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Longer Semi-trailer Feasibility Study and Impact Assessment

Final Summary Report

Department for Transport

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1 Introduction

1.1 BACKGROUND

1.1.1 In June 2009, the Freight and Logistics Division of the Department for Transport (DfT) commissioned this study to examine the feasibility and impacts of allowing longer semi-trailers to operate within the British road haulage market. The primary objective of this study was to establish whether the introduction of longer semi-trailers would deliver overall economic, environmental and societal benefits or disbenefits.

1.1.2 The current UK maximum semi-trailer length is 13.6 metres. Some vehicles, particularly those carrying lighter consumer goods, tend to reach their payload volume capacity before their gross vehicle weight (GVW) limit of 44 tonnes. Additional semi-trailer length would enable such vehicles to carry more cargo within the existing GVW restrictions, even if the increase in the weight of the semi-trailer led to a reduction in the maximum payload weight carried. This might provide operating efficiency gains and reduced environmental impacts if fewer vehicles were required to carry the same volume of goods.

1.1.3 This research study was constrained to consider only length increases up to a maximum of 2.05m and only candidate vehicle configurations that would be capable of meeting all existing regulations (other than length). This would mean an increase in semi-trailer length from around 13.6m to no more than 15.65m, which would provide the same loading length as a rigid truck/drawbar trailer combination. This represents the limit of what could be achieved under EU rules without the risk of having to accept longer combination vehicles into the UK. This would translate to an increase in overall length from 16.5m to around 18.55m. Providing an additional 2.05m to the length of a semi-trailer would permit an additional two rows of pallets to be conveyed (four pallets single-stack or eight pallets double-stack if sufficient height were available). No increase in maximum permitted mass[1] above 44t was to be considered.

PROJECT CONTEXT

1.1.4 European legislation, particularly Council Directive 96/53/EC, places constraints on the size of vehicles that Member States may permit in national or international traffic. For tractor unit/semi-trailer articulated combinations, Council Directive 96/53 specifies that the maximum length of a combination is 16.5m and that the maximum length of semi-trailer is effectively 13.6m (12m to the rear +1.6m to the front of the kingpin, Figure 1.1). Rigid and drawbar trailer combinations are permitted up to maximum length of 18.75m. However, within their own borders there is scope for individual EU member states to relax these constraints on vehicle dimensions.

1.1.5 In 2006, the Department for Transport commissioned research to scope the use of longer heavier vehicles (LHV). The study report[2] highlighted a number of issues that make the introduction of LHVs impractical on both a permanent or trial basis. Consequently, the then Secretary of State ruled out their implementation. However, the analysis indicated that there might be affordable benefit to introducing longer trailers that may not require changes to the UK road network. As the 2006 study considered a wide

[1] Also referred to as Gross Vehicle Weight (GVW) - the combined weight of the vehicle and its load.
[2] Longer and/or Longer and Heavier Goods Vehicles (LHVs) - a Study of the Likely Effects if Permitted in the UK (2008) is available on request from DfT or from www.trl.co.uk.

range of options for longer-heavier vehicles, a narrower more focused approach was needed to understand the costs and benefits of the introduction of longer semi-trailers.

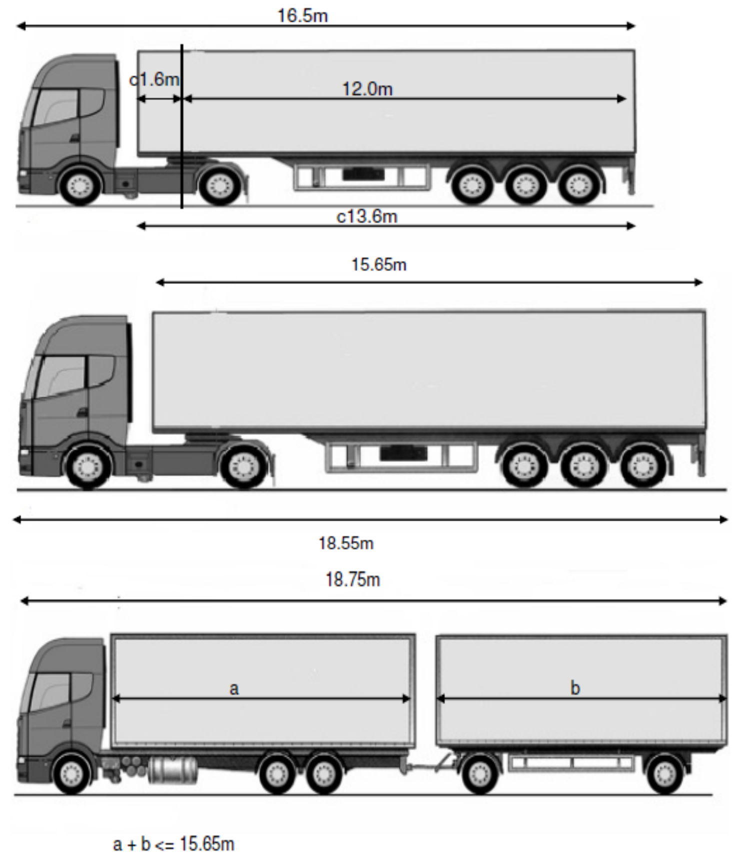

Figure 1.1: Existing, longer semi-trailer and rigid and drawbar trailer combinations

1.1.6 Evaluation of the likely effects of an increase in semi-trailer length of up to 2.05m implies consideration also of an increase of less than 2.05m; current regulations only limit a maximum length - there is no minimum. There are a variety of standard load units in existence, for example, 40' containers 45' containers, ISO pallets, CEN pallets, roll cages etc. Within the overall envelope of a potential 2.05m increase, there could be a number of interim loading lengths useful in different market sectors. Therefore, if amended regulations were to increase maximum length of articulated vehicles to 18.55m, then the road haulage industry would be free to specify any trailer length that suited their operation up to a maximum of 15.65m.

1.2 STUDY OBJECTIVES AND METHODOLOGY

1.2.1 The main aims and objectives are to examine the following:

- The extent to which longer semi-trailers would be used by different freight sectors and journey types (e.g. primary, secondary and tertiary distribution);
- What configuration (e.g. magnitude of length increase, overall height, etc) of longer articulated vehicle would be used? What are the implications for vehicle design (need for steering axles etc) and safety (tail-swing and stability)?

- The impact for road networks and for the current and potential use of non-road modes;
- The overall environmental impact, including but not restricted to CO_2 emissions, across freight modes as a whole;
- The effects on fatalities and serious injuries;
- Compatibility with existing infrastructure, including road networks; distribution centres and retail outlet loading bays;
- The impact on the cost of transporting goods by road, as well as on the economy.

1.2.2 The study methodology comprised the following main tasks:

- An assessment of vehicle specification and performance, based on mathematical modelling techniques and on interpretation of existing data. This determined the relative safety, fuel economy and emissions performance of selected longer semi-trailer technology options;
- Evidence gathering from industry and operators to: investigate the potential take-up rate and any operational issues associated with the use of longer semi-trailers; and to determine the vehicle configurations that are likely to be of greatest interest to operators;
- Review international experience and studies in the use of longer semi-trailers;
- Quantitative analysis of the likely level of usage of longer semi-trailers in future years and estimate their economic and environmental impacts;
- Draw together the evidence base to prepare a draft Impact Assessment of the introduction of longer semi-trailers, which measures their economic, social and environmental costs and benefits.

1.3 STUDY TEAM

1.3.1 The study team, led by consultants WSP, included MDS Transmodal who carried out the evidence gathering and economic assessment, as well as the freight logistics specialists Dr. Andrew Palmer and Professor Alan McKinnon who reviewed these study outputs. TRL provided inputs to the vehicle engineering and safety component of the work, supported by specialist dynamics expertise from MIRA and Cambridge University Engineering Department and by specialist safety advice from VSRC.

1.4 REPORT STRUCTURE

1.4.1 This Final Summary Report (Deliverable D7) provides an overview of the main analysis and findings of the research conducted. This report is supported by a series of detailed technical reports (Table 1.1) that encapsulate the full methodology, analysis and results of the work undertaken. They will be of particular use to those wishing to examine the precise assumptions, data sources and methods that underpin this study.

Table 1.1: Reports delivered from this study

Deliverable	Report Title	By	See Section
D3	The Likely Effects of Permitting Longer Semi-Trailers in the UK: Vehicle Specification Performance and Safety	TRL	3
D4	Industry Evidence Gathering and International Review	MDST& WSP	2 and 4
D5	Economic Assessment	MDST	5 and 6
D6	Impact Assessment of Longer Semi-Trailers	WSP	5 to 7
D7	Final Summary Report	WSP	-
D8	Safer Aerodynamic Frontal Structures for Trucks	TRL	3.4
D9	Comparing the Results of Cost Benefit Analysis for the Longer Semi-Trailer and LHV Studies	TRL	6.3

1.4.2 The following Chapter of this report reviews various trials and other published studies mainly from outside the UK of Longer Semi-Trailers (LSTs) and Longer Heavier Vehicles (LHVs). Chapter 3 summarises the work on vehicle performance and safety including the potential impacts of the use of safer aerodynamic fronts. Evidence gathering from industry on the potential demand and usage of longer semi-trailers is reported in Chapter 4. Chapter 5 presents the methods and assumptions used in the economic assessment while the main economic assessment results are summarised in Chapter 6. Chapter 7 outlines some wider issues that were considered within the Impact Assessment. The main conclusions from this study are then summarised in Chapter 8.

2 Review of Studies and Trials

2.1 BACKGROUND

2.1.1 This Chapter reviews recent desk studies and trials, mainly within the European Union, from which factors and experience affecting the potential introduction of longer semi-trailers into the UK can be derived.[3] Although many of these studies were focused on longer heavier vehicles (LHV), they nonetheless provide broad indications of the types of issues that would need to be addressed for the introduction into Great Britain of longer semi-trailers. The major study 'Longer and/or Longer and Heavier Goods Vehicles (LHVs) – a Study of the Likely Effects if Permitted in the UK' carried out for DfT by TRL and Heriot-Watt University in 2008 covered a wide range of LHVs and included an 18.75m LST and so has provided a useful starting point for the work in this current study.

2.1.2 There appears to be no country that has recently introduced a directly comparable longer semi-trailer for widespread usage in a context similar to that relevant to the UK. First, many European countries have a 4 metre height limit whereas the *de facto* limit in the UK is 4.9 metres. This has enabled the UK to gain additional cubic capacity vertically, reducing the need for lengthening. Second, much greater use is made of drawbar trailer combinations (up to the 18.75m length limit) in other European countries, with proportionally less use of semi-trailers. .

2.1.3 Nevertheless, in a number of countries vehicles that have broad similarities to the longer semi-trailer proposition are already in widespread use, or have recently commenced trials. The current usage of longer semi-trailers by country is summarised in Table 2.1. This also lists some LHVs currently allowed in a selection of countries, together with comments on their availability. Column 2 lists for the combination its maximum allowed length in metres and its maximum GVW in tonnes.

Table 2.1: **Summary of semi-trailer and selected other combinations in use**

Countries	Total vehicle length / GVW	Comments on vehicle
		Semi-trailer vehicles
EU	16.5m / 40t	Standard semi-trailer vehicle allowed within the entire EU.
UK, Ireland	16.5m / 44t	UK domestic standard semi-trailer
UK	18.55m / 44t	The longer vehicle being considered in this study
Germany, (Poland, Czech, Russia, Ukraine, Belarus)	17.8m / 40t	Trial that started in Germany in 2006 with 300 semi-trailers and more recently extended to these other countries. Example: Kögel Big-MAXX.
Italy	18m / 44t	Trial of a limited number of longer semi-trailers; started in May, 2009.
Canada	21.55m / 46.5t	Widely used across the country.
USA	19.77m / 41.9t	Widely used across the country.
Australia	19m / 45.5t	Widely used across the country.

[3] This material is presented in greater detail in Chapter 5 of Deliverable D4: Industry Evidence Gathering and International Experience.

Countries	Total vehicle length / GVW	Comments on vehicle
		Trailer combination vehicles and Longer Heavier Vehicles (LHVs)
EU	18.75m / 40t	Standard rigid & drawbar vehicle allowed within the entire EU.
UK	18.75m / 44t	UK domestic standard rigid & drawbar vehicle.
Sweden, Finland	25.25m / 60t	European Modular System (EMS) - similar combinations have been in use since the 1970s; allowed on most of the road network. Since 2009, Sweden has trialled 30m/90t vehicles for hauling timber in the north of the country.
Netherlands, Denmark, Norway	25.25m / 60t	EMS vehicles of 60t are allowed since 2008; on the major road network in the Netherlands and on selected main roads in Denmark and Norway.
(Belgium, France)	25.25m / 60t	Trials of EMS have been considered. France had planned to start a trial in 2010 with a 57t limit but this was suspended.
Germany	25.25m / 50t	Trials solely within some Länder are underway with a 50t limit; at Federal level trials expected to start in 2011.
Canada, Australia, USA	-	Very large vehicle combinations (up to 117.5t in Australia) are allowed on parts of the road network for certain operations.

2.1.4 In some countries, with low population densities and long distances between settlements, such as Sweden and Finland, there has been a long history of usage of vehicle combinations of around 60 tonnes GVW. This has led to the current European Modular System (EMS), which comprises, for example, an EU standard tractor and semi-trailer coupled to a standard rigid drawbar trailer. The use of EMS has been expanding in the EU, with Netherlands and Denmark now allowing their use on the major road network. Belgium, Germany and France are considering the initiation of EMS trials, though government attitudes to EMS have fluctuated back and forth in the latter two countries in recent years. The UK and Austria have continued to oppose the introduction of EMS in their territories.

2.2 EUROPEAN TRIALS OF LONGER SEMI-TRAILERS

2.2.1 In Germany there have been trials of a 17.8m vehicle, which increases the available semi-trailer load volume by about 10% above the EU standard but leaves the GVW unchanged at 40 tonnes. In August 2006, the trailer manufacturer Kögel initiated its trial of 300 Big-MAXX[4] semi-trailers using special permits that covered the whole of Germany. Kögel charges an additional 5,000 euro for this longer semi-trailer. Around 40 different companies used these semi-trailers and the results of the trials were analysed by the Institute for Automotive Engineering at the RWTH Aachen who, it is claimed by Kögel, have "confirmed that the Big-MAXX will not have any impact on the road safety of other road users".[5]

2.2.2 The trials of the 17.8m vehicle were since extended to a number of countries in the east: Poland, Czech Republic, Belarus, Ukraine and Russia.

