Metropolitan Transport Research Unit

Analysis of new research into the introduction of longer, heavier vehicles (LHVs) in the EU

Report prepared for Freight on Rail

May 2009

Analysis of recent EU study on LHVs (TM Leuven Report)

Contents

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Summary

This report focuses on the key issues in the recent report for the European Commission by TM Leuven (TML).

While the TML report provides some valuable insight into how the operation of goods vehicles should be predicted, its calculations are flawed in three critical respects, one of which has been recognised by the authors. This error applies to their first method of calculation and on its own significantly alters the balance of costs and benefits for LHVs in the report.

Their conclusion, that LHVs would provide a wide range of benefits, is reached despite the fact that individual vehicles will be more dangerous and polluting than current permitted HGVs. TML argue that this will be balanced by significant reductions in the overall traffic (vehicle kilometres) from the LHVs plus the HGVs which are not replaced. This rightly aims to allow for some transfer from rail and waterway to LHVs. It also allows for some generation of traffic through longer journey lengths and other changes in stockholding and depot location.

It is this claimed reduction which is the subject of the first part of this report.

To estimate the reduction TML use three methods of calculation. The first method uses an elasticity figure to calculate the extra goods vehicle traffic caused by the reduction in cost per tonne kilometre for LHVs compared to existing HGVs.

The second uses different factors to estimate LHV share within road goods transport such as:

- *Low take up of LHVs by small hauliers*
- *Reduction in LHV share due to operational limitations*
- *Limits to where LHVs can travel compared to existing HGVs*.

Finally, the report uses an EU wide model, TRANS-TOOLS, to calculate the impact of LHVs overall.

In the report it appears that all three produce similar figures.

Unfortunately, there is a simple but serious error in the first of these calculations which has the effect of seriously exaggerating the reductions in lorry traffic. It occurs in the calculation of how many LHVs are needed to replace the current HGVs. While the carrying capacity is 50% greater, this does not mean that only 50% of the lorries are needed. In fact, a 50% increase in payload means that three HGVs at the current limit could be replaced by two LHVs – a 33% reduction. The TML report used a 50% reduction figure. TML have now agreed that this was a mistake.

MTRU has been able to use the formula in the TML report to recalculate the figures. Thus if 30% of road freight in HGVs is transferred to LHVs, TML calculated between 8% and 13% reduction, based on elasticities of 0.3 to 1.2. The MTRU figures (including an extra elasticity value of 1.5) are between 1% and 8%. It is also the case that a zero reduction is possible within the range of

published elasticities for road goods travel. The report asserts that the elasticity value needed to wipe out any benefits from LHVs is implausibly high, at 2.5, a figure only found in studies of long distance US trucking.

After correction for this error, the elasticity figure at which a zero reduction in HGV traffic would occur is in fact 1.65, a value which is reported in one of the most recent European studies of the subject and quoted in the TML report itself.

The predicted decrease also depends on other factors, for example whether goods travel further because it's cheap to do so, or how much traffic is attracted from rail. This figure is calculated using a range of price sensitivity (elasticity) values for HGV goods traffic. TML have chosen to use elasticities between 0.3 and 1.2, at the low end of those in the published research. The results are therefore at the optimistic end of LHV benefits, rather than a central estimate.

Thus the benefits from LHVs have been seriously overstated, and as they fall to low percentages, they become less robust to other slight changes in the underlying assumptions. A detailed analysis of how the calculations work and the implications of the new results are further explored later in this report.

The second calculation is also explored in detail, and is useful in identifying factors which may influence the impact of LHVs. However, the size and even direction of the effects are not sufficiently analysed or justified in the report.

There is also another key assumption in the TML analysis which has a major impact on the results. LHVs are always assumed to run full (100% load factor) even when the HGVs they replace may not have done so. Given the pattern of HGV use after decades of increases in size and weight, this is extremely unlikely.

In addition, in some cases the replacement of HGVs with 100% loaded LHVs is assumed not to reduce the load factor of the HGVs remaining. This is clearly counter intuitive, since the LHVs will capture the larger HGV loads first. If they do not, the LHVs are unlikely to achieve the 100% load factor. TML's research partner has been made aware of this but feels unable to discuss the issue.

The final method uses a traffic model and an elasticity for the amount of goods in tonnes, rather than goods transport (tonnes X distance). This is widely accepted as being less sensitive to price change, and is reported as such in the TML main report.

This lack of model sensitivity means it will underestimate changes in tonne kilometres and thus in total traffic. Thus the model predicts that the impact of LHVs will be to reduce overall vehicle kilometres significantly, even if tonne kilometres go up slightly. For this reason the TRANS-TOOLS model results should not be used as the sole guide to the effects of LHVs.

Thus the report claim that all three methods give similar results is no longer valid. Of the three methods used, it has been agreed that one needs to be corrected, one makes an unreasonable assumption about LHVs travelling 100% full, and the final one is not sensitive to the costs changes which would occur.

The unreasonable assumption of 100% load factors in the second method also means that the tables provided show that an overall increase in vehicle kilometres is likely rather than a decrease.

For this reason the safety and environmental effects of LHVs would be negative not positive, and congestion could be increased rather than reduced.

Overall a combined policy and vehicle standards approach is required, such that a wide range of vehicle sizes is available to match customer demand, access to the road network is controlled to minimise environmental and safety impacts, and goods vehicles meet their true road costs, including environmental, safety and congestion.

For a small number of specialised freight flows there could be merit in using LHVs, but this would depend on 100% utilisation. This would be balanced by having to use the LHVs for other flows where this savings is not available. The likelihood is that a general introduction will weaken alternative modes and not deliver the overall improvements required. It also should be noted that the bulk flows where LHVs might offer a benefit are precisely the flows most suited to rail or water.

The final section of this report reiterates the need for existing problems to be addressed, in particular that:

- HGVs do not currently meet their safety, environmental, infrastructure and congestion costs,
- HGVs are much more likely to be involved in fatal accidents than cars,
- 36% of HGVs fail their annual MOT test at the first attempt, 20% still fail after correcting minor defects at the testing station.

