Evaluation of the Longer Semi-Trailer Trial: Annual Report 2020 Update

A report for the Department for Transport

July 2021

Issue 1

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Client reference: 1-1025 P4102020

Report reference: J0083-20 (AR2020)

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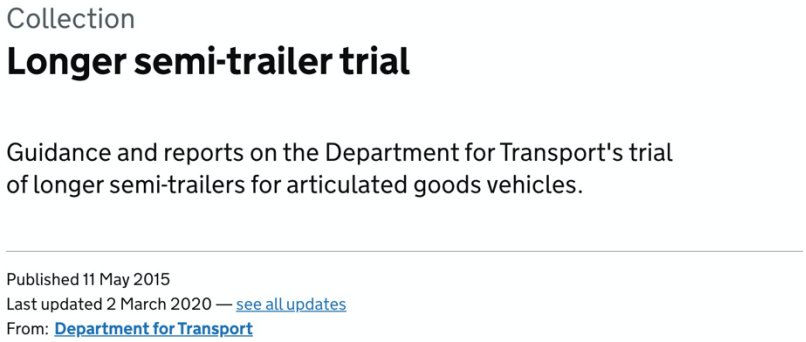
LST Trial information and contacts

The latest information regarding the trial, including participation criteria and data collection requirements, are always available from the DfT website.


Collection
Longer semi-trailer trial

Guidance and reports on the Department for Transport's trial of longer semi-trailers for articulated goods vehicles.

Published 11 May 2015
Last updated 2 March 2020 — see all updates
From: Department for Transport

For questions relating to the trial contact:

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The project is sponsored by the DfT Freight Policy Group. All communications should, in the first instance, be directed to the project manager/sponsor.

Acknowledgements

Risk Solutions and the Department for Transport (the DfT) would like to record thanks to all operators on the trial, especially the individual data contacts, for their continued positive cooperation and hard work in collating, cleaning and submitting data in keeping with the operator undertaking. Without this effort evaluation of the trial could not take place.

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LST TRIAL EVALUATION: HEADLINES

(Rounded figures – as at 31 Dec 2020 except where stated otherwise)

Trial Take Up

2,696	LSTs registered on current or past Vehicle Special Orders (VSOs) and not confirmed as scrapped as at May 2021 (96% of revised trial maximum of 2,800 trailers)
2,621	LSTs on the road and submitted trial data (93% of revised trial target of 2,800 trailers)
250	Number of operators with trailers on the road and **due** to submit data in final period of 2020. Note – increased to 272 for the first period of 2021.

A Vehicle Special Order (VSO) grants permission for a specific operator to operate specific special trailer(s) on GB roads for the duration of the VSO. All LSTs require a VSO from the Vehicle Certification Authority (VCA) before the trailers go on the road.

Utilisation and km saved

7.2 million	Journey legs travelled by LSTs during the trial
899 million	km travelled by LSTs during the trial. Analysis in 2017 showed LST usage to be 85% Trunk, 13% Principal & 2% Minor Roads
66 to 73 million	Vehicle km saved by LST operations (end 2020). Lower - Upper estimates (Upper includes matched empty return legs)

Journeys saved

Estimates of equivalent standard (13.6m) trailer journeys saved across the whole trial period and all operators

525 to 582,000	Journeys by standard trailers saved by using LSTs based on 125km average journey. Upper estimate (including some return legs) is used in the saving and emissions figures that follow
1 in 12 (8.3%)	Average saving across all operators, 1 in 'n' journeys
1 in 7.5 (13.5%)	Highest saving achieved by individual operators, 1 in 'n' journeys

Emissions Saved

To date 2012-20 and Trial projection to 10 years

To Date	10 Years	Emission type	
60,000	68,000	CO2(e)	Tonnes of CO2(e)
92	96	NOx	Tonnes of NOX

of which 6.2% saved within 200m of 'Designated Areas' (2017 modelling estimates)

Carbon dioxide equivalent or CO2e is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO2e signifies the amount of CO2 with an equivalent global warming impact. Savings of CO, PM (Exhaust) and VOC are also calculated in the report.

NOX savings are lower than projected in AR2019 as Euro VI engine impact is now being modelled.