[4] http://www.big-maxx.com/en/history
[5] http://www.big-maxx.com/en/benefits/4-safety/4-safety

2.2.3 The other major European trial is "Progetto Diciotto / Project Eighteen" in Italy, which is introducing longer semi-trailers with a resulting vehicle length of 18 metres. The project[6] is a collaboration of the Italian Ministry of Transport with vehicle and trailer manufacturers. Transporters and logistics operators are key actors in the experiment; the firms will operate the vehicles in a standard commercial environment but only within Italian territory.

2.2.4 The proposal is for use of a standard tractor together with a specially designed semi-trailer that is 1.5 metres longer than the current EU standard, producing an 18m vehicle that could carry 37 euro-pallets, 4 more than on existing semi-trailers. One of the rules laid down for the trial by the Ministry of Transport, is that exclusively well-trained and experienced truck drivers drive these vehicles.

2.2.5 There are six logistics operators taking part in the trials themselves, which commenced in May 2009 conducting on-road trials. Their experience[7] so far suggests: that they have not seen any problems, except for manoeuvrability and on the approach to narrow loading ramps; and that additional costs are low but these costs could increase if a steering axle was added and loading capacity decreased.

2.2.6 Any lessons from the Italian trial of 18m longer semi-trailers need to be cautiously interpreted because their road haulage industry is quite different from that in the UK. Moreover, the vehicles being tested are 5-axle combinations with a GVW limit of 44t, in keeping with Italian regulations. Within the UK, 5-axle combinations would be subject to a 40t limit.

2.3 STUDIES OF LONGER OR HEAVIER VEHICLES

2.3.1 The TRL and Heriot-Watt University (2008) study investigated the likely effects of permitting longer and/or longer and heavier vehicles (LHVs) in the UK. It found that the overall benefits of the larger vehicle options assessed were uncertain, with the potential to bring significant benefits within the road sector but also with the potential for adverse environmental effects, principally as a result of modal shift from rail to road, and potentially very large investments in improved parking facilities. However, the report did suggest that there could be worthwhile benefits from permitting a modest increase in the length of semi-trailers.

2.3.2 A major EU study "The effects of adapting the rules on weights and dimensions of heavy commercial vehicles as established within Directive96/53/EC" by Transport & Mobility Leuven (TML) and others was published in November 2008. This was commissioned by the EC to assess positive and negative implications of a possible revision of these rules. The findings of this study prompted significant reaction from industry, rail and environmental lobbyists. Follow-on studies included the report by the European Commission Joint Research Centre Institute for Prospective Technological Studies (JRC) dated 2009, and a study for the Community of European Railway and Infrastructure Companies (CER) conducted by The Fraunhofer-Institute for Systems and Innovation Research (ISI) and others, dated May 2009. A major review commissioned by the Swedish Government into the operation of LHVs was published by VTI (2008).

[6] http://www.fastrasporti.com/documentazione/progetto18.pdf provides a detailed specification in Italian of the aims and the main steps in this Project 18.
[7] http://www.allbusiness.com/transportation/road-transportation-trucking-trucking/12813779-1.html

2.3.3 One of the key points of debate regarding the conflicting results from the different forecasting studies of LHVs/LSTs relates to the embedded demand elasticities within the models that were used. There is clearly great uncertainly about which values to use to model both the impact of LHVs on the demand for road freight services and on freight mode split. Different studies, including the TRL/Heriot Watt study, have used elasticity values derived in different ways. These are likely to be country-specific, reflecting conditions in national freight markets. This frustrates any attempt to extrapolate the results of LST or LHV studies from one country to another.

2.3.4 The Commission has recently funded a further study to consider the possibility of making amendments to Directive 96/53/EC on heavy vehicle dimensions and weights in light of proposals from stakeholders and practice in various Member States. An inception report has been produced by the team led by the TRL (2010) which describes the approach that will be adopted to assess the options considered.

2.3.5 Since 2000, the Netherlands has been carrying out trials with EMS. Monitoring of the trials found that the EMS could absorb part of the expected future growth in (road) transport; help in lowering costs, and increase transport efficiency for low density and longer distance hauls. From the trials, it was found that the average payload carried was in the region of 16-35 tonnes, which is well below the maximum permitted payload. The results were considered sufficiently positive to justify the legalisation of EMS in the Netherlands in 2008 after an investigation concluded that the EMS did not damage bridges.

2.3.6 A recent Dutch government report (Rijkswaterstaat, 2010) summarises experiences with LHV's in the Netherlands from 1995 to 2010, including an overview of thirty Dutch reports, leading to the following finding.

> *The conclusions confirm that the use of LHVs in the Netherlands has several benefits, while showing at the same time that potential downsides of LHV use have not materialized. … By replacing regular large trucks, LHVs have a positive effect on the reduction of overall vehicle mileage, operating costs and emissions. In short, LHVs have both economic and environmental benefits.*

2.3.7 The relevance to Great Britain of Dutch experience is probably greater than that in Scandinavia owing to similarities in geography and population density. Even though the EMS combinations are much larger than the longer semi-trailer changes considered in the current study, these EMS related findings should be of considerable relevance to longer semi-trailers. In particular, the proliferation of payloads below the maximum weight supports the view that it is the volume extension rather than the weight extension that was particularly attractive to operators in the Dutch experiment.

2.3.8 The Joint Transport Research Centre (JTRC) of the OECD and the International Transport Forum (ITF) formed an international working group to conduct a study on the productivity improvements achievable by heavy goods vehicles. The working group comprises experts from 21 countries including the UK and from the European Commission. It has reported its findings in OECD/ITF JTRC (2010).

2.3.9 The study carried out international benchmarking of HGV safety, performance and productivity effects. It analysed 39 HGVs from working group nations, including both the standard (workhorse) vehicles in common use, contrasting these with longer and / or heavier vehicles with higher capacities. This benchmarking includes vehicle dynamic simulation, using tools developed by ARRB. It used eight performance based standard (PBS) measures to examine the on-road safety of each vehicle.

2.3.10 A total of 23 of the 39 vehicles met all of the PBS safety requirements, including existing longer semi-trailers in regular use in Australia, Canada, South Africa and the US that are broadly similar to those considered in this study. This provides support for the safety performance of longer semi-trailers.

2.3.11 General findings across the range of studies reviewed include:

- Allowing the use of larger vehicles generally leads to economic and to safety benefits due to fewer road vehicles being needed to carry the same goods.
- Whether there would be corresponding reductions in carbon emissions is less clear-cut, particularly due to the impacts of the switching of some freight movements from rail to road. Country-specific, detailed market studies are needed to throw more light on this issue.
- In general, the debate is highly political so that the same evidence has been interpreted in rather different ways, depending on whether the protagonists are connected on the one hand to the road or wider logistics industry or on the other hand to rail or green groups.

3 Vehicle Performance

3.1 INTRODUCTION

3.1.1 An understanding of the potential performance of longer semi-trailers was an important part of this feasibility study. This Chapter first summarises the results of the analyses from the vehicle specification, vehicle performance and safety aspects of the work.[8] The vehicle work involved:

- A review of scientific and commercial literature on trailer specification, performance and cost;
- Evidence gathering with the vehicle industry;
- Computer modelling and simulation of static load distribution, low speed manoeuvrability, dynamic stability, and susceptibility to cross winds;
- Quantification of the implications on running costs;
- Analysis of accident data.

3.1.2 Based on this vehicle analysis, Section 3.3 summarises the regulatory possibilities to be considered and then defines the set of representative longer trailer options selected for further detailed analysis.

3.1.3 In conclusion, Section 3.4 describes work undertaken by TRL[9], as a supplementary part of this study, into the potential impact of safer-aerodynamic fronts for HGVs. It explains how it would be possible with changed regulations to improve safety and other performance characteristics of HGVs through re-designing their frontal shape in a way that could reduce both fuel consumption and the number of accident casualties.

3.2 CONCLUSIONS ON VEHICLE PERFORMANCE

3.2.1 The cost and mass implications of longer semi-trailers have been well defined in cooperation with the vehicle industry. The additional function and complexity of steered axle systems currently adds both mass and capital cost to a new semi-trailer. The typical effect on the mass of the vehicle has been estimated based on a combination of comparison of published technical data for different axles and of information provided directly by manufacturers and developers. The results are shown in Table 3.1. The mass implications for steered axles span a considerable range depending on type. The estimated additional costs of steering axles are shown in Table 3.2, noting that due to lack of information the cost for a twin command steer and both the cost and mass for active steer are assumed, rather than quoted, values.

Table 3.1: Additional mass for steering axles

System type	Additional mass (kg), compared with standard fixed axle		
	Mean	Min	Max
Self steer (one axle)	190	140	250
Command steer (One axle)	688	300	900
Command steer (Two axles)	1,145	1,040	1,280
Active steer (Three axles)	1,250	1,250	1,250

[8] This material is presented in greater detail in Deliverable D3: Vehicle Specification Performance and Safety.
[9] This material is presented in greater detail in Deliverable D8: Safer Aerodynamic Frontal Structures for Trucks.

Table 3.2: Additional capital costs of steered axles.

System type	Additional cost (£), compared with standard fixed axle		
	Mean	Min	Max
Self steer (one axle)	2,300	1,650	2,700
Command steer (One axle)	4,000	4,000	4,000
Command steer (Two axles)	6,600	-	-
Active steer (Three axles)	6,000	-	-

3.2.2 Increasing the length of semi-trailers to 15.65m would be likely to increase total unladen mass by between approximately 575kg and 1,750kg. Capital costs could increase by between about £3,300 and £7,200. Both would depend on the level of steering technology applied and cheaper, lighter solutions would be available for length increases of less than 2.05m.

3.2.3 Bridge loading and pavement wear effects have not been studied in detail because the previous study (TRL and Heriot-Watt University, 2008) confirmed that increased length without increased GVW or axle weight would cause no adverse bridge loading effects and would have only marginal effects on structural pavement wear from vertical loading. However, the review has identified theoretical evidence to suggest that steered trailer axles reduce pavement wear caused by turning HGVS, although there was insufficient data to allow this to be quantified.

3.2.4 Simulation results predicted that increasing the length of semi-trailers would at full vehicle load produce a small increase in the fuel consumed (up to 1.8%) and in consequent tail pipe emissions per vehicle km. For empty running and for part loaded movements of longer vehicles, the percentage increase in fuel consumed would be somewhat greater. The consumption increase is due both to a small increase in the aerodynamic drag from the vehicle's longer length and to a small increase in the unladen weight of the vehicle. This is considered against an increase in pallet capacity of approximately 15% and a decrease in payload mass capacity of up to approximately 5%. There is also evidence to suggest that steered axles on trailers can substantially reduce tyre wear, which would reduce the emissions associated both with their manufacture (e.g. CO_2) and wear (e.g. particulates).

3.2.5 Increasing vehicle length by more than about 0.4m (to 16.9m) with fixed, closely coupled trailer axles is only possible within current axle load and manoeuvrability regulations if the maximum load carried is reduced (assuming uniformly distributed load). An 18.55m vehicle would be possible if the GVW were limited to 38 tonnes. However, this is only possible because the existing legislation allows semi-trailer manoeuvrability to be approved by numerical methods and no tailswing limit is applied. Longer, fixed axle vehicles at reduced weight will have much greater tail swing than current vehicles (more than double, from 0.17m to 0.37m, for a 17.5m vehicle and approximately 4 times, from 0.17m to 0.67m for an 18.55m vehicle compared with the baseline).

3.2.6 The appropriate use of existing (non active) steering axle technology can allow vehicles to comply with all existing regulations at a GVW of 44 tonnes and a length of up to 18.55m (semi-trailer length 15.65m) but the tail swing produced in a "drive in" roundabout manoeuvre will be much greater than for current vehicles (around 0.6m, depending on specific design, compared to the existing 0.17m). Prototype active steer systems have demonstrated the potential to allow 18.55m vehicles at 44 tonnes whilst reducing tail swing to near zero.

3.2.7 Longer vehicles that make use of steering axles to achieve manoeuvrability and axle load compliance will tend to have longer wheelbases. Those using fixed axles and reduced weight will have shorter wheelbases similar to existing articulated vehicles.

3.2.8 The dynamic stability of vehicles travelling at speed is more sensitive to wheelbase than to overall length:

a) Vehicles that achieve increased length by increasing their wheelbase will be more susceptible to crosswinds than existing vehicles (e.g. an 18.55m long, 9.75m wheelbase vehicle will have a 10% increase in load transfer ratio during crosswinds compared to a 16.5m, 8m wheelbase vehicle). They will also have a slightly worse rollover threshold in steady state cornering than those with shorter wheelbases (e.g. an 18.55m long, 9.75m wheelbase vehicle will have a 0.75% poorer steady state rollover threshold compared to a 16.5m, 8m wheelbase vehicle). However, vehicles with a longer wheelbase will tend to have better dynamic performance (e.g. path error, rearward amplification etc.) in transient manoeuvres such as a lane change than existing vehicles.

b) Vehicles that achieve increased length with shorter wheelbases similar to existing vehicles (i.e. extending behind rear axles) will tend to be significantly less stable in transient manoeuvres such as a lane change (e.g. an 18.55m vehicle with 8m wheelbase would display a 40% increase in path error and a 15% increase in rearward amplification compared with the standard vehicle). However, the steady state rollover threshold and susceptibility to cross winds would be comparable to existing vehicles.

3.2.9 The analyses suggest that it would be very difficult for a longer vehicle to provide an improved performance over an existing vehicle in every metric considered. There are no combinations where the performance is reduced in all metrics at the same time – there is a trade-off based on wheelbase such that the metrics which are adversely affected are often accompanied by metrics where there is an improvement. This means that overall there can be net performance improvements relative to existing vehicles. Where individual reductions in performance are predicted these can be mitigated or improved by the imposition of design restrictions or new performance standards that force the use of new technology. For example, a height limit of around 4.6m would allow 18.55m vehicles to have approximately the same high speed stability performance as a 16.5m vehicle at 4.9m height, while electronic stability control would be expected to mitigate the risk associated with reduced rollover stability.

3.3 REGULATORY POSSIBILITIES AND VEHICLE OPTIONS

3.3.1 The findings of the vehicle simulation work helped identify three regulatory possibilities:

i) Retain existing length limits (do nothing);

ii) Increase trailer length, require compliance with all other existing regulations;

iii) Increase trailer length, require longer vehicles to match or exceed actual performance of existing vehicles.

