

# Freight Behavioral Modeling

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# Global trends and issues

- Economic development
- Society interest on environmental impacts and sustainability
- Energy shortages and new technologies
- Urbanization

Urban freight should be a hot topic...





Underutilized-Saturated



20%-30% filling rates



Space use

# Public Sector intervention

- Identify the problem (observations)
- What is the problem - what is causing the problem (analysis)?
- What type(s) of initiative(s) could be more effective in solving a specific problem?

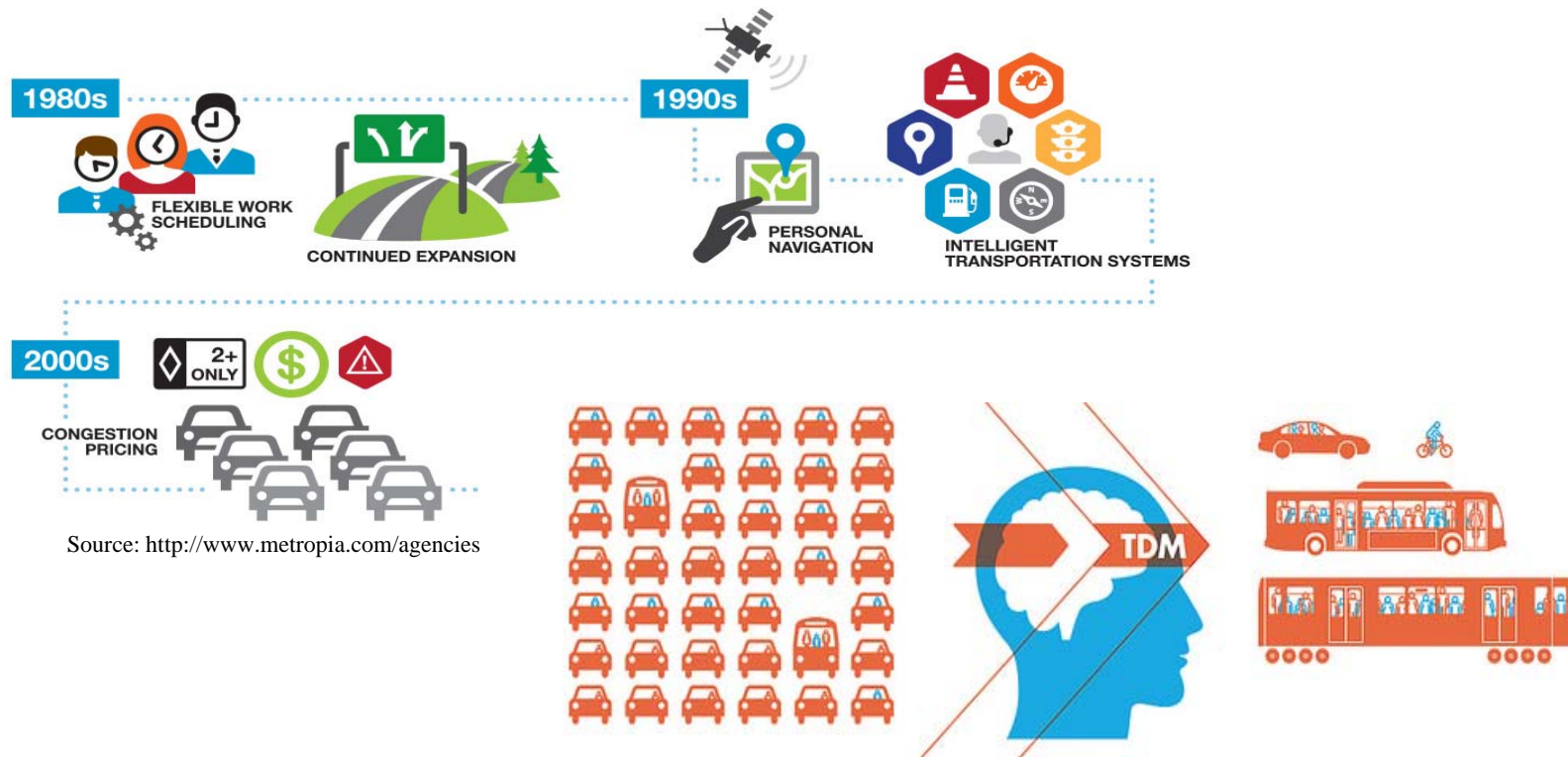
# Literature on interventions

| Year  | Infrastructure | Parking | Veh Tech/<br>ITS | Traffic Mgt | Pricing | Logistical<br>Mgt | Freight<br>Demand Mgt/<br>Land Use | Total |
|-------|----------------|---------|------------------|-------------|---------|-------------------|------------------------------------|-------|
| 1970  |                |         |                  |             |         | 2                 | 1                                  |       |
| 1973  |                |         |                  |             |         |                   | 1                                  |       |
| 1978  |                |         |                  |             |         |                   | 1                                  |       |
| 1988  | 2              |         |                  |             |         |                   |                                    |       |
| 1992  | 3              |         |                  | 2           | 1       |                   |                                    |       |
| 1993  | 1              | 1       |                  |             |         |                   |                                    |       |
| 1996  | 1              |         |                  |             |         |                   |                                    |       |
| 1997  |                |         |                  |             |         |                   | 1                                  | 1     |
| 1999  | 1              |         |                  |             |         |                   |                                    | 1     |