Injury incidents – National Comparison

Collisions	Casualties	*Collisions / Casualties where LST on public highways or public access areas (2012-2020) resulting in injury*
46	58	All personal injury incidents involving an LST
4	4	Incidents/casualties judged to be 'LST Related'
53	59	Three-year average safety incident rate (ALL collisions or casualties per billion LST vehicle km, 2018-2020)
98	138	Equivalent three-year rate for all GB articulated HGVs, (per billion vehicle km 2017-2019 - 2020 not yet published)
0.53	0.43	Collision/Casualty rate ratio (LST vs All GB Artic. HGVs)

On a per kilometre basis, nationally, we estimate LSTs have been involved in around 47% fewer personal injury collisions than GB articulated HGV average.

Injury Incidents – Road Type Comparison

URBAN	MINOR	*Collisions / Casualties where LST on public highways or public access areas (2012-2020) resulting in injury*
6	5	Personal injury incidents involving an LST (All – regardless of any 'LST Related' judgement)
51	278	Safety incident rate (collisions per billion LST vehicle km)
511	861	Equivalent rate for all GB articulated HGVs over whole trial period, 2012-2019 (per billion vehicle km)
0.10	0.32	Collision rate ratio (LST vs All GB Artic. HGVs)

On a per kilometre basis, compared with the average for all GB articulated HGVs, LSTs on the trial have been involved in 90% fewer personal injury collisions per km when operating on roads in urban areas and 68% fewer when on minor roads.

Injury Incidents – Vulnerable Road Users *(Regardless of whether it was "LST related")*

Collisions	Casualties	*LST collisions on public highways or public access areas (2012-2020) that resulted in one or more injury to a pedestrian or cyclist*
4	4	All LST personal injury incidents and casualties where a pedestrian or cyclist was involved
4.45	4.45	LST collision and casualty rates (per billion vehicle km) over whole trial period, 2012-2020
10.31	10.71	Equivalent rates for all GB articulated HGVs 2012-2019
0.43	0.42	Rate ratios (LST vs All GB Artic. HGVs)

The LST injury incident rate for vulnerable road users in all locations, appears to be lower than that for the GB HGV fleet, but there are too few incidents for the difference in rates to pass a classical statistical significance test.

Damage Incidents – Comparison within sample of operator fleets

LST	Non-LST	*2018 data from 92 operators for LSTs and Non-LSTs in the same fleet*
0.87	6.7	Mean number of incidents expected for an LST fleet and a non-LST fleet after 1 million vehicle km exposure.

On a per kilometre basis, the average number of damage incidents for non-LSTs is greater than that for LSTs by a factor of about 8.

Executive Summary to 10th* GB LST trial Annual Report

**Although the trial has been running for eight years, this is the 10th report as in some years two reports were issued.*

Background

The Department for Transport (DfT) is evaluating the impact of the operation of longer semi-trailers (LSTs) on Great Britain's (GB) roads. These trailers are up to 2.05m longer than the standard 13.6m units commonly seen on the roads in this country. The DfT launched the 10-year trial in 2012, permitting up to 1,800 trailers to operate under Vehicle Special Orders (VSOs) granted by the Vehicle Certification Agency (VCA). In 2017, the DfT extended the trial, adding a further 1000 trailer allocations and 5 years. At the time of writing (May 2021) around 2600 trailers are on VSOs and are expected to be on the road during 2021.

Evaluation scope

A reduction in emissions may be expected from using LSTs because when operated efficiently they allow the same quantity of goods to be transported in fewer journeys. The question is whether this can be done without a detrimental effect on safety or asset damage.

We have expressed these aims in terms of seven evaluation questions:

1. What do operators use LSTs for?
2. What are the savings realised in HGV journeys?
3. What are the resulting reductions in emissions?
4. What about safety – will LSTs cause more injuries?
5. What about damage and the associated costs – will LSTs cause more damage?
6. Might any special operational requirements be appropriate for LSTs?
7. What proportion of the existing GB fleet of semi-trailers might be replaced by LSTs?

Evaluation approach and methods

The design of the evaluation and the methods used to collect and analyse the trial data are summarised in this report. Full explanations of the approaches used, where these have not changed from previous years, can be found in previous annual reports and published project notes. A route map to these is provided in Annex 1.

