September 25th — 26th, 2017 | Darmstadt, Germany
Interdisciplinary Conference
on Production, Logistics and Traffic
www.icplt.org

A cost and CO_2 comparison of using trains and higher capacity trucks when UK FMCG companies collaborate

Andrew Palmer[1], Phil Greening[1]

[1]Centre for Sustainable Road Freight, Heriot-Watt University, Edinburgh

Abstract. Practical examples of companies working in collaboration in Europe has shown that it is possible to achieve higher vehicle capacity utilisation and reduced empty running, resulting in lower costs and improved sustainability through reduced emissions and congestion. Collaboration produces higher volumes of goods to be moved than individual companies shipping goods on their own which means that efficiencies may be possible by considering rail and higher capacity vehicles. Real world transport flow data for one month was provided by ten FMCG companies. Detailed road and rail costs and operating characteristics were obtained and, with the transport flows, applied to a model to quantify the economic and environmental implications. The results of the analyses show potential savings by using double deck trailers, for just under half the transport flows, longer heavier vehicles for 30% of the flows and rail with different wagon configurations for the rest.

1 Background

EU statistics show that road transport efficiency has hardly changed over a ten year period with a range of between 24% and 28% empty vehicle running, and a capacity utilisation by weight ranging from 54% to 57% [1]. Optimizing truck movements through collaboration routinely achieves cost savings and efficiency gains of between 6% and 10% according to Transport Intelligence [2]. When companies collaborate there are higher volumes to be moved than if companies operate individually. The majority of long haul FMCG road traffic is undertaken by articulated trucks up to 44 tonnes with 13.6m semi-trailers capable of handling 26 UK sized pallets, single stacked. The FMCG sector tends to be more time constrained than most and the generally low density of freight carried means it is suitable for the use of higher volumetric capacity vehicles or trains.

The study addressed in this manuscript is part of a wider project to assess the potential for transport efficiency improvements by modelling the strategic opportunities for vertical and horizontal collaboration in FMCG supply chains. One particular strategy involving the use of regional consolidation centres was selected to examine in more detail because it produces a high volume of goods to be moved between regional consolidation centres which means that efficiencies may be possible by relaxing the freight mode constraints. The aim of the study is to focus on UK transport options and to set a credible independent, objective and impartial basis for an economic and sustainable evaluation that is rational and robust.

Information on road based truck costs and operations is readily available from various sources. However, the paucity of information from official and industry UK rail sources has long been a major problem in analysing multimodal sector cost and performance structures [3]. Despite this, sufficient

reliable information has been obtained to identify theoretically possible cost effective and environmentally beneficial modes of transport for various high volume flows so that FMCG companies can make informed, sustainable decisions which would be less freight transport intensive.

2 Methodology

Ten FMCG companies, consisting of two retailers, one wholesaler and seven manufacturers, provided comprehensive data on freight movements in either May or June 2013. This included all freight transport flows between depots and customers, inter-depot movements, returns from customers and supplier collections under the company's direct control (i.e. paid for by the company). For all the eligible flows, data was provided on the origin and destination postcode locations, the type of vehicle used, the number of pallets moved and frequency of delivery.

Transport costs were not requested from the participating companies because they would not form a consistent basis for comparison. In the UK there are various sources from which road based costs and operating characteristics can be sourced for a range of different vehicles. The Road Haulage Association cost tables were selected and used to apply fixed and variable costs to the various road based vehicle types used by the companies [4]. Obtaining rail freight costs and operating characteristics have been challenging. Because there are so few rail freight companies there is a reluctance to divulge sensitive commercial information. However, the necessary data were derived from two key papers [5,6], and a spreadsheet used by the Department for Transport for assessing rail freight grants was an important source of information.

The objective of the study was to consolidate part loads into nine regional consolidation centres located as shown in Figure 1. Centre of gravity techniques were used to position them to maximise the number of depots operated by the ten companies that fall within a 35km radius. Combined loads would be trunked between the regional consolidation centres, with local collection and delivery of the part-loads within each region. The consolidation centres would not be used for any intra-regional flows of part-loads.

In order to analyse this data an Excel based heuristic model was developed specifically to examine the cost and CO_2 impact of different road based and multi modal flows between these regional consolidation centres.

The following transport options were considered in the model:

- Semi-trailers containing two internal deck levels and increasingly being used in the UK (double decks).
- Longer semi-trailers (up to 15.65m) – a trial of this 2m longer semi trailer is taking place in the UK.
- Longer heavier vehicles - 25 metre, 60 tonne vehicles not currently permitted on UK roads but in use in various European countries.
- Locomotive with 26 wagons each carrying one 45' container filled with pallets
- Locomotive with 20 wagons as above
- Locomotive with 12 wagons as above
- TruckTrain with 5 wagons - a high speed, self-propelled rail freight concept that collects and delivers products by rail in close proximity to the origin and destination locations.

