Logistics tightening for greener transport: a case study in the Paris region

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Introduction

Freight transport essential component of **urban logistics**, as demand for **manufactured goods** continues to **grow** in **densely populated areas**.

Faced with the **urgent need** for society to adapt to **climate change**, the issue of **sustainable transport** has become a priority.

The **last 20 years** have been marked by the **rise of *e-commerce***.

$\Rightarrow$ **Nuisances** in urban areas have increased: pollution, noise, congestion, accidents, etc.

Introduction

For **several decades**: noticeable **"sprawl" of logistics activity**.

Definition: *“the growth in the number of warehouses on the outskirts of large cities, particularly in peri-urban areas where densities are low, land is available and inexpensive, and plot sizes are large“.*

In many European and global conurbations: **platforms operated by parcel delivery companies** mainly located **on the outskirts of high-density areas**, where deliveries are **less concentrated**.

⇒ This **remoteness** increases the **distances travelled**, vehicle **fuel consumption** and **greenhouse gas emissions** for the **last mile**, the **final link** in the transport chain.

Introduction

However, **transport operations** are themselves **correlated with the flows** generated by the consumption needs of city dwellers.

⇒ The last mile **cannot be the only criterion considered**: the **origins of shipments** and **long-distance journeys** must also be taken into account.

Aim of this study: assess the **environmental** and **logistical relevance** of **relocating part of the parcel delivery activity** in the **city of Paris**.

Introduction

- Part 1: **theoretical framework** for the study based on **existing literature** about **logistics sprawl and logistics tightening**.
- Part 2: **methodology**, **case study** and **data used** for addressing the subject.
- Part 3: **logistics tightening simulation process** using this data and the **results obtained**.
- Part 4: **results** and **their consequences** on **optimization of freight transport**.

1) Theoretical framework and issues

Literature: **impact** of **deliveries** on **environmental sustainability well established**.

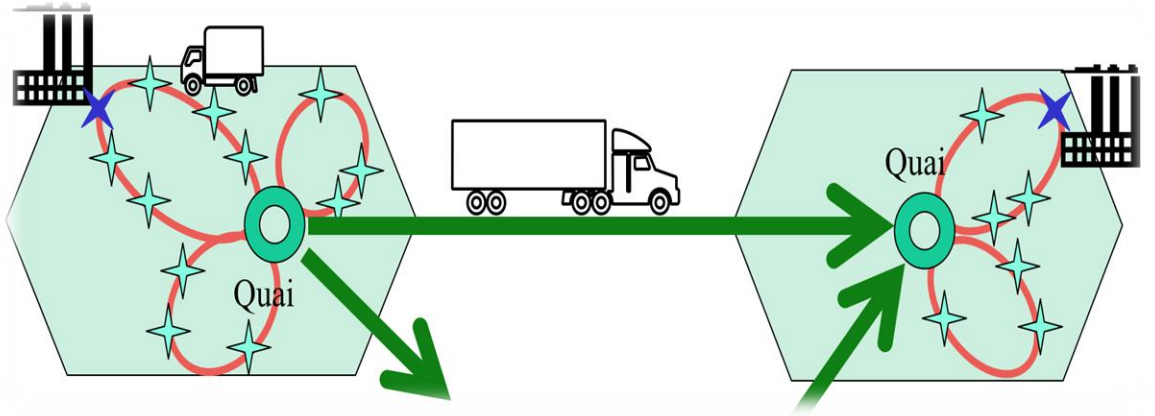
⇒ **Last mile most polluting** and **least efficient stage** of the supply chain.

Factors contributing to the **growth in CO_2 emissions** for the last mile:

- ❑rise of e-commerce;
- ❑large number of empty journeys;
- ❑difficulty in optimizing load capacity;
- ❑urban congestion;
- ❑failed deliveries;
- ❑etc.

1) Theoretical framework and issues

Courier services: activity of **transporting** and **delivering goods** weighing **less than 3 tons** within a **short time frame** (one to two days).



Step 1: goods **collected** from the **shippers** via a **round** with a **light commercial vehicle** ("first mile").

Step 2: goods **deposited** at a **nearby agency** and **sorted** with **other shipments** for **long-distance transport** with **large goods vehicles** to an **agency near** the **final destination** ("line-haul trip").

Step 3: goods **grouped with shipments** to be **distributed in the same geographical area** (municipality, district, neighborhood, etc.).