Progress against evaluation questions and changes in 2020

In our report on the trial to the end of 2019 and we were pleased to be able to say that **we believed we had sufficient quantitative data and other evidence to provide a robust evaluation response to all seven key evaluation questions.**

In this, the report to the end of 2020, we provide updated quantitative results, further supporting the trial conclusions in AR2019 and confirming that there were no new developments or indications in the data that detracted from those conclusions.

The sole quantitative change to report is that we have now changed the basis of calculation used for the emissions modelling to incorporate the growing use of Euro VI class engines during the lifetime of the trial, which reduces the reported net saving in NOX and other air quality related emissions, whilst not significantly affecting the estimates for reductions in greenhouse gases (CO2e).

LST Trial 2020 Annual Report Summary

For an overview of the whole trial, readers may refer to the **2020 Annual Report Summary** designed to meet the interest from public sector leaders, haulage industry, and civil society groups who have a valid interest in the key results of the trial, and the evidence supporting them, but do not necessarily have the resources to study the main report.

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1 INTRODUCTION

The LST trial timeline

1.1 The Department for Transport (the DfT) has been running a trial of the operation of longer semi-trailers (LSTs) on roads in Great Britain (GB) for the past eight years.

1.2 These trailers are permitted to be up to 2.05m longer than the standard 13.6m units commonly used in this country. Details of the trial can be found on the DfT website.

1.3 The trial was created to gather evidence about the operational performance of LSTs in terms of safety, environmental impact and economics. In order to participate in the trial, hauliers sign an 'Operator Undertaking' which included a commitment to data collection.

1.4 The trial was originally scheduled to last for 10 years from its launch in 2012 and allowed up to 1,800 LSTs to be built and operated. The first semi-trailers were granted Vehicle Special Orders (VSOs) early in 2012 and data collection began on 1 May 2012. (Note: A VSO grants permission for a specific operator to operate specific special trailer(s) on GB roads for the duration of the VSO. All LSTs require a VSO to operate legally as they exceed the standard length. The operator must apply to the Vehicle Certification Authority (VCA) for a VSO before the trailers are used on the road, citing all the trailer Vehicle Identification Numbers (VINs). This is often done as soon as the VINs are fixed by the manufacturer during build.)

1.5 In January 2017 the DfT agreed to extend the number of semi-trailers in the trial by 1,000 trailers and extended the prospective trial length by 5 years to 2026/7. This followed an industry consultation during 2016. In March 2017 the DfT invited operators to bid for a share of this additional allocation. The first LSTs from this new allocation entered service from 1 May 2017. View details of the trial extension on the DfT website.

1.6 The outputs from the trial are intended to feed into a decision about whether to permit an increase in the length of semi-trailers authorised for operation on roads in GB beyond the trial. More broadly, subject to acceptable outcomes in terms of safety and property damage, the trial was designed to contribute to the DfT's work to:

- identify deregulatory measures to reduce burdens on business; and
- identify measures to reduce carbon emissions from HGVs.

1.7 In November 2020, the DfT published an initial policy impact assessment, setting out their initial proposals for three possible policy regimes under which LSTs might be operated outside the current trial conditions. The impact assessment was published alongside the 2019 Trial Annual Report.

1.8 At the same time, the DfT launched a consultation on:

a. Whether each of the policy options was viable
b. Whether the trial should end early, with one of the options being implemented.

The trial evaluation timeline

1.9 Fuller details about the design of the evaluation and methods used can be found in previous annual reports. A route map to the detailed description of methods used for each aspect of the evaluation can be found in Annex 1 and references are provided throughout the report. (Note: references are given in the form AR20nn, for example AR2018 refers to the 2018 trial report published in 2019. A link to each report is provided the first time the report is referred to. Links to all the reports are provided in Annex 1.)

1.10 Clicking on the report title links to the web page on the DfT website where the report, and any accompanying published project notes (PNs) can be downloaded

1.11 The primary objective of the trial is set out in the 2010 impact assessment of LSTs (IA no. DfT 00062). It is to provide evidence to the DfT to support long term policy decisions on **"…. the most socially beneficial length of Heavy Goods Vehicle semi-trailers"**.