| 2000  |                |         |                  | 1           |         |                   |                                    | 1     |
| 2001  | 4              | 2       | 1                |             |         | 3                 | 2                                  | 12    |
| 2002  | 1              | 2       | 2                | 1           |         |                   | 1                                  | 7     |
| 2003  | 3              |         | 2                | 5           |         | 3                 | 1                                  | 14    |
| 2004  | 1              |         | 2                | 1           |         | 4                 |                                    | 8     |
| 2005  | 1              |         | 2                | 2           | 3       | 3                 | 1                                  | 12    |
| 2006  | 1              | 1       | 1                | 2           | 1       | 2                 | 1                                  | 9     |
| 2007  | 1              | 5       | 5                | 8           | 4       | 3                 | 1                                  | 27    |
| 2008  | 1              |         |                  | 7           | 2       | 4                 | 2                                  | 16    |
| 2009  | 2              | 5       | 7                | 7           |         | 4                 | 2                                  | 27    |
| 2010  | 4              | 1       | 5                | 5           | 2       | 10                | 3                                  | 30    |
| 2011  | 4              | 5       | 13               | 12          | 5       | 7                 | 4                                  | 50    |
| 2012  | 2              | 8       | 5                | 7           | 1       | 2                 | 8                                  | 33    |
| 2013  | 1              | 2       | 8                | 6           | 8       | 2                 | 3                                  | 30    |
| 2014  |                |         | 2                |             |         |                   |                                    | 2     |
| Total | 34             | 32      | 55               | 66          | 27      | 49                | 33                                 | 296   |

These initiatives are very effective but require behavioural changes



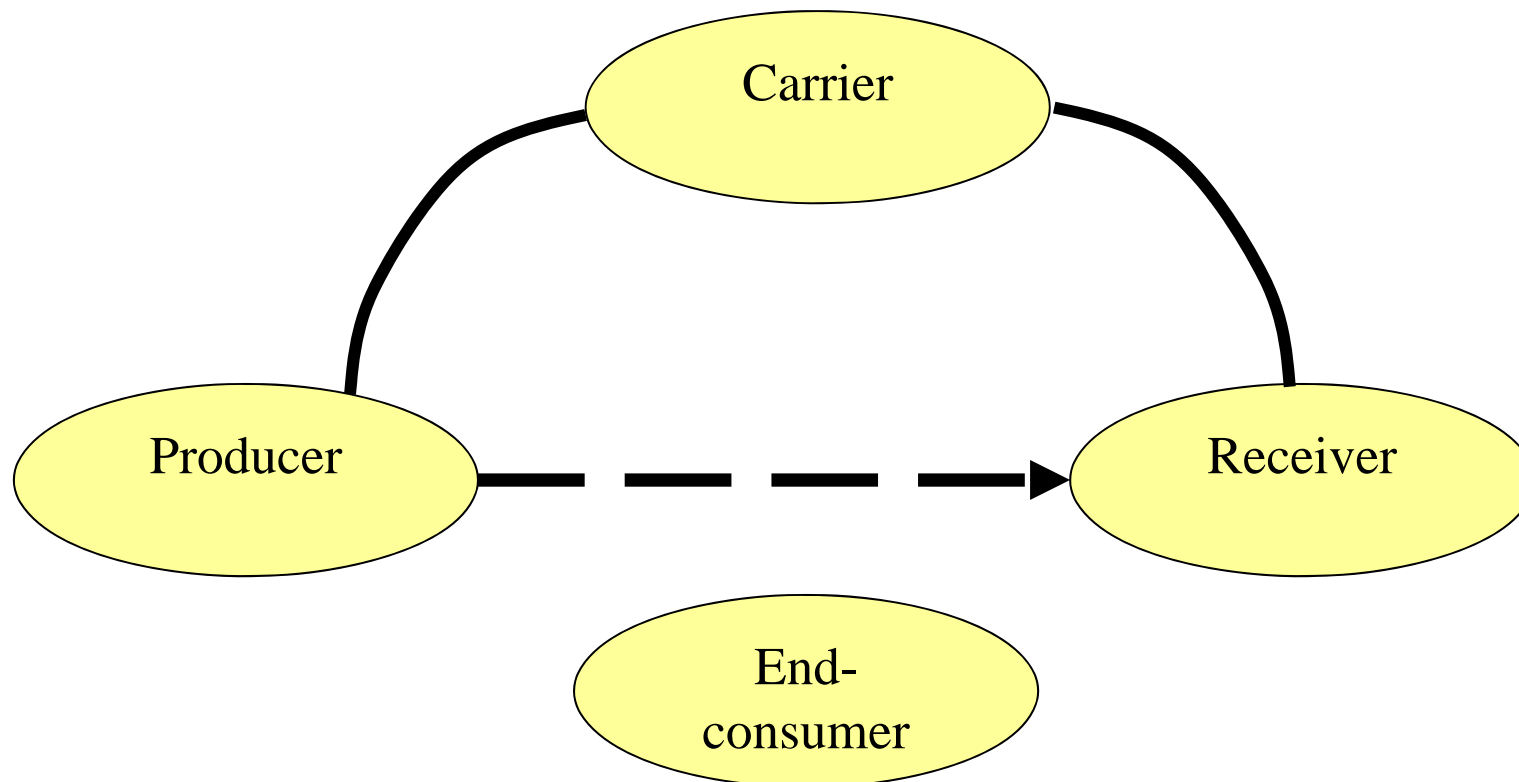
# Path for passenger transport...



Source: <http://chi.streetsblog.org/2013/12/09/saving-time-and-money-through-transportation-demand-management/>

# The complex freight system...

- The conglomerate of all the economic entities involved in the generation, transportation, consumption, and transformation of cargo. Very simplified scheme:



# Induce Behavioral Change

- Who should be the target of the policy stimuli?
- What is the best policy lever (regulation, pricing, incentives)?
- What should be the magnitude of the stimuli?



# Freight Behavioral Research

Objective: Understand freight agents (e.g., receivers) behavior and how they react to policy

- Techniques:
  - Focus groups/ interviews to gain insights
  - Surveys: revealed preferences and/ or stated preferences
  - Disaggregated models based on observed choice
  - Behavioral models: discrete choice models are based on random utility theory (McFadden)

# Examples of Behavioral Research

# 1. Carriers in Brasilia

Who: 23 carriers in Brasilia, 12,600 daily deliveries

Semi-structured interviews

What did we learn:

- OHD and VPRS are the preferred initiatives
- OHD: Safety and receiver willingness are the biggest concerns
- JDS: Interest but concerns about practical issues

| Initiatives<br>↓                 | Factors               | Influence    |                  | Will |    |
|----------------------------------|-----------------------|--------------|------------------|------|----|
|                                  |                       | No Influence | Strong Influence | Yes  | No |
|                                  |                       | 0            | 10               |      |    |
| Off-Hour Delivery (OHD)          | Law                   | [ 8 ]        |                  | 23   | 0  |
|                                  | Cost Reduction        | [ 7 ]        |                  |      |    |
|                                  | Receiver Willingness  | [ 8 ]        |                  |      |    |
|                                  | Compet Initiate Proj. | [ 7 ]        |                  |      |    |
|                                  | Infrastructure        | [ 2 ]        |                  |      |    |
|                                  | Govern Suport         | [ 9 ]        |                  |      |    |
| Joint Delivery System (JDS)      | Law                   | [ 7 ]        |                  | 21   | 2  |
|                                  | Cost Reduction        | [ 8 ]        |                  |      |    |
|                                  | Receiver Willingness  | [ 6 ]        |                  |      |    |
|                                  | Compet Initiate Proj. | [ 8 ]        |                  |      |    |
|                                  | Infrastructure        | [ 9 ]        |                  |      |    |
|                                  | Govern Suport         | [ 0 ]        |                  |      |    |
| Vehicle Park. Res. System (VPRS) | Law                   | [ 10 ]       |                  | 23   | 0  |
|                                  | Cost Reduction        | [ 9 ]        |                  |      |    |
|                                  | Receiver Willingness  | [ 1 ]        |                  |      |    |
|                                  | Compet Initiate Proj. | [ 1 ]        |                  |      |    |
|                                  | Infrastructure        | [ 10 ]       |                  |      |    |
|                                  | Govern Suport         | [ 10 ]       |                  |      |    |

## 2. Unstaffed off-hour deliveries

Who: 248 receivers in NYC

Stated preferences

What did we learn:

- Food and retail stores are the most interested
- Not only monetary incentives
- Trusted vendor could be equivalent to offering USD\$13,000

| Variables                        | Willingness |
|----------------------------------|-------------|
| <b>Industry Sector</b>           |             |
| Food and beverage stores         | +++         |
| Clothing stores                  | +           |
| Accommodation                    | +           |
| <b>Incentive</b>                 |             |
| One-time monetary incentive      | +++         |
| Trusted vendor                   | +++         |
| Shipping discounts               | ++          |
| Public recognition               | +           |
| Business support                 | +           |
| <b>Other receiver attributes</b> |             |
| Number of deliveries             | -           |

# 3. Purchasing in Sweden (Preliminary Study)

Who: 175 large transport  
purchasers in Sweden

Stated preferences

What can we learn:

- Who gives more importance  
to environmental efficient  
transport:
  - Industry sectors
  - influential factors in future

## 4. Receiver-led Consolidation

- Can receivers lead consolidation?
  - London Delivery Service Plans: 20% reduction in Palestra building, reduction of deliveries by 2/3 Almo, significant cost reduction Emirates stadium
  - Case of Waldorf Astoria in New York City, OHD + Consolidation
- Can we build an extensive program around this? Which receivers should be targeted?





# 4. Receiver-led consolidation

Who: 248 receivers in NYC

Stated preferences

What did we learn:

- About 20% of receivers are interested
- Large accommodation and food stores are the most interested
- Potential savings between 5 and 16% of delivery traffic in Manhattan

| Independent variables  | Elasticity |
|--|------------|
| Constant   | -0.290     |
| <b>North American Industry Classification System (NAICS)</b> |            |
| 444 (Building material)                                      | 0.248      |
| 442 (Furniture stores )                                      | 0.397      |
| 721 (Accommodation)  | 0.448      |
| 445 (Food and beverage stores )                              | 0.643      |
| ⋮  |            |
| <b>Interaction terms: Area &amp; NAICS</b>                   |            |
| Area and NAICS 445 (Food and beverage stores)                | -0.123     |
| <b>Interaction terms: Deliveries &amp; NAICS</b>             |            |
| Deliveries and NAICS 424 (Nondurable wholesalers)            | 0.005      |
| Deliveries and NAICS 445 (Food and beverage stores)          | 0.009      |
| n  | 231        |
| Pseudo R <sup>2</sup>  | 0.15       |
| Log Likelihood   | -98.05     |

# Conclusion

- The public sector has a key role to play to improve efficiency and sustainability of urban freight
- Supply approaches alone (e.g., infrastructure, technology) do not always lead to more sustainable outcomes:
  - More infrastructure or better technology leads to lower costs, it may induce demand
  - Demand management can bring about major benefits
- Holistic approaches are the key: infrastructure, technologies, operational changes, freight demand management
- Understanding freight behavior is crucial to take the right steps (target the right agent, offering the right policy lever, and the right magnitude)

Freight behavioral research can play an important role in informed decision-making

Thanks!

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