Transport for London

INVESTIGATING THE CONSTRUCTION INDUSTRY'S USE OF HGV TYPES

Final Report

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Transport for **London**

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EXECUTIVE SUMMARY

This study was initiated to look into the potential for using heavy goods vehicles (HGVs) with a higher payload to carry bulk construction materials in London, with a view to reducing overall HGV volumes. The study undertook desktop research and consultation to look at the barriers to the use of larger vehicles. Several recommendations have been made which have the potential to reduce the number of construction vehicles on London's roads.

OBJECTIVES

The overall objective was to conduct a technical comparison into the use of rigid versus articulated HGV combinations, within the construction industry - including the reasons for use of each type, barriers to entry and a commercial, environmental and safety benefit analysis.

The specific objectives of the project included:

- Undertake technical research on a range of construction vehicle operators within London and Europe to understand the reasons for using specific HGV types.
- Quantify and compare the commercial, environmental, operational and safety benefit/s of each variant
- Outline who receives the commercial gain from any improved efficiency
- Investigate any infrastructure, construction or disposal site barriers to use either of the HGV types specified
- Identify and case study any innovations which have addressed previous limitations/concerns on vehicle choice i.e. sliding floors
- Identify and case study operators using articulated HGVs in comparison with an articulated variant
- Engage with industry and trade associations.

SUMMARY OF FINDINGS

The review confirmed that the rigid vehicles dominate bulk construction movements in London. This was true for both tippers and mixers. While the industry and its decision making processes are complex, the reason for the dominance of rigid vehicles can be summarised as industry concerns about safety and access within sites.

Site Safety

Regarding safety, the concern is that tippers can and do tip over while unloading. The data on the incidence of tip overs, particularly the relative incidence between rigid and articulated tippers, is poor. While incidents undoubtedly happen it seems that they are rare, and almost always avoidable.

Some operators are content to use articulated tippers and ensure safety by checking construction sites, applying best practice for safe unloading, and training drivers appropriately. Others use articulated vehicles with safety adaptations or precautions ranging from non-stick liners to moving floors and tipping frames. TfL's construction safety initiative, CLOCS, is setting standards for construction sites so that conditions can be assessed and improved for safe movement on site.

Access

Articulated vehicles routinely access almost all construction sites carrying products such as windows or structural beams.

Within sites, while articulated and rigid tippers have similar turning circles, it is true that articulated vehicles need slightly more space to unload and cannot climb the steepest gradients in poor conditions. In most cases, minor site adjustments can make sites accessible for both rigids and articulated HGVs.

Demolition Material and Excavated Spoil

These products present particular challenges. Some materials are “sticky” and so difficult to tip. Sites at both ends of the journey frequently have very poor conditions with unmade roads.

Ready Mixed Concrete

Articulated mixers are particularly rare in London. Interviewees informed the study that batching plants in the city are often small and hard to access. Rigid mixers are well suited to the scale of most orders. However, there is evidence that articulated mixers are a cost effective and efficient solution for big pours, and there are signs of industry acceptance of articulated mixers in this role.

Benefits of Using Larger Vehicles

The benefits to the construction industry are clear: potentially a 30% reduction in the cost per tonne for transport when using standard articulated tippers compared to standard rigid tippers. Using moving floor semi-trailers reduces the benefit to 20%.

For society as a whole the benefits are even greater – potentially a 37% reduction in vehicle numbers (30% for moving floor), and a 32% reduction in CO_2 emissions (25% for moving floor). Fewer vehicle movements will result in lower emissions, reduced congestion, and improved highway safety.

Industry Take Up

The construction industry in London is already seeing a growth in the use of articulated vehicles for bulk transport. The main focus is on new investment in moving floor semi-trailers, although some operators are happy to use standard articulated tippers with suitable precautions.

Moving or sliding bogies are a relatively recent introduction that seem to offer useful benefits.

Initial growth has been in the captive market between permanent facilities controlled by the major aggregates companies. But materials suppliers and hauliers who have invested in articulated vehicles are demonstrating those vehicles to contractors with the aim of widening their use.

Key Challenge

The key challenge is to support hauliers and materials suppliers in their efforts to persuade contractors and developers that the benefits of using articulated vehicles outweigh any actual or perceived costs or safety concerns.

Potential Measures

Improving the average payload of bulk vehicles carrying construction traffic can be seen as a good example of where interventions from TfL can accelerate an industry trend which is already visible. There is a window of opportunity as current use of articulated vehicles is focussed on core flows where materials suppliers can control volume and secure investment in new vehicles. Extending this success to the wider construction industry faces barriers of perception and habit.

A range of measures were suggested by interviewees or in discussion with stakeholders. These range from simply providing information, to restrictions on vehicle types.

Information

TfL has achieved significant success by encouraging the sharing of best practice in logistics, particularly through the FORS and CLOCS programmes. Through commissioning research and publicising case studies TfL has supported transport businesses to improve safety, compliance, and environmental performance.

This report has clearly identified and addressed the concerns which have deterred greater use of articulated vehicles in the construction sector. Circulation of the report and its case studies will be a first step in providing information to show that articulated vehicles can be used efficiently and safely.

The effectiveness of the case studies will be enhanced if they are available on the internet and if they feature in FORS and CLOCs training and publicity. The case studies should also be circulated to planners, consultants, and developers.

Promotion

A step up from providing information passively is to consider arranging workshops and presentations to actively promote the use of articulated bulk vehicles. This could include Best Practice workshops for construction businesses.

Construction Logistics Plans

CLPs are TfL's primary tool to promote and require construction logistics best practice for planned developments. TfL's new guidance for CLPs is more prescriptive than previous versions. In particular, developers and contractors are expected to demonstrate that they have assessed a range of best practice options to reduce the impact of construction traffic.

CLPs should have clear guidance on the costs, benefits, and safe usage of articulated vehicles. Businesses completing CLPs should be expected to use articulated vehicles unless they can demonstrate clear reasons why use would not be appropriate.

RECOMMENDATIONS

The construction industry (suppliers, contractors, hauliers, and developers) is open to the idea of increasing the number of articulated bulk vehicles carrying construction materials in London. While the industry itself is making progress on this issue, with evidence of recent innovation, there are obstacles including concerns about safety and access, even though these can be addressed.

A key objective should be to discourage contractors or construction sites from any blanket restriction on articulated vehicles. Open access should be the norm, and restrictions should only be imposed if there is evidence that this is necessary.

Recommendation 1: Construction Logistics Plans

Construction Logistics Plan Guidance should be modified with the addition of a section (as proposed in the report) to the Planned Measures that should be agreed and committed to during the planning application process.

Recommendation 2: CLOCS Site Assessment Ratings

The newly developed CLOCS Site Assessment Ratings will be a useful tool to help suppliers to understand ground conditions at new sites, and to help developers and contractors to plan sites to allow a larger range of HGVs to be received. The Site Assessment Ratings are primarily aimed at reducing the use of "off road" rigid vehicles (N3G standard). In itself this is useful as it highlights sites with poor ground conditions. However, this is not enough information for suppliers to decide whether articulated vehicles can be used or not.

One option would be to add a field to the assessment "Site is suitable for unloading from articulated tippers and mixers". This could be added as a star to the ratings (e.g. CLOCS 1*). This would be a useful interim measure.

Recommendation 3: Best Practice Information and Advice

This report includes information and case studies which make it clear how articulated vehicles can be operated for construction materials safely and efficiently. Information in this report also clearly identifies the benefits to the industry and to London. It is recommended that:

- Information from this report is circulated widely across the construction industry.
- TfL arranges two or three demonstration days, showing the safe operation of articulated vehicles.
- Information on the benefits and safe operation of articulated vehicles is provided on the Construction Logistics, FORS, and CLOCS websites.
- This report is included as a case study on the Safe Quarry and MPA websites.
- Borough councils and developers should be invited to a presentation explaining the benefits of articulated vehicle operations and how it can be encouraged

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1

PROJECT BACKGROUND

1 PROJECT BACKGROUND

1.1 TFL FREIGHT

1.1.1. Transport for London (TfL)'s Freight and Fleet team runs a series of projects, guidance and training initiatives specifically within construction to improve the safety and efficiency of construction logistics within London.

1.1.2. As a significant majority of London's freight is moved by road, this puts acute pressure on the capital's road infrastructure leading to related traffic congestion problems and poor air quality. Construction activity in London is essential as a world city, for the regeneration of the infrastructure with an increasing urban population and enables the provision of buildings and infrastructure changes. However, the construction industry faces a number of challenges in its attempt to increase operational efficiency, while reducing the risks and environmental impact of deliveries. This is due primarily to the severe pressure on London's road network, which is causing the relevant authorities to actively promote alternative modes to reduce congestion.

1.1.3. The London Plan makes specific reference to construction logistics planning as a way of making better and more efficient use of the road network. Policy 6.3 and 6.14 in Chapter 6 'Transport' encourages developers to submit a Construction Logistics Plan (CLP) and consider freight movements. As a result, CLPs are now secured for all planning applications which are referable to the Mayor.

1.1.4. TfL has already undertaken preliminary work into construction logistics over the past 12 months, this includes:

- Direct industry engagement through the Chartered Institute of Logistics and Transport (CILT) Construction Logistics Forum and the Construction Logistics and Community Safety (CLOCS) working groups. This engagement has helped shape the proposed programme
- Production of the London Construction Consolidation Centre Directory, which has identified and case studied nine existing consolidation centres in London
- Market research to investigate the most popular delivery management systems used to coordinate the delivery of construction materials
- Market research into existing vehicle holding areas to manage vehicular movement in construction supply chains
- Development of an Impact Assessment Tool to enable land use planners to predict and therefore mitigate the impact construction activity will have on the local road network
- A concentrated 'development zone' case study, applying the Impact Assessment Tool to the Vauxhall Nine Elms Battersea (VNEB) opportunity area
- Development of a Water Freight Planning Tool in collaboration with the Canal & River Trust
- Extensive work through CLOCS and the safer trucks programme to improve construction HGV safety and standards for construction site ground conditions

1.1.5. As a part of this programme, and in line with the Mayor's Transport Strategy, TfL is constantly seeking ways to reduce heavy goods vehicle (HGV) traffic on London's roads. This study looks into the potential for using HGVs with a higher payload to carry bulk construction materials, with a view to reducing overall HGV volumes

1.2 PURPOSE AND CONTENT OF THIS REPORT

PRIMARY OBJECTIVE:

1.2.1. To conduct a technical comparison into the use of rigid versus articulated HGV combinations, within the construction industry - including the reasons for use of each type, barriers to entry and a commercial, environmental and safety benefit analysis.

SPECIFIC OBJECTIVES:

1.2.2. The specific objectives of this project are to:

- Undertake technical research on a range of construction vehicle operators within London and Europe to understand the reasons for using specific HGV types. This shall include:
- HGV articulated and rigid tippers and mixers
- Quantify and compare the commercial, environmental, operational and safety benefit/s of each variant
- Outline who receives the commercial gain from any improved efficiency
- Identify manufacturer or dealer incentives/commercial pressure to procure certain types
- Identify any client contractual requirement/s that specify certain types of HGVs on specific tasks
- Investigate the decisions process made when procuring HGVs, and provide reasons why one type (or specific manufacturer) was chosen predominantly over the other
- Investigate as to whether the HGV driver shortage has an effect on vehicle procurement i.e., employing Cat C (Class 2) drivers (Rigid) versus Cat C+E (Class 1) drivers (Articulated) plus any other associated costs or benefits
- Investigate the industry cultural trends and differences on vehicle procurement both in London and the EU, as to why the same type of vehicles are always procured by the same individual commercial operator
- Investigate any infrastructure, construction or disposal site barriers to use either of the HGV types specified
- Investigate if there are residual value differences between vehicle types specified
- Identify and provide case studies for any innovations which have addressed previous limitations/concerns on vehicle choice i.e. sliding floors
- Identify and provide case studies for any operators using articulated HGVs in comparison with an articulated variant
- Engage with Industry Trade Associations.

1.3 CONTENT OF THIS REPORT

1.3.1. The report encompasses the following chapters:

- Chapter 2 reports on the background research undertaken and provides context for the report.
- Chapter 3 presents the results of our discussions with industry players.
- Chapter 4 presents our results and conclusions
- Case Studies are provided in Appendix A

2

BACKGROUND RESEARCH

2 BACKGROUND RESEARCH

2.1 PURPOSE

2.1.1. The purpose of this task was to carry out a desk-based review of existing research to provide insights into the issue and to guide the subsequent discussions with stakeholders.

2.1.2. The research includes quantitative and qualitative research, including from academic sources; construction industry and vehicle standards and specifications; safety and traffic statistics; best practice and guidance produced by industry and government.

2.2 METHOD

2.2.1. A large volume of data sources and reports have been examined to provide a background to further research. In addition to standardised Google searches, sources of data were suggested or provided by TfL, The Mineral Products Association (MPA), the CILT, and individual interviewees.

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2.3 TYPICAL DESCRIPTION OF VEHICLE TYPES

2.3.1. It is recognised that a wide range of vehicles access construction sites, ranging from vans to large vehicles carrying cranes. This report is focussed on bulk vehicles, particularly tippers and cement mixers.

2.3.2. Tippers are the 'workhorses' of the construction industry. They move excavation spoil and demolition rubble away from sites and bring in sand, gravel, stone, and tarmac. The payload of tippers varies according to the type of vehicle and the commodity carried, and each commodity has different loading and handling characteristics.

2.3.3. Cement mixers deliver prepared ready mix concrete to site from nearby batching plants, and should be distinguished from the much larger bulk cement powder carriers, which take dry cement powder from the cement works to batching plants and are not covered by this study.

