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INTERNATIONAL GROUP FOR LEAN CONSTRUCTION
DUBLIN | IRELAND | 1ST - 7TH JULY 2019

Economics of using a third party logistics provider for a renovation housing project

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Summary

1. **Research Context: Construction logistics**

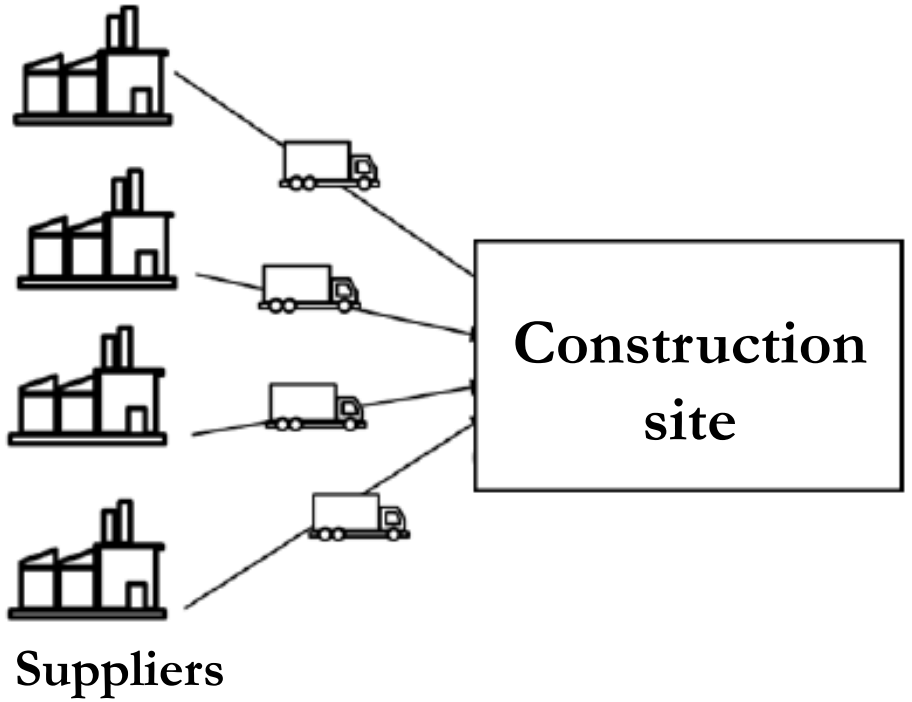
2. **Research objective:** To measure the underlying costs of using a distribution center

3. **Case study presentation:** action research

4. **Results and discussion**
   - 4.1. Measure the economics of using the distribution center
   - 4.2. Logistics budget caluculation
   - 4.3. Generalization of other similar types of projects

5. **Conclusion & perspectives**

How logistics are managed today ?



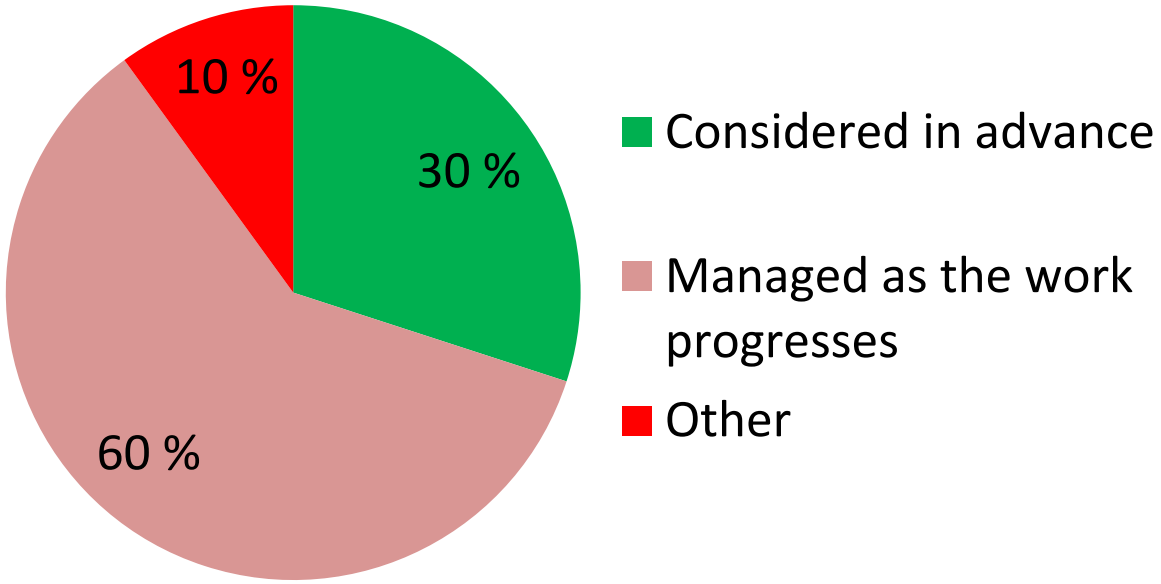
The classic model of delivery on construction site

Problems of the current model

- Delivery in **large quantities**
- Storage **on site**
- Difficulty tracking product **inventory**
- **Defective products** identified during installation.

What construction managers think of logistics?

