



**RRUK PROJECT C3
REPORT C3/5**

FREIGHT MODELLING FINAL REPORT

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Contents

1. INTRODUCTION.....	5
2. FREIGHT MODELLING PROPOSALS	5
2.1 Uses for Freight Transport Models.....	5
2.2 The Need for Detail and Disaggregation.....	5
2.3 What are the Required Model Outputs?	6
2.4 Inventory of Multimodal Freight Models.....	6
2.5 Update regarding GB freight models.....	7
3. THE LEFT3 MODEL.....	8
3.1 Background: The LEFT2 model.....	8
3.2 LEFT3.....	9
3.2.1 Introduction	9
3.2.2 LEFT3 architecture.....	9
3.2.3 Road Transport Cost Functions in LEFT3.9	10
3.2.4 Rail transport cost functions in LEFT3.9	17
3.2.5 LEFT3.9 representative road vehicle types	25
3.2.6 Generalised cost functions.....	26
3.2.7 Model Calibration.....	29
3.3 Deriving base 2010 and 2016 projections	29
3.4 Predicting effect of policy changes	30
3.5 LEFT3.9 Theory	32
3.5.1 Notation	32
3.5.2 Determining the New Total Market Size and the Split by Mode and Type (TF/TU)	33
3.5.3 Determining the New Distributions over Distance Bands.....	34
4. RAILFREIGHT IN GREAT BRITAIN.....	36
4.1 Historical setting.....	36
4.2 Government policy towards rail freight transport	36
4.3 The Ten Year Plan and the SRA Freight Strategy.....	37
4.4 Growth in rail freight tonne-kilometres.....	39
4.5 The current situation.....	43
5. EXTERNAL SCENARIOS	44
5.1 Introduction	44
5.2 External Scenarios	44
5.3 Potential Impacts on Rail Freight Transport	46
5.4. Rail and Road Strategies	48
6. STRATEGIES, POLICIES AND SCENARIOS TESTED.....	48
6.1 Scenarios.....	48
6.2 Pro-rail policies	49
6.3 Pro-road policies.....	51
6.4 Strategies	52
7. RESULTS.....	53
7.1 Tables of results.....	53
7.2 Results by Mode.....	64
7.2.1 Pro-rail strategy	64
7.2.2 Pro-road strategy	64
7.3 Results by Commodity	64

7.3.1 Pro-rail strategy	65
7.3.2 Pro-road strategy	65
7.4 Vehicle Kilometres	66
8. CONCLUSIONS	66
ACKNOWLEDGEMENTS.....	67
REFERENCES.....	68

1. INTRODUCTION

This report presents the final results from the freight modelling part of RRUk project C3. Proposals for freight demand modelling were set out in report C3/3, and these will be briefly recapped in Section 2 to set the scene. Section 3 will describe the LEFT3 model in some detail. Section 4 will set out the current and past position of rail freight in Great Britain. Section 5 will explore the external influences on rail freight. Section 6 will list the 13 policy tests and their grouping into two strategies. Section 7 presents results for each policy/strategy by mode and commodity. Final conclusions are presented in Section 8.

2. FREIGHT MODELLING PROPOSALS

2.1 Uses for Freight Transport Models

The Review of Freight Transport Modelling undertaken for the DfT (ME&P-WSP et al, 2002) makes it clear that there are two basic uses for demand models:

- to predict likely freight volumes and/or modal shares at various times in the future; and
- to undertake testing of the effects of various influences on the freight market, or of various potential policies that might influence the use of freight transport, either directly (e.g. modal subsidies) or indirectly (e.g. revised regulations on employment conditions).

Following the review stage of RRUk project C3, reported in report C3/3 (Fowkes et al, 2005), it was decided that we needed a model or models capable of meeting **both** of these uses.

2.2 The Need for Detail and Disaggregation

In order to be meaningful, freight modelling must be undertaken at the appropriate level of detail and data disaggregation. There are some aspects for which some disaggregation will generally be needed. Commodity type is one such dimension, though very fine disaggregation is rarely possible here. Other potential disaggregations might include the method of rail freight operation (i.e. trainload, wagonload, intermodal) and length of haul. The requirement for further disaggregation and detail depends very much on the purpose of the modelling exercise. The modelling phase of project C3 has concentrated on strategic modelling of UK freight, for which geographic disaggregation was not necessary. Another relevant issue relates to the range of transport modes incorporated into the model. The modelling phase of project C3 has restricted consideration to road and rail.

2.3 What are the Required Model Outputs?

The outputs required from any modelling exercise will depend largely on the reasons for undertaking that exercise. Given that the then current stated objectives of government and the rail industry at the time of commencement of this work, as set out in the Ten Year Plan (DETR, 2000), were to increase rail freight by 80% in terms of tonne-kilometres between 2000 and 2010, then there is a clear need for models to produce outputs expressed in physical measures such as tonnes lifted and tonne-kilometres moved. It is conceivable that the focus of policy might move away from physical growth in rail freight towards increasing rail's market share. Hence it is important that freight models can produce forecasts of modal shares for the scenarios to which they might be applied.

Emphasis might also be placed on implications for externalities, in which case it will be important to estimate vehicle kilometres for different types of lorry, for example.

2.4 Inventory of Multimodal Freight Models

There is relatively little history of multimodal freight demand modelling in the UK. For road transport, considerable effort has been expended on the National Road Traffic Forecasting (NRTF) methodology, but (as suggested by the title) this concentrates more or less entirely on road traffic and attention to rail freight is minimal. Following work by ITS, Leeds (Fowkes et al, 1992), a disaggregation by commodity was re-introduced in the 1997 NRTF, but rail was ignored other than in the coal sector.

There is also a history of paucity of information regarding rail freight flows on which to base any modelling. Rail freight data has tended to be held by the operators, and whilst it has been made available to various studies over the years, it is presented in terms of terminal-to-terminal flows. Origin-destination matrices, showing traffic distributed between a set of zones, have not been compiled by operators. Estimation of such O-D matrices for rail freight has therefore been a significant task facing any organisation attempting to construct a multimodal freight demand model with a geographic component.

Another complication is that Railtrack and Network Rail have recorded freight flows in terms of gross tonne-kilometres, including the weight of locos and wagons, rather than the more usual net tonne-kilometres. In this paper, we refer to net tonne-kilometres.

The following models were identified in Report C3/3 as having been used for multimodal freight modelling in Great Britain in recent years.

- GB Freight Model (GBFM) (MDS Transmodal)
- EUNET Model (TransPennine Model) (WSP)
- SRA 'Additional Freight Model' (SKM)
- SRA Freight Interchange Model (CAST-DPM, Radical).

More recently, as part of its contribution to the ITeLS project, University of Leeds ITS had begun development and testing of the Leeds Freight Transport Model (the LEFT model).

The purpose behind this development was to provide a means of rapid testing of strategic options. A short description of each of these 5 models was presented in tabular format in Appendix 2 of Report C3/3.

2.5 Update regarding GB freight models

Taking each of the 5 models in turn, we now update the picture regarding available GB freight models, using such information as is now publicly available. Much of the latest information was obtained at or in relation to a “workshop for freight modelling research” hosted by the ITEA division of the Department for Transport in July 2006 (DfT, 2006b).

Firstly, the Great Britain Freight Model (GBFM) has further established its position as part of the DfT National Transport Model suite. GBFM works from base OD matrices and allocates traffic to road, rail and intermodal on the basis of Generalised Costs. Following the DfT/SRA/HA/TfL Review of Freight Modelling (ME&P-WSP et al, 2002), an audit of the then current GBFM was commissioned by DfT. This identified some shortcomings, but concluded that it would remain a key part of DfT forecasting capability in the short and medium term. Consequently, DfT had funded MDST to develop a new version (V5) of GBFM, which appeared in 2006. ITS Leeds had access to version V4 during this time, and could have used it for RRUK had we had reason to consider geographically specific effects.

Secondly, the EUNET model of ME&P (now WSP) has continued to progress. The DfT/SRA/HA/TfL Review of Freight Modelling concluded that this model could form the basis of an eventual National Freight Transport Model (NFTM). It is envisaged that it will contain considerable detail on Production and Consumption points for freight, from which Origin/Destination flows for freight could be deduced using models of supply chains. The review recognised that such a model would be some way off in the future, but that it was important that funding be made available to provide a regional pilot, and this is now available for the Trans-Pennine corridor (WSP Policy & Research, 2005). DfT is planning to fund further development of this model, but nothing of use to project C3 was available in our timescale.

Thirdly, the “Additional Freight Model” was taken forward a little by the SRA, but personnel changes at SKM and the demise of the SRA appear to have halted progress with this model.

Fourthly, we understand that Radical Ltd. has not further developed their CAST model (a model for strategic supply chain design) for mode choice purposes. In the longer term, having the fine detail (e.g. of the road network) of CAST available for use with strategic freight planning models could be extremely beneficial. Radical are interested in developing links between CAST and other models, but they do not see it as their role to develop CAST into a strategic mode choice freight model. ITS Leeds is co-operating with Radical in areas of mutual benefit.

Fifthly, we have ITS Leeds’ own model LEFT. Version LEFT2 is now well documented (Fowkes, A.S., Johnson, D.H. and Whiteing, A. E., 2004). It was felt that a custom built new version, to be called LEFT3, would best suit RRUK Project C3’s needs.

Consequently, RRUK funding was used to build LEFT3, and this formed a large proportion of our activity on Project C3. Accordingly, a large proportion of this report is devoted to presenting LEFT3, and its results for the policies, strategies and scenarios of interest to RRUK. In brief, LEFT3 has no geography, but is disaggregated by 7 commodity groups, 9 distance bands, and 2 consignment sizes (expressed in regards of the suitability of rail to carry that traffic). Market size in each of the 126 cells varies in accordance with the Generalised Costs of the two modes, and a Logit model allocates the resulting traffic between modes. Outputs are tonnes and tonne-km, but an attempt is also made to approximate vehicle kms by lorry type and kms for rail locos. These figures can be used to infer effects on externalities.

An international overview of freight models can be found in Tavassy, (2006).

3. THE LEFT3 MODEL

3.1 Background: The LEFT2 model

Construction of the LEeds Freight Transport Model (LEFT) series was begun as part of the Engineering and Physical Sciences Research Council LINK FIT project ITeLS, (Lalwani et al, 2004) funded by the Department for Transport (DfT), although other funding has helped and will take forward its development. The initial version, retrospectively referred to by us as LEFT1, was a simple mode split model intended to give a rough idea of the magnitudes of the effects of various scenarios, possibly as a way of filtering which scenarios might be investigated using more detailed models. Besides being limited to mode split, LEFT1 suffered from a range of minor defects and deficiencies which led to its abandonment in favour of its successor, LEFT2.

LEFT2 was constructed in 2004, again as part of the ITeLS project. We acknowledge here the help and useful comments from many persons associated with that project. Besides mode split effects, LEFT2 allowed scenarios to alter the total size of the (road plus rail) market (defined in tonne-kilometres), although the elasticity (of tonne-kilometres with respect to Generalised Cost) used was small. The purpose of LEFT2 was to provide instantaneous ballpark estimates of road and rail freight tonne kilometres under various 'scenarios'. At its base is a desire that the scenarios should not affect the sum of tonnes moved by both road and rail modes. This was because we felt that our scenarios should be viewed as having a neutral macroeconomic effect. For example, if taxes on lorry usage were increased, we would expect other taxes to be lower than otherwise (or government spending to increase) so that total demand in the economy would not change. Consumers might buy their goods from closer sources than hitherto, but they would not be expected to consume less in total. For example, if prices of some goods rose slightly due to higher road user charges, the consumer would have more to spend due to offsetting reduced income tax (or whatever) and much the same total quantity would be bought. Similarly, industrialists as a whole might find input prices increasing slightly, but will find they can charge slightly more for their outputs. We recognise that this is only an approximation, with the possibility of substitution effect remaining, but did not feel that developing a dubious set of small elasticities of tonnes with respect to Generalised Cost would be cost effective in view of the minimal effect it would have, and the consequent need to reduce the tonne-km elasticities input so that the correct tonne-kilometre effects would be achieved.

In summary, in its final form LEFT2 was a spreadsheet based model that provided a near instantaneous estimate of the effect of macroeconomically neutral scenarios on mode split (road, trainload and wagonload), average length of haul and total market size. LEFT2 did not load the traffic onto vehicles, and so did not produce magnitudes of HGV vehicle kilometres, for instance. Consequently it did not produce estimates of emissions or other nuisances.

3.2 LEFT3

3.2.1 Introduction

LEFT3 has much in common with LEFT2. It has no geography and uses (recalibrated) Logit models to perform mode split. Its market size can vary, though by a very different means from that used in LEFT2.

Disaggregation within LEFT3 is by the following dimensions:

- i) The base total market is split as regards whether it is favourable for rail operations or not. For Bulks, rail favourable traffic is that we deem suitable for trainload movement from origin to destination. For Non-bulks (Food etc, and Miscellaneous) rail favourable traffic is that to which we have assigned the need for collection and delivery (at most) at one end. This represents a change from LEFT2.
- ii) The base data is split over 7 commodity groups (as in LEFT2)
- iii) The base data is split over 9 distance bands, (as in LEFT2). In LEFT3 it is made explicit that these are road distance bands. The distance on rail is taken as equal to the road distance, but when road collection and delivery is involved, the total distance for rail is that much greater (though still within the original distance band).

Whilst developing LEFT3, we have produced several versions, and this paper reports detail for version LEFT3.9, together with results from that version.

3.2.2 LEFT3 architecture

As in LEFT2, seven commodity groups are used in the LEFT3 model consistent with the categories provided in the Continuing Survey of Road Goods Transport (CSRGT) data.

- A. Food, Drink and Agricultural Products
- B. Coal, Coke and related items
- C. Petroleum and Petroleum Products
- D. Metals and Ores
- E. Aggregates and Construction
- F. Chemicals and Fertilisers
- G. Other, including manufactures, miscellaneous, containerised, and international.

Nine distance bands are used in the model, again consistent with the CSRGT data.

1. 1-25 km
2. 25-50 km
3. 50-100 km
4. 100-150 km
5. 150-200 km
6. 200-300 km
7. 300-400 km
8. 400-500 km
9. Over 500 km

We assumed the midpoint of the 500+ distance band to be 550 km.

The data used was collected from a variety of sources. For road, the primary source has been the Continuing Survey of Road Goods Transport (DfT, annual). For rail we have used Transport Statistics Great Britain (DfT, annual). In recent years the data for rail has become difficult to obtain, and gaps have been filled by our own best estimates and some discussion with the SRA personnel. The full data set is commercially confidential.

Traffic (in tonne-km.) was next split according to whether it was train-friendly (TF) or not (TU). Generalised Costs per tonne are required for each of the 126 TF- TU / commodity/ distance cells.

3.2.3 Road Transport Cost Functions in LEFT3.9

This closely followed and built on what had been done in LEFT2.

3.2.3.1 Lorry Standing Costs

Standing costs do not vary with tonnage or length of haul and are usually taken to consist of the items discussed in the paragraphs of this section.

Overheads

These are indirect as they do not relate directly to a vehicle but are costs borne by the whole fleet. *Fleet overhead* costs consist of costs of all the backup or reserve equipment needed to run an efficient fleet. *Business overheads* can be subdivided into transport department and company administrative overheads. *Transport department overheads* cannot be directly related to any one vehicle (i.e. salaries and wages, cars and expenses, telephone, rent and rates). *Administrative overheads* are those costs that are central to the running of a business and which have to be apportioned between all the different company departments, including directors' fees, legal fees, bad debts and bank charges. Costs of spare resources are also often treated as overheads.

Licence costs

There are two main licences to be costed against a vehicle. These are Vehicle Excise Duty (based on max gross vehicle weight of HGVs and number of axles) and an operator's licence, which is a legal requirement for the operator to run his business.

Insurance

The actual amounts of insurance required can vary depending on region, fleet size, type and value of loads, but only vary loosely with distance run.

Depreciation

It is necessary to take account of the cost of the vehicle over the period of its expected life. This is known as depreciation. There are two possibilities for calculating depreciation:

1. Straight line method
2. Reducing balance method.

The straight line method is simple, requiring initial cost of the vehicle, resale or residual value of the vehicle and expected life of the vehicle in years. Annual depreciation is calculated by subtracting the resale value from the original purchase price and dividing the result by the expected life of the vehicle.

The reducing balance method assumes depreciation is greater in the early years of a vehicle's life, and becomes less severe in later years. This approach mirrors the fact that initially repairs tend to be few and inexpensive but tend to increase as the vehicle ages.

A vehicle typically lasts 5-8 years, depending on type of work it has to do. It will typically run between 20-100,000 kilometres per year.

Finance

Interest on capital is accrued from either the cost of borrowing money or the (opportunity) cost of forgoing interest on a company's own capital.

Wages

Most companies treat drivers' basic wages as a fixed cost as wages are payable regardless of whether a driver is actually 'on the road'. Basic wages are a fixed cost, but bonuses and overtime are classified as operating costs, as will be the wages of drivers hired in to meet demand peaks.

3.2.3.2 Lorry Operating Costs

The operating cost is assumed to be directly related to the mileage run by the vehicle. Whereas standing costs are analogous to fixed costs, running costs can be considered as analogous to variable costs. However, for operating costs we only consider variability which is mileage related. On that basis, operating costs are usually taken to include the following:

Fuel

This is normally the largest of all the operating costs.

