Europe in my region/city.

A urban consolidation center for L’Hospitalet de Llobregat

Plans de millora de la qualitat de l’aire. Mesures i experiències

Centre d’Innovació del Transport, CENIT
Miquel À. Estrada Romeu
Mireia Roca-Riu

Setmana europea de les regions i ciutats
Barcelona, 31 d’Octubre de 2013
Significant mileage and pollution associated to the freight transport sector in cities. Barcelona (2008):
- 18% of the total distance travelled
- 36.9% of the total amount of CO₂ produced by transport sector.

Cities are continuously congested and not prepared for handling freight shipments
Passenger VS. freight network planning and operation →
Regulations, coercitive measures….

Freight distribution: it is a need for maintaining the economic activity of the city…
but it really bothers several stakeholders

Emissions caused by the Distribution fleet:
\[ E(v) = \sum F_E(v)_{(i,j)} \cdot \text{veh-km} \ (i,j) \]

TREND?
L’Hospitalet de Llobregat (I)

• L’Hospitalet suffers from the common problems of urban distribution
  
  ▪ High operation costs and delays in last-mile delivery
  ▪ Commercial opening hours tightens distribution network affecting punctuality and reliability
  ▪ High number of commercial vehicles entering the city, congestion and indirect effects. In emissions, at the maximum limit (ICAEN, 2010)
  ▪ Illegal parking in unloading.

### Energy Consumption and CO₂ Equivalents

<table>
<thead>
<tr>
<th></th>
<th>kWh</th>
<th>Tn CO₂ Eq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Tertiary</td>
<td>17%</td>
<td>22%</td>
</tr>
<tr>
<td>Public Services</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Transport</td>
<td>41%</td>
<td>35%</td>
</tr>
<tr>
<td>Housing</td>
<td>26%</td>
<td>25%</td>
</tr>
</tbody>
</table>

### Annual movements of goods

<table>
<thead>
<tr>
<th></th>
<th>To/ From demo site</th>
<th>Within demo site</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 vehicle kilometres</td>
<td>618,781</td>
<td>148,101</td>
<td>766,882</td>
</tr>
<tr>
<td>1000 truck movements (trips)</td>
<td>553</td>
<td>224</td>
<td>777</td>
</tr>
<tr>
<td>1000 passenger km</td>
<td>599,698</td>
<td>120,136</td>
<td>719,834</td>
</tr>
<tr>
<td>1000 tonne km</td>
<td>706,755</td>
<td>24,798</td>
<td>731,554</td>
</tr>
</tbody>
</table>
Municipality:
- Area 12 km²
- Population 258,000 hab
- Density 21,000 hab/km²

Stores by type:
- Others: 36%
- Household equipment: 7%
- Personal equipment: 9%
- Restaurant Industry: 19%
- Leisure & Culture: 17%
- Daily food: 7%
- Daily non-food: 5%

Land uses:
- Residential: 28.9%
- Tertiary: 13.4%
- Green Areas / Equipment: 24.5%
- Industry: 32.2%
- Infrastructures: 1.0%
Demonstration Overview

Demonstration Concept. Basic Idea

“Consolidate flows in terminals (UCC) before urban distribution in order to improve the efficiency of last mile network”

Operational objectives:
- Increase vehicle load factor
- Reduce the number of freight vehicles entering the area
- Maintain the level of service for retailers

Stakeholders involved:
- Interurban Carrier
- Urban Carrier
- Other shippers
- UCC manager
- Goods Receivers
- City Council
- Residents

Operation of vehicles in zero emission zones
Optimization of terminals
New regulatory solutions
Urban Distr. to reduce impact on residents

Decoupling supply lines and distribution
Collaboration between stakeholders
Demonstration Overview

Demonstration Concept. Past experiences (I)

Current Scenario:
- carriers
- Downtown

Proposed Solutions:
- A)
- B)

Kassel: -60% mileage, -13% frequency, +15% weight/stops
Freiburg: -33% trips, -48% time
Fukuoka (Japan) since 1977: 36 companies. 100,000 shipments/month (1/3 total)
Área Metropolitana BCN: Distrust, but pharmaceutical sector does it
Demonstration Concept. Past experiences (II)

- **France. ELCIDIS La Rochelle:**
  - 84,000 inhabitants with difficult access in the city center
  - Municipal subsidy of 26% of the operational costs (4 €/shipment) & 40% of construction costs from EU.
  - 300-400 shipments/day from 12 companies, less than 600 forecasted
  - Initially (2001) municipal vehicles
  - Immediate future: Operator will be responsible also for electric minibuses, car-sharing and urban goods distribution

- **Monaco:**
  - Municipal subsidy of 21% of costs (4€/shipment)
  - Concession to a one private company

- **DHL Experiences:**
  - **Bristol.** Public-private partnership. 604m², located at 16km from the city center. 72% trip reduction.
  - **Heathrow Airport.** 40% of retailers participating, potential savings in both supply chain and staff costs
Demonstration Concept. Critical points of past experiences