It goes on to discuss some of the underlying problems caused by increases in weight creating powerful dynamic forces, particularly where there are one or more trailers (articulation points). There is clearly a tension where greater manoeuvrability at low speed, for example on local roads, can lead to less stability at higher speed, for example on motorways.

1 Introduction

This project has two main aims. The first is to analyse the final TM Leuven (TML) report to the Commission on the predicted impact of LHVs. Some of the content was presented to a seminar last year[1] and comments have already been made by MTRU, including contact with the consultants. The second aim is to compare the findings of the TML work with the 2008 TRL report[2] on impacts in the UK, and the MTRU report[3] which provides both a commentary on that report and additional new material on the external costs of HGVs and LHVs. It also points to the need for a thorough overhaul of policy in this area. This needs to include distance based taxation, non-UK registered vehicle use, and the issue of how far existing vehicles are unsuitable for many of the roads they are now permitted to use, in particular their congestion and safety impacts.

The TRL report sets out the safety and manoeuvrability issues of LHVs in clear terms and the conclusion that there are significant problems to be addressed is supported in earlier studies. The TML report appears to interpret some of the data in a different way, particularly on the side to side stability of longer, heavier vehicles, and this needs to be clarified. Overall, there seems to be agreement that there will be increased risks, and measures are proposed which could counteract these. Examples are electronic braking, which would avoid the delays caused by hydraulic brakes having to transmit pressure over a longer length, and steered axles on trailers, which would reduce the "swept path" of HGVs and LHVs. The latter reduces the risk of low speed turning movements crossing pavements and cutting across the path of other road users. Extra driver qualifications have also been proposed as part of a package.

The approach to justifying LHVs (including a simple lengthening of existing vehicles at the same weight) appears to rest on a series of assumptions. Not all of these have been properly justified. The main assumptions are:

1 Existing HGVs have an acceptable safety and pollution record and their comprehensive access to non-motorway roads causes few or at least acceptable problems in terms of noise, congestion, and air pollution (especially particulates).

2 The introduction of LHVs will reduce the total amount of all HGV traffic (LHV+HGV) sufficient to compensate for any increase in the damage caused by individual vehicles. This in turn depends on two further assumptions (3 and 4 below).

3 LHVs will capture a limited amount of both current and future traffic from rail and water, insufficient to cause an absolute increase in all HGV traffic from the predicted level without LHVs.

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1 EU Stakeholder Seminar July 2008
2 PPR 285, TRL, 2008
3 MTRU, January 2009

4 The reduction in cost offered by LHVs will not of itself encourage significant additional vehicle kilometres, either by generating traffic[4] or by causing greater centralisation and concentration of depots and stockholding.

5 Infrastructure requirements are modest and limited to the road network as opposed to facilities such as parking, overnight accommodation and refuelling (the TRL report addresses this issue in some detail).

The TML report does not really address the first or last assumptions in much detail, at least in part due to its EU wide nature. In relation to the first, it is difficult to make a clear comparison, but there are variations in relation to the permitted use of the road network in different EU countries. One example is the use of weekend and public holiday restrictions in Germany, Italy and France[5].

As regards the final issue, it is clear that a much more detailed study needs to be undertaken since these are potentially significant, requiring a wide range of new or altered facilities. It is not clear how these would be funded or enforced.

It needs to be understood that the creation of a limited network with special facilities would limit the practicality of LHV use for general purposes. In fact it would probably be lesser in size than current rail networks, and significantly less than rail and water freight networks combined.

The next section of this report focuses on assumptions 2 to 4, which are explored in the TML analysis.

This is followed by examples of the current negative environmental and economic impacts from road freight, drawn from UK experience. Returning to the TML report, the particular problems of LHV size and weight are discussed. This focuses on the tension caused by seeking greater manoeuvrability at low speed, which is usually achieved by lower stability at higher speed.

[4] See MTRU Report 2009 Annex for a description of how tonnes can stay constant while traffic (tonne-kilometres) can increase.

[5] *Further increases in the permitted size or weight combinations for heavy goods vehicles in the UK – a review* MTRU, Freight on Rail, January 2009

2 Changes in vehicle kilometres after introduction of LHVs – the use of elasticities

The TML report suggests that there are major possibilities for reducing overall heavy goods vehicle traffic in the EU by using LHVs. This is done by making various assumptions about how much traffic would be switched from rail and water, added to any traffic (measured as tonne kilometres) generated by reducing the cost of heavy goods transport. The tonne kilometres are fitted on to a mix of LHVs and existing HGVs to produce changes in vehicle kilometres.

The report uses several different methods to assess these impacts, but the way in which the overall effect is calculated is clearly set out in the report. This uses standard economic theory which predicts that a price reduction will cause more traffic. The level of change for any given change in price is the elasticity value, and this can be calculated for road, rail and water and for different distances. Where the effect is a sensitivity of mode choice, this is referred to as a cross elasticity. The TML report uses both.

It is generally accepted (including by TML) that the total amount of goods, measured as tonnes, is less sensitive to changes in price than tonne kilometres. The former relates more to the requirements of businesses and consumers. The latter reflects change in choice of stockholder, depot organisation and other changes to the supply system. It is clear that the distance goods travel is far more susceptible to price changes than the amount of goods in the economy. There is one important caveat on tonnes relating to how data is collected. The standard measurement of tonnes is goods "lifted" – every time goods are picked up they are counted towards the total tonnage. In a simple system with little intermediate stockholding this is close to the amount of goods used by businesses or consumers (although the onward movement of manufactured items will add to the total). The problem is that tonnes lifted can go up if goods pass in and out of depots more frequently. For this reason, a "handling factor" is often calculated to accompany tonnes lifted[6] to provide a more accurate picture.

In relation to the price elasticity of road freight the true picture would require a split between the many different commodities which constitute the overall flow of goods in the economy. This also applies to cross elasticities – some road or rail freight is insensitive to price because of volume, type of goods or geography. Other commodities are much more sensitive, for example container traffic.