RIGID TIPPERS

Typical configurations

2.3.4. Rigid tipper configurations comprise 2, 3 and 4 axles. 4 axle rigid tippers running at 32 tonnes Gross Vehicle Weight (GVW) are the most prevalent within the construction activity covered by this study. Weights and illustrative dimensions are presented below. (Source – assorted, including operator and manufacturer online specifications)

Table 1 - Illustrative rigid tipper specifications

Configuration	2 axle	3 axle	4 axle
Length (m)	6.9	7.9	9.6
Width (m)	2.5	2.5	2.5
Running height (m)	2.9	3.2	3.5
Tipping height (m)	5.6	7.0	9.0
Gross Vehicle Weight (t)	18	26	32
Payload (t)	11.5	16	20

2.3.5. In addition to these relatively standard specifications there are various modifications and enhancements available, notably lorries equipped with grabs for loading, and lorries modified to meet CLOCS standards for visibility.

2.3.6. Rigid HGVs are also categorised according to the conditions they are designed for as follows:

- On-road (N3) – a vehicle designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes
- Off-road (N3G) – a vehicle designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes with off-road capabilities
- Low Entry Cab (LEC) – a vehicle with enhanced safety features including large panoramic windscreens, cross cab vision and provision for external cameras and sensors. A variant of Category N3, LEC vehicles have reduced ground clearance capability compared with the other vehicle categories.

2.3.7. A visual comparison of N3 and N3G vehicles is shown below:

Articulated Tippers

Figure 1 - Comparison of N3 and N3G Vehicles

ARTICULATED TIPPERS

Typical configuration

2.3.8. Articulated tipper configurations comprise 4, 5 and 6 axle tractor unit and semi-trailer combinations. By far the most prevalent articulated tipper combination used on construction activity relevant to this study is the 6 axle articulated tipper, for which illustrative weights and dimensions are presented below. (Source – assorted, including online operator and manufacturer specifications).

Table 2 - Illustrative articulated tipper configuration

Configuration	6 axle
Length (m)	14.2
Width (m)	2.5
Running height (m)	3.8
Tipping height (m)	9.7
Gross Train Weight (t)	44
Payload (t)	29

Figure 2 - Example articulated tipper

Figure 3 - Modern articulated tipper (Glendinning)

RIGID MIXERS

Typical configurations

2.3.9. Some typical mixer configurations are shown below.

Table 3 - Illustrative mixer configuration

Configuration	3 axle	4 axle
Gross weight and payload	26 tonnes carrying 6m3	33 tonnes carrying 8m3
Length	8.7m	9.15m
Height	3.75m	3.75m
Width	2.55m	2.55m

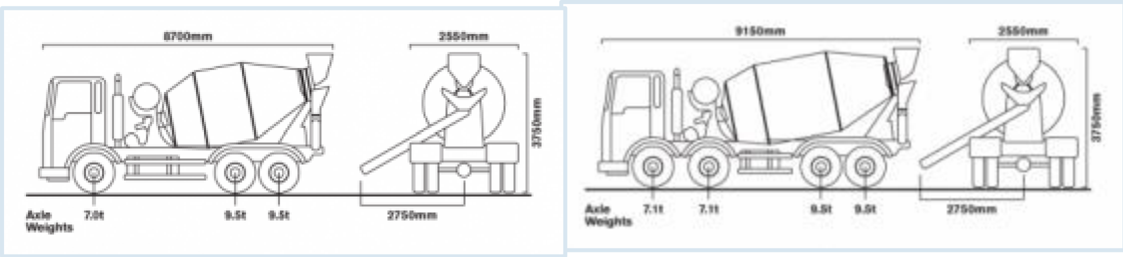

Figure 4 - Typical rigid mixer configurations (Hanson website)

Figure 5 - Example 3 axle mixer

ARTICULATED MIXERS

Typical configurations

2.3.10. These vehicles are very difficult to find in the UK. A typical EU specification is as follows:

Table 4 - Illustrative articulated mixer configuration

Configuration	4 axle (2 axle semi-trailer)	5 axle (3 axle semi-trailer)
Gross weight and payload	32T 9m3	40T 12m3
Dimensions	9.7m semi-trailer length, 2.5m width, 3.78m height	

2.4 CAPITAL AND OPERATING COSTS

RIGID TIPPER

2.4.1. Operating costs for the prevalent 4 axle rigid tipper at 32 tonnes GVW are presented below. (Source – Freight Transport Association Managers' Guide to Distribution Costs, October, 2016). Truck operating costs comprise both fixed (standing) and variable elements, as detailed in the table below.

VEHICLE OPERATING COSTS
4 axle rigid tipper 32 Tonnes GVW
Costs as at 1st October 2016

General Information	Average Mileage	Higher Mileage	Lower Mileage
Annual mileage	55,000	65,000	50,000
Life (years)	7	5	8
Life (miles)	385,000	325,000	400,000
Replacement cost (£)	98,334	101,869	96,465
Fuel consumption - mpg	8.0	8.5	7.0
Annual fuel used (litres)	31,254	34,764	32,472
Fuel price - pence per litre	90.17	90.17	90.17
Tyre life (miles)	50,000	60,000	45,000

	Costs £ Per Annum			Costs p per mile		
	Average Mileage	Higher Mileage	Lower Mileage	Average Mileage	Higher Mileage	Lower Mileage
Standing costs VED	1,200	1,200	1,200	2.18	1.85	2.40
Insurance	2,810	3,397	2,166	5.11	5.23	4.33
Depreciation	11,800	16,095	10,611	21.45	24.76	21.22
	15,810	**20,692**	**13,977**	**28.75**	**31.83**	**27.95**
Running costs						
Fuel	28,182	31,347	29,280	51.24	48.23	58.56
Tyres	1,877	1,789	1,796	3.41	2.75	3.59
Maintenance	11751	13345	11358	21.37	20.53	22.72
	41,810	**46,481**	**42,434**	**76.02**	**71.51**	**84.87**
Total vehicle cost	**57,620**	**67,173**	**56,411**	**104.76**	**103.34**	**112.82**
Employment cost of driver	33,365	35,651	29,754	60.66	54.85	59.51
Cost of vehicle and driver	**90,985**	**102,824**	**86,165**	**165.43**	**158.19**	**172.33**
Overheads						
Transport	7,553	7,553	7,553	13.73	11.62	15.11
Business	7,553	7,553	7,553	13.73	11.62	15.11
TOTAL COST	**106,091**	**117,930**	**101,271**	**192.89**	**181.43**	**202.54**

Figure 6 - Vehicle Operating Costs

2.4.2. Tippers in London are often associated with low annual mileages, although this depends on the commodity carried. The lowest annual mileage used by the FTA, 50,000, would be towards the upper end of mileages for London operators. Using the operating cost from the 'lower mileage band' of £2.025 per mile a 30 mile round trip would have a cost to the operator of £60.76. Transporting a payload of 19 tonnes would give a per tonne operating cost figure for that trip of £3.20.

Articulated Tippers and Moving Floor semi-trailers

2.4.3. Specific operating costs for a 6 axle (3+3) articulated tipper combination running at 44 tonnes are not available from the FTA. In particular, the FTA cost tables for articulated lorries typically apply to vehicles covering high annual mileages, which would be the case for most articulated vehicles but not for urban tippers. The table below shows the "official" FTA costs for the lowest mileage band articulated HGV and columns estimating the values for an articulated tipper covering 50,000 miles per annum and for an articulated moving floor vehicle.

VEHICLE OPERATING COSTS
44T GVW articulated vehicle
3 axle tractor, 3 axle curtain sided semi trailer
Costs as at 1st October 2016. Tipper Costs WSP Estimates

General Information	Lower Mileage	Artic Tipper (WSP est)	Moving Floor Artic (WSP est)
Annual mileage	70,000	50,000	50,000
Life (years) tractor	8	8	8
Life (years) trailer	12	12	12
Life (miles) tractor	560,000	400,000	400,000
Life (miles) trailer	840,000	600,000	600,000
Replacement cost (£) tractor	103,350	103,350	103,350
Replacement cost (£) trailer	22,488	35,000	70,000
Fuel consumption - mpg	7.5	7.0	7.0
Annual fuel used (litres)	42,430	32,472	32,472
Fuel price - pence per litre	90.17	90.17	90.17
Tyre life (miles) tractor	70,000	70,000	70,000
Tyre life (miles) trailer	60,000	60,000	60,000

	Costs £ Per Annum			Costs p per mile		
	Lower Mileage	Artic Tipper (est)	Moving Floor (WSP est)	Lower Mileage	Artic Tipper (est)	Moving Floor (WSP est)
Standing costs VED	1,200	1,200	1,200	1.71	2.40	2.40
Insurance	2,144	2,144	2,144	3.06	4.29	4.29
Depreciation Tractor	11,239	10,000	10,000	16.06	20.00	20.00
Depreciation Trailer	1,874	2,998	5,997	2.68	6.00	11.99
	16,457	**16,342**	**19,341**	**23.51**	**32.68**	**38.68**
Running costs						
Fuel	38,259	29,280	29,280	54.66	58.56	58.56
Tyres - tractor	1,590	1,650	1,650	2.27	3.30	3.30
Tyres - trailer	1,398	1,400	1,400	2.00	2.80	2.80
Maintenance Tractor	7,290	7,000	7,000	10.41	14.00	14.00
Maintenance Trailer	4,002	5,000	6,000	5.72	10.00	12.00
	52,539	**44,330**	**45,330**	**75.06**	**88.66**	**90.66**
Total vehicle cost	**68,996**	**60,672**	**64,671**	**98.57**	**121.34**	**129.34**
Employment cost of driver	31,414	31,414	31,414	44.88	62.83	62.83
Cost of vehicle and driver	**100,410**	**92,086**	**96,085**	**143.44**	**184.17**	**192.17**
Overheads						
Transport	9,783	9,783	9,783	13.98	19.57	19.57
Business	9,783	9,783	9,783	13.98	19.57	19.57
TOTAL COST	**119,976**	**111,652**	**115,651**	**171.39**	**223.30**	**231.30**

Figure 7 - Vehicle Operating Costs

COST SAVING

2.4.4. Using the estimated pence per mile operating cost figure of 223.30, a 30 mile round trip would have a cost to the operator of £66.99 in an articulated tipper, and £69.39 in a moving floor semi-trailer. Transporting a payload of 30 tonnes would give a per tonne operating cost figure for that trip of £2.23 for an articulated tipper and £2.48 for a moving floor semi-trailer carrying 28T.

2.4.5. This represents a theoretical saving per tonne of 30% compared to using a rigid tipper for articulated tippers and 23% for moving floor tippers.

2.4.6. This saving could be eroded if, for example, articulated vehicles achieve fewer round trips in a day than rigids. The cost differential is explored in the industry interviews in the next chapter.

2.5 DATA OR OTHER EVIDENCE ON SAFETY ISSUES

2.5.1. The major concern in the construction industry is the risk of tipper vehicles tipping over. However, this is not the only risk associated with tipper operation on construction sites. In addition to the normal risks of any vehicle movement in a workplace, there is also a risk that tippers will strike overhead objects, particularly power lines, while being unloaded.

TIPOVER INCIDENCE

2.5.2. “Tipovers” refers to tippers tipping over during unloading. This is distinct from “rollovers” which commonly means lorries rolling over while being driven, for instance if going too fast round a corner.

2.5.3. There is high awareness in the construction industry of the risk of tipovers, particularly from articulated vehicles. The industry is extremely concerned about safety and goes to considerable lengths to avoid incidents and eliminate risk.

2.5.4. It is not possible to obtain disaggregated data on tipover incidents from standard data sources such as the Health and Safety Executive. However, the Mineral Products has carried out research, and this was reported in a presentation authored by Cemex. (Cemex, 2012). The MPA reported 50 tipover incidents over a 3 year period.

2.5.5. A research report from the Health and Safety Executive (Health and Safety Executive, 2009) identified 6 fatal and 68 major accidents involving goods transport vehicles on construction sites between 2003/4 and 2007/8.

2.5.6. While none of this data distinguishes between articulated and rigid vehicles, reports of accidents from Cemex suggest that all tip over incidents involved articulated vehicles.

TIPOVER CAUSES

2.5.7. The MPA and construction companies have extensively researched the cause of tipovers on site. A tipper can become unstable and overturn when tipping on a cross slope as low as 5º, despite being certified to tip at angles of up to 7º. Investigations revealed that most tipovers resulted from more than one single factor including:

- Tipping on an incline or uneven ground
- Tipping on soft ground that cause the trailer to sink and lean
- Not tipping with the tractor and trailer in line
- Load sticking in body, on one side of the body, uneven or overloaded
- Moving forward causing instability whilst load at height
- Raising body too quickly with excessive product retained inside
- Load freezing / sticking to body floor
- Poor maintenance of the chassis and suspension
- Strong cross winds

2.5.8. MPA research indicated the following chief causes of tipovers

Table 5 - Principal Circumstance of Overturn

Principal Circumstance of Overturn		Totals	
2011	Transverse slope at point of discharge	6	14
	Unevenly loaded to one side	0	
	Unevenly loaded (front to back)	0	
	Other reason	8	
2012	Transverse slope at point of discharge	4	14
	Unevenly loaded to one side	4	
	Unevenly loaded (front to back)	0	
	Other reason	6	
2013	Transverse slope at point of discharge	8	22
	Unevenly loaded to one side	2	
	Unevenly loaded (front to back)	0	
	Other reason	12	
		50	

2.5.9. SafeQuarry.com is a web site provided by the Mineral Products Association (MPA) (Mineral Products Association, 2017). It includes a wealth of reports and guidance on industry safety issues. For example, a presentation by Cemex in 2013 assessed that 86% of rollovers took place in unmade stocking yards rather than more permanent facilities.

