platform is meant to support shippers in finding a partner and is successfully applied in various cases.

This paper is organized as follows. In section 2, we describe the identified impediments. In section 3, we describe our holistic approach for finding potentially attractive matches for horizontal collaboration. In section 4, we describe in more detail our method to quantify the logistics benefits of horizontal collaboration. In section 5, we focus on the social psychology and legal aspects. In section 6, we describe various cases to explain the benefits, based on the usage of the tooling and we close in section 7 with our conclusions and recommendations for next steps.

2. Impediments for horizontal collaboration

Horizontal collaboration is very closely linked to the program Cross-Chain Control Centers (4C), which has been studied over the last ten years amongst others by the Dutch Top sector Logistics. Recently, an overview of all finding and recommendations has been published in a book (Cruijssen, 2020). Horizontal collaboration was identified ten years ago as a great opportunity, but the adoption and implementation are going much slower than expected. A survey by Cruijssen et al. (Cruijssen, 2007) shows that the allocation of the gains, the identification of partners that can coordinate the activities and finding suitable partners are viewed as the most important impediments. Koch (Koch, 2017) has published an updated overview of impediments, classified in the order of importance: (1) Finding the right partner. Since companies are not known with the concept of horizontal collaboration, and/or or not familiar with the tools and methodology to find a partner. (2) Operational requirements needed to fulfill the service and characteristics of the goods. (3) Operational service level agreements with suppliers and/or customers. By collaborating procedures will change, which might influence the agreements. (4) The benefits are not always clear upfront since the actual cooperation can differ from the regular business. (5) A fair sharing of the cost and benefits can be complex to compute and realize. (6) Companies should trust each other to share information and meet other obligations. (7) The companies should have the right infrastructure to share the data real-time in the right format, which might require investments. (8) Possible violation of the competitive law rules.

Providing transport solutions is the core business of transport companies. Therefore, horizontal collaboration can be challenging, because handing over a slice of the achieved benefits in transportation to shippers may impede their business model. For shippers, horizontal collaboration is challenging for a different reason. In general, the logistics costs are a low percentage of the overall costs of a company that wants to ship goods to its customers. Therefore, the priority from management was low in the past, but the pressure on achieving logistic sustainable goals has changed this.

Creating collaboration is generally a process associated with increasing dependencies between the collaborators which requires time. Such aspects of collaboration may hinder companies that are more focused on short term benefits. Taken together, these aspects indicate that, even if horizontal collaboration has great benefits, it may be hard to realize in practice. Similar conclusions are described in the book of Cruijsen (Cruijsen, 2020).

3. A holistic approach

Our methodology, based on the impediments mentioned in section 2, is a holistic approach to find the right partner by focusing on quantitative and qualitative aspects, and to focus on increasing customer value rather than cost savings only. In this section, we explain how this was accomplished.

From each interested shipping company, we requested two types of data: logistic characteristics (to compute possible benefits), and information on the company organization and culture. For the latter, a questionnaire was created and reviewed by scientists in supply chain and social psychology. The underlying idea is that companies with a similar culture have a higher success on matching, based on the similarity attracts principle (Montoya et, 2008). Each question was categorized in one of the categories Personal, Company, Supply Chain Maturity, and Legal. For each pair of companies, a score was calculated representing how well they match. This calculation was based on the answers given by the individuals on the questionnaire. The individuals were also able to mark questions as less or more important, which affected the weight given to each question.

For each pair of companies C_1 and C_2 , a matching score, representing the qualitative similarity in culture between the two companies, was derived

from the answers to the questionnaire in three steps. First, the matching scores for each question was determined by comparing the answers given by both companies. If these answers fit well together the question gets a high matching score. A perfect fit is denoted by a score of 5, whereas the worst possible fit gets a score of 0. Notice that for some questions having the opposite answers is desired, while for other questions it is desired that the two companies have similar answers. Next, a matching score per category was determined by the weighted average of the matching scores for the questions belonging to a certain category using weights indicated by company C_1 . Finally, an overall matching score was determined from the category scores. Notice that the matching scores between two companies are thus not necessarily symmetric, because the companies might have indicated different importance (weights) to each of the questions.