Engine oil and lubricant costs

These are typically very small relative to fuel costs.

Tyres

Tyres are classified as a running cost as tyre usage is linked to mileage.

Repairs and maintenance costs

These costs tend to be the second highest operating cost again related to mileage. Three factors make up these costs: labour, spare parts and workshop / garage costs.

In some cases the distinction between standing and operating costs is unclear, eg wages as discussed above.

Please note, however, that there are many different ways of categorising elements of road transport cost. It should be noted that the most important categories of cost appear to be wages and fuel, but that depends to some extent on how individual categories are combined.

3.2.3.3 Derivation of Lorry Monetary Cost Functions

For the derivation of the lorry monetary cost functions used in LEFT3.9, we focussed on 9 vehicle types using DFF cost data for 1998 (DFF International, 1998). For estimation of costs for 2010 and 2016 we updated fuel efficiency and wage cost figures using information from RHA (2003) and up to date figures on fuel costs vehicle excise duty, and extrapolations of earnings using real annual earnings growth rates. We replaced the 38 tonne articulated with a 44 tonne articulated lorry for 2010 and beyond, as these have now become legal and commonplace on British roads. We also considered a 50 tonne gross vehicle weight (GVW) vehicle as a future policy option.

At 40km, we take the cost to be equal to half a day’s standing cost. We have chosen to set the intercept at one quarter of a day’s standing cost, with the remainder related linearly to distance.

For non-stopping journeys of over 40km (one-way), the cost of the journey will encompass the remaining share of standing cost, for however long the journey will take. For example, for a journey taking one day, we take a day’s standing cost and add a day’s operating cost, to get the total cost for the distance travelled in a day.

The data we have provides us with necessary information on ‘half day standing’ and ‘full day standing and operating’ costs which give us two points on our cost function. The cost function is likely to be non-linear in nature, as costs not only increase with distance (from operating costs), but also with time (from standing costs). From these two data points and the assumptions about the form of non-linearity, we were able to construct a cost function for each vehicle type of the following form for journeys >40km:

$$C(D) = \frac{k_1 D}{\ln(k_2 D)} \tag{3.1}$$

Where C is transport cost, in £, for a one-way movement assuming no backloads
 D is one way distance (km)
 k_1 and k_2 are parameters.

For each lorry type, k_1 and k_2 can be derived by simple re-arrangement of equation 3.1 using the two data points at 40km and a full day's distance. These are highlighted in the table below which shows the 9 vehicles we used and their corresponding operating and fixed costs.

Table 3.1: Cost functions for the 9 representative vehicle types

Vehicle Type	3.5 tonne rigid	7.5 tonne rigid	13 tonne rigid	17 tonne rigid	26 tonne rigid	32 tonne rigid	32 tonne artic 2 + 2 axles	38 tonne artic 2 + 3 axles	44 tonne artic 3 + 3 axles
Assumed max kms per day	483	497	430	550	617	591	658	845	845
Annual standing costs (including Wages, VED and other costs)	24,434	29,777	34,540	37,997	44,193	49,157	45,207	50,715	55071.8
Operating costs £ per km	0.11	0.17	0.20	0.24	0.30	0.35	0.33	0.36	0.40
Half day cost £	60.1	76.0	88.0	98.3	115.9	130.8	120.5	134.7	147.1
Full day cost £	157.1	210.5	230.3	290.3	367.8	414.0	405.0	518.5	571.5
<i>k1</i>	2.06	2.80	3.51	3.56	4.14	4.91	4.39	4.55	5.04
<i>k2</i>	0.10	0.11	0.12	0.11	0.10	0.11	0.11	0.10	0.10

Figures 1a and b plot the functions over a range of one way distance kms.

Figure 1a: Road costs for rigid vehicles by distance and vehicle type, for 1998 in 2000 prices

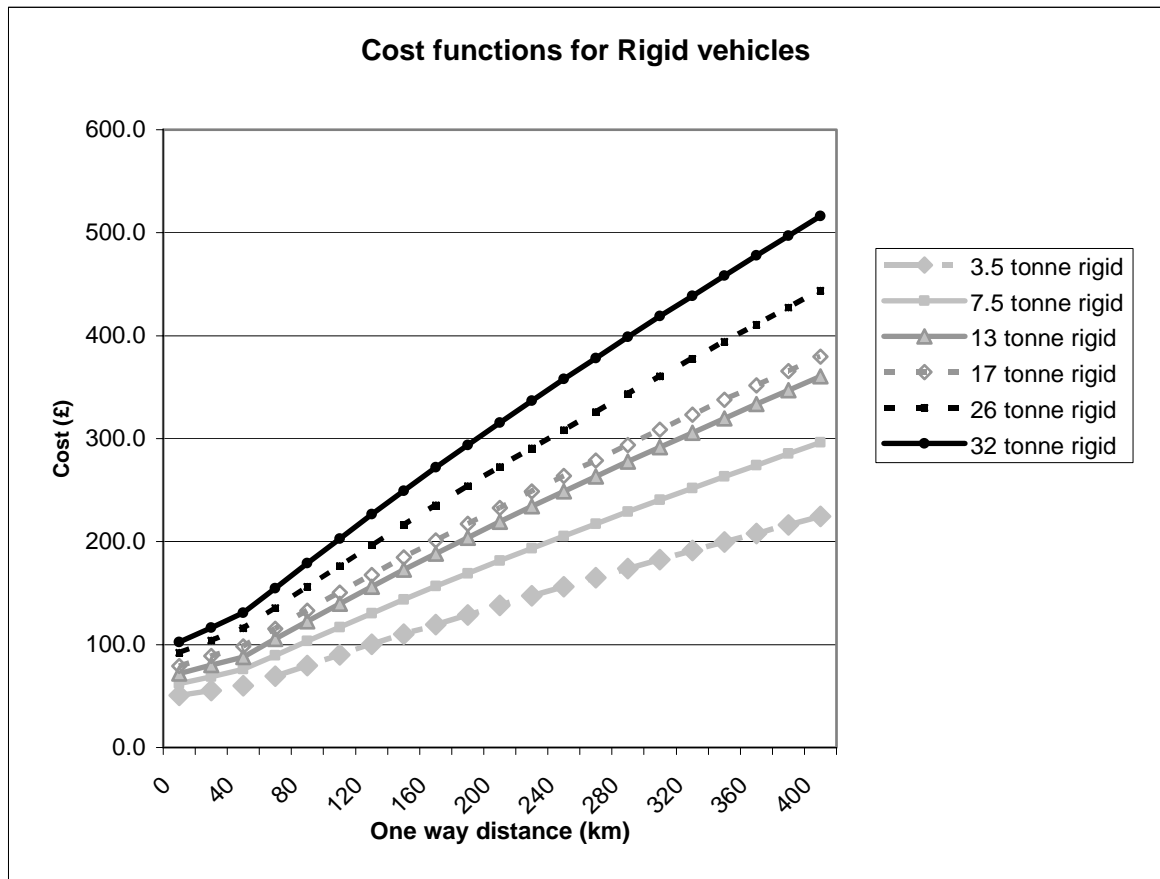
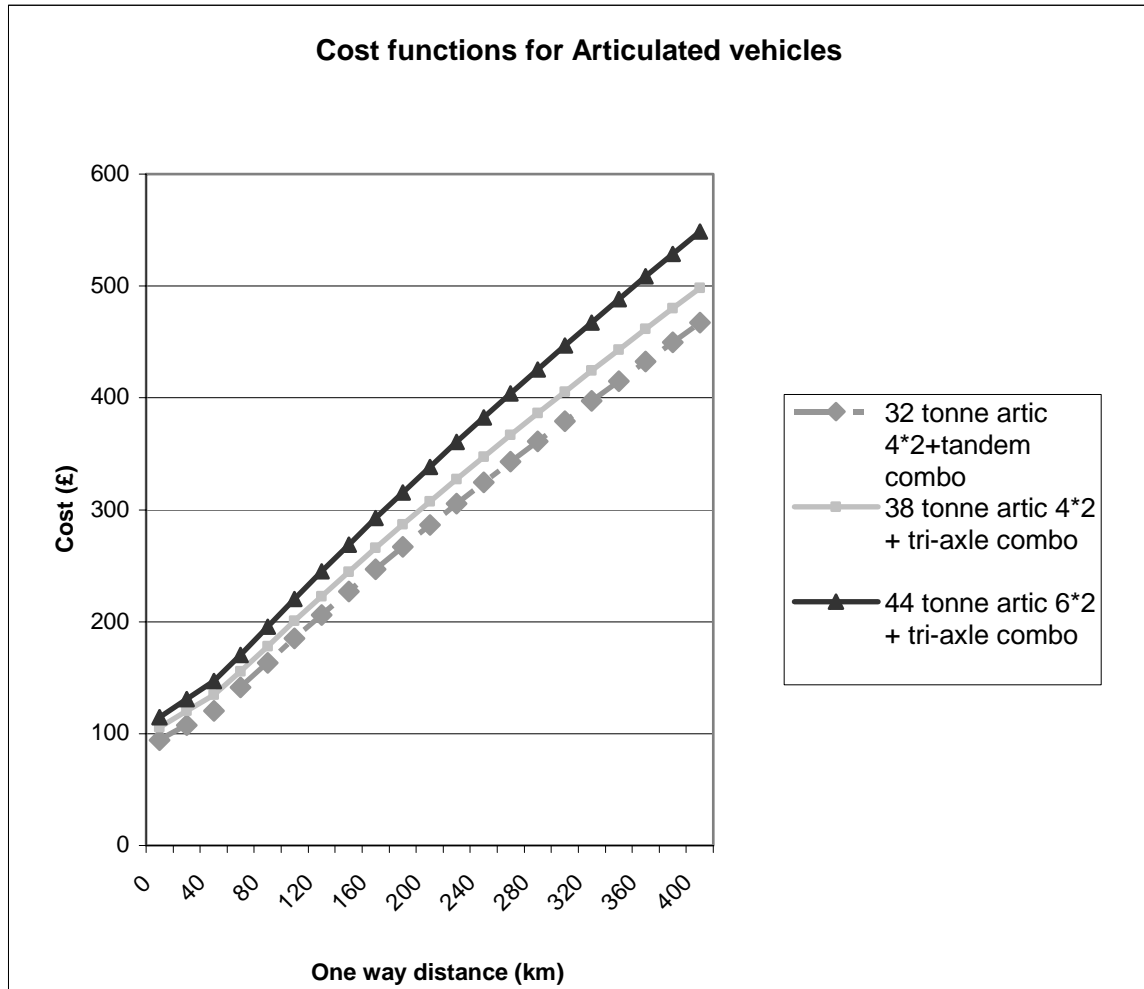


Figure 1b: Road costs for articulated vehicles by distance and vehicle type, for 1998 in 2000 prices, (with hypothetical 44T articulated vehicle)

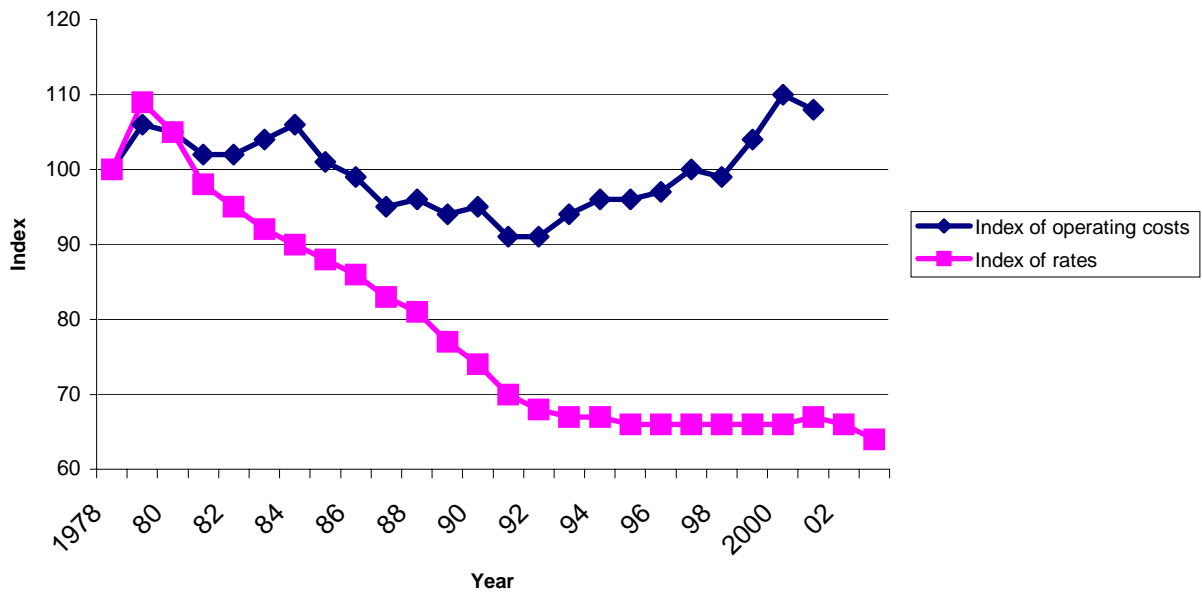


3.2.3.4 Operating costs and rates over time

The Survey of Freight Transport Including Cost Comparison for Europe (SOFTICE, 1999) examined the interactions between production costs, transport costs and transport demand for freight, and the benefits of harmonized freight transport costs. SOFTICE reports that during the previous two decades the UK fleet of articulated vehicles increased by a little more than half, whereas the freight moved (in tonne km) more than doubled. Working with FTA data, presented in Figure 2, it was shown that operating costs drifted down in real terms until the early 1990s, after which there were increases mainly related to the Fuel Duty Escalator. We have used FTA (2003) data and similar, to extend the series.

Operators have clearly reduced their rates charged in real terms but since 1992 this trend has levelled off. For its 2000 base, LEFT2 has assumed no change in real operating costs and charges for road transport, and LEFT3 has done the same.

Figure 2: Real Operating Costs and Rates over time (1978=100)



Source: SOFTICE (1999) & FTA (2003).

There are already some signs that this price stability may end. Congestion is beginning to have a more serious impact on journey times and hours of operation, fuel prices are volatile, and the Working Time Directive has increased drivers’ costs.

On the other hand, technological change continues to improve fuel consumption and reduce maintenance costs, and operators are improving the utilisation of their fleets through techniques such as better routing and scheduling, back loading and shared loading.

3.2.4 Rail transport cost functions in LEFT3.9

Analysis of rail is less straightforward than road. The procedure in LEFT3 differed significantly from that in LEFT2.

Unlike for road traffic, rail costs differ according to whether the traffic is rail-friendly or not. The former will often be trainload traffic where wagon turnaround times are quite quick, whilst the latter will usually involve waiting for trains to be marshalled from disparate portions, with the result that wagon turnarounds are lengthened. Also, the costs of any rail tripping movements or road collection and delivery legs have to be added.

Within each commodity there are a variety of different wagon and locomotive types suitable. We have assigned upto five wagon types for each commodity. Associated with each of these wagon and locomotive types are different track access costs, journey times, collection and delivery legs and rail tripping legs. Track access costs are available for each vehicle and locomotive type (ORR, 2003). Journey time was imputed from our own observations of freight timetables. Splits of the different wagon types were imputed both

for train-friendly and train-unfriendly traffic. Similarly the number of rail tripping and road collection and delivery legs were imputed on the basis of expert knowledge.

Rail freight costs are more complicated than road costs, and we cannot apply a simple rule of thumb methodology. Costs vary significantly due to a number of factors, as outlined in the South and West Yorkshire Multi-Modal Study (SWYMMS, 2001):

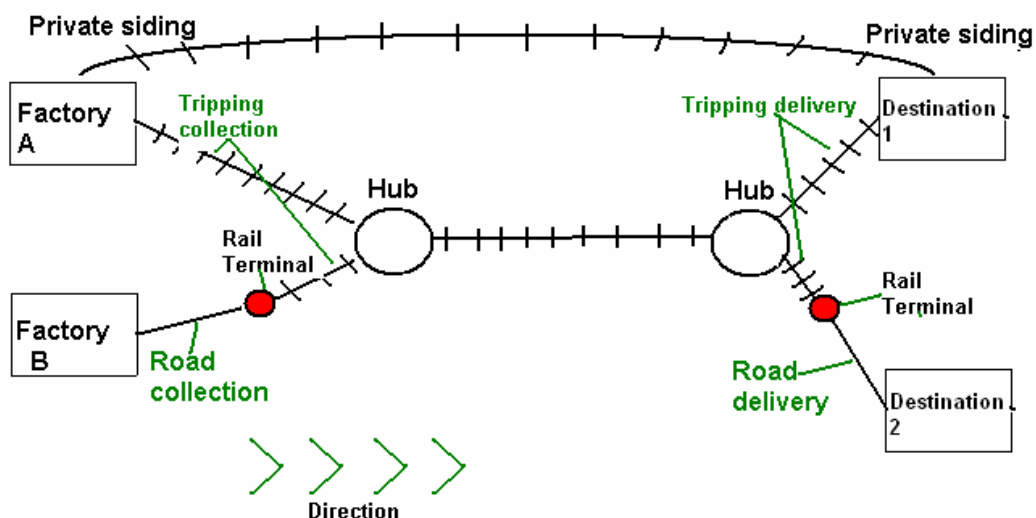
- The cost of loading freight on to the train, either at collection, delivery or transfer points;
- Whether the goods can be moved in trainload quantities, wagon/lorry load quantities or less than wagon/ lorry load quantities;
- The efficiency of the route being operated, i.e. overall distance of journey, distance from rail hubs and efficiency of the terminal operations;
- How wagons are loaded; typically rail wagons can carry more weight but have lower volume capacity than the equivalent road vehicle;
- The kind of goods being transported. Bulk freight (mainly industrial materials such as aggregates and petrochemicals) often benefits from direct access to rail, as opposed to non-bulk freight (mainly manufactured and packaged goods), which have to pass through rail terminals.