The overall elasticity is an average of all these effects and has been calculated in many studies[7]. However, these vary hugely, probably reflecting the different geography (some are from US research) and the different mix of commodities which were studied. The most recent European studies, quoted in the TML report and elsewhere[8] give a range of elasticities for tonne kilometres. In their first method of estimation, TML use some of these but not the highest, plus some lower values. Thus TML use 0.3 to 1.2, where values of 0.6 to 1.6 would be a

6 See McKinnon, May 2008
7 See Glaister et al, 2004
8 See MTRU, January 2009

better representation of the research. There are values for tonnes which are lower, but elasticities for tonne kilometres for longer distances, for example, often exceed one. An example table is given below.

Table 1: Elasticities of demand for rail, inland waterways and road freight

Total cost variation						
Elasticities	Short distance			Long distance		
Tonne-km	Road	Railways	Water	Road	Railways	Water
Road	- 0.84	0.36	0.10	-1.64	0.71	0.09
Rail	2.08	- 2.87	1.70	1.11	- 0.64	0.43
Waterways	2.60	1.66	- 2.01	0.78	0.48	- 1.59

Source: Beuthe et al. 1999

Changes in vehicle kilometres – TML results

The TML report uses a range of elasticities for tonne kilometres from 0.3 to 1.2. Thus the first conclusion is that the range is narrow, and uses a particularly low value but not high or even normal values (see above). It is also stated that the elasticity would have to be very high (2.5) for the introduction of LHVs to cause enough generated and transferred tonne kilometres (and thus vehicle kilometres) to cause an absolute increase in traffic.

Unfortunately, this statement, and the calculations in the report, are subject to an even more serious error in the formula which also significantly affects this conclusion, seriously overestimating the benefits of LHVs. There are other calculations and conclusions in the report which are not affected and which are analysed later.

TML report calculations and corrected version

Figure 1 following is the summary chart copied from the TM Leuven report.

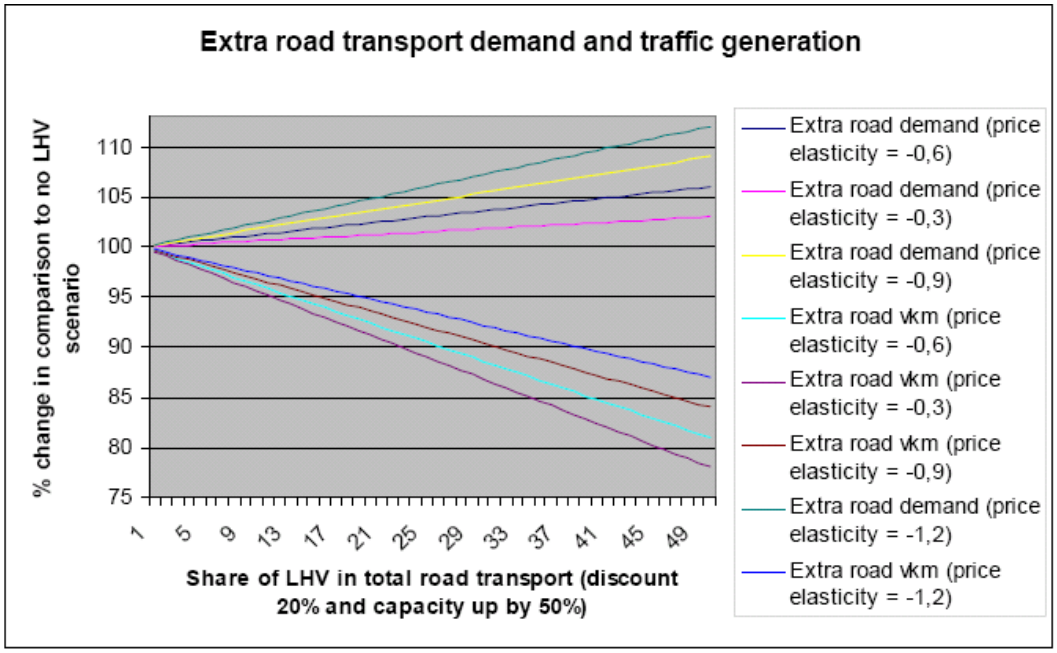
It shows an increase in tonne kilometres caused by a fall in LHV transport costs. These are the lines above the 100% level. It then adjusts this new total downwards to allow for additional carrying capacity of LHVs compared to HGVs.

The report sets out the methodology clearly, and uses the following assumptions[9]:

- Fixed 20% reduction in cost per tonne kilometre LHV compared to HGV
- Four elasticities for the increase in road tonne kilometres resulting from the above cost reduction, from 0.3 to 1.2
- Share of all road freight tonne kilometres taken by LHVs, from 0 to 50%
- Ratio by which LHVs compared to HGVs will reduce vehicle kilometres, fixed at 50%

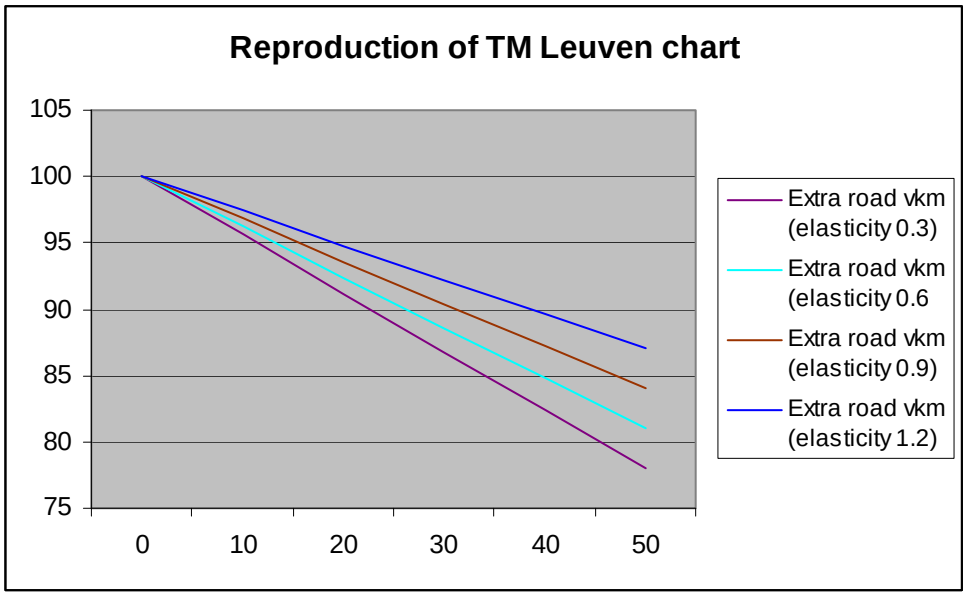
[9] TML Report page 43

Figure 1
Extract from TML Report
(including error)



