Freight Demand Management: Role in Sustainable Urban Freight Systems

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The Challenge
Global Drivers

- Economic Globalization
- Urbanization:
  - World’s population: 7+ billion people, 9 billion by 2045
  - In 2010, for the first time, 50% of world population is urban, by 2050, 70% of the world population will be urban
  - In US/Canada/Europe, the future is here: +80% urban
- Impacts of the Internet on Supply Chains:
  - Millions of citizens expect fast and inexpensive deliveries
  - The diminished importance of proximity to customers as a competitive advantage, together with anti-freight attitudes and policies, leads to logistical sprawl
- Increased Citizen Expectations
This is what we all want…
This is what we need to change...
Who needs to change behavior??

- Not only the freight carriers $\rightarrow$ entire supply chains need to change behavior...

The shippers  The carriers  The receivers

The Economy
The Urban Freight System
The Freight System

- The conglomerate of all the economic entities involved in the generation, transportation, consumption, and transformation of cargo

- Key agents:
  - Producers, the ones that manufacture/produce the goods
  - Shippers, the ones that send the goods
  - Receivers, the ones that use the goods transported
  - Carriers, the ones that transport the goods
  - Ancillary functions: warehouses, distribution centers, etc.

- The typical power relations:
  - Shippers have power over Carriers
  - Receivers have power over Shippers
Key insights

- The carriers cannot unilaterally change operations, they are the weakest element of the chain.
- Although the carriers are the ones that produce the externalities, the actual source of the problem is the demand.
- In most cases, the carriers have no choice...

Due to competitive market forces:

- Carriers are very efficient from the private point of view, not necessarily efficient from the social point of view.
- In many instances, if carriers could freely decide how to do things (without constraints), private optimal solutions would coincide with social optimal.
- The solution: modify the markets thru policy interventions.
What Could Be Done To Foster Sustainable Urban Freight Systems?

Based on the research conducted as part of NCFRP 38 “Improving Freight System Performance in Metropolitan Areas”
Groups of Public Sector Interventions

- Infrastructure Management
- Traffic Management
- Logistical Management
- Vehicle Related Initiatives
- Pricing, Incentives, Taxation
- Demand and Land Use Management
- Stakeholder Engagement

For a comprehensive Initiative Selector, see: http://transp.rpi.edu/~NCFRP38PG/assessment.htm
Freight Demand Management: The Next Frontier
Freight Demand Management

- It focuses on inducing changes in demand, by influencing the economic agent(s) that generate the demand for freight...
- Holds great potential because these agents have a great deal of power over supply chains...using this power could transform supply chains for the better
- Examples:
  - Off-hour deliveries
  - Retiming of deliveries
  - Receiver-led consolidation programs
  - Transport for London took advantage of the four Rs (Retime, Reduce, Re-route, Revise mode) during the London Olympics achieving a 10% reduction in large truck traffic
Off-Hour Delivery Programs
A project that has been, at times...

- A science mystery
- A political thriller
- A melodrama
- A comedy
- A Greek tragedy
- A good drama with a happy ending...
Voluntary Off-Hour Delivery Programs

- Induce a shift to deliveries made during the off-hours (7PM to 6AM), by providing incentives to receivers for their commitment to accept off-hours deliveries (OHD)
- Purpose: reduce congestion and pollution during daytime hours
- Could switch to off-hours 20-40% of delivery traffic

Examples:
- PierPass Program, California
- OHD, New York City
1st Phase: Pilot Test

- At the beginning, nobody wanted to participate... the obstacles were perceived to be unsurmountable... biggest challenge → need for multi-party cooperation

- Three separate one-month stages:
  - Foot Locker (ten stores)/NDL
  - Whole Foods (four stores)
  - Sysco (twenty one stores)

- About 35 receivers, 20 trucks/vendors
  - Half doing staffed OHD
  - Half doing unassisted OHD
Regular vs. Off-Hour Deliveries
Regular vs. Off-Hour Deliveries
Results From Satisfaction Surveys