Naturally we have had to adopt a simplified approach.

3.2.4.1 Rail Journey Components

Figure 3 illustrates the possible permutations of multimodality and other sources of cost involved in a freight rail journey.

Figure 3: Different Types of Rail Journey



A typical rail journey consists of some or all of the components described below.

Road collection and delivery legs

Where there is no direct access to rail, there are extra costs incurred through transshipment and road collection/delivery. Such short road collection/delivery legs can be disproportionately expensive. Bulk products typically benefit from direct access to rail, but this is rarely now the case for non-bulk products. There will also be cases where there is a rail connected facility at one end of the journey, with a collection or delivery road journey at the other end. There is no scope for scheduling these journeys as freight train movements are sparse, with road collection/delivery movements all required at the same time.

Transfer to/from rail wagon

For bulk products, transshipment methods, such as a hopper, are relatively straightforward. Most non bulk products on the other hand will need to be transferred by fork lift or crane which, according to the SWYMMS study, is at a cost of at least £1.50 per tonne (SWYMMS, 2001). Intermodal freight terminal costs will vary considerably, depending on utilisation. According to Whiteing (2003), they could vary from £15 - £100 per container transfer.

Rail trip leg between rail terminal and rail marshalling yard

Rail tripping can occur at either or both ends of the trunk haul (between hub and rail terminal) and can prove relatively expensive due to poor utilisation of tripping locomotives.

Marshalling at rail yard/ hub

Marshalling costs can be incurred for transfer of tripped wagons to trunk train services and vice versa. Clearly, partially filled wagons will still require the same amount of marshalling as a full wagon, so we treat this element as a fixed cost per wagon.

Trunk rail journey

This is the hub to hub leg shown in Figure 3. This is typically the cheapest part of the journey per kilometre, although it will often be the longest. For trainload traffic the trunk rail journey constitutes the whole rail journey, as illustrated by the line directly joining factory 1 to destination 1 in Figure 3.

3.2.4.2 Rail Standing and Operating Costs

For our train cost functions, we assume rail costs (for both the locomotive and wagons) are comprised of fixed costs and variable time and distance related costs. Unit time and distance-related costs for locomotives and wagons were derived from GBFM (Newton and Wright, 2003) and other industry sources. We use figures on average loadings and our own internal data of number of wagons on particular types of trains to convert these figures into costs per tonne.

Distance related costs are comprised of access charges (which are levied per gross tonne-km) and traction costs. These were calculated in the following way :

$$\begin{aligned} \text{Traction cost per tonne}(l,w) &= tc(l) * d * ls(w) \\ \text{Loco access cost per tonne}(l,w) &= la(l) * d * (lw/1000) * ls(w) \\ \text{Wagon access cost per tonne}(w) &= wa(w) * d * (ww/1000) * ws(w) \end{aligned}$$

Where:

w is the wagon type transporting commodity i over distance d

tc is the traction cost per km of locomotive type l ;

j is the distance band of the rail movement. Distance d is taken to be the midpoint of the distances in distance band j

la is the locomotive access charge per 1000 gross tonne km and based on locomotive type;

ls is proportion of the full train taken up by one tonne for our movement, and based on the capacity of wagon type w used for commodity;

lw is locomotive weight in tonnes;

wa is the wagon access charge per 1000 gross tonne km, and is based on wagon type w , and whether or not there is a full or empty load;

ww is wagon weight is in tonnes and varies by wagon type w and;

ws is proportion of a wagon taken up by one tonne for our movement and also varies depending on the capacity of the wagon type.

Other monetary costs include marshalling costs for loads involving rail tripping. The cost of marshalling a wagon, m , is converted into the cost per tonne by using the proportion of the wagon taken up by one tonne.

$$\text{Marshalling cost per tonne}(w) = m * ws(w) * \text{trips}$$

Collection and delivery legs involve extra lifting costs and road transit costs based on the costs for the largest vehicle allocated to that commodity over the delivery leg distance.

$$\text{CD cost per tonne}(i,hd,v) = GCh(i,hd,v) * \text{no.of collections/deliveries}, \text{ where}$$

GCh is Generalised Cost per tonne of a road movement based on commodity i , road distance hd using road vehicle type v

Road legs of rail journeys also involve lifting costs to/from rail wagons.

$$\text{Lifting cost per tonne}(i,j) = \text{cost per lift} * \text{lift share}(w,v)$$

Where lift share is the proportion of the payload taken up by one tonne of the commodity being moved.

Time related costs include locomotive and wagon hourly costs. Locomotive costs are converted from annual standing costs based on the assumption of 250 days per year and 12 hours per day.

$$\text{Traction cost per hour}(l) = \text{annual traction cost}(l)/(250*12)$$

Wagon costs are based on figures on standing costs and annual maintenance costs provided in GBFM, with maintenance costs scaled by the number of axles and 24 hour a day operations.

$$\text{Wagon cost per hour}(w) = (\text{wagon annual standing cost}(w) + \text{wagon maintenance cost}(w)) / (250 * 24)$$

Totalling all these time and distance related components gives the monetary cost of a rail movement of commodity i over distance d using wagon type w and locomotive type l

$$\begin{aligned} MCr(i,j,w,l) = & \text{Traction cost per tonne}(l,w) + \text{Loco access cost per tonne}(l,w) + \text{Wagon} \\ & \text{access cost per tonne}(w) + \text{Marshalling cost per tonne}(w) + \text{CD cost per tonne}(i,hd,v) + \\ & \text{Lifting cost per tonne}(i,j) + \text{traction cost per hour}(l) * \text{loco hours}(j,w) * ls(w) + \\ & \text{wagon cost per hour}(w) * \text{wagon hours}(j,w) * ws(w) \end{aligned}$$

Where $loco\ hours(j,w)$ and $wagon\ hours(j,w)$ show the hours worked by locomotives and wagons respectively for a particular distance band and wagon type as shown in tables 3.3 and 3.4.

The table 3.2 below details the representative locomotive and wagon types used for train-friendly and train-unfriendly traffic for each commodity in 1998.

Table 3.2 Wagon and locomotive types, charges and capacities, 1998

Commodity	Modified TOPS Wagon Type Code	Tare (Tonnes)	Load (Tonnes)	Access cost loaded (per gtkm)	Access cost empty (per gtkm)	Load factor	Gross weight (Tonnes)	Loco Class	Loco access cost per gtkm
Food, Drink, Ag	OTA	16	24	2.56	1.60	0.83	1293	47	2.91
	VGA	17	24	2.87	2.00	0.87	1326	47	3.28
	IWA	27	63	2.53	1.64	0.87	1309	47	3.28
Coal & Coke	HAA	15	30	3.87	1.93	1	1530	60	3.93
	HEA	14	31	2.14	1.48	0.83	1192	58	3.50
	MEA	15	30	2.79	1.57	1	1530	56	3.42
Petroleum	TEA	28	74	2.25	1.61	1	1530	60	3.48
	TTAP	14	32	2.03	1.48	1	1380	60	3.48
	TUA	14	37	2.76	1.81	1	1530	60	3.48
Ores & Metals	BDA	22	58	2.02	1.30	0.73	1415	60	3.48
	SPA	15	28	2.53	1.65	1	1462	60	3.48
	JTA	25	77	3.66	1.79	1	2754	60	3.93
Construction	PGA	13	38	3.63	1.66	0.81	1926	60	3.48
	PHA	22	68	3.75	1.87	0.91	1845	60	3.48
	JNA	24	78	2.84	1.24	0.82	1319	60	3.48
Chemicals	TTAC	14	32	2.03	1.48	0.60	332	37	2.87
	TIA	15	25	2.13	1.26	0.80	350	37	2.87
	TCA	35	53	2.43	1.63	1	880	37	2.87
Others	IFA2	41	87	1.68	1.46	0.58	1006	47	3.28
	FFA	20	52	2.49	1.58	0.77	1201	47	3.28
	PJB4	62	25	2.17	1.65	1	609	47	3.28
	IWA	27	63	2.53	1.64	0.87	1309	47	3.28

Table 3.3: Rail journey data inputs for Train-Friendly traffic, 1998

Commodity	Modified TOPS Wagon Type Code	Train Friendly													
		Collection / delivery legs	Trip legs	No wagons per train	Split (%) within commodity	Journey times (hours) by distance band									
						12.5	37.5	75	125	175	250	350	450	550	
Food, Drink, Ag	OTA	0	1	36	40	48	48	54	60	66	72	78	84	90	
	VGA	1	2	35	30	48	48	60	72	84	96	102	108	114	
	IWA	1	1	16	30	48	48	54	60	66	72	78	84	90	
Coal & Coke	HAA	0	0	34	80	6	8	10	12	16	24	30	36	42	
	HEA	0	0	30	10	6	8	10	12	16	24	30	36	42	
	MEA	0	0	34	10	12	16	20	24	24	30	36	42	48	
Petroleum	TEA	0	0	15	60	12	16	20	24	24	30	36	42	48	
	TTAP	0	0	30	30	12	16	20	24	24	30	36	42	48	
	TUA	0	0	30	10	12	16	20	24	24	30	36	42	48	
Ores & Metals	BDA	0	0	22	60	12	16	20	24	24	30	36	42	48	
	SPA	0	0	34	20	12	16	20	24	24	30	36	42	48	
	JTA	0	0	27	20	6	8	10	12	16	24	30	36	42	
Construction	PGA	0	0	44	50	6	8	10	12	16	24	30	36	42	
	PHA	0	0	22	25	6	8	10	12	16	24	30	36	42	
	JNA	0	0	15	25	12	16	20	24	24	30	36	42	48	
Chemicals	TTAC	0	0	10	50	12	16	20	24	24	30	36	42	48	
	TIA	0	0	10	40	12	16	20	24	24	30	36	42	48	
	TCA	0	0	10	10	42	42	42	42	42	48	54	60	66	
Others	IFA2	1	0	11	10	42	42	42	42	42	48	54	60	66	
	FFA	1	0	20	70	42	42	42	42	42	48	54	60	66	
	PJB4	0	0	7	10	12	16	20	24	24	30	36	42	48	
	IWA	0	0	16	10	42	42	42	42	42	48	54	60	66	

Table 3.4: Rail journey data inputs for Train-Unfriendly traffic, 1998

Commodity	Modified TOPS Wagon Type Code	Train Unfriendly													
		Collection / delivery legs	Trip legs	No wagons per train	Split (%) within commodity	Journey times (hours) by distance band									
						12.5	37.5	75	125	175	250	350	450	550	
Food, Drink, Ag	OTA	0	2	36	10	48	48	60	72	84	96	102	108	114	
	VGA	2	2	35	40	48	48	60	72	84	96	102	108	114	
	IWA	2	2	16	50	48	48	60	72	84	96	102	108	114	
Coal & Coke	HEA	0	1	30	50	48	48	54	60	66	72	78	84	90	
	MEA	1	2	30	50	48	48	60	72	84	96	102	108	114	
	TEA	0	1	20	100	48	48	54	60	66	72	78	84	90	
Petroleum	TTAP	0	1	20	100	48	48	54	60	66	72	78	84	90	
	TUA														
	BDA	1	0	18	80	12	16	20	24	24	30	36	42	48	
Ores & Metals	SPA	0	1	30	20	48	48	54	60	66	72	78	84	90	
	JTA														
	PGA	1	0	30	100	6	8	10	12	16	24	30	36	42	
Construction	PHA														
	JNA														
	TTAC	0	1	10	50	48	48	54	60	66	72	78	84	90	
Chemicals	TIA	0	1	10	40	48	48	54	60	66	72	78	84	90	
	TCA	0	1	10	10	48	48	54	60	66	72	78	84	90	
	IFA2	2	1	11	10	48	48	54	60	66	72	78	84	90	
Others	FFA	2	1	20	40	48	48	54	60	66	72	78	84	90	
	PJB4	1	1	7	10	48	48	54	60	66	72	78	84	90	
	IWA	1	2	16	40	48	48	60	72	84	96	102	108	114	

3.2.5 LEFT3.9 representative road vehicle types

For each commodity/distance band we have assigned a mix of 3 representative road vehicle types to reflect differences in costs of different vehicles' usage. In each year, these are selected from the 8 vehicle types for which we have constructed cost functions. This represents a much more detailed treatment than was incorporated in LEFT2. The mix of vehicles was chosen to replicate vehicle kilometres reported for each vehicle type from CSRG data for 1998, in conjunction with available information on lading factors and empty running proportions as well as payloads.

Table 3.5: Representative road vehicle types by commodity and distance band in 1998

Commodity	Distance band								
	0-25	26-50	51-100	101-150	151-200	201-300	301-400	401-500	>500
Food, Drink, Ag	3.5T rigid	3.5T rigid	17T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	32T artic
	7.5T rigid	32T artic	32T artic	32T artic	32T artic	32T artic	38T artic	38T artic	38T artic
	32T artic	38T artic	38T artic	38T artic	38T artic	38T artic			
Coal & Coke	17T rigid	17T rigid	17T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	32T artic
	32T rigid	32T rigid	32T artic	32T artic	38T artic	38T artic	38T artic	38T artic	38T artic
	38T artic	38T artic	38T artic	38T artic					
Petroleum	17T rigid	32T rigid	17T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	32T artic
	26T rigid	32T artic	32T artic	32T artic	38T artic	38T artic	38T artic	38T artic	38T artic
	38T artic	38T artic							
Ores & Metals	17T rigid	17T rigid	17T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	38T artic
	32T rigid	38T artic	38T artic	38T artic	38T artic	38T artic	38T artic	38T artic	38T artic
	38T artic								
Construction	13T rigid	17T rigid	17T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	32T artic
	26T rigid	32T rigid	32T rigid	32T rigid	38T artic	38T artic	38T artic	38T artic	38T artic
	32T rigid		38T artic	38T artic					
Chemicals	13T rigid	17T rigid	17T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	32T artic
	17T rigid	32T artic	32T artic	32T artic	38T artic	38T artic	38T artic	38T artic	38T artic
	38T artic	38T artic	38T artic	38T artic					
Others	3.5T rigid	3.5T rigid	3.5T rigid	17T rigid	26T rigid	26T rigid	26T rigid	26T rigid	32T artic
	7.5T rigid	13T rigid	32T artic	32T artic	32T artic	32T artic	38T artic	38T artic	38T artic
	26T rigid	32T artic	38T artic	38T artic	38T artic	38T artic			

For 2010 we have adjusted the mix of vehicle types and backload factors to retrieve National Road Traffic Forecasts for 2010 (DETR, 2000). In 2010 we replaced the 38 Tonne artic with the 44 Tonne artic, which are now commonplace on our roads.

3.2.6 Generalised cost functions

In addition to the financial cost of road and rail transport, modelling should include other attributes such as time and delay costs as well as a mode specific constant. This latter is a penalty (expressed as a percentage of the road costs) for using rail as opposed to road, implemented by adding to rail cost. The scheduled journey times and delay times require an appropriate valuation of time to convert the time measures into financial cost. These are then summed with financial cost to give a Generalised Cost (GC).

3.2.6.1 Journey time costs

To convert journey times into a monetary measure we applied a value of journey time to average journey times for each distance/commodity category. In order to derive average journey times, we assumed typical road and rail speeds by distance. In the case of rail, speeds vary due to the different wagon types used.

Longer distance road traffic will use a higher proportion of trunk and motorway routes, and will spend lower proportions of time in congested urban areas, so will achieve higher speeds.

These speeds were then applied to each distance band to derive an average journey time by distance. To turn these journey times into costs, we needed an appropriate value of journey time.

3.2.6.2 Delay time costs

In order to construct a measure of delay costs we need measures of delay and an appropriate value of delay time. Coupled with travel costs, an accurate representation of transport costs must consider costs of time spent waiting, loading and unloading. The values of delays are used based on LASP interviews undertaken by Tony Whiteing and Geoff Tweddle in 2003-2004.

These figures were applied to each commodity specific values of delay time taken from Fowkes et al (2004) to yield commodity specific valuations of delay time per tonne.

3.2.6.3 Backloading

A backload factor tells us the proportion of loads which are backloads. A loaded return leg will typically add an extra fuel and wage element to costs depending on the extra time and distance. Typically an A to B outward (prime) leg will not find a B to A return leg, but hauliers will try to find a load close to B wishing to go in the general direction of A. Obtaining this load will involve some administrative effort, extra travel time, waiting time, loading time and fuel usage. In practice these elements will vary enormously from case to case. In return for fitting in with the haulier's schedule, the backload movement might only

be charged as little as half of the normal rate. The availability of backloads can also be reflected in the rate for the outbound movement.

It is our belief that profitability in the road haulage industry is such that our formula (Equation 3.1) reflects well underlying costs if that term is taken to include normal profit. In the absence of more detailed data, we have taken the usual rule of thumb of adding 50% to the one-way rates and costs for a journey loaded in both directions. Hence a journey from A to B and loaded in both directions would have a cost of 150% of that obtained from our formula for a single A to B movement.