2.5.10. The Cemex presentation included the following photographs which clearly illustrate how alarming and dangerous a tipover incident can be:

Table 6 - Tipover incidents

2.5.11. In summary, the evidence that articulated tippers are more likely to tip over is largely anecdotal, albeit based on real experiences of industry operators. Whatever the incidence, there is no doubt that tipovers do happen regularly. In an industry seeking zero casualties it is right that there is a focus on eliminating risks of major accidents.

HIGHWAY SAFETY

2.5.12. An important consideration is the relative safety of rigid and articulated HGVs on roads, particularly in London. Increased use of articulated vehicles will reduce the number of vehicles used (greater payload), but if the vehicles used have a higher risk profile then the benefits of their use will be reduced.

2.5.13. Comprehensive research by TRL for TfL (Transport Research Laboratory, 2012) examined the number of journeys and distance covered in London by rigid and articulated vehicles and their involvement in accidents and fatalities involving cyclists. The relevant finding was as follows:

It is clear that light commercial vehicles of no more than 3,500kg GVW present the least risk to cyclists in left turn manoeuvres, being involved in only one such fatality in London in 12 years (representing 2.2% of all such fatalities in that time period) but being responsible for approximately 80% of all goods vehicle traffic (billion vehicle kms, based on data from 2008).

The risk per unit of distance travelled by articulated HGVs is greater, being involved in the collisions resulting in five (11%) of the relevant fatalities but only 5% of the total vehicle kilometres driven by goods vehicles in London.

However, it is clear that by far the greatest risks per unit of distance travelled are presented by rigid HGVs, being involved in 87% of the relevant fatalities, despite making up just 15% of the total goods vehicle traffic.

In the context of this analysis the risk from LCVs can be considered statistically negligible. If both the casualties and distances travelled by LCVs are excluded from the analysis then consideration of HGVs shows that rigid vehicles make up 89% of the fatalities from 75% of the distance travelled. Articulated vehicles are responsible for 11% of the fatalities from 25% of the distance driven.

When the freight task is also considered this analysis becomes much more stark, with rigid vehicles involved in 89% of the fatalities but only 54% of the freight lifted (tonnes) or 27% of the freight moved (tonne km). Articulated vehicles are involved in 11% of the fatalities despite lifting approximately 46% of the freight (tonnes) or 73% of the freight moved (tonne km), on journeys to, from and within London.

On the surface this would imply that moving freight from rigid vehicles to larger articulated vehicles would reduce the number of cyclists killed in left turns. However, this would ignore the possibility that within this traffic data there is a different distribution by class of road, for example, articulated vehicles may be doing a greater proportion of their total distance on relatively safe major arterial roads whereas rigid vehicles might be used more on local unclassified roads where the chances of a conflict with a cyclist may be greater.

2.5.14. In summary, far from representing a higher risk, articulated vehicles are involved in fewer accidents with cyclists per vehicle kilometre than rigid vehicles. Very broadly, rigid vehicles appear to be involved in 2 to 3 times as many incidents per km than articulated vehicles.

2.5.15. While it is true this could be because articulated vehicles make more use of safer trunk roads, there is also anecdotal evidence that cyclists are more wary of the larger artics and perhaps their turning circle is more predictable than for a rigid vehicle. Whatever the reason, it seems clear that replacing rigid vehicles with fewer articulated vehicles is likely to reduce risk and very unlikely to increase risk to vulnerable road users.

2.6 INDUSTRY STANDARDS AND GUIDANCE

THE LAW

2.6.1. An industry code of practice (Institute of Road Transport Engineers, 2009) provides the following summary of the law:

If a driver fails to discharge a load or operate a tipping vehicle safely, both the operator and driver may be responsible for seriously injuring themselves or others, perhaps even fatally. Both the operator and driver could also be contravening health and safety law.

Employers, owners and managers have a responsibility to provide and maintain safe systems of work, and to take reasonable and practicable precautions to ensure the health and safety of all workers and members of the public who may be affected by their activities. They should ensure safe systems of work for discharging a load and operating tipping vehicles are understood, and procedures are in place to check they are followed.

All drivers, including the self-employed, have a responsibility for their own health and safety, and that of other people who could be affected by their actions.

2.6.2. Because of concerns associated with tippers, and as part of routine efforts to improve safety at construction sites, there is a range of industry standards and practices referring to tipper vehicles, construction sites, and loading and unloading operations. These include:

HEALTH AND SAFETY EXECUTIVE STANDARDS

2.6.3. The Health and Safety Executive produces a guide for clients, designers, contractors, managers and workers involved with construction transport (Health and Safety Executive, 2009). This covers all types of vehicles and movements within construction sites. For tippers a short section provides basic guidance as repeated below.

Tipper lorries and lorry loaders

62 Rear-tipping lorries can overturn during tipping operations. On unmade or uneven ground, tipper-trucks of Stability Category A or equivalent should be used. To prevent overturning:

- *Always tip on firm level ground*
- *Never tip on a slope*
- *Never tip during high winds*
- *Ensure the load is evenly distributed in the body of the truck*
- *For articulated vehicles, ensure that the tractor is in line with the trailer body*
- *Ensure a competent signaller is on hand to supervise tipping operations*
- *Tip the load gradually so that it is discharged in a controlled manner; and*

- *Watch out for loads sticking, which could cause instability during tipping*

63 Visibility from the driving position during reversing operations can be improved by fitting visibility aids such as convex mirrors and CCTV. Warning devices, eg alarms and lights, should operate when lorries and lorry loaders are reversing.

64 During maintenance operations under tipper-lorry bodies or cabs, proprietary props designed to withstand the lowering forces should be used to secure them in the raised position and prevent their collapse.

65 Lorry loaders should be operated on firm, level ground with their stabilisers fully extended and the parking brake applied when loading and offloading. On soft or uneven surfaces, suitable packing should be used under stabiliser feet to spread the load and prevent movement, in accordance with the manufacturer's instructions.

66 Lorry drivers should only stay in their cabs during loading operations if it is safe for them to do so, eg when loose pea gravel is being loaded, rather than when demolition debris is being loaded. The safety of tipper-lorry cabs is increased when there is an extension of the tipper body over the cab.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

2.6.4. The IRTE has a long standing role in the provision of guidance and industry standards for goods vehicles, and has produced reports and guidance on the use of tippers on construction sites.

2.6.5. Their code of practice (Institute of Road Transport Engineers, 2009) goes beyond the HSE guidance. The code refers to the importance of good vehicle maintenance and provides guidance for safe loading and driving of tippers and provides a more comprehensive checklist for vehicle and site personnel.

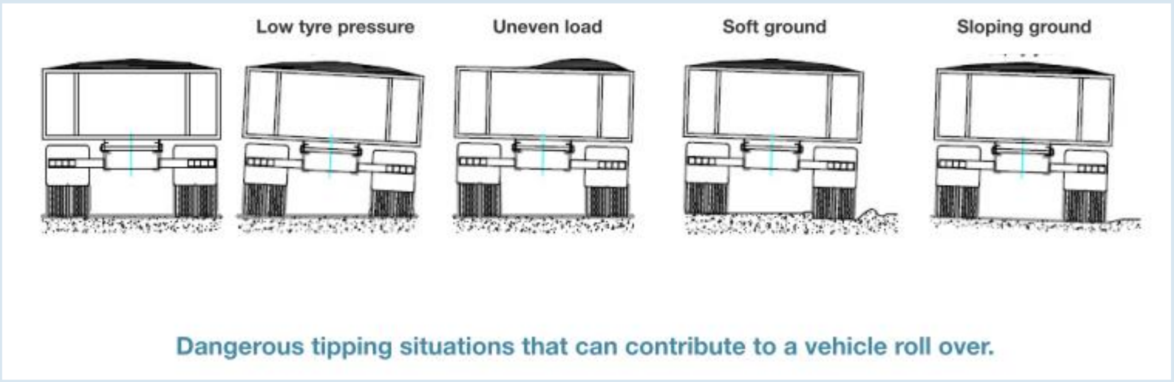

Figure 8 - Illustration from SOE Code of Practice

2.6.6. There is currently no British or European recognised design standard which tipper truck manufacturers or body builders can use to ensure the integrity and stability of tipper trucks during operation. As a consequence, the IRTE produces a guide (Institute of Road Transport Engineers, 2004) that is essentially a performance standard that sets out specific stability performance criteria to be met by end tipping vehicles.

2.6.7. The guide divides vehicles and trailers into two categories according to the maximum side-slope on which the full load can be lifted to maximum elevation.

- Vehicles in category A can cope with 7° or more of side-slope
- Vehicles in category B can cope with 5° to 7°.

2.6.8. The implication being that any vehicle unable to cope with 5° of side-slope under the specified conditions is unsuitable for tipping.

CLOCS

2.6.9. CLOCS is an organisation initiated by TfL which brings together the construction logistics industry to revolutionise the management of work related road risk and embed a road safety culture across the industry as the UK's population and economy grows.

2.6.10. CLOCS has a common standard for use by the construction logistics industry (CLOCS, 2015). Implemented by construction clients through contracts, this new Standard provides a framework enabling the management of road safety by the industry in a way that can be adhered to in a consistent way by fleet operators.

2.6.11. Eleven separate standards, codes of practice and policies relating to work related road safety were reviewed and bought together into a single common standard.

2.6.12. The willingness of organisations to set aside individual positions and to work together in support of a common principle allowed the rapid delivery of the Standard. It represents a united response to improve road safety across the industry and greater social responsibility which will save lives.

2.6.13. Developing and sharing effective practice is vital to keep organisations up to date about the latest standards and procedures currently being applied in their industry in relation to managing road safety.

2.6.14. CLOCS is responsible for monitoring the implementation of the Standard, its effectiveness and future versions.

2.6.15. CLOCS continues to support the Standard by producing supplementary guidance on a range of topics, including compliance monitoring, driver training and collision reporting.

2.6.16. The CLOCS standard applies to all vehicle types and construction sites. There is no tipper specific standard for vehicles, but there is a general requirement for construction sites:

Clients should provide a stable, graded surface on-site for vehicle loading and unloading.

Clients should ensure an appropriate person is nominated to manage all deliveries and collections to site and supervise the loading and unloading process.

Clients should identify a suitable 'offloading area' and ensure that approved loading and unloading plans are in place where it is not possible to unload on site.

2.6.17. CLOCS also produces a guide to assessing construction site ground conditions (CLOCS, 2017) which is aimed largely at ensuring sites which are suitable for low cab or general construction vehicles are clearly identified, allowing the use of specialised off road vehicles to be minimised.

2.6.18. The guide enables site operators to classify their sites under one of the following headings:

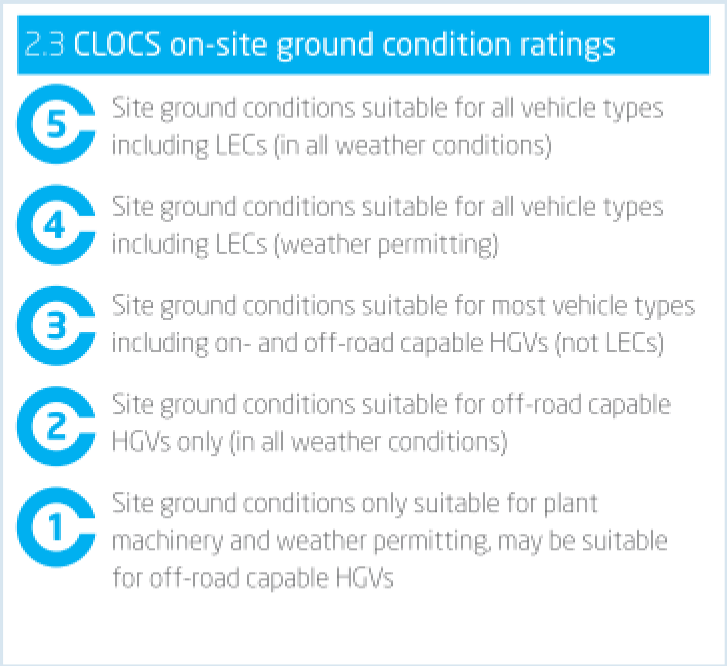

Figure 9 - CLOCS Ground Condition Ratings

2.6.19. However, the site assessment only measures four characteristics:

- Ground condition 1: Approach angle. The maximum angle of a ramp onto which a vehicle can climb from a horizontal plane without interference.
- Ground condition 2: Material type. The surface condition that determines the likelihood of loss of traction.
- Ground condition 3: Rutting and bumps. The depth and profile of the ground surface that impacts on tyre penetration.
- Ground condition 4: Water. The presence and depth of surface water that impacts the ground material (see Ground Condition 2) and affects vehicle traction.

2.6.20. The ground condition ratings are not intended to and cannot be used to assess the availability of a safe unloading area for tippers.