Do you consider the storage question to be…

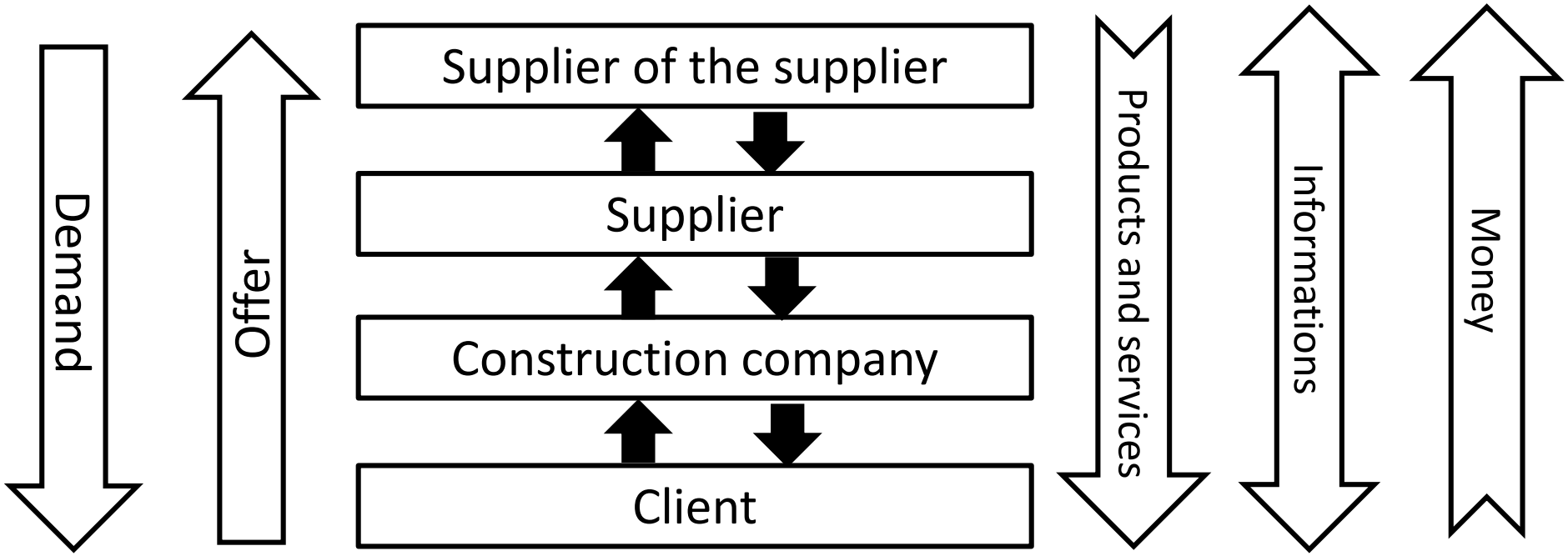


Dakhli, Z., & Lafhaj, Z. (2018)

Also, construction managers do not consider **logistics as their primarly concern.**

Is it true?

Construction as a production process ?



Construction is a type of supply chain

Koskela, 1992

Advances on Construction logistics

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A New Perspective of Construction Logistics and Production Control: An Exploratory Study,
Malek Ghanem, Farook Hamzeh, Olli Seppänen & Emile Zankoul, 2018

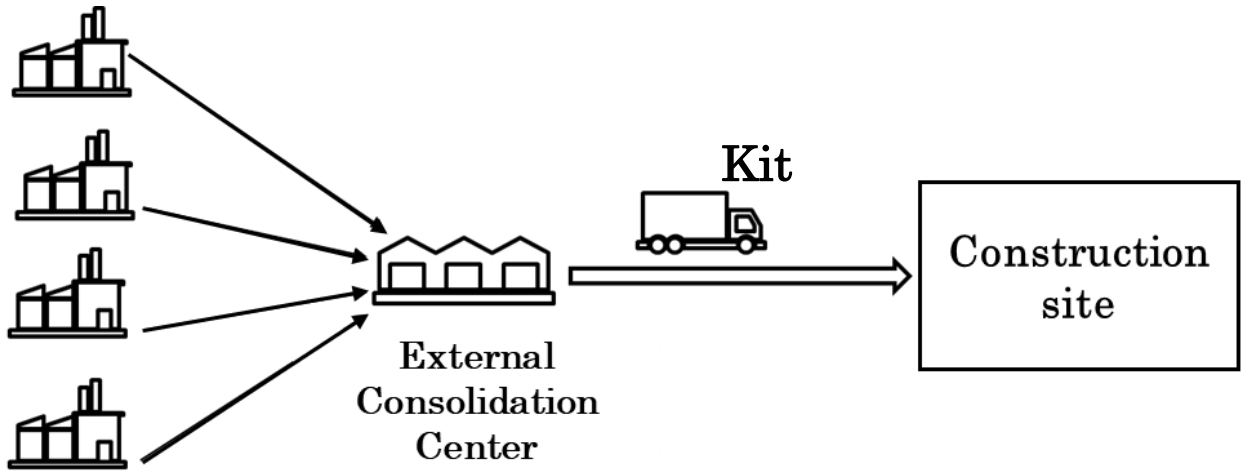
Supply Chain Management in Construction From a Production Theory Perspective,
Rafaella D. Broft & Lauri Koskela, 2018

Key Performance Indicator for Managing Construction Logistics Performance,
Fei Ying & John Tookey, 2017

