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Collaborative shipping: Logistics in the sharing economy

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Vertical supply chain collaboration has been around for decades. In a vertical collaboration, companies within one and the same supply chain collaborate, for instance to improve their forecast accuracy or inventory management. Horizontal collaboration is a more recent phenomenon where companies at the same level of the supply chain (i.e., between suppliers or between buyers) establish partnerships. An example of such a type of collaboration in transportation and logistics is collaborative shipping, where multiple shippers bundle volumes to fill the same transport. This more holistic view across individual supply chains brings many advantages for the logistics industry such as higher vehicle fill rates, reduced transportation costs and less transport emissions as more scale is available to enable a modal shift towards greener transport modes.

Without counteractions, total annual transportation emissions are expected to increase by 70 percent by 2050 compared to 2010, whereas they need to be reduced by 40 percent to 70 percent during that timeframe to keep the increase in average global temperature well below 2°C by 2100 (IPCC, 2014). With today's average vehicle fill rates of less than 50 percent, the current state-of-the-art freight system is environmentally not sustainable. While the integration of electronic data

interchange (EDI) technology into enterprise systems has enabled vertical collaboration (such as outsourcing logistics or vendor-managed inventories) between supply chain partners for a long time, horizontal collaboration is yet to break through.

Proactive Sharing of Transport

Bundling of freight is nothing new; this is exactly what logistics providers do. When companies outsource their logistics, a logistics service provider will combine freight loads of its customer base if shipment times are identical, and if there is a geographical match. Collaborative shipping is different; bundling opportunities are detected prior to shipment, and, if necessary, the timing of a shipment can be altered. For example, in 2011, healthcare multinationals Baxter and UCB established a horizontal collaboration to bundle their temperature-controlled pharmaceutical flows using intermodal rail transport.

It is unusual for two pharmaceutical companies to partner up in logistics, which makes this case interesting. Synergies were created through flexible planning: Baxter has the possibility to postpone some of its orders, which frees up space for UCB who was shipping low volumes with a lower frequency. This example clearly illustrates the difference with traditional freight groupage that is mainly reactive, and in which decisions are made in the execution phase rather than in the planning phase. The more flexible the participating companies are, the greater the synergies.

Collaborative shipping fits within the Physical Internet initiative proposed by Benoit Montreuil (2011) to tackle the inefficiencies in transportation and logistics. In the open and interconnected Physical Internet, inspired by its digital counterpart, physical goods are routed and scheduled efficiently through the seamless integration of standardized units, interfaces and protocols. As the foundation of the Physical Internet is built around multi-dimensional collaboration, it

complements the emerging sharing economy in which goods and services are being shared and exchanged more easily than ever. Moreover, the increased availability of information and communications (ICT) technologies paves the way to explore new types of collaboration through data analytics.

Bundling, Backhauling and Collect & Drop Opportunities

The potential of horizontal supply chain collaboration remains largely untapped. Practice has shown that establishing a horizontal collaboration is not that straightforward. Even when companies are willing to cooperate, there are still many practical impediments. One of the most important hurdles is to find suitable partners with whom to collaborate. Creemers et al. (2017) developed an algorithm that can quickly analyze extremely large data sets for all the transport routes of one or more companies, looking for ways to combine geographically compatible shipments. Among other things, it uses the GPS coordinates of the beginning and end of each route. Typical examples of opportunities include:

• Bundling of shipments: routes with a starting and destination point in the same area, making it possible to use the same means of transport and thus increase the load factor (see Figure 1).
• Backhauling: routes in the opposite direction, thus avoiding an empty return journey (see Figure 2).
• Roundtrips: different routes that tie in with each other, allowing them to be combined into one tour, also putting an end to empty miles (see Figure 3).

The algorithm also identifies collect and/or drop-off opportunities, allowing you to pick up an extra load en route, i.e., near an existing route, and drop it off further along the same route (see Figure 4). This

allows us to tie in seamlessly with the sharing economy. Many things will naturally need to be resolved before the "Uberization" of freight transport is achieved, but one thing is certain: The algorithm demonstrates genuine opportunities for participation in the sharing economy. And the sharing economy is where we are heading.