MINERAL PRODUCTS ASSOCIATION

2.6.21. The SafeQuarry website (Mineral Products Association, 2017) provides examples of guidance and best practice from members of the MPA. Examples provided on their website include:

- The Tipper Rollover Prevention Campaign from Cemex (see below)
- Various incident reports
- Point of Delivery Check Sheet from Quarry National Joint Advisory Committee (QNAC) (Quarry Joint National Advisory Committee, 2016)

2.6.22. The most detailed guidance provided by the MPA is contained within its Driver's Handbook (Mineral Products Association, 2016). This publication covers all types of vehicles involved in transporting mineral products. It includes chapters aimed at guidance for drivers, guidance for vehicles, and guidance for site operations. Of particular note the handbook provides:

- A common standard for tipper vehicles
- A detailed checklist for drivers covering all activities
- Vehicle exclusion zone guidance

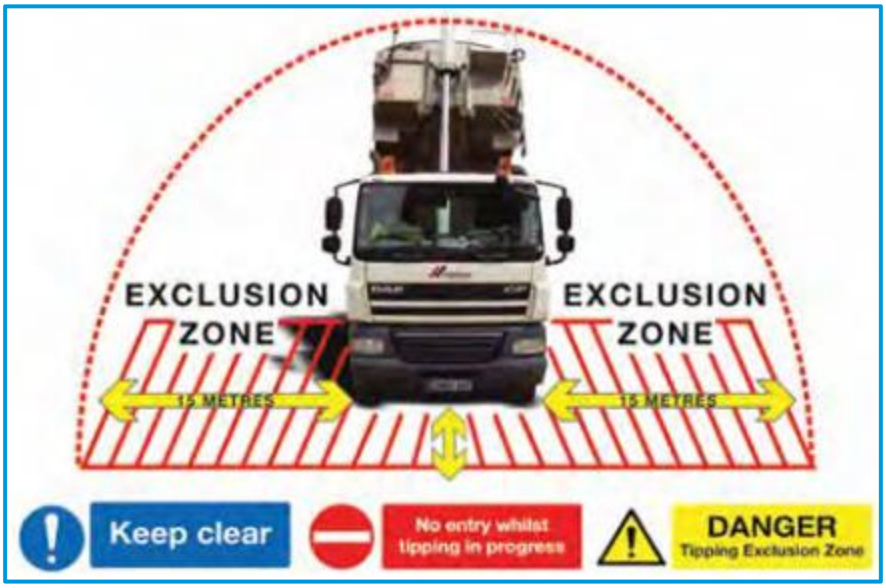

Figure 10 - Illustration from MPA Driver's Handbook

INDIVIDUAL BUSINESSES

2.6.23. A number of companies have produced and published standards and guidance for tipper operations. Notable examples are the tipper safety campaign promoted by Cemex, and Artic Tipper Guidance from Tarmac, which are featured in the Case Studies section of this report.

2.7 MITIGATION AND PREVENTION EXAMPLES

2.7.1. A range of solutions have been developed to address the risks of tipper operations.

VEHICLE DESIGN

2.7.2. Rigid vehicles are not immune from tipping over. An article in Transport Engineer (Tinham, April 2011) reports comments from Newton Trailers that neither rigid nor articulated tippers can tolerate angles greater than 7 degrees, and argues that articulated trailers may be more stable than rigids which have a narrower track.

2.7.3. The same article suggests that the detailed design of articulated trailers can reduce vulnerability to roll overs. For example, the width of the axle and using tipping gear which maximises torsional rigidity. This is confirmed by guidance which emphasises that all aspects of semi-trailer design impact potential for rollover (Institute of Road Transport Engineers, 2004).

2.7.4. While 7 degrees tilt is the recognised limit for most semi-trailers, effectively any tilt of 3 degrees or more presents a risk. The Transport Engineer article suggests that Newton Trailers are working on a solution that involves self- trimming of the suspension to compensate for tilt.

SITE PREPARATION

2.7.5. On the continent articulated vehicles are the standard. In the UK one of the cited reasons for using rigids is that site access is often via unmade roads, whereas in Germany, for example, “the roadways go in first” (Tinham, April 2011).

2.7.6. CLOCS has set a standard for site conditions (see above). While this is mainly aimed at encouraging the use of standard tippers rather than off road tippers, the standard does at least provide an indication of suitability for articulated vehicles.

INCLINOMETERS

2.7.7. Inclinometers are simple devices which monitor the angle of the vehicle to the ground. Simple inclinometers, particularly for rigid vehicles, can be mounted in cab and provide information only.

More complex inclinometers can monitor the angle in two directions (left – right, front – back), and be linked to the tipping system to stop operations automatically if certain parameters are exceeded.

2.7.8. Inclinometers can also be linked to systems to provide warning of high voltage cables overhead and to cameras to monitor loads.

2.7.9. Inclinometers are increasingly fitted to vehicles, and are required by some operators. A typical inclinometer costs in the region of £1,000 plus the cost of fitting.

Figure 11 - Example of Inclinometer (TSafe Tipper Safety System

TIPPING FRAMES

2.7.10. A tipping frame is a simple fixed piece of equipment which physically restrains a tipper from rolling over. They are comparatively rare in the UK, and are generally only used at fixed tipping locations, rarely or never at construction sites.

Figure 12 - Example of Tipping Frame, Courtesy Cemex

MOVING FLOORS / EJECTORS

2.7.11. Moving floor semi-trailers discharge material by pushing from beneath the load rather than by tipping. They are also called “Walking Floor” semi-trailers, but this is a trademark of Keith Manufacturing Company based in Madras, Oregon. Ejector systems push the load from the front towards the back using a large ram. There are various designs available including:

- Cargofloor of the Netherlands
- Half Pipe Ejector System from BMI
- Keith Walking Floor
- Keith V-Floor (a heavy duty version of the Walking Floor)

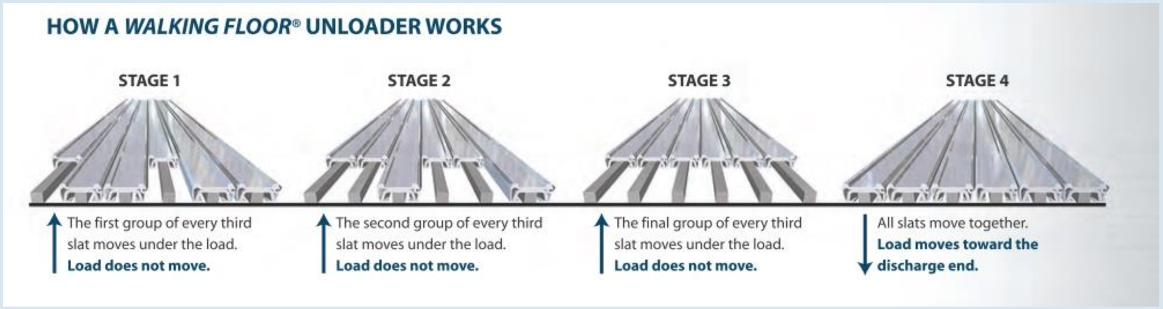

Figure 13 - Illustration from Keith Walking Floor Brochure

2.7.12. There are clear benefits from this type of system:

- Avoids any risk of roll over or striking any overhead objects
- Because the semi-trailers do not tip they can be longer than tipping semi-trailers, providing a greater cubic capacity which may allow increased payloads for higher cube products.

2.7.13. Compared to standard tipping semi-trailers:

- Tare weight is higher (6.5T to 7.5T compared to 6T for standard tippers)
- Maintenance costs are higher as slats sometimes need to be repaired or replaced
- Capital cost is higher (£42,000 compared to £32,000 for standard tipping semi-trailers (Tinham, April 2011))

ROLLING OR SLIDING BOGIES

Another solution to the risk of tipovers during unloading is the rolling or sliding bogie. In this system the rear bogie can move forward before unloading. This means that the rear of the tipper can drop at the same time as the front is being lifted. This reduces the height of the fully lifted body, and also allows product to be tipped at close to ground level.

The dimensions of the Glendinning example above are: height 3.60 m, width 2.59 m, length 13.20 m (long) / 11.80 m (short), capacity 28 tonnes.

Dennison, who also manufacture a sliding bogie tipper, report that in tests undertaken by MIRA for tipping stability, their trailer remained stable at 8.5 degrees, exceeding the requirement set to obtain class A certification by 13%. The trailer stability is due to the sliding bogies wide chassis centre and shorter chassis length in the tipping position. The trailer is more manoeuvrable than an 8 wheel rigid when in the shorter wheelbase mode, which is useful on site.

Crick Trailers, who sell the Dennison Sliding Bogie Tipper make the following claims on payload and cost:

"With the trailer's low unladen weight, the payload with a steel body is approximately 28.5 tonne with a GVW of 44 tonnes (subject to the tractor unit ULW). With an aluminium body the payload is approximately 29.5 tonne. Compared with a 19.7-tonne payload an 8×4 tipper, this offers you 9.8 tonne greater payload, which reduces miles on the road for the same product movement and greater income. On average for every 3 journeys made by an 8 x 4, you will only need to do 2 journeys with the sliding tipper."

TRAILER LINERS

Plastic tipper liners (PE-UHMW – Polyurethane Ultra High Molecular Weight) have several important benefits for tipper operators:

- They improve safety by reducing the tipping height required to eject a load – particularly for sticky materials
- They ensure that all of the load is ejected, with nothing remaining sticking to the floor or sides
- They protect the tipper body, extending the operating life
- There is a small payload penalty, typically 200-250kg.

2.8 POTENTIAL BENEFITS OF IMPROVED UTILISATION

2.8.1. Payloads of tippers and bulk vehicles vary significantly depending on the commodity carried. However, in all cases an articulated vehicle will have a higher payload than a rigid vehicle. A reasonable comparison would be as follows:

- Rigid payload: 19T
- Articulated tipper payload: 30T
- Articulated moving floor payload: 28T

2.8.2. Articulated tipper advantage: Therefore 1 articulated tipper fully loaded equates to 1.58 rigid tippers, while a moving floor semi-trailer would equate to 1.47 rigid vehicles.

TRAFFIC / CONGESTION

2.8.3. The impact on congestion depends on the characteristics of each vehicle type. Articulated lorries are longer than rigid lorries, so take more road space, but they are similar in terms of manoeuvrability (similar acceleration and turning circle).

2.8.4. In terms of length, an artic equates to 1.48 rigids. However, TfL highway models typical have the same value for rigids and artics, equating 1 lorry to 2 cars, therefore a reduction in the number of lorries would reduce the modelled forecast of congestion.

2.8.5. If all movements of primary aggregates on London's streets were made in articulated moving floor vehicles rather than rigids, there could be 325,000 fewer lorry movements per annum, or 1,300 fewer per day.

2.8.6. (This is a conservative estimate. It does not include secondary aggregates or spoil. It only assumes one round trip for each tonne of aggregates, whereas on many occasions 2 round trips are required, for example from railhead to asphalt plant to site.)

EMISSIONS

2.8.7. Both articulated tippers and rigid tippers achieve similar fuel consumption at approximately 7 miles per gallon. This can be interpreted as a similar level of CO2 and other emissions, and therefore a reduction in vehicle miles will show a genuine reduction in emissions.

2.8.8. The saving in CO2 emissions per Tonne for using articulated tippers is estimated to be 37% compared to rigid tippers.

2.8.9. Based on basic assumptions for primary aggregate movements in London, this could equate to a saving of 8,250 Tonnes of CO2 per annum.

2.9 KEY ISSUES IDENTIFIED IN BACKGROUND RESEARCH

2.9.1. The findings of the background research are:

- → There is little data on the risk of tipovers for articulated vehicles compared to rigid vehicles
- → Standards for safe tipping are the same for both types – a maximum 7 degree angle
- → There is clear guidance on the safe operation of tippers
- → There are a range of additional measures that can further improve safety
- → It costs around 30% less per Tonne to move bulk goods in an articulated vehicle than in a rigid

3

PRIMARY RESEARCH

3 PRIMARY RESEARCH

3.1 PURPOSE

3.1.1. The primary research is intended to explore in detail the characteristics of the various vehicle types, the experience of businesses that use them, how decisions on vehicle type are made, and what actions could be taken to encouraged increased efficiency.

3.1.2. Specifically, the research was required to address the following questions:

- Outline who receives the commercial gain from any improved efficiency
- Identify manufacturer or dealer incentives/commercial pressure to procure certain types
- Identify any client contractual requirement/s that specify certain types of HGVs on specific tasks
- Investigate the decisions process made when procuring HGVs, and provide reasons why one type (or specific manufacturer) was chosen predominantly over the other
- Investigate as to whether the HGV driver shortage has an effect on vehicle procurement i.e., employing Cat C (Class 2) drivers (Rigid) versus Cat C+E (Class 1) drivers (Articulated) plus any other associated costs or benefits
- Investigate the industry cultural trends and differences on vehicle procurement both in London and the EU, as to why the same type of vehicles are always procured by the same individual commercial operators
- Investigate any infrastructure, construction or disposal site barriers to use either of the HGV types specified
- Investigate if there are residual value differences between vehicle types specified

3.2 METHOD

3.2.1. Our interview sample was based on targets for the numbers of interviewees provided in the brief, split into various categories. The categories, targets, and key issues to be addressed for each category are set out in the table below

Group	Specification	Comments on Sample	Example Questions To Be Asked
Transport Operators	London based transport operators (10) currently using HGV construction vehicles (rigid and articulated) on commercial contracts across central, inner and outer London, to provide a realistic representation across the capital	Important to include 2 or 3 major operators and SME operators also. Include tipper and ready mix operators	How clients specify the type of vehicle required. Data on fleet make up. Impact of driver shortage. Utilisation and other issues with artics. Cost impact of different vehicle types. Has the market changed? Is it going to change? Residual values.
Overseas Operators	Overseas (EU based) construction industry transport operators (6), in three different cities, to further investigate their cultural and commercial choices of vehicle types to offer a comparison.	Selection to be made with WSP Sweden and SOE (IRTE).	Data on fleet make up. Who specifies vehicle type. Scenarios where rigid or artic are required or avoided.

Group	Specification	Comments on Sample	Example Questions To Be Asked
Dealers	Commercial vehicle dealers (3) that supply HGVs to the construction industry.	Names checked with CLIG and from trade publications.	Range of chassis and body types available. Market trends. Cost and other implications of types. Secondhand values and market.
Manufacturers	Vehicle manufacturers that supply HGVs to the construction industry (3).	Already well known and from trade sources.	Range of chassis and body types available. Market trends. Cost and other implications of types. Secondhand values and market.
Bodybuilders	Bodybuilders that supply to the construction industry (3).	Already well known and from trade sources	Range of chassis and body types available. Market trends. Cost and other implications of types. Secondhand values and market.
Drivers	HGV drivers (20) from identified transport operators that have driven both rigid and articulated HGV vehicles on construction sites.	From operators. 5 drivers per operator will be engaged through 1 hour workshops on site at the end of the day of visit.	Experiences of driving both types. Ease of use / operation on roads / on sites, particularly in London. Any issues with tipping or other operations on site.
Developers	London based developers (5).	WSP client sources. To include at least 1 major infrastructure project. Checked with CLIG.	Are they aware of issues around vehicle specification? When developing projects or preparing CLPs do they actively seek to reduce vehicle numbers? Is construction planned in a way that takes into account site conditions? Is vehicle type specified?
Construction Companies	London based construction companies (5),	WSP contacts. Checked with CLIG.	Who specifies vehicle types? How and why are vehicles selected? Importance of cost, risk, safety, other issues?