Critical Points

- Coercitive measures
- Financial Issues
- Lack of Demand Consolidation

Proposed Alternatives

- Collaborative solutions
- Private-Public Partnership
- Business model solution
- Hybrid Concept UCC
Hybrid Concept UCC. Big demand Attractor

Commercial Mall (Gran Via 2)

Local Retailer

Supplier vehicles do not access the city center
Demonstration Overview

Demonstration Concept. Hybrid Concept (II)

Hybrid Concept UCC. Multiple Supply Chains Managed Individually

Local different sized retailers

Supply chain 1
Supply chain 2
Supply chain N

Supplier 1
Supplier 2
Supplier N

Surrounding platforms

UCC (DHL)

City Council

Surrounding platforms

City Council
Demonstration Overview

Demonstration Design. Diagnosis

Retail’s survey (Jan-Feb’12). 504 stores

- General Common Questions. Shop features
- Types of shipment reception
- Features of the shipment
  - Frequency, dimensions, volume/weight, preferences
- Other issues or suggestions

Reception frequency per store type

Food & Restauration → everyday

Personal & House → Once/twice
Demonstration Overview

Demonstration Design. Enrolment of stores

• Enrolment of stores
  ▶ Selection of potential stores
  ▶ Interviews small retailers 70 (10 signed the agreement)
  ▶ Involvement of Gran Via 2 (Carrefour)
  ▶ Last action: Some DHL customers consolidation

• Benefits/motivation
  ▶ Advertisement in local media
  ▶ Sticker environment responsibility
  ▶ Social responsibility

• Performance
  ▶ Retailers sign a collaboration agreement
  ▶ Retailers change the delivery address to the UCC
  ▶ DHL serves from UCC to Gran Via 2 and local retailers
Demonstration Overview

Demonstration Studies. LSA Methodology

Analytic Model to approximate length, vehicle and cost savings

**Strategy A.** Each company operates independently

<table>
<thead>
<tr>
<th>Local distance</th>
<th>Line-haul distance</th>
<th>Time</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d_{L_{i}} = \frac{d_{L_{i}}}{2} + 3 \frac{1}{t_{L_{i}}^{1/2}}$</td>
<td>$d_{L_{i}} = \frac{2}{d_{L_{i}}^{1/2}} + 1 \frac{1}{t_{L_{i}}^{1/2}} \left( \frac{1}{t_{L_{i}}^{1/2}} - \frac{2}{t_{L_{i}}^{1/2}} \right) + \left( \frac{1}{t_{L_{i}}^{1/2}} + \frac{1}{t_{L_{i}}^{1/2}} \right)$</td>
<td>$d_{L_{i}}(\frac{d_{L_{i}}}{2} + \frac{3}{t_{L_{i}}^{1/2}}) + \frac{d_{L_{i}}}{2}$</td>
<td></td>
</tr>
</tbody>
</table>

**Strategy B.** Each company brings the goods to the UCC and a neutral carrier does local delivery.

<table>
<thead>
<tr>
<th>Local distance</th>
<th>Line-haul distance</th>
<th>Time</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d_{L_{i}} = \frac{d_{L_{i}}}{2} + 3 \frac{1}{t_{L_{i}}^{1/2}}$</td>
<td>$d_{L_{i}} = \frac{2}{d_{L_{i}}^{1/2}} + 1 \frac{1}{t_{L_{i}}^{1/2}} \left( \frac{1}{t_{L_{i}}^{1/2}} - \frac{2}{t_{L_{i}}^{1/2}} \right) + \left( \frac{1}{t_{L_{i}}^{1/2}} + \frac{1}{t_{L_{i}}^{1/2}} \right)$</td>
<td>$d_{L_{i}}(\frac{d_{L_{i}}}{2} + \frac{3}{t_{L_{i}}^{1/2}}) + \frac{d_{L_{i}}}{2}$</td>
<td></td>
</tr>
</tbody>
</table>

10-14% in operating saving cost
**Demonstration Overview**

**Demonstration Studies. UCC Location Criteria**

**Location Criteria:**
- Acces time/distance to the delivery area
- Existing equipment
- Availability of space
- Investment needed
- New potential demand

**Location Alternatives:**
1. Devoted infrastructure
2. Shared infrastructure- Small mall center
3. Shared infrastructure- Big mall center
4. Owned infrastructure

<table>
<thead>
<tr>
<th>Criterion</th>
<th>1. Can Serra</th>
<th>2. La Farga</th>
<th>3. Gran Via 2</th>
<th>ZAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>0.5-1.5 km</td>
<td>&lt;0.5 km</td>
<td>2.5-3.5 km</td>
<td>6 km</td>
</tr>
<tr>
<td>Equipments</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Space availability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Investment</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>~0</td>
</tr>
<tr>
<td>New demand</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Decision</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Demonstration Overview