Step 4: goods **loaded onto** a **light commercial vehicle** making a **delivery round** during which they are **handed over** to their respective **recipients** ("last mile").

1) Theoretical framework and issues

Intuition: **greater proximity** between **logistics spaces** and **delivery areas improves** the **environmental performance** of the last mile.

Principle: bringing **hubs closer to city centers.**

⇒ Use of **low-emission** and relatively **inexpensive vehicles** (cargo bikes).

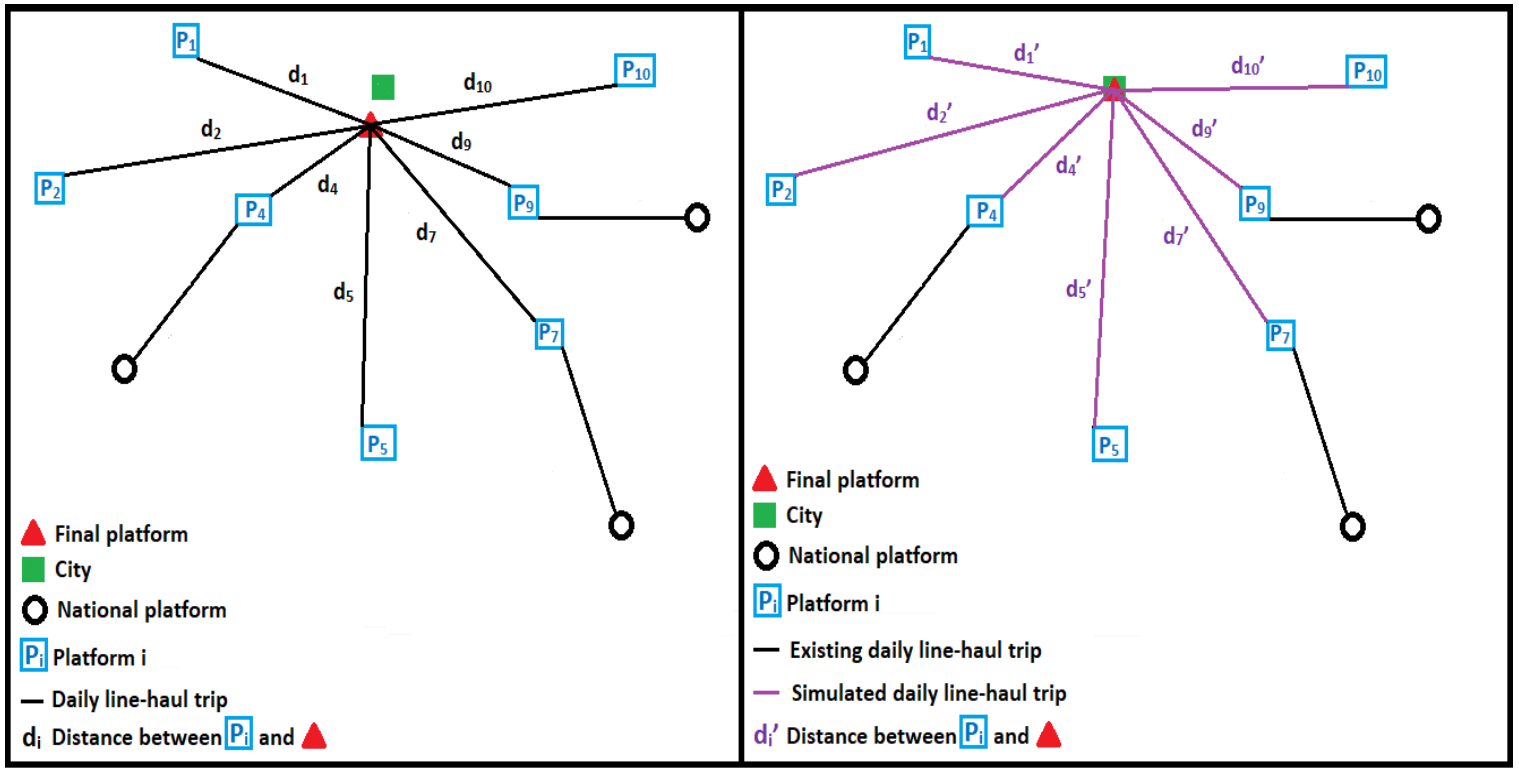
⇒ **Shorter distances** between platforms and recipients.