3.2.2. Face to face interviews were undertaken in nearly all cases, with a few interviews carried out by telephone. An interview guide was prepared for each meeting, with specific questions for the various categories. The interview guides are provided in the appendices. The guides were not followed rigidly, as the intention was to explore issues as they emerged in discussion rather than obtaining a quantified response.

3.2.3. Notes were taken during the interviews, and most interviews were recorded with permission of the interviewee. Interviewees were asked if they were happy to be named and for their views to be attributed to them. While almost all agreed, we have kept quotations in the report anonymous unless it is particularly relevant to a specific business.

3.2.4. Finally a workshop was held internally involving the three people who carried out all of the UK interviews. Issues arising were discussed and common themes identified

3.3 WHO WE SPOKE TO

The following businesses or organisations kindly agreed to be interviewed as part of this study. Where noted, site visits were completed, or drivers were met and interviewed.

- HS2
- Crossrail
- Wincanton
- Skanska
- Mace
- DHL
- Hargreaves HQ
- Hargreaves Harlow Site
- Hargreaves Driver Shift
- Tarmac HQ
- Tarmac Norfolk Site
- Tarmac Driver Shift
- Cemex
- O'Donovan
- Day Aggregates
- Wilcox
- Tarmac site visit and driver interviews
- BMI
- Carillion
- PPG Fabrications
- Thompsons UK
- Hills Aggregates site visit and driver interviews
- CILT Construction Logistics Forum
- TfL Construction Logistics Improvement Group
- Mineral Products Association
- DKLBC AB
- Betongindustri AB
- James Booth Haulage

3.4 INDUSTRY STRUCTURE

3.4.1. Understanding the structure of the construction industry is essential in order to understand how transport decisions are made and who can influence the choice of vehicle.

3.4.2. We asked each interview who their customers are, and how their business fits in to the construction supply chain. While the overarching structure of construction supply chains is fairly standard across the industry, there is obviously considerable variation within that structure, particularly between larger and smaller projects.

3.4.3. The table and diagram below summarise our findings from the interviews.

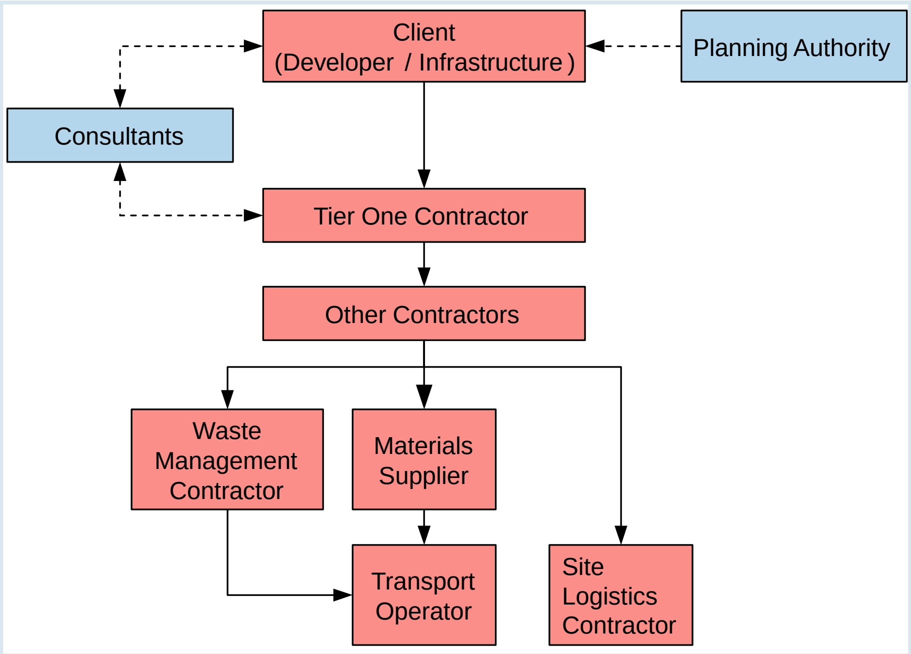

Figure 14 - Typical construction industry structure

Organisation	Role in Construction	Role In Supply Chain
Planning Authorities	Consider planning application.	Seeks to reduce impact on highways and communities. May require CLP. Will require traffic assessments. May set standards such as FORS or CLOCS compliance.
Developer Client	Initiates and funds projects. Procures services for successful delivery.	Primary interest is to deliver project at low cost within timescale. May also have interests in environment or good neighbour policy. Interfaces with planners and therefore engages on sites access issues.
Infrastructure Client	Initiates and funds projects. Procures services for successful delivery.	As with developer client, but likely to take more interest in transport issues and impacts as these will be dominant issues during planning process.

Organisation	Role in Construction	Role In Supply Chain
Consultant	Advises client and contractor on specialist issues from planning process through environmental issues to transport planning and design.	Prepares traffic assessment, initial CLP etc. Is therefore likely to have an interest in minimising traffic impacts.
Lead Contractor	Varies, but takes the client's instructions and manages the process of delivering the project.	Strong interest to deliver project on time and on or below budget. May specify materials and transport. May be responsible for procurement of large volume materials. Plans project phasing and construction site access.
Demolition Contractor	Procured by client or led contractor to prepare the site and, usually, to remove and dispose of materials. This category also covers excavation contractors.	Generally procures transport within the contract for demolition / excavation. Frequently uses own fleet.
Other Contractors	Responsible to the lead contractor and / or client. Deliver selected aspects of the projects. May be involve several tiers of sub-contractors	Procures materials at a delivered price from materials suppliers. Wants them delivered at lowest price but with minimal risk to project delivery.
Site Logistics Contractor	Plans and manages on site logistics and site access.	Plans and manages vehicle deliveries.
Materials Supplier	Procured by contractors to provide materials from gravel to fixtures and fittings.	Procures or provides haulage for materials to the construction site.
Waste Contractor	Procured by contractors to remove waste from the site - possibly excluding demolition rubble and spoil.	Generally disposes of waste for a price which includes haulage. Procures or provides haulage.
Transport Operator	Transports materials to the construction site. May be owned by a materials supplier or independent.	Transports materials to the site for materials suppliers or excavation / demolition companies.

3.4.4. An important point to note is that several types of organisation have an interest in the procurement of road haulage and the type of vehicle used. The influence of each party is explored later in the next section.

3.4.5. Materials Suppliers have a central role. Often these are large multinational companies such as Tarmac or Cemex. They sell materials to the contractors and arrange for them to be delivered to the site. Delivery may be in their own vehicles, in “franchised” vehicles, or by independent hauliers. “Franchised” vehicles are hauliers who are more or less dedicated to a major materials supplier, with vehicles branded in that supplier’s name and meeting the supplier’s standards.

3.4.6. Similarly for demolition or excavation arisings, a contractor will take the arisings away and dispose of them, which will include the transport element. Vehicles used for demolition or spoil may also be used for the movement of aggregates, either secondary aggregates from their own locations or primary aggregates from their own locations or for other aggregates companies.

3.5 TYPICAL JOURNEYS

3.5.1. Aggregates are a low value commodity, and transport makes up a large percentage of their delivered cost. Therefore journeys tend to be short, from well located origins such as railheads or wharves, to building sites or processing sites.

3.5.2. Within London, journeys for aggregates and for concrete in mixers tend to be very short, on average 5 to 10 miles. Readymix concrete has the shortest average journey, as would be expected, and originating from numerous small to large concrete plants around the capital.

3.5.3. Movement of demolition rubble also tends to be over a short distance, generally to a concrete crusher or processing plant to be recycled. Excavated spoil is different. Where possible it is reused within the site or nearby, but more often it must be moved over a longer distance to a location which can use the material for landscaping or a similar purpose. Most of these locations are outside London.

3.5.4. Some businesses combine these operations. For example, a typical shift for a Hargreaves vehicle might be taking aggregates from Harlow into London, then two or three round trips within London carrying aggregates, then a final journey back to Harlow carrying material for recycling or reuse.

3.5.5. Three types of operation were identified in the discussions:

- Permanent short journeys within London
- Permanent longer journeys, often between central London and locations beyond the M25
- Mixed operations including a variety of journey types

"We deliver materials from railheads or wharves. The main destinations are our own batching plants or road stone plants, or construction sites. These are rarely more than a few miles away." Aggregates supplier.

"We can take concrete rubble to our crusher in inner North London, so trips are not long. But excavated spoil has to be taken further, very often to golf courses in Hertfordshire."

"Even taking spoil out of London we get more than 3 round trips in a day."

"All of our work is within 20 miles of our depot."

DRIVERS AND DRIVING

"Most of the drivers in London are day men, so they want to be home so they start early. They are generally paid on a 12 hour shift. So they are doing between 55 to 60 hours per week."

"Drivers for artics need a different license, but we don't mind training them up for that. Then we generally pay them £1 per hour more."

3.6 PAYLOADS

Typical responses from interviewees were:

Vehicle Type	Range of Responses
RIGID TIPPERS	19T to 19.5T payload and 32T gross
ARTICULATED TIPPERS	30T payload 44T gross
MOVING FLOOR TIPPERS	26T to 28T payload 44T gross

3.7 VEHICLE COSTS AND LIFESPAN

3.7.1. Some operators suggested that an articulated operation would have a benefit over a rigid in that the tractors have a longer life than the trailers. Tractors could also be used or reused for other traffics. However it was difficult to get quantification of this benefit, so it has not been included in the cost exercise.

3.7.2. Some operators have concerns about the additional cost of moving floor trailers, in particular the need to maintain the floors and occasionally replace the “slats” that move the load forwards.

“We watch our haulage costs very closely. That’s why we choose to safely operate articulated tippers rather than use moving floor trailers.”

3.7.3. Typical responses from interviewees included:

“**We operate our rigids for 5 years out of their potential 8 year life and then sell them on.”**

“A rigid tipper costs us about £105k. An artic tractor costs £100k plus £35k for the trailer, but a V Floor trailer costs £70k.”

“Over the life of a moving floor trailer we might have to pay an additional £15k in maintenance.”

3.8 WHO PAYS FOR TRANSPORT?

3.8.1. Ultimately the developer covers all of the costs of any development. The developer invests significantly in planning the development, but will then package out work to contractors who will, to some extent or other, be working to fixed or capped contract prices. It is therefore in the contractors’ interest to keep costs down.

3.8.2. Contractors procure materials from suppliers, almost always priced on a delivered basis – in other words, the price includes delivery to the construction site.

3.8.3. Materials suppliers will either use their own vehicles, or contract deliveries to hauliers.

3.8.4. Materials are purchased at a “per Tonne” cost. Materials suppliers pay their hauliers either per Tonne or per load.

3.8.5. Clearly, if the payment is per tonne then hauliers using articulated vehicles would be paid more per trip than those using rigid vehicles. If payment is per load, then a rigid vehicle operator might receive more as more journeys would be required.

“Payments to remove and dispose of spoil were included in the contractors’ tender prices. We checked for overloading and discouraged unrealistic shift targets.” Infrastructure developer.

3.8.6. In practice, materials suppliers take this into account when setting prices for haulage, paying a different amount depending on whether the vehicle is articulated rigid. Hauliers are thus limited in the opportunity to add value: whatever vehicle they use, materials suppliers will eventually squeeze their margins by adapting prices.

“The haulier’s margin always gets squeezed.” Haulier.

3.8.7. Nonetheless, some hauliers have invested and are investing in articulated vehicles, including tippers and moving floor trailers. The reasons for investment are discussed in later sections, but it would seem that some operators are able to make slightly better margins using articulated vehicles which is driving limited investment.

3.8.8. “Drivers benefit from using an articulated tipper by way of an increased higher hourly rate and the HGV training category C+E (previously known as class 1) is paid for by some operators. Customers benefit from buying bigger quantities of material at a time through lower prices” Driver of a materials supplier.

3.9 WHO INFLUENCES DECISIONS ON VEHICLE TYPES?

3.9.1. The client for hauliers in most cases is the materials supplier, whether an aggregates company or a demolition or excavation disposal company. Materials suppliers therefore ultimately make the decision as to which type of vehicle to use for each operation.

3.9.2. However, materials suppliers sell their materials to contractors. It is contractors who tend to issue restrictions or specifications for acceptable vehicle types. The reasons for specifying different types are explored below, but the most common position is an assumption in all contracts that rigid vehicles will be used. Contractors may be open to persuasion, but it is the haulier or materials supplier who is taking responsibility to make the case to contractors for larger capacity vehicles.

"We try to encourage the use of artics, but some contractors specify rigids on all their contracts." Aggregate supplier.

"One contractor we deal with has it explicitly written into contracts that only rigid vehicles are permitted on their sites." Materials supplier.

3.9.3. Working up the chain of command, it is rare for developers to become involved in decisions about vehicle type. Developers are involved in discussions with planners and consultants about the numbers of vehicles accessing sites, mainly for traffic management purposes but also in order to generate numbers for Construction Logistics Plans (CLPs). Several reasons were given for this:

- Often traffic volumes generated in peak hours are too low to require any mitigating action – if the traffic planners approve plans there is no need to take further action.
- There is a concern, not discouraged by contractors that adding restrictions or forcing a change of vehicle types could lead to added costs, delays, or risks to programme. This is a strong deterrent to innovation or change.
- The contractor is often building to a fixed cost of some type, and therefore possibly the developers assume that it is for the contractor to decide the most efficient way to construct.