- **Carriers/Vendors:** 1.55
- **Drivers:**
  - Travel speeds = 1.33
  - Parking = 1.11
  - Time to deliver = 1.38
  - Time to complete the route = 1.44

- **Scale:** 1 = Very favorable, 5 = Very unfavorable

- **Drivers:**
  - Congestion = 1.11
  - Stress levels = 1.11
  - Feeling of safety = 1.86

- **Receivers:**
  - Impression of off-hour deliveries = 1.50
  - How likely are you to off-hour deliveries = 1.42
  - If all liability issues were addressed, would you be interested in receiving unassisted OHD? = 2.17
Average Space Mean Speeds

More than twice as fast
Average Service Times

More than three times as fast
After the End of the Pilot

- All of the receivers doing staffed OHD reverted back to the regular hours
- Almost all the receivers doing unassisted OHD remained in the off-hours
  - The reason: reliability of OHD
  - “Our locations will continue to receive ‘night drops’ even though this program has ended as our managers now favor the dependability of night drops vs. late day time deliveries. Thanks again for the program.”
  Nick Kenner, Managing Partner, Just Salad LLC

- **Key lesson:** Unassisted OHD work for large numbers of receivers, and do not require on-going incentives
2nd phase: Unassisted OHD

- Main focus of the 2nd phase of the OHD project
  - Unassisted OHD:
    - Only a one-time-incentive is needed
    - Once they try it and like it, receivers stay in the off-hours
  - Large Traffic Generators (large buildings/establishments)

- Research was conducted to find out how to:
  - Foster:
    - Unassisted OHD at businesses establishments (retail and the food sector are the top priority)
    - OHD at Large Traffic Generators
  - Use technology to:
    - Reduce noise during OHD
    - Facilitate Unassisted OHD
**Unassisted OHD: Behavioral Research**

- **Key determinants in OHD participation:**
  - One-Time-Incentive (financial)
  - Discounts from vendors (financial)
  - Business Support Services to participants
  - Public Recognition to participants
  - Trusted Vendor Certification programs

- **Suggestions:**
  - Public → Incentives, Business Support, Public Recognition
  - Carriers/vendors → Shipping discounts
  - Business groups → Create a “Trusted Vendor” program

- **Re-align federal/state incentive programs:**
  - Environmental, economic, etc. to support OHD
  - Require recipients to accept OHD
Current Status…

- **Key participants (+400 companies):**
  - *Sysco:* 31 OHD routes/week (18% of their routes, 171) delivering to 140 unassisted off-hour delivery customers
  - *Wakefern:* 5 OHD routes/day (25% of their total)
  - *Duane Reade:* Approximately 120 of their 160 Manhattan stores receive OHD on a regular basis
  - *Dunkin Donuts:* 72 stores out of 121 in Manhattan
  - *Beverage Works (Red Bull)* has approximately 130 routes in the NY Metro, 22% are OHD
  - *Waldorf Astoria*
Economic Impacts

- Implementing various forms of off-hour delivery policies in Manhattan leads to:
  - Travel time savings to all highway users of about 3-5 minutes per trip
  - Travel time savings to carriers that switch to the off-hours of about 48 minutes per delivery tour
  - Savings in service times (per tour) could be up to 1-3 hours

- Depending on the extent of the implementation, economic savings are between $100 and $200 million/year in travel time savings and pollution reductions
### Environmental Pollution Reductions

#### TOTAL/YEAR

<table>
<thead>
<tr>
<th>Scenario % OHD</th>
<th>CO (tonnes)</th>
<th>HC (tonnes)</th>
<th>NOx (tonnes)</th>
<th>PM(_{10}) (kg)</th>
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</thead>
<tbody>
<tr>
<td>6.49%</td>
<td>101.20</td>
<td>24.05</td>
<td>3.00</td>
<td>20.29</td>
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<td>14.10%</td>
<td>169.58</td>
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<td>202.75</td>
<td>39.97</td>
<td>11.82</td>
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<td>25.34%</td>
<td>253.14</td>
<td>56.56</td>
<td>15.04</td>
<td>90.09</td>
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<tr>
<td>29.07%</td>
<td>383.81</td>
<td>55.76</td>
<td>26.33</td>
<td>149.86</td>
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</table>

