Facilitating the modal shift: demand management strategies & arbitration mechanisms
- Case study in Belgium

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Outline

- Problem setting
- Main concepts
- ABM framework
- Next steps
1. Problem setting

- **Import & export freight traffic:** expected increase of approx. 30% by 2040
  - Presence of large seaports: Antwerp – Bruges, North-Sea-Port & Ostend
  - Well connected international infrastructure

- **National freight traffic:** expected increase of 3% by 2040

Source: NR, MALTESE, PLANET v5.0.
### 1. Problem setting

<table>
<thead>
<tr>
<th></th>
<th>Road</th>
<th>Rail</th>
<th>Waterway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2019</strong></td>
<td>13</td>
<td>10</td>
<td>77</td>
</tr>
<tr>
<td><strong>2040</strong></td>
<td>11</td>
<td>12</td>
<td>77</td>
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</tbody>
</table>

**CURRENT AND FORECASTED MODAL SPLIT FREIGHT TRANSPORT BELGIUM (% BASED ON T-KM)**

*Source: Own creation based on Federaal Planbureau (2022)*
1. Problem setting

External effects

<table>
<thead>
<tr>
<th></th>
<th>ANTWERP</th>
<th>BRUSSELS</th>
<th>GHENT</th>
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<tr>
<td>2019</td>
<td>55</td>
<td>27</td>
<td>76</td>
</tr>
<tr>
<td>2040</td>
<td>49</td>
<td>26</td>
<td>68</td>
</tr>
</tbody>
</table>

**Average Speed During Peak Hours (km/h)**

Source: Own creation based on Federaal Planbureau (2022)

**Evolution Speed on Main Roads During Peak Hours**

**EU (Convention) – Share of Transport Greenhouse Gas Emissions**

- Other Transportation: 71.7%
- Aviation: 13.4%
- Road transport: 13.9%
- Maritime: 1.9%
- Railways: 0.1%

Source: Databank Transport en PLANET V5.0 (Federaal Planbureau)
1. Problem setting

- Waterborne transport:
  - Large & branched waterway network in Belgium

- Safest and most reliable mode
- Transport emissions per ton-mile are lower compared to trucks
1. Problem setting

- To stimulate modal shift: inter-, multi-, co-, synchronmodality
  - Operational research: maturity phase
    ⇔ not yet often implemented in practice
      • Industry reluctance
      • CSF: Coordination, cooperation and control

- Main observations of today’s practices:
  - Still heavy reliance on truck transport → externalities
  - Operationalization of multi- and synchronmodality: challenged by CSFs
2. Main concepts

1. Freight demand management strategies
   • **Which freight demand management strategies can be implemented to better utilize the available capacity on other modes and thus stimulate the modal shift?**

Scope: Hinterland transport chain for import and export containers
2. Main concepts

Arbitration mechanisms

- Where in the transport chain should these be implemented?
- Which and how should arbitration mechanisms be implemented?
2. Main concepts

Mode-free booking
3. ABM framework

**Barriers**
- Different business interests
- Unequal impact on costs and gains
- Information asymmetry
- Complex dynamic interactions

**Actors & their properties**
- Utility function
- Business interests
- Cost functions
- Gain functions
- Information sources and use

**Actors & their interactions**
- Interactions

**Agent-based model**
- Agents and their properties
- Agents’ interactions
- Agents’ environment
- Agents’ behavioral rules

**Inputs**
- Demand management strategy
- Quantifiable impact of the strategy
- Potential arbitration mechanisms

**Simulation**
- Initial impact on demand after activation of demand management strategy
- Check where conflicts arise
- Solve imbalances by applying the appropriate arbitration mechanisms
- Additional demand

Feedback loop
4. Next steps & corresponding methodologies

1. Literature review
   - Freight demand management strategies
   - Arbitration mechanisms
2. Interviews & workshops
3. Data exploration
4. Next steps & corresponding methodologies

- **Data:**
  - *Strategic Freight Model Flanders*
  - *On-board Unit (OBU): GPS points*
    - New point emitted every 15 sec
    - Infrastructure level: calculate densities
      - truck level: origin-destination information
  - *O-D data for barges*
    - Flemish Waterways
4. Next steps & corresponding methodologies
Thank you!