Using the formula in the report, MTRU has replicated the above results in a spreadsheet model. The assumptions can then be varied. The final one (LHV replacement ratio) immediately appears high in relation to the reduction in cost and it is this which needs to be corrected. The results are set out below, beginning with the replicated TML result.

Figure 2
(including error but reproduced using MTRU spreadsheet)



Source: TML report, MTRU spreadsheet

The above include a capacity increase of 50% which is assumed to produce a reduction in vehicle kilometres of 50%. However, this is measured as tonnes of payload. In fact, a 50% increase in loading would allow 3 HGVs to be replaced by 2 LHVs, a 33% reduction in vehicle kilometres.

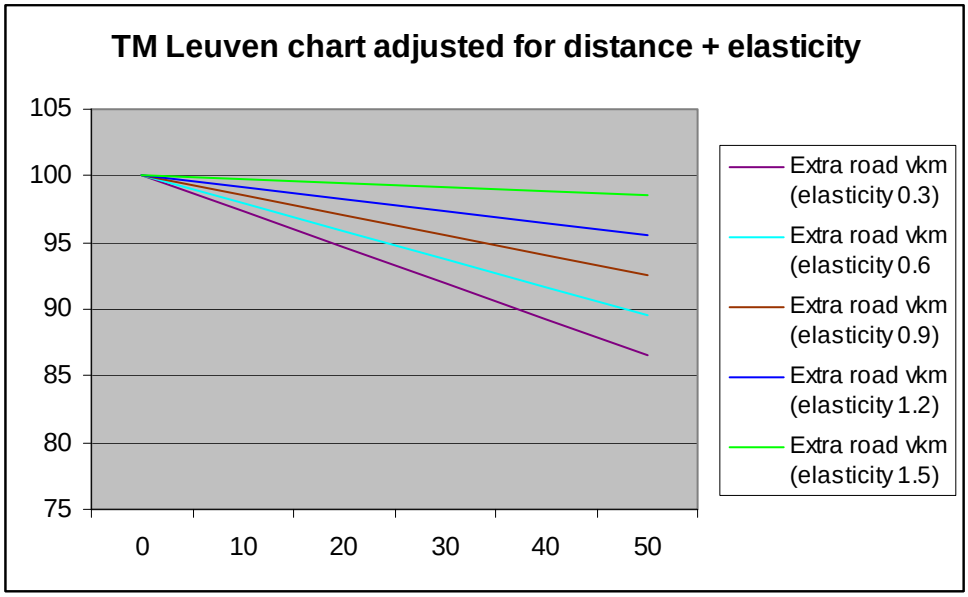
Applying this 33% figure in the TML formula, gives the results shown in Figure 3 below. A test using an elasticity of 1.5 is also applied in this MTRU rerun since several studies have shown this value or more. The tonne kilometre elasticity of 0.3 used by TML is considered very low but is included for comparison.

As noted earlier, the TML report says that an elasticity (price sensitivity) of 2.5 would be required to cause an increase in vehicle kilometres. If the TML error is corrected, this figure should be 1.65. This is in fact virtually the same as the long distance value (1.64) from the Beuthe study (Table 1) and is thus within the plausible range.

Correcting the formula would have a significant impact on the results. It is quite likely that there would be no noticeable decrease in total vehicle kilometres, but the individual vehicles would be longer, heavier, and potentially more dangerous and polluting.

The corrected version of the chart is shown below.

Figure 3

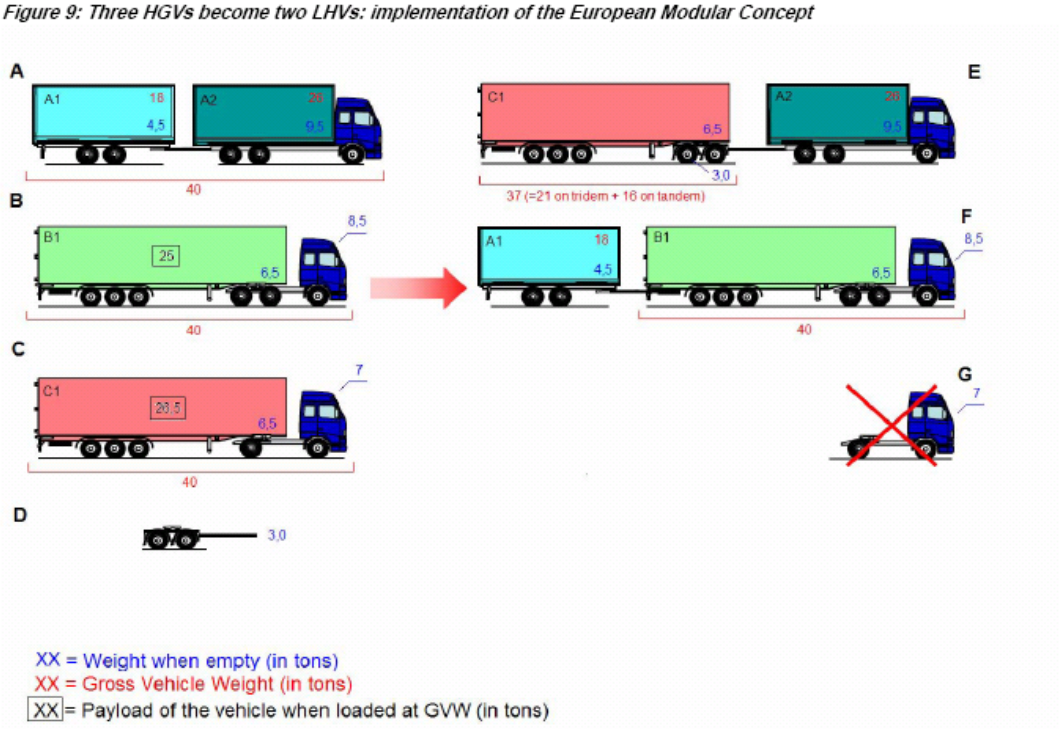


Source: MTRU spreadsheet

The reason for using 33%, rather than 50%, is illustrated by the useful example diagram in the TML Report, reproduced below.