1.12 The DfT commissioned Risk Solutions as an independent evaluator, so that:

- The raw operational data would remain confidential – it is not seen by or available to the DfT or any party other than the originating company and Risk Solutions. Without this arrangement many companies would not have been willing to participate or would have only agreed to provide summary data.
- The analysis of the data and the conclusions are made independently of the DfT.

1.13 Trial data is analysed and reported on annually, and recommendations are made regarding the conduct of the trial where appropriate. View all our Annual Reports and a number of supporting documents.

1.14 Risk Solutions was re-commissioned to continue in the role of independent evaluation consultant for the trial in 2013, 2015 and 2017. The company was re-appointed for the period 1 January 2018 to 31 December 2019 via a competitive process, and to September 2021 by a further direct award. At the time of writing, this has been further extended to March 2022, to allow time for the emerging DfT policy development process and any subsequent legislation, to be completed.

1.15 The trial was set to run for a long period to ensure it generated a sufficient volume of reliable data for a decision to be made whilst also allowing participants to recover the costs of investing in LSTs.

1.16 For the first six years of the trial the data collection requirement was quite onerous, with details of each journey made by each trailer reported and analysed in detail. Details of the data collection requirements and processes can be found in the early trial annual reports (2012-14) and in the guidance given to operators. The datasets collected have provided a rich picture of the performance of LSTs. (Note: Annual Reports and details of the data collection requirements can be found on the DfT web-site.)

1.17 The stability of the datasets generated in this way, and the level of detail collected, enabled the DfT to reduce the burden of data collection on operators at the end of 2017.

1.18 From the start of January 2018 (2018-P1) a new data collection framework was introduced. This framework requires only summary data on overall trailer operation but captures an increased level of detail on any incidents that have occurred.

1.19 The new 2018 data format also required operators to provide details about non-LST incidents and vehicle-kilometres for their comparable non-LST fleet, just for 2018.

1.20 Finally, from mid-2019, operators with more than a full year of consecutive, acceptable past data submissions, are being migrated to a short-format data submission which collects only the total number of legs and distance for each trailer, as well as any incident data. Details of the updated data collection processes can be found in AR2019.

About this report

1.21 This is the 10th GB LST Trial Annual Report and it covers the performance of the LST fleet on the road up to the end of 2020.
(Note: Although the trial has been running for eight years, this is the 10th report as there was a 'first evaluation' report and then in 2014 we published the results in two parts, either side of the 2015 general election.)

1.22 As in 2018 and 2019, it presents updates to existing key results tables and charts without repeating the related detailed method statements. Details of methods, unchanged from previous years, can be found in previous annual reports as listed in Annex 1

1.23 Terminology used in the trial and data collation is also defined in those earlier reports. Major terms appear in the glossary.

1.24 The remainder of this report presents the summary of results as follows:

- Section 2 presents data concerning:
  - Trial trailers and participants, and
  - Operational data – distance covered by LSTs, nature of use, and how well the extra capacity has been utilised.
  - In particular, this section reports on an increase in the number of very small operators on the trial and explains why this trend has grown since 2019.
- Section 3 presents findings in terms of key trial outputs – most notably the savings in distance and number of journeys from the operation of the trial LSTs.
- Sections 4, 5 and 6 present the resulting trial outcomes, in terms of emissions saved (4), safety impact (5) and (repeated from AR2019) collisions resulting in damage (6).
- Section 7 refers to the consultation with a selected group of operators to collate industry insights covering the issues considered and measures taken by real operators when adopting LSTs, in particular focusing on establishing an efficient and safe operation. The resulting industry insights document was published alongside AR2019.
- Section 8 – Scaling-up refers to the equivalent section in AR2019 which describes the work to map the trial savings in journeys, emissions and injuries, to the freight carriage data for the whole GB fleet of articulated HGVs expressed in the Continuing Survey of Road Goods Transport (CSRGT). Once mapped, this then generates a model to provide long term projections of the potential impact of LSTs under different scenarios. In this year's report we outline a number of small additions made to the model in order to enable the DfT to perform scenario analysis, as well as the incorporation of the emissions modelling for Euro VI class engines.
- Section 9 – Additional analysis notes that while there has been no completely new special topic analysis this year, the evaluation team have provided support and challenge to the DfT policy options and impact assessment, focusing on ensuring the trial evidence is applied appropriately. In addition, trial insights have been developed where relevant to DfT considerations of other larger or heavier vehicle formats.
- Section 10 notes that the 2020 data does not contain any quantitative or qualitative results that change the broad answers to the seven evaluation questions presented in AR2019 and refers readers to that report for the summary.
- **As in previous years, a summary of the whole trial process and results will be published on the DfT website alongside this full report.**