3.3.2 Within the regulatory constraints of possibility number ii) industry could react in a number of different ways:

a) **Low tech** – A maximum vehicle length of up to 18.55m would be possible with a wheelbase of approximately 8m without steering axles. However, the maximum load carried would need to be limited to 38 tonnes to avoid trailer axle overload. Forty tonnes would be possible at a length of up to around 17.8m. Both configurations would exhibit reduced stability in dynamic manoeuvres such as lane changes, for example, the path error exhibited by the 18.55m configuration would be in excess of 33% greater than for an existing 16.5m vehicle. Tail swing would be increased by approximately 215% for a 17.8m vehicle and by approximately 400% for an 18.55m vehicle.

b) **Medium tech** – Vehicles could be up to 44 tonnes GVW and up to 18.55m overall length if existing steer axle technology was to be used. Such vehicles would increase tailswing by approximately 350% (in a "drive in" manoeuvre), suffer a small increase in the susceptibility to cross winds of approximately 5% at 17.5m and approximately 10% at 18.55m, with a reduction of just under 2% in steady state rollover threshold, compared with a 16.5m vehicle. However, the other vehicle dynamics parameters would match or better those of the standard 16.5m vehicle, for example, a reduction of 7% in the rearward amplification and a slight reduction in cut-in during low speed manoeuvring. The high-speed performance assumes that like all existing systems the steer axles are locked at speed. New regulation may be required to enforce this condition.

3.3.3 There are possible deficiencies in current regulation, for example, manoeuvrability regulations are intended to limit tailswing for all vehicle types but trailers are approved by calculation. This produces existing vehicle combinations that exhibit tailswing well within the limits applied for rigid trucks and buses. However, if the calculation formula were applied to longer semi-trailers it would prevent an increase in wheelbase, limiting industry to the low tech approach described above. These low tech vehicles could exceed the tailswing limits applied to other vehicle types. If it was considered desirable to allow the medium tech approach and to enforce the spirit of the existing legislation, then it would be necessary to introduce a specific test for an articulated combination with an appropriate tailswing limit and to prescribe the test speed for evaluation (e.g. 6km/h). Similarly, all existing steered trailer axles are locked at high speed but this is not a regulatory requirement. If it was considered necessary to ensure that this could not change it would be necessary to introduce either a technology limiting requirement that steered axles were locked at high speed or a performance based requirement that the vehicle remained stable in a lane change (or similar dynamic) manoeuvre based on parameters such as load transfer ratio or rearward amplification.

3.3.4 Under regulatory possibility number iii), only one approach would be possible:

c) **High tech** - Vehicles would need to be fitted with a new generation of active trailer steering systems. Vehicles of up to 44 tonnes and 18.55m overall length (15.65m semi-trailer length) could be considered. Maximum length vehicles would have a 10% increase in load transfer during crosswinds and slightly less than 2% reduction in steady state rollover threshold compared with a 16.5m vehicle. However, tailswing could be almost eliminated and cut-in could be reduced, thus substantially improving low speed manoeuvrability in comparison with existing 16.5m vehicles, and it is possible that tuning the system could improve performance by around 20% in high speed transient manoeuvres such as lane changes.

3.3.5 If it was decided that regulatory possibility number iii) were to be implemented, this could be achieved by implementing a more stringent tail swing limit for an articulated combination (around 0.2m in a drive-in test at 6 km/h). Regulatory possibility iii) allows vehicles that match or exceed existing performance in all regulatory tests as well as in terms of overall net performance, including unregulated high speed stability metrics. However, within this some individual metrics, for example cross wind stability, can still be of a reduced standard compared with existing vehicles. Enforcing a condition where all individual metrics matched or exceeded existing performance would require either a height limit of around 4.6m (design prescriptive) or a dynamic stability and cross wind sensitivity test (performance based) evaluated in terms of parameters such as load transfer ratio.

3.3.6 It should be noted that the active steer system likely to be required for regulatory possibility iii) (high tech) may take in the region of 18 months to two years to develop for production and currently it appears that the system is outside the scope of the technical requirements of UNECE Regulation 79. Although Type Approval could possibly still be granted via an exemption for new technology, provided equivalent levels of safety can be demonstrated, an amendment to Regulation 79 may ultimately be required.

3.3.7 A conservative analysis has been undertaken to assess the potential casualty effects of these changes compared to the current situation. This analysis has suggested that:

- Regulatory possibility ii) would be likely to result in a very small increase in the casualty risk per vehicle km but so small as to be immeasurable in casualty data after implementation. Introducing a limit that reduced the height of the tallest vehicles to around 4.6m would be enough to eliminate this increase in risk.
- Regulatory possibility iii) would be likely to result in a small reduction in the casualty risk per vehicle km but again this is likely to be so small as to be immeasurable.

3.3.8 Although the economics of the operation were to be considered separately from the vehicle design and regulatory environment, the two cannot be considered in isolation. Each of the three regulatory approaches described above has quite different implications for capital cost, unladen weight, ability to access difficult sites and fuel consumption. This in turn could have a substantial influence on whether it is economically attractive to have the increased carrying capacity. All of these factors were therefore considered in the analysis of vehicle running costs discussed below in Section 5.3.

3.3.9 To structure the analysis of the impact assessment of longer semi-trailers, the vehicle types have been consolidated into a standard set of *Vehicle Options* listed in Table 3.3, for which more detailed economic and performance analysis has been carried out. The penultimate column relates to complementary Options that adopt the use of longer 15.6m intermodal units to make efficient use within the rail system of the extra length available on the road feeder legs.

Table 3.3: Summary of modelled vehicle options

Trailer length extension	Axle Type	GVW (tonnes)	Vehicle Option	
			Existing intermodal	Longer intermodal
+0.00	Baseline: existing vehicle	44		
+1.00m	Fixed Axles	**40**	1	8
+1.00m	Single Self Steer Axle	44	2	9
+1.00m	Active Steering	44	3	10
+2.05m	2 Self Steer Axles	44	4	11
+2.05m	1 Command Steer Axle	44	5	12
+2.05m	2 Command Steer Axles	44	6	13
+2.05m	Active Steering	44	7	14

3.4 SAFER AERODYNAMIC FRONTS

3.4.1 The vehicle design possibilities considered in previous sections assumed that the regulations on the design of the cab would remain unchanged. However, it would be possible with changed regulations to improve safety and other performance characteristics that are discussed here.[10]

3.4.2 Most trucks are currently designed to maximise the load space that can be achieved within the legally permitted maximum dimensions. This usually means that the front of the truck approximates to a flat vertical surface where the cab is positioned above the engine. This design has a number of disadvantages.

3.4.3 It is possible to re-design the frontal shape of trucks in a way that all of the disadvantages could be reduced or eliminated, thus reducing the fuel consumption and the numbers of pedestrian, truck occupant, car occupant and other casualties. Robinson & Chislett (2010) suggested that when estimated costs and implementation dates were considered, this “nosecone” concept (to introduce a curved profile at the front of a truck) was one of the top heavy vehicle safety priorities. Feist & Gugler (2009) suggested that aerodynamic improvements resulting from changes to the frontal shape of trucks could result in a reduction of fuel consumption of up to 5% to 10%.

3.4.4 It is highly likely that this type of concept could not be incorporated on vehicles without either reducing the payload space (with resultant productivity and environmental disbenefits) or increasing the maximum permitted length. For this reason the UK Department for Transport (DfT) commissioned TRL to draw together the various strands of safety and environmental research in this area to produce an initial assessment of the likely feasibility, regulatory implications, costs and benefits of introducing such an integrated frontal design for trucks. The scope included potential benefits for the safety of light vehicle occupants, heavy vehicle occupants, and vulnerable road users, potential improvements in aerodynamics and potential dis-benefits in terms of manoeuvrability and unladen mass.

[10] This material is presented in greater detail in Deliverable D8: Safer Aerodynamic Frontal Structures for Trucks.

3.4.5 A range of different frontal geometries and lengths (up to 2.25m, which would take articulated vehicles up to the existing maximum permitted length for drawbar combinations of 18.75m) have been analysed and modelled in various ways, to estimate:

- The energy absorption and casualty reduction potential in frontal collisions with light vehicles;
- The energy absorption and casualty reduction potential in frontal HGV impacts with other large, heavy vehicles and objects;
- The energy absorption, impact kinematics, forward field of view and casualty reduction effects in frontal HGV impacts with pedestrians and pedal cyclists;
- The effects on approach angles, ramp angles and ability to comply with the turning requirements of 97/27/EC;
- The effects on aerodynamic drag, fuel consumption and emissions;
- The overall costs and benefits of the defined options.

3.4.6 All analyses were based on a modified vehicle towing a standard 13.6m semi-trailer.

CONCLUSIONS

3.4.7 In general, the analyses show the biggest casualty savings are for pedestrians. For example, before changes in exposure to risk (e.g. increased HGV traffic as a result of reduced payload mass) are considered, it was found that a 1m pedestrian-friendly nosecone applied to all tractor units would be likely to save 10 pedestrian fatalities per year in GB and 2 pedal cyclists. Designing a 1m nosecone just for truck to car/car derived van impacts would probably save 2 car/car derived van occupants per year, and designing purely for HGV to HGV impacts would be likely to save around 1 HGV occupant death every other year (assuming all HGV drivers wear seat belts).

3.4.8 The aerodynamic effects were found to be somewhat less than quoted in the literature (in the region of 3% to 6%). It was also found that for longer nosecones there was a trade-off between aerodynamic improvements to the tractor unit and the characteristics of the semi-trailer. The indication is that if a standard tractor unit is simply modified to include a nosecone (designed to give very good aerodynamic performance for the tractor), but it is then coupled to a standard semi-trailer, the overall vehicle drag (and, therefore, fuel consumption and emissions) may actually increase slightly. The effect seems to get worse as nosecone length increases. Conversely, if an articulated vehicle combination is designed as a single package, with optimised and matched aerodynamic features on both the tractor and semi-trailer, then longer nosecone lengths can produce reductions in whole vehicle aerodynamic drag, and not just in the drag of the tractor unit.

3.4.9 Modelling the combined effect, over realistic duty cycles, of these changes to aerodynamic drag and unladen mass showed only small effects on fuel consumption and emissions. For example, a 1% reduction in fuel consumption was evident with a 500mm nosecone on a vehicle laden to its maximum authorised mass.

3.4.10 Considering specific length increases, it was found that:

1 A 0.2m length increase could allow two different approaches:

a An “add-on” approach where the front-end would be designed to protect pedestrians and other vulnerable road users (VRUs) in frontal impacts with articulated HGVs in a manner similar to the steel and foam “safety-bar” concept developed by the APROSYS FP6 project (Feist and Gugler, 2009). This would be expected to save around 4 lives per year in Great Britain, have no significant effects on manoeuvrability or aerodynamics and minimal effects on traffic generation through reduced payload mass capacity. The limited benefit of this approach for vehicle operators (i.e. no aerodynamic effect) meant that it was not considered in the full cost benefit analysis.

b An “integrated” approach where a mildly shaped front end would also be expected to save around 4 lives per year but could also produce small aerodynamic benefits at the cost of a small increase in unladen mass and a consequent small increase in HGV traffic for the same loads transported. This would be expected to produce net benefits, excluding congestion costs, of around £18.5million per year.

2 An increase of about 0.5m would allow a shaped front end that could offer substantially improved field of view, deflect VRUs away from the front of the truck in an impact and have an outer skin of foam to absorb energy in collisions with VRUs. In addition to this, it could have short sections of crumple zone intended to protect car occupants and truck occupants. This would be expected to reduce fatalities by about 9 per year at the same time as reducing fuel consumption and emissions per vehicle km. If appropriately shaped this would be unlikely to cause significant manoeuvrability difficulties. However, unladen mass and, thus, HGV traffic would be increased further. The net benefit, excluding congestion costs, would be expected to be around £30.5million/year.

3 An increase of about 1m would allow a front end that was optimised for safety in terms of field of view, VRU kinematics and energy absorption, and car occupant protection. It would also allow an improved capacity for HGV occupant protection. Some manoeuvrability difficulties would be likely but could be overcome with relatively straightforward modifications such as making the rearmost trailer axle self-steered. This would be expected to reduce fatalities by about 14 per year. However, other effects would depend on how the aerodynamics were controlled:

a If the optimised tractor towed a standard trailer there would be an increase in unladen mass and, thus, in HGV traffic. There would be very little effect on aerodynamic drag. The increased mass would combine with the increased traffic to produce a significant increase in emissions (e.g. c.97k tonnes of CO_2), resulting in net costs of about £65million/year.

b If the tractor and trailer aerodynamics were optimised as a combination then the aerodynamic drag would be improved as would the fuel consumption and emissions. However, this would be expected to require additional aerodynamic aids, and hence unladen mass, on the trailer, further reducing payload and generating additional HGV traffic. The beneficial effect on aerodynamics would not be expected to outweigh the disbeneficial effect of the mass, resulting in a net annual cost of about £43.5million/year.

4 If a 2.25m length increase were applied solely to the front of the cab, the additional safety benefits over the 1m nose length would be limited to 1 or 2 more HGV occupant fatality savings per year. Manoeuvrability problems would be significant making compliance with Directives 97/27/EC (turning requirements) and 2000/40/EC (front underrun protection) difficult. Aerodynamically, the effects of such a nosecone are difficult to predict and likely to be highly dependent on the aerodynamic characteristics of the whole vehicle combination. Coupling such a tractor unit to a conventional semi-trailer (rather than one designed to be aerodynamically highly efficient) could actually lead to increased fuel consumption and emissions. The mass implications of such a front end are likely to be significant. For all these reasons, the cost benefit of such a change was not analysed in detail.

5 The analyses were based on a limited set of policy options and assumptions of how the industry would react. A range of subtle variations would be possible and could influence the results. In particular, investigating the following possibilities could identify further optimisation of the concept:

a Extending application of the policy to rigid goods vehicles

b Restricting application of the policy to vehicles carrying loads not constrained by mass, possibly approximated by excluding tipping and tank bodied vehicles.

c Removing consideration of requirements for car and truck occupants, potentially allowing lower mass solutions which may (or may not) improve net benefits when both safety and environment are considered.

d Investigating the potential for advanced engineering and materials to offer solutions with a mass lower than that assumed in this analysis.

3.4.11 The results described above would be equally valid if semi-trailers of up to 15.65m in length were to be permitted, except for manoeuvrability where further analysis may be required if the overall combination length exceeded 18.75m. They are also based on applying the principles of safer aerodynamic fronts to articulated vehicles only. Further casualty reductions, particularly for vulnerable road users, could be achieved if the measures were also applied to rigid vehicles.

4 Evidence on Potential Usage of Longer Semi-Trailers

4.1 INTRODUCTION

4.1.1 This Chapter[11] provides a summary of the evidence gathering task undertaken with the logistics sector and other key stakeholders. It outlines the main messages and key issues that emerged regarding the impacts and likely take-up of longer semi-trailers.