The data we have is purely based on tonnes lifted by distance and commodity groups. This tells us nothing about which of these loads are backloaded. In order to incorporate the cost efficiencies arising from backloading we had to assume backload factors. These assumptions were based on our estimates of empty running of vehicles for the different commodities. We determined a relationship between empty running (E , which can be between 0 and 1) and the backload factor (B , between 0 and 1) shown below.

If all loads are backloaded, $B=1$, and correspondingly, $E=0$

If half outbound loads have backloads:

- 50% of all lorries on road are loaded and on an outward leg
- 25% of all lorries on road are running a backload
- 25% of all lorries on road are running empty.

This means that of the loaded lorries, 66% have loads in both directions.

More generally, if out of 10 outward trips, y are loaded back

$$E = (10 - y) / 20 \tag{3.2}$$

$$B = 2y / (10 + y) \tag{3.3}$$

Re-arranging (3.2) in terms of y gives

$$y = 10 - 20E \tag{3.4}$$

Substituting (3.4) into (3.3) gives

$$B = (20 - 40E) / (20 - 20E)$$

i.e.

$$B = (1 - 2E) / (1 - E) \tag{3.5}$$

Re-arranging this in terms of E gives

$$E = (1 - B) / (2 - B) \tag{3.6}$$

We assumed the empty running factors for each commodity shown in Table 3.6. These were based on information on empty running figures for 1998 and 2001, from Transport Statistics Great Britain 2001. From these we derived the proportions of journeys containing a backloaded leg which were used in conjunction with our cost function to derive the average financial cost per tonne lifted by commodity.

Table 3.6: Assumed road and rail backload factors

	Road Empty running 1998	Road Empty running 2010	Rail Empty running (1998 & 2010)
Food, Drink, Agriculture	0.278	0.269	0.50
Coal & Coke	0.348	0.285	0.50
Petroleum	0.356	0.359	0.50
Ores & Metals	0.272	0.273	0.45
Construction	0.350	0.350	0.50
Chemicals	0.303	0.230	0.50
Others	0.223	0.217	0.13

3.2.6.4 Road Generalised Cost

The road Generalised Cost of moving a tonne of commodity *i* over the mid-point *d* of distance band *j* using vehicle type *v* is calculated in the following way:

$$GCh(i,j,v) = 0.5 * EhiMCh(i,d) + 0.75 * MCh(i,d,v) + JTh(i,j) + DTh(i,j)$$

Where :

MCh(i,d,v) is the road monetary cost of a moving one tonne of the good distance *d* using vehicle type *v*, as described in section 3.2.3.3

Ehi is the road empty running factor for commodity *i*, used to make the cost adjustment to account for any backloading, as described in section 3.2.6.3 above.

JTh(i,j) represents the journey time cost of the road movement described in 3.2.6.1.

DTh(i,j) represents the delay time cost of the road movement described in 3.2.6.2.

3.2.6.5 Rail Generalised Cost

The rail Generalised Cost of moving a tonne of commodity *i* over distance *d* is calculated in the following way:

$$GCr(i,j,w) = (1 - 2Eri) * (MCr(i,j,w,l) + 2Eri * ((MCr(i,j,w*,l) + MCr(i,j,w,l))) + JTr(i,j) + DTr(i,j) + ASCr(i,j)$$

Where:

MCr(i,j,w,l) is the rail monetary cost of moving a tonne of the good distance *d*, as described in section 3.2.4.2, and *MCr(i,j,w*,l)* is the rail monetary cost of the empty return leg of this journey.

Eri is the rail empty running factor for commodity *i*, used to make the cost adjustment to account for any backloading.

JTr(i,j) represents the journey time cost of the rail movement.

$DTr(i,j)$ represents the delay time cost of the rail movement.
 $ASCr(i,j)$ represents the rail specific constant for commodity i over distance band j .

3.2.7 Model Calibration

The mode split procedure was as follows. Each commodity / distance band was split into train-friendly traffic and train-unfriendly traffic. This split was done by judgement. For Bulks, all current rail trainload traffic was taken as friendly, plus a little of the road traffic (particularly in commodity groups with existing large amounts of rail trainload traffic). For Non-bulks traffic, certain technical issues broadly dictated the split.

In each of the resulting 126 cells, we have been able to calculate Generalised Costs for road and rail by summing all the monetary elements together with the time and delay elements weighted as appropriate. A simple Binary Logit, using these Generalised Costs, gave mode splits of tonne kilometres. For each cell a proportion of traffic captive to road or rail was specified, with the Binary Logit model merely allocating the remainder. During the manual fitting process, adjustments were made so as to closely match the actual base splits with those of the model, for the purpose of reproducing the base data, by means of

- (i) adjusting the scaling parameter of the Binary Logit model;
- (ii) adjusting the proportion of traffic taken as captive to road;
- (iii) adjusting the proportion of traffic captive to rail; and
- (iv) adjusting the Generalised Cost of rail.

Close attention was paid to the composite generalised costs so generated, to check that they were not implausibly far below actual generalised costs. The mode share of rail was estimated in the following way for each distance band/ commodity/ rail type group:

$$MS_{rail} = (1 - cap_{road} - cap_{rail}) * Exp(\lambda GC_{rail}) / (Exp(\lambda GC_{rail}) + Exp(\lambda GC_{road})) + cap_{rail} \tag{3.7}$$

where:

- MS_{rail} is the market share of tonne kms for rail
- cap_{road} is the road captive proportion
- cap_{rail} is the rail captive proportion
- λ is the scale parameter
- GC_{road} is the road generalised cost, using the biggest lorry type available to that cell
- GC_{rail} is the rail generalised cost

Due to the risk of aggregation bias, in applying this model, the generalised costs for each wagon type were compared in turn with the chosen (i.e. biggest available) lorry type in each of the 126 cells.

3.3 Deriving base 2010 and 2016 projections

In order to derive estimates of 2010 ‘do nothing’ projections, i.e. a continuation of current trends, the following procedures were used. It is important to note that the 2010 estimates

are not a forecast of what will actually happen in 2010. In particular, it is assumed in LEFT3 that 2010 will be on trend, rather than a boom or slump year. Unlike LEFT2, LEFT3 goes on to project to 2016.

Firstly, we seek to make projections of road plus rail totals (for tonnes and average length of haul) using all data to hand. We have access to regression extrapolations made in 2000 for 2003 using data from 1974 to 1998. These were compared to actual 2003 data. Secondly, the published SRA Market Studies summaries (SRA, 2004c) were consulted where they were available. Thirdly, other knowledge to hand was consulted. A view was then taken as to whether the 2000 extrapolations were at all helpful and, if so, how they needed amending when taken forward to 2010. If they were not deemed helpful, 2010 and 2016 figures were constructed from the other sources. Fourthly, for 2016 only, we derived Low and High forecasts for tonnes (with average length of haul fixed). These actually corresponded to the width of the range between the 2000 extrapolations using GDP growth of 2% and 3% as compared to the central estimate of 2.5% starting in 1998. However, since we have already reached 2006 and know what the GDP growth has been up to that time, the implied GDP growth rates from 2006 to 2016 will be roughly 1.5% to 3.5%. As it is not clear what GDP assumptions were made in the SRA Market Studies, it is in any event not clear that our central estimate is (in LEFT3) any longer for 2.5% p.a. GDP growth. It is probably reasonable to say that the 2016 Low to High range probably covers a large enough range that we can be practically certain that the future lies between.

3.4 Predicting effect of policy changes

After calibrating the base 2000 figures and producing the 2010 and 2016 base projections the model is ready to forecast the effect of input changes. Other than the “Low” and “High” GDP effects, forecasts are based on changes in variable or fixed cost components of road and rail transport costs only. These can be implemented through either standing or operating costs, as appropriate.

LEFT3 will then calculate the new Generalised Costs per tonne for each cell. These are applied first to the tonne-kms for that cell using suitably chosen special elasticities in order to obtain a new market size by summation. These special elasticities omit any effect due to mode switching (which will be dealt with elsewhere). They merely affect market size. As discussed in section 3.5, this new market size is then adjusted to maintain tonnes constant, after which a mode split is undertaken. This gives us our forecast.

Because of the neutral macro-economic effect, discussed earlier, which leaves overall tonnes lifted constant, changes in tonne kilometres are driven by changes in average length of haul. This would be straightforward for a model with no distance bands, but in LEFT2 it proved very tricky. It was achieved by moving tonnages into different distance bands in a sensible and systematic way such that we could retrieve the predicted tonne kilometres. We needed to move exactly the right number of tonnes between bands (i) where distance bands have differing widths, and (ii) without wiping out all traffic in the short distance bands (which we expected to continue to serve many needs into the future). In fact, mathematically there were an infinite number of solutions. The new distribution of tonnes was derived in LEFT2 from a weighted combination of high (roughly double), medium

(base 2000 figures) and low (roughly half) distributions of tonne kms, each of which kept tonnes lifted constant. These reference points were derived iteratively, applying restriction (ii) in each iteration. We therefore sought to locate our solutions on a pathway from roughly half to roughly twice base tonne-km, moving smoothly and paying heed to restriction (ii). Cost changes that yield forecasts outside that range were heavily censored by LEFT2, as though these possibilities were not to be believed.

Unfortunately, this procedure did allow the effects of changes to one mode to leak into the forecasts of the alternative mode, even where there was no sensible interpretation of that. This problem worsened as the market size effects were increased. In LEFT3 it was decided, after careful review, to increase the magnitude of the market size effects, and this exacerbated the problem to a point where a remedy was needed. Consequently, after the input of considerable effort, LEFT3.9 was provided with a new procedure (described earlier) which cured this problem.

The base 2010 and 2016 figures were chosen to conform to the projections by commodity. The breakdown by train-friendly/train-unfriendly was by reference to the 1998 split. Breakdowns by distance band were made by the same iterative method referred to above. Again, Low and High reference points were constructed, censoring tonnages. Forecasts (for all distances) were then related to this continuum.

One complication ignored in LEFT2, is that a switch from road to train-unfriendly rail should really increase tonnages by road, since we have assumed at least one road collection or delivery for each rail train-unfriendly movement. In our view, our base road data does contain such collection and delivery movements, though they are fairly trivial in magnitude compared to main mode road traffic. In LEFT3.9 we decided to deal with this complication in the following way. Firstly we deducted the tonnages of road collection and delivery traffic for rail from the base data, on an assumed distribution of such distances. Secondly the methodology outlined above was then applied to the remaining traffic. In particular, when we speak of “tonnes being held constant” it is only applicable at this second stage. Thirdly we add on any implicit collection and delivery tonnes for the scenario outputs from the second stage. It follows that tonnes will not be constant as between the base and scenario cases even where we have looked at only macroeconomically neutral scenarios. Naturally, this change also has a (minor) effect on tonne-km outputs. For simplicity, we have assumed that the length of the rail portion of a rail movement involving collection and delivery is equal to the equivalent road movement, with a switch from road to rail in those circumstances therefore leading to an increase in tonne-km moved. This is acceptable since rail movements involving collection and delivery are usually significantly longer than equivalent road distances due primarily to the scarcity of transfer terminals which dictates that the deviation from crow fly distance will be greater than for road journeys.

3.5 LEFT3.9 Theory

3.5.1 Notation

Starting position	1
Middle (intermediary) positions	M, N
Desired new position	D
New position	2
Road	H
Rail	R
Road plus Rail	Z
Train Friendly	F
Train Unfriendly	U
Tonnes	T
Tonne-Kilometres	K
Generalised Cost	G
Captive Market Share	C
Mode split logit model parameter	λ
Probability	P
Elasticity of A with respect to the G of B	EAB
Distance Band i ($i=1,9$)	i
Type Band j ($j=F,U$) (Type means Train Friendly or not)	j
Mid-point distance in band	L_i

3.5.2 Determining the New Total Market Size and the Split by Mode and Type (TF/TU)

All that follows has to be repeated separately for each of the 7 commodity groups.

Two modes are considered: Road (H) and Rail (R), summing to Total (Z).

The LEFT3.9 Mode Split Model (giving the probability of choosing Rail) calibrated on the 1998 base data is (repeating Equation 3.7 in this new notation):

$$PR_{ij} = CR_{ij} + (1 - CR_{ij} - CH_{ij}) / (1 + \exp(\lambda_{ij} (GH_{ij} - GR_{ij}))) \quad (3.8)$$

where CR_{ij} and CH_{ij} are the proportions of the market deemed captive to Rail and Road respectively, GR_{ij} and GH_{ij} are their Generalised Costs, and the λ_{ij} are scaling parameters. This is applied separately for each wagon type compared to the biggest lorry in that cell, with road Generalised Cost perturbed by -10%, -5%, 0, +5%, +10%.

When the Generalised Cost of one mode rises two things happen. Firstly, the market size contracts as customers find the overall offer less attractive. Secondly, some traffic switches from the mode with the increased G to the alternative mode.

When the Generalised Costs of both modes rise, three things happen. Firstly, the market size contracts. Secondly, the increase in G for each mode diverts traffic away to the other mode. Thirdly, the G increase for the other mode diverts some traffic back from that mode. The first two of these elements are accounted for by the own price elasticities. The third element is accounted for by the cross-elasticities. Clearly, the second and third elements are mirror images, but they need to be treated separately in this way.

A set of own-price Generalised Cost elasticities (EHH & ERR) are imported into this process separately for each of the 7 commodity groups split by Train Friendly/Unfriendly (i.e. 14 sets of 2 in all). These values were chosen after a consideration of the literature.

The LEFT3.9 model without market size effects (i.e. with that routine switched out) was then run with 10% Generalised Cost changes in order to derive mode-split only Generalised Cost elasticities and cross-elasticities (MEHH, MEHR, MERR, MERH).

We were then guided by the method of Taplin (1982), which explored relativities between the various elasticities and part elasticities that are consistent with economic theory. After some iteration, input values for EHH and ERR were so adjusted that the following values for the Market Size element of the own-price Generalised Cost elasticities (NEHH, NERR) were obtained as differences (EHH-MEHH, ERR-MERR).

Table 3.7: Assumed Elasticities

	NEHH	NERR	NEHH	NERR
	TF	TF	TU	TU
Commodity				
Food, Drink, Ag	-0.60	-0.01	-0.60	-0.01
Coal & Coke	-0.01	-0.13	-0.17	-0.01
Petroleum	-0.01	-0.19	-0.20	-0.01
Ores & Metals	-0.01	-0.10	-0.02	-0.01
Construction	-0.01	-0.05	-0.13	-0.01
Chemicals	-0.10	-0.01	-0.15	-0.01
Others	-0.40	-0.01	-0.70	-0.01

As can be seen, the method used was to set the elasticity of the minority mode at the lowest value we deemed reasonable, i.e. -0.01. Changes in the Generalised Cost of the minority mode were deemed unlikely to have much effect on total market size. Using these values as seed values, the market size elasticities for the majority mode were determined. Mode split elasticities are the opposite way round, being larger for the minority mode, where small proportionate losses from the majority mode lead to large proportionate gains for the minority mode. As mode shift effects are elsewhere handled in the model, we were spared having to deal with the large mode split (and hence overall) elasticities than can arise for some commodities.

We can now find desired new totals for tonne-kms that satisfy economic theory.

$$HKD_{ij} = HK1_{ij}((GH2_{ij}/GH1_{ij})^{**}NEHH)$$

$$RKD_{ij} = RK1_{ij}((GR2_{ij}/GR1_{ij})^{**}NERR)$$

$$ZKD_{ij} = HKD_{ij} + RKD_{ij}$$

Since we are desiring to hold tonnes constant by type of traffic (having dealt separately with Collection and Delivery effects), we have:

$$ZTD_j = ZT1_j = HT1_j + RT1_j$$

3.5.3 Determining the New Distributions over Distance Bands

We now use the ADJUST procedure in LEFT3.9. This takes the new total market size figures by mode and type, HKD_j and RKD_j, and allocates these tonne-km over distance bands *i*, such that the associated intermediate tonnes figures (HTM_{ij} and RTM_{ij}) sum exactly to their initial level of tonnes, HT1_j and RT1_j. This is because, with mode shift

dealt with elsewhere, we want tonnes by mode to be constant with respect to market size changes.

The method uses three way-points. When the desired HKD_j (or RKD_j) falls within an adjacent pair of these, the associated splits by distance band are averaged by interpolation. In the unlikely event that HKD_j (or RKD_j) falls outside the range of the three way points, extrapolation is used. The outputs from ADJUST are, therefore, HTM_{ij}, HKM_{ij}, RTM_{ij} and RKM_{ij}.

The next step is to sum over the two modes.

$$ZKM_{ij} = HKM_{ij} + RKM_{ij}$$

We then use the LEFT3.9 mode split model (Equation 3.8, but with new Generalised Costs GH2 and GR2) on these totals of traffic by distance band (ZKM_{ij}). This procedure produces HKN_{ij} and RKN_{ij}. Clearly, the sum of the HKN_{ij} over i and j is HKD, and likewise the sum of the RKN_{ij} over i and j is RKD. Hence the total tonne-km will be HKD + RKD = ZKD.

However, we may not have preserved total tonnes ZT1. In order to check and correct for that we form:

$$HTN_{ij} = HKN_{ij}/L_i$$

$$RTN_{ij} = RKN_{ij}/L_i$$

$$HTN_j = \sum_i HTN_{ij}$$

$$RTN_j = \sum_i RTN_{ij}$$

$$ZTN_j = HTN_j + RTN_j$$

$$ZTD_j = ZT1_j = \sum_i ZT1_{ij}$$

$$HT2_{ij} = HTN_{ij} (ZT1_j/ZTN_j)$$

$$HK2_{ij} = (HT2_{ij})(L_i)$$

$$RT2_{ij} = RTN_{ij} (ZT1_j/ZTN_j)$$

$$RK2_{ij} = (RT2_{ij})(L_i)$$

These last four lines give us the Road and Rail Tonnes and Tonne-kilometres for the new position (2).

4. RAILFREIGHT IN GREAT BRITAIN

4.1 Historical setting

The long-term downward trend in rail freight in Great Britain since World War Two is well known. The trends in rail freight tonnage, tonne-kilometres and in market share continued downwards from the start of published time series data in 1952 until around 1994. By that year, rail carried some 97 million tonnes of freight per annum, representing a mere 5% of the GB market. In terms of (net) tonne-kilometres, the rail performance was little better at 13 billion, or some 6% of the market. Over the years rail freight had become increasingly characterised by bulk movements, mostly moved in trainload consignments for specific customers. By 1993 a relatively limited commodity base was involved. The baseload traffic was mostly coal, metals, minerals, building aggregates and declining amounts of oil and chemicals.

Following privatisation, the possibility of competition from own-account rail operators greatly reduced cross-subsidy and monopoly profits. Rates for moving bulk traffics, such as coal, fell sharply and there was considerable traffic growth, particularly in tonne-kms. The largest private operator, English Welsh and Scottish Railways (EWS) talked in bullish terms of doubling or tripling traffic over 10 years, though the base was never made clear.

4.2 Government policy towards rail freight transport

Present British government policy towards rail freight transport is based around two broad themes:

- Competitive rail freight operations; and,
- The promotion of greater sustainability of freight transport.

Railfreight is expected to pay its way in terms of avoidable cost, except where additional subsidy can be justified through benefits from preventing the traffic switching to modes (basically road) which do not cover their avoidable costs.

Competitive rail freight operations

The long-term decline in rail freight set out above formed the backdrop to privatisation of the railways, including the rail freight sector, as set out in the relevant White Paper (Department of Transport, 1992). The eventual outcome of privatisation was that the previous British Rail freight business was split between two operators. EWS Railways inherited the bulk freight business, the postal traffic and the remains of the wagonload traffic. Freightliner Limited operated the network of intermodal services, largely connecting larger cities to the key ports for the deep-sea container trade. Under the provisions of privatisation, these companies were free to compete against each other. The Act also established 'Open Access', which paved the way for new operators to enter the rail freight market.

Sustainable Distribution

As the British government has moved towards strategies aimed at fulfilling obligations arising from the Rio and Kyoto conventions, its transport strategies have started to pay more attention to the concept of sustainability.

In line with this trend, the government's 'Sustainable Distribution' document (a 'daughter document' of the 'New Deal for Transport' White Paper (DETR, 1998)) made considerable play of the need to transfer freight from road to rail and other more sustainable transport modes (DETR, 1999). Emphasis was placed on intermodal transport options where appropriate. Grant-aid schemes to promote modal transfer, such as the Freight Facilities Grant, were highlighted.

4.3 The Ten Year Plan and the SRA Freight Strategy

Following the White Paper the government set out its Ten Year Plan for transport. The aspiration in terms of freight was that there would be growth of 80% in terms of tonne-kilometres in the decade to 2010. This target was incorporated into the Strategic Rail Authority's 2001 Strategic Plan (SRA, 2001a). Freight forecasts undertaken for the SRA by various consultants produced mid-range estimates of growth in net tonne-kilometres of some 70 – 80% between 2000 and 2010 under policies then in place or firmly planned (SRA, 2001b). Under very favourable conditions for rail, growth might exceed 130%. Most significantly for the purposes of this report, the SRA envisaged that premium and general freight, and maritime intermodal traffic would contribute most of the growth, rather than new bulk traffic (Table 4.1). The SRA's analysis also demonstrated that Channel Tunnel rail freight was no longer expected to be the salvation of the British rail freight industry.

Table 4.1: Contributions to rail freight growth, 2000-2010

<i>Sector</i>	<i>Contribution to percentage rail freight growth, 2000-2010</i>
Premium logistics traffic and general freight traffic	30
Bulk traffic	27
Maritime intermodal	18
Channel Tunnel	5
All commodities	80

Source: SRA (2001b)

The Strategy was built around four key elements - *Network, Interchanges, Funding and Service Delivery*.

Network Strategy

This envisaged investment that would:

- improve the reliability and resilience of the rail network;
- improve rail freight productivity by catering for longer trains;
- improve journey times, especially on the core network for mail, parcels and premium services;
- increase axle loading on key freight routes;
- enhance the loading gauge on key routes, particularly to ports and the Channel Tunnel; and,
- reduce the conflict between freight and passenger trains at bottlenecks by providing alternative routes and additional capacity.

Interchange Strategy

It was acknowledged that for rail to succeed in those distribution and intermodal market segments targeted for greatest growth, there may be a need for investment to develop a strategic terminal network. This issue was addressed by the SRA who commissioned a study of strategic terminal interchange requirements. This study found that in much of the country suitable terminal locations existed and provided adequate capacity, but that there was a clear shortfall in London and the South East. These findings have been used by the SRA to develop its Strategic Rail Freight Interchange Strategy (SRA, 2004a). To encourage the development of terminals, the SRA aimed to:

- safeguard sites of strategic importance;
- improve the planning environment by influencing planning guidance at national, regional and local level;

- provide input into local plans; and,
- where necessary, intervene directly in support of specific applications.

Funding Strategy

This encompassed the application of public funds to rail freight through five mechanisms:

- direct investment in the network, in partnership with Network Rail, operators, customers and other stakeholders;
- company-specific support through Freight Facilities Grants and Track Access Grants;
- a new scheme of Company Neutral Revenue Support for targeted sectors, in particular intermodal traffic for which transfer to rail would lead to demonstrable reductions in ‘sensitive lorry miles’;
- financing for the interchange strategy, in the form of investment or loans for the development of strategic freight interchanges; and,
- grants for the development of innovative systems for rail freight. Intermodal systems including trials with Freight Multiple Units and piggybacking of road trailers were early recipients of such grants.

Service Delivery Strategy

This overarching strategy utilised the mechanisms outlined in the other strategies outlined above in order to reduce barriers to entry into rail freight markets and to support and encourage operators to improve service quality.

4.4 Growth in rail freight tonne-kilometres

If a commodity breakdown is required it is not possible to produce a consistent time series of data for the period since privatisation, due to various changes in the way that rail freight data is collected, published and presented. Hence in this section, data is presented in terms of gross tonne-kilometres (by commodity) for the first part of the period (Table 4.2) and in terms of net tonne-kilometres for more recent years (Table 4.3). From these tables it can be seen that decline of rail freight traffic appears to have been halted around 1994/95, and a modest upward trend then set in.

Around 1998, representatives of EWS Railways, the largest rail freight operator, frequently claimed that the aim of the company was to double or possibly treble their business in a decade. After the dismissal of chief executive Ed Burkhardt, these aspirations were watered down, although the company remained bullish about its medium term prospects. The main areas of growth for EWS at that time were in coal traffic, where lengths of haul were increasing significantly, and in metals, where the restructuring of the steel industry was also leading to more longer-distance shipments. Maritime container traffic was also growing significantly on rail. In the midst of the media attention on EWS, the growth rates achieved by Freightliner Ltd went comparatively unnoticed. Both companies made major investments to modernise their fleets of locomotives and rolling stock.

Another positive aspect in the late 1990s and early in the new century was the emergence of new Open Access rail freight operators. Though these accounted for a small percentage of total rail freight, they tended to operate services for freight that was new to rail. Competition also intensified between the two main players, with Freightliner winning major contracts in bulk markets (partly at the expense of EWS) and EWS expanding its intermodal capabilities.

It must be remembered that rail freight volumes are susceptible to economic performance both nationally and internationally, and also to the performance of the rail network. By 1999 general growth in rail freight seemed to have stalled. 102 million tonnes were carried in financial year 1998/99, compared with 105 million tonnes the previous year, though the continuing increase in average length of haul meant that billion (net) tonne kilometres rose from 16.9 to 17.4 over the same period. Traffic increased further to 18.4 (net) billion tonne kilometres in 1999/2000. The rail freight industry was then hit very hard by the aftermath of the Hatfield derailment in Autumn 2000, when numerous severe speed restrictions were imposed across the rail network. Available capacity and service levels both suffered as a result.

At roughly the same time, protests against the price of petrol and diesel fuel, as well as the treatment of UK hauliers compared to continental counterparts, led to a backtracking by government. Inter alia, this included the ending of the fuel duty escalator, reducing duty on derv and greatly reducing VED for lorries. Furthermore, these reduced figures have remained in place since then, the fuel duty figures being increased by less than inflation, and VED not at all. In consequence, the SRA 2000 forecast assumptions were grossly violated, and both government and the SRA stopped talking about a 80% increase between 2000 and 2010.

Data relating to the period since 2001/02 shows that rail freight (net) tonne-kilometres have continued to grow strongly year-on-year. This growth is almost entirely accounted for by

- increased coal traffic over longer distances, with Scottish opencast and imported coal replacing UK coal mined close to the power stations. This traffic has increased notably in the most recent period as coal has replaced expensive oil and gas for power generation
- Domestic intermodal traffic, due to high and increasing volumes of containerised freight to and from major ports, and an increasing rail share of such traffic.

Construction traffic on rail has also seen significant growth. Earlier growth in metals has not really been sustained, and oil and petroleum traffic on rail has continued at relatively low levels, though with an increase most recently. The data also highlights that whilst rail has made some modest traffic gains in the premium logistics market, it has failed (to date) to make the real breakthrough required in this sector. The data also reflects the impact of the rail's loss of most of its Royal Mail traffic.

Table 4.2: Trends in rail freight performance 1994/95 – 2001/02 (millions of gross tonne kilometres, including empty trains)

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02
<i>Commodity</i>								
Coal	6,899	6,840	6,711	8,117	9,960	10,800	10,586	13,647
Metals	3,625	3,722	4,193	4,531	4,416	4,850	4,597	5,394
Construction	3,708	3,467	3,004	3,389	3,902	3,880	4,620	5,373
Oil and petroleum	3,496	3,331	3,199	3,265	3,290	3,162	2,834	2,534
International	1,182	2,037	2,311	2,829	2,828	2,197	2,365	1,491
Domestic intermodal	5,008	5,974	6,294	7,144	9,010	8,404	8,145	7,532
Others	7,711	6,346	6,909	7,281	9,806	10,897	10,886	11,700
Total	31,629	31,717	32,621	36,556	43,212	44,189	44,033	47,670

Sources: *Railtrack Freight Commercial (cited in Rail Express, December 1997, p.20)*
Railtrack Network Management Statement, 2002
(cited in Whiteing, 2003).

Table 4.3: Trends in rail freight performance 1998/99 – 2005/06 (billions of net tonne kilometres)

	<i>1998/99</i>	<i>1999/00</i>	<i>2000/01</i>	<i>2001/02</i>	<i>2002/03</i>	<i>2003/04</i>	<i>2004/05</i>	<i>2005/06</i>
<i>Commodity</i>								
Coal	4.47	4.85	4.77	6.17	5.66	5.82	6.98	8.57
Metals	2.10	2.19	2.09	2.43	2.64	2.41	2.56	2.19
Construction	2.06	2.04	2.43	2.81	2.51	2.68	2.84	2.96
Oil and petroleum	1.57	1.50	1.36	1.22	1.15	1.19	1.20	1.28
International	1.10	1.01	0.99	0.60	0.46	0.48	0.52	0.46
Domestic intermodal	3.53	3.92	3.84	3.54	3.38	3.53	4.03	4.41
Others	2.51	2.73	2.60	2.62	2.72	2.77	2.45	2.25
Total	17.34	18.23	18.09	19.39	18.52	18.87	20.57	22.11
<i>Infrastructure</i>	<i>0.79</i>	<i>0.78</i>	<i>0.93</i>	<i>1.18</i>	<i>1.18</i>	<i>1.23</i>	<i>1.30</i>	<i>1.42</i>

Source: ORR, 2006

4.5 The current situation

The continued progress of rail freight has benefited from various developments since the publication of the SRA's 2001 Freight Strategy, including reductions in track access charges for freight operations (worth about £170 million in 2003-04). Rail freight operating companies have improved productivity levels and have continued their programmes of investment in new locomotives and rolling stock. New operators, most notably GB Railfreight, have led to increased competition in both the bulk and intermodal markets. With the demise of the SRA in 2005, overall responsibility for the railways now rests with the Department for Transport.

Nevertheless, the investment crisis in the railway industry generally and the need to focus attention on maintenance and renewals rather than on business expansion has placed limits on what the rail freight industry has been able to achieve. Hence whilst the aims and mechanisms set out in the 2001 Freight Strategy remain in place to a large extent, there has inevitably been a reduction in investment funds available for freight-related schemes. Some target dates have been pushed back and all schemes are now subject to much greater scrutiny in terms of costs and value for money. Various stakeholders and interest groups, most notably The *Rail Freight Group* (a widely based representative body of the rail freight industry, including customers, operators, contractors suppliers and manufacturers), *Freight on Rail* (a partnership between the Rail Freight Group, the transport trade unions, Network Rail, the rail freight operating companies and Transport 2000) and The *Freight Transport Association* (FTA) (an industry association representing all modes of freight transport) have expressed disappointment and dismay regarding these problems. The most vociferous criticism has been targeted at the temporary cessation of the financial grant regimes (Freight Facilities Grant and Track Access Grant) in England in Spring 2003. There has also been concern over the limited funds available for the new Company Neutral support scheme and the restrictions on the types of traffic to which it applies.

The recent White Paper (DfT, 2004a) suggests that freight should be given greater priority over key routes, but that the quid pro quo for that is that it will be required to pay a share of the fixed costs. Track access charges may also be raised to cover the full cost of freight only routes.

On a more positive note, gauge enhancement to enable the movement of high containers on conventional wagons between Felixstowe and Scotland via the West Coast Main Line is now complete. Similar enhancement on other key port routes seems likely, though not for several years. Network Rail is currently consulting on its Freight Route Utilisation Strategy, which will inform the development of key freight corridors in the years to come (Network Rail, 2006).

5. EXTERNAL SCENARIOS

5.1 Introduction

When testing transport strategies the most obvious course of action is to do so for some past year for which data is available and the only uncertainty arises from the adequacy of the model. Our ‘data year’ is 1998, and we will indeed be testing our strategies for that year. However, there is naturally much greater interest in seeing how the strategies will impact on some future prediction. A consequential first step is to produce such a base prediction for a future year or years. Transport planning often considers futures 30 or even 60 years ahead, but uncertainties then become so great that using these as a base for strategy tests is not sensible. We have therefore chosen 2010 and 2016 as our future test years. We turn next to consider the matter of such external scenarios.

5.2 External Scenarios

The road and rail policies to be tested in this report are to be seen against a background of external influences that affect the demand for both rail and road travel. These factors tend to be a mix of economic and social trends. Work by the Foresight programme (DTI, 2003) produced four external scenarios (World Markets, Global Sustainability, National Enterprise and Local Stewardship) based around two ‘drivers’, social values and systems of governance. Here, two of these external scenarios (Local Stewardship and World Markets) will be considered along with the reference base scenario. Report C3/3 concluded that for freight it was not sensible to test every possible combination, and suggested what might be termed a ‘Pro-Road’ strategy and a ‘Pro-Rail’ strategy might be tested with a high growth and a low growth scenario respectively. We now consider that to be too restrictive and therefore no longer wish to pair (transport) strategies with (external) scenarios, but test all combinations

Nevertheless, it is worth reminding ourselves of the World Markets and Local Stewardship scenarios so that we can see how our thinking has developed, and to permit some ‘cross-referencing’ of our results. It should be noted, however, that much of the description of these two scenarios is not directly relevant for freight.

The *World Markets* scenario assumes that individuals take on a liberal view and are less concerned with society as a whole. Businesses focus on developing global markets and there are fewer firms that dominate many sectors. The market is allowed to play a more significant role in the provision of social services, education and healthcare, whilst governments increasingly focus on global co-operation as opposed to national governance. The key factors underlying the scenario are described in greater detail in Table 5.1.

Table 5.1 World Markets – Key Drivers & Trends

Drivers	
Social values	Internationalist; Libertarian.
Governance structures	Weak; Dispersed; Consultative.
Role of policy	Minimal; Enabling Markets.
Economic Trends	
Economic development	High Growth; High Innovation; Capital Productivity
Structural change	Rapid; Towards Services.
Fast growing sectors	Health & Leisure; Media & Information; Financial Services; Biotechnology; Nanotechnology.
Declining sectors	Manufacturing; Agriculture.
Social Trends	
Unemployment	Medium-Low.
Income	High.
Equity	Strong decline.
Areas of Conflict	Social exclusion; Immigration/Emigration; Political Accountability.

(DTI, 2003)

The Local Stewardship scenario is in stark contrast to the World Markets scenario in that people see themselves as part of the local community and encourage regional development using local resources. The political system reflects the regionalisation of the economy and involves more decision makers at the local level. Healthcare, education and social services are publicly funded via taxation. The key factors underlying the scenario are outlined in Table 5.2.