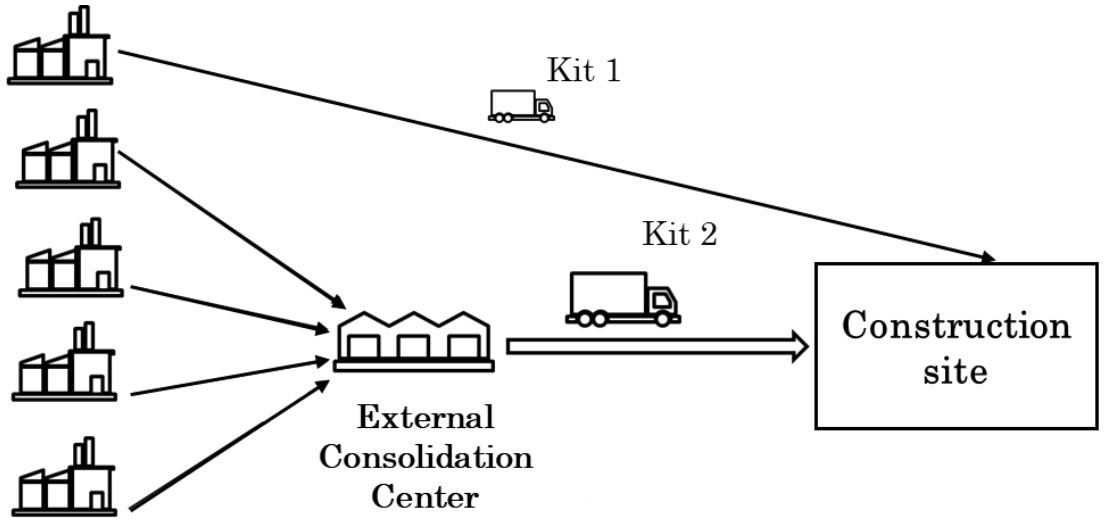
A New Model for Construction Material Logistics: From Local Optimization of Logistics Towards Global Optimization of on-Site Production System,
Olli Seppänen & Antti Peltokorpi, 2016

The Lean construction community really helped advance the research on construction logistics.

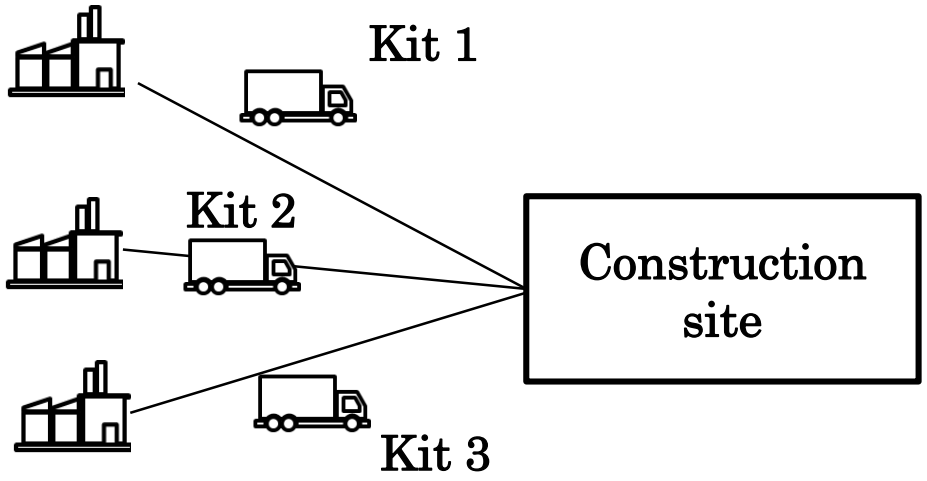
Construction logistics models



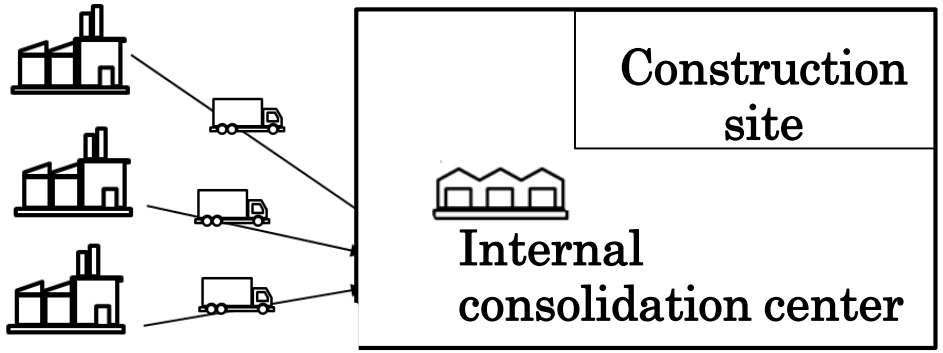
1. Model with an external consolidation center