3.9.4. In the case of infrastructure developers much more interest is taken in logistics. This is the case for Crossrail, HS2, and Thames Tideway. Such projects generate huge volumes of spoil and inbound aggregates, meaning that transport is a major element of costs, and that transport impact is an important factor in the planning process. While major schemes benefit from a different planning regime (under the 2008 Planning Act), they are required to take into account stakeholder concerns and demonstrate that transport impact has been minimised and accommodated. The result of this different focus is that alternative modes are frequently used to reduce traffic impact, and that articulated vehicles are more likely to be accommodated by infrastructure developers.

3.9.5. Infrastructure developers must still work through contractors, and the ultimate decision on mode and vehicle type may be left with the contractor in some cases. In other cases the developer may specify mode or vehicle number targets.

3.9.6. Borough and TfL planners don't seek to influence vehicle types. They are primarily concerned with traffic numbers. If construction traffic is forecast to become an issue, they may issue operating hours restrictions or vehicle numbers restrictions. Again, a concern is that being too prescriptive could lead to an unfair imposition of costs on the developer, leading to grounds for appeal or compensation.

3.9.7. Finally, at the receiving end of the logistics supply chain, are the Logistics Contractors. Despite the name, these organisations to not operate haulage, but they do control day to day access to the site and movement within the site. They may restrict vehicle types, presumably by agreement with the contractor, potentially as a reaction to changing site conditions or local road traffic conditions.

"At one site we called at we were ordered away aggressively and told to never "bring one of those things" onto the site again." Observer of articulated delivery.

3.10 VEHICLE OPERATOR AND FLEET SIZES

3.10.1. Most of the interviewees were either larger operators, or materials suppliers who owned and controlled large numbers of vehicles.

"We have 50 bulk vehicles operating into and in London. Of these only 2 are articulated, both moving floor." Operator

"We operate over 500 vehicles in London each day, 200 to 300 of these are subcontractors. We only own 2 articulated bulk vehicles. 70% of our daily deliveries are in rigids. The artics are used mainly for our internal movements, many operated by sub-contractors." Aggregate supplier.

3.11 WHY ARE RIGID VEHICLES PREFERRED?

3.11.1. Two concerns dominate:

- Safety concerns
- Access concerns

SAFETY CONCERNS

3.11.2. Many of the people we spoke to had direct experience or had heard about incidents on site where vehicles had tipped over during unloading. However, it was difficult to identify any recent examples, nor to be certain that similar incidents didn't happen to rigid tippers.

"We had a serious incident a few years back when an articulated tipper tipped over into another tipper. Apart from the obvious risk to life and the extensively damaged vehicles, the incident closed our unloading operation for more than a day, which had a serious impact on our business."

3.11.3. Whatever the incidence of tipovers, the construction industry takes safety extremely seriously, and so anything which is perceived to increase risk is likely to be avoided. As well as risk to life and limb, tipovers cause extreme disruption to the building programme.

ACCESS AND SITE CONCERNS

3.11.4. Some interviewees said that London's tight roads are not suited to articulated vehicles, and getting into some sites is difficult. However, others noted that articulated vehicles are routinely used to deliver a range of non-bulk materials such a structural beams and windows without too much difficulty.

3.11.5. The bigger concern is access within the site. Contractors, in particular, commented that the internal layout of building sites is continually changing. Each change needs to be planned and designed. While many deliveries are received at the periphery of sites, tippers are generally required to drive close to the point of use, tipping within the building site. This applies in particular to vehicles taking away rubble or spoil.

"Artics turning circle is better than rigids. Artics with a walking floor can even unload at an angle."

3.11.6. One issue that was raised is that rigid tippers have two powered axles, whereas standard articulated tippers have only one. Therefore rigids can climb steeper gradients in poor conditions than articulated tippers.

"We have had to use a rigid tipper to pull an articulated tipper up a slope when it got stuck." Materials supplier.

3.11.7. Tippers require firm and reasonably level ground to be unloaded (maximum 7 degrees cross gradient). This is easier to provide at a permanent or semi-permanent location than on a site where the unloading point is constantly changing. (However this should apply to both rigid and articulated tippers as both meet the same standard.)

3.11.8. There are particular issues for articulated mixers. Concrete is delivered from numerous batching plants which need to be as close to the end user as possible. Often the batching plants are on very small sites tightly fitted into urban areas. Difficulty accessing batching plants was reported by several interviewees.

3.11.9. There are also industry specific issues for vehicles collecting spoil or demolition waste. In these cases loading takes place in a very dynamic environment likely to have poor conditions. Spoil unloading is also often at very poorly prepared sites where land reclamation is taking place. This not only means that rigids are preferred, but also that the N3G specification for "off road" use is preferred.

3.12 WHEN ARE ARTICULATED VEHICLES USED?

3.12.1. The interviews included several businesses, including some very large companies, who have been increasing their use of articulated tippers.

3.12.2. One clear trend is for major suppliers such as Tarmac and Cemex to use articulated vehicles for "internal" movements. These are movements between two locations which are operated by the company, for example between an aggregates rail head and an asphalt plant or concrete plant. In such cases the supplier has a strong motive to reduce costs by improving payload, and the supplier has control of conditions at both ends of the journey. Use of articulated vehicles is made simpler as both ends of the journey would be permanent, rather than temporary construction sites.

3.12.3. This has led some major suppliers contacted to make use of moving floor articulated trailers on journeys they control, and then to extend use out to other contracts on a case by case basis.

3.12.4. Other approaches have been taken to increasing payloads. Cemex makes use of tipping frames at some of their depots. These are permanent installations at the depot which physically prevent vehicles from tipping over.

3.12.5. Day Group also makes use of articulated tippers, but they prefer to rely on the experience and training of drivers, as well as clear controls at each location, to ensure safe tipping.

3.12.6. This is not to suggest that articulated vehicles are only used on internal movements. Hargreaves and Tarmac, for example, have invested in moving floor trailers. These are used on movements where they control both ends of the journey, but both companies also encourage contractors to specify, or at least allow, articulated tippers. This may include running demonstration days, or trial operations of articulated vehicles.

"On a major highway project outside of London we will potentially operate 60 to 70 trucks for 2 years. It's specified as rigids, but we are demonstrating articulated vehicles to them and showing them how the V Floor works."

"We operate nearly 100 walking floor trailers nationally. Our competitors are also moving that way. We would like to use 100% walking floor trailers on HS2."

3.13 ISSUES WITH DEMOLITION MATERIALS AND SPOIL

3.13.1. During demolition the main material generated is concrete or brick rubble. This can be crushed and recycled as secondary aggregates useful in construction projects as a replacement for crushed rock or gravel. At least 80% of demolition rubble arising in London is recycled locally, at small or large crushers located across the city.

3.13.2. After demolition, ground works typically require the removal of large volumes of spoil, comprising mainly topsoil or clay. Disposing of this material at landfill would incur very high landfill taxes, so contractors seek to use the material on landscaping projects. Typical uses include landscaping of golf courses, or capping and landscaping former landfill sites. If possible spoil can be held locally within London for reuse, but this is not easy for large volume projects.

3.13.3. The largest projects are major tunnelling schemes such as Crossrail and HS2. In these cases spoil is moved out of London by rail (or barge for Thames Tideway), but some sites such as ventilation shafts are not rail accessible.

The nature of this business makes it more difficult to use articulated vehicles for several reasons:

- The demolition and excavation phases of construction are the most difficult times to provide good quality loading areas. The loading areas tend to move from week to week.
- Unloading sites for spoil tend to require the lorry to drive directly to the point of need within the site, often along poor quality mud tracks and possibly involving steep gradients and soft ground.
- The material concerned, particularly topsoil and clay, is often sticky, making tipping more difficult and potentially increasing the risk of a tip over when using articulated tippers. Such material is less suited to moving floor trailers, either due to sticking or to damage from lumps of concrete

"We charge by the load, and there is always the risk that contractors will try to overload our vehicles. This is a bigger risk in articulated tippers because of the high cube of the trailers."

"Most of the sites we collect from have an absolute ban on articulated tiipers."

3.14 ARTICULATED TIPPERS AND MOVING FLOOR SEMI-TRAILERS IN USE

OPERATION

Interviewees reported that unloading moving floor semi-trailers was not significantly slower than unloading tipper semi-trailers – possibly just a few minutes longer and not enough to impact site operation nor the economics of the operation.

Both moving floor semi-trailers and tippers need maintenance, but the cost for moving floor semi-trailers is higher, although this is not considered to be a significant cost.

The "slats" of moving floor trailers may need to be replaced from time to time, depending on the type f material being carried.

Figure 15 - Moving Floor Unloading (BMI Trailers)

"Moving floor semi-trailers do need to have the floor replaced from time to time. This depends on how you load and what you are carrying."

"It only takes 30 seconds longer to unload a moving floor trailer than a tipper." Aggregates supplier.

INVESTMENT AND COSTS

3.14.1. It is easy to see why some large materials supply businesses invest in moving floor semi-trailers. They benefit directly from the increased payload between their sites. They can predict movements between their own sites and encourage major customers to use the larger vehicles, perhaps through price incentives. Because they can plan the workload, they can ensure that the articulated vehicles are always busy, making sure there is a good return on the investment. This base load of traffic underpins use of articulated vehicles for customer deliveries where possible. The supplier can then focus on persuading more and more end users to accept their articulated vehicles.

3.14.2. For "franchised" hauliers, small operators working for a major supplier, or for independent hauliers, it is more difficult to predict the nature of their work. Even if they could be sure of using articulated vehicles for most journeys, there would be a risk that at some point they would not be able to keep articulated vehicles busy. As these businesses run on very small margins, this would be an unacceptable business risk.

3.14.3. A key challenge will be to encourage smaller operators to invest in articulated vehicles. Alternatively, movement of bulk products in London may become increasingly dominated by larger operators.

"I can't yet justify buying an articulated trailer. It's too risky because some sites will just turn me away." Haulier.

OTHER SOLUTIONS

3.14.4. A feature of the interviews was the range of solutions favoured by different operators. While some were happy to operate standard tipper semi-trailers, subject to best practice in safe operation, others favoured moving floor semi-trailers or liners. Sliding bogie semi-trailers are beginning to be considered.

"Sliding bogies semi-trailers are new to us. We will take a look, but it's hard to see the benefits over other solutions."

3.15 WHO BENEFITS?

3.15.1. This is a complex question because construction supply chains are complicated, and contractual arrangements vary.

3.15.2. If bulk materials are sold at a "delivered" price (i.e. the price includes delivery to the construction site), as is the norm, then materials suppliers benefit from reduced costs of transport per tonne of material. As aggregates are a low value material, this transport saving is significant.

3.15.3. In a competitive environment, it would be expected that this cost reduction would get passed on to contractors through a lower cost of materials. However, materials suppliers can also use transport cost savings to extend their market, becoming competitive in geographic areas where previously competitors were able to offer the lowest price. Eventually, though, contractors should benefit from lower materials costs. The suppliers and hauliers would aspire to benefit from a greater market share and, possibly, particularly early on, from increased margins for their transport operations.

3.15.4. In turn, reduced costs of materials should lead to reduced costs of construction. However, contractors may be working to an agreed fixed cost of construction, in which case developers may not directly benefit. Over the longer term, and given a competitive market, cost reductions should pass on to developers as a lower cost of construction.

3.15.5. Potential cost savings for bulk materials are more significant for major infrastructure projects, which would explain why their developers take a greater interest in vehicle type and transport costs.

3.16 INCREASED COSTS AND RISK

3.16.1. One issues raised is that even if the benefits are clear, a degree of risk and cost is left with the contractor to resolve. There is seen to be a cost penalty in designing dynamic construction sites to accommodate artics – although the extent of changes needed is open to question. If there are any incidents, cost and delay impacts the contractor.

"The risks fall on the contractor, and are not spread across all stakeholders." Infrastructure developer.

3.17 SUGGESTIONS TO IMPROVE VEHICLE PAYLOADS

3.17.1. Hauliers and materials suppliers are very keen to see more use of articulated vehicles, and some are frustrated with the amount of effort it takes to convince their customers to use the most efficient vehicles.

"For major contracts in the North we took clients out for a day to show them how artics can be operated safely." Aggregate supplier.

3.17.2. Perhaps surprisingly, several interviewees suggested that stronger encouragement from planners, including insisting on articulated vehicle use, could have the impact of shifting use of articulated vehicles from the exception to the rule.

"Ideally developers should be forced or encouraged to specify artics except where they demonstrably cannot be used. We also made a promotional video for articulated tippers." Operator.

"Contracts should be awarded taking into account safety and emissions as well as price." Aggregate supplier.

"Developers should get more involved in decisions about vehicle types." Aggregate supplier.

"There should be some enforcement, or at least expectation that articulated vehicles MUST be used."

3.17.3. Several interviewees also mentioned that rigid tippers are deigned to meet European standards, with a maximum gross weight of up to 38T. In the UK they are plated to allow up to 32T. Hauliers think that relaxing this national restriction would allow payloads to be increased easily, leading to a reduction in vehicle movements.

3.17.4. Other hauliers and materials suppliers would like to see improvements in site standards.

"Site conditions need to be improved to meet CLOCS standards."

"Commercial models need to be aligned to encourage investment. Some commitment is required rather than the unitised, bundled arrangements that include delivery/disposal within the overall price. The commercial incentive needs to be more explicit. Be prepared to initially invest." Infrastructure developer.