⇒ **Less polluting** and **less costly journeys** (empty returns).

1) Theoretical framework and issues

Main issue: **most scientific papers** deal with **logistics sprawl** and its **negative consequences on the last mile**, but **very few** with the **effects of the opposite phenomenon** on the **other links** of the transport chain.

⇒ Need of **comparison** between **actual scheme** and **logistics "tightening"**.



EXISTING SITUATION

SIMULATION LOGISTICS TIGHTENING

1) Theoretical framework and issues

⇒ **Research question**: is the **tightening** of **logistics activity** in **urban centers necessarily** a **sign of optimization** of the **transport chain**?

2) Methodology, case study and data

Objective 1: **compare** the **daily carbon footprint** of the **actual scheme** with that of the **logistics tightening scenario** by determining, for each day, the **sign** of **CO_2 emissions** from:

$$S = \sum_{i=1}^{n}(d'_i + q) + h' - (\sum_{i=1}^{n} d_i + h) = \sum_{i=1}^{n}(d'_i - d_i) + n \times q + h' - h$$

with:

- d'_i = **distance** between **platform** P_i and the **relocated terminal**;
- q = **distance** between the **relocated terminal** and the **actual terminal**;
- h' = **total distance** for the **last mile** in the **scenario**;
- d_i = **distance** between **platform** P_i and the **actual terminal**;
- h = **total distance** for the **last mile** in the **actual scheme**;
- n = **total number** of **direct connections** between the **actual terminal** and the **other platforms** in the network.

Objective 2: **evaluate** the **operational efficiency** of this **tightening** for **the carrier**.

2) Methodology, case study and data

Case study: DB SCHENKER and its activity in the **Paris region**.

Major company in the **courier sector**, both in **France** and **abroad**.

2020 France	Road transport hubs	73
	International line-haul trips	100
	Domestic line-haul trips	1,400
	Delivery rounds	**2,800**
	Average daily tonnage	**7,000**
	Parcels delivered per day	**180,000**

2) Methodology, case study and data

DB Schenker's deliveries in the Paris region:

- at the **arrondissement level** for Paris;
- at the **municipal level** for the rest of the region.

Each area **associated** with **one or more agencies**, often based on **geographical proximity** and **accessibility**. (Gennevilliers, Stains, Rungis, etc).

2) Methodology, case study and data

Data: **files provided by *DB Schenker*** listing **all deliveries in Île-de-France** for **January** and **February 2018**.

One file = one specific department of the region.

One observation = **one "shipment"**, i.e. a **quantity of goods** carried by the courier from a **shipper** to a given **recipient**.

2) Methodology, case study and data

Last file: information on **daily connections** to the **Rungis terminal** for a **full week** in the **first quarter of 2022**.

Table 3. Examples of journeys to Rungis.