Figure 4
Extract from TML report: Capacity comparison HGVs and LHVs

Figure 9: Three HGVs become two LHVs: implementation of the European Modular Concept



In order for the reduction factor to be 50%, the carrying capacity of LHVs would have to be ***twice*** that of existing HGVs.

Implications of the error for policy

The issue has been discussed with TML, who agree that the assumption is incorrect. They have given an assurance that new results will be produced to correct this, although this is still awaited after several months. They should be in line with the MTRU spreadsheet unless new methodological changes are introduced.

In this case, using a recent European elasticity value (1.64), would mean virtually no reduction in overall goods vehicle traffic, but a significant increase in their average size and weight. As well as the individual vehicles being longer and heavier, they would be potentially more dangerous and polluting. There would also be significant infrastructure costs. This is a very different picture from the claimed LHV benefit of reduced overall traffic from heavy goods vehicles.

3 Other methods used in the TML Report

There are two other methods of assessing the overall impact of LHVs on the road share of the overall freight market and the impact on vehicle kilometres.

i) EU wide transport model

The EU wide TRANS-TOOLS model[10] is used to calculate mode share and vehicle kilometres. Unfortunately the calculations are undertaken using total tonnes rather than tonne kilometres. As confirmed by the TML Report itself[11], total tonnes are significantly less sensitive to price changes than tonne kilometres and it is tonne kilometres which determine vehicle kilometres. This is confirmed by the most recent European studies. Thus the TRANS-TOOLS model approach is bound to seriously underestimate the impact of LHVs on traffic.

The TML report recognises the insensitivity of the model and looked in closer detail at why this was. It appears that the model is not sensitive to choice of supplier or market area change. In fact it is driven by EU trade. This is by its nature insensitive to transport price because transport is a small component of the final price of goods[12].

This section (5.2.1 a) ends by stating that,

"The modelling results and analytical results are converging on a 10% -15% decrease in "traditional" HGV (*heavy goods vehicle)* vehicle kilometres."

Given the error in calculation described earlier this is no longer the case, but is relatively easy to explain given the insensitivity of the model and the use of tonnes rather than tonne kilometres.

For this reason the results of the TRANS-TOOLS model are not considered further here.

ii) LHV market share within road transport adjusted by:
Low take up of LHVs by small hauliers
Reduction in LHV share due operational limitations
Limits to where LHVs can travel compared to existing HGVs

The other key method which TML use to predict the impact of LHVs is an econometric approach, again using elasticities, but by assuming certain "real world" operational limitations. The three limitations listed above are considered in the following sections. The overall approach is useful and interesting and reveals certain assumptions about how Governments and businesses might respond.

For example, it assumes that the penetration of LHVs onto the road network will increase over time. This is of course not necessarily the case if LHVs individually

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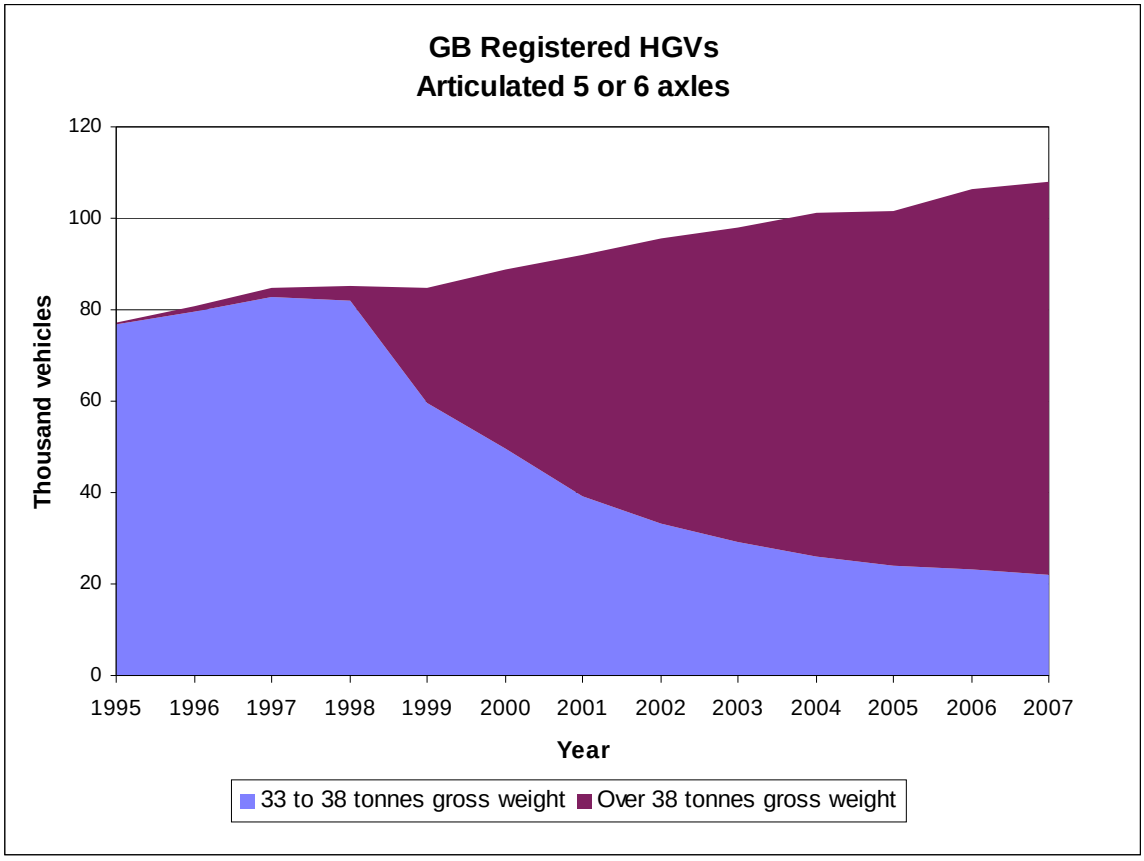
10 Including the CGEurope model
11 See page 63 of the TML Report
12 See above page 67

were seen to be unsuitable in some areas. In this scenario, road access could be reduced rather than increased.

