Improving the Economic Efficiency and Environmental Sustainability of Road Haulage

Professor Alan McKinnon

*Kühne Logistics University*

*Hamburg*

Irish Haulage Strategy Webinar

*16th June 2021*
Road Haulage Sector: **defining characteristics**

- low barriers to entry
- few economies of scale
- highly fragmented
- intensely competitive
- treated as commodity service
- low margin
- high level of subcontracting
- under-utilisation of capacity

Operational inefficiencies largely the result from need to meet clients’ logistics requirements

Prioritising commercial performance / survival over environmental sustainability

Survey of 800 small and medium-sized European road carriers

Priority to be given to decarbonisation in road freight sector

Importance of fuel efficiency in long term strategy

<table>
<thead>
<tr>
<th>Priority</th>
<th>Low</th>
<th>Moderate</th>
<th>Large</th>
<th>Very Large</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19%</td>
<td>32%</td>
<td>11%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>32%</td>
<td>32%</td>
<td>11%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>3</td>
<td>32%</td>
<td>11%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>4</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>5</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Business opportunity in improving sustainability?**

- very large: 5%
- large: 11%
- moderate: 32%
- small: 32%
- none: 19%

Decarbonising Road Freight Transport by 2050

Leveraging key freight parameters to achieve a 90% reduction in CO₂ emissions

Scenario 1

- Transfer 30% of road tonne-kms to rail
- 80% reduction in carbon intensity of rail freight
- 25% improvement in efficiency of truck routeing
- 30% increase in loading of laden trucks
- 30% reduction in empty running of trucks
- 50% increase in truck energy efficiency
- 60% drop in carbon content of truck energy

90% reduction in carbon intensity

At 2017 rate of truck replacement in EU:
13 – 14 years to replace the fleet once mass production and uptake begins

28% more accumulated CO₂ emissions by 2050

Heavier reliance on switch to low carbon energy

25% improvement in efficiency of truck routeing
Transfer 30% of road tonne-kms to rail
80% reduction in carbon intensity of rail freight

EU road tkm reference scenario (with constant carbon intensity)

BAU trend

2025 peak
2035 peak

2015 2020 2025 2030 2035 2040 2045 2050

BAU
2035 peak
2025 peak

- Modal shift to rail
- Improve routing of road freight
- Raise lorry load factor
- Reduce lorry empty running
- Increase lorry energy efficiency
- Reduce carbon intensity of energy
Possible Contribution of MOB Options to Road Freight Decarbonisation

- Faster to implement
- Yield economic + environmental benefit
- Low capital investment
- Need changes in business practice, operating procedures, skill levels and mindset

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is

UK road freight trends in key parameters

- Weight-based load factor on laden trips
- Average fuel efficiency of road freight operations
- % of empty running

IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is

42% contribution of logistics to fuel savings

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is


IEA (2017)
The Future of Trucks: A Clean Solution

IEA (2017)

ETC (2019)
https://bit.ly/3jcc1is

Constraints on the Utilisation of Vehicle Capacity

many factors constraining vehicle utilisation

- Market-related
  - Demand fluctuations
  - Lack of knowledge loading opportunities
- Regulatory
  - Health and safety regulations
  - Vehicle size and weight restrictions
  - Unreliable delivery schedules
  - Just-in-Time delivery
- Inter-functional
  - Goods handling requirements
- Infrastructural
  - Limited storage capacity at facilities
  - Incompatibility of vehicles and products
  - Geographical imbalances in freight flow
- Equipment-related
  - Poor coordination of purchasing, sales and logistics

retrospective analysis of potential for backloading

9000 journeys by 29 lorry fleets over 48 hours

Source: McKinnon and Ge, 2005
Optimising the Utilisation of Vehicle Capacity

% empty running

loaded trips

average payload weight

% space utilisation

% weight utilisation

2-dimensional view
floor-area coverage

3-dimensional view
cube utilisation

data availability

high

Macro-level Truck Utilisation Statistics: available data in EU

https://bit.ly/3vpWDoV
Supply Chain Collaboration

Deep decarbonisation of road freight transport will need much greater sharing of vehicle capacity