****** Insert Figures 1-4 about here *******

Big Data Analytics Through Digitally Enabled Platforms

The strength of the algorithm is that it can handle data sets of almost any size. You might just about manage to analyze a few hundred transport routes in Excel, but for 10,000 routes you need heavier artillery. The algorithm has been implemented at Cargostream, an independent Pan-European platform that helps participating shippers reduce their truck transportation kilometers by bundling their regular transportation needs with other shippers and facilitates a shift to multi-modal transportation. The Cargostream platform currently includes more than 30,000 routes of multinational firms, including Procter & Gamble, Etex, Bridgestone, Duracell, General Mills, etc. (http://www.cargostream.net/). The availability of big data through such platforms allows the identification of ample collaborative shipping opportunities. The algorithm provides a list of opportunities ranked according to potential cost savings and environmental benefits. Recent research and proven results in the past three years have shown the following benefits:

- reduction of transportation costs by 10 percent to 15 percent,
- reduction of CO2 emissions by 20 percent to 25 percent, and
- reliability improvement of more than 10 percent.

In a second phase the frequency of the shipments among the collaboration partners are synchronized to streamline the inventory

replenishments. As a result, not only can transportation costs be reduced, but inventory reductions can be realized as well when shippers join forces in the sharing economy (Gijsbrechts and Boute, 2017).

Standardized Cooperation Agreements for SMEs

Because of the large transaction costs associated with cargo bundling, it is presumed that only larger companies can afford to invest in such projects. As small- to medium-sized enterprises (SMEs) may lack the volume, time and money to obtain efficiency gains through cargo bundling, De Bruecker and Verheyen (2017) developed an online matching tool to facilitate the bundling process for use in a community-based context (business parks, sector organizations or intra-organization bundling). When users enter their shipment data on this platform (quantity, origin and destination, product type, shipping day and sequence), the tool proposes opportunities to bundle the shipment. By indicating preferences and constraints regarding product types and partner characteristics, food avoids being bundled with dangerous chemicals, for example, or the shipment is not bundled with a direct competitor.

When the partners accept the proposed bundle, a standardized autocompleted cooperation agreement is automatically developed. The goal of these standardized autocompleted contracts is to further eliminate the transaction costs for the SMEs. The agreements include rules with respect to the management, liability and the distribution of the bundling costs to ensure that each partner gets its fair portion of the bundling gains. This ensures that both small as well as large SMEs, who may already benefit from lower transportation costs, have an incentive to bundle their shipments.

Collaborative Shipping: Cheaper and Better for the Environment

Collaborative shipping allows companies to reduce transport costs, which is generally also their primary motive for seeking out opportunities to share transport. However, collaborative shipping also enhances the sustainability of logistics. Improving the load factor reduces the number of vehicles on the roads. Fewer vehicles means lower emissions of harmful greenhouse gases, less congestion and fewer chances of accidents. Collaborative shipping also facilitates the shift to more sustainable transport modes, such as rail transport. The greater the economies of scale that can be achieved through collaborative shipping, the easier this shift will be. In addition, this will also make multimodal transport accessible to SMEs; working together makes it possible to achieve the freight volumes required to bring rail transport within financial reach.

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References

Creemers, S., Woumans, G., Boute, R., Beliën, J., 2017, "Tri-Vizor uses an efficient algorithm to identify collaborative shipping opportunities," *Interfaces*, forthcoming.

De Bruecker, P. and Verheyen, W., 2017, "Automatized cargo bundling for SMEs," ORBEL31 Conference, Brussels, Feb. 2-3.

Gijsbrechts, J. and Boute, R., 2017, "Synchronization of intermodal freight shipments in the sharing economy," working paper, KU Leuven.

IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 pp.

Montreuil, B., 2011, "Towards a Physical Internet: Meeting the Global Logistics Sustainability Grand Challenge," *Logistics Research*, Vol. 3, No. 2-3, p. 71-87.

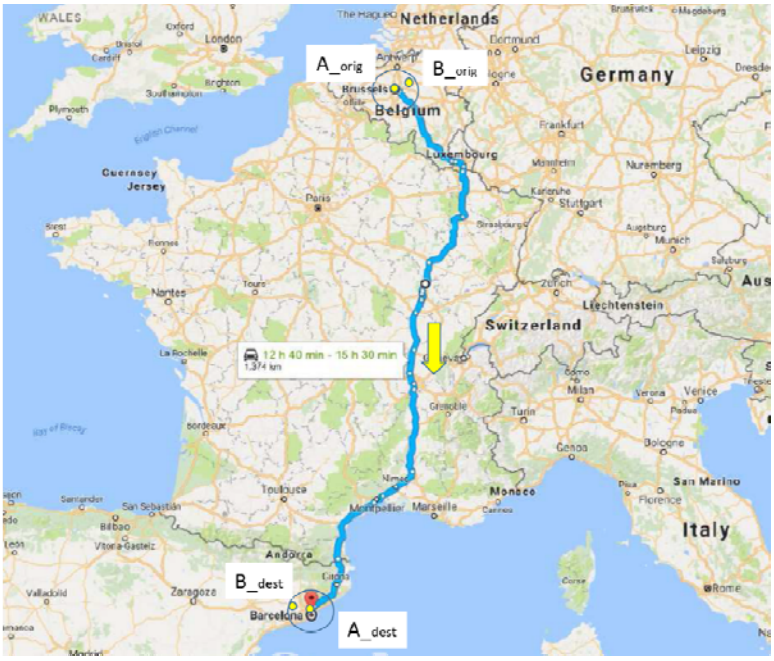

Figure 1: Example of a bundling opportunity. Shipments A and B both have their origin near Brussels and their destination near Barcelona, which allows for a bundling of shipments.