2. Model with an ECC and direct kitting



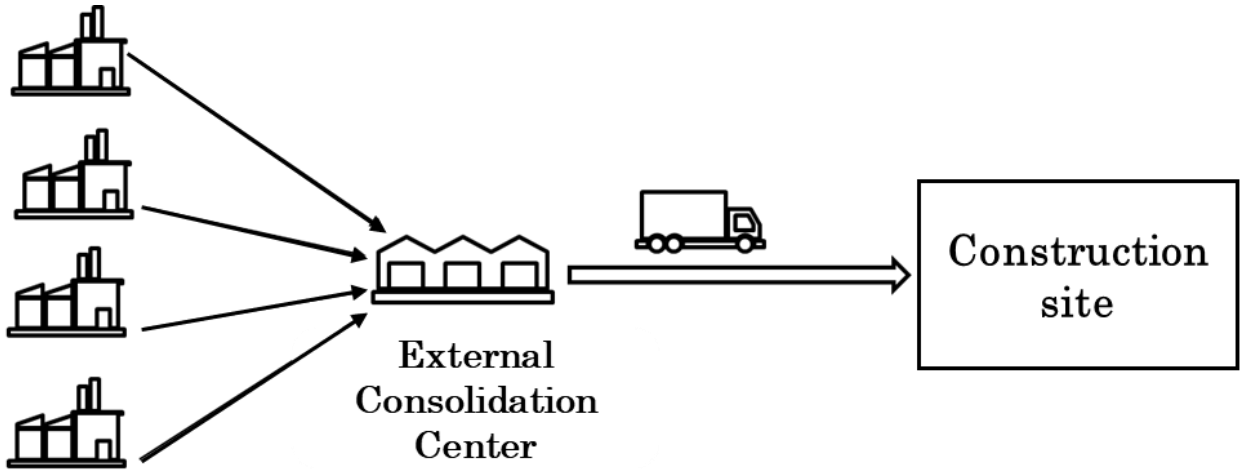
3. Direct Kitting without ECC



4. Internal consolidation center

Research objective

To measure the economics of using a distribution center to manage construction logistics



Intermediary results: Logistics budget calculation
Generalization

Case study

The case study is a renovation project in an occupied environment of a former mining city with **184 housing units.**

Case study = Project **Lens 184**
This project used a **distribution center**

The pin point

This operation is **a follow up of a previous similar operation** (similar types of housing) in the **same district** that renovated 95 houses and was launched few years ago **by the same general contractor.**

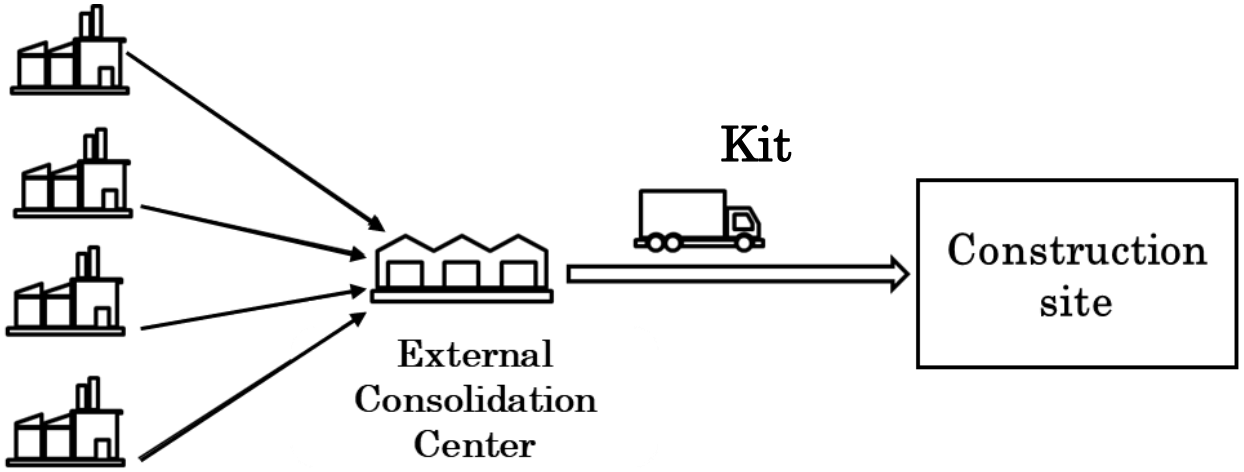
Base for comparaison = Project **Lens 95**
This project used a **"classic logistics"**

Case study

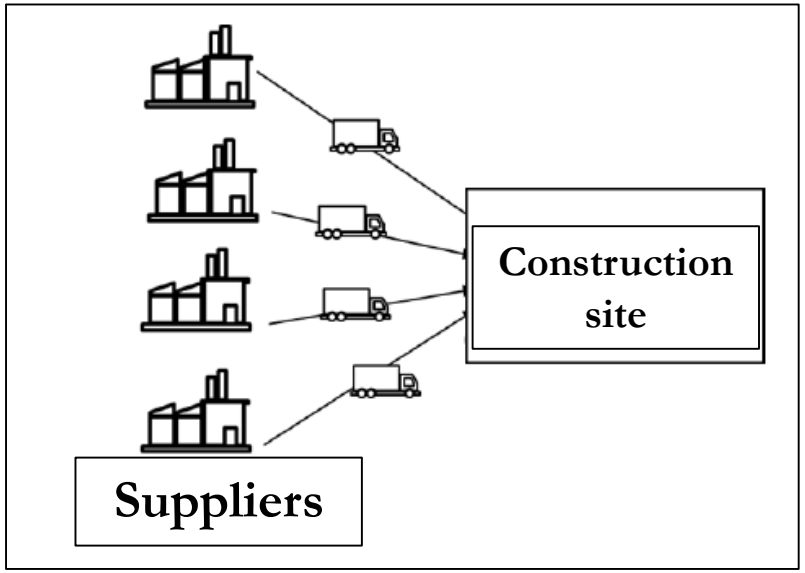
To sum up:

Same conditions for comparaison

Case study = Project **Lens 184**
This operation used a **distribution center**



Base for comparaison = Project **Lens 95**
This operation used a **"classic logistics"**



Case study

Work repartition for the case study project Lens 184

Table. Work repartition

Contracted work	Sub-contracted work
Border tiles. electric switchboards.	building curage (structural cleaning)
Floors	Roofing and house covering
Sanitation	Asbestos disposal
External woodworks, windows	Coatings, painting
Plastering work (50%)	Plastering work (50%)
Plumbing	Floor coverings
Doors, Interior joinery	Electricity, gas

Trades subjected to the distribution center

Trades **NOT** subjected to the distribution center

Case study

PLANNING AND LABOUR MANAGEMENT

Average number of employees: 22 workers for the general contractor and 80 in total.