Nestle – Pepsico Horizontal Collaboration in Benelux

1. Separate delivery operations
2. Groupage by Logistics Provider
3. Collaborative synchronisation

Kg CO2 / tonne

1. Separate delivery 43.8
2. Groupage 27.3
3. Collaborative synchronisation 20.3

Source: Jacobs et al 2014

EU project: Supply Chain Collaboration

The Physical Internet

applying networking of principles of the internet to physical movement of freight

Open, collaborative network with full visibility and incentivized asset sharing

‘Physical encapulation’ of goods in a new generation of modularised containers

The Physical Internet

High Capacity Transport: *relaxing truck size and weight constraints*

<table>
<thead>
<tr>
<th>Country</th>
<th>Maximum Length (metres)</th>
<th>Maximum Weight (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>25.25</td>
<td>40/44</td>
</tr>
<tr>
<td>Sweden</td>
<td>25.25</td>
<td>74</td>
</tr>
<tr>
<td>UK</td>
<td>Trial of 1-2 m longer trailers</td>
<td>Extensive use of double-deck trailers</td>
</tr>
<tr>
<td>Finland</td>
<td>34.5</td>
<td>76</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25.25m</td>
<td>60</td>
</tr>
<tr>
<td>Denmark</td>
<td>25.25</td>
<td>60</td>
</tr>
<tr>
<td>Norway</td>
<td>25.25</td>
<td>60</td>
</tr>
<tr>
<td>Spain</td>
<td>25.25</td>
<td>60</td>
</tr>
<tr>
<td>Flanders</td>
<td>HCT pilot project</td>
<td></td>
</tr>
</tbody>
</table>

*Load consolidation cuts truck-kms, fuel use, emissions, accidents and labour demands*

*Net CO₂ savings even after allowance made for modal shift and induced traffic*

**UK longer semi-trailer trial**

- **2013-2018**
- **37K tonnes of CO₂ e saved**


**Gaining extra capacity vertically:** UK double-deck trailer – *major contributor to UK road freight efficiency and decarbonisation*

- **5m**
  - UK ‘custom and practice’ 4.9m
  - Ireland 4.65m
  - Finland 4.4m
  - Slovenia 4.2m

*Double-decking within 4 m height limit: EWOS (Netherlands)*

*Case study*

https://bit.ly/3cO7GSl 48% reduction in CO₂ emissions

Source: ITF (2015)
Impact of digitalisation on the efficiency and sustainability of road haulage

% rating the impact of digitalisation on logistics as ‘high or transformational’

<table>
<thead>
<tr>
<th></th>
<th>in past 5 years</th>
<th>in next 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>total sample</strong></td>
<td>22%</td>
<td>74%</td>
</tr>
<tr>
<td><strong>Industry leaders</strong></td>
<td>25%</td>
<td>85%</td>
</tr>
<tr>
<td><strong>Logistics providers</strong></td>
<td>38%</td>
<td>86%</td>
</tr>
<tr>
<td><strong>Shippers</strong></td>
<td>9%</td>
<td>64%</td>
</tr>
</tbody>
</table>

survey of 92 logistics executives

Online freight procurement and optimisation
Upgrading of web platforms and software tools

Internet of things
Consignment-level visibility and connectivity

Data pooling
cloud computing, software-as-a-service

Supply chain applications of Blockchain

Smart road infrastructure

Intelligent connected vehicles

Advances in vehicle routeing / scheduling
Big data, predictive analytics etc

https://bit.ly/3e5cYlY

% rating the impact of digitalisation on logistics as ‘high or transformational’

<table>
<thead>
<tr>
<th></th>
<th>in past 5 years</th>
<th>in next 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>total sample</strong></td>
<td>22%</td>
<td>74%</td>
</tr>
<tr>
<td><strong>Industry leaders</strong></td>
<td>25%</td>
<td>85%</td>
</tr>
<tr>
<td><strong>Logistics providers</strong></td>
<td>38%</td>
<td>86%</td>
</tr>
<tr>
<td><strong>Shippers</strong></td>
<td>9%</td>
<td>64%</td>
</tr>
</tbody>
</table>
Some suppliers have adapted better than others to the disciplines of just-in-time delivery.