4

CONCLUSIONS

4 CONCLUSIONS

4.1 SUMMARY OF FINDINGS

4.1.1. Our review confirmed that the rigid vehicles dominate bulk construction movements in London. This was true for both tippers and mixers. While the industry and its decision making processes are complex, the reason for the dominance of rigid vehicles can be summarised as industry concerns about safety and access within sites.

SITE SAFETY

4.1.2. Regarding safety, the concern is that tippers can and do tip over while unloading. Both rigid and articulated tippers must meet the same performance standards regarding stability. The data on the incidence of tip overs, particularly the relative incidence between rigid and articulated tippers, is poor. While incidents undoubtedly happen it seems that they are rare, and almost always avoidable.

4.1.3. There is evidence that the design of articulated tippers, in particular, has an impact on stability.

4.1.4. Some operators are content to use articulated tippers and ensure safety by checking construction sites, applying best practice for safe unloading, and training drivers appropriately. Others are using articulated vehicles with safety adaptations and precautions ranging from non-stick liners to moving floors and tipping frames. CLOCS is setting standards for construction sites so that conditions can be assessed and improved for safe movement on site.

4.1.5. There is a wealth of best practice and case studies that illustrate that articulated bulk HGVs can be used safely in most situations.

4.1.6. Unfortunately some contractors will not accept the use of articulated vehicles, and some construction sites have blanket bans on the use of articulated bulk HGVs.

ACCESS

4.1.7. Access onto sites should also not be an issue. Articulated vehicles routinely access almost all construction sites carrying products such as windows or structural beams.

4.1.8. Within sites, while articulated and rigid tippers have similar turning circles, it is true that articulated vehicles need slightly more space to unload and cannot climb the steepest gradients in poor conditions. In most cases, minor site adjustments can make sites accessible for both rigids and articulated HGVs.

DEMOLITION MATERIAL AND EXCAVATED SPOIL

4.1.9. These products present particular challenges. Some materials are “sticky” and so difficult to tip. Sites at both ends of the journey frequently have very poor conditions with unmade roads.

READY MIXED CONCRETE

4.1.10. Articulated mixers are particularly rare in London. Interviewees informed the study that batching plants in the city are often small and hard to access. Rigid mixers are well suited to the scale of most orders. However, there is evidence that articulated mixers are a cost effective and efficient solution for big pours, and there are signs of industry acceptance of articulated mixers in this role.

BENEFITS

4.1.11. The benefits to the construction industry are clear: potentially a 30% reduction in the cost per tonne for transport when using standard articulated tippers compared to standard rigid tippers. Using moving floor semi-trailers reduces the benefit to 20%.

4.1.12. For society as a whole the benefits are even greater – potentially a 37% reduction in vehicle numbers (30% for moving floor), and a 32% reduction in CO_2 emissions (25% for moving floor).

Fewer vehicle movements will result in lower emissions, reduced congestion, and improved highway safety.

WHO BENEFITS – WHO PAYS THE COSTS

4.1.13. The direct beneficiaries of transport cost reductions may be the materials suppliers. However, their costs savings are likely to eventually feed through to reduced construction costs – a benefit for developers.

4.1.14. There are two types of additional costs involved in using higher capacity vehicles:

- Costs to the haulier of investing in larger vehicles – recouped as long as materials suppliers differentiate between articulated and rigid vehicles when paying for transport
- Costs to the contractor of ensuring that sites are suitable for articulated vehicles. Depending on the site this could be zero or a modest sum to re-plan handling areas. This should be recouped through lower materials costs and a reduction in the number of vehicles to be managed on site.

Organisation	Benefits of larger vehicles	Costs of larger vehicles
Planning Authorities	Reduced vehicle numbers. Reduced congestion.	None
Developer Client	Reduced materials costs. Compliance with CLP Reduced impacts on neighbours	Possible increased costs to make sites suitable
Infrastructure Client	Reduced materials costs. Compliance with CLP Reduced impacts on neighbours	Possible increased costs to make sites suitable
Lead Contractor	Reduced materials costs. Reduced vehicle numbers on site Reduced traffic management issues	Possible increased costs to make sites suitable
Demolition Contractor	Reduced costs of transporting material.	Requires vehicles which may not be useable on most projects.
Other Contractors	Reduced costs of transporting material	May require changes to site layout and planning.
Site Logistics Contractor	Reduced numbers of vehicles on site. Reduced traffic to and from site.	Need to ensure site is suitable and safe for larger vehicles.
Materials Supplier	Reduced costs of transport. Makes supplier more competitive – increases market.	Requires investment in new vehicles.
Waste Contractor	Reduced costs of transport. Makes supplier more competitive – increases market.	Requires investment in new vehicles.
Transport Operator	Reduced transport costs – some opportunity to increase returns. Easier to manage smaller fleets on major projects. Fewer drivers required.	Investment in new vehicles. Need to train drivers for larger vehicles.

INDUSTRY TAKE UP

4.1.15. The construction industry in London is already seeing a growth in the use of articulated vehicles for bulk transport. The main focus is on new investment in moving floor semi-trailers, although some operators are happy to use standard articulated tippers with suitable precautions.

4.1.16. Moving or sliding bogies are a relatively recent introduction that seem to offer useful benefits.

4.1.17. Initial growth has been in the captive market between permanent facilities controlled by the major aggregates companies. But materials suppliers and hauliers who have invested in articulated vehicles are demonstrating those vehicles to contractors with the aim of widening their use.

DIFFICULT MARKETS

4.1.18. There is evidence that the concrete industry is not yet ready to make extensive use of articulated vehicles in London. This is due to site restrictions, a smaller payload advantage, and the suitability of smaller vehicles for typical delivery batches.

4.1.19. There is also evidence that businesses transporting spoil and demolition rubble may be slower to take up use of articulated vehicles. They have more difficulty with site conditions and with managing payloads to keep within weight restrictions.

KEY CHALLENGE

4.1.20. The key challenge is to support hauliers and materials suppliers in their efforts to persuade contractors and developers that the benefits of using articulated vehicles outweigh any actual or perceived costs or safety concerns.

4.2 POTENTIAL MEASURES

4.2.1. Improving the average payload of bulk vehicles carrying construction traffic can be seen as a good example of where interventions from TfL can accelerate an industry trend which is already visible. There is a window of opportunity as current use of articulated vehicles is focussed on core flows where materials suppliers can control volume and secure investment in new vehicles. Extending this success to the wider construction industry faces barriers of perception and habit.

4.2.2. A range of measures were suggested by interviewees or in discussion with stakeholders. These range from simply providing information, to restrictions on vehicle types.

INFORMATION

4.2.3. TfL has achieved significant success by encouraging the sharing of best practice in logistics, particularly through the FORS and CLOCS programmes. Through commissioning research and publicising case studies TfL has supported transport businesses to improve safety, compliance, and environmental performance.

4.2.4. This report has clearly identified and addressed the concerns which have deterred greater use of articulated vehicles in the construction sector. Circulation of the report and its case studies will be a first step in providing information to show that articulated vehicles can be used efficiently and safely.

4.2.5. The effectiveness of the case studies will be enhanced if they are available on the internet and if they feature in FORS and CLOCs training and publicity. The case studies should also be circulated to planners, consultants, and developers.

PROMOTION

4.2.6. A step up from providing information passively is to consider arranging workshops and presentations to actively promote the use of articulated bulk vehicles. This could include Best Practice workshops for construction businesses.

CONSTRUCTION LOGISTICS PLANS

4.2.7. CLPs are TfL's primary tool to promote and require construction logistics best practice for planned developments. TfL's new guidance for CLPs is more prescriptive than previous versions. In particular, developers and contractors are expected to demonstrate that they have assessed a range of best practice options to reduce the impact of construction traffic.

4.2.8. CLPs should have clear guidance on the costs, benefits, and safe usage of articulated vehicles. Businesses completing CLPs should be expected to use articulated vehicles unless they can demonstrate clear reasons why use would not be appropriate.

PLANNING RESTRICTIONS

4.2.9. TfL and London Boroughs can set restrictions on construction sites as part of the planning approval process. The most common restriction is for hours of operation, but in some cases the number of vehicle movements may also be restricted over a nominated time period.

4.2.10. It seems that Boroughs may also be able to require contractors to use articulated vehicles. However, the Borough would need to be sure that this was a deliverable and pragmatic option that would not impose unreasonable costs on the developer.

CHANGED PLATING FOR RIGID VEHICLES

4.2.11. Finally, several hauliers suggested that relaxing the maximum gross weight for rigid tippers to 38T would provide immediate benefits in terms of fewer vehicles. However, this is a nationally set standard, and change would need to go through an extensive consultation period.

4.3 RECOMMENDATIONS

4.3.1. The construction industry (suppliers, contractors, hauliers, and developers) is open to the idea of increasing the number of articulated bulk vehicles carrying construction materials in London. While the industry itself is making progress on this issue, with evidence of recent innovation, there are obstacles including concerns about safety and access, even though these can be addressed.

4.3.2. A key objective should be to discourage contractors or construction sites from any blanket restriction on articulated vehicles. Open access should be the norm, and restrictions should only be imposed if there is evidence that this is necessary.

RECOMMENDATION 1: CONSTRUCTION LOGISTICS PLANS

Construction Logistics Plan Guidance should be modified with the addition of the following section to the Planned Measures that should be agreed and committed to during the planning application process.

CLP Planned Measure: Use of Articulated Vehicles

Using articulated vehicles can be a cost-effective and efficient method of transporting a range of goods and commodities. It is a sustainable approach that reduces the number of construction vehicles on London's roads, and can reduce the amount of harmful emissions associated with a development. The development should specify that articulated vehicles are welcome at the site, and contractors should be required to assume that articulated vehicles will be used during construction.

Where there is doubt that safe unloading locations can be provided, or where access may restrict articulated vehicles, evidence should be provided as to why restrictions may be necessary.

4.3.3. CLP Training for developers, contractors, and planners should include a short section on the benefits of using larger vehicles with case studies showing safe operation.

RECOMMENDATION 2: CLOCS SITE ASSESSMENT RATINGS

CLOCS Site Assessment Ratings will be useful tool to help suppliers to understand ground conditions at new sites, and to help developers and contractors to plan sites to allow a larger range of HGVs to be received. However, the Site Assessment Ratings are primarily aimed at reducing the use of "off road" rigid vehicles (N3G standard). In itself this is useful as it highlights sites with poor ground conditions. However, this is not enough information for suppliers to decide whether articulated vehicles can be used or not.

In most cases, of course, hauliers or suppliers can find this information from a phone call or site visit. However, a key objective is to provide a standard which contractors can work towards when planning, designing, and managing a site.

One option would be to add a field to the assessment “Site is suitable for unloading from articulated tippers and mixers”. This could be added as a star to the ratings (e.g. CLOCS 1*). This would be a useful interim measure.

Another option would be to provide more detail on site conditions, notably cross fall of the unloading area in degrees (maxim 7), steepest egress gradient, and confirmation that the unloading area will be long enough for an articulated vehicle.

RECOMMENDATION 3: BEST PRACTICE INFORMATION AND ADVICE

This report includes information and case studies which make it clear how articulated vehicles can be operated for construction materials safely and efficiently. Information in this report also clearly identifies the benefits to the industry and to London. It is recommended that:

- Information from this report is circulated widely across the construction industry.
- TfL arranges two or three demonstration days, showing the safe operation of articulated vehicles.
- Information on the benefits and safe operation of articulated vehicles is provided on the Construction Logistics, FORS, and CLOCS websites.
- This report is included as a case study on the Safe Quarry and MPA websites.
- Borough councils and developers should be invited to a presentation explaining the benefits of articulated vehicle operations and how it can be encouraged

Appendix A

CASE STUDIES

CEMEX Case Study – Award Winning Tipper Safety Campaign

About CEMEX

CEMEX are a leader in the building materials industry that provides high-quality products and reliable service to both customers and the communities they work in. CEMEX aim to serve the needs of their customers and create value for their stakeholders by becoming the most efficient and innovative building materials company.

Each year within the construction industry, approximately ten people die on sites as a result of being struck by vehicles (Source CEMEX)

Since 2005, CEMEX have been on a journey to reduce accidents and have achieved a staggering 95% reduction in the number of reported employee lost time injuries - as they strive towards achieving their goal of zero injuries for life.

Rollover Campaign

Nationally, across the industry, CEMEX report that incidents of vehicle roll overs occur more than 20 times per year. CEMEX were determined to improve site safety and developed a major "Rollover Campaign" which included a series of leaflets emphasising Best Practice..

In terms of safe tipping, CEMEX believe incidents are caused by a combination of uneven and soft ground, as illustrated below. In terms of artic trailer combinations they advise drivers to ensure the whole vehicle train is positioned in a straight line, to reduce the risk of a rollover.

Source: CEMEX leaflet "5 Steps to Safer Deliveries"

CEMEX provide examples of safe and unsafe tipping and the following list of some of the most commonly cited reasons for rollovers:

- Tipping on an incline or uneven ground
- Tipping on soft ground that causes the trailer to sink and lean
- Load sticking in body or sitting unevenly on one side of the body
- Moving forward causing instability whilst load raised at height
- Not tipping with the tractor and trailer in line
- Raising body too quickly with excessive product left inside
- Load freezing / sticking to body floor
- Strong cross winds

CEMEX also set out the safety control measures drivers are advised to follow:

- ✓ Vehicle movements on site are controlled and adequately supervised
- ✓ Ensure that seat belts are worn – Seat belts save lives in vehicle roll over's and ensure heavy loose items in cab are secured
- ✓ Drivers stay in cabs unless required to assess tipping area, open / close rear doors
- ✓ If drivers exit cabs – they are wearing PPE
- ✓ Tipping vehicles have room to safely manoeuvre and tip with cab in alignment
- ✓ Weather conditions – high winds can compromise safety of tipping trailers
- ✓ If daylight is reduced – is the working area adequately lit

Significantly, CEMEX made all of their materials available publicly, notably through the Mineral Products Association's safety forum, SafeQuarry.com.