On the other hand, the assumption that small hauliers would not replace their HGVs with LHVs may also be incorrect. In the UK, HGVs are hugely concentrated around the maximum limit[13]. This is shown in the chart below.

Figure 5



*Source: Transport Statistics Great Britain (**TSGB**) 2007 & 2008*

It should be noted that either of these two examples would have complex effects on items which include load factors, LHV market share, environmental impact, need for transhipment, and changes in average length of haul. This may change the impact of LHVs on overall traffic in either direction, although the lack of flexibility caused the concentration of HGV registrations at the heaviest limit will tend to cause an increase rather than reduction in overall vehicle kilometres.

Nevertheless, it is possible to describe the items as they are included by TML. Since this is a prediction of future responses, TML use two values, short term, which they call “static” and longer term, allowing for some further adaptation, which they call “dynamic”.

Low take up of LHVs by small hauliers

[13] See MTRU 2009

The assumption is that smaller operators will not buy LHVs in the short term and thus limit LHV market share. The proportion assumed is based on French data. This suggests that 40% of goods transport is undertaken by firms with over 50 employees and this is used for the TML static approach. For the dynamic approach this is changed to 50% - partly due to firms becoming bigger.

While the actual proportion may not be right for Europe as a whole, or would be better applied at the national and commodity level, the idea of including this is clearly sensible. What is needed is a great deal more analysis (rather than opinion seeking) of how companies actually respond.

Reduction in LHV share due to operational limitations

TML call this the "logistical organisation effect" and again its identification is important. The example given is where the flow of goods between two areas is insufficient to justify the use of LHVs.

Obtaining a robust estimate of the different elements contained within this single effect is not yet possible. This is particularly true for the wide range of countries and regions and commodities needed. TML assume that 70% of all road goods transport in HGVs would be suitable for LHVs in the static approach. This rises to 80% in the dynamic approach. It is difficult to comment on what are in fact issues of judgement, but they should be clearly recognised as such.

Limits to where LHVs can travel compared to existing HGVs

Again TML have drawn attention to an important influence on the balance between use of HGVs and LHVs. The problem is a lack of data and lack of policy analysis. LHVs may well be restricted by various local authorities including major towns and cities. This would have a major impact. MTRU undertook a preliminary discussion of the UK and EU approaches in the January 2009 LHV Review report. There are clearly significant differences and public attitudes have not been tested in relation to the larger vehicle sizes.

For example, creating a situation where only LHVs were available (through most operators buying them instead of existing types of HGV) could reduce the available network significantly and lead to more transhipment.

It should be noted that rail and water networks are extensive, for example compared to full motorway standard networks. Possible scenarios including network restriction, more use of rail and water, and vehicle dimension changes have not been tested. This is probably due to the drafting of the brief rather than the study itself.

Overall impact of the three elements

Identification of such elements in a proper analysis is supported by UK and EU data on firm size, area/commodity flows, and network suitability. The analysis here has to rely extensively on judgements about their extent. However, the

overall impact is mostly dependent[14] on one particular assumption about how fully loaded LHVs will be. This is set out in the following section.

Underlying methodology in calculating the change in HGV and LHV traffic (vehicle kilometres)

The three operational items above are used to predict the overall market share in terms of tonne kilometres. This is again an elasticity approach and uses the following values.

Table 2
Copy of TML Leuven Report
Table 9: Choice of elasticities for the choice of modal shifts

	Total Road cost variation			
Elasticities	Short distance		Long distance	
tkm	Low elast.	High elast.	Low elast.	High elast.
Road	-0.7	-1.0	-1.0	-1.6
Rail	2.0	3.0	1.1	1.9
Waterways	2.6	4.0	0.7	0.8

These are applied to the forecasts for EU tonne kilometres to predict a change in traffic, assuming a load factor for LHVs and any HGVs which continue to operate. This process contains a critical assumption – that LHVs are always fully loaded even if the HGVs they replace were not. This does not appear to reflect a realistic pattern of use. The assumption, and its effect, is analysed in detail below.

Use of load factors in calculating the change in HGV and LHV traffic

The current average load for HGVs is calculated as 13.1 tonnes, compared to a maximum payload of 25.8 tonnes. It is assumed that LHVs will first carry the loads which filled HGVs. Thus the LHV load factor would be 100%, while the HGV load factor would fall. This is true for some commodities, but not all. However, the assumption can be tracked by extracting data from the TML report.

What is extremely unlikely, however, is that LHV load factors will always be 100%, no matter how much is transferred from HGVs. Nor is it likely that, as more traffic is transferred, that HGV load factors will stay the same. Logically, both should fall as more traffic is transferred.

Again this is complicated by the fact that goods vehicles may be fully loaded when they leave their depot, but make more than one delivery. Overall, the assumption that LHVs will always be fully loaded, but capture an increasing share of all freight transport, is unlikely. One crucial factor will be that when operators need to replace an HGV, they will have to choose between an HGV of the same

[14] It should be noted that there should be some relationship between the three elements and load factors – this is also very complex and may work in different directions for different commodities and areas of origin or destination.

size or an LHV. Evidence is that many will choose the largest possible vehicle they will ever need. This reduces the ability of the total fleet to match vehicle size to customer demand, particularly for non-bulk commodities. In turn this makes the achievement of high load factors (including back loads) more difficult.