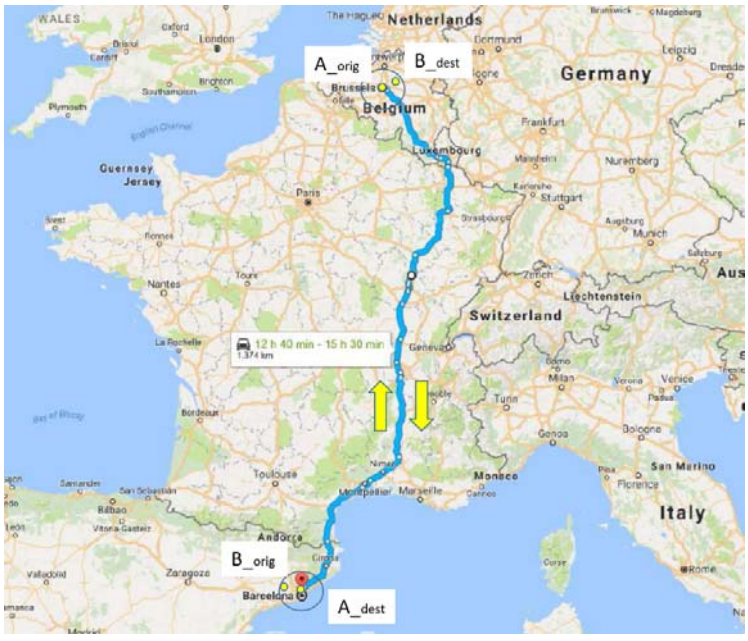

Figure 2: Example of a backhauling opportunity. The destination of shipment A (Barcelona) lies close to the origin of shipment B, whose

destination (Brussels) is close to the origin of shipment A. The empty truck after delivery of shipment A can be used for shipment B.

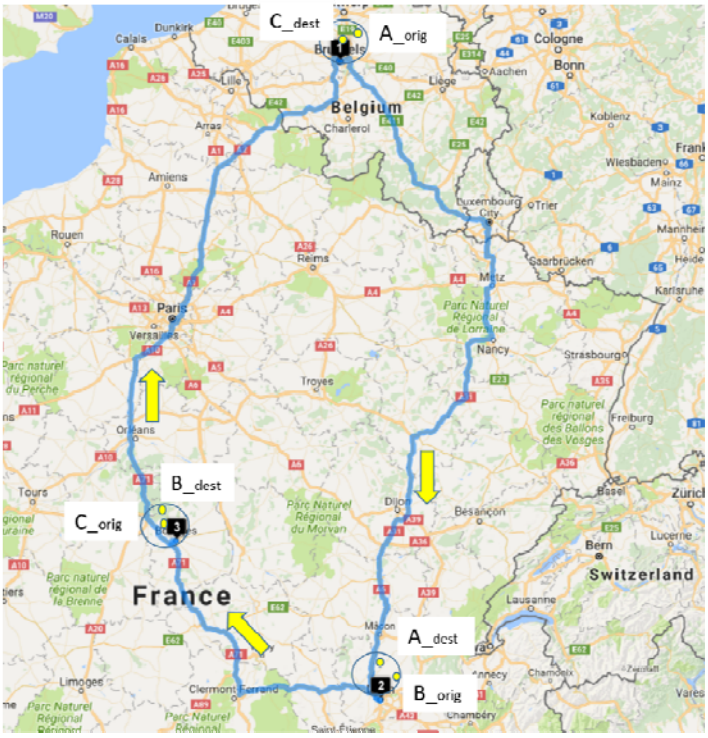

Figure 3: Example of a roundtrip opportunity that includes three shipments (A, B and C). The destination of A (Lyon) is close to the origin of B, whose destination is close to the origin of shipment C (Bourges). The destination of C (Brussels) is again close to the origin of A, which completes the roundtrip.

Figure 4: Example of a complex collaboration opportunity. The roundtrip including shipments A, B and C is completed with the collection of shipment D in Dijon as a bundling with shipment A. This shipment D is dropped off near Paris on the route from Bourges back to Brussels (after a bundling with shipment C).