4.1.2 Section 4.2 provides an overview of the objectives of the evidence gathering. To ensure a representative spread of interested parties across the industry, a targeted approach to operators, third party logistics providers (3PLs), trade bodies and other stakeholders was adopted for eliciting views as presented in Section 4.3. Section 4.4 identifies the potential market for longer semi-trailers. Section 4.5 summarises the evidence provided by stakeholders regarding the likely impacts of the potential introduction of longer semi-trailers into the British road freight market, including potential solutions to specific issues raised regarding the scope to use longer intermodal units with longer semi-trailers to improve overall intermodal transport efficiency.

4.2 OBJECTIVES OF EVIDENCE GATHERING

4.2.1 The main objective of this task was to gather information in three broad areas.

4.2.2 Firstly, identifying and assessing potential industry benefits through discussion with the logistics sector, both the shippers of cargo and the providers/suppliers of transport services. In particular:

- Identifying freight operations constrained by a vehicle's cubic capacity / deck area limits but that do not reach its gross vehicle weight limits - this is the market for longer semi-trailers as they can provide greater cubic capacity, coupled with reduced payloads;
- Whether or not the introduction of longer semi-trailers would result in fewer HGV trips and in cost savings to industry;
- Identification of the longer semi-trailer combinations likely to be of most interest to industry and assessment of the potential switch rates to them.

4.2.3 Secondly, to seek quantitative operational data that either demonstrates the benefits to industry or supports the case against longer semi-trailers. The vehicle cost and performance data collected was used to validate the road and rail freight cost models developed for this project, as outlined in Chapter 5.

4.2.4 Thirdly, to identify other factors that could influence the project's findings. In particular:

- Why do more operators not upgrade to rigid and drawbar trailer combinations? The longest rigid and drawbar combinations already provide an additional 2.05m (approx.) load-platform length compared with existing maximum length semi-trailers; and
- Why do operators not upgrade to double-deck (4.9m tall) semi-trailers? These are able to offer nearly double capacity, compared with standard single deck semi-trailer, by their ability to double stack fully loaded pallets.

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[11] This material is presented in greater detail in Deliverable D4: Industry Evidence Gathering and International Experience.

4.2.5 In addition, the exercise sought the views and opinions of other interested stakeholders. These included intermodal rail freight operators whose market could potentially be affected by the change.

4.2.6 It is important to note that a formal proposal (concerning a change to the current regulations limiting the maximum length of semi-trailers) has yet to be published by the DfT, and that this is considered to be a *feasibility and impact study* which will subsequently inform Ministers when deciding on any legislative change. On this basis, the evidence gathering exercise was not considered to be a *formal consultation* process. Any formal legislative change subsequently proposed by Ministers will have consultation undertaken in the normal manner.

4.3 COVERAGE OF EVIDENCE GATHERING FROM INDUSTRY

4.3.1 In order to provide a broad industry evidence base, the study targeted a representative range of businesses, trade bodies and other organisations. In conjunction with the DfT, a sample was drawn up of major shippers, third-party logistics providers (3PLs) and road hauliers (small to large in size). The approach was to interview participants at face-to-face meetings, supplemented by short questionnaires, rather than conduct a wider ranging postal questionnaire survey. The Road Haulage Association (RHA) and the Freight Transport Association (FTA), the principal trade bodies representing the operators and shippers, were contacted at an early stage in the process. Seminar meetings were arranged in conjunction with the FTA and RHA, each attended by 15-20 organisations.

4.3.2 Direct contact was also made with the Rail Freight Group (RFG). The RFG represents the interests of rail freight operators, shippers of cargo who utilise rail freight within their supply chains and other organisations with interests in the rail freight sector. Membership includes a number of operators and shippers who use domestic intermodal services. The consultant team presented a paper on this study at a RFG meeting of members, who were invited to respond and provide evidence in a similar manner to the FTA/RHA events.

4.3.3 Contact was also made with the Highways Agency and with the rail freight operators DB Schenker, Freightliner, GBRf and DRS. During the vehicle performance research a number of semi-trailer manufacturers were also contacted. Table 4.1 summarises the numbers of businesses and organisations that contributed to the evidence gathering.

Table 4.1: Summary of contributors to evidence gathering

Organisation/ Company Type	Meeting undertaken (either at FTA/RHA seminar or face-to face)	Detailed data/case study or submission supplied
Trade Body	3	3
Retailers	4	5
Manufacturers	10	11
Hauliers/Logistics Operators	18	5
Intermodal Operators	2	2
Rail Traction Providers	4	1
Others	2	0
TOTAL	43	27

4.3.4 It was deemed important that respondents supplied actual operational data and information as evidence to underpin any views offered in order to assess the extent to which introducing longer semi-trailers would yield benefits.

4.3.5 It was stressed to the trade bodies and their membership that anecdotal evidence would not be regarded as sufficient. For reasons of commercial confidentiality, attendees at seminars were invited to submit detailed data/information direct to the consultant team. Much of this data was provided in the form of case studies focussing on those individual flows within an organisation's overall supply chain for which longer semi-trailers would or would not be beneficial.

4.4 DEFINING THE MARKET FOR LONGER SEMI-TRAILERS

4.4.1 The evidence gathering exercise identified the sectors within the inland logistics market that would potentially utilise longer semi-trailers. This involved desktop research and initial discussions with the logistics industry; the main findings were subsequently presented to industry for validation.

4.4.2 The characteristics of the freight market that would be served by longer vehicles were examined. For most bulk and semi-bulk goods (e.g. sand, cement, metals, timber, etc.) the inherent weight of their loads ensures that current length vehicles can already be loaded to their maximum permitted 44 tonne GVW. Because longer semi-trailers will weigh more they would entail a reduction in the permissible payload for these denser goods so it would be inefficient to use longer vehicles. Likewise, most maritime containers can be carried on existing vehicles and so they would not benefit from a semi-trailer length increase.

4.4.3 Having eliminated these markets, this leaves the domestic shippers of lighter weight goods, as the market sector that potentially would take advantage of the additional carrying capacity that longer semi-trailers provide. The main types of operations in this market would be:

- Factories to National Distribution Centres (NDCs) and to Regional Distribution Centres (RDCs);
- Flows between NDCs and RDCs, and from them to retail stores;
- Mail/parcels;
- Palletline trunking operations; and
- Low-density industrial supplies.

4.4.4 However, the shipment of lighter weight palletised consumer goods is also a key and growing market sector for the rail freight industry i.e. domestic intermodal rail freight. This is particularly the case for flows between Midlands NDCs and RDCs in Scotland. As new rail-linked warehousing developments are delivered, shorter distance flows by rail within England and Wales are likely to become more viable. Forecasts produced by the FTA/RFG and by the rail freight operators, suggest that domestic intermodal rail freight is likely to be one of the largest growth sectors over the medium to longer term. If the road haulage sector were to gain significant competitive benefits from the introduction of longer semi-trailers, this may result in some intermodal traffic switching to road transport, or some traffic that otherwise would have transferred to rail may remain on road. For this reason, Chapter 6 assesses the potential impact on the rail freight sector.

4.5 RESULTS AND KEY FINDINGS FROM STAKEHOLDERS

4.5.1 Expectations regarding the impacts of the introduction of longer vehicles differed significantly, depending on the respondent's role within the transport and logistics industry.

4.5.2 Overall, the longer semi-trailers were well received by attendees at the FTA[12] Seminar, though some organisations did note that they would not be suitable for their operations (weight constrained). The main points included:

- Most organisations provided anecdotal evidence, based on actual product flows, describing how some/all of their operations reach cubic capacity below gross weight limits, and that the introduction of longer semi-trailers would enable a reduction in vehicle trips and HGV kilometres. As a result, cost savings and CO_2 emission reductions would be achieved.
- The preferred option was for a 15.65m semi-trailer i.e. the full 2.05m length increase.
- Longer semi-trailers would provide additional flexibility within their supply chains, in particular the ability to move extra cargo without the need to use double deck semi-trailers (which are not compatible with or suitable for some delivery operations).
- Potential benefits for domestic intermodal rail operations were also noted. The ability to operate 15.65m semi-trailers would also allow the introduction of new longer 15.6m intermodal units. The Megafret intermodal wagon, used for most domestic flows, has a 15.6m loading deck so new rolling stock would not have to be developed. An additional 4 pallets (single stack) could be conveyed per intermodal unit, for the same cost as a train conveying existing length (13.6m) intermodal units.

4.5.3 The majority of the FTA attendees subsequently supplied more detailed case study data and information to support their views.

- The base assumptions and costs utilised in the road and rail freight cost models developed for this study were validated by the data supplied by industry.
- Traffic data supplied by shippers suggests that most inter-depot trunking operations (i.e. not deliveries to retail outlets) are full-load movements. These would therefore benefit greatly from the introduction of longer semi-trailers, principally through a reduction in total HGV trips. A switch to longer semi-trailers, perhaps over an 18-24 month period, is likely to be widespread. Overall, a reduction of around 10-15% of HGV trips and HGV kilometres could be the result on such operations.
- In addition, some retail outlets have a high throughput of trade and could justify the use of and physically accommodate a larger vehicle. Again, evidence supplied suggests that such flows would benefit greatly from the introduction of longer semi-trailers and that a switch to use them would occur. However, many town centre retail outlets and smaller *metro* or *express* store formats either cannot accommodate existing maximum length HGVs or their trade volumes do not warrant the use of a large vehicle so a switch to longer vehicles is less likely. Data supplied by retailers suggests that, on average, only around 40-50% of HGV trips to retail outlets would be suitable for a longer semi-trailer.

[12] The Freight Trade Association seminar attendees mainly represented manufacturers, major retail chains or third party logistics providers.

4.5.4 In contrast, the attendees at the RHA[13] seminar were virtually unanimous in arguing against the introduction of longer semi-trailers. Their main points included:

- Customers would force the haulage operators to purchase and operate longer semi-trailers. Most operators stated that there is unlikely to be any associated rate increase, to compensate for the additional costs, following the introduction of longer semi-trailers. Consequently, most operators felt that all the costs associated with the introduction of longer semi-trailers (i.e. the write-off costs of existing equipment together with the higher capital costs of purchasing new trailers and the additional running costs) would be incurred by road haulage operators. All the benefits would be realised by their customers (being able to move more cargo at the same per semi-trailer rate).
- Longer semi-trailers will be heavier due to the extra length and/or requirement to fit steering axles. As a result, longer semi-trailer equipment will convey less cargo on those operations that do reach gross vehicle weight. Consequently, additional vehicle trips may be required, the opposite of the intended purpose of introducing longer semi-trailers. If longer semi-trailers are introduced it should at least be on a 'payload neutral' basis.[14]
- The need for longer semi-trailers can be greatly over-stated. Most operators indicated that existing 13.6m semi-trailers are not fully utilised to the maximum potential and that there is scope for operating these semi-trailers more efficiently. More distribution centres could be redesigned to accept double-deck (i.e. 4.9m) semi-trailers. On many vehicle trips, the semi-trailer deck 'foot-print' is full but it is well below the volume capacity of the semi-trailer i.e. not loaded to roof. The ability to double-stack and mix pallets would generate extra space in existing 13.6m semi-trailer equipment, thereby allowing more cargo to be conveyed per trip. The introduction of longer semi-trailer equipment would consequently exacerbate this inefficiency.
- Neither double-deck semi-trailers nor rigid and drawbar combinations are well suited to the general haulage market, for a variety of reasons. Instead, they are effectively niche equipment confined to a limited number of niche flows for which they provide a cost-effective service.

4.5.5 However, the attendees at the RHA seminar would not necessarily be representative of all decision makers in the road haulage industry. The market structure also contains other important players.

4.5.6 A significant proportion of the semi-trailers used for retail outlet deliveries are actually owned/leased by the major retailers themselves, even when they are hauled by the 3PLs on their behalf on a dedicated contract basis. These retailers will directly control the semi-trailer replacement strategy and hence exert a strong influence on the longer semi-trailer adoption rate. In general, these retailers foresaw clear benefits from use of such vehicles on those routes where they were appropriate.

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[13] The Road Haulage Association seminar attendees mainly represented hauliers who actually operate the vehicles on the roads.
[14] 'Payload neutral' denotes that the increase in vehicle weight due to the increased trailer length and axle technology, would be compensated by an equal regulatory increase in permitted gross vehicle weight so that the same maximum weight of cargo (payload) could be carried as at present.

4.5.7 In contrast, the semi-trailers used to collect goods from suppliers (for delivery into distribution centres) and for inter-depot trunking, tend to be owned by the transport companies represented by the RHA. The experiences of these operators regarding the impacts of previous changes in vehicle weights and regulations had caused most of them to be quite apprehensive about the impacts of allowing the introduction of longer semi-trailers.

4.5.8 The attendees at the meeting with the Rail Freight Group (RFG) expressed concerns in their response to the study. A number of points were made, including:

- Longer semi-trailers should be confined to moving longer intermodal units between warehouses and the nearest suitable intermodal terminal. This would provide rail freight with a significant cost benefit over road haulage, allowing it to win traffic on key long distance routes (and provide significant environmental benefits).
- This would be the thin end of the wedge again. Every time the road haulage industry has been provided with a gross vehicle weight increase or length increase, it has been followed up shortly after with further increases e.g. 32 tonnes to 38 tonnes to 40 tonnes to 44 tonnes. It will only be a matter of time before a further increase of some type is provided again. All regulatory changes in future must provide rail freight with significant benefits over road haulage.

4.5.9 The ability to operate 15.6m semi-trailers means that longer (15.6m) intermodal units could potentially be carried on rail in place of the existing 13.4m intermodal units in current use. By utilising the spare space available on the Megafret intermodal wagon (used for most domestic intermodal flows), which has a load platform length of approximately 15.6m, rail could achieve an increase in efficiency analogous to that available to road vehicles. Many RFG attendees initially appeared to accept the broad thrust of the potential for use of longer intermodal units resulting from the introduction of longer semi-trailers. However, the RFG supplied the study team with a letter setting out a number of concerns raised by members following the initial meeting. The main issues raised, as well as potential solutions that have since emerged to address some of them, are summarised as follows.

4.5.10 *High cube intermodal unit.* It may not be feasible to develop a unit capable of accommodating double-stack pallets, and therefore it should not be included in the overall analysis.

4.5.11 *Flexibility*. The longer intermodal units would need to be cheap to procure, have the ability to be used flexibly and should not create operational constraints that make rail use more difficult. In particular, *i*ntermodal units need flexibility to operate over diversionary routes with a less generous loading gauge profile.