The assumption of load factors is critical to any prediction of the impact of LHVs. They will vary by commodity and area and have had a relatively low level of attention in the study of road freight transport.

The assumptions used by TML are shown in the following Table.

Table 3
HGV and LHV load factors with different LHV road freight share

	Static approach			Dynamic approach		
	HGV Load in tonnes	**LHV** Load in tonnes	**LHV** tonne kms	**HGV** Load in tonnes	**LHV** Load in tonnes	**LHV** tonne kms
Reference case (no LHV)	13.1 (51%)	-	-	13.1 (51%)	-	-
Scenario 2 + low elasticity	11.2 (43%)	38.7 (100%)	634.63	11.2 (43%)	38.8 (100%)	949.77
Scenario 2 + high elasticity	11.2 (43%)	38.8 (100%)	653.37	11.2 (43%)	38.8 (100%)	992.71

Source: TML report, Tables 18 and 19

From the above it is clear that the dynamic approach has 50% more tonne kilometres transferred to LHVs but they retain a 100% load factor. The HGV load factor does not fall, despite a transfer of over 250 billion more tonne kilometres.

Despite this assumption, there is no reduction in vehicle kilometres from HGVs + LHVs in the static approach at high or low elasticity. It only occurs in the dynamic approach when:

- access to the road network for LHVs is increased to 94%,
- haulage operators increase in size, and
- companies adapt their operations to be 80% compatible with LHVs.

This is shown in the following Table.

Table 4
Vehicle kilometres with different LHV road freight share

	Static approach			Dynamic approach		
	HGV Vehicle kms	**LHV** Vehicle kms	**Total** Vehicle kms	**HGV** Vehicle kms	**LHV** Vehicle kms	**Total** Vehicle kms
Reference case (no LHV)	178.87	-	178.87	178.87	-	178.87
Scenario 2 + low elasticity	164.11	16.38	180.49	140.91	24.51	165.42
Scenario 2 + high elasticity	168.95	16.86	185.81	147.28	25.62	172.90

Source: TML report, Tables 18 and 19

In order to assess the sensitivity of these results to the load factor assumptions, MTRU has produced the following analysis. In the dynamic case it is assumed that LHVs start to capture HGV loads which are not simply bulk flows from one origin to one destination (such as coal to power stations), where the bigger the lorry the fewer are needed.

Instead, it is assumed that the LHVs over and above those in the static approach will achieve the same load factor as HGVs do today (51%). Thus it still allows for 100% load factors for most of the LHVs. The overall LHV load factor is therefore still about 60% - higher than that achieved by HGVs at present. If this reasonable assumption is applied, the results would change significantly, as shown in Table 5 below.

Table 5
Change in vehicle kilometres with new LHV load factor

	Dynamic approach					Static (Table 4)
	HGV vehicle kms	**Original LHV** veh-kms	**New LHV** veh-kms	**New Total** veh-kms	Increase over original	
Reference case (no LHV)	178.87	-		178.87	-	-
Scenario 2 + low elasticity	140.91	24.51	40.44	181.35	+1.4%	+0.9%
Scenario 2 + high elasticity	147.28	25.62	42.77	190.05	+6.3%	+3.9%

Source: TML report, Tables 18 and 19, MTRU calculation

The conclusion from this is that the TML method does not support a reduction in vehicle kilometres from heavy goods vehicles as a whole (HGVs + LHVs) if the unreasonable assumption about LHV 100% load factors is adjusted to a modest degree.

In fact, the most likely result would be a small increase in traffic, with between 10% and 20% of the new total driven by the larger, heavier vehicles.

4 Additional impacts from LHVs

The final section of this report reiterates the need for existing problems to be addressed, in particular that:

- HGVs do not currently meet their safety, environmental, infrastructure and congestion costs,
- HGVs are much more likely to be involved in fatal accidents than cars,
- 36% of HGVs fail their annual MOT test at the first attempt, 20% still fail after correcting minor defects at the testing station.

It goes on to discuss some of the underlying problems caused by increases in weight creating powerful dynamic forces, particularly where there are one or more trailers (articulation points). There is clearly a tension where greater manoeuvrability at low speed, for example on local roads, can lead to less stability at higher speed, for example on motorways.

The TML Leuven report relies upon a reduction in total vehicle kilometres to argue that the increased problems with LHVs compared to HGVs at the individual vehicle level will be balanced by a fall in the overall traffic level. It should be noted that this is a slowing down of traffic growth rather than an absolute reduction from today.

The report also makes the same assumption as many other analyses, that the current fiscal and regulatory framework produces an acceptable social, economic and environmental outcome.

This is in fact not the case. UK data shows that HGVs do not currently meet their overall safety, environmental, infrastructure and congestion costs[15], nor are they used in the most efficient manner.

Competition has not led to efficiency

There is strong competition in the road goods sector, but this does not currently lead to efficiency. This is because consignments have a wide range of sizes, weights and destinations. Efficiency relies upon close matching of vehicles capacity to individual loads.

In fact, vehicle size and weight regulations have produced a pattern of vehicle ownership with a very strong focus on registrations at the largest permitted level (see Figure 5 above). This means that vehicles of the right size are less likely to be available to be matched to specific loads. Consolidation and multiple deliveries are required to raise efficiency but this has administrative and competition barriers. In fact, single consignments are frequently carried which do not fill the vehicle. This was discussed further in Section 3 ii) and is one of the reasons that the optimistic assumptions on LHV load factors were criticised.

[15] See MTRU 2008

UK data shows maintenance and safety are still major issues

UK data shows that heavy goods vehicles are much more likely to be involved in fatal accidents per mile of road than other vehicles, as shown in Table 6 below.

Table 6
HGV traffic and fatal accidents by road type

Traffic in billion veh kms	HGV traffic	All motorised traffic	HGV %	% fatalities involving at least 1 HGV	**Ratio of HGV to all motor vehicles**
Motorway	12.1	99.2	12.2%	41.0%	**336.0%**
A	13.3	226	5.9%	17.2%	**292.2%**
B	3.7	181.1	2.0%	7.2%	**352.6%**

Sources for Tables 2 & 3: TSGB 2007, Goods Vehicle Statistics 2007, Goods Vehicle Accidents and Casualties 2007, all DfT

In addition, 36% of them fail their annual MOT test, with 20% still failing after minor faults are corrected at the testing station. This is shown in Table 7 below.