Given a set of company profiles obtained from the questionnaire, the matching scores between a particular company and all other companies were listed on a 0-5 scale and sorted in descending order. This enables to company to quickly assess the cultural similarity with other companies interested in collaboration.

For the quantitative matching, a similar approach was applied. Each company supplied characteristics about logistic activities for which they are looking for a match. This can be in bundling transport goods towards the receiver, for example, in inner-city logistics, but it can also be in international transport, to obtain a modal shift towards rail and barge. By bundling goods resources are better utilized, resulting in transportation costs reduction and reduced CO₂ emissions. Moreover, bundling can also enable a higher delivery frequency, implying a faster reaction to demand changes, and as such, lower inventories in the supply chain and a higher service. Specially for service-oriented companies, this can even be of higher priority than just lowering the transportation costs.

Transport flows that are in opposite direction can also be optimized by creating a backhaul roundtrip. This option might be even possible within subsidiaries of the same company by reviewing these transport flows from a more central perspective. In the next section, we describe in more detail how cost savings in transportation can be quantified.

As mentioned, in the academic literature there is a huge focus on transportation costs (Cruijssen, 2020), when considering horizontal collaboration. However, there might also be opportunities for sharing warehouses and/or sharing employees. For employees, during the COVID-19 lockdown measures, some countries launched special legislation rules to facilitate in- and outsourcing of employees between companies. A recent questionnaire from *evofenedex* (personal communication) showed that 34% from the interviewed companies were interested to make use of these special regulations but had difficulties to find the right partner.

No matter whether the opportunity for logistics matching is for bundling, backhauling, exchanging in warehousing or in employees, the applied methodology is similar: for a given company A, the matching with all the other available companies is computed by calculating a score. As a final step, these companies are sorted based on this score, and the matching is shown by an indication on a 0-5 scale. So, there are two separate rankings. The most interesting candidate companies for a given company A are shown, by using the indication on the quantitative and qualitative aspects.

4. Quantifying the transportation benefits

In section 3, we explained how we matched organizations in terms of qualitative and quantitative aspects. In section 5, we will continue how this matching was also inspired by social psychological insights and embedded in legal considerations. In this section, we explain how the potential benefits of collaboration in transportation between two companies in transportation can be quantified. We limit ourselves to two ways of synergy in transportation to quantify its benefits: bundling and backhauling.

Figure 1. Transportation lanes A and B without collaboration.

Creemers et al. (2017) also mention two other possibilities, but these require at least three routes, which we leave out of scope here.

Consider two transportation lanes A and B from two different companies as depicted in Figure 1. Lane A can be characterized by a transport from a source s_A to a destination d_A with a volume v_A and frequency f_A (lane B is characterized analogously). We assume that in the original situation without collaboration, a truck drives back empty from the destination back to the source as indicated by the dashed lines in Figure 1.

Bundling two lanes implies first loading at source s_A and then at s_B (or vice versa), then drive to the destination d_A and next to d_B (or vice versa) for unloading after which the truck returns to the starting location. For this we assume that the combined volume fits in one truck. This results in four possible bundling options as shown in Figure 2. Depending on the ge-

Figure 2. Four bundling options for lanes A and B.

ographical locations of the source and destination of lanes A and B, savings can be made on the total km driven compared with the original situation. Let $BundlingDist(A, B)$ denote the length of the shortest roundtrip of the four options and let $OriginalDist(A, B)$ denote the total km driven in the original situation. The percentual km savings of bundling is then given by

$$DistSaving(A, B) = \frac{OriginalDist(A, B) - BundlingDist(A, B)}{OriginalDist(A, B)} \times 100\%.$$