2 TRIAL PARTICIPANT AND OPERATIONAL DATA

2.1 In this chapter we present the key charts and statistics concerning:

- Trial trailers and participants – the number and nature of trailers and operators
- Operational data – distance covered by LSTs, nature of use, and how well the extra capacity has been utilised, and
- LST patterns of movement – analyses of journey end points by Local Authority and the flows of LSTs/goods within and between regions.

Trial trailer and participant statistics

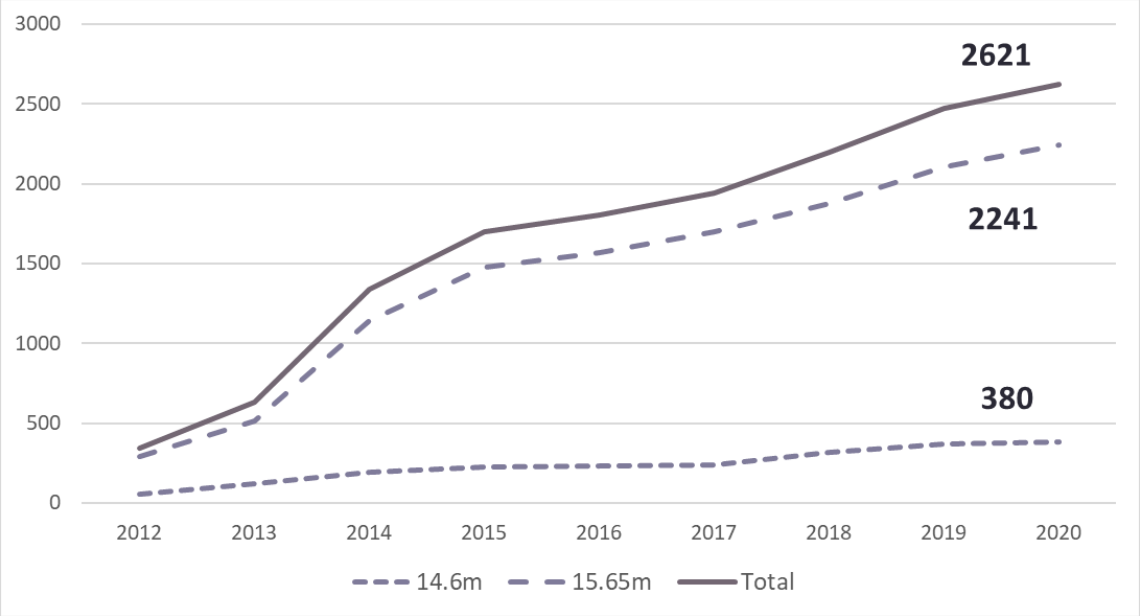
Note on method and data sources

2.2 Most of the data presented here is drawn from the data returns submitted by operators three times a year. The data on the size of companies and the nature of their operations is drawn from the company information sheet in the data submission file, completed by each trial participant, usually in their first data period, or by all existing operators in an update requested in 2018.

