A Short History of Green Logistics Research in the UK

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Logistics Research Centre

Heriot-Watt University
Scope

- Most logistics research focuses on ways of saving money / increasing profitability

- Many efficiency improvements also yield environmental benefits

- Review confined to research which is explicitly concerned with the environmental impact of logistical activity
Research Sponsors and Participants

universities

research councils

Green Logistics Research

Green Logistics Project Launch  Birmingham 2006
Green Logistics Project Launch  Birmingham 2006

Research Sponsors and Participants

- environmental pressure groups
  - T2000, FoE, Greenpeace, CPRE
- central government
- government agencies (TRRL)
- local authorities
- consultants
- companies
- universities
- research councils
- trade associations
  - CSDF, FTA
- professional institutes
  - CILT, ICE, IHT, CIPS

funding
participation
Research Themes

• Reducing the environmental impact of freight transport

• Managing the return flow of waste – reverse logistics

• Minimising the effects of warehousing on surrounding areas
1970s

Origins of physical distribution / logistics as an academic discipline

Emergence of environmental campaigning against heavy lorry traffic and road construction

Concern mainly about localised impact of freight traffic

Cooling trend since 1945 causing concern about return of the Ice Age
Intrusion of the heavy lorry……..

‘Smash the next lamp on the left, flatten the pavement by the pub, nudge the sweet shop, scrape the Market Cross, then just follow the skid marks to London’

Punch 1973

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Growth of Anti-Lorry Sentiment

Reasons:

- Sharp increase in lorry traffic
- Erosion of freight traffic from rail
- Increased use of large trucks in retail delivery role
- Campaigning by environmental organisations: Civic Trust ‘Heavy Lorries’ (1970)

Initiatives

- Dykes Act (1973) on Lorry Routing
- Lorries and the Environment Committee (1974-79)
- Pettit Inquiry (1973) ‘Lorries and the World We Live In’
- Armitage Inquiry 1980
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Transport and Road Research Laboratory: Freight Studies

- Quiet heavy vehicle
- Urban freight studies
- Empty running by lorries
- Lorry routing schemes
- Public perception of lorries
Many Small versus Few Big Dilemma

Some environmental costs correlate strongly with vehicle numbers:

e.g. air pollution, noise and accident risk

Others correlate mainly with vehicle size and weight:

e.g. vibration, accident severity, visual intrusion

1 x 16 tonne load  2 x 8 tonne loads  4 x 4 tonne loads
Testing Public Perceptions of Vehicle Size

330 people interviewed in two towns

**Inconclusive result:**

‘no clear preferences can be established’

4 small and 1 large vehicle combinations were equally disliked.

2 medium sized vehicles were the least disliked
Urban Freight Studies

1970s: ‘heyday of the urban freight study’

Differing emphasis:

_North America:_ load consolidation – ‘small order problem’

_Europe:_ load disaggregation – ‘ban large vehicles from towns’

Urban transhipment

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Consultant / Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammersmith</td>
<td>1974</td>
<td>Metra Ltd.</td>
</tr>
<tr>
<td>Camberley</td>
<td>1975</td>
<td>CIDP Ltd.</td>
</tr>
<tr>
<td>Chichester</td>
<td>1975</td>
<td>Lichfield and Assocs</td>
</tr>
<tr>
<td>Bradford</td>
<td>1975</td>
<td>WYTCONSULT</td>
</tr>
<tr>
<td>Swindon</td>
<td>1976</td>
<td>Transport and Road Research Lab. (TRRL)</td>
</tr>
<tr>
<td>Hull</td>
<td>1976</td>
<td>Lorries and the Environment Committee</td>
</tr>
<tr>
<td>Barnsley</td>
<td>1976</td>
<td>Urquhart (PhD thesis)</td>
</tr>
</tbody>
</table>

Urban Distribution Centre
1980s

- Greater London Council:
  - freight on freight consolidation and freight complexes
  - Wood Inquiry into the night lorry ban

- Impact of warehousing development (Dept of the Environment)

- Development of intermodal transport (‘combined transport’)
Industry Initiative: Greening of the ILDM 1993

- Analysing the environmental impact of logistics
- Establishing environmental best practice
- Promoting adoption of green practices
- Heading-off tougher government regulation

78% of logistics managers considered the EU to be the main source of pressure to green logistics operations.
Importance of Environmental Issues to Logistics Managers

1994 survey

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>% of Logistics Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste / packaging material</td>
<td>25%</td>
</tr>
<tr>
<td>Vehicle emissions</td>
<td>25%</td>
</tr>
<tr>
<td>Public perception of trucks</td>
<td>20%</td>
</tr>
<tr>
<td>Fuel utilisation</td>
<td>15%</td>
</tr>
<tr>
<td>Road congestion</td>
<td>10%</td>
</tr>
<tr>
<td>Environmental costs</td>
<td>5%</td>
</tr>
<tr>
<td>Choice of transport mode</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: PE Consulting / Institute of Logistics

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Local Environmental Impact of a Distribution Centre

