Modelling the future impact of freight transport on the environment

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5th September 2007
Green Logistics

- The Green Logistics project is a 4 year project funded by the Engineering and Physical Sciences Research Council (EPSRC).

- The research team - a consortium of 6 UK universities (Leeds, Cardiff, Heriot-Watt, Lancaster, Southampton and Westminster).

- The aim of GL project is to look at different ways to improve the economic, environmental and social sustainability of the UK transport industry.

- Heriot-Watt University - leadership in WM2, WM8 and WM12.

www.greenlogistics.org
WM2- Understanding and forecasting Business-as-Usual (BAU) trends

- Reason: To be able to predict the effects of future policies we need to project what the future would be like without any new interventions
- Time scale: January 2007- May 2008

Objectives of WM2:
- Analyse business-as-usual trends in a series of key parameters which determine the environmental impact of freight movement
- Canvas expert opinion on future trends in these parameters (Focus Groups, Delphi survey)
- Construct a forecasting model capable of making baseline projections of these parameters
**Modal split**
- % of freight moved by rail
- % of freight moved by water

**Supply chain structure**
- Number of links in chain
- Average length of links

**Vehicle utilisation**
- Level of empty running
- Load factor on laden trips

**Fuel management**
- Fuel efficiency
- Carbon content of fuel
Focus group research

- Seven focus group workshops (March – June 2007)
- Organised and conducted in co-operation with Cardiff University (WM1)
- Five locations across UK to represent the intensity of logistics flows in Britain (London×2, Nottingham×2, Birmingham, Edinburgh, Cardiff)
- Sample:
  - 156 invitations sent+ 21 more invitees
  - 84 acceptances, 58 participants (acceptance rate 50%, attendance rate 35%, absenteeism rate 31%)
Focus group research

Participants

- Logistics experts from different types of organisations: shippers, enablers, carriers, trade bodies, customers and policy makers
- Representatives of 13 different industry sectors: retail, 3PLs, IT providers, waste and recycling, construction, health etc.

Key issues discussed

- What will be the business-as-usual trends to 2020?
- What will be the key drivers of these trends?
- Are changes likely to be gradual and / or dramatic?
- To what extent will trends vary between sectors?
Focus group research

Analysis

- Digital recordings of each session
- Notes taken at the event by the research team
- Detailed summary of the focus groups based on the notes and recordings
- Frequency tables

Results

- Identification of different factors affecting key supply chain trends & parameters
- Better understanding of issues influencing different types of supply chains
- Results used to construct a Delphi questionnaire
Decoupling of economic growth and road freight traffic growth

Reasons for decoupling:

- Changing composition of GDP (service-based industry)
- Offshoring of manufacturing, increase in imports
- Miniaturisation, lighter and higher value-density products
- Modal split
- Better stock management
- Displacement of freight to vans
- Growing penetration of the UK haulage market by foreign operators

The participants expected the decoupling trend to continue in the future.
Supply chain structure – handling factor

Factors influencing the handling factor:

- Hub-and-spoke networks
- Consolidation initiatives:
  - Primary consolidation
  - Urban delivery consolidation centres
- E-commerce
- Reverse logistics
- Import of store-ready goods (DC bypass)
- Road pricing/ fuel prices/ congestion

The handling factor represents the average number of links in the supply chain.

The overall effect is difficult to predict because the different trends contradict each other.
Supply chain structure – average length of haul

Average length of the links in the supply chain

Factors influencing the average length of haul:

- Centralisation vs. decentralisation
- Geographical extend of sourcing
- Hub-and-spoke networks
- IT systems (CVRS, satellite tracking)
- Road pricing/ fuel prices/ congestion
- Working Time Directive / Drivers’ Hours Rules
- Expanding port hinterlands

Again, the overall effect is difficult to predict because the different trends contradict each other.
Freight modal split

**Issues affecting rail freight transport:**
- Suitability of rail to move particular products
- Reliability and vulnerability of the rail network
- Capacity problems with existing infrastructure
- Fuel prices, road charging and congestion of road infrastructure
- Need for ‘real’ Government policies
- Potential use for container traffic
- Flexibility issues
- Ability to support JIT replenishment

**Factors affecting coastal shipping:**
- Development of coastal ro-ro services
- Feeder movements from the deep sea ports
- Relative cost
- Competition between rail and coastal shipping
- Consolidation initiatives (loading hubs) e.g. timber