Number of trailers allocated to the trial and on the road

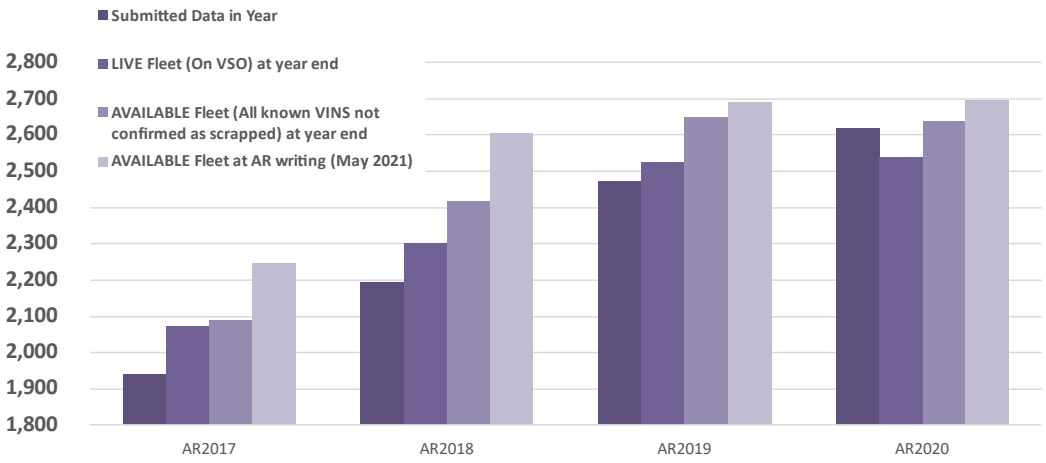
2.3 Figure 1 shows the growth of the LST fleet from the start of the trial to the end of 2020.

Figure 1: Growth of the LST fleet submitting data (source LST Trial data)



2.4 Of the trailers put into operation during the trial to date 85% have been 15.65m length. As has been noted in earlier reports – once it was proven, early in the trial, that a 15.65m LST with a self-steer axle could be built to comply with the turning circle requirements, this rapidly became the most popular design. That said – some operators choose the 14.6m LSTs to fit their loads, or for access to a greater variety of locations.

Figure 2: Trial fleet measures and recent growth trend



Annual Report	AR2017	AR2018	AR2019	AR2020
LST submitting data in year (Basis of annual report results)	1,939	2,194	2,473	2,621
LIVE LST Fleet at year end (On a live VSO at 31 Dec)	2,073	2,300	2,524	2,537
AVAILABLE LST Fleet at year end (All LST VINS not confirmed as scrapped)	2,088	2,418	2,650	2,639
AVAILABLE LST Fleet at time of writing (May-June year n+1)	2,244	2,604	2,691	2,696

LSTs 'Live Fleet' vs 'Available fleet'

2.6 We are now using two measurements for the size of the LST trial fleet.

- The **Live Fleet** refers to those trailers on a live VSO at the time of the measurement.
- The **Available Fleet** refers to all LST VIN numbers which are known to have existed at some point on the trial and which have not yet been confirmed as scrapped.

2.7 Figure 2 shows four measurements of fleet size for the most recent trial years showing the number of trailers for which we had data in that year, the live fleet and available fleet size measured at 31 December of the year, and the available fleet only at the time the annual report was being written (nominally May-June of the following year)

2.8 Data should be being submitted for all the live fleet trailers, but the number can differ from the actual number of trailers seen in the data over a full year (as in 2020) as it is a point in time measurement. Indeed in 2020 more trailers appeared in the data for the full year (2,621) than were on VSOs at the 31 December that year.

2.9 Since the start of the trial, DfT assigned a code to LSTs in their database to indicate whether a trailer (VIN number) had been scrapped. During 2020 we have expanded this to identify a wider range of cases (other than scrapped) where a trailer with a defined status code has come off one VSO and so is no longer in the live fleet but does not immediately appear on a replacement VSO. We have ongoing work to confirm status codes for all trailer VINS that are not linked to a currently live VSO.

2.10 Table 1 shows the May 2021 table of 102 LST VINS that are not in the Live Fleet and their status codes, based on the information provided by the operator. Of the 102 listed,

42 are confirmed as being scrapped, so the remaining 60 are counted as available and could re-enter service in the future.

Table 1: LST counts by status

Status Codes for LST VINs not on a live VSO (excluding code X=On Live VSO and Z=VIN assigned by never built)	At May 2021
A. Scrapped or planning to scrap	42
B. Kept on your site pending future sale	0
C. Kept on your site as storage	14
D. Sold / Selling to another operator	17
E. Sold / Selling to an intermediary / 2nd hand	1
F. Returned to leasing company	15
G. Other (with notes)	1
K. Status unknown – operator unable to trace trailer	12
Total	**102**
Total not confirmed as scrapped	**60**

2.11 Status Code 'A' is now only assigned once we have a confirmation that the trailers have been destroyed, as we have had two cases of trailers being sent for dismantling and being declared as scrapped, but later finding the dismantler had found a buyer and the trailer re-entered service.

