Performance measurement in freight transport:

its contribution to the design of public policy

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Freight Transport Performance Measurement

Oh, if only it were so simple
Alignment of Freight Data Collection with Policy Formulation

Need a set of basic freight statistics to get started

As freight policy evolves – statistical requirements expand

Main Forms of Public Policy Intervention in Freight Transport

Fiscal measures: taxes and charges
  - Financial incentives
  - Regulation
Nationalisation / privatisation / public-private partnerships
  - Infrastructure investment
  - Land use planning
  - Advisory / best-practice programmes
Support for research and development

Evidence-based decision-making in freight transport is very ‘data hungry’
Main areas of performance measurement in freight transport

1. Transport intensity: freight per unit of economic output
European trends in freight transport intensity

Ratio of freight tonne-kms to GDP
(index values 2000 = 100)

Source: Eurostat 2014

Source: Havenga and Simpson, 2014
Main areas of performance measurement in freight transport

1. Transport intensity: *freight per unit of economic output*

2. Modal split: *division of freight between transport modes*
Choice of metric for measuring modal split

\textit{tonne-kilometres or tonnes?}

\begin{itemize}
  \item Road: 65\% captive to road
  \item Rail: 15\% captive to rail
  \item Road-rail competition: 20\%
\end{itemize}

No allowance for:
- \textit{cubic volume value of the freight}
- Mis-representation of distance and inter-modality

**EU 27 Freight Modal Split**

\begin{itemize}
  \item Road: 80\% of freight market (tonnes-lifted)
  \item Rail: 10\% (tonne-km)
  \item Inland waterway: 10\%
\end{itemize}

Data source: Eurostat, 2009

Contestability of the freight market
Main areas of performance measurement in freight transport

1. Transport intensity: *freight per unit of economic output*

2. Modal split: *division of freight between transport modes*

3. Market diversity: *range of logistics services available*
Further differentiation by speed and range of logistics services
Main areas of performance measurement in freight transport

1. Transport intensity: \textit{freight per unit of economic output}

2. Modal split: \textit{division of freight between transport modes}

3. Market diversity: \textit{range of logistics services available}

4. Operational efficiency: \textit{use of resources / capacity}
Productivity and Utilisation in the Freight Sector

Productivity: \textit{tonne-kms relative to vehicle numbers, employees, infrastructure capacity etc}

5-fold increase in productivity of UK trucking in 50 years

Does not indicate the proportion of vehicle carrying capacity actually used

Utilisation measures:
- Weight-based measures (deck-area coverage)
- Freight density
- Space-related measures (cube utilisation)
- % empty running
- Loaded trips

2-dimensional view: stacking height
3-dimensional view: cube utilisation
Articulated Trucks with a gross weight over 33 tonnes (UK)

**Lading factor: % of available tonne-km capacity used**

![Graph showing the lading factor from 2000 to 2010. The graph indicates a decline in performance from 67% in 2000 to around 59% in 2010.]

- Weight-based measured performance declined

**% of Loads Constrained by Volume and Weight in the UK**

Large increase in % of loads subject to volumetric constraint

![Bar chart showing the percentage of loads constrained by weight, volume, and both for the years 2000 and 2010. The chart shows a significant increase in loads limited by both constraints in 2010.]
Measuring the Efficiency of Multiple Drop Rounds: *lading factor vs fuel efficiency*

**drop heavy loads last**

1 → 2 → DC → 3 → 4 → 5

- **Actual:** 550 tonne-kms
- **Maximum:** 900 tonne-kms
- **% lading factor:** 61%

**drop heavy loads first**

1 ← 2 ← DC ← 3 ← 4 ← 5

- **Actual:** 350 tonne-kms
- **Maximum:** 900 tonne-kms
- **% lading factor:** 38%

\[ X = \text{tonnes delivered} \]

Journey leg all 10 km

**fuel use and CO\(_2\) 57% higher**
Energy efficiency and carbon intensity of freight transport

Energy efficiency of US railfreight (ton-miles per gallon)

Different methods of estimating carbon footprint of UK trucking – yield very different trends

Projected trends in CO₂ emissions from trucking in Germany

<table>
<thead>
<tr>
<th>Method</th>
<th>Index (1990 = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. NAEI (pre-March 2008)</td>
<td></td>
</tr>
<tr>
<td>2. NAEI (post-March 2008)</td>
<td></td>
</tr>
<tr>
<td>5. Our estimate (NRTS veh-km - pre 2008 CSRGT values)</td>
<td></td>
</tr>
<tr>
<td>6. Our estimate (CSRGT veh-km + 2008 CSRGT revision)</td>
<td></td>
</tr>
<tr>
<td>7. Our estimate (NRTS veh-km + 2008 CSRGT revision)</td>
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<table>
<thead>
<tr>
<th>Year</th>
<th>% Increase</th>
</tr>
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<tbody>
<tr>
<td>1980</td>
<td>101%</td>
</tr>
<tr>
<td>1990</td>
<td>42%</td>
</tr>
<tr>
<td>2000</td>
<td>19%</td>
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</table>
Main areas of performance measurement in freight transport

1. Transport intensity: *freight per unit of economic output*

2. Modal split: *division of freight between transport modes*

3. Market diversity: *range of logistics services available*

4. Operational efficiency: *use of resources / capacity*

5. Service quality: *mainly transit time and reliability*
Service Quality Metrics

Network performance

**Average speed**
**Average delay per vehicle-km**

Terminal performance

**Average throughput time**
**Variability in throughput time**

Cross-border performance

**Average border crossing time**
**Customs-related delays**

Logistics system performance

**% of on-time deliveries**
**% of on-shelf availability**

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**Average Weekday Delay to Trucks on UK Trunk Roads**

<table>
<thead>
<tr>
<th></th>
<th>Morning peak</th>
<th>Off-peak</th>
<th>Afternoon peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes</td>
<td>0</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

**Speed-flow curve**

- **Unreliability**
  - Interaction with other causes of logistical unreliability
  - Indirect effect of delays on other economic activities
  - Monetary valuation of direct and indirect costs of delay
Main areas of performance measurement in freight transport

1. Transport intensity: freight per unit of economic output

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4. Operational efficiency: use of resources/capacity

5. Service quality: mainly transit time and reliability

6. Environmental impact: atmospheric emissions, noise and accidents
Environmental Variables

\[ \text{CO}_2 \text{ emissions} = f(\text{fuel use}) \]

Noxious gases:

- fuel use
- fuel quality
- vehicle emission standards

Traffic accidents involving freight vehicles

Fatalities in accidents involving trucks in EU 19

Emission standards of Dutch truck fleet

Internalisation of the environmental costs of freight transport

Monetary valuation of externalities
Compiling Freight Performance Statistics

Problems and Constraints

- Insufficient attention given to performance measurement in the freight policy-making process.
- Isolating and evaluating the effects of individual freight policy initiatives is difficult.
- Different metrics give differing impressions of performance.
- Ensure that metrics induce the desired behavioural response.
- Major differences in the nature and amount of performance data available for different modes.
- Chronic lack of volumetric data: over-reliance on weight-based statistics.
- Data relate to individual freight journeys: lack a supply chain perspective.

- Of less relevance in a 3D printed world.
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