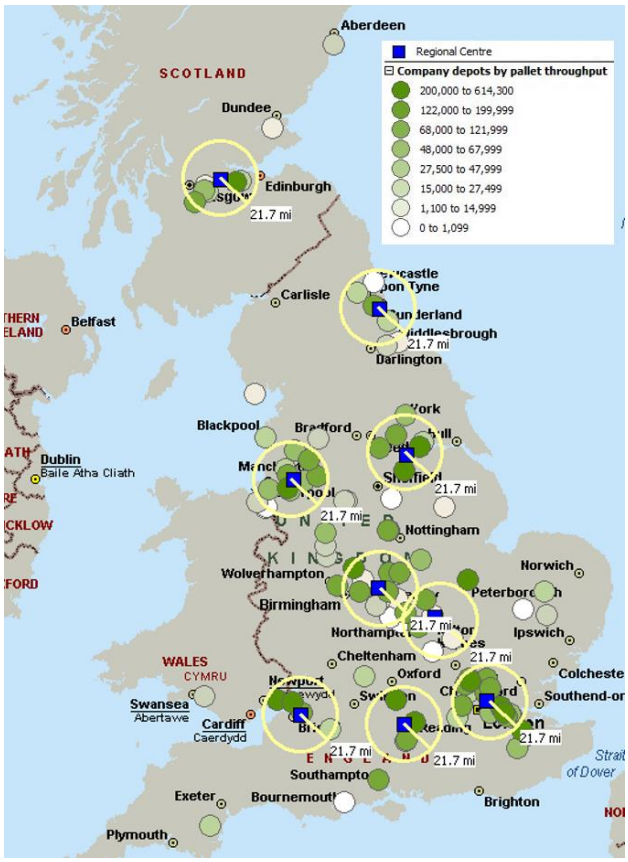

Figure 1. Location of regional consolidation centres

3 Results

Of the 1.8 million part load pallets delivered by the ten companies in one month, 1.35 million pallets remained within a region and 450,000 pallets were consolidated for movement between the nine regional consolidation centres. In total there were 51 flows between the regional consolidation centres, of which 11 were one way flows. Although in practice hauliers would always try to find return loads for vehicles with an outbound leg only, a worst case scenario assumption has been made in the model that any vehicle with a one way flow would be

costed as having an empty return leg. The volume of pallets moved between the nine regions varied from 31 pallets to over 31,000 pallets per month.

Two options have been modelled and analysed. The first is to place the regional consolidation centres at the centre of gravity location which means that the depots, customers and suppliers in a region have the lowest overall distance to travel to and from the regional consolidation centre. The second option is to place the regional consolidation centre at the nearest rail freight terminal which eliminates the road feeder distances between the rail freight terminals and the regional consolidation centres. In theory this should encourage the rail options to be selected by the model for the inter-regional movement, but may have a negative impact on distances between the depots, customers and suppliers moving goods to and from the regional consolidation centres.

The total transport costs of the ten companies operating individually was just over £77 million in the month considered, travelling 62 million kilometres and emitting just under 59,000 tonnes of CO_2. Table 1 shows the results of three strategies as a percentage saving against these totals. The first (base case) is based on a standard 44 tonne articulated truck for moving pallets between the regional consolidation centres and show almost a 4.8% reduction in kilometres and a similar fall in CO_2 emissions compared to the way the individual companies currently operate. However the smaller cost reduction reflects a relatively smaller saving in time. One of the disadvantages of considering regional consolidation centres is the additional time taken for cross-docking. Part loads undergo additional handling at consolidation centres in both the origin and destination regions. This inflates unloading and loading times and potentially increases the risk of product damage. Option 1 shows an extra 0.9% cost saving by using the alternative higher capacity vehicles or rail with a commensurate reduction of 1.8% in kilometres and 1.4% in CO_2. However, if regional consolidation centres are located at the nearest rail freight terminals (option 2) instead of their centre of gravity location, then the cost, kilometres and CO_2 savings are much lower. The cost saving for option 2 is less than half that of option 1. This is due to a higher cost of moving all part load goods between the depots, customers and suppliers and the co-located regional consolidation centres and rail freight terminals. These results are for transport operations only and do not include the costs of any consolidation centre.

Table 1. Savings from regional consolidation centre model compared to individual company operations

Collaboration Option (% saving over the entire fleet operation)		Total Cost	Total Kms	Tonnes of CO2
Totals for 10 individual company operations for one month in 2013		£77,360,485	62,037,850	58,737
Base case	Regional consolidation centres located at their centre of gravity - 44 tonne vehicle only	2.0%	4.8%	4.4%
Opt. 1	Use of alternative modes in conjuction with regional consolidation centres located at the centre of gravity	2.9%	6.6%	5.8%
Opt. 2	Use of alternative modes in conjuction with regional consolidation centres at rail freight terminals	1.1%	3.8%	3.6%

4 Conclusions

This study has provided a greater insight into the strategic planning of companies' physical logistics networks by improving awareness of the economic and environmental benefits of alternative transport modes. It supplements current efforts by industry to improve road freight sustainability through the use of road and rail at operational and technological levels with a review of the higher-level, strategic options, for making logistics networks and supply chains less freight transport-intensive.

The savings identified in the analyses represent the theoretical maximum, which it may not be possible to realise in practice. Once companies undertake tactical and operational assessments of the various transport initiatives, they may find the savings to be significantly lower. Nevertheless the results of this study should give the participating companies, and the FMCG sector as a whole, encouragement to develop multimodal collaborative strategies for sustainable logistics.

A detailed paper covering this study has been submitted for publication.

Acknowledgements

This study was undertaken by the Centre for Sustainable Road Freight which is funded by EPSRC (EPSRC Reference: EP/K00915X/1).

References

1. Eurostat http://ec.europa.eu/eurostat/statistics-explained/index.php/Road_freight_transport_by_journey_characteristics (accessed 31st January 2017}. (2016)

2. L. Graham: Transport collaboration in Europe. Technical report. *ProLogis Corporate*. (2011)
3. A.G. Woodburn: Intermodal rail freight activity in Britain: where has the growth come from?, *Research in Transportation Business & Management: Airport Management,* **5**, pp. 16-26. (2012)
4. RHA: Road Haulage Association cost tables 2013. *Prepared by DFF International* (2013)
5. MDS Transmodal: Impact of changes in track access charges on rail freight traffic. *Stage 1 Report, ORR, (2012)*
6. ARUP: Review of revenue support freight grant schemes: summary report. *DfT IR002,* (2014)