2.12 Status code 'Z' is particularly challenging to detect. It occurs where a manufacturer has provided the operator with a series of VIN numbers before or early in the manufacturing process, so that an application can be made for a VSO. Then, when the trailers are completed, this early assignment of VINs is overlooked and new VINS are assigned as this is the time when this step normally occurs. It is important that we remove duplicate VINS from the system when they are found, to avoid double counting.

2.13 **We continue to work with DfT and VCA to keep track of trailers that move off a live VSO so that we can track the total available fleet.**

Reduced fleet growth

2.14 Looking at the fleet growth rate, it is clear that it is slowing down as we have entered 2020. In 2017 and 2018 there is a clear difference between the number of trailers on the road and submitting data at the year end, the live fleet at the year end and the live fleet at the time the report was being written – about 5 months into the subsequent year. This spread of figures published each year shows the funnel of new trailers coming into the fleet.

2.15 By 2019, the difference between the figures had almost disappeared and the number of trailers in the live fleet has only increased by 13 between 2019 and 2020. The number of trailers in the available fleet was actually lower at the end of 2020 (2,639) than at the end of 2020 (2,650), as several batches of trailers were scrapped. When compared at the time of Annual Report writing, the available fleet in 2021 (for AR2020) is only five greater than at the same time in 2020 (for AR2019).

Three reasons for reduced trial fleet growth

2.16 While we have not conducted a formal survey of operators on the topic of fleet growth or reductions, we have sought to communicate with operators who have released trailers and also those entering the trial for the first time, to get insight into the factors influencing their decisions. We also had the opportunity to speak to a sample of operators privately about their thinking on future LST investment, at a workshop in November 2019. We can also see some evidence of their reasoning emerging in the data submissions.

LSTs reaching end of lease / end of life

2.17 During 2019 and into 2020 we began to see more instances of operators removing LSTs from their fleet for a number of reasons:

- The original lease agreements from 2012/2013 were reaching their seven-year term and the trailers were returned to the leasing company. We have had verbal confirmation of at least one case where a lease was extended by a year, but leasing companies are generally reluctant to extend leases further. Leasing companies have then sold, or are in the process of selling, the trailers into the second-hand market rather than leasing them to a new operator.
- Purchased trailers were reaching the end-of-life or the normal renewal date for the company and they were either sold into the second-hand market or sent for dismantling by the original owner.

Delayed or deferred LST investment decisions

2.18 Operators selling or returning the trailers to the leasing company have in some cases replaced some or all of the trailers, but we know of at least two operators who have between them released 70-80 trailers, but have told us that their decision to reinvest and replace the trailers is being delayed by a combination of:

- The focus of management resources on EU-Exit impacts in 2019;
- The focus of all resources on COVID19 issues in early 2020;
- The uncertainty around the DfT's future plans for the trial or longer-term use of LSTs.

2.19 While we cannot provide evidence that these same issues might also be limiting the flow of new operators coming forward to take up large allocations of LSTs during the same time period, it would be reasonable to consider that this might be the case (see also next).

Reduced size of requests for allocations by new operators

2.20 Finally, we note that during the second half of 2019 and throughout 2020, while we have seen a continuing flow of new operators joining the trial, they have mostly been small operators buying one to three trailers (some of them from the second-hand supply noted above) for a specific purpose. A significant number of these have been operators taking on LSTs to transport straw to power stations. This change in company size profile is discussed further below,

Operators on the trial

2.21 One of the DfT's stated intentions was that the trial should be accessible to operators of all sizes – not just large operators. Figure 3 summarises the range of companies (based on their data submissions) by size, Figure 4 by the nature of their primary operations. (Note: Further details of the categorisation of companies and all other data gathering in the CIFs can be found in earlier trial annual reports.)

2.22 Figure 3 shows that the trial does include a significant number of small and very small operators. Figure 4 shows the balance between a small number of own operation fleets (retailers, parcel companies) with larger numbers of LSTs, and a large number of general hauliers with fewