Impact of Collaboration on Urban Logistics

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Abstract: **The development of collaboration is a major strategy in the implementation of sustainable supply chains. It associates independent and sometimes even competing organizations through the pooling and coordination of logistics means and information specific to each actor. This paper aims to show the growing importance of logistics pooling practices in the context of the construction of sustainable supply chains by describing these practices and emphasizing on the modes of coordination that accompany them.**

Keywords: **Collaboration, Supply Chain, Transport, Urban Logistics.**

I. INTRODUCTION

For the last 25 years, supply chain management has become a key driver of business competitiveness. Initially, this concept was only an extension of logistics practices to a larger number of business partners upstream or downstream of a company's operations (Bechtel and Jayaram 1997; Paché and Sauvage 1999). Today, logistics is the connecting point of practices from multiple areas such as quality management, product design, service to customer or data management (Anderson and Delattre, 2003). Moreover, the globalization of trade and exacerbated competition have led companies to look for new and better ways to improve their performance, and best meet the expectations of their customers. Further, the globalization of the economy with the internationalization of production processes and the relocation of activities have created geographic and cultural distance between industrial partners, often making coordination and collaboration between actors more difficult.

As businesses are facing an important worldwide competition, companies may be left behind without a strong supply chain to move goods. Moreover, as companies evolve, expand, and enter new markets, supply chain management becomes an even greater challenge. Stocking more goods from new markets and delivering on time means that the import and export business is becoming more complex. When faced to complex procurement decisions and the need to balance compliance with business needs, many companies - including those with experienced supply chain teams - realize that the global market presents challenges for which they are not ready yet.

On the average, around 65% of shipments reach consignee within scheduled time according to the World Data Bank in 2016. According to the Annual State of Logistics Report of 2017 (A.T Kearney analysis), logistics costs represented 7.50% of the GDP and as per the World Economic Forum (2009), the trucks are transporting 23% of the goods in the European Union. At the same time, there are increasing concerns at a worldwide level about climate change and environmental hazards related to CO2 emissions. Companies face these challenges and reconsider their logistics activities among the major contributors to this phenomenon, especially road transport – which accounts for about 23 per cent of the total EU emissions (European Commission, 2012). During the 1980s and 1990s, the importance of collaboration between providers and clients was recognized by researchers and practitioners (Sandberg, 2007). Since then, a large number of literature has addressed the collaboration in the logistics chain. Some organizations, sometimes competing, may have to cooperate as they do not have in-house physical resources such as warehouses, financial or human, needed to carry out a project (Pohle and Chapman, 2006; Kacioui-Maurin, 2012). Although collaboration and competition may seem contradictory, their merger can lead to an improvement in the performance of both actors (Nalebuff and Brandenburger, 1996; Bengtsson and Kock, 2000). Most innovations require a high level of interaction not only between teams, but across the traditional boundaries of organizations. As a result, the current economic environment encourages businesses to build alliances to access markets and resources, reduce risk and use resources effectively (Frank Tian and Johnston, 2004). In this context, Gray (1989) recalls that collaboration allows parties to find common interests, to reframe problems, to have a common definition of problems, and to seek a solution that satisfies the interests of stakeholders.

A multitude of definitions of collaboration have been proposed over the years. Huxman and Vangen (2005) see collaboration as a dynamic in which people come from different backgrounds and work towards a common purpose. Wilson et al. (1995) define collaboration as a set of inter-organizational relationships that can be broken down into different terms: alliances, joint ventures or strategic partnerships. Wood and Gray (1991) suggest that collaboration occurs when a group of stakeholders engage in an interactive process using rules, norms and structures to develop a solution to a problem.

Pooling involves pooling logistics resources and means (storage warehouses, transport, information systems) between legally and financially independent organizations in order to better organize the flow of goods. The literature distinguishes two forms of logistics collaboration (Barratt, 2004):

- Vertical collaboration relies on the pooling of logistics assets so as to integrate the management of flows between actors located at different levels of the same chain, for example between manufacturers and a distributor or between a franchisor and its franchisees.

