The Freight Landscape: Convergence and Divergence in Urban Freight Distribution

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Outline

Urban Density and Freight
Assessing the Freight Landscape
Convergence and Divergence
Putting Freight into the Urban Landscape

• Diversity of urban freight distribution
  • Different purposes, modes of operation and locational characteristic.
  • Urban spatial structure as a key element of city logistics.
  • Freight activities have significant imprint on urban land uses.
  • Freight related activities, locational behavior and circulation remain relatively absent from the concerns of urban planning.

• Large metropolitan areas
  • Complex spatial structure.
  • Range of socioeconomic activities and their organization.

• Freight landscape
  • Spatial distribution in freight activity and intensity within urban areas.
  • Spatial variations of the demand for freight and related freight flows.
The Freight Landscape: A Multidimensional Concept

Political Landscape

- Jurisdictions and regulations impacting the locational and operational behavior of freight distribution.
- Zoning and building codes, operating hours, parking and delivery conditions.

Socioeconomic Landscape

- General land uses; population and employment densities.
- Economic and social functions.
- Commercial, institutional, residential, manufacturing and logistics districts.
- Main generators and attractors of freight flows.
The Freight Landscape: A Multidimensional Concept

**Infrastructure Landscape**
- Transportation infrastructure supporting urban freight flows.
- Freight terminals; ports, rail yards and airports.
- Many cities acting as commercial gateways to global trade.

**Mobility Landscape**
- Dynamic aspect of city logistics.
- Freight flows and the means that carry freight.
- Vehicles, technologies, routes, scheduling, pickups and deliveries.
Relationship between Urban Density and Commercial Freight Deliveries

- **Sparse Demand**
  - Smaller loads
  - Ample inventory space
  - Less frequent deliveries
  - Limited constraints for loading and parking
  - Long delivery distances

- **Moderate Demand**
  - Full truck loads
  - Ample inventory space
  - More frequent deliveries
  - Few constraints on loading and parking
  - Shorter delivery distances

- **Concentrated Demand**
  - Smaller loads
  - Limited inventory space
  - Frequent deliveries
  - Many constraints on loading and parking
  - Shortest delivery distances

**Delivery Costs per Unit**

- **Rural**
- **Low density suburban**
- **Medium density suburban**
- **Inner suburbs**
- **Inner core**
- **Outer core**
- **CBD**
Types of Freight Landscapes

Four Quadrants
A (High Density Convergence): Commercial and financial districts.
D (Low Density Convergence): Suburbia.

Quantile classification of two density axis (population and employment)
Four population (P1 to P4) and employment (E1 to E4) classes

Number of spatial units in a cell (Px/Ey)
Depicting the Freight Landscape

A. High density convergence
- Commercial and financial districts
- Retail and service activities related to high employment densities.
- Apartment complexes (high population densities).
- Complex city logistics framework (courier services, retail logistics, food deliveries, home deliveries).

B. Employment-based divergence
- Manufacturing and warehousing districts (high employment densities).
- Transport terminals (airports, ports and rail yards).
- Driven by externalities, regulations and planning.
- Freight distribution and haulage (FTL, LTL) flows.
Depicting the Freight Landscape

C. Population-based divergence

- Specialized residential districts.
- Lower employment density.
- Retail logistics and home deliveries.

D. Low density convergence

- Various forms of peri-urban and suburban activities (low density residential areas, malls and some light manufacturing or distribution clusters).
- The realm of logistics sprawl and suburban logistics.
- An increasingly prevalent freight landscape.
# The Spatial Unit Problem

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Type of spatial unit</th>
<th>Number of spatial units</th>
<th>Total surface (square km)</th>
<th>Average size (square km)</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York CSA</td>
<td>Census Tract</td>
<td>5,444</td>
<td>36,775.94</td>
<td>6.75</td>
<td>19.47</td>
</tr>
<tr>
<td>Los Angeles CSA</td>
<td>Census Tract</td>
<td>3,918</td>
<td>87,604.23</td>
<td>22.36</td>
<td>372.27</td>
</tr>
<tr>
<td>Paris region (Region Ile-de-France)</td>
<td>Municipalities</td>
<td>1,300</td>
<td>12,057.62</td>
<td>9.27</td>
<td>7.75</td>
</tr>
<tr>
<td>Seoul Metropolitan Area</td>
<td>Gu (equivalent to borough or district)</td>
<td>79</td>
<td>11,752.68</td>
<td>148.77</td>
<td>226.53</td>
</tr>
</tbody>
</table>
Average Population and Employment Densities by Quantile (per square km)

**Population Density**

- New York
- Los Angeles
- Paris
- Seoul

**Employment Density**

- New York
- Los Angeles
- Paris
- Seoul
Level of Divergence of Freight Landscapes

I (High Convergence)  
II (Significant Convergence)  
III (Limited Convergence)  
IV (Divergence)

Population Density  
Employment Density

Share of spatial units in category

Divergence Index (D)

\[ D = 1 - \sum_{1}^{N} \frac{|C_N - C|}{S} / 1.5 \]

Complete divergence = 1
New York: Pattern III (Limited Convergence)

N=5,444

D=0.64
Los Angeles: Pattern IV (Divergence)

N=3,918

D=0.73
Paris: Pattern I (Strong Convergence)

N = 1,300

D = 0.30
Seoul: Pattern II (Average Convergence)

N=79

D=0.30

P1 P2 P3 P4
E1 E2 E3 E4
Los Angeles: Freight Landscape Matrix by Distance from CBD
Conclusion: What the Freight Landscape Reveals about City Logistics?

- Identify specific geographical conditions in which urban freight distribution is taking place
- Diversity of freight landscapes in terms of the spatial and functional distributions of population and employment densities.
- The four sampled metropolitan areas (New York, Los Angeles, Paris and Seoul) revealed different levels of convergence and patterns.
- Research is needed to more effectively link employment density, freight activity and the urban spatial structure.