#### PER RECEIVER/YEAR

<table>
<thead>
<tr>
<th>% OHD</th>
<th>VMT (veh-mi)</th>
<th>VHT (veh-hrs)</th>
<th>CO (kg)</th>
<th>HC (kg)</th>
<th>NOx (kg)</th>
<th>PM(_{10}) (kg)</th>
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</thead>
<tbody>
<tr>
<td>6.49%</td>
<td>348.93</td>
<td>438.20</td>
<td>19.56</td>
<td>3.19</td>
<td>0.58</td>
<td>0.0039</td>
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<td>14.10%</td>
<td>549.40</td>
<td>207.09</td>
<td>14.90</td>
<td>1.81</td>
<td>0.72</td>
<td>0.0043</td>
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<tr>
<td>20.90%</td>
<td>551.69</td>
<td>195.51</td>
<td>12.05</td>
<td>1.88</td>
<td>0.70</td>
<td>0.0042</td>
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<td>25.34%</td>
<td>542.89</td>
<td>233.92</td>
<td>12.41</td>
<td>2.12</td>
<td>0.74</td>
<td>0.0044</td>
</tr>
<tr>
<td>29.07%</td>
<td>1,052.06</td>
<td>244.31</td>
<td>16.40</td>
<td>1.41</td>
<td>1.13</td>
<td>0.0064</td>
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</table>
### Average CO₂ Emissions

- Estimated using truck GPS data and the Comprehensive Modal Emission Model

<table>
<thead>
<tr>
<th>Road type</th>
<th>Segment</th>
<th>Off-hours</th>
<th>Regular hours</th>
<th>Difference</th>
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<tbody>
<tr>
<td><strong>Highway</strong> (grams/mile)</td>
<td>#1</td>
<td>2566.2</td>
<td>2636.8</td>
<td>-2.70%</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>1496.2</td>
<td>2408.0</td>
<td>-37.90%</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>2225.4</td>
<td>3365.9</td>
<td>-33.90%</td>
</tr>
<tr>
<td><strong>Toll Road</strong> (grams/mile)</td>
<td>#1</td>
<td>2232.4</td>
<td>4006.4</td>
<td>-44.30%</td>
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<tr>
<td></td>
<td>#2</td>
<td>2899.6</td>
<td>3607.9</td>
<td>-19.60%</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>2286.8</td>
<td>3660.0</td>
<td>-37.50%</td>
</tr>
<tr>
<td><strong>Manhattan</strong> (grams/mile)</td>
<td>#1</td>
<td>1921.5</td>
<td>7747.8</td>
<td>-75.20%</td>
</tr>
<tr>
<td></td>
<td>#2</td>
<td>4028.8</td>
<td>7036.3</td>
<td>-42.70%</td>
</tr>
<tr>
<td></td>
<td>#3</td>
<td>2160.5</td>
<td>8458.7</td>
<td>-74.50%</td>
</tr>
</tbody>
</table>
Noise
Noise Policy

- **1st Layer: Commitment**
  - Code of conduct / Training
  - Low noise strategies / tech.

- **2nd Layer: Training**
  - Driver behavior
  - Low cost measures – noise absorbing materials
  - Low noise trucks/equipment

- **3rd Layer: Enforcement**
  - NYC Depts. of Transportation and Environmental Protection monitor, investigate violations and enforce compliance

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**Code of Conduct and Standards for Participants in the NYC deliverEASE Program**

The success of this program depends on an honest business relationship between carriers and receivers. Drivers, fleet managers and receiving companies participating in the NYC deliverEASE program must adhere to the following code of conduct:

**COMMITMENT TO MAINTAIN A GOOD RELATIONSHIP WITH FELLOW CARRIERS AND RECEIVERS**

- **Receivers**: A receiving business shall ensure that anyone delivering to the location will have a safe and healthy work environment. The driver shall have no obstacles when delivering in the off-hours. Receivers will help identify strategies to accommodate unassisted deliveries if staff is not available.