Table 7
HGV MOT tests and failure rates

	Number of tests	Failures		Failures as %	
		Initial	Final	Initial	Final
2004/5	465,258	181,117	116,155	**38.9**	**25.0**
2005/6	467,698	172,478	104,216	**36.9**	**22.3**
2006/7	466,215	184,248	103,127	**39.5**	**22.1**
2007/8	462,820	168,837	93,397	**36.5**	**20.2**

Source: VOSA 2008[16]

As weights increase the dynamic forces increase at any given speed and these are very complex in heavy vehicles which have one or more trailers. These were discussed in detail by the recent TRL report in the UK[17], and MTRU. This is summarised in the following section of this report.

The TML Leuven report draws on the TRL report and other references, but some of these do not appear immediately compatible with the TRL results, on which they are partly based. The TML report has a summary of vehicle handling in Table 27, reproduced below. The key to the symbols follows.

[16] VOSA Effectiveness Report, 2007/8, Annex 1 http://www.vosa.gov.uk/vosacorp/repository/VOSA%202007-08%20Effectiveness%20report%20with%20links.pdf

[17] TRL Report PPR285, and MTRU 2008

Figure 6
Extract from TML Report, page 80

Table 27: Assessment results of the handling characteristics according to Knight (2008) and Wöhrmann (2008)

	manoeuvre / concepts	Gross Vehicle Weight	steady state circular test	sinusoidal steering	single lane change manoeuvre		manoeuvra-bility	Scenario
			behaviour	behaviour	required space	yaw damp-ing	behaviour	
1		60 t	↗	↗	↘	↗	↘	2 & 3
2		60 t	↗	↯	↓	↯	↘	2 & 3
3		60 t	↗	↗	↘	↗	↘	2 & 3
4		48 t	↗	↘	↘	↓	↘	2 & 3
5		40 t	↗	↗	↗	↗	↗	4
6		40 t	further research is needed to assess the driving dynamics and the manoeuvrability of this future option					2 & 3

Figure 7
Key to TML report symbols

Table 26: Evaluation scale for the handling characteristics of LHVs according to Wöhrmann (2008)

Assessment of handling characteristics at the limits	
↗	equivalent or better behaviour than standard heavy duty vehicles
↘	slightly inappropriate behaviour than standard heavy duty vehicles
↘	unfavourable behaviour compared to standard heavy duty vehicles
↓	significant unfavourable behaviour compared to standard heavy duty vehicles
↯	not acceptable

Column one of Figure 6 seems to be the equivalent of the TRL manoeuvrability test, based on EU limits. It appears from the text that most of the vehicles have steered trailer axles but this is not in the table. The text is also clear that manoeuvres at speed require steered trailer axles to be lockable or they may make side to side oscillation more likely.

There is thus no immediate comparison with a standard vehicle with a lockable steered trailer. In this case the indicators in the first column would worsen in most cases, except for the double articulation of vehicle 2.

The double articulation improves manoeuvrability, but increases side to side oscillation and problems with other manoeuvres. The extra articulation will reduce turning space at slow speed, but this same feature increases the likelihood of a "snake" occurring at higher speeds, for example changing lane on a dual carriageway. This was highlighted in the MTRU report and is evident for vehicle 4 as well as vehicle 2.

It is also worth noting the improvement in all columns achieved by combining a lower weight with longer trailer (vehicle 5). This is 17.8m long with maximum vehicle weight of 40 tonnes. The additional length reduces the likelihood of sway and there is no extra energy created by additional weight.

For comparative purposes, the MTRU summary tables, which were in turn based on the results from the TRL report, are set out below. The first[18] summarises the ***manoeuvrability,*** the second[19] shows the effect of design characteristics, such as weight, length and number of axles, on ***stability.***

Extracts from MTRU Report

Manoeuvrability

Table 8
(Table 6 in original MTRU report)
TRL low speed manoeuvrability tests and EU limits

TRL vehicle type number	Vehicle length metres	Vehicle weight tonnes	Axles	Swept path 100% is limit	Out-swing performance: limit is 0.8m
1 & 2	16.5	44	6: trailer unsteered	94%	<0.3m
3	18.75	44	6: trailer steered	74%	<0.1m
N/A	18.75	45.8	6: trailer unsteered	100%	0.8 – 1.2m (fail)
4	25.25	44	8 on 2 artic trailers	84%	Pass
5	25.25	49.5	8 rigid + trailer	146% (fail)	<0.1m
6	25.25	60	8 on 2 artic trailers	84%	Pass
7	25.25	63.2	8 rigid + trailer	146% (fail)	<0.1m
8	34	82	11 on 2 artic trailers	128% (fail)	<0.1m

Source: TRL PPR 285
Orange row denotes fail

[18] MTRU, 2008, Table 6
[19] MTRU, 2008, Table 4

Stability

Table 9
(Table 4 in original MTRU report)
Vehicle characteristics and stability

	Static rollover threshold	Rearward amplification	High speed off tracking
Higher gross weight	**XX**	**XX**	**X**
More articulation points	**-**	**XX**	**X**
Longer trailers	**-**	**-**	**XX**
Longer wheelbase	**-**	✓✓	✓
Longer overhangs	**-**	**XX**	**X**
More axles	✓✓	**XX**	**X**
More axle spread	**-**	**XX**	**X**

Source: TRL PPR285

It can be seen that there are significant tensions between low speed manoeuvrability, particularly turning movements, and higher speed stability, particularly on motorways and dual carriageways. For example, a double articulation, with a tractor unit and two trailers, is better at turning corners, but if the tractor makes a relatively small movement to right or left the trailers will tend to swing out of alignment and continue to oscillate. Overall weight increases would increase the forces involved and thus the strength of these outswinging movements.