Demonstration Studies. Traffic Simulation

RESULTS:
Mileage, Fuel, Traffic Flows & Emissions

Comments
- Benefits in consolidated routes are highly positive. (mileage, vehicles, travel time and fuel)
- However, the impact is very small in the total amount of the city.
- Savings in CO₂ are perceptive but small
- Two methodologies are compared to approximate emissions Aimsun (based on Luc Int Panis) and indirect approximation (based on unit emission factors).
- The Aimsun method should be a lot more accurate than the indirect approximation but differences are very high.
Demonstration Overview

STRAIGHTSOL Framework. MAMCA & Key Performance Indicators (KPI)

Cost

<table>
<thead>
<tr>
<th>Cost type</th>
<th>After demonstration</th>
<th>During demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating costs (€)</td>
<td>€ 70.132</td>
<td>52.810€ (transport) +85.173€ (staff UCC) +40.390€ (IT/Engineering) = 178.373€</td>
</tr>
<tr>
<td>Investment costs (€)</td>
<td>€ -</td>
<td>€ 14.308</td>
</tr>
</tbody>
</table>

25% in transport cost savings but staff+infrastructure are very high

Air Quality

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NO, NO₂, NOₓ (µg/m³)</td>
<td></td>
<td>NO avg 4,97 / max 159,74 NO₂ avg 30,38 &lt; 40 / max 88,87 NOₓ avg 38,00 &gt; 30 / max 313,93</td>
<td></td>
</tr>
<tr>
<td>Ozone (µg/m³)</td>
<td>38,08 &lt;180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM10 (µg/m³)</td>
<td>Avg 28,1 &gt;20</td>
<td>“&gt;50” 2 times/month (max 7/year)</td>
<td></td>
</tr>
</tbody>
</table>

No comparison information, only current situation Some indicators are over recommended
Transport Operations

<table>
<thead>
<tr>
<th>Cost type</th>
<th>Before demonstration</th>
<th>During demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Km truck</td>
<td>~ 2.366km/veh-month</td>
<td>1.773 km/veh-month</td>
</tr>
<tr>
<td>Km Van</td>
<td>~ 1.320km/veh-month</td>
<td>990 km/veh-month</td>
</tr>
<tr>
<td>Avg Vehicles</td>
<td></td>
<td>3.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1,93 trucks 1,15 vans)</td>
</tr>
<tr>
<td>Load Factor</td>
<td>68%</td>
<td>73%</td>
</tr>
<tr>
<td>Total Deliveries</td>
<td>677</td>
<td>727</td>
</tr>
<tr>
<td>Travel time</td>
<td></td>
<td>4h 30min/veh-day</td>
</tr>
<tr>
<td>Fuel consumption</td>
<td></td>
<td>8 l/100 km (van)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 l/100km (truck)</td>
</tr>
</tbody>
</table>

- **Reduction in mileage** is proportional to the transport cost 25%
- **Load Factor** during pilot test is **5% higher**
- In deliveries a **7% more** during pilot test, but not perceived changes in weight

Customer Satisfaction

• The **customer with more shipments** is **highly satisfied** with the service, **but there is a delay** of one. It is acceptable if it is not urgent deliveries
• Other customers with few or no shipments are **not satisfied** with the solution. Some experienced problems with their transport providers.
Challenges/Things to be aware:

• The **leadership of a public body is essential** for improving City Logistics by means of UCC implementation.

• Effort must be focussed on **persuading 3PLs to participate and feed the UCC**, not the small shops.

• We truly believe that **more savings** can be obtained from a collection of **small retailers**, they do contribute to generate a lot of small and frequent shipments.

• **However**, small retailers are owned and run for one or two people that normally cover a lot of tasks, they **do not have time** or interest in these side problems. Indeed, the **economic crisis** has deeply affected the number of shops, and the stores business activity.

• The **combination of supply chains demand** with demand of small retailers is **promising**

• **Business model need.** The key deterrent for the development of UCC is the **high fixed costs** (infraestructure and UCC personnel).

**New versions of UCC ?**
STRAIGHTSOL Project. Mobile depot in Brussels

Objectives of Mobile Depot

• Cost-efficiency
• Employee satisfaction
• Less emissions
• Smooth information flows
• Customer satisfaction
Features:

- Pilot test in 2011 for Home Deliveries for a supermarket branch
- Currently working in different places of Barcelona: Ciutat Vella, Gràcia,…
- Access difficulties for vans and trucks, pedestrian areas, lack of un/loading areas
- TNT and SEUR are mainly working to transfer some of parcels to VANAPEDAL

Potentialities:

- Consolidate more demand from different stakeholders:
  - Retailers
  - Transport operators mainly dedicated to long-haul
  - Provide added value services in the PICK UP
  - Service to Municipal buildings
  - Big demand attractors (hotels, big retailers,…)
- PROVIDE alternatives for access restriction
- Explore tri-cycles advertisement possibilities
A consolidation center for L’Hospitalet de Llobregat

Thank you!!

Center for Innovation in Transport, CENIT
www.cenit.cat
miquel.estrada@upc.edu
mireia.roca-riu@upc.edu