The actual savings, however, also depend on the volume and frequency that can be matched. Suppose that lane A has a frequency of twice a week, with volume 30 each, and lane B has a frequency of once a week with volume 40, then we assume that lane A can be combined once a

week with lane B , with a total volume of 30. In other words, the actual savings for transport lane A , given transport lane B , are

$$BundlingSaving(A|B) = \frac{\min(f_A, f_B) \times \min(v_A, v_B)}{f_A \times v_A} \times DistSaving(A, B).$$

For the example above, this gives $BundlingSaving(A|B) = \frac{1}{2}DistSaving(A, B)$ and $BundlingSaving(B|A) = \frac{3}{4}DistSaving(A, B)$. It is interesting to remark that if lane B 's characteristics can be changed such that the frequency is increased to two by splitting the volume in half, then the fractions of actual savings in term of the km savings change to $\frac{3}{4}$ and $\frac{1}{1}$, respectively.

The other form of synergy on lanes A and B is backhauling, which is potentially favorable if the destination of one lane is relatively close the source of the other lane. The roundtrip starts in one of the sources and then continues to the corresponding destination after which the empty truck continues to load at the other source and unload at its destination as illustrated in Figure 3. For computing the actual savings, we only need to correct for the frequency, because by backhauling there is no dependency between the volumes of the two lanes:

$$BackhaulingSaving(A|B) = \frac{\min(f_A, f_B)}{f_A} \times DistSaving(A, B),$$

where $DistSaving(A, B)$ is now based on the lengths of the backhauling roundtrip and the original total distance.

Figure 3. Backhauling roundtrip for lanes A and B .

Given two transport companies C_1 and C_2 , we compute the actual savings of bundling or backhauling between every lane A from C_1 and lane B from C_2 times the corresponding volume. The potential savings by bundling transportation lanes between companies C_1 and C_2 follows by an optimal selection of matches between the transportation lanes of C_1 and C_2 , such that the sum of the actual savings is maximized, and that the frequency for a lane, matched with other lanes, does not exceed the total frequency for that lane.

5. Applying social psychology and legal aspects

In the previous sections, we explained the method for computing the score for qualitative and quantitative benefits. We apply this method to select a shortlist of potential partners out of a longlist. The next step is to organize meetings and more in-depth analysis with these potential partners to bring clarity in whether a sustainable horizontal collaboration is achievable. This in-depth analysis includes a more detailed computation of the quantitative benefits, by using representative historical data, as explained in Section 4.

Next to this in-depth analysis, we considered the method how to act and cooperate during this process, based on social psychology, and, more precisely, applying the principles of stages of small group development (see Tuckman, 1977). The first stages are focused on building trust and establishing a relationship and to define the plan for collaboration. Within this plan multiple tasks have to be worked out: (a) exchanging the (common) goals and objectives, (b) the analysis of advantages and disadvantages, (c) formulating the operational necessities, (d) design of the cooperation, and (e) analysis of the legal aspects.

A recent literature study by (Amiranti, 2020) creates a good overview of best practices to apply when establishing a collaboration. One of these best practices relates to the sharing of costs and benefits of the collaboration in a fair way. Fairness means that every company should at least get the benefits compared to working separate, and that the remaining costs and benefits of the cooperation are shared by reasonable allocation rules to each company (Tyler, 1988). From the academic literature in game theory, the Shapley Value is often proposed as a fair way, but we note that

this measure is often difficult to explain and to apply. We advise to involve an expert, to identify fair and explainable rules for sharing costs and benefits, as defined in procedural fairness (Lind, 1988, Tyler, 2003).

In addition to the social psychology aspects, there are legal aspects to be investigated during the in-depth analysis, which focus on the legislation related to the competition law. For Europe, this is formulated in Article 101(1) of the Treaty of the Functioning of the EU (TFEU, 2012). This article relates to price cartels but can be applied to horizontal collaboration as well. Notice that if financial benefits for the end consumer can be made clear, and/or sustainability goals can be achieved, then the rules are less strict from a legal perspective. Next to this, a governance structure is necessary to describe the rules for engagement. Here, you can distinguish who is monitoring the cooperation. From an organizational perspective, it is most likely that an external trustee will lead the operational cooperation and will monitor the exchange of data, create transparency and measure the objectives. Because it is not allowed to share sensitive data between companies. Notice that when the collaboration is achieved by using a logistic platform, then it is crucial to review the responsibilities and accountability rules during execution (Verheyen, 2021).