- Horizontal collaboration means a pooling of logistical resources between companies directly competing at the same stage of the supply chain, for example between manufacturers in the same sector or between distribution groups. It refers to the concept of coopetition (Bengtsson and Kock, 2000), which is defined as a dyadic relation in which the actors are at the same time in a situation of competition (in terms of marketed products for example) and brought to collaborate on one or more of their activities (storage and transportation, for example).

According to Becker (2003), a vertical collaboration is determined as a "common process management in a supply chain by sharing complementary knowledge and resources in order to efficiently use energy for planning, deployment, operation follow-up and control".

Collaborative transport management is used to reduce delivery time and improve delivery reliability as the carrier becomes able to establish collaboration between the manufacturer and the reseller during the planning, forecasting and execution phase of the process (Tyan, Wang and Du, 2003). In their work, Bahinipati and Deshmukh (2012) develop and solve real-life e-market models for complex buyer-supplier supply issues by estimating the quantities to be ordered in the collaborative supply chain. They conclude that the vertical collaboration process would be more efficient if the length of the horizon and the size of the orders during the planning are considered as a negotiating parameter between the buyer and the supplier. In addition, Álvarez-SanJaime et al. (2013) demonstrate that a transmission line that builds its own terminal is strategically profitable to continue to carry some of its cargo through open port facilities, and to retain its non-exclusive terminal. Thus, by virtue of non-exclusivity, the shipping lines offer a greater variety of services, the total freight increases and resulting equilibrium rates are higher than with a dedicated terminal.

Collaborative transport management between supply chain actors is becoming a topic of great interest to some and a critical strategic element for others (CTM, 2004). According to Chan and Zhang (2011), collaborative transportation management can reduce total costs and increase the level of service of retailers. This was the result of a simulation approach that was used to evaluate the benefits of collaborative transport management and optimize delivery time capacity. It is also possible to determine the success of the collaborative initiative by summarizing the importance of the predictive degree of collaboration using a generic quantitative model (Bahinipati, Kanda and Deshmukh, 2009). Furthermore, Buijs and Wortmann (2014) deal with horizontal supply chain collaboration between autonomous freight carriers in the truck industry. The main purpose of the study is to identify and explain the challenges with joint operational decision-making in this context and to investigate the precise role of information technology. In addition, Bookbinder and Higginson (2002) have proposed a probabilistic approach to study the impact of a consolidation program on the management of the international supply chain. Tyan, Wang and Du (2003) developed a mathematical model to prove that the implementation of a collaborative consolidation policy improves the level of service and minimizes costs. Wang, Kopfer, and Gendreau (2014) study the freight forwarder planning process and discuss the benefit of including external resources. Moreover, Ankersmit, et al. (2014) provide a case study on the transport of air cargo on the Schiphol airport ground. This study reveals the potential for horizontal collaboration in the transportation of cargo ships between multiple freight forwarders at the same airport. Thus, in order to determine the research problem, a thorough review of the literature was conducted. It was deduced that a lack of work is noted in the field of logistics collaborations and in particular in the field of transport.

The purpose of this paper is to understand the impacts of logistical collaboration on the performance of the companies concerned and the environment. The theoretical interest of this research is to contribute to a better understanding of horizontal logistic collaboration (inter-company). Moreover, some companies decide to come together to pool resources. Business-to-business collaboration is a response to this changing environment.

II. METHODOLOGY

The cases of collaborative practices are relatively new. For this case, we have used a quantitative method that aims to provide information, evaluates it, synthesizes the results and uses it to apply a rigorous, verifiable and reproducible method.

On the basis of a true partnership, collaborative logistics can bring out the economic, organizational and environmental gains that these companies would not be able to benefit from in isolation. These gains translate into a mass flow, a pooling of resources, an increased sharing of information and skills, the joint development of new services for better profitability and a better service to the customer. In this transformation perspective, the real-time exchange of information concerning planning, execution monitoring and performance management plays a fundamental role.

There are a number of elements necessary for the proper functioning of a collaborative mode: they involve the very relationship between the actors (characterized by mutual trust and transparency), as well as the tools necessary to ensure the operations (especially mastery of information systems).

Different actors, public or private, can take part in the construction and operation of this type of organization. These steps include business networking, feasibility study, fundraising and grant-making, implementation support, promotion and development.