Typical work cycle:

- 20 houses at the same time.
- **Delivery of 3 units (houses) per week.**
- The work is realized in a 8 to 10-week timeframe.

DISTRIBUTION CENTER

- Buffer stock (Distribution centre) 10 minutes from the site.
- Delivery frequency : Monday-Wednesday-Thursday.
- Delivery on site (Just-in-time).
- Order preparation time: 3 hours.

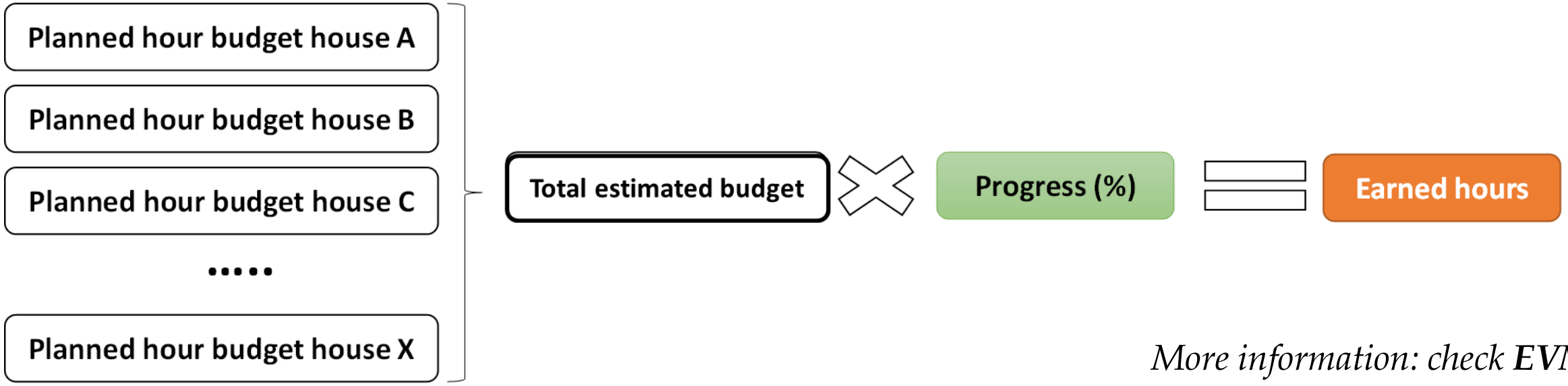
Storage at the distribution center

Case study

BUDGET FORMULATION

Project expenses are analysed in terms of **person.hours**

Can easily be converted into euros if necessary using an **average hourly rate.**



*More information: check **EVM***

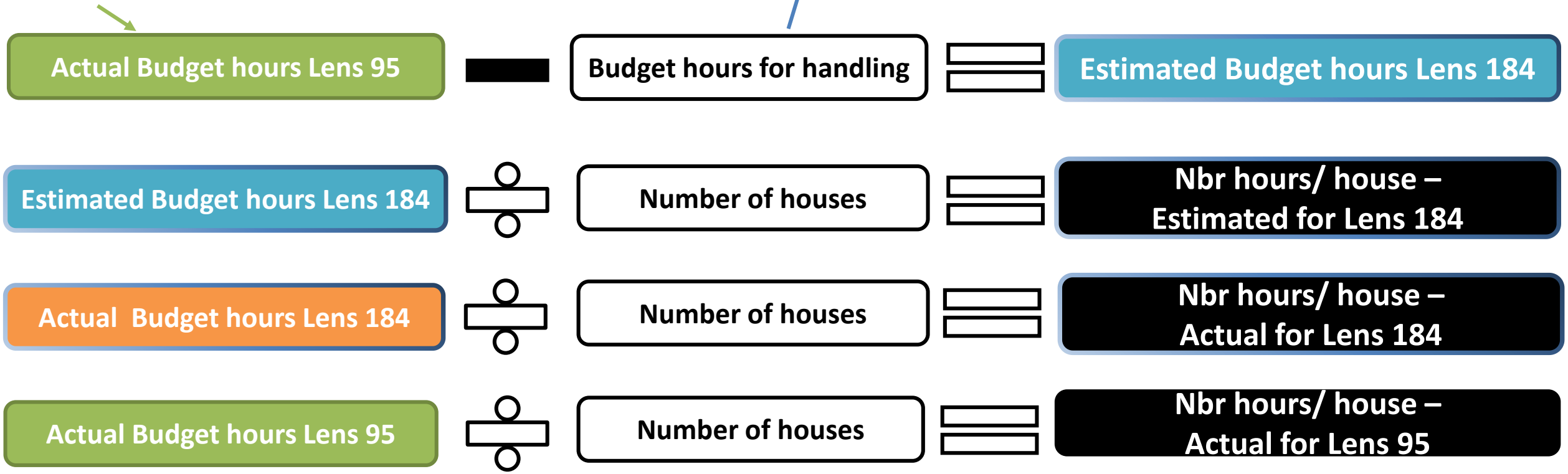
Results & Discussion

Estimated Person.hours (budget) for project Lens 184

The use of the previous project (actual hour Lens 95) to **calculate the estimation Person.hour budget** for the current project Lens 184.

