Collaborative Urban Logistics – Challenges, Current Practices and Future Research

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Last Mile Urban Logistics

• The "last mile problem": Last leg of the supply chain is least efficient, comprising up to 28% of the total logistics cost

• Challenge of last-mile logistics
  – making deliveries in urban areas (shopping malls, hotels and restaurants, offices in a central business district often contribute to congestion, pollution and safety problems.
Urban Logistics in Singapore

Statistics about Urban Freight in Singapore

• Last-mile transit of urban freight from the distribution centers to the city center (malls, offices and homes) amounts up to **75% of total logistics costs** in Singapore.

• 19% of the CO₂ emission is caused by transportation, and freight contributes about **50% of the pollution**, even though freight transport takes up only **17% of total traffic volume**.

• Growth of goods vehicles
Challenges in Last-Mile Logistics

Government
1. Road congestion and mobility
2. Environmental pollution
3. Safety

Businesses
1. Sustainability (corporate social responsibility)
2. Safety stock prediction
3. Service level and reliability

- Urbanization
- E-Commerce
- Sustainability
- Manpower crunch
- Uncoordinated Urban Freight
Getting Stakeholders to Collaborate

Getting stakeholders (authorities, customers, providers) to collaborate to improve urban logistics operations

### Urban Logistics ...

- ... aims to
  - **reduce costs** of goods distribution in urban areas
  - **increase** flexibility, speed and **service level** and supporting **adding additional value creation**
  - **improve city’s social & environmental situation**
    - .....through the use of **business & decision analytics**

- ...addresses **city's & industry’s needs**
- ...**leverages city and government authorities** as major supporters
- ...promotes **innovative and best-practice solutions across the industry**

### Stakeholders

#### Authorities

- **.....as enablers**
  - Implement policies to reduce city challenges, e.g. pollution, congestion
  - Support urban logistics through regulations or incentives, e.g., city toll, delivery restrictions, etc.

#### Business owners

- **.....as customers**
  - Implement products to reduce cost, increase flexibility, speed and **service level**
  - Implement solutions that increase the value add for the customer

#### Service Providers

- **.....as partners**
  - Implement optimized and collaborative services
  - Design innovative solutions that further increase productivity
Collaborative Urban Logistics (Project funded by A*STAR)

- Goal: Develop technology that enable stakeholders (shippers, carriers, service providers and receivers) to collaborate on last-mile delivery through an e-marketplace
- Singapore as a living laboratory for experimentation with innovative urban concepts and paradigms
SMU’s Collaborative Last-mile Logistics Research

• Mechanism design and Optimization for getting business stakeholders (shippers, carriers, retailers) to collaborate to improve last mile delivery operations

• enables multiple parties to bid/negotiate on delivery jobs and coordinate timings of deliveries while respecting their individual constraints and statutory requirements of city authorities

• seeks win-win solutions
  • environmentally and economically sustainable
  • operationally efficient and cost effective
Urban Consolidation Center (UCC)

A facility in which freight flows from outside the city are consolidated with the objective to bundle inner-city transportation activities so as to reduce volume of distribution activities in the city.

Primary functions:
1. Consolidation
2. Warehousing
3. Cross docking
4. Last-mile delivery
UCC : Current Practices and Future Prospects
UCC : Examples

• **Carrier-Led UCC**
  - Tokyo Station (Japan)
  - Tenjin Joint Distribution System (Japan)
  - La Petite Reine (Paris)

• **Receiver-Led UCC**
  - Binnenstadservice.nl (Netherlands)
  - Heathrow Airport (UK)
  - Westfield Stratford City Shopping Mall (UK)
UCC Challenges

• Operational
  – Carriers/suppliers lose direct contact with their customers
  – Scale: Service area too small to show significant results
  – Poor UCC location (too far from the service area)
  – Biasness towards certain carriers or retailers

• Economic / Financial
  – Financial viability of UCC
  – Unfair distribution of cost and benefits for different stakeholders
  – Unwillingness to participate in the scheme due to lack of incentives
  – Poor revenue management
Solution: Market-based Coordination Mechanisms

• Enable multiple parties to bid and negotiate on delivery jobs: synchronize timings of deliveries, consolidate LTLs while respecting their individual constraints and requirements of city authorities

• UCC serves as exchange, allowing shippers to buy and carriers to sell capacity
  – Carriers post capacity, and shippers bid
  – Shippers post loads (demand) and carriers bid
  – Bidders must be able to specify their preferences and constraints
  – Other UCC operational constraints (e.g. regulatory constraints)
UCC Mechanism Design

1. **Shippers** bid for the last-mile delivery slots
   - Estimated arrival time
   - Delivery due date
   - Location
   - Consignment details (volume, weight)
   - Price

2. **Carriers** collaborate through
   - Order sharing
   - Capacity sharing
## Illustration of Solution

### Collaborative Logistics in Urban Environment

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<th>No.</th>
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<th>Zone</th>
<th># Accepted Bids</th>
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Conclusion: Ongoing Research@SMU

- Application to Jurong Gateway Retail Precinct Management
- Mobile crowdsourcing as an alternative form of urban logistics

(Maps powered by streetdirectory.com)