Participants did not anticipate any major changes in the share of the rail freight transport. However, the share of the coastal shipping services is likely to increase.
Vehicle utilisation – empty running

Factors influencing empty running:

- Technology (Telematics, CVRS)
- Working Time Directive / Drivers’ Hours Rules
- Consolidation / collaboration initiatives
- Hidden empty running e.g. empty containers
- Reverse logistics
- Freight exchanges / online matching services
- Increasing costs of transport
- Need to prioritise outbound delivery
- Waste regulations

Participants anticipated empty running to fluctuate around the present level.
A weight-based measure
% of available capacity utilised on laden trips

Factors influencing vehicle loading:
- Consolidation / collaboration initiatives
- JIT / lower inventory levels
- Need for more space-efficient packaging/handling equipment
- Loads are volume-limited
- Demands from the retailers
- Increase in max weight and size of lorries
- Business is service- rather than cost-driven

Again participants were not expecting significant changes to the loading factor of vehicles.
Fuel management

Factors affecting fuel management:

- SAFED training/ fuel efficiency programmes
- New Euro emission standards
- Night- time delivery / ‘out of hours’ operation
- Technology (Telematics, speed limiters, cruise control devices)
- Alternative fuels – bio-diesel, electric trucks
- Fuel prices- if oil becomes very expensive companies will switch to alternative fuels
- Electricity- the infrastructure already exists

Participants generally had concerns regarding the future use of biodiesel.

Fuel efficiency: average kms per litre
Carbon intensity: average CO2 per litre
Spreadsheet model

- Developed in Excel
- Data sources:
  - Government statistics, reports and other publications (DfT, DEFRA)
  - Statistics and publications from trade bodies (FTA, RHA)
  - NAEI data (National Atmospheric Emissions Inventory)
  - Other sources (UK and EU projects etc.)
- Initial modelling
- Delphi study – quantification of possible changes in key parameters
- Final modelling based on the results from the Delphi survey
- Synthesis of results in final report
Initial results

- Three theoretical scenarios
- Cost data sourced from reports published by DfT and DEFRA
- Cost of carbon (in 2005 prices):
  - low estimate = £43.95 per tonne
  - medium estimate = £82.59 per tonne
  - high estimate = £159.88 per tonne
- Stern Review ≈ £232 per tonne (2005 prices)

<table>
<thead>
<tr>
<th>Supply Chain Structure/ Modal split</th>
<th>Optimistic scenario</th>
<th>Neutral scenario</th>
<th>Pessimistic scenario</th>
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<tbody>
<tr>
<td>Distance travelled by HGVs</td>
<td>no change</td>
<td>15% increase</td>
<td>30% increase</td>
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<tr>
<td>Vehicle utilisation</td>
<td></td>
<td></td>
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<tr>
<td>Empty running</td>
<td>10% reduction</td>
<td>no change</td>
<td>10% increase</td>
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<tr>
<td>Lading factor</td>
<td>10% increase</td>
<td>no change</td>
<td>10% reduction</td>
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<tr>
<td>Fuel management</td>
<td></td>
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</tr>
<tr>
<td>Fuel efficiency</td>
<td>10% increase</td>
<td>5% increase</td>
<td>no change</td>
</tr>
<tr>
<td>Carbon intensity of fuel</td>
<td>10% reduction</td>
<td>5% reduction</td>
<td>no change</td>
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<tbody>
<tr>
<td>Low cost estimate</td>
<td>£6783m</td>
<td>£6079m</td>
<td>£7727m</td>
<td>£7980m</td>
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<tr>
<td>Medium cost estimate</td>
<td>£7152m</td>
<td>£6263m</td>
<td>£7983m</td>
<td>£8267m</td>
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<tr>
<td>High cost estimate</td>
<td>£7688m</td>
<td>£6584m</td>
<td>£8431m</td>
<td>£8774m</td>
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Internalisation of the external cost of road freight transport

**Taxes:** VED, fuel duty + VAT

**Externalities:** air pollution, noise, congestion, accidents and damage to roads/bridges

If congestion costs are not included the total external costs of road freight transport are almost fully internalised (91%).
Next step- Delphi questionnaire

- September 2007-December 2007
- Purpose: to quantify the trends identified by focus group participants
- Two rounds
- Expected sample size ≈ 100 responses
- Assuming response rate of 25% ≈ 400 questionnaires will be distributed
- Target group: participants of the focus groups who expressed an interest, senior managers, policy makers, academics, supply chain experts etc.