Table 5.2 Local Stewardship – Key Drivers & Trends

Drivers	
Social values	Localism; Co-operative.
Governance structures	Strong; Local; Participative.
Role of policy	Interventionist; Social & Environmental.
Economic Trends	
Economic development	Low Growth; Low Innovation; Modular & Sustainable.
Structural change	Moderate; Towards Regional Systems.
Fast growing sectors	Small-scale manufacturing; Food & Organic farming; Local Services.
Declining sectors	Retailing; Tourism; Financial Services.
Social Trends	
Unemployment	Medium-Low (larger voluntary sector).
Income	Low.
Equity	Strong improvement.
Areas of Conflict	Land use; Under-Investment; Environmental Restrictions.

DTI (2003)

For each of the four scenarios mentioned above the Foresight Programme has also produced a snapshot of key indicators for the year 2010. These are presented in Table 5.3 and cover a wide range of areas.

Table 5.3 Snapshot 2010

Indicator	Reference Base	World Markets	National Enterprise	Global Responsibility	Local Stewardship
GDP growth per year	2.5%	3.5%	2%	2.75%	1.25%
Total Investment - % of GDP	19%	22%	18%	20%	16%
Economic activity in sectors %					
services	66%	75%	68%	72%	70%
production	27%	20%	25%	22.5%	22%
construction	5%	4%	5%	4%	5%
agriculture	2%	1%	2%	1.5%	3%
ICT Sector – % of value added	3.3%	7%	5%	6%	4%
Qualifications age 19 – population with level 2 qualification	75%	85%	75%	90%	95%
Unemployment	5%	5%	8%	4%	5%
Poverty - % of people with income below 60% of median income	18%	23%	25%	15%	10%
Health life expectancy – years lived in good/fairly good health	67 yrs	68.5 yrs	67.5 yrs	69 yrs	68 yrs
Newly developed land-hectares per year	6,500 ha	6,000 ha	4,500 ha	3,000 ha	1,000 ha
Passenger Transport – average change per year	-	2%	1%	1.5%	0%
passenger-kilometres	720 billion	910 billion	810 billion	860 billion	715 billion
Traffic Congestion- % of network at 100% stress	6%	11%	13%	9%	5%
Primary Energy Consumption Ave Change Per Year	-	+1.7% pa	+1.5% pa	+0.1% pa	+0.1% pa
Tonnes of Oil Equivalent	230 million	280 million	270 million	230 million	230 million

DTI (2003)

5.3 Potential Impacts on Rail Freight Transport

This section considers developments in freight transport and their likely impact on the use of rail freight. Any attempt to examine potential futures for rail demand must appreciate that rail does not operate in isolation from the rest of the UK transport system. It is necessary to explore likely developments in other, often competing modes as these will have a crucial bearing on future rail demand.

Road network unreliability resulting from congestion has severe consequences for goods movement in the UK and with the predicted lengthening of journey times this problem is likely to grow with damaging consequences for the UK economy. In particular it may make just-in-time logistics increasingly unviable and imposes additional costs upon business. It is predicted that deteriorating motorway reliability and urban road congestion will mean that by 2016 a lorry journey from the port of Southampton to Manchester is forecast take 70% longer than in 2003 (Freight Transport Association website).

The problem of road network efficiency is compounded by increasing restrictions being placed upon the working practices of haulage companies. The EC Working Time Directive of November 1993 introduced a limit on the maximum hours of work for employees in Europe to 48 hours. This Directive initially specifically excluded workers in the transport sector. The Road Transport Directive which details breaks, rest periods and working time of HGV drivers was implemented in March 2005 (European Commission, 2002).

The growing difficulties associated with moving goods on the road network have the potential to make rail freight an increasingly attractive option for UK business. Several UK retailers have turned to rail freight to meet their need for efficient and reliable transport in recent times (Rail Freight Group, undated). The degree to which rail can meet increasing demands in this regard is limited by capacity issues and the fact that freight traffic has to compete with passenger services for access to infrastructure. A long term role for dedicated freight lines has been identified by the industry, but at present the Government remains committed to a single railway for passenger and goods movement (Darling, 2003).

Other modes are also being actively explored for their potential to address concerns over the efficient and reliable movement of goods in the UK. In particular, short-sea shipping has been identified as a means of moving goods between ports quickly and efficiently and this can be seen as a particularly important option given the fact that 95% of UK trade passes through sea ports (Roberts, 2003) and that between 1989-99 there was a 100% rise in deep-sea container traffic in UK, mostly centred upon Felixstowe and Southampton and further year-on-year growth is forecast (SRA, 2003c). Here again the consequences for rail could be profound as the increased port capacity needed to meet demand is likely to depend on meeting planning criteria which will demand that a high proportion of inland movements to and from the ports are undertaken by rail to reduce local environmental impacts (SRA, 2003c).

Improvements in the environmental impact of road vehicles have been dramatic in recent years and with alternative fuel and new engine technologies developing it is likely that the environmental advantage that rail holds over road transport may be increasingly under threat. However, road transport remains the fastest growing source of carbon dioxide emissions (Bosworth, 2003). Improvements to power stations providing electric for rail and reduced emissions from diesel-powered trains are essential to improving the environmental credentials of rail travel (SRA, 2003c).

Freight transport access to urban areas is also a growing issue of environmental concern. The development of expanded distribution centres on the fringes of urban areas could help to reduce this impact; however they would need to be compatible with planning policies on out of town development. One approach that would make these centres more sustainable would be to locate them at interchange points between a range of transport modes and for the ongoing distribution to the urban centres to be undertaken by vehicles powered by alternative fuels such as electricity and/or hydrogen. Automated urban goods distribution also offers the prospect of enhancing reliability and reducing environmental impact. Many local authorities are using vehicles powered by alternative fuels in their fleets and a number of trials of automated vehicles in controlled urban environments are ongoing across Europe (see MIRACLES (undated) and NETMOBIL (undated)).

5.4. Rail and Road Strategies

There is a need for road and rail strategies to be outlined in conjunction with one another from both a supply and a demand perspective. A range of individual policies will be tested in Section 6. Some of these are alternatives or mutually exclusive. We have formed two groupings of policies to form a 'Pro-Rail' strategy (A) and a 'Pro-Road' strategy (B). Both of these will be tested against a 'Do Nothing' strategy (0).

These three strategies, and the full set of policy tests, will be run for our data year, 1998, and for two future years, 2010 and 2016. For 2010 only a central estimate is given. For 2016 we have given Low and High estimates based on extreme assumptions regarding GDP growth. Models of tonne kms as a function of the rate of GDP growth were available to us from work conducted by us for the SRA in 2000. Based on a starting point of 1998 we had estimates for an average of 2% or 3% pa in GDP. The 2016 Low and High estimates may be interpreted in that way. More reasonably, however, given that many years have already passed since 1998, we could interpret the Low and High estimates in the light of the implied GDP growth rates from 2006 to 2016. In that case, our calculations show that the Low estimate implies a GDP growth rate of 1.5% pa and the High estimate a growth rate of 3.5% pa.

These figures of 1.5% per annum and 3.5% per annum GDP growth show a marked similarity to those shown in Table 5.3 for Local Stewardship and World Markets respectively, although we are using these differential growth rates for 2006-2016 whereas Table 5.3 implies their use from 2000-2010. Given that we are already in 2006, we felt that this was as close to the spirit of Table 5.3 as we could sensibly come.

6. STRATEGIES, POLICIES AND SCENARIOS TESTED

6.1 Scenarios

We decided to test scenarios relative to base 'no change' scenarios, of which we have four: 1998; 2010; 2016 LO; and 2016 HI. Our base data is representative of the position around the year 1998. We have also made projections to the years 2010 and 2016. In both cases we have chosen a base against which we can test policies. As at 2006 we already know that, for instance, the Working Time Directive (WTD) policy has been implemented. It is not however in the 2010 and 2016 (LO & HI) bases – it is a policy to be tested against the base to establish its effects. To have proceeded the other way round and put WTD in the 2010 base would have meant that the only test of WTD we could have performed would have been its removal, which would have struck many readers as odd. Similar considerations apply to several of the policy tests. It should therefore be stressed that the base figures are in no way a neutral prediction, merely something to compare the policies and scenarios against. Predictions can be obtained by choosing that package of policies that are to be supposed to have been implemented, and applying these to the relevant base. For 2016 a central estimate, which may be taken to be consistent with an assumption of an average 2.5% GDP growth for all years since 1998, can be found by averaging the LO and HI predictions. Other levels of average GDP growth (since 1998) can be handled by

interpolation, taking the LO prediction to be based on a 2.0% pa average and the HI prediction on a 3.0% average.

All the following policies apply equally in 2010 and 2016.

6.2 Pro-rail policies

A1 Rail maintain as in 1998

This policy test assumes that there is modernisation on the West and East Coast Mainlines to maintain current capacities for rail freight. We have interpreted this as reducing rail journey times from 2010 base by 2% for ‘Food Drink & Agriculture’ and ‘Coal & Coke’ commodities, and by 4% for ‘Others’, which includes containerised traffic. The remaining commodities make relatively little use of these routes so are assumed not to be affected.

A2 Reduced rail ‘tripping’ costs

Here we have assumed an investment in rolling stock such as to lead to a 10% reduction in rail tripping costs. This might be achieved, for example, by what are termed ‘freight multiple units’ - essentially single ended low powered locos with room for some payload, which can work with wagons in between, and can reach a marshalling yard without waiting for a tripping loco to visit each terminal.

A3 Company Neutral grant scheme

SRA (2004b) describes a scheme introduced in 2004 which replaces previous Track Access Grant support to Freightliners Limited. This new scheme, called the Company Neutral Revenue Support scheme (CNRS) is open, on a non-discriminatory basis, to any individual operator moving containers by rail. Rates are published in that document, updated in 2006 (DfT, 2006a), although no guarantee is given that sufficient budget will be available to accommodate all compliant bids. Our CNG policy test has assumed that these rates apply to all traffic that we have allocated to container wagons if moved by rail. For that traffic the monetary cost of movement by rail has been set equal to that of the largest road vehicle used in that cell. No budget limit has been applied.

The government has recently announced that in future bids for funding to deliver road efficiency gains will be considered alongside revenue support grants for rail freight, so that there will effectively be competition for the fixed budget. The new scheme is called the Rail Environmental benefit Procurement Scheme (REPS). The rail aspect is in two parts: REPS (Intermodal) which replaces CNRS; and REPS (Bulk) which replaces Track Access Grants.

A4 Upgrading of gauge of freight routes for container traffic

The increased prevalence of the 9 foot 6 inches high containers in maritime movements will have a significant impact on rail container movements in Britain because the rail structure gauge does not (on most routes) permit the use of standard container carrying wagons. In the 2010 and 2016 bases we have assumed that roughly 2/3 of containers moving through ports will be too large to be carried on standard container wagons on the general British rail network. We have therefore assumed that special low platform wagons will be used in those years at higher cost to the user. We are assuming only 25% of containers are moving on the standard wagons, the remainder on special low height wagons.

In our policy test we have assumed that sufficient of the British rail network is enlarged in terms of the structure gauge such that only about 15% of containers need to move in this way, the remainder (85%) being carried on standard wagons. This significantly reduces the cost of container movements by rail.

A5 Net fuel cost double

This policy test aims to capture a future situation where the price of oil has risen such that fuel costs, net of duty, double. This is equivalent to a 25% rise in total fuel costs for road and 10% for rail. This will clearly have more of a punitive impact on road traffic.

A6 Working Time Directive for Road Transport (WTD)

The UK Regulations on working hours in force from March 2005 cover mobile workers who are participating in road transport activities that are covered by EU drivers' hours rules. The main provisions under the regulations are:

- Working time is limited to an average 48 hour week (as opposed to the previous limit of 55 hours), over a 4 month reference period.
- Up to 60 hours working time can be performed during a single week, providing the average working time does not exceed 48 hours during the reference period.
- Working time at night is limited to 10 hours in any 24 hour period.
- Workers cannot work more than 6 consecutive hours without taking a break. If working between 6-9 hours, a break of at least 30 minutes is required. If working over 9 hours, breaks totalling 45 minutes are required.
- Derogations are available that would permit an extension to the 4 month reference period, and allow night workers to work longer than 10 hours.

Unlike preceding legislation on working time, individuals cannot choose to "opt-out" of the average 48 hour week. However, any time classified as a break, rest, or a "period of availability" does not count towards any of the working time limits. These periods are not defined as working time under the WTD.

Our policy test assumes that the effect of the implementation of the Working Time Directive in the UK is such that the effect is equivalent to an increase of £36 per day in the

standing costs of running an HGV. This was based on an average reduction of working hours from 12 to 9.6 per day.

A7 Road Marginal Social Cost pricing

Here the costs of running road vehicles are increased to offset external costs from pollution, noise, congestion etc, using marginal external cost valuations from Sansom et al (2001). That report found that rail freight was more or less meeting its marginal social costs.

A8 Longer Trains

This strategy assumes extra investment in infrastructure to facilitate trains with 20% more wagons (except for chemical sector trains which are already running shorter than the infrastructure will permit).

6.3 Pro-road policies

B1 Rationalisation of wagonload rail freight

For this policy test we have assumed a rationalisation of rail freight wagonload services, which will lead to fewer and longer distance tripping trains. This will have knock on effects on journey time of 10% and 30% for one ended and two ended wagon load freight respectively.

B2 Road journey times maintained as in 1998

This policy test involves investment in roads schemes and bypasses, and we have assumed that this will maintain road journey times at 1998 levels. Otherwise we have assumed road journey times to increase by 20% by 2010. Also, delays (due to congestion) will be maintained at 1998 levels if the ten year plan is successfully implemented, otherwise we have assumed them to be 25% higher than 1998 levels.

B3 Heavier road vehicles

In this policy test we have assumed the introduction of a 50 tonne HGV with an extra 4 tonnes capacity over existing 44 tonne HGVs, with corresponding increases in vehicle running costs per vehicle. This is modelled as a complete replacement of 44 tonne HGVs by the new 50 tonne HGVs.

B4 Road investment

Here we have assumed a further package of investment for road which leads to a 10% reduction in delays and journey times, over and above what would be achieved in B2.

B5 Double rail Track Access Charges

Here, access charges for rail freight operators are doubled by the Office of Rail Regulation.

6.4 Strategies

Strategy 0 No change

Strategy 0 assumes that none of the listed policies will be implemented and that the trajectory of traffic figures will continue in a 'do nothing' way, to some extent reflecting past trends, but also incorporating foreseen underlying external forces as identified, for example, by the SRA Market Studies (SRA, 2004c).

This base strategy serves two purposes. Firstly, in the 1998 base it checks that the calibration data is recovered at the level of aggregation presented in the tables. That means that any changes in the 1998 base as the result of other strategies can be safely interpreted as due to that strategy being tested, and not due to any divergence between the model and the data in the 1998 base. Secondly, it shows how our base assumptions for 2010 and 2016 differ from our 1998 base, in the absence of any policy changes.

Strategy A – Pro rail

This package includes the following policies bundled together to provide a 'best case strategy' for rail:

- A1 Rail maintain as in 1998
- A2 Reduced rail 'tripping' costs
- A4 Upgrading of gauge of freight routes for container traffic
- A5 Net fuel cost double
- A6 Working Time Directive
- A7 Road Marginal Social Cost pricing
- A8 Longer Trains

Note that this strategy does not include A3 Company Neutral Grant scheme as this is subsidising rail to be equivalent to road costs, and would overlap with A7 MSC pricing, where road is taxed to offset its external costs.

Strategy B – Pro road

This package includes the following policies bundled together to provide a 'best case strategy' for road:

- B1 Rationalisation of wagonload rail freight
- B2 Road journey times maintained as in 1998
- B3 Heavier road vehicles
- B4 Road investment
- B5 Double rail Track Access Charges

7. RESULTS

7.1 Tables of results

We present results three sets of results each for the three scenarios, 2010, 2016HI and 2016LO. These are:

1. Modal results for each strategy and individual policy (tables 7.1-7.3)
2. Commodity specific results for the three strategies (tables 7.4-7.6)
3. Rail and Road vehicle kilometres for the three strategies (tables 7.7-7.9)

These results are presented with the road collection and delivery legs of rail traffic included. This may mean results are not quite as transparent for some commodities, as an increase in rail's share of traffic for commodity groups such as 'Others', which have a large amount of road collection and delivery, will partially offsets the loss of road market share from the difference in road and rail generalised costs. As an illustration of this effect we also present commodity specific results for 2010 with road collection and delivery traffic removed in table 7.10.