Base comparaison project

Chrono-analysis sheets



Results & Discussion

Macro-analysis

Base comparaison project

Nbr hours/ house – Lens 95 Actual for Lens 95	=	279 hrs / house
Nbr hours/ house – Estimated for Lens 184	=	259 hrs / house
Nbr hours/ house – Actual for Lens 184	=	238 hrs / house

** All trades included*

Results & Discussion

Detailed analysis by trade:

Trades using the distribution center

Tasks	Ratios (Hour /house)		
	Base reference Lens 95	Estimated ratio Lens 184	Actual ratio Lens 184
Supervision	17,12	8,63	14,17
Sanitation	15,50	15,50	11,37
Houris floors	12,31	12,31	7,12
Restructuring	4,10	4,10	0,00
Masonry	3,37	3,37	2,33
Listels	15,54	15,14	18,44
Windows installation	23,36	19,48	24,97
Plumbing	45,10	43,56	48,26
Interior joinery	57,54	57,14	40,63
Plasterwork	77,34	72,26	61,32
Serrurerie	6,01	6,01	0,00
Finitions	6,08	6,08	9,30

Results & Discussion

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Detailed analysis:

Considering only trades subjected to the distribution center

Trades subjected to the distribution center's logistics
Border tiles. electric switchboards.
Floors
Sanitation
External woodworks, windows
Plastering work (50%)
Plumbing
Doors, Interior joinery

Nbr hours/ house – Lens 95 Actual for Lens 95 = **219 hrs / house**

Nbr hours/ house – Estimated for Lens 184 = **208 hrs / house**

Nbr hours/ house – Actual for Lens 184 = **194 hrs / house**

Results & Discussion

Logistics budget calculation

Deducing the logistics budget of the operation (implicitely induced in the trades budget):

For that, we use the **« actual » numbers** of the two projects:

Base comparaison project

Nbr hours/ house – Actual for Lens 95 − **Nbr hours/ house – Actual for Lens 184** = **Logistics budget (h)**

Logistics budget (h) × **Hourly rate** = **Logistics budget (€)**

Logistics budget (€) × **Nbr of houses = 184** = **145 k€**

Results & Discussion

Profitability of using a distribution center

Nbr hours/ house – Estimated for Lens 184	−	Nbr hours/ house – Actual for Lens 184	=	Logistics gain (h)
Logistics gain (€)	×	Hourly rate	=	Logistics gain (€)
Logistics gain (€)			=	80 k€

Let's compare this gain with what we actually paid for the service:

Invoice distribution center	=	88 k €

Budget estimation for the logistics service was quite good given the benefits

Results & Discussion

How to generalize the results and come up with a practical indicator for future operations?

Number of hours/ house → The construction manager measures the progress using the number of houses realized and the resources spent in hours

This indicator is **incomplete** to use it for other renovation operations

Even if supply chain dynamics of this kind of operations are quite similar, **the concept of "house"** is fundamentally too generic.

Number of hours/ house → **Nbr of hours/ type**

Create typologies of houses

Results & Discussion

Number of hours/ house → **Nbr of hours/ type**

We Proposed to establish **three categories of houses according to their size**. More specifically, the total floor area of the house.

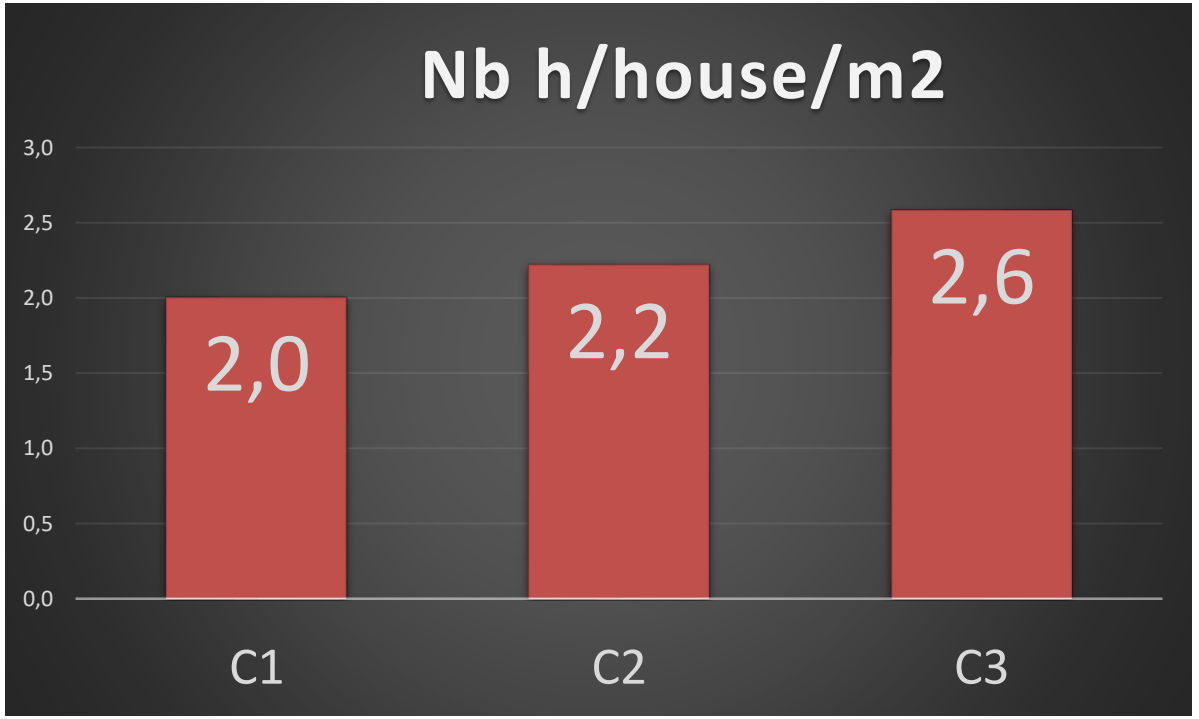
It is an easily measurable criterion when designing /bidding for other similar operations and is a good indicator of the total volume /size of the house.