The results of this type of collaboration are not all measurable because of the lack of actual decline in some cases. In a few cases, however, significant gains have been achieved in the order of 20% on:

- Transportation costs
- Inventory level
- CO2 emissions

The objectives, or potential gains sought, are multiple and can be found at several levels in the value chain. The purpose being, for companies that are part of this type of approach, to improve their profitability and their level of service. The finding made in 2005 by mass retailers in France points to the limits of logistics models, especially those set up with manufacturers via the Vendor Managed Inventory (VMI) :

- the rate of linear break in stores is maintained at a high level, close to 10%;

- the level of stock remains high (10 to 12 days of stock on the central distribution warehouses to the stores, 40 to 60 days on the whole chain);

- the average delivery time remains important;

- logistical costs remain high on the sector.

Suppliers must therefore adapt and deliver more frequently in smaller quantities. In addition, distributors are now showing a strong desire to develop their own brands via Private Label. To avoid a drastic increase in their logistics costs, suppliers must pool their supplies.

The establishment of Consolidation and Collaboration Centers (CCC), at the initiative of Carrefour, appears to be a key factor for adaptation and development for SMEs and very small companies, which can then, by regrouping, benefit from economies of scale in transport and logistics services and thus respond to the problem of flow tension.

H1: Collaborative logistics have a positive impact on negative externalities.

The case of urban logistics

To answer and study this hypothesis, the quantitative study has been selected.

III. DATA COLLECTION

For H1, we will try to determine the price of the negative externalities thanks to online researches. We will then, create a case study to determine if urban logistics can decrease the price of negative externalities. We will analyze if the use of electric vehicles and a pooling of the warehouses have a positive impact on the externalities. It is a deductive approach that starts from the classification of characteristics, the analysis of statistical data and obtains the answer to the problem.

This methodology leaves no room for subjectivity by providing answers by digital evidence.

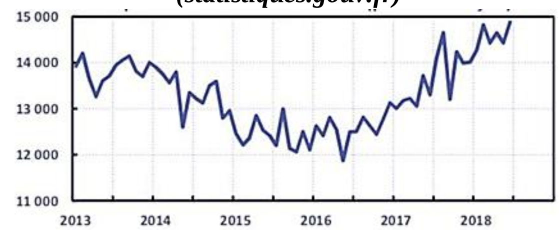
The purpose of this study is therefore to try to establish a prediction of pooled sales.

IV. URBAN LOGISTICS CASE

Hypothesis 1: Collaborative logistics have a positive impact on negative externalities - The case of urban logistics. One of the main goals of the logistics of freight transport is to optimize its cost as well as its pollution.

The fight against the greenhouse effect is a national priority, reaffirmed in the 2004 Climate Plan, particularly in transport. Due to the growth of their greenhouse gas emissions, this sector tends to erase the progress achieved between 1990 and 2001 in industry (-17.1%), energy production (-16%) and waste treatment. (-5.7%). Transport (+ 21.6%) and buildings (+ 18%) show worrying trends, despite the technological advances on the new one (cars and buildings). The strong growth in the distances travelled in transporting goods, with an increasing preponderance of the road, contributes to the drift of fossil energy consumption. Reducing consumption in the housing and transport sectors would also contribute to the country's energy independence. According to the French government, land freight transport in France increased by 6.8% between 2016 and 2017, Table 1(according to the French government's sustainable development statistics).

Table 1: Road freight transport in France per million tonnes (statistiques.gouv.fr)



In a world that is evolving in a "green" trend with the desire of customers to buy less polluting goods, it is urgent to find a solution to reduce these negative impacts related to the transport of goods. At the national level, the last mile of delivery is expensive: it weighs about 20% of the traffic, occupies 30% of the roads and is responsible for 25% of greenhouse gas emissions, according to the figures published by the Strategic Analysis Committee. As the product gets closer to its final destination, the unit cost of transportation increases and therefore reaches its peak in the last mile. Moreover, 50% of the diesel consumed in the city is for the transport of goods (including purchases).

In this work, the concept of logistic pooling as a form of collaboration between actors in the supply chain is used.