4.5.12 *Construction and strength*. In order to be compatible with existing lifting equipment, a longer intermodal unit will need to be fitted with the 'lifting points' in the same position as a standard 40/45ft maritime shipping container. It has been suggested that it may not be possible to construct such a unit with the required 'rigid strength'. However, we understand that Wincanton[15] have commissioned a design for a 15.6m intermodal unit which is compatible with existing lifting equipment and has sufficient in-built rigid strength.

[15] See http://annualreport2010.wincanton.co.uk/business-review/working-responsibly.html

4.5.13 *Compatibility with skeletal trailers*. Longer skeletal semi-trailers (to convey longer intermodal units by road) will need to be 'flexible' and compatible with existing standard 40/45ft maritime shipping containers. Otherwise, industry will be required to operate two types of skeletal trailers (which will add to industry costs). We understand that Wincanton have commissioned a design for a 15.6m skeletal semi-trailer which is universal and is able to convey 40/45ft maritime shipping containers, 13.6m swap-bodies and their design for the longer intermodal unit.

4.5.14 *Dispose of existing length units*. Operators would be forced to dispose of existing length intermodal units before the end of their economic/operational life i.e. before they had been fully depreciated. The second-hand market would consequently be 'flooded' with partially depreciated 13.6m/45ft units that would be difficult/impossible to sell. Such units may ultimately have to be scrapped. Operators would be forced to partially write-off recent capital investments.

4.5.15 Also, many existing intermodal units were partly funded through Freight Facility Grants (FFG), and must therefore run throughout the commitment period without replacement. Replacing these units would generate additional costs for operators. This is a realistic argument and operators would potentially have to write-off equipment before the end of its useful life in order to adopt longer intermodal units. However, the road haulage industry is in the same position, with road haulage operators potentially needing to write-off existing trailer equipment early to benefit from longer semi-trailers.

4.5.16 *Investment in new equipment*. Similar to the above argument, the rail industry would need to invest in a new fleet of longer intermodal units in order to achieve the forecast benefits. Again, this is a realistic argument. However, the road haulage industry is in the same position, with road haulage operators potentially needing to invest in new semi-trailers to benefit from any efficiency savings. As mentioned previously, major future growth is forecast in rail domestic intermodal, which will imply a substantial increase from the existing fleet of intermodal units, so much of the new rail investment would arise in any scenario.

4.5.17 *Cranes*. Equipment at some intermodal terminals might not be suitable for longer intermodal units. In particular, they might not longitudinally fit through the gap between rail-mounted gantry crane legs. Discussions with Freightliner suggest that their cranes are able to 'twist' container units when being lifted so that they fit through the gap between rail-mounted gantry crane legs lengthways.

4.6 SUMMARY OF FINDINGS FROM USAGE AND DEMAND ANALYSIS

4.6.1 The evidence suggested that whereas for long haul trunking activity to distribution centres the take-up of longer vehicles would be very high, in contrast for delivery to retail stores the requirements for local access and smaller consignment size would reduce the take-up rate of longer vehicles. The full 2.05m added length would be the most popular option.

4.6.2 The views of stakeholders differed between sectors. Manufacturers, major retailers and logistics providers generally supported the introduction of longer vehicles and expected them to be widely used within the markets for which they are cost-effective. The smaller haulage firms did not support their introduction. They expected that the switch to longer vehicles would increase their capital and operating costs without providing them with a compensating increase in the rates they could charge to customers.

4.6.3 The rail industry expected that longer vehicles could potentially gain mode share from rail in its key domestic intermodal market that otherwise would have major potential for rail traffic growth. The extent to which longer vehicles would either compete with rail, or would provide road feeder services to support rail's position within the domestic intermodal market, depends critically on the types of longer semi-trailers that would be permitted (length and whether single or double deck) and on the level of take-up within the rail industry of longer intermodal units.

5 Economic Assessment Method

5.1 INTRODUCTION

5.1.1 This Chapter outlines how the economic assessment was undertaken.[16] The overall aim of the economic assessment is to estimate the likely cost savings (or increased costs) that would accrue to industry following the introduction of longer semi-trailers. It also establishes the potential impact on the cost plus viability of rail freight services and quantifies any modal shift to/from rail. The forecast economic and environmental impact results are then presented in Chapter 6.

5.2 THE METHODOLOGY FOR FORECASTING IMPACTS

5.2.1 The tasks listed in Box 5.1 summarise the methodology that was used to estimate the likely cost savings (or increased costs) that would arise from the introduction of longer semi-trailers. These tasks are applied to that section of the freight market (as specified in Section 4.4) that potentially might adopt the use of longer semi-trailers, hereafter termed the "in-scope market".

Box 5.1: The tasks to forecast the impacts of longer semi-trailers

1 Establish the current capital and operating costs for existing tractor unit and semi-trailer combinations and for rigid and drawbar combinations.

2 Establish current rail freight operating costs for the in-scope market.

3 Quantify the total amount of cargo currently lifted and moved by road goods vehicles; identify and quantify the sectors (by vehicle type, commodity etc) of the in-scope market.

4 Quantify the current total amount of cargo lifted and moved by rail freight, for the in-scope market.

5 Estimate the current total cost at the national level of moving goods by road transport and by rail freight for the in-scope market (i.e. the direct cost to industry).

6 Establish the future year capital and vehicle operating costs for existing length and for longer semi-trailer combinations; establish future rail freight operating costs.

7 Forecast future traffic flows for both road transport and rail freight for the in-scope market, on the basis that longer semi-trailers are not introduced (the Baseline scenario).

8 Estimate the resulting forecast national cost of moving goods by road transport and rail freight for the in-scope market (i.e. the direct cost to industry), on the basis that longer semi-trailers are not introduced (the Baseline scenario).

9 Repeat steps 7 and 8 for a variety of scenarios and assumptions on take-up rates of longer semi-trailers.

10 Compare the results from each longer semi-trailer scenario with the Baseline; calculate the direct economic benefits to industry and the external benefits to society, including reductions in noise, congestion and pollution.

5.2.2 The years selected for the main forecasts are 2015, 2020 and 2025; values for intermediate years are then interpolated from these. The key assumptions and methods underpinning these 10 tasks are outlined in turn in the following Sections.

[16] This material is presented in greater detail in Deliverable D5: Economic Assessment.

5.3 DEVELOPMENT OF COST MODELS

5.3.1 The first stage in the assessment was the production of a series of cost models for existing goods vehicles and trailer/semi-trailer combinations, for various longer semi-trailer options and for domestic intermodal rail freight services. This work made use of the GB Freight Model (GBFMv5) which incorporates a series of cost models for goods vehicles and rail freight. It replicates rates in the market and explains mode choice by route. These cost models have been further developed and extended specifically for this study, to reflect operations in future years with both existing length and potential longer semi-trailers.

5.3.2 A series of cost models were developed for the most popular vehicle combinations utilised in the in-scope markets. In addition, capital costs of equipment and fuel consumption rates were sourced from industry during the evidence gathering exercise. These have been used to validate these particular model components. Fuel consumption rates have also been verified by TRL. All the individual cost elements contained in the models, and hence the outputs, are in 2009 prices.

5.3.3 All the individual cost elements contained in the models have constant real (2009) prices through to 2025, with the exception of fuel costs; fuel efficiency of HGVs; and driver wages. These change for each forecast year in line with guidance from WebTAG Unit 3.5.6.

5.3.4 In order to estimate the future costs for longer semi-trailers, the relevant cost models for existing maximum length goods vehicles in the forecast years 2015, 2020 and 2025 were amended to reflect the following (see Section 3.2 for details):

- The higher capital costs of longer semi-trailers, resulting from the additional length and steering axle technology; and
- Higher fuel consumption rates due to the additional tare weight associated with the extra length and axle technology and to extra aerodynamic drag.

5.3.5 It is assumed that all other capital and operating costs in the forecast years will be the same as for existing maximum length goods vehicles. Fuel consumption rates (on a vehicle-km rather than tonne-km basis) are around 2.8% higher, depending on the longer semi-trailer option, than for existing vehicles.

5.3.6 Given the above, the capital and operating costs of longer semi-trailers would be expected to be higher *per vehicle* than existing length articulated HGVs. However, the higher cargo capacity of the longer semi-trailers could result in them being more efficient, when measured on a *per tonne lifted*, *per pallet*, *per tonne-km* or *per pallet-km* basis. Additionally, for a given total cargo volume to be moved, the longer semi-trailers would lead to an overall reduction in the number of HGV trips and HGV kilometres, which should generate further external benefits.

5.3.7 Cost models were also required for rail freight domestic intermodal flows. The intermodal rail freight model (component of the GB Freight Model) has been further developed and extended specifically for this study, to reflect existing operating conditions and operations in future years. The model is based on a Class 66 diesel locomotive hauling a rake of Megafret intermodal platform wagons, together with the use of open access terminals.

5.3.8 Individual rail freight operating cost components have been obtained from a number of sources, including costs in the public domain. They have also been validated during the evidence gathering exercise with the rail freight industry and by cost data held by the DfT, which was used to value the current Mode Shift Benefit (MSB) grants to rail.

5.3.9 This rail cost model was reproduced for the forecast years 2015, 2020 and 2025. All the individual cost elements have constant real (2009) prices through to 2025, with the exception of fuel costs and driver wages which are derived from WebTAG. In the Baseline scenario, train productivity is also assumed to be constant through to 2025, together with the continued use of Megafret wagons and of existing size (13.6m) intermodal units.

5.4 QUANTIFYING THE CURRENT MARKET

5.4.1 The next stage in the assessment was the quantification of the *in-scope markets* identified in Section 4.3, both for road and for the domestic intermodal rail market. For road, this used the sample in the Continuing Survey of Road Goods Transport (CSRGT) database, which was expanded to the national total. This quantified for the road sector the tonnes lifted, vehicle kilometres and tonne-kilometres by vehicle and commodity type for a total of four years combined data. The mean of the four years data was used in order to reduce the impact of sampling errors when representing current road freight activity.

5.4.2 The analysis of the CSRGT shows that lighter weight palletised goods, general cargo and mail/parcels moved in existing maximum length HGVs currently comprise around 24% of the road haulage market in terms of tonnes-lifted and 39% of the market when expressed as tonne-kilometres. Rigid and drawbar combination vehicles currently carry only a very small share of this market.

5.4.3 While most bulk and semi-bulk cargoes generally are weight constrained, there are some niche flows and commodities within these sectors that are volume constrained. Most bulk and semi-bulk cargoes that are weight constrained were removed from the analysis. Also, goods moved on rigid and shorter single-axle semi-trailers were removed from the analysis since operators of such vehicles can already upgrade to larger vehicles.

5.4.4 The domestic intermodal rail freight market was identified as the key competitor sector. Therefore, the domestic intermodal rail market for 2008 was quantified using Network Rail billing data to create a record of current domestic intermodal rail freight activity showing (Baseline Output): annual tonnes lifted and annual tonne-km.

5.4.5 The results quantified the total domestic unit load traffic (i.e. road and domestic intermodal traffic combined) within each of the identified in-scope sectors and markets.

5.5 TOTAL CURRENT ANNUAL OPERATING COSTS

5.5.1 The next stage in the assessment was to estimate the total current annual operating costs of road freight activity in the in-scope sectors and markets (i.e. for those vehicle combinations and commodities which may upgrade to longer semi-trailers). The total annual cost of moving goods by domestic intermodal rail freight was also calculated. These combined figures represent the total direct cost to industry of moving goods by road transport in the identified sectors and by domestic intermodal rail freight. This produces the Baseline cost against which future options/scenarios can be compared.

5.5.2 The mean operating cost per vehicle trip (by vehicle type and commodity) was calculated, as the sum of:

- Mean trip time per vehicle trip x Fixed cost per operating hour; plus
- Mean kilometres per vehicle trip x Running cost per kilometre.

5.5.3 The resulting mean operating cost per vehicle trip (by vehicle type and commodity) was multiplied by the annual number of vehicle trips to produce the total annual operating costs for that vehicle type and commodity. The total annual operating costs on road for each vehicle type and commodity were then summed to produce the total annual operating costs in the in-scope sectors and markets.

5.5.4 Similarly, the total annual cost of moving goods by domestic intermodal rail freight was produced. The sum of both figures is the Baseline output cost for the current year.

5.6 TRAFFIC AND COST FORECASTS AND MODE CHOICE

5.6.1 The next stage in the assessment was the production of traffic forecasts for both road freight and domestic intermodal rail freight in the in-scope markets. Two forecasting tools have been utilised, namely:

- The MDS Transmodal GB Freight Model version 5 (GBFMv5); and
- The GB intermodal forecasting module.

5.6.2 The GBFMv5 is an established analysis and forecasting tool for freight traffic, which has been adopted by the DfT as part of the National Transport Model. The GB intermodal forecasting module is an add-on tool to the GBFMv5, which was utilised to produce national rail freight forecasts for the DfT in Autumn 2009.

5.6.3 The GBFMv5 was utilised to establish the growth rates (scaling factors) for total domestic traffic in 2019 for the in-scope markets (i.e. road and domestic intermodal rail combined), for both tonnes-lifted and tonne-kilometres. These scaling factors were then applied to the current total domestic in-scope traffic figures, as calculated in Section 5.4 above, to produce tonnes-lifted and tonne-kilometres figures for total in-scope traffic in 2019. Forecast years 2015, 2020 and 2025 were then interpolated / extrapolated from the 2019 forecasts.

5.6.4 The rail forecasts for this project for the domestic intermodal sector are consistent with the revised national rail freight forecasts recently produced for the DfT by MDS Transmodal. These forecasts assumed that significantly more intermodal rail traffic by 2019 would be to/from terminals with warehousing on-site (i.e. no need for expensive local road hauls).

5.6.5 At this stage of the analysis, both total domestic road traffic and domestic intermodal rail traffic for the forecast years 2015, 2020 and 2025 have been established for the in-scope market. It is assumed that the proportion of cargo conveyed in the different HGV types (including double-deck semi-trailers) will remain constant at current rates.

5.6.6 The process is undertaken on the basis that transport costs form a small proportion of the overall total cost of goods. As a result, total cargo demand is constant, with changes in modal transport costs effectively determining which mode particular freight flows utilise, e.g. as road transport becomes more expensive relative to rail, there is mode switch away from road freight to the intermodal sector, though the total amount of cargo lifted will remain constant.

5.6.7 The output, assuming longer semi-trailers are not introduced, was a forecast of domestic unit load freight activity in 2015, 2020 and 2025 in the in-scope markets and sectors (Baseline Output) analogous to that for the current year that was presented in Section 5.4 above.