Table 7.1 Results for each policy and strategy package, by mode, 2010

Policy/ strategy	Road						Rail						Total					
	Tonnes (millions)	%chan ge from do nothing	Tonne kms (billions)	%chan ge from do nothing	Length of Haul	%chan ge from do nothing	Tonnes (millions)	%chan ge from do nothing	Tonne kms (billions)	%chan ge from do nothing	Length of Haul	%chan ge from do nothing	Tonnes (millions)	%chan ge from do nothing	Tonne kms (billions)	%chan ge from do nothing	Length of Haul	%chan ge from do nothing
Do nothing	1863.5		157.99		84.8		184.52	0.00	26.01	0.00	141.0		2048.0	0.00	184.00	0.00	89.8	
A Pro-Rail package	1844.4	-1.03	131.82	-16.56	71.5	-15.70	220.47	19.49	34.64	33.18	157.1	11.46	2064.9	0.82	166.47	-9.53	80.6	-10.27
B Pro-road package	1872.0	0.45	166.79	5.57	89.1	5.09	172.69	-6.41	23.44	-9.91	135.7	-3.74	2044.6	-0.17	190.23	3.38	93.0	3.55
A1 Rail maintain as now	1863.4	-0.01	157.81	-0.11	84.7	-0.11	185.20	0.37	26.21	0.73	141.5	0.36	2048.6	0.03	184.02	0.01	89.8	-0.02
A2 Reduced rail tripping costs	1863.4	0.00	157.96	-0.02	84.8	-0.01	184.67	0.08	26.04	0.10	141.0	0.02	2048.1	0.00	184.01	0.00	89.8	0.00
A3 Company neutral grant	1863.4	-0.01	157.70	-0.19	84.6	-0.18	185.95	0.78	26.34	1.23	141.6	0.45	2049.3	0.06	184.03	0.01	89.8	-0.05
A4 Upgrading of freight routes	1863.5	0.00	157.98	-0.01	84.8	-0.01	184.56	0.02	26.03	0.04	141.0	0.02	2048.1	0.00	184.01	0.00	89.8	0.00
A5 Net fuel cost double	1860.7	-0.15	153.58	-2.79	82.5	-2.64	188.92	2.39	27.04	3.95	143.1	1.53	2049.6	0.08	180.62	-1.84	88.1	-1.91
A6 Working Time Directive	1859.0	-0.24	152.77	-3.30	82.2	-3.07	190.06	3.00	26.85	3.19	141.2	0.18	2049.1	0.05	179.62	-2.38	87.7	-2.43
A7 Road MSC pricing	1851.7	-0.64	140.84	-10.86	76.1	-10.29	205.19	11.20	30.95	18.98	150.8	6.99	2056.9	0.43	171.79	-6.64	83.5	-7.04
A8 Longer Trains	1861.9	-0.09	157.33	-0.42	84.5	-0.33	187.44	1.58	26.75	2.84	142.7	1.24	2049.3	0.06	184.08	0.04	89.8	-0.02
B1 Rationalisati on of freight	1863.9	0.02	158.12	0.08	84.8	0.06	183.89	-0.34	25.88	-0.53	140.7	-0.19	2047.8	-0.01	184.00	0.00	89.9	0.01
B2 Road maintain as now	1863.8	0.02	160.20	1.40	86.0	1.38	183.94	-0.31	25.94	-0.30	141.0	0.01	2047.8	-0.01	186.14	1.16	90.9	1.17
B3 Heavier Road Vehicles	1867.2	0.20	161.84	2.44	86.7	2.23	179.68	-2.62	25.18	-3.20	140.1	-0.60	2046.9	-0.06	187.02	1.64	91.4	1.70
B4 Road investment	1863.7	0.01	159.24	0.79	85.4	0.78	184.16	-0.19	25.96	-0.20	141.0	-0.01	2047.9	-0.01	185.21	0.65	90.4	0.66
B5 Double TAC	1866.4	0.16	159.16	0.74	85.3	0.58	180.16	-2.36	24.67	-5.16	136.9	-2.87	2046.6	-0.07	183.83	-0.09	89.8	-0.02

Table 7.2 Results for each policy and strategy package, by mode, 2016 LO

Policy/ strategy	Road						Rail						Total					
	Tonnes (millions)	%change from do nothing	Tonne kms (billions)	%change from do nothing	Length of Haul	%change from do nothing	Tonnes (millions)	%change from do nothing	Tonne kms (billions)	%change from do nothing	Length of Haul	%change from do nothing	Tonnes (millions)	%change from do nothing	Tonne kms (billions)	%change from do nothing	Length of Haul	%change from do nothing
Do nothing	1801.3		150.25		83.41		185.65	0.00	26.25	0.00	141.38		1987.0	0.00	176.50	0.00	88.83	
A Pro-Rail package	1783.6	-0.98	125.85	-16.24	70.56	-15.41	219.40	18.18	34.51	31.49	157.31	11.26	2003.0	0.81	160.36	-9.14	80.06	-9.87
B Pro-road package	1810.5	0.51	159.42	6.10	88.05	5.56	173.03	-6.80	23.64	-9.93	136.63	-3.36	1983.5	-0.17	183.06	3.72	92.29	3.90
A1 Rail maintain as now	1801.2	-0.01	150.08	-0.11	83.32	-0.10	186.30	0.35	26.43	0.68	141.86	0.34	1987.5	0.03	176.51	0.01	88.81	-0.02
A2 Reduced rail tripping costs	1801.2	0.00	150.23	-0.01	83.40	-0.01	185.76	0.06	26.27	0.08	141.41	0.02	1987.0	0.00	176.50	0.00	88.83	0.00
A3 Company neutral grant	1801.2	-0.01	149.97	-0.19	83.26	-0.18	187.02	0.74	26.56	1.17	141.99	0.43	1988.2	0.06	176.52	0.01	88.78	-0.05
A4 Upgrading of freight routes	1801.3	0.00	150.24	-0.01	83.41	-0.01	185.69	0.02	26.26	0.04	141.40	0.02	1987.0	0.00	176.50	0.00	88.83	0.00
A5 Net fuel cost double	1799.0	-0.13	146.28	-2.64	81.31	-2.52	189.23	1.93	27.14	3.39	143.41	1.44	1988.2	0.07	173.42	-1.74	87.22	-1.81
A6 Working Time Directive	1797.8	-0.19	145.52	-3.15	80.94	-2.96	189.86	2.27	26.93	2.60	141.85	0.33	1987.7	0.04	172.45	-2.29	86.76	-2.33
A7 Road MSC pricing	1790.4	-0.61	134.40	-10.55	75.07	-10.00	204.64	10.23	30.89	17.67	150.92	6.75	1995.0	0.41	165.28	-6.35	82.85	-6.73
A8 Longer Trains	1800.0	-0.07	149.68	-0.38	83.15	-0.31	188.05	1.29	26.89	2.45	143.00	1.14	1988.1	0.06	176.57	0.04	88.81	-0.01
B1 Rationalisation of freight	1801.6	0.02	150.37	0.08	83.46	0.06	185.13	-0.28	26.12	-0.47	141.11	-0.19	1986.7	-0.01	176.49	0.00	88.84	0.01
B2 Road maintain as now	1801.6	0.02	152.26	1.34	84.52	1.33	185.11	-0.29	26.17	-0.31	141.36	-0.01	1986.7	-0.01	178.43	1.10	89.81	1.11
B3 Heavier Road Vehicles	1806.0	0.26	154.75	3.00	85.69	2.73	179.64	-3.24	25.36	-3.40	141.14	-0.17	1985.7	-0.07	180.11	2.05	90.70	2.11
B4 Road investment	1801.5	0.01	151.39	0.76	84.04	0.75	185.32	-0.18	26.20	-0.20	141.35	-0.02	1986.8	-0.01	177.58	0.62	89.38	0.63
B5 Double TAC	1803.7	0.14	151.28	0.69	83.87	0.55	182.02	-1.95	25.04	-4.62	137.54	-2.72	1985.8	-0.06	176.32	-0.10	88.79	-0.04

Table 7.3 Results for each policy and strategy package, by mode, 2016 HI

Policy/ strategy	Road						Rail						Total					
	Tonnes (millions)	%chan ge from do nothing	Tonne kms (billions)	%chan ge from do nothing	Length of Haul	%chan ge from do nothing	Tonnes (millions)	%chan ge from do nothing	Tonne kms (billions)	%chan ge from do nothing	Length of Haul	%chan ge from do nothing	Tonnes (millions)	%chan ge from do nothing	Tonne kms (billions)	%chan ge from do nothing	Length of Haul	%chan ge from do nothing
Do nothing	2063.7		188.05		91.12		216.34	0.00	32.53	0.00	150.37		2280.0	0.00	220.58	0.00	96.74	
A Pro-Rail package	2043.1	-1.00	156.74	-16.65	76.71	-15.81	257.46	19.01	43.18	32.74	167.72	11.54	2300.6	0.90	199.92	-9.37	86.90	-10.18
B Pro-road package	2074.3	0.51	199.62	6.15	96.24	5.61	201.59	-6.82	29.33	-9.84	145.50	-3.24	2275.9	-0.18	228.95	3.79	100.60	3.98
A1 Rail maintain as now	2063.6	-0.01	187.81	-0.13	91.01	-0.12	217.21	0.40	32.79	0.81	150.98	0.40	2280.8	0.03	220.60	0.01	96.72	-0.02
A2 Reduced rail tripping costs	2063.6	0.00	188.03	-0.01	91.11	-0.01	216.47	0.06	32.56	0.08	150.40	0.02	2280.1	0.00	220.58	0.00	96.74	0.00
A3 Company neutral grant	2063.6	0.00	187.65	-0.21	90.93	-0.21	218.01	0.77	32.97	1.34	151.22	0.57	2281.6	0.07	220.61	0.01	96.69	-0.05
A4 Upgrading of freight routes	2063.7	0.00	188.04	-0.01	91.12	-0.01	216.39	0.02	32.54	0.04	150.40	0.02	2280.1	0.00	220.58	0.00	96.74	0.00
A5 Net fuel cost double	2061.0	-0.13	182.93	-2.72	88.76	-2.60	220.61	1.97	33.65	3.44	152.54	1.44	2281.7	0.07	216.58	-1.81	94.92	-1.88
A6 Working Time Directive	2059.7	-0.19	182.32	-3.05	88.52	-2.86	221.19	2.24	33.35	2.53	150.79	0.28	2280.9	0.04	215.67	-2.23	94.56	-2.26
A7 Road MSC pricing	2051.1	-0.61	167.68	-10.83	81.75	-10.28	239.15	10.54	38.37	17.94	160.42	6.69	2290.2	0.45	206.05	-6.59	89.97	-7.00
A8 Longer Trains	2062.1	-0.08	187.29	-0.41	90.82	-0.33	219.34	1.38	33.38	2.61	152.19	1.21	2281.5	0.06	220.67	0.04	96.72	-0.02
B1 Rationalisati on of freight	2064.0	0.02	188.22	0.09	91.19	0.07	215.68	-0.31	32.36	-0.53	150.02	-0.23	2279.7	-0.01	220.58	0.00	96.76	0.01
B2 Road maintain as now	2064.0	0.02	190.82	1.47	92.45	1.46	215.70	-0.30	32.44	-0.29	150.38	0.01	2279.7	-0.01	223.26	1.21	97.93	1.23
B3 Heavier Road Vehicles	2069.0	0.26	193.40	2.85	93.48	2.58	209.52	-3.15	31.44	-3.36	150.04	-0.22	2278.6	-0.07	224.84	1.93	98.68	2.00
B4 Road investment	2063.9	0.01	189.62	0.83	91.88	0.83	215.95	-0.18	32.47	-0.19	150.35	-0.01	2279.8	-0.01	222.09	0.68	97.41	0.69
B5 Double TAC	2066.6	0.14	189.40	0.72	91.65	0.57	211.82	-2.09	30.98	-4.78	146.24	-2.75	2278.5	-0.07	220.38	-0.09	96.72	-0.02

Table 7.4 Results for each strategy package, by commodity, 2010

Tonnes lifted (millions)										
	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		439.71	27.22	80.25	71.60	597.30	56.10	591.35	1863.52
	Rail		0.43	38.60	8.65	26.42	97.39	0.50	12.52	184.52
A Pro-Rail	Road		440.59	25.37	78.71	68.37	588.46	53.20	589.70	1844.40
		<i>% difference from do nothing</i>	0.20	-6.81	-1.92	-4.51	-1.48	-5.17	-0.28	-1.03
	Rail		3.22	40.43	10.19	31.35	110.45	3.93	20.90	220.47
		<i>% difference from do nothing</i>	642.21	4.73	17.86	18.67	13.41	682.20	66.88	19.49
B Pro-road	Road		439.70	28.14	80.37	74.66	601.29	56.26	591.53	1871.95
		<i>% difference from do nothing</i>	0.00	3.38	0.15	4.28	0.67	0.28	0.03	0.45
	Rail		0.38	37.68	8.53	22.97	91.33	0.31	11.48	172.69
		<i>% difference from do nothing</i>	-11.67	-2.39	-1.37	-13.04	-6.22	-37.66	-8.29	-6.41
Tonne kms (Billions)										
	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		52.77	1.82	6.94	7.64	22.30	7.38	59.14	157.99
	Rail		0.21	5.18	1.86	3.45	11.39	0.12	3.81	26.01
A Pro-Rail	Road		42.65	1.57	6.14	6.27	18.73	6.23	50.23	131.82
		<i>% difference from do nothing</i>	-19.17	-14.00	-11.56	-17.93	-16.00	-15.57	-15.06	-16.56
	Rail		1.15	5.37	2.26	4.80	14.28	0.93	5.86	34.64
		<i>% difference from do nothing</i>	451.44	3.76	21.33	39.15	25.34	695.92	53.90	33.18
B Pro-road	Road		55.84	1.93	7.07	8.28	23.87	7.51	62.29	166.79
		<i>% difference from do nothing</i>	5.82	6.23	1.88	8.32	7.04	1.78	5.32	5.57
	Rail		0.20	5.00	1.82	2.78	9.86	0.08	3.70	23.44
		<i>% difference from do nothing</i>	-3.30	-3.34	-2.43	-19.50	-13.47	-32.92	-2.83	-9.91
Length of Haul (km)										
	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	Average
Do nothing	Road		120.00	66.90	86.46	106.72	37.34	131.57	100.01	84.78
	Rail		479.52	134.12	215.22	130.68	116.99	231.14	303.89	140.99
A Pro-Rail	Road		96.80	61.74	77.97	91.72	31.83	117.15	85.19	71.47
		<i>% difference from do nothing</i>	-19.33	-7.71	-9.83	-14.05	-14.74	-10.96	-14.82	-15.70
	Rail		356.27	132.87	221.56	153.22	129.30	235.19	280.27	157.14
		<i>% difference from do nothing</i>	-25.70	-0.93	2.95	17.25	10.52	1.75	-7.77	11.46
B Pro-road	Road		126.99	68.74	87.96	110.85	39.70	133.53	105.30	89.10
		<i>% difference from do nothing</i>	5.82	2.75	1.73	3.87	6.33	1.49	5.29	5.09
	Rail		524.97	132.81	212.92	120.98	107.95	248.72	321.99	135.71
		<i>% difference from do nothing</i>	9.48	-0.98	-1.07	-7.42	-7.73	7.60	5.95	3.74

Table 7.5 Results for each strategy package, by commodity, 2016 LO

Tonnes lifted (millions)										
Strategy	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		420.71	26.59	103.82	68.94	582.74	53.80	544.70	1801.30
	Rail		0.40	39.05	10.90	25.66	97.48	0.55	11.61	185.65
A Pro-Rail	Road		421.56	25.12	101.80	66.13	575.08	50.74	543.14	1783.57
		<i>% difference from do nothing</i>	0.20	-5.53	-1.94	-4.07	-1.31	-5.69	-0.29	-0.98
	Rail		3.26	40.53	12.92	30.00	108.90	4.18	19.61	219.40
		<i>% difference from do nothing</i>	724.02	3.79	18.51	16.93	11.71	657.72	68.94	18.18
B Pro-road	Road		420.73	27.84	103.98	71.53	587.52	54.00	544.88	1810.47
		<i>% difference from do nothing</i>	0.00	4.70	0.16	3.76	0.82	0.38	0.03	0.51
	Rail		0.38	37.81	10.74	22.76	90.41	0.31	10.63	173.03
		<i>% difference from do nothing</i>	-4.43	-3.20	-1.51	-11.29	-7.25	-44.46	-8.46	-6.80
Tonne kms (Billions)										
Strategy	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		49.69	1.79	8.88	7.16	21.65	7.08	53.99	150.25
	Rail		0.19	5.26	2.33	3.33	11.51	0.13	3.50	26.25
A Pro-Rail	Road		40.27	1.56	7.86	5.94	18.40	5.91	45.91	125.85
		<i>% difference from do nothing</i>	-18.97	-12.58	-11.45	-17.10	-15.02	-16.58	-14.96	-16.24
	Rail		1.13	5.43	2.83	4.54	14.13	0.98	5.46	34.51
		<i>% difference from do nothing</i>	496.01	3.33	21.92	36.26	22.75	675.68	55.79	31.49
B Pro-road	Road		52.92	1.92	9.07	7.75	23.38	7.23	57.14	159.42
		<i>% difference from do nothing</i>	6.49	7.59	2.21	8.16	7.99	2.10	5.83	6.10
	Rail		0.20	5.07	2.27	2.71	9.91	0.08	3.42	23.64
		<i>% difference from do nothing</i>	3.80	-3.62	-2.55	-18.63	-13.95	-39.69	-2.48	-9.93
Length of Haul (km)										
Strategy	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		118.12	67.27	85.52	103.89	37.16	131.60	99.12	83.41
	Rail		481.80	134.63	213.24	129.83	118.10	229.38	301.92	141.38
A Pro-Rail	Road		95.52	62.25	77.23	89.78	32.00	116.40	84.53	70.56
		<i>% difference from do nothing</i>	-19.14	-7.46	-9.69	-13.58	-13.89	-11.55	-14.72	-15.41
	Rail		348.49	134.03	219.37	151.30	129.77	234.81	278.42	157.31
		<i>% difference from do nothing</i>	-27.67	-0.44	2.88	16.53	9.88	2.37	-7.78	11.26
B Pro-road	Road		125.78	69.12	87.27	108.30	39.80	133.85	104.86	88.05
		<i>% difference from do nothing</i>	6.49	2.76	2.05	4.25	7.12	1.72	5.79	5.56
	Rail		523.25	134.04	211.00	119.10	109.57	249.05	321.63	136.63
		<i>% difference from do nothing</i>	8.60	-0.44	-1.05	-8.27	-7.22	8.58	6.53	3.36