The aim of this research is thus to determine if it is possible to reduce transport costs as well as CO2 emissions in the city by pooling the transport of goods between the different brands but also by changing the types of transport.

In order to verify this hypothesis, it is important to carry out a case study in order to be able to compare the logistics cost between non-shared transport and others that are shared between different companies. Assumptions:

- In 2018, there were approximately 8,300 deliveries per 100,000 inhabitants per day in France (1 million deliveries in Ile-de-France area per day for a population of 12,000,000)(Sia Conseil, 2012).

- Let's presume that 100% of the transports in town weigh less than 3.5 tons.

- On the average, a truck travels 80 kilometres (from pick-up point to warehouse return)

- Calculations will be based on a 250-day year (full year excluding weekend)

To contextualize this case study, we focus this study with two criteria:

- The collaboration takes place on the last 5 kilometres of the delivery

- The mode of transport used is alternative: for this, we will use the data recorded current prices of diesel brand oil (gasoline type of logistics transport trucks) We can thus describe the different possible cases taking into account these two axes in Figure 1:

	NO COLLABORATIVE LOGISTICS	COLLABORATIVE LOGISTICS
NORMAL VEHICLE (DIESEL GAS)	**CASE 1** : *the use of referential transports* the vehicle is using Diesel gas and is not mutualised	**CASE 3** : *the pooling of urban transport from a consolidation platform near the city center* The growth of activity in the city center, to which e-commerce and local distribution contribute, is generating more and more traffic, without necessarily optimizing the filling of the delivery vehicles. Pooling appears as an interesting solution to limit traffic in the city.
ALTERNATIVE MOTORIZED VEHICLE	**CASE 2** : *the use of alternative motor vehicles to ensure urban logistics* The alternative engines (NGV, hybrid, electric, ...) emit less particles and harmful gases locally and have a lower carbon impact than thermal vehicles. They therefore have significant benefits weighted by the lack of LCV offer with such engines on the market.	**CASE 4** : *the use of alternative motorized vehicles coupled with the mutualisation of transport* The coupling of the two solutions makes it possible to add the advantages provided by one and the other. Le couplage des deux solutions permettent d'additionner les avantages apportés par l'une et l'autre.

Figure 1: Four different cases of transport

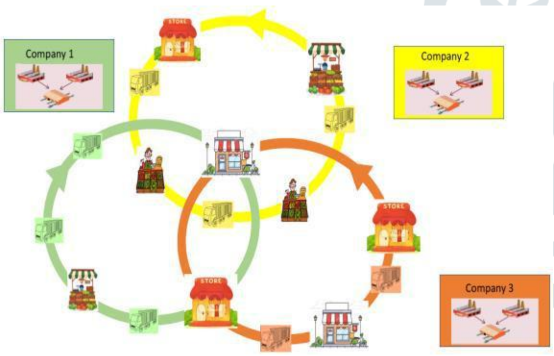


Figure 2: Use of Referential Transports

CASE 1 - The use of referential transports:
This is displayed in Figure 2.

- Vehicles are using diesel fuel

- Each company manages its logistics from its warehouses to the customers' shops.

CASE 2: the use of alternative motor vehicles Figure 3 displays this case.

- Companies are using alternative motorized vehicles
- Each company manage its logistics from its warehouses to the customers' shops.

CASE 3: The pooling of urban transport from a consolidation platform near a city Center
Figure 4 displays this case.
- Vehicles are using diesel fuel

CASE 4: The use of alternative motorized vehicles coupled with the collaborative transports
Figure 5 displays this case.
- Companies are using alternative motorized vehicles,
- Companies gather their product in one common warehouse and use the same vehicles to deliver them in the city.
- Companies gather their product in one common warehouse and use the same vehicles to deliver them in the city
A study carried out by the Ecole des Mines de Paris on pooling estimates that this reduces flows by 19% to 30%: the assumption used here is a rate of 23%.

The fluidity brought by the pooling of flows and the reduction of the vehicles has the virtuous effect of reducing consumption (a vehicle consumes about twice as much in traffic jams), and therefore, the emissions of thermal vehicles for a given distance. This effect was not taken into account due to lack of data.