5.6.8 These traffic forecasts were used to estimate the total annual operating costs of road and rail freight activity for the forecast years in the in-scope markets. The combined figure represents the forecast total direct cost to industry of moving goods in the in-scope markets. This when compared with the current year Baseline output will estimate the likely change in transport costs (to industry) over the medium/long term on the basis that longer semi-trailers are not introduced i.e. a *Baseline* or *do-nothing* scenario.

5.7 LONGER SEMI-TRAILER TAKE UP OPTIONS AND SCENARIOS

5.7.1 The next stage in the assessment was the production of traffic forecasts in the in-scope markets on the basis that longer semi-trailers are introduced. This has taken into account the following:

- The differing types of longer semi-trailers that may be introduced i.e. 14.6m or 15.65m, self-steer, active-steer etc;
- The use of existing length intermodal units on domestic intermodal flows i.e. 13.6m/45ft; and
- The potential introduction of longer intermodal units on domestic intermodal flows i.e. 14.6m or 15.6m.

5.7.2 Fourteen main *Vehicle Options*, as listed in Table 3.3 above, were modelled for a *Best Estimate* scenario as well as for further variant scenarios. These Vehicle Options and their variants can be grouped in terms of the *Regulatory Options*: (ii) comply with existing standards; (iii) match existing performance, which were described in Section 3.3 above. Table 5.1 maps the modelled options to the regulatory possibilities. The Regulatory Option: (ii) existing standards contains more than one modelled Vehicle Option as indicated by the multiple codes in columns 2 and 3.

Table 5.1: Summary of modelled Vehicle Option codes for Regulatory Options

Regulatory Option	LST Length Change		4m (Single Deck) LST Height Limited?	Complementary Longer Inter Modal Units?
	+1.00m	+2.05m		
Existing Standards	1, 2	4, 5, 6	No	No
	1S, 2S	4S, 5S, 6S	Yes	No
	8, 9	11, 12, 13	No	Yes
Existing Performance	3	7	No	No
	3S	7S	Yes	No
	10	14	No	Yes

5.7.3 Next, the analysis estimated take-up rates for longer semi-trailers i.e. to differentiate the road traffic forecasts between the goods remaining on existing length semi-trailers and those switching onto longer semi-trailers. For various reasons, a 100% take-up of longer semi-trailers in the in-scope road freight markets is unrealistic. Accordingly, the CSRGT database of vehicle movements was used to quantify the markets in which LSTs could compete, based on the following characteristics of the individual journey records:

- Length of haul – this was used as a proxy to distinguish: inter-depot trunking movements (i.e. not deliveries to retail outlets) which generally are over medium to long distances and would be well suited to use longer semi-trailers; from movements from distribution centres to retail outlets, which are generally over shorter distances and which in some instances would not gain advantages from use of longer semi-trailers due, say, to not needing extra loading capacity because of the small consignment sizes to be delivered or to manoeuvrability restrictions in small unloading bays at individual stores;
- Loads which are weight constrained i.e. reach gvw before cubic capacity, and so would be disadvantaged by the reduced payload weight provided by longer semi-trailers;
- Loads which are volume constrained i.e. reach cubic capacity before gvw; and
- Loads that are neither weight nor volume constrained.

5.7.4 A *Best Estimate* scenario has therefore been developed that applies appropriate proportions to the various in-scope journey type categories identified within the CSRGT, as summarised in Table 5.2.

Table 5.2: Summary of LST take-up input assumptions for each scenario

Scenario			**Conventional HGV-km in 2009**	**Low**	**Best Estimate**	**High**
					Distance threshold	
			%	150km	120km	100km
Category	1	Volume-constrained but not weight-constrained travelling distances greater than threshold	34.1%	50%	90%	100%
Category	2	Volume-constrained but not weight-constrained travelling distances less than threshold	8.4%	0%	45%	75%
Category	3	Not volume or weight constrained travelling distances greater than threshold	34.3%	50%	90%	100%
Category	4	Not volume or weight constrained travelling distances less than threshold	12.3%	0%	45%	75%
Category	5	Weight constrained travelling distances greater than threshold	8.9%	0%	20%	25%
Category	6	Weight constrained travelling distances less than threshold	2.0%	0%	5%	10%

5.7.5 In addition to the *Best Estimate* scenario, *High* and *Low Take-up scenarios* were also created to illustrate their change in impacts, adopting differing distance threshold and take-up percentages within relevant sub-categories of the in-scope traffic.

Further sensitivity tests were carried out to examine the influence of variations in the take-up rates of longer semi-trailers, in the transport cost elasticity of total tonne kilometres moved and in future rail costs.

5.7.6 The split between rail and road is determined by the relative costs per tonne on each mode. As rail freight's cost base changes relative to road transport, the domestic intermodal sector will gain or lose traffic accordingly.

5.7.7 The output for each vehicle Option was a *Best Estimate* forecast (and a set of forecasts for the sensitivity tests and scenarios) for 2015, 2020 and 2025. The forecasts measure freight activity levels in a form analogous to the Baseline output for the current year that was presented at the end of Section 5.4 above.

5.8 EXTERNAL COSTS

5.8.1 In addition to internal freight industry costs, changes in road and rail operations through introduction of longer semi-trailers could impose external costs or benefits on society and the environment of the types shown in Table 5.3.

5.8.2 The DfT has provided a methodology and cost values for marginal changes in both HGV-kilometres and train-kilometres, which are based on the research carried out to estimate external costs for use in Mode Shift Benefit calculations.[17]

5.8.3 The effect of congestion is an important component. Based on DfT's National Transport Model (NTM), congestion value adjustments were applied to estimate congestion externalities for each future year.

5.8.4 The net road effect is a combination of changing volumes of HGV-km and longer semi-trailer (LST)-km, and the costs attached to each. The external costs and benefits from the introduction of longer semi-trailers were calculated in a form differentiated into area and road type categories for the following components:

- The change in HGV-km for conventional vehicles (the 'average articulated lorry' vehicle type used in the Department's external cost calculations);
- The change in longer semi-trailer-km;
- The change in train-km.

5.8.5 These calculations were made for the two road vehicle types (LSTs and Conventional HGVs), together with the change in rail usage, in the case with and without the introduction of longer semi-trailers. The appropriate cost component value was applied to each change in vehicle kilometres and then the result summed across vehicle types / modes in order to calculate the external costs or benefits.

5.8.6 For each external cost component, it was necessary to determine the appropriate value for the longer semi-trailer cost where this differs from that of the representative articulated vehicle. The approach adopted adjusted the existing cost component to take account of the characteristics of the specific longer semi-trailer vehicle design under consideration. In some components, the longer semi-trailers have been forecast to impose greater external costs than their conventional HGV counterpart (such as congestion), and in some components there was no change assumed (such as noise). Table 5.3 summarises the cost component adjustments for longer semi-trailers.

[17] See http://www.dft.gov.uk/pgr/freight/railfreight/modeshiftben/

Table 5.3: Longer semi-trailer externalities adjustment factors compared to conventional HGV

External Cost Component		Factor for +1.0m LST	Factor for +2.05m LST	Rationale
1	Congestion	1.020	1.041	Contribution to congestion increases in proportion to one-third of additional length above standard 16.5m articulated HGV.
2	Accidents	1.000	1.000	No significant difference estimated by TRL
3	Noise	1.000	1.000	No difference assumed
4	Local Air Pollution	Approx. 1.016, varies between Options	Approx. 1.036, varies between Options	Increase in emissions in proportion to increased fuel consumption (TRL research showed small increase owing to additional unladen weight and aerodynamic drag).
5	Climate Change	Approx. 1.016, varies between Options	Approx. 1.036, varies between Options	Increase in emissions in proportion to increased fuel consumption (TRL research showed small increase owing to additional unladen weight and aerodynamic drag).
6	Infrastructure	1.000	1.000	No difference assumed as gvw not changed.

5.8.7 There is no available body of empirical evidence on the impacts on congestion of the length increase of the longer semi-trailers. Various strands of analysis when combined, suggested that under reasonably congested conditions most of the driving time would be in circumstances in which the difference in impacts would be relatively small. Accordingly, an estimate of an increased impact of one-third the percentage increase in total vehicle length seems appropriate. Sensitivity analysis on these factors was also conducted.

6 Economic Assessment Results

6.1 INTRODUCTION

6.1.1 This Chapter summarises the forecasts of the economic impacts of the introduction of longer semi-trailers, taking into account both direct cost savings to industry and external costs and benefits to society and the environment. These benefit estimates are based on the forecasting methods and the evidence that have been explained in Chapter 5. Other non-economic impacts are reviewed later in Chapter 7.

6.1.2 Section 6.2 presents forecast traffic results for the *Best Estimate* and other scenarios. Section 6.3 presents the costs and benefits associated with these scenarios and then summarises the results from sensitivity tests and alternative scenarios[18] that are used to confirm the robustness of the main findings.

6.2 TRAFFIC FORECASTS TO 2025 FOR SCENARIOS

6.2.1 Table 6.1 presents a summary of the traffic forecast results to 2025 for the Baseline without longer semi-trailers and for the *Best Estimate* scenario for longer semi-trailer Options 1 to 7. This scenario reflects the use of existing length (13.6m/45ft) intermodal units on domestic intermodal flows.

Table 6.1: *Best Estimate* summary traffic forecasts by mode– Options 1-7

Option	***Domestic Intermodal Rail***	**000s tonnes**				**+/- v Baseline**		
		2009	2015	2020	2025	2015	2020	2025
	Baseline	1,955	6,586	10,444	14,303			
1	14.6m Fixed Axles		4,636	6,871	9,105	-1,949	-3,574	-5,198
2	14.6m Single Self-steer Axle		4,636	6,871	9,105	-1,949	-3,574	-5,198
3	14.6m Active Steering		4,636	6,871	9,105	-1,949	-3,574	-5,198
4	15.65m 2 x Self-steer Axles		3,139	4,126	5,113	-3,447	-6,319	-9,191
5	15.65m 1 x Command-steer Axle		3,139	4,126	5,113	-3,447	-6,319	-9,191
6	15.65m 2 x Command-steer Axles		3,139	4,126	5,113	-3,447	-6,319	-9,191
7	15.65m Active Steering		3,139	4,126	5,113	-3,447	-6,319	-9,191

Option	***Road Haulage***	**000s tonnes**				**+/- v Baseline**		
		2009	2015	2020	2025	2015	2020	2025
	Baseline	430,834	438,361	444,633	450,906			
1	14.6m Fixed Axles		440,310	448,207	456,104	1,949	3,574	5,198
2	14.6m Single Self-steer Axle		440,310	448,207	456,104	1,949	3,574	5,198
3	14.6m Active Steering		440,310	448,207	456,104	1,949	3,574	5,198
4	15.65m 2 x Self-steer Axles		441,808	450,952	460,096	3,447	6,319	9,191
5	15.65m 1 x Command-steer Axle		441,808	450,952	460,096	3,447	6,319	9,191
6	15.65m 2 x Command-steer Axles		441,808	450,952	460,096	3,447	6,319	9,191
7	15.65m Active Steering		441,808	450,952	460,096	3,447	6,319	9,191

	Total Domestic Unit Load	**000s tonnes**				**+/- v Baseline**		
		2009	2015	2020	2025	2015	2020	2025
	All modes	**432,789**	**444,947**	**455,078**	**465,209**	**0**	**0**	**0**

6.2.2 Under the Baseline, domestic intermodal rail freight is forecast to grow very rapidly to around 14.3 million tonnes-lifted by 2025 (from 2.0 million tonnes in 2009), with

[18] A more comprehensive listing of the forecast results is provided in the set of tables in Deliverable D5: Economic Assessment, Technical Annex.

road freight increasing from 431 million tonnes-lifted (in 2009) to 451 million tonnes lifted by 2025. This large growth in domestic intermodal rail freight forecast under the Baseline is primarily due to the assumed development of distribution centre floorspace on rail-linked sites. This reduces the rail to road transfer costs, and the consequent network effect from joining up these developments results in rail freight gaining additional traffic (at the expense of the road haulage market), particularly over medium-distance flows.

6.2.3 The introduction of longer semi-trailers in the road haulage sector but with domestic intermodal continuing to use existing length units, results in a switch from rail to road freight transport. For 15.65m semi-trailers (Options 4 to 7 in Table 6.1), domestic intermodal rail freight would be around 9.2 million tonnes-lifted lower (-64%) by 2025 compared with the Baseline.

6.2.4 Under these future operating conditions in the *Best Estimate* scenario, the road haulage market would gain efficiency savings associated with the greater payload capacity offered by the introduction of longer semi-trailers, but the rail freight sector would not benefit. As a result, the road haulage sector is able to capture freight traffic that otherwise would have been handled by domestic intermodal.

6.2.5 Table 6.2 summarises the traffic forecasts for an alternative longer semi-trailer scenario, which reflects the widespread adoption of *longer intermodal units* (15.6m/51ft) on domestic intermodal flows. These results use the other assumptions from the *Best Estimate scenario* discussed above.

Table 6.2: *Longer intermodal units* summary traffic forecasts – Options 8-14

	Domestic Intermodal Rail	**000s tonnes**				**+/- v Baseline**		
Option		2009	2015	2020	2025	2015	2020	2025
	Baseline	1,955	6,586	10,444	14,303			
8	14.6m Fixed Axles		6,942	11,097	15,253	356	653	949
9	14.6m Single Self-steer Axle		6,942	11,097	15,253	356	653	949
10	14.6m Active Steering		6,942	11,097	15,253	356	653	949
11	15.65m 2 x Self-steer Axles		6,974	11,156	15,338	388	711	1,035
12	15.65m 1 x Command-steer Axle		6,974	11,156	15,338	388	711	1,035
13	15.65m 2 x Command-steer Axles		6,974	11,156	15,338	388	711	1,035
14	15.65m Active Steering		6,974	11,156	15,338	388	711	1,035

	Road Haulage	**000s tonnes**				**+/- v Baseline**		
Option		2009	2015	2020	2025	2015	2020	2025
	Baseline	430,834	438,361	444,633	450,906			
8	14.6m Fixed Axles		438,005	443,981	449,956	-356	-653	-949
9	14.6m Single Self-steer Axle		438,005	443,981	449,956	-356	-653	-949
10	14.6m Active Steering		438,005	443,981	449,956	-356	-653	-949
11	15.65m 2 x Self-steer Axles		437,973	443,922	449,871	-388	-711	-1,035
12	15.65m 1 x Command-steer Axle		437,973	443,922	449,871	-388	-711	-1,035
13	15.65m 2 x Command-steer Axles		437,973	443,922	449,871	-388	-711	-1,035
14	15.65m Active Steering		437,973	443,922	449,871	-388	-711	-1,035

Total Domestic Unit Load	**000s tonnes**				**+/- v Baseline**		
	2009	2015	2020	2025	2015	2020	2025
All modes	**432,789**	**444,947**	**455,078**	**465,209**	**0**	**0**	**0**

6.2.6 Using the greater payload capacity of longer intermodal units, the domestic intermodal sector is able to secure a slightly higher level of efficiency benefits than the road transport market. As a result, rail is able to win some further traffic compared with the Baseline. Table 6.2 shows that the adoption of longer intermodal units, would result in a switch to domestic intermodal rail freight compared with the Baseline. For the 15.65m semi-trailer length options, rail is forecast to gain an additional 1.0 million tonnes-lifted (+7%) by 2025, over and above the large increase in the rail market shown in the Baseline between 2009 and 2025.