**Intrusion:**
- Visual Air Noise
- Energy
  - generators
  - refrigeration units
- Maintenance
  - storage
  - fuel/oil storage
  - vehicle wash
  - parking
- Time
- Distance
- Wind
- Seasonal

**Contamination:**
- Water Land
- Waste oil
  - chemicals
  - litter

**Risk:**
- Safety
- Fire
- Property
- Effects on residences
- Vehicle routes
  - site access
- External depot
- Security
  - Lights;
  - Load speaker
- Source: Worsford / Department of Transport

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The Landscaped Warehouse

Source: Logistics Manager 1/2005

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Some suppliers have adapted better than others to the disciplines of just-in-time delivery
• Funded research at Heriot-Watt and Cranfield on the relationship between logistics trends, freight traffic growth and environmental impact

• Developed new frameworks for the analysis of this relationship and conducted extensive surveys of logistics managers in different industrial sectors

• Formed the basis for later EU 4th and 5th Framework research projects on links between logistics and freight traffic growth at a European level: REDEFINE and SULOGLTRA

SuLLy chain LOGistics TRAnsport
EU Research Frameworks

Support for research on many aspects of Green Logistics

- REDEFINE
- Infredat
- STEMM
- Sulogtra
- Possum
- Trilog Europe
- Emma
- Stella
- Sprite
- BEST

Green Logistics Project Launch  Birmingham 2006
### Effect of Transport Cost Increases on the Optimum Number of Distribution Centres

<table>
<thead>
<tr>
<th>Value Density £/tonne</th>
<th>Typical Product</th>
<th>Present Level</th>
<th>+50%</th>
<th>+100%</th>
<th>+150%</th>
<th>+200%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>W</td>
<td>D</td>
<td>W</td>
<td>D</td>
<td>W</td>
</tr>
<tr>
<td>50</td>
<td>Cement</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>100</td>
<td>Compound Fertiliser</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>500</td>
<td>Paper</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>1000</td>
<td>Cakes</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5000</td>
<td>Stainless Steel Sinks</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10000</td>
<td>Clothing</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>20000</td>
<td>Personal Computers</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

W = Weekly Delivery
D = Daily Delivery

Optimum number of distribution centres to supply the UK
The Food Miles Issue


Transportation Relationships
STRAWBERRY YOGHURT
Showing the main transportation of materials for the manufacture of 150g pot of strawberry yoghurt

Transport Intensity and environmental impact of the yoghurt supply chain

For every pot of yoghurt sold in a German supermarket a truck travels 9 metres

S. Boge, Wupperthal Institute 1993
‘Food Miles’ Issue

Effect of Globalisation on the Christmas Dinner

Guardian 11 Dec 2001

Bottled water airfreighted to the UK from Fiji

The Validity of Food Miles as an Indicator of Sustainable Development

Final Report produced for DEFRA
Social Costs of Food Transport

Total social costs of UK-generated food transport 2002
£9.1 bn

Source: AEA Technology et al 2005
‘We recommend that all urban authorities adopt a presumption against access for HGVs over 17 tonnes’

‘The target we propose for rail is to increase the proportion of tonne-kms carried by rail from 6.5% to 10% by 2000 and 20% by 2010’

‘We believe a sustainable transport policy would be based on growth of no more than 10% a decade in overall demand for freight transport over the next 30 years.’
Challenging Freight Transport Planning Orthodoxy

Freight Transport, Logistics
—and—
Sustainable Development

‘Freight absurdities - the movement of goods over large distances for no apparent reason...need to curb the rise in pointless freight transport’

Fallacy of ‘predict and provide’
Weak versus Strong Sustainability

Weak sustainable development:

- environmental objectives are traded-off against economic and social objectives

Strong sustainable development:

- environmental considerations impose an absolute constraint on the achievement of economic and social objectives

Source: Whitelegg, 1995
Close Correlation between Economic Growth and the Growth of Road Freight Transport

Index 1990=100

GDP
Tonne-km

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Decoupling of road tonne-km GDP trends

Index value (1990=100)

- GDP
- road tonne-kms
Factors Contributing to the Decoupling

- Erosion of manufacturing to other countries
- Changing structure of the economy
- Domestic supply chains becoming fully extended

Tonne-kms in line with GDP

- Foreign haulier penetration: 33%
- Modal shift: 67%
- Higher rates
- Other factors

1997 - 2004
Freight Modal Split 1985-2004

Source: DfT

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Application of the polluter pays principle

Source: INFRAS/IWW3/2000

Green Logistics Project Launch  Birmingham 2006
Variations in CO$_2$ Emissions per Tonne-km by Mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>CO$_2$ Emissions (g per tonne-km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft (500km)</td>
<td>1420</td>
</tr>
<tr>
<td>Aircraft (1500km)</td>
<td>800</td>
</tr>
<tr>
<td>Truck (20 tonnes)</td>
<td>200</td>
</tr>
<tr>
<td>Truck (35 tonnes)</td>
<td>100</td>
</tr>
<tr>
<td>Train (diesel)</td>
<td>69</td>
</tr>
<tr>
<td>Train (electric)</td>
<td>38</td>
</tr>
<tr>
<td>Barge</td>
<td>40</td>
</tr>
<tr>
<td>Coastal vessel</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: Dings and Dijstra (1997)
Research on Freight Modal Split