To determine if the hypothesis is right, we will focus only on electric vehicles as the use of alternative motorized vehicles. The electric vehicle does not emit CO2 locally, but the electricity production in France emits the equivalent of 28g / km.

The electric vehicle does not emit noise: the associated cost is therefore zero.
According to the CGDD (Commissariat Général du

Développement Durable) and the Institut Technique de l'Agriculture Biologique sources, we can assume the different costs of the negative externalities:

Therefore, we can now apply these costs to the four different cases. We will calculate the cost of the negative externalities for an entire year and a city of 100 000 inhabitants. According to the INSEE data base, the cost of the different externalities are determined. This is displayed in Table 2.

Based on the results, it can be concluded that the urban logistics decreases the price of negative externalities. Although it can be difficult to deliver the products with electrical vehicles, it can be seen that the collaborative logistics decreases the price up to 23% (from 5,09 euros to 3,92 euros) of the negative externalities as displayed in Table 3.

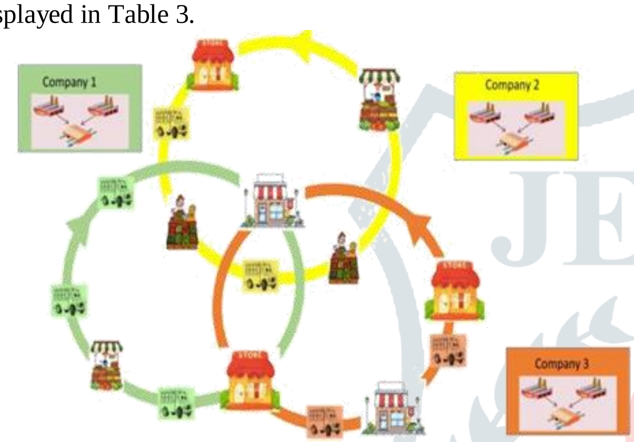


Figure 3: Case 2

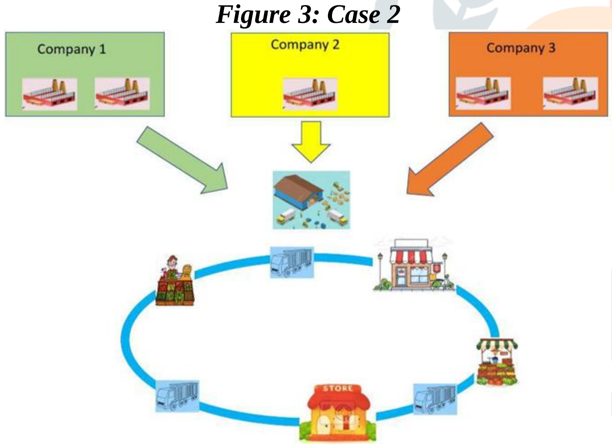


Figure 4: Case 3

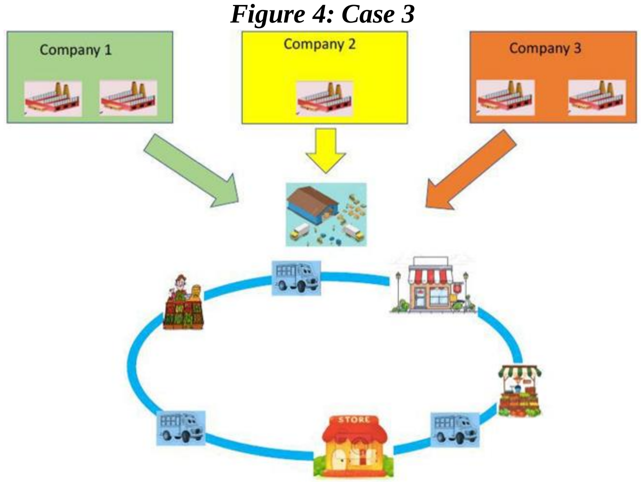


Figure 5: Case 4

Table 2: Negative externalities

DATA COLLECTION

Cost of the externalities		
CO2	€ 32,00	per ton
Nox	€ 0,01	per gram
PM10	€ 0,05	per gram
PM2.5	€ 0,15	per gram
NOISE IN URBAN ZONE	€ 0,01	per kilometer

Emission per kilometer	Diesel	Electric
CO2	500	28 gram
Nox	0,25	0 gram
PM10	0,012	0 gram
PM2.5	0,013	0 gram

Operations	8300	per day
	2075000	per year
Round	830	per day
	207500	per year

Table: cost of the negative externalities

V. CONCLUSION

The transport of goods in the city is a fundamental link between the economic actors of the city, and at the same time causes nuisances that impact on the quality of life of its inhabitants (pollution, traffic-related annoyances, etc.). This represents one of the major challenges to local authorities in terms of mobility.