Relaxing JIT - an effective means of cutting carbon emissions?

Relaxing JIT:
- more time to consolidate loads and find backhauls
- easier for rail and water to compete for freight

But:
- JIT is business paradigm that minimizes waste
- contributes to energy / CO₂ savings in production + warehousing

Improving Energy Efficiency in the Road Freight Transport Sector

**Vehicle Technology:** new build + retrofits

**Driver Training and Monitoring:**
- eco-driver training
- telematic monitoring

**Change Operating Practices:**
- e.g. reduce maximum speed or rescheduling

**Improve Vehicle Maintenance**

**Upgrade Fuel Efficiency of Ancillary Equipment**
- e.g. more efficient transport refrigeration units, better insulation, improved operational procedures, alternative refrigerants

**Truck Platooning**

**Truck Automation**
20-75% CO₂ reductions in urban areas
Source: Sanchez-Diaz et al 2017
https://bit.ly/3gsLe3m

Effects of varying start times for deliveries across the UK trunk road network

Source: Palmer and Piecyk, 2010
https://bit.ly/3cL5lYh

constraints: synchronisation of production and logistics
noise disturbance
misalignment of stakeholder objectives
Increasing awareness and understanding of efficiency / sustainability interventions

<table>
<thead>
<tr>
<th>Measure</th>
<th>% Awareness</th>
<th>% Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-Driver training</td>
<td>76</td>
<td>69</td>
</tr>
<tr>
<td>Fleet manager training</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>Transport route optimization</td>
<td>64</td>
<td>57</td>
</tr>
<tr>
<td>Fuel consumption monitoring</td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>Driver performance tracking</td>
<td>64</td>
<td>60</td>
</tr>
<tr>
<td>Shorter vehicle-renewal cycles</td>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>Vehicle aerodynamics</td>
<td>33</td>
<td>24</td>
</tr>
<tr>
<td>Low rolling resistance tires</td>
<td>37</td>
<td>28</td>
</tr>
<tr>
<td>Light weighting</td>
<td>28</td>
<td>19</td>
</tr>
<tr>
<td>Anti-idling devices</td>
<td>23</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 3.2: Results from SRF Optimiser

<table>
<thead>
<tr>
<th>Carbon-saving measure</th>
<th>Net Present Value (£)</th>
<th>Cost savings per annum (£)</th>
<th>CO₂ savings per annum (KgCO₂)</th>
<th>Fuel saved (Litres)</th>
<th>Payback period (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telematics</td>
<td>11,400</td>
<td>3,600</td>
<td>7,800</td>
<td>3,100</td>
<td>0.8</td>
</tr>
<tr>
<td>Tear-drop trailer</td>
<td>11,300</td>
<td>4,400</td>
<td>9,600</td>
<td>3,700</td>
<td>2.3</td>
</tr>
<tr>
<td>Side skirts</td>
<td>8,300</td>
<td>1,800</td>
<td>4,000</td>
<td>1,600</td>
<td>1.4</td>
</tr>
<tr>
<td>Cab-roof fairing</td>
<td>6,100</td>
<td>1,800</td>
<td>3,900</td>
<td>1,500</td>
<td>1.5</td>
</tr>
<tr>
<td>Boat-tail</td>
<td>5,100</td>
<td>1,800</td>
<td>4,000</td>
<td>1,600</td>
<td>2.1</td>
</tr>
</tbody>
</table>


Freight Carbon Review 2017

https://bit.ly/2TDZWeY
Professor Alan McKinnon

Kühne Logistics University – the KLU
Wissenschaftliche Hochschule für Logistik und Unternehmensführung
Grosser Grasbrook 17
20457 Hamburg

tel.: +49 40 328707–271
fax: +49 40 328707–109

e-mail: Alan.McKinnon@the-klu.org
website: www.the-klu.org
www.alanmckinnon.co.uk

@alancmckinnon