- **Carriers**: If needed a carrier will identify technologies and suggest changes to driver behavior for drivers to reduce any noise resulting from deliveries. If unassisted deliveries are taking place, the driver will ensure that the receiver's property is not damaged in any way and that the products being delivered are handled appropriately.

**COMMITMENT TO THE COMMUNITY**

- **Health and Safety**: Participants shall ensure that food is handled safely and that food deliveries and storage adhere to the NYC Health Code.

- **Quiet Neighbor**: In order to remain a quiet neighbor and respect the local community, receivers and carriers must ensure that the building and commercial vehicle infrastructure is designed to be as quiet as possible. All participants in NYC deliverEASE are encouraged to attend a free noise webinar to learn how to improve both infrastructure and behavior in order to make quiet deliveries in the off-hours and abide by the NYC Noise Code.

**PARTICIPANTS SHALL MAKE EFFORTS TO MINIMIZE NOISE THEY PRODUCE WHILE MAKING DELIVERIES**

- **Changes to driver behavior**:
  - Do not slam truck doors or lift gates (into truck or sidewalk)
  - Do not shout
  - Turn off the radio
  - Reduce engine idling (3 minutes or less unless vehicle is used to operate equipment)
  - Use equipment quietly and gently as to reduce noise

- **Physical changes for both carrier and receiver**:
  - As needed, provide retrofits for vehicles, store and equipment to reduce noise

The OHD team will provide information on how to make changes to driver behavior and what technologies can be used for retrofits to both reduce noise and support unassisted deliveries.

NYC DOT and Rensselaer Polytechnic Institute are committed to the highest standards of business conduct and require all participants to treat employees fairly and all employees to perform their job with the utmost level of professionalism.
Noise Profile of a Delivery Truck

- Scrolling cart
- Picking moving ramp
- Moving cart inside
- Closing back door
- Closing lift

No/minimal car flow 1 2 3 4 5 No/minimal car flow

1 2 3 4 5
There is Public Support...as Reflected by Media

TIME magazine listed the OHD project as a “Top 10 Ideas” March 25th, 2013
Receiver-Led Consolidation Systems
Currently, receivers place orders without considering the impacts of their actions

- They are the ones that create the demand that translates into truck-trips and congestion...
- We need to encourage them to change behavior

Receiver-Led Consolidation (Delivery and Servicing Plans) encourage managers of large buildings to quantify and reduce delivery traffic

- A pilot test in London: 20% reduction of traffic
Survey collected data from 248 receivers (Manhattan), and inquired about the interest on “asking your vendors to reduce the number of individual deliveries that your company receives through consolidation”

Notes: (1) NAICS 72: Accommodation / food services; NAICS 42: Wholesale trade; NAICS 44-45: Retail trade; NAICS 81: Other services; NAICS 31-33: Manufacturing; NAICS 71: Arts / entertainment / recreation; NAICS 48-49: Transportation / warehousing; NAICS 52: Finance / insurance; and, NAICS 62: Healthcare / social assistance.
(2) Percentages under the NAICS code indicate the proportion in the sample.
## Potential Impacts