Table 7.6 Results for each strategy package, by commodity, 2016 HI

Tonnes lifted (millions)										
Strategy	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		499.07	27.00	112.02	73.52	711.26	58.00	582.83	2063.70
	Rail		0.68	40.30	12.04	27.13	118.43	0.60	17.16	216.34
A Pro-Rail	Road		500.18	25.51	109.76	70.48	701.72	54.69	580.78	2043.14
		<i>% difference from do nothing</i>	0.22	-5.51	-2.01	-4.13	-1.34	-5.71	-0.35	-1.00
	Rail		4.59	41.80	14.30	31.84	132.68	4.52	27.74	257.46
		<i>% difference from do nothing</i>	572.92	3.71	18.74	17.34	12.03	658.65	61.63	19.01
B Pro-road	Road		499.10	28.27	112.20	76.28	717.20	58.23	583.02	2074.27
		<i>% difference from do nothing</i>	0.01	4.68	0.16	3.75	0.83	0.38	0.03	0.51
	Rail		0.66	39.04	11.86	24.06	109.64	0.33	16.00	201.59
		<i>% difference from do nothing</i>	-2.99	-3.14	-1.48	-11.33	-7.42	-44.48	-6.78	-6.82
Tonne kms (Billions)										
Strategy	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		62.97	1.81	9.56	7.73	26.55	7.66	71.77	188.05
	Rail		0.34	5.70	2.66	3.59	14.27	0.14	5.82	32.53
A Pro-Rail	Road		50.83	1.58	8.43	6.39	22.38	6.39	60.72	156.74
		<i>% difference from do nothing</i>	-19.28	-12.58	-11.79	-17.23	-15.68	-16.59	-15.40	-16.65
	Rail		1.70	5.88	3.25	4.90	17.66	1.06	8.73	43.18
		<i>% difference from do nothing</i>	397.34	3.16	21.85	36.56	23.71	675.89	49.90	32.74
B Pro-road	Road		67.02	1.95	9.77	8.36	28.71	7.82	75.99	199.62
		<i>% difference from do nothing</i>	6.43	7.60	2.21	8.21	8.14	2.10	5.87	6.15
	Rail		0.35	5.50	2.60	2.92	12.16	0.08	5.72	29.33
		<i>% difference from do nothing</i>	2.91	-3.53	-2.54	-18.80	-14.79	-39.68	-1.76	-9.84
Length of Haul (km)										
Strategy	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		126.18	67.14	85.32	105.09	37.32	132.11	123.14	91.12
	Rail		500.99	141.39	221.25	132.38	120.53	229.85	339.33	150.37
A Pro-Rail	Road		101.63	62.12	76.81	90.73	31.90	116.86	104.54	76.71
		<i>% difference from do nothing</i>	-19.46	-7.48	-9.97	-13.67	-14.54	-11.54	-15.10	-15.81
	Rail		370.27	140.64	227.05	154.07	133.09	235.08	314.71	167.72
		<i>% difference from do nothing</i>	-26.09	-0.53	2.62	16.39	10.42	2.27	-7.26	11.54
B Pro-road	Road		134.29	69.01	87.07	109.60	40.03	134.37	130.33	96.24
		<i>% difference from do nothing</i>	6.43	2.79	2.05	4.30	7.24	1.71	5.84	5.61
	Rail		531.43	140.82	218.89	121.23	110.95	249.72	357.60	145.50
		<i>% difference from do nothing</i>	6.08	-0.40	-1.07	-8.42	-7.95	8.64	5.38	3.24

Table 7.7 Vehicle kilometres 2010 (millions)

Strategy		Rail		Road (with collection and delivery)				
		Locomotive kms	Wagon kms	Rigids below 32t	32t Rigid	32t Artic	44t Artic/ 50t Artic	All road vehicles
Do nothing	Million Vkms	41.6	924.2	3026.3	2685.2	493.4	8797.3	15002.2
A Pro-Rail	Million Vkms	50.0	1297.9	3131.0	2693.4	575.1	6999.7	13399.2
	<i>% difference from do nothing</i>	20.31	40.43	3.46	0.30	16.57	-20.43	-10.69
B Pro-road	Million Vkms	36.9	831.6	2794.1	2458.2	423.7	7848.2	13524.2
	<i>% difference from do nothing</i>	-11.28	-10.02	-7.67	-8.46	-14.12	-10.79	-9.85

Table 7.8 Vehicle kilometre 2016 LO (millions)

Strategy		Rail		Road (with collection and delivery)				
		Locomotive kms	Wagon kms	Rigids below 32t	32t Rigid	32t Artic	44t Artic/ 50t Artic	All road vehicles
Do nothing	Million Vkms	41.7	930.9	2893.0	2647.1	482.0	8379.6	14401.7
A Pro-Rail	Million Vkms	49.8	1299.1	2988.4	2656.1	560.0	6696.8	12901.3
	<i>% difference from do nothing</i>	19.48	39.56	3.30	0.34	16.18	-20.08	-10.42
B Pro-road	Million Vkms	36.9	836.8	2671.5	2423.4	414.8	7515.0	13024.7
	<i>% difference from do nothing</i>	-11.47	-10.11	-7.66	-8.45	-13.94	-10.32	-9.56

Table 7.9 Vehicle kilometre 2016 HI (millions)

Strategy		Rail		Road (with collection and delivery)				
		Locomotive kms	Wagon kms	Rigids below 32t	32t Rigid	32t Artic	44t Artic/ 50t Artic	All road vehicles
Do nothing	Million Vkms	52.5	1164.1	3156.6	3211.6	532.8	10284.2	17185.2
A Pro-Rail	Million Vkms	62.4	1624.9	3264.6	3223.2	625.4	8203.5	15316.7
	<i>% difference from do nothing</i>	18.84	39.58	3.42	0.36	17.37	-20.23	-10.87
B Pro-road	Million Vkms	46.5	1048.6	2918.4	2939.3	459.0	9253.6	15570.2
	<i>% difference from do nothing</i>	-11.31	-9.92	-7.55	-8.48	-13.85	-10.02	-9.40

Table 7.10 Results for each strategy package, by commodity, 2010, road collection and delivery removed

Tonnes lifted (millions)										
	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		439.09	27.22	80.25	68.06	566.82	56.02	581.29	1818.74
	Rail		0.43	38.60	8.65	26.42	97.39	0.50	12.52	184.52
A Pro-Rail	Road		436.30	25.39	78.71	63.12	553.76	52.59	572.91	1782.79
		<i>% difference from do nothing</i>	-0.63	-6.71	-1.92	-7.25	-2.30	-6.12	-1.44	-1.98
	Rail		3.22	40.43	10.19	31.35	110.45	3.93	20.90	220.47
		<i>% difference from do nothing</i>	642.21	4.73	17.86	18.67	13.41	682.20	66.88	19.49
B Pro-road	Road		439.14	28.14	80.37	71.50	572.88	56.21	582.32	1830.57
		<i>% difference from do nothing</i>	0.01	3.38	0.15	5.06	1.07	0.34	0.18	0.65
	Rail		0.38	37.68	8.53	22.97	91.33	0.31	11.48	172.69
		<i>% difference from do nothing</i>	-11.67	-2.39	-1.37	-13.04	-6.22	-37.66	-8.29	-6.41
Tonne kms (Billions)										
	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	TOTALS
Do nothing	Road		52.76	1.82	6.94	7.58	21.75	7.38	58.96	157.18
	Rail		0.21	5.18	1.86	3.45	11.39	0.12	3.81	26.01
A Pro-Rail	Road		42.57	1.57	6.14	6.18	18.11	6.22	49.95	130.73
		<i>% difference from do nothing</i>	-19.31	-13.91	-11.56	-18.49	-16.76	-15.70	-15.29	-16.83
	Rail		1.15	5.37	2.26	4.80	14.28	0.93	5.86	34.64
		<i>% difference from do nothing</i>	451.44	3.76	21.33	39.15	25.34	695.92	53.90	33.18
B Pro-road	Road		55.83	1.93	7.07	8.19	23.36	7.51	62.12	166.02
		<i>% difference from do nothing</i>	5.82	6.23	1.88	8.09	7.39	1.79	5.37	5.62
	Rail		0.20	5.00	1.82	2.78	9.86	0.08	3.70	23.44
		<i>% difference from do nothing</i>	-3.30	-3.34	-2.43	-19.50	-13.47	-32.92	-2.83	-9.91
Length of Haul (km)	Mode		Food , Drink, Ag	Coal & Coke	Petroleu m	Ores & Metals	Construc tion	Chemical s	Others	Average
Do nothing	Road		120.15	66.90	86.46	111.33	38.38	131.72	101.43	86.42
	Rail		479.52	134.12	215.22	130.68	116.99	231.14	303.89	140.99
A Pro-Rail	Road		97.57	61.74	77.97	97.84	32.70	118.29	87.18	73.33
		<i>% difference from do nothing</i>	-18.79	-7.71	-9.83	-12.12	-14.79	-10.20	-14.05	-15.16
	Rail		356.27	132.87	221.56	153.22	129.30	235.19	280.27	157.14
		<i>% difference from do nothing</i>	-25.70	-0.93	2.95	17.25	10.52	1.75	-7.77	11.46
B Pro-road	Road		127.13	68.74	87.96	114.53	40.78	133.62	106.68	90.69
		<i>% difference from do nothing</i>	5.81	2.75	1.73	2.88	6.25	1.44	5.18	4.94
	Rail		524.97	132.81	212.92	120.98	107.95	248.72	321.99	135.71
		<i>% difference from do nothing</i>	9.48	-0.98	-1.07	-7.42	-7.73	7.60	5.95	3.74

7.2 Results by Mode

The modal results in tables 7.1 to 7.3 show tonnes, tonne kilometres and average length of haul figures for road and rail and both together.

7.2.1 Pro-rail strategy

The Pro-rail strategy has the effect of removing around 16-17% of tonne kilometres from road. Rail increases its share of tonne kilometres by around 31-33% over the three scenarios, and tonnes by 18-20%.

Rail trips are also increasing in length, by between 11-12% and road trips falling by 15-16%, indicating that the extra traffic gained from road is long distance. This highlights the fact that rail is more competitive over the longer distances.

With reference to the individual Pro-rail policies it is clear that road MSC pricing (A7) has the largest impact, increasing rail tonne kilometres by 18-20% and reducing road tonne kilometres by 11%. The Working Time Directive (A6) and doubling of net fuel cost (A5) policies also have significant impacts. Of the policies which reduce rail's costs, the Company Neutral Grant (A3) has the largest impact of around 1% increase in rail tonne kilometres, although this impact is concentrated on the containerised traffic in 'Food, Drink & Agriculture' and 'Other' commodities.

Overall this package has a punitive effect on the freight market, as the significant component policies make road more expensive. Average length of haul falls by some 10%, as goods are sourced closer to their point of use. Tonnage moved rises slightly due to the increase in rail related collection and delivery work.

7.2.2 Pro-road strategy

For the Pro-road package, there is an overall increase in tonne kilometres of between 3-4% across the scenarios. Road increases tonne kilometres by 5-6%. The largest component strategy is allowing heavier road vehicles, which accounts for almost half of the overall effect of the Pro-road strategy,

Rail's tonne kilometres falls by around 10% over all scenarios, and tonnes by 6-7%.

Rail's length of haul falls as road's rises, showing that road is picking up some of the longer distance rail traffic, while rail is keeping its shorter distance bulks traffic but losing longer distance wagonload traffic.

7.3 Results by Commodity

The commodity specific results shown in tables 7.4- 7.6 show tonnes, tonne kilometres and average length of haul for each commodity by road and rail. Table 7.10 shows these results for 2010, but without road collection and delivery for rail traffic.

7.3.1 Pro-rail strategy

The ‘Do nothing’ strategy highlights the low market share for rail in ‘Food, Drink & Agriculture’, ‘Chemicals’ and ‘Others’.

The Pro-rail package has a negative impact on road tonne kilometres of between 12% (‘Petroleum’) and 19% (‘Food, Drink & Agriculture’) over the three scenarios. In terms of tonnes, the effect on road of the Pro-rail strategy is to reduce tonnes lifted by between zero (‘Food, Drink & Agriculture’) and 7% (‘Coal & Coke’). The negligible effect on ‘Food, Drink & Agriculture’ tonnes lifted is due to the offsetting effect of road collection and delivery tonnages, which accrue to road but are caused by an increase in rail’s market share. This is illustrated in table 7.10 for 2010 where the results are purged of road collection and delivery, and ‘Food, Drink & Agriculture’ tonnes lifted fall by almost 1 percent.

For rail, because of its lower overall market share, the effect of this strategy is more volatile. The largest impact is on ‘Food, Drink & Agriculture’ and ‘Chemicals’, increasing tonnes and tonne kilometres many times over, but this is due to the low base share of rail in these commodities, and the absolute increases in traffic are small.

There are significant absolute gains in rail traffic in tonne kilometres for ‘Construction’ and ‘Others’.

Average lengths of haul for rail increase by around 11-12% overall but fall for ‘Food, Drink & Agriculture’ and ‘Others’. For these two commodity groups this highlights that rail, in increasing its market share, is capturing some shorter distance traffic traditionally more suitable for road.

7.3.2 Pro-road strategy

For the Pro-road package there are gains for road in tonne kilometres over all commodities, varying between 2% increase for ‘Chemicals’ to 8% for ‘Ores & Metals’. Similarly, there are reductions in rail tonne kilometres over all commodities (except for ‘Food, Drink & Agriculture’ in 2016LO) of between 2% (‘Petroleum’) and 40% (‘Chemicals’).

There are large absolute increases in road traffic in terms of tonnes and tonne kilometres for ‘Food, Drink & Agriculture’ and ‘Others’. These increases are mainly generated rather than being abstracted from rail.

For rail there are losses in tonnes lifted for all commodities ranging from 1% (‘Petroleum’) to 44% (‘Chemicals’ in 2016). Similarly, rail tonne kilometres fall for all commodities, ranging from 2% (‘Petroleum’) to 40% (‘Chemicals’). The largest absolute falls in rail tonnes and tonne kilometres are in ‘Construction’.

Lengths of haul for road increases, particularly in ‘Food, Drink & Agriculture’, ‘Construction’ and ‘Others’ as it captures some of the longer distance rail market. For rail the picture regarding average length of haul is more mixed.

7.4 Vehicle Kilometres

The results for road and rail vehicle kilometres are shown in tables 7.7-7.9. Clearly for road, the largest share of kilometres is to the larger articulated vehicles.

The Pro-rail strategy increases wagon kilometres by around 40% - in line with the increase in rail tonne kilometres shown in tables 7.4-7.6. The increase in locomotive kilometres of 19-20% is below the increase in rail tonne kilometres, because the strategy includes 20% longer trains meaning fewer locomotive kilometres per tonne kilometre. This strategy leads to a decrease in overall road vehicle kilometres by 10-11%. This is less than the reduction in road tonne kilometres for this strategy shown in tables 7.4-7.6. There are some increases in kilometres run by the smaller vehicle types. This is because of an increased amount of road traffic in shorter distance bands, where smaller vehicles are typically used.

The Pro-road strategy leads to a drop in locomotive kilometres of 11% and wagon kilometres of 10% in line with the drop in tonne kilometres for rail from this strategy of around 10%, as shown in tables 7.4-7.6. This strategy also leads to reductions in road vehicle kilometres. This is because of the introduction of the larger 50 tonne vehicle type, which means that increased tonnages can be carried but with fewer vehicle kilometres. Road vehicle kilometres fall in the smaller vehicles as there is an increased amount of road traffic in the longer distance bands where heavier vehicles and increased lading factors are more typical.

8. CONCLUSIONS

This report has reported on the final stage of the RRUUK Project C3 work on Freight Modelling. It has reprised some of the material that sets out why we did what we did. Our main activity has been building and running the LEFT3 model, and much of the report is given over to describing that activity in sufficient detail for its results to carry weight with decision makers. Thirteen policies and two groups of policies (i.e. strategies) have been tested against four background scenarios, covering the years 1998, 2010 and 2016. The results for 1998 are not presented, as being of only specialist interest. For 2016, (very) high and low growth scenarios are presented. Results are included for 2010 and 2016, covering the effects on tonnes, tonne-kilometres, length of haul and vehicle kilometres for the 13 policy tests and 2 strategies. Results for the 2 strategies are also presented by commodity. Consideration of these results should help inform the debate on the desired and likely future developments of rail freight in the UK.

The Pro-rail strategy is formulated as the most favourable combination of plausible policies. It includes some policies that make rail more attractive and also policies which increase the cost of road transport. The overall effect of this strategy is to remove around 16-17% of tonne kilometres from road. Rail increases its share of tonne kilometres by around 31-33% over the three 'do nothing' scenarios, and tonnes by 18-20%. Rail trips are increasing in length, by between 11-12% and road trips falling by 15-16%. This indicates firstly that the extra traffic gained from road is long distance and secondly that increasing road costs lead to more local sourcing. The Pro-rail strategy reduces road vehicle kilometres in line with the reduction in road's market share.

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