In addition, to be able to generalize the indicator, we, of course, **considered the trades common to this type of operations, and subjected to the distribution center**

Number of hours/ house → **Nbr of hours/ type** → **Nbr of hours/ type/m^2**

Results & Discussion

Type of houses (case study)	Average floor area (m2)	Area range (m2)	Categories (for generalization)
A	99	90 - 110	C1
B	80	70 - 90	C2
C	64	50 - 70	C3



Average : 2.3 h/ m^2

Logistics budget (€)	=	145 k€
Maximum logistics budget	=	3,5 €/ m^2

Conclusion & perspectives

- Logistics are an inherent part of the construction manager's job.
- The need to develop framework, tools for construction logistics.
- The first step to convince Managers of the potential provided by logistics configuration is to assess the benefits in terms of cost.

Case study - action research: housing operation

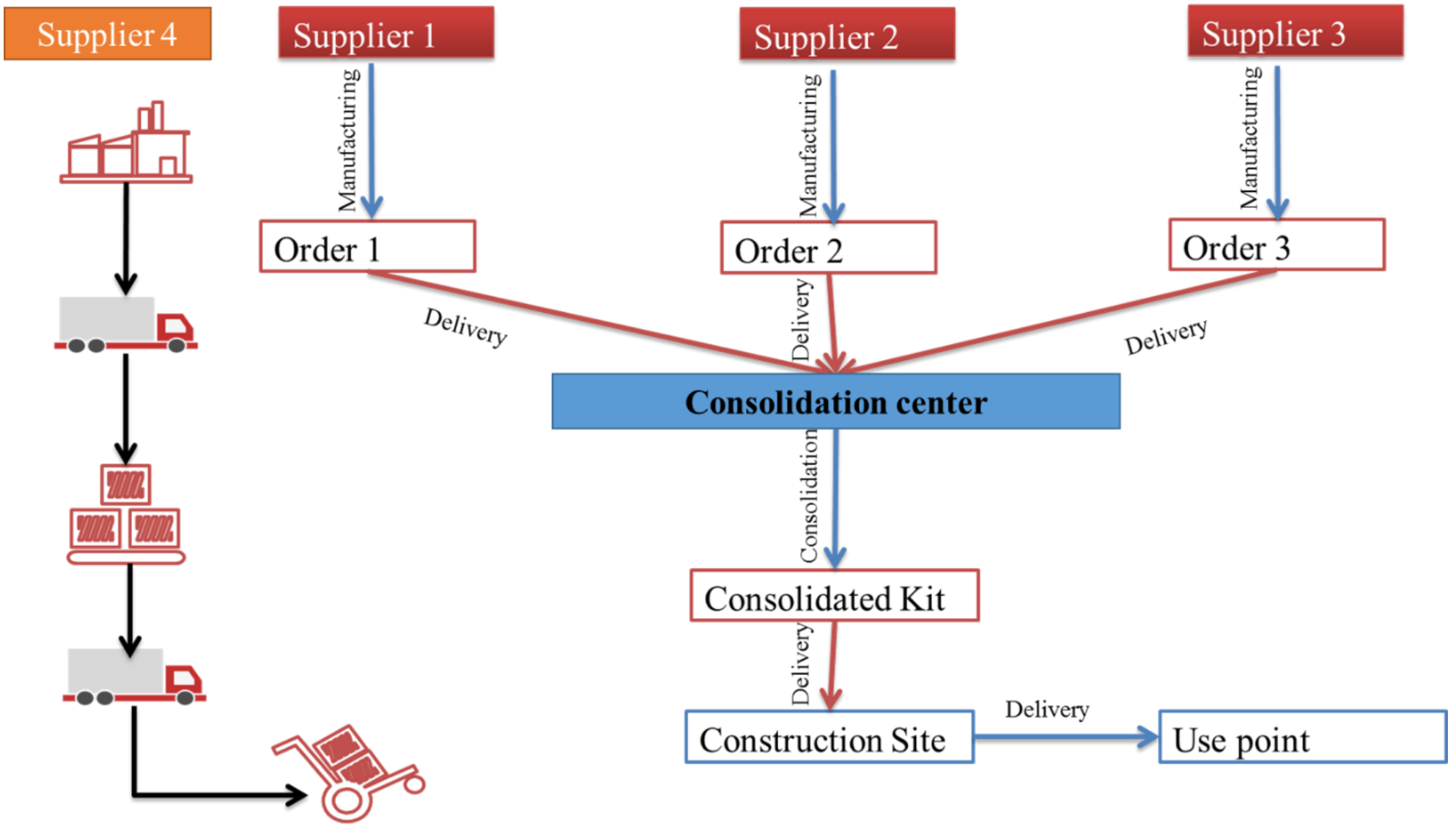
279 hrs / house	259 hrs / house	238 hrs / house