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Base Case</th>
<th>Scenario 1 (1 delivery/day)</th>
<th>Scenario 2 (25% of base case)</th>
<th>Scenario 3 (50% of base case)</th>
<th>Scenario 4 (75% of base case)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTG</td>
<td>FTG</td>
<td>FTG</td>
<td>FTG</td>
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</tr>
<tr>
<td>County</td>
<td></td>
<td>Red. (%)</td>
<td>Red. (%)</td>
<td>Red. (%)</td>
<td>Red. (%)</td>
</tr>
<tr>
<td>Manhattan</td>
<td>163,239</td>
<td>144,436 11.5%</td>
<td>145,555 10.8%</td>
<td>151,450 7.2%</td>
<td>157,345 3.6%</td>
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<tr>
<td>Brooklyn</td>
<td>86,856</td>
<td>80,830 6.9%</td>
<td>80,268 7.6%</td>
<td>82,464 5.1%</td>
<td>84,660 2.5%</td>
</tr>
<tr>
<td>Queens</td>
<td>86,454</td>
<td>80,334 7.1%</td>
<td>79,903 7.6%</td>
<td>82,086 5.1%</td>
<td>84,270 2.5%</td>
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<tr>
<td>Bronx</td>
<td>29,507</td>
<td>27,070 8.3%</td>
<td>26,900 8.8%</td>
<td>27,769 5.9%</td>
<td>28,638 2.9%</td>
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<tr>
<td>Staten Island</td>
<td>15,283</td>
<td>14,216 7.0%</td>
<td>14,150 7.4%</td>
<td>14,528 4.9%</td>
<td>14,905 2.5%</td>
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<tr>
<td>Total</td>
<td>381,340</td>
<td>346,886 9.0%</td>
<td>346,776 9.1%</td>
<td>358,297 6.0%</td>
<td>369,817 3.0%</td>
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</table>
Potential Impacts: Freight vehicle trip reductions
### Potential Impacts: Vehicle-miles reductions

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Base Case</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Daily FTA</td>
<td>105,758</td>
<td>87,810</td>
<td>89,011</td>
<td>94,593</td>
<td>100,175</td>
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<tr>
<td>Daily FTA Savings</td>
<td>-</td>
<td>17,948</td>
<td>16,747</td>
<td>11,165</td>
<td>5,583</td>
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<tr>
<td>Total savings per day</td>
<td>-</td>
<td>$1,447.24</td>
<td>$1,327.92</td>
<td>$898.67</td>
<td>$412.66</td>
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<td>(US$ thousands)</td>
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<td>Unit savings</td>
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<td>$79.29</td>
<td>$80.49</td>
<td>$73.91</td>
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<td>(US$/ delivery)</td>
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<tr>
<td><strong>Distance</strong></td>
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<tr>
<td>Daily FTA</td>
<td></td>
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<tr>
<td>Distance</td>
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<td>37,923.49</td>
<td>26,921.27</td>
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<tr>
<td>Unit savings</td>
<td>-</td>
<td>2.34</td>
<td>2.26</td>
<td>2.41</td>
<td>2.17</td>
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<td>(miles/delivery)</td>
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<td><strong>Time</strong></td>
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<td>(min/delivery)</td>
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</table>
Concluding Thoughts ...
How Could We Make it Happen?
How Could We Change Things?

- By influencing the *key* decision maker so that they force a change in supply chains...

- Remember the power relations:
  - Shippers have power over Carriers
  - Receivers have power over Shippers

  Receivers $\rightarrow$ Shippers $\rightarrow$ Carriers

- Implication: Convincing the receivers to participate in the quest for sustainability is ESSENTIAL

- How could we convince receivers to change behavior?
  - Incentives
  - Regulations
Citizens-Led Change...

- Citizens could provide the incentives needed to foster sustainability of supply chains:
  - A certification program that rates the degree of sustainability of the supply chains serving an establishment will
    - Provide information to citizens about what the companies are doing for sustainability
    - Lead citizens to patronize the businesses doing good
    - Ultimately, provide the incentives needed to foster transformation
- Achieving sustainability is all about behavior change
- Transformation of supply chains is possible, we (THE CITIZENS) have the power...
Thanks!

For a comprehensive Initiative Selector, see:
http://transp.rpi.edu/~NCFRP38PG/assessment.htm