- Numerous research papers and theses on freight modal split issue
- Innovative methodologies developed: stated preference models
  Leeds Adaptive Stated Preference (LASP) model
- Development of new multi-modal freight forecasting tools

‘Marine Motorways’
New Initiatives on Packaging Waste
Reverse Logistics

- packaging waste directives in Europe
- growth of interest in returnable packaging
- Jim Stock’s CLM White Paper on ‘Reverse Logistics’
- US academics associate Green Logistics with Reverse Logistics

‘The movement of materials from the earth through production, distribution and consumption back to the earth.’

Jonathan Weeks (1996 chairman of the Institute of Logistics)

- impact of the recycling of packaging waste on freight transport system
- rationalising the movement of domestic waste in urban areas
Modelling the Reverse Supply Chain

Information
new product
return flow
Central Recovery Unit

Original channel

Raw materials

Service

Secondary market channel

Waste Management
7. Incineration
8. Land filling

Product Recovery Management
5. Cannibalisation
6. Recycling

Direct Reuse
2. Repair
3. Refurbishment
4. Remanufacture
1. Direct reuse / resale

Source: based on Thierry et. al. Integrated supply chain (1995)
Research on Sustainable Distribution

- Identified new research areas
- Promise of a new journal of sustainable distribution research
- Future Integrated Transport research programme:
  - 5 freight projects out of 44
- Formation of the Freight and Logistics Research Group
- Funding of research to support TransportEnergy Best Practice Programme
Industry – Government – University Collaboration

- Best practice initiatives
- Support for industry-led benchmarking schemes
- Advisory programmes

Transport KPI programme

Key Performance Indicators surveys:

- Food supply chain
- Pallet load networks
- Automotive supply chain
- Parcel delivery network
- Non-food retail distribution
- Construction supply chain

- ‘synchronised audits’ over 48 hour periods
- benchmarking of vehicle utilisation and energy efficiency
Greening of Road Freight Transport

Effects of Tightening Euro-emission Standards

Source: Dureal

Projected Emissions from Road Freight Operations in the UK

Source: UK Dept for Transport

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Vehicle Telematics and Routing Systems

- Cutting vehicle kilometres
- Minimising exposure to traffic congestion
- Cutting fuel consumption and CO2 emissions
- Permitting more environmentally-sensitive charging systems

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Press and Public Continue to Dislike Lorries
Climate Change: the New Priority

32.4 m tonnes of CO2 from freight transport
20% of all transport CO2 emissions
5% of total UK CO2 emissions

Source: Lefevere

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Retail Consolidation Systems

Freight Consolidation Scheme

University of Westminster review of urban freight consolidation for DfT

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Development of the Life Cycle Approach
Logistics Contribution to Total Externalities

Need to minimise ‘embedded carbon’ in products
Use of Supply Chain Mapping Tools to Measure CO$_2$ Emissions

University of Cardiff, 2004
Applying Lean Supply Chain Principles on CO₂ Emissions

Analysis of a food supply chain in the UK
Concluded that leaner supply chains also had lower CO₂ emissions

<table>
<thead>
<tr>
<th></th>
<th>Current State</th>
<th>Future State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
<td>%</td>
</tr>
<tr>
<td>VA</td>
<td>22.2h</td>
<td>5.3</td>
</tr>
<tr>
<td>NNVA</td>
<td>6.5h</td>
<td>1.6</td>
</tr>
<tr>
<td>NVA</td>
<td>387h</td>
<td>93.1</td>
</tr>
<tr>
<td>Total</td>
<td>416h</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Mason et al, Cardiff University, 2002

ITeLs Project
Impact of Inventory Centralisation on CO₂ Emissions

Case study: ITT Flygt

<table>
<thead>
<tr>
<th></th>
<th>Decentralised system</th>
<th>Centralised system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average length of haul</td>
<td>1512 km</td>
<td>2153 km</td>
</tr>
<tr>
<td>Total tonne-kms (ann.)</td>
<td>2.2 million</td>
<td>2.9 million</td>
</tr>
<tr>
<td>CO₂ emissions (ann.)</td>
<td>92.2 tonnes</td>
<td>131.1 tonnes</td>
</tr>
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Kohn 2005
Conclusions

• Research objectives evolved from curbing the HGV to wider analysis of supply chain impacts
• Emphasis shifted from localised environmental impacts to global warming
• Close involvement of government, industry and trade bodies
• Priority given to green-gold measures – weak form of sustainability
• Externalities per tonne-km in the UK have been declining
• Globally tonne-kms are increasing – exporting the pollution problem
• Sharp increase in corporate awareness of environmental issues
• Plenty work still to be done
Contact details

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http://www.sml.hw.ac.uk/logistics