6.2.7 The *Best Estimate* scenario can be viewed as a worst case growth scenario for the rail industry. The alternative scenario in which the rail industry capitalises on the opportunity to use longer intermodal units in order to generate efficiency savings on rail similar to those achieved on road can be viewed as a best case for domestic intermodal.

6.2.8 A longer semi-trailer may need to be height restricted in order to comply with other regulations or with the actual performance of existing maximum-length semi-trailers e.g. a longer double-deck semi-trailer may be less stable in high crosswinds. On that basis, a *Single Deck* scenario[19] was undertaken, where longer semi-trailers were restricted to single-deck equipment only (4.0m overall height, in-line with EU free circulation rules).

6.2.9 The position of rail is further enhanced in this *Single Deck* scenario when combined with the widespread adoption of longer intermodal units. For the 15.65m semi-trailer length options, rail is forecast to gain an additional 7.5 million tonnes-lifted by 2025 compared with the Baseline (21.8 million rail tonnes-lifted in total by 2025). Correspondingly, road freight activity is forecast to be around 2.0 billion tonne-km lower by 2025. Preventing the use of double deck longer semi-trailers allows rail freight to gain competitive advantage (associated with its greater payload capacity) compared with the road transport market. This encourages modal shift to rail.

6.3 COSTS AND BENEFITS TO 2025 FOR SCENARIOS

6.3.1 Table 6.3 shows the estimated average annual benefits over the period 2011 to 2025 likely to accrue to industry (direct cost savings net of indirect tax) for each Vehicle Option in each scenario compared to the Base Case without longer semi-trailers. The *High* and *Low* scenarios represent sensitivity test variants on the *Best Estimate*, which have higher and lower rates of take-up of longer semi-trailers, respectively.

6.3.2 The 15.65m semi-trailer with single command-steer axle (Options 5 and 12) produces the greatest direct benefits to industry in each scenario, though it is only marginally better than two self-steer axle (Options 4 and 11). This is due to a combination of the following factors:

- The additional 2.05m generates larger efficiency savings compared with the +1.0m options; and
- The lower capital costs of the single command-steer technology compared with the other steering axle solutions.

[19] This scenario assumed that no longer semi-trailer could be double deck. In reality, there is not necessarily a one-to-one relation between vehicle height and number of decks. Some companies with low density, stackable products operate 4.9m high single deck semi-trailers. Some in the UK and particularly in Europe operate 4m high double deck semi-trailers.

Table 6.3: Average Annual direct industry benefits 2011 to 2025 (net of indirect taxation) for *Best Estimate, High, Low* and *Single deck* scenarios

		£ Millions Average annual **direct benefits 2011-2025 (net of indirect tax))**			
	Option	**Best Estimate**	**High**	**Low**	**Single deck**
1	14.6m Fixed Axles	£45	£69	-£8	£49
2	14.6m Single Self-steer Axle	£142	£188	£31	£142
3	14.6m Active Steering	£105	£140	£19	£106
4	15.65m 2 x Self-steer Axles	£317	£415	£75	£314
5	15.65m 1 x Command-steer Axle	£321	£420	£76	£318
6	15.65m 2 x Command-steer Axles	£296	£388	£69	£295
7	15.65m Active Steering	£268	£355	£57	£266
8	14.6m Fixed Axles	£97			
9	14.6m Single Self-steer Axle	£192			
10	14.6m Active Steering	£155			
11	15.65m 2 x Self-steer Axles	£402			
12	15.65m 1 x Command-steer Axle	£406			
13	15.65m 2 x Command-steer Axles	£382			
14	15.65m Active Steering	£356			

6.3.3 The results in Table 6.3 indicate that industry is likely to achieve significant direct financial benefits following the introduction of longer semi-trailers. This will particularly be the case should the rail freight sector also take advantage of the greater payload capacity offered by longer intermodal units. For option 12 (15.65m semi-trailers and longer intermodal units), the *Best Estimate* scenario forecasts that the direct industry benefits would be £406m per annum higher on average over the period 2011-2025.

6.3.4 The scenario with the restriction to *Single Deck* for longer semi-trailers significantly increases rail mode share and leads in Table 6.3 to a minimal increase in overall internal industry costs compared to the *Best Estimate* scenario. This appears to be counter-intuitive; it is natural to assume that a restriction should *decrease* industry costs. The economic benefit results have been calculated using the *road and rail cost models* developed for the project. These are intended to replicate market rates incurred by the logistics industry i.e. pure financial cost. The traffic forecasts and modal split analysis use g*eneralised costs*, which account for the quality of service and flexibility characteristics of a particular mode in addition to the actual transport operating costs. For a number of movements road is more expensive than rail in pure *financial* terms but was the chosen mode because its *generalised costs* were lower i.e. quality of service and flexibility characteristics encouraged the use of road even though the financial (operating) costs were higher.

6.3.5 However, assessing direct economic benefits for industry is only part of the equation and the wider external cost impacts also need to be assessed and quantified. For each Option 1 to 7 for the *Best Estimate* scenario, Figure 6.1 presents the change from the Baseline in the present value of each external cost component. For Options 2 to 7 all individual external cost components improve as a result of the introduction of longer semi-trailers, mainly due to the reduction in the number of vehicle kilometres required to carry the required goods. In contrast due to its 40t GVW limit, Option 1 does not reduce HGV kilometres and so leads to increases in road congestion and road emissions,

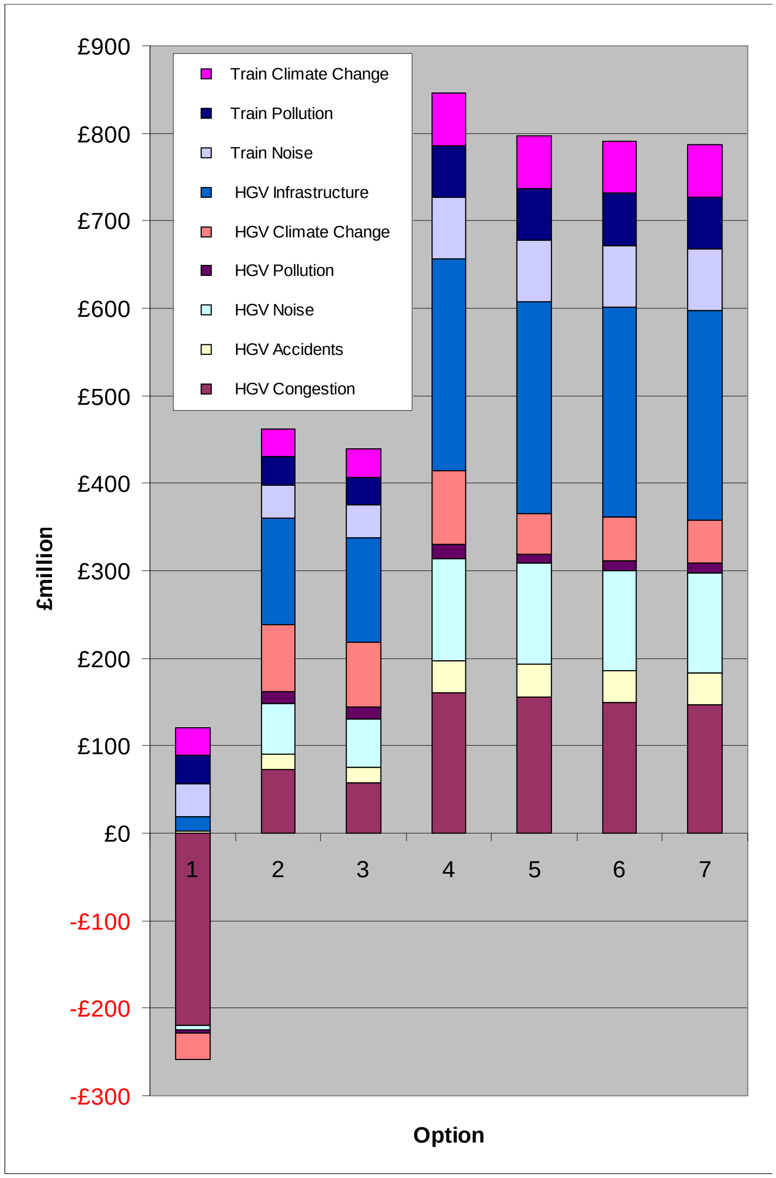

Figure 6.1: Summary of change in external cost components (present value 2011-2025, £m), *Best Estimate* compared to Baseline

6.3.6 The average annual total external benefit is summarised in Table 6.4 for the *Best Estimate* and the alternative scenarios. For Options 1-7 for the *Low* scenario and Option 1 for the *Best Estimate* and *High* scenarios, there are external disbenefits, all other cases produce benefits. In particular, the Options 8-14, which assume widespread use of longer intermodal units, greatly increase the external benefits in the *Best Estimate* scenario.

Table 6.4: Average Annual external benefits 2011 to 2025 for *Best Estimate, High, Low* and *Single deck* scenarios

		£ Millions Average annual **external benefits 2011-2025 (net of indirect tax)**			
	Option	**Best Estimate**	**High**	**Low**	**Single deck**
1	14.6m Fixed Axles	-£15	-£6	-£41	£2
2	14.6m Single Self-steer Axle	£39	£58	-£17	£54
3	14.6m Active Steering	£37	£56	-£17	£52
4	15.65m 2 x Self-steer Axles	£72	£107	-£30	£100
5	15.65m 1 x Command-steer Axle	£67	£102	-£32	£95
6	15.65m 2 x Command-steer Axles	£67	£101	-£32	£95
7	15.65m Active Steering	£67	£101	-£32	£95
8	14.6m Fixed Axles	£55			
9	14.6m Single Self-steer Axle	£109			
10	14.6m Active Steering	£106			
11	15.65m 2 x Self-steer Axles	£189			
12	15.65m 1 x Command-steer Axle	£185			
13	15.65m 2 x Command-steer Axles	£184			
14	15.65m Active Steering	£184			

6.3.7 Table 6.5 combines the direct industry benefits (net of indirect tax) with the external cost components of Table 6.4. It shows for each Option the average annual total economic and environmental benefits to industry plus wider society.

Table 6.5: Average Annual total economic benefits 2011 to 2025 (net of indirect taxation) for *Best Estimate, High, Low* and *Single deck* scenarios

		£ Millions Average annual **total economic benefits 2011-2025 (net of indirect tax)**			
	Option	**Best Estimate**	**High**	**Low**	**Single deck**
1	14.6m Fixed Axles	£45	£69	-£50	£50
2	14.6m Single Self-steer Axle	£181	£246	£14	£196
3	14.6m Active Steering	£142	£195	£3	£158
4	15.65m 2 x Self-steer Axles	£389	£522	£44	£414
5	15.65m 1 x Command-steer Axle	£388	£522	£44	£414
6	15.65m 2 x Command-steer Axles	£363	£489	£37	£390
7	15.65m Active Steering	£335	£456	£25	£361
8	14.6m Fixed Axles	£152			
9	14.6m Single Self-steer Axle	£301			
10	14.6m Active Steering	£262			
11	15.65m 2 x Self-steer Axles	£591			
12	15.65m 1 x Command-steer Axle	£591			
13	15.65m 2 x Command-steer Axles	£566			
14	15.65m Active Steering	£539			

6.3.8 Most of the options for most scenarios yield overall economic and environmental benefits but Option 1 for the *Low* scenario produces an overall negative economic impact. The Options 4 and 5 (plus 11 and 12) produce the highest overall economic benefits for each scenario.

TESTING THE ROBUSTNESS OF THE ANALYTICAL FINDINGS

6.3.9 Sensitivity tests have been carried out to confirm that in cases where there was uncertainty on the appropriate value for an input assumption, the overall conclusions that are drawn from this study do not change greatly in response to variations in this input value.

6.3.10 Sensitivity tests of variations to the congestion cost element of the externalities for the *Best Estimate* scenario do not substantially change the above results for overall economic benefits. The results from a series of other sensitivity tests are also reported in Deliverable 5, Economic Assessment: Technical Annex. Overall, these sensitivity tests provide solid support for the main conclusions that have been drawn.

6.3.11 An alternative test of robustness was to revisit the cost benefit analysis model used in the previous LHV study by TRL and Heriot-Watt University (2008). That model was designed very differently to the freight model and cost benefit analysis approach used in the current study. Furthermore, it was intended for slightly different applications. The inputs derived elsewhere in this study required much adaptation to fit the old model, which limited the scope of the analysis and the validity of comparisons.

6.3.12 However, in the small set of scenarios that were possible to analyse,[20] it was shown that the old model provided generally comparable answers to the new analysis. It therefore supports the findings of the new analysis and confirms that changes from the results of the previous study are the result of the different input values derived for key factors such as take-up rate and mode shift and not the result of the different analytical methods used.

6.4 SUMMARY OF FINDINGS FROM ECONOMIC ASSESSMENT

6.4.1 The main conclusions drawn from this economic analysis are as follows:

6.4.2 There would be higher capital costs for longer semi-trailers. For a 15.65m semi-trailer and taking into account the various axle steering systems, the capital costs are around £6,000-£7,000 higher compared with an existing 14.6m tri-axle semi-trailer.

6.4.3 The higher capital costs and additional length (drag) and tare weight of the longer semi-trailers do marginally increase vehicle operating costs. For a standard tractor unit and 15.65m semi-trailer, the fixed operating costs are around £0.40-£0.60 higher per operating hour (depending on steering axle system), while running costs are approximately 2.5% higher.

6.4.4 However, the most important figure to consider is the consequent cost per pallet-kilometre, which is the measure of the vehicle's overall efficiency when fully laden. Due to the longer load-platform capacity, in terms of pallet-kilometre costs, a 15.65m semi-trailer vehicle is around 12% more efficient when fully laden. Similarly, a 14.6m semi-trailer is around 7% more efficient.