While the regulatory levers have for a long time been privileged by the communities, they try today to widen their field of reflection and action to favour the creation of a high quality urban distribution, particularly with the environmental, creative value and jobs.

Urban logistics involves a multitude of actors and is highly complex. E-commerce, delivery at home or in relay points, the development of local services are accompanied by an increase in freight transport sometimes not optimized in terms of vehicle loading rates. The environmental footprint and congestion of cities are thus increased.

Decisions in the field of goods distribution should not be made to the detriment of commercial dynamism and the attractiveness of cities. The answers will therefore have to combine economic performance with environmental and societal performance.

Thus, the use of alternative motorized vehicles as well as the pooling of warehouses on the edge of the city would allow: In offering the best possible delivery service to businesses and individuals in acceptable economic conditions. Moreover, it will respond to new requirements and regulations related to Sustainable Development. Furthermore, it would optimize urban development patterns by integrating current and future freight mobility needs.

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Table 3: Negative externalities and associated costs

DIESEL	CO2	NOX	PM10	PM 2.5	NOISE IN URBAN ZONE
Distance per year	16 600 000	16 600 000	16 600 000	16 600 000	16 600 000
Total emission (in g)	8 300 000 000	4 150 000	199 200	215 800	
Total emission (in t)	8 300				
Price	€ 265 600,00	€ 31 955,00	€ 9 960,00	€ 2 589,60	€ 199 200,00

ELECTRIC	CO2	NOX	PM10	PM 2.5	NOISE IN URBAN ZONE
Distance per year	16 600 000,00	16 600 000,00	16 600 000,00	16 600 000,00	16 600 000,00
Total emission (in g)	464 800 000,00	-	-	-	-
Total emission (in t)	464,80	-	-	-	-
Price	€ 14 873,60	€ -	€ -	€ -	€ -

Price per case

	CASE 1	CASE 2
Vehicule use	The use of referential transports	The use of alternative motorized vehicles
CO2	265 600,00 €	14 873,60 €
NOX	31 955,00 €	- €
PM10	9 960,00 €	- €
PM 2.5	2 589,60 €	- €
NOISE IN URBAN ZONE	199 200,00 €	- €
TOTAL	509 304,60 €	14 873,60 €
TOTAL PER INHABITANT	5,09 €	0,15 €

CASE 3		
	The pooling of urban transport	
Warehouses	NON MUTUALISED	MUTUALISED
CO2	€ 265 600,00	€ 204 512,00
NOX	€ 31 955,00	€ 24 605,35
PM10	€ 9 960,00	€ 7 669,20
PM 2.5	€ 2 589,60	€ 1 993,99
NOISE IN URBAN ZONE	€ 199 200,00	€ 153 384,00
TOTAL	€ 509 304,60	€ 392 164,54
TOTAL PER INHABITANT	€ 5,09	€ 3,92

CASE 4				
	NON MUTUALISED		MUTUALISED	
VEHICULE USED	DIESEL	ELECTRIC	DIESEL	ELECTRIC
CO2	€ 265 600,00	€ 14 873,60	€ 204 512,00	€ 11 452,67
NOX	€ 31 955,00	€ -	€ 24 605,35	€ -
PM10	€ 9 960,00	€ -	€ 7 669,20	€ -
PM 2.5	€ 2 589,60	€ -	€ 1 993,99	€ -
NOISE IN URBAN ZONE	€ 199 200,00	€ -	€ 153 384,00	€ -
TOTAL	€ 509 304,60	€ 14 873,60	€ 392 164,54	€ 11 452,67
TOTAL PER INHABITANT	€ 5,09	€ 0,15	€ 3,92	€ 0,11