In June 2016 CEMEX won the Tipper Safety Award ate Tipex for this campaign.

The CEMEX campaign also includes a video which is available on YouTube: https://www.youtube.com/watch?v=NZE9wxuOx_8

International Case Study: DKLBC AG

The Company

DKLBC is a typical Swedish haulage company, acting in many ways as a conglomerate of smaller hauliers. Today, the company has more than 100 partners who have over 300 trucks and cars and machines in varying sizes and designs to meet market needs.

Stockholm Operation

DKLBC carries construction materials from all over Stockholm. Recently this has included many railway construction projects that have included the use of articulated rigs. But they also work on housing developments both large and small and in the early stages of projects including excavation.

Of the 165 vehicles used in Stockholm, all are operated by sub-contractors because that is their business model. Of the 165 tippers, 145 are rigids and 25 are articulated.

Unusually, compared to a UK operation, 25 of their rigid vehicles operate as a rigid tipper plus a tipper trailer (drawbar type operation).

Figure 1: Rigid + Trailer Combination

Typical Operations

Typical shifts are 8.5 hours Monday to Thursday and 6 hours on Friday. Most trips are short distance, but disposing of spoil sometimes requires longer journeys. These trucks rarely cover more than 500km in a day, usually 250km to 400km.

They offer a variety of vehicle types:

- Artic: 6-7 axles and loads on average 30 tones.
- Rigid: 3 axles loads 13 tones. Tridem loads 16-17 tones.

- Rigid+trailer loads 33 tonnes to 40 tonnes

Larger Vehicles In Operation

They use articulated tippers or rigids plus trailers whenever space allows.

Figure 2: Rigid + Trailer Combination

They find that artics can nearly always access a construction site, but this is not true for a rigid with trailer. Easy and quick access is crucial. A rigid+trailer takes more time to manoeuvre and when they unload they have to disconnect the trailer which takes even more time. Artics have the advantage of getting in or out quickly and have a larger load per trip, and are considered to be the preferred HGV type.

DKLBC tries to help clients by having input on access roads and such. But artics will are always deemed to be OK.

The main limitation on the use of larger vehicles are vehicle restrictions which are in place in many urban areas, limiting them to use rigids.

DKLBC think the use of artics will grow:

“Everybody will benefit from that. Take fuel consumption, an artic vehicle might use 30 % more diesel, however they load three times as much as rigid and the environmental benefit is significant as well as the economic impact. The more material you can load, the lower you can reduce price per ton. Construction projects will be cheaper, and hopefully also for the end customers. It is a huge difference with artics compared to rigids when it comes to costs.”

Hanson: Articulated Mixer Case Study

Company

Hanson UK is a leading supplier of heavy building materials to the construction industry. They produce aggregates (crushed rock, sand and gravel), cement, and concrete materials.

Hanson UK are part of the HeidelbergCement Group, one of the largest building materials manufacturers in the world, the global market leader in aggregates which also has leading positions in cement, concrete and other downstream activities. The Group employs around 45,000 people at 2,300 locations in 40 countries. The UK headquarters is in Maidenhead.

Their principal markets are the major conurbations in England and Wales and the central belt of Scotland. Where practical Hanson locates its production sites close to core markets to reduce the costs and impact of transport.

Fleet

Hanson has a fleet of more than 1,200 vehicles to deliver its products, including 850 tippers and mixers operated by independent owner-drivers under a franchise agreement.

Recently, the company has been trialing a new vehicle configuration for its cement mixers in several locations around the country. Hanson have typically used either 6x4 or 8x4 rigid mixer vehicles.

Figure 3: McPhee Mixers

The new configuration consists of a DAF tractor and a trailer supplied by Muldoon Transport Systems and uses a McPhee mixer.

Figure 3: DAF Tractor & Trailer with McPhee Mixer, Source: Commercial Motor (Roger Brown)

Another feature of this new trial set-up is the fact the tractor engine is used to power the mixer drum instead of a separate auxiliary engine, which is the system used on many mixer semi-trailers. This has reduced the tractor-trailer kerbside weight to 16,500kg.

Hanson's Regional Transport Manager Tim Sage commented "the truck/trailer combination has been a resounding success on sites across the UK - our operations team are all responding with positive feedback – there's certainly the potential for more units to come into service".

According to Tim the new vehicle configuration can carry 12 cubic metres on certain products which is almost double the volume compared to the usual vehicles used.

Hanson have been able to demonstrate through this trial that artic vehicles are suitable for delivering materials to construction sites. The higher volume capacity has improved productivity, reduced the number of vehicle trips and emissions and operationally the vehicle has been able to safely navigate London's streets.

Hargreaves Moving Floor Trailers Case Study

The Company

Hargreaves Services Plc delivers key projects and services in the infrastructure, energy and property sectors. One of their constituent businesses is Hargreaves Logistics, which has grown to become one of the largest bulk haulage operators for customers across the United Kingdom.

Hargreaves was named Tip-Ex Haulier of the Year 2012, and has been a finalist in the Motor Transport Haulier of the Year competition in 2013 and again in 2014.

The Hargreaves reputation is the result of continuous and significant investment; in vehicles designed to tackle an increasingly wide range of tasks, and in people who are the very best in their profession.

Hargreaves operates a fleet of more than 250 vehicles, in both their own and clients' liveries, and their fleet is enhanced by the use of approximately 250 dedicated sub-contracted vehicles. This combination gives greater capacity than most competitors, and it also provides a huge degree of flexibility.

Construction Sector

Much of Hargreaves heritage stems from hauling coal between pits, concentration depots, and end users such as power stations. Here, the articulated tipper rules, and is the only way to compete where pricing is tight.

Hargreaves also operates in the construction sector, notably from a depot in Harlow which services customers in Hertfordshire, Essex, and London. Hargreaves recognised that many sites would not accept deliveries in articulated tippers, and so their core business is supplied by rigid tippers.

Hargreaves wanted to bring the same economies of scale to their clients in the South East as they provide to their industrial clients elsewhere. Recognising the concerns about safe tipping on construction sites, Hargreaves have invested in a number of articulated bulk trailers equipped with moving floors.

Moving Floors In Operation

A lot of Hargreaves' work is on major infrastructure projects such as road building or railways. Presently Hargreaves have focussed their articulated vehicles on these projects, where cost per tonne for huge volumes of materials might be crucial.

Using an articulated vehicle makes good economic sense. While the combination might cost £170k compared to £100k for a rigid, driver costs and fuel costs are almost the same (with perhaps 8.5mpg in an artic versus 7.5mpg for a rigid.)

The V Floor walking floor system selected by Hargreaves is manufactured by Keith. Keith are the main suppliers of moving floor systems, and own the trademarks “Walking Floor” and “V Floor”. The V Floor differs from standard walking floors in that the floor slats are in the shape of an upturned V. This is well suited to aggregates and maximises the volume of material emptied.

V Floor are available in aluminium or steel, but most aggregates hauliers, including Hargreaves, select steel for durability.

Hargreaves have found that the moving floor trailer work extremely well, with unloading times only 30 seconds longer than for a smaller rigid tipper. The biggest challenge is persuading sites to accept the vehicles, with some sites still turning away any articulated vehicle. However, Hargreaves is prepared to work with its customers to demonstrate the benefits of moving floor operations. They often arrange trial loads or demonstrations for their customers.

Hargreaves believe that once customers see the benefits of the walking floor in providing very safe operation but with high payloads, they will switch away from using rigid tippers for most jobs.

Tarmac Case Study

The Company

Tarmac, a CRH company, is the UK's leading sustainable building materials and constructions solutions business. They provide services and solutions with the aim to help deliver the infrastructure needed to maintain the growth of the economy. They are the UK's largest supplier of construction materials.

Tarmac are a company dedicated to providing safe working conditions and committed to delivering value to their customers. Tarmac have over 150 years of experience and with that experience they have combined breadth of capability and expertise that extends to aggregates and asphalt, ready-mix concrete, cement, lime and powders, contracting and building products.

Tarmac are a substantial employer of nearly 7000 colleagues, operating on around 400 different sites. These include access to 120 quarries, 74 asphalt plants, 100 ready-mix cement plants, 22 contracting offices and three cement and lime plants.

Moving Floor Trailers

Tarmac made a deliberate change circa five years ago, to invest in Moving Floor Trailers. This was part of a company wide drive towards safety and flexibility.

Initially, there was substantial internal resistance to change (which still has pockets of vocal supporters). The Moving Floor Trailer mechanism has however proved fairly reliable, with mechanical problems encountered often proving to be age related issues once investigated (e.g. Valve box worn etc.).

Tarmac do not allow artic tippers on potentially unstable/ ground, however many deliveries are to permanent locations (e.g. Concrete batching plant) where the company has greater control over conditions.

The positives for Tarmac of Moving Floor Trailers are that they are a lot safer, with the 'body in air' concerns being completely designed out. With the associated camera systems, they can also be unloaded from inside the cab, so the driver does not need to be placed at greater risk than necessary.

Very little cross contamination has been observed, with the retractable headboard sweeping the floor sufficiently clean (however this will depend on precise material being transported).

With respect to timings, loading times show no real difference between Moving Floor Trailers and artics, however unloading times are negligibly longer on Moving Floor Trailers.

A recent site visit witnessed two deliveries, namely 40mm shingle and sand to a concrete plant. Both successfully showcased the Moving Floor Trailer technology, but a mechanical problem halted the concrete plant delivery. The reliability of newer vehicles is noted as being much improved compared to the earlier Moving Floor Trailer technology, but fundamentally, the additional moving parts require maintenance, which increases expenditure. Contract rates for delivery therefore need to reflect higher maintenance costs and cost of ownership.

In the UK, there three main Moving Floor Trailer manufacturers, who use either Keith or Titan mechanical moving floor solutions:

- Wilcox (Keith);
- Martrans (Keith); and
- Newton (Titan).

There are no extra qualifications to drive a Moving Floor Trailer, which aids take up by drivers. In informal conversations with drivers, all drivers stated how challenging artics were in dense urban areas (e.g. Central London), as buildings are so close together.

Future Use

Tarmac actively promotes use of moving floor trailers, because they are relatively safe and offer substantial cost and emissions savings. As an example, a major customer wouldn't accept articulated vehicles. So Tarmac spent a day with them with moving floor trailers, and showed them how they worked. They also showed a promotional video to show the benefits, and they worked on site with senior directors/ managers of business – once they saw everything it was fine ' a no brainer'.

Case Study: Trailer Options

Moving Floor Trailers

We know there are several options available when selecting a tipper – from 4 wheelers, the most commonly used 6 or 8 wheelers, through to tipper trailers and moving floor trailers.

"Eight wheelers barely exist in Europe, since everyone uses bulk trailer combinations", said Andrew Smith, Managing Director of Newton Trailers in April 2011 (Source Transport Engineer, April 2011).

So what is the difference between construction sites in the UK versus the continent? In the UK, construction vehicles have to negotiate unmade tracks, making rigids more attractive, whereas in Germany for example the roadways go in first.

Andrew Smith, Managing Director of Newton trailers insists that for the vast majority of on-road applications, tipping trailers are just as driveable as rigids. Payload and efficiency are of course significantly better with the artic trailers.

So where is the resistance? Using artics does require greater driving skills and perhaps some companies are not willing to invest, Smith believes that change is happening, in the area of bulk waste for example.

Smith believes horizontal discharge trailers will eventually take over. The discharge rates should also be of great appeal. A modern 90m3 moving floor trailer will complete a discharge in just over seven minutes, which is only slightly more time and yet with 50% more material. Research carried out by Transport Engineer magazine has shown that an operator with 16 trailers could expect to save around £300,000 per year in reduced journeys and fuel.

Rear Steers

If UK operators were willing to add rear steers to their tipping trailers, this would exceed the maneuverability of an eight wheeler. IMS Ltd is the sole distributor of VSE – a leading manufacturer of intelligent steering systems for trailers.

With the VSE system, operators have easy access to urban locations previously unreachable with conventional trailers. In many instances, a VSE-equipped trailer can replace rigid prime movers and 'urban trailers'

The VSE steering system allows use of a 13.6 metre trailer in any operation where a 12.6 metre urban trailer is normally used, and even a number of occasions where 10.5 metre urban trailers would typically be deployed. As well as improved manoeuvrability, rear steering reduces scrub on tyres, which in turn reduces costs and environmental impact.

This innovative and highly configurable steering system is available for one to three steered axles and axle loads of 5 up to 16 T. It can be fitted to trailers with 17.5", 19.5" and 22.5" rims; both single and double tyres.

The system is fitted to the trailer shown below, provided by Priden.

Sliding Bogies

The sliding bogies tipper is relatively new to the market. Trailer manufacturers Dennison provide an example, which has been successfully used by hauliers such as GRS Roadstone.

Dennison claim the following benefits from the sliding bogies system:

The Dennison sliding bogie is a truly innovative tipper that offers remarkable benefits to operators of eight wheel rigids. Dennison sliding bogie tippers save time and money by reducing the number of trips needed to deliver materials to sites – even those with restricted access up to 10 tonne more payload over an 8 wheeler.

They can shed a full metre in length, meaning that when coupled with the flexibility of an artic rig, they can get into places that even eight-wheel vehicles can't. They carry up to 50% more payload than an eight-wheel tipper, operate legally at 44 tonne GVW and can cut fuel consumption by up to 19%.

Key features of their straight frame tippers include:

- Operates legally at 44 tonne GVW
- Saves on time and fuel costs
- Slides a full metre for flexibility and maneuverability
- Up to 50% more payload than an equivalent 8-wheeler
- Added safety feature stops tipping when chassis is in open position
- Stability tested to 8.5°


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