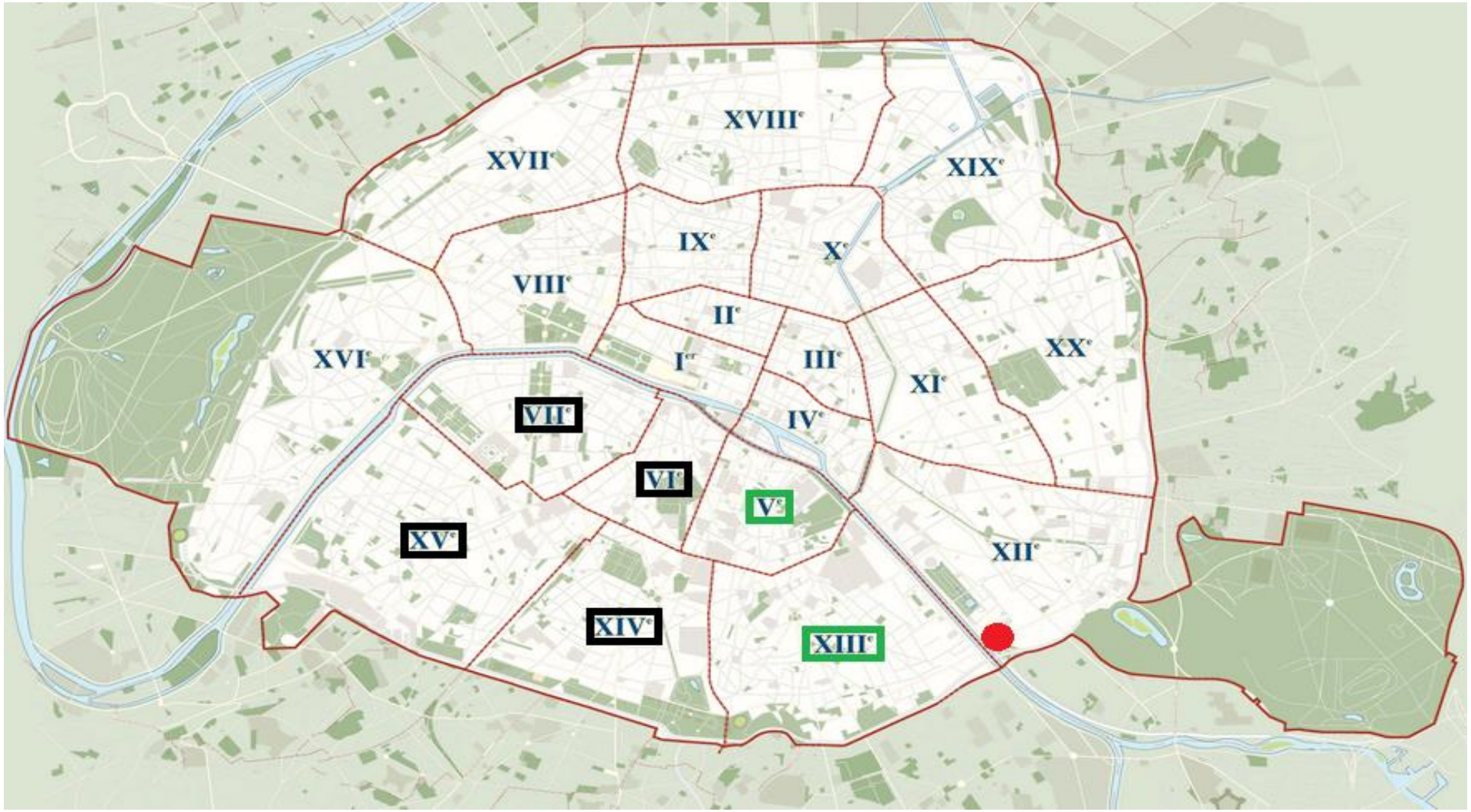
Journey ID	Arrival platform	Departure day	Departure time	Arrival day	Arrival time	Road distance
5	Rungis	Tuesday	H_5	Wednesday	H_5 +5h50	>300km
7	Rungis	Tuesday	H_7	Wednesday	H_7 +6h45	>400km

Source: *DB Schenker*.

One line = one direct route between **the departure platform and Rungis.**

Each route: day/time of departure, day/time of arrival and **road distance**.

3) Simulation of logistics tightening based on real courier data



3) Simulation of logistics tightening based on real courier data

Situation	Logistics space	Location	Areas delivered	Decarbonized rounds
Actual scheme	DB SCHENKER *Rungis*	Rungis	Paris 5, Paris 6, Paris 7, Paris 13, Paris 14, Paris 15	None
Scenario - Config.1	**SOGARIS *Quai Bercy***	**Paris 12**		**Paris 5, Paris 13**
Scenario - Config.2				
Scenario - Config.2a				
Scenario - Config.2b				
Scenario - Config.2c				
Scenario - Config.3				
Scenario - Config.4				

Situation	Vehicles used for the steps before the last mile	Vehicles used for the last mile	Fuel type
Actual scheme	40T semi-trailers	Light commercial vehicles (LCV)	Natural gas for vehicles (NGV)
Scenario - Config.1	**19T trucks**	**Cargo bikes and LCVs**	**Electric (bikes) + NGV (LCVs)**
Scenario - Config.2	**40T semi-trailers**		
Scenario - Config.2a	**40T semi-trailers + 19T trucks**		
Scenario - Config.2b	**40T semi-trailers + 19T trucks**		
Scenario - Config.2c	**40T semi-trailers + 16/19T truck**		
Scenario - Config.3	**40T semi-trailers + LCVs 3.5T**		
Scenario - Config.4	**Road trains [19T truck + trailer 19T]**		

3) Simulation of logistics tightening based on real courier data

Table 10. Simulation results.