6. Results

We applied the method, described in the previous sections, in the matching platform of Compose². Compose is focusing on strategic collaboration between shippers, which can be in bundling or backhauling in transportation, in sharing warehousing, or in exchanging employees. Over fifty companies are involved as active members, to identify, search and apply opportunities for collaboration. During the testing of the method for quantifying the benefits, described in section 4, it was verified by practitioners that the most attractive lanes and partners indeed yield the highest matching scores. In this section, we describe a few cases where the tooling and methodology is applied.

The first case considers the search of a large Dutch production company for horizontal collaboration in logistics. Here, the questionnaire (explained in Section 3) was very helpful to describe its own positioning, desired objectives, and possible opportunities for cooperation. The next

² See www.supplychainsamenwerking.nl to use the matching tooling.

step was to create a longlist of possible partners, by considering (a) which other (production) companies are located nearby, (b) which other companies are also delivering to their customers, (c) other shipping companies, which are already bundled by the involved logistic service providers, and (d) companies from larger (public) databases, like from the members of *evofenedex*. By desk research, this longlist was reduced to about ten possible partners. Using the matching tool for the potential partners, two attractive candidates were selected. One of them is a sister company in a different country. Given other priorities within the company to reach short-term benefits, the implementation of the possible horizontal cooperation was postponed. But the journey of positioning, identifying benefits and selecting the shortlist out of the longlist helped the company to set the right goals, their own positioning, and objectives for the longer term.

The second case is the possible cooperation between a carton producer and a glass wool producer, located in the same area in the Netherlands. By gathering the data of the most important inbound and outbound transportation lanes of both companies, ten strong matches could be identified, using the method, described in Section 4. By the in-depth analysis of these ten opportunities, using operational requirements and details of allowed time windows, five of them are still valid to implement in practice. This project is put on the agenda of the management.

The third case focuses on the international transport through Europe from an international feed production company with plants in fourteen countries. The current logistic and transportation process is completely decentralized. The objective of the company is to design common processes over the countries and to implement a more centralized approach. The matching tooling is used to identify transportation synergies between the international lanes in the various countries. These insights supported the plan to accelerate the centralization process.

These are just three examples out of multiple cases, where the tooling was applied. Since the underlying technique to compute the quantitative benefits are based on Creemers et al. (2017), the results and experiences are comparable. Notice that our quantitative matching is part of the overall matching between shippers, and only used to identify the right partners to discuss next steps towards a strategic partnership.

7. Conclusions and recommendations

In this paper, we described a holistic approach to establish sustainable horizontal collaboration among shippers. Our methodology takes into account both quantitative aspects, based on the method of Creemers et al. (Creemers, 2017), as well as qualitative aspects, based on social psychology, and embedded these in legal considerations. The approach was used to develop a matching tool³, which was applied in a community of over fifty shipping companies. Our approach yielded two important outcomes. First, the application of our approach did indeed result in horizontal collaborations. Second, even when horizontal collaboration was eventually not achieved, it increased awareness of companies about what goals they wanted to prioritize.

We also wish to offer various recommendations for further research. First, the implementation of horizontal collaboration at shippers requires a transition in thinking and acting for the company. This is also recognized as the gap between knowing and doing (Pfeffer & Sutton, 2000). Second, companies are often more focused on short term benefits which may hamper a focus on strategic partnerships, which pay off at the longer term. This is unfortunate as one of the most important lessons learned from setting up Compose is that the journey towards finding a strategic partnership already has immediate benefits, which is increased understanding about the company's positioning. The journey provides answers to questions like: what is important and core business for us and what are opportunities to collaborate, either with a sister organization or by re-viewing the market? We recommend investigating how to motivate companies to prioritize projects with longer term more uncertain benefits.

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³ See www.supplychainsamenwerking.nl for more information and tooling.

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