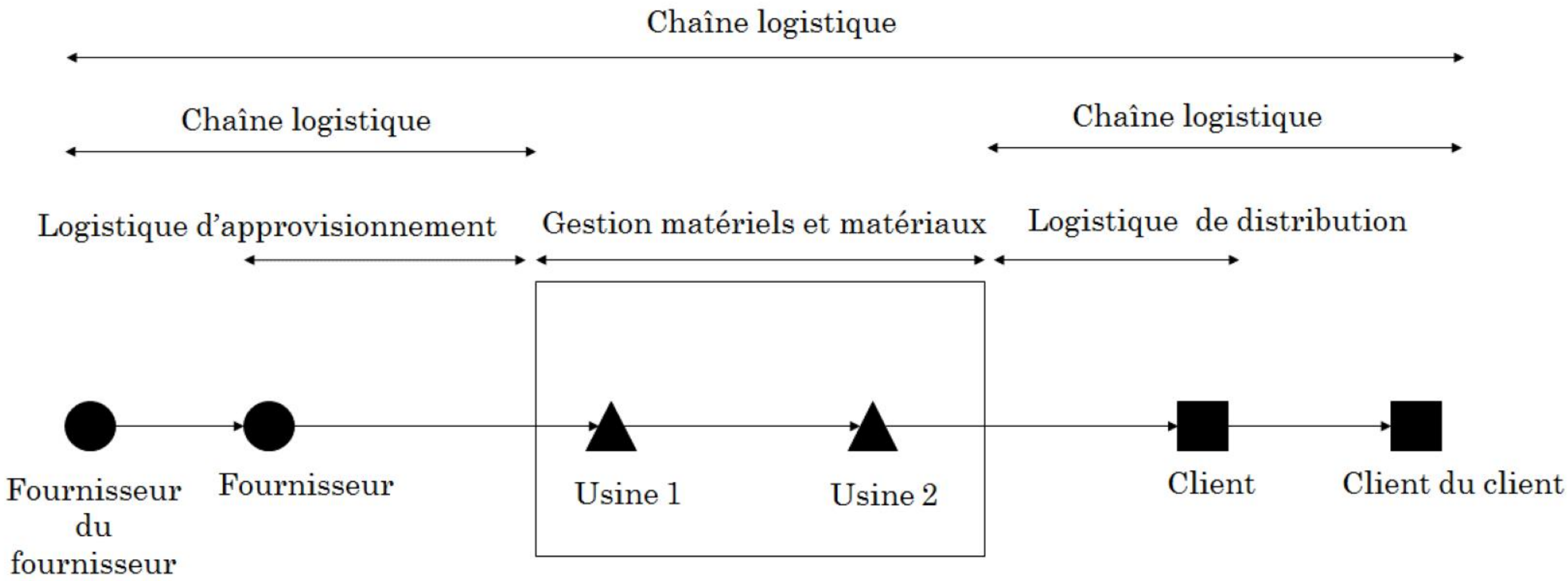
Logistics budget (€)	=	145 k€
Logistics gain (€)	=	80 k€

Generalization: 3 typologies of houses according to a range of floor area: **Average : 2.3 h/ m^2**

Maximum logistics budget	=	3,5 €/ m^2

Thank you


Supplier 4
Supplier 1
Supplier 2
Supplier 3
Manufacturing
Manufacturing
Manufacturing
Order 1
Order 2
Order 3
Delivery
Delivery
Delivery
Consolidation center
Consolidation
Consolidated Kit
Delivery
Construction Site
Delivery
Use point


Chaîne logistique
Chaîne logistique
Chaîne logistique
Logistique d'approvisionnement
Gestion matériels et matériaux
Logistique de distribution
Fournisseur du fournisseur
Fournisseur
Usine 1
Usine 2
Client
Client du client

Effect of good logistics on the income

Assumptions = good logistics results in materials savings, (labor hour savings not considered here)

(illustrative example)

	Percentage of cost reduction in materials			
	Reference	5%	10%	15%
Revenue (k€)	1 000	1 000	1 000	1 000
Materials (k€)	390	371	351	332
Labor (k€)	275	275	275	275
Gross Margin (k€)	335	354	374	396
Operating expenses (k€)	200	200	200	200
Net income (before taxes) (k€)	135	154	174	193
% improvement		14%	29%	43%

Results & Discussion

ABC ranking – Actual hours spent

Tasks	Type	Total hours spent (%)	Expense class
Plasterwork	Plasterwork	31	A
Plumbing	Plumbing	50	A
Interior joinery	Interior carpentry	64	A
Windows installation	Exterior carpentry	74	B
Listels	Structural work	82	B
Sanitations	Structural work	88	B
Supervision	Structural work	93	C
Finitions	Finitions	96	C
Floors	Structural work	99	C
Masonry	Structural work	100	C
Restructuring	Structural work	100	C
Locksmithing	Locksmithing	100	C

ABC ranking– Estimated hours spent

Tasks	Type	Total hours spent (%)	Expense class
Plasterwork	Plasterwork	27	A
Plumbing	Plumbing	49	A
Interior joinery	Interior carpentry	66	A
Windows installation	Exterior carpentry	73	B

Validation of the estimated budget for the project lens 184