6.4.5 The introduction of longer semi-trailers in the road haulage sector (but with domestic intermodal continuing to use existing length intermodal units), would result in a

[20] This material is presented in greater detail in Deliverables D9: Comparing the Results of Cost Benefit Analysis for the Longer Semi-Trailer Project and the Previous LHV Project.

switch to road freight transport. For 15.65m semi-trailers, domestic intermodal rail freight would reduce by around 9.2 million tonnes-lifted, compared with the Baseline. The road haulage market would gain efficiency savings associated with the greater payload capacity offered by the introduction of longer semi-trailers, but the rail freight sector would not benefit. As a result, the road haulage sector would be able to win traffic that otherwise would have used domestic intermodal.

6.4.6 However, the widespread adoption of longer intermodal units would result in a marginal switch to domestic intermodal rail freight compared with the Baseline. For the 15.65m option, rail is forecast to gain an additional 1.0 million tonnes-lifted by 2025 due to its greater payload capacity per train. Assuming the widespread adoption of longer intermodal units, at worst the impact of longer semi-trailers would be neutral on the domestic intermodal sector, while there may actually be some benefits to rail.

6.4.7 Industry is likely to achieve significant direct financial benefits following the introduction of longer semi-trailers. This would particularly be the case should the rail freight sector also take advantage of the greater payload capacity offered by longer intermodal units. For options with 15.65m semi-trailers and longer intermodal units, the *Best Estimate* scenario forecasts that industry would achieve around £5 billion of direct benefits NPV over the years 2011 to 2025. These would be augmented by around a further £1.5 billion NPV of external / environmental benefits to society.

7 Assessment of Other Impacts

7.1 INTRODUCTION

7.1.1 Any proposal that imposes or reduces costs on businesses requires an Impact Assessment (IA). The IA sets out the options for assessment and includes a Summary: Analysis and Evidence table for each option considered as compared to the Baseline[21].

7.1.2 The IA presents an evidence base drawing on the technical material prepared for the study and in support of the summary for each option under consideration. Much of this evidence is based on the traffic and economic forecasts covering the direct industry costs and the external costs for each of the vehicle Options. These have already been summarised in Chapter 6.

7.1.3 The IA also includes the results of the Specific Impact Tests conducted for the study and it is the more significant of these that are reviewed in this Chapter.

7.2 SPECIFIC IMPACT TESTS

7.2.1 Twelve Specific Impact Tests listed in Table 7.1 were screened for this study. For those tests that are relevant to the introduction of longer semi-trailers, the Table identifies the manner in which that impact was assessed.

Table 7.1: Specific Impact Tests of the Impact Assessment

	Type of testing undertaken	Results in Evidence Base	Representation of Impacts
1	Competition Assessment	Yes	See Section 7.2 below
2	Small Firms Impact Test	Yes	See Section 7.3 below
3	Legal Aid	No	n/a
4	Sustainable development	Yes	Reductions in the number of vehicles and vehicle-km improve sustainability, but this has not been quantified or monetised
5	Carbon Assessment	Yes	The annual cost (saving) of climate change is explicitly included in the external cost estimates - also see Section 7.5 below
6	Other Environment	Yes	The annual cost (saving) for local air pollution is explicitly included in the external cost estimates
7	Health Impact Assessment	Yes	The annual cost (saving) for road accidents is explicitly included in the external cost estimates
8	Race Equality	Yes	No impacts are expected
9	Disability Equality	Yes	No impacts are expected
10	Gender Equality	Yes	No impacts are expected
11	Human Rights	No	n/a
12	Rural Proofing	No	n/a

7.3 COMPETITION ASSESSMENT

7.3.1 The purpose of the competition assessment is to identify whether the impact of a proposal is pro- or anti- competitive in relation to affected markets, and to assess whether this impact on competition is significant. There are four filter questions, and the answers are listed below with a summary of the explanatory material.

7.3.2 Would the regulatory proposal:

[21] This material is presented in greater detail in Deliverable D7: Impact Assessment of Longer Semi-Trailers

- **Directly limit the number or range of suppliers**? Not significantly.
- **Indirectly limit the number or range of suppliers**? YES. It is possible that rates charged by hauliers may not increase in line with the increased quantity of freight they carry per trip. This view was voiced by some hauliers, notably smaller firms, but it was not possible to quantify or monetise this possible impact. In general, policies raising the costs of entry will act as a deterrent and thereby have a detrimental impact on potential competition and efficiency, though in this case the impact is unlikely to be large.
- **Limit the ability of suppliers to compete**? YES. As above. However, by permitting a wider range of possible services and niches, i.e. by operating a range of vehicle types best suited to the task in hand, the ability to compete may increase. However, the general view from the evidence gathering, particularly for small firms, was that the change in the de facto standard vehicle might cause some inefficiency by deployment of unnecessarily long vehicles for some tasks. This could indirectly limit the ability of those smaller suppliers to compete with the flexibility within the larger fleets of the bigger firms and with the prices charged.
- **Reduce suppliers' incentives to compete vigorously**? Not significantly.

7.4 SMALL FIRMS IMPACT TEST

7.4.1 The structure of sector and businesses likely to be affected is an important consideration in the Impact Assessment.

7.4.2 The principal sector affected by the proposal is the road haulage sector. If fleet size serves as a proxy for firm size, 97% of operators have fewer than 20 goods vehicles and 94% have fewer than 10 goods vehicles, so most businesses in the road haulage are small businesses. Therefore, it is expected that the impacts of this regulation will fall disproportionately on smaller firms.

7.4.3 Feedback from industry suggests that there is a significant likelihood that these firms will feel competitive and client pressures to adopt LSTs. In general, the representative firms that were contacted believed that the proposal would have important implications for their business. The firms work in a highly competitive environment and are generally 'price takers'. There was also a feeling that the customers are unlikely to reward operators with higher rates in return for higher productivity (the same rate per load will apply regardless of the additional volume carried).

7.4.4 Whereas large firms with large fleets can retain specialist equipment, the small operators will need an all-purpose workhorse vehicle. There was a strong belief that the longer semi-trailer would become the *de facto* standard vehicle and would be demanded by customers. Therefore, the additional costs of switching to a longer semi-trailer will be imposed on small firms, which will have to make the greatest changes with regard to their operations and will bear the greatest impact. However, this is common in all industries where small firms are less able to take advantages of economies of scale.

7.4.5 The issue of the premature write-off of existing trailer capacity has wider implications for the study – beyond its impact on the intermodal market. Competitive pressures to upgrade to the new LST trailers may force hauliers to dump perfectly good trailers well before their normal 'retirement' age. Finding the money to invest in the new trailers will be difficult for many hauliers (particularly given current trading conditions), and may put additional strain on already fragile balance sheets. The shippers may then obtain most of the benefit whereas the financial position of the haulage industry may worsen. The second-hand market in the 13.6m trailers will also be over-supplied, driving down prices and reducing the capital required for new entrants into the haulage industry. Environmental concerns might be raised about the replacement of good kit with newly manufactured units if the longer semi-trailer is to become the new workhorse of the industry.

7.4.6 There does not seem to be a viable means of allowing exemptions for small firms from this regulation, since the adoption of LSTs would be entirely voluntary and existing vehicle types would remain in use.

7.5 CARBON ASSESSMENT

7.5.1 The carbon impact of the potential regulation change to increase the permitted length of semi-trailers is presented in Table 7.2, which shows the change relative to the Baseline in annual average 2011-2025 and total 2011-2025 CO_2 equivalent tonnes for each Option for the *Best Estimate* scenario.

7.5.2 The increase in emissions for vehicle Option 1 arises because it has a 40t GVW limit. The other vehicle Options all lead to reductions in carbon emissions, through the reduction in the number of vehicles needed to carry the volume of freight.

Table 7.2: *Best Estimate* scenario: change in CO_2 equivalent emissions (tonnes) compared to Baseline

Option	Annual Average 2011-2025	Total 2011-2025
1	58,670	880,048
2	-115,699	-1,735,478
3	-112,458	-1,686,871
4	-163,271	-2,449,069
5	-97,277	-1,459,155
6	-103,634	-1,554,512
7	-100,436	-1,506,533

8 Conclusions

FINDINGS FROM LONGER SEMI-TRAILERS ANALYSIS

8.1.1 It is clear from the analysis above that **introducing longer semi-trailers has the potential to generate substantial industry benefits and external/ environmental benefits**. However, the level of these benefits and the impacts on various sectors of industry and society are influenced by the exact characteristics of the vehicles that would be permitted and by any complementary measures that might be considered to mitigate unintended consequences.

8.1.2 In general, the benefits from permitting the full 15.65m semi-trailers are substantially greater than those for the shorter 14.6m alternative. Accordingly, there does not appear to be a strong case for restricting to the 1m extension instead of adopting the full 2.05m length increase, though in practice users may of course adopt intermediate lengths to cater for specific niche markets. **The full 2.05m semi-trailer length increase appears most beneficial**.

8.1.3 An identical ranking of benefits across the set of all seven vehicle options arises in most scenarios and sensitivity tests. The ranking of direct industry benefits by vehicle option tends to be broadly similar to that of external benefits, so that **there is not a major conflict across options between internal industry and external cost savings.**

8.1.4 **Within the set of 15.65m trailer options, the 2 self-steer axle, Option 4, produces the highest overall economic benefits** in NPV, though there is little difference in NPV from the single command-steer axle, Option 5. The performance of both of these options would **comply with all existing vehicle regulations (Regulatory possibility ii).** Their high-speed performance assumes that like all existing systems the steer axles are locked at speed. New regulation may be required to enforce this condition.

8.1.5 The above two vehicle options generate tail swing in the legislative turning manoeuvres that is greater than that for current vehicles. However, this could be limited by introducing a specific test for an articulated combination with an appropriate tail swing limit (either 0.6 for a drive in test, comparable to buses, or 0.8 in a steady state test comparable to rigid trucks) and to prescribe the test speed. Also, the analyses suggest that there are no vehicle options where the performance is reduced in all metrics at the same time – there is a trade-off such that the measures that are adversely affected are always accompanied by other measures where there is an improvement. This means that overall there can be net performance improvements relative to existing vehicles. Any increase in the casualty risk per vehicle km would be likely to be so small as to be immeasurable in casualty data after implementation. Introducing a limit that reduced the height of the tallest vehicles to around 4.6m would be one potential means to eliminate this increase in risk.

8.1.6 **If it is further required that longer vehicles should match or exceed the actual performance of existing vehicles (Regulatory possibility iii), the active steering axle option 7 is the only full-length candidate.** Due to its higher tare-weight and cost, it has a lower NPV than the other full-length options (around 10-15% below that of Option 4, depending on the scenario or sensitivity test). It would be likely to result in a small reduction in the casualty risk per vehicle km but again this is likely to be so small as to be immeasurable.

8.1.7 The *Best Estimate* scenario has assumed that mode switch would apply to all in-scope traffic. An alternative regulatory possibility is that length increases would be restricted to single-deck (assumed 4 metre high) trailers. This would leave the competition between double-deck semi-trailers and rail unchanged from the Baseline, so it would reduce the level of switch particularly for longer distance hauls. This height restriction would also provide some small improvements in accident rates. **The LST single-deck only scenario yields similar net benefits for industry but greater benefits for the environment than the *Best Estimate* scenario.** This is because the forecast loss of rail share to LSTs is significantly reduced in all future years, compared to the *Best Estimate* scenario.

8.1.8 In the *Best Estimate* forecast scenario the introduction of longer vehicles leads to a major diversion of the growth in domestic intermodal traffic from rail to road, though nevertheless this rail traffic market would still grow strongly over time. This scenario is based on the assumption that the rail industry continues to use existing length intermodal units rather than purchasing longer units that would cater more cost-effectively for the growth in domestic intermodal traffic. In all tests for all future years, **Scenarios that assume the widespread adoption by rail of longer intermodal units generate much larger benefits than the *Best Estimate* scenario.** Such scenarios indicate that at worst the impact of longer semi-trailers would be neutral on the domestic intermodal sector, and the widespread adoption of longer intermodal units might actually generate some marginal benefits to the rail industry. There are improved benefits both to industry and to the environment. However, some uncertainty remains about whether there are significant operational or cost issues that might prevent the rail industry from making maximum use of longer intermodal units.

8.1.9 This *longer intermodal unit* scenario effectively estimates an upper bound for the benefits to rail from the introduction of LSTs, whereas the *Best Estimate* scenario provides a corresponding lower bound to the rail industry from their introduction. The widespread adoption of longer intermodal units would amplify substantially the added benefits to the economy overall, as well as to the environment and to the rail industry in particular, from introducing LSTs. It highlights the importance of encouraging their usage in tandem with the introduction of LSTs.

8.1.10 The overall impacts on competition from the introduction of LSTs are expected to be minor, with potentially some small negative impacts in the short term as fleets adjust.

8.1.11 Despite the significant benefits to the freight industry overall, the evidence suggested that **smaller haulage firms might lose out from the introduction of longer semi-trailers**. They may gain no benefits in rates charged to clients but may incur extra capital costs due to being forced by large clients to switch promptly to purchase LSTs, leading to premature write-off of their existing trailer capacity.

8.1.12 **All the LST options, except the 40 tonne GVW, Option 1, are forecast to lead to overall reductions in CO2 emissions in all years**, relative to those for the corresponding scenario without LSTs.

FINDINGS FROM SAFER AERODYNAMIC FRONTS ANALYSIS

8.1.13 The vehicle design possibilities considered in the main part of this study assumed that regulations on the design of the vehicle cab would remain unchanged. However, it would be possible with changed regulations to improve safety and other performance characteristics through re-designing the frontal shape of vehicles in a way that could reduce both fuel consumption and the number of accident casualties

8.1.14 In general, the analyses of introducing such an integrated frontal design for trucks have shown that the biggest casualty savings are for pedestrians, with safety performance improving strongly up to a nosecone length increase of 1m and with little further benefit thereafter.

8.1.15 The aerodynamic effects were found to be relatively small (in the region of 3% to 6%). The benefits are dependent both on the design of the nosecone and on the extent to which the tractor and trailer aerodynamics are optimised as a combination to improve the aerodynamic drag, so reducing fuel consumption and emissions. However, this would be expected to require additional aerodynamic aids on the trailer, and hence extra unladen mass, further reducing payload and generating some additional HGV traffic.

8.1.16 Trade-offs between improved nosecone safety plus aerodynamics versus increased mass and reduced manoeuvrability suggest that an increase in nosecone length of around 0.5m appears most beneficial overall but more detailed analyses could refine these results. This would be expected to reduce fatalities by about 9 per year at the same time as reducing fuel consumption and emissions per vehicle km. If appropriately shaped this would be unlikely to cause significant manoeuvrability difficulties. However, unladen mass and, thus, HGV traffic would be increased further. The net benefit, excluding congestion costs, is expected to be around £30.5million per year.

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