Scenario	CO_2 emissions differential in kg[1]	Massified and pooled flows for long distances	Greener last mile[2]	Daily environmental balance[3]	Daily operational efficiency[3]
Configuration 1	≥ +3245*	✗	✓	Unfavourable	Unfavourable
Configuration 2	[+369,+425]	✓	✓	Unfavourable	Unfavourable
Configuration 2a	[+304,+350]	✓	✓	Unfavourable	Unfavourable
Configuration 2b	≤ +52	✓	✓	Favourable	Unfavourable
Configuration 2c	≤ +93	✓	✓	Favourable	Unfavourable
Configuration 3	≤ +88	✓	✓	Favourable	Unfavourable
Configuration 4	[+304,+350]	✓	✓	Unfavourable	Unfavourable

(1) compared to the existing situation, last mile not included.

(2) compared to the existing situation.

(3) compared to the existing situation, last mile included.

4) Discussion

Constraints inherent in logistics tightening **offset** a less polluting last mile:

- ❑from an **ecological** point of view for some of the configurations studied;
- ❑from an **operational** perspective for each configuration.

⇒ Such a **contradiction** is **not surprising**, as an in-depth analysis of the **transport chain** shows **how interconnected its links are**.

⇒ Anything that **affects one link** will de facto **have an impact on the others**.

⇒ The **empirical results** of this study clearly **strengthen** such a notion.

4) Discussion

Emissions more sensitive to **consumption** than to **distance**.

⇒ The **increase** in **daily long-distances** covered by **heavy trucks** is **not a problem** regarding **the second parameter**.

Key factor: **bulk flows** => **greater loading capacity** => vehicles equipped with **more powerful engines** => **higher consumption** => **more CO_2 emitted**.

⇒ **4 out of 7** configurations: **critical number** of **heavy vehicles** used to **reach the final space** within Paris.

4) Discussion

DB Schenker's **virtuous initiatives**: use of **urban logistics facilities** and **cargo bikes** for inner deliveries, part of the fleet **electrified**, etc.

Problem: **balance** between **economic feasibility** and **operational efficiency**.

Not all companies have **the same weight** in the market.

Subcontracting extremely **common** in the courier sector: *DB Schenker*'s deliveries in the Paris region are **mainly entrusted to "little" third-party carriers** that **can't afford replacing their current fleet**.

4) Discussion

For *DB Schenker*:

- ❑recent acquisition of *Les Triporteurs Français*;
- ❑purchase of 16/19t electric trucks.

Instead of a full fleet of "green" light commercial vehicles that would make deliveries **directly from regional platforms** (Rungis).

⇒ Transport chain suffering from the **addition of an extra link** compared to the usual scheme.

⇒ **Freight becomes more difficult to optimize.**

4) Discussion

Last point: courier service relies on the **massification and pooling of flows**.

⇒ The Rungis terminal **cannot be relocated for its entire operation** due to the **cross-docking characteristic of *DB Schenker*'s activity**.

In the Paris region, **collection rounds** take place in **areas with high industrial density**. This density **decreases** as one **gets closer** to the **heart of the capital**.

Conclusion

Logistics tightening makes sense in terms of **reducing pollutant emissions** for the **last mile**.

But **financial**, **technical** and **logistical constraints** underlying its implementation:

- ❑ increased need for optimization;
- ❑ flexibility requirements;
- ❑ massification and pooling more complex;
- ❑ additional journeys;
- ❑ offloading;
- ❑ limited loading capacity for carbon-free delivery routes;
- ❑ more handling operations;
- ❑ tighter deadlines;
- ❑ heavy vehicles being immobilized for longer periods.
- ❑ etc.

Conclusion

⇒ **Environmental benefits offset** by significant **operational costs**, leading, at best, to a **zero-sum game** for the various players involved.

Solutions exist to **consolidate urban logistics**, but the **courier business** is subject to an **optimization logic** based on a **set of parameters**.

From a **theoretical** perspective: need to **study the transport chain as a whole** and **not to isolate its link**.

From a **practical** point of view: reflection on approaches to **public policy**.

Conclusion

Limits:

- findings of this research relate to a **specific region** and a **specific company**.
- **operational data** not only **difficult to obtain** but generally **not designed** for this type of analysis.

Avenues for improvement: **new case studies** to deepen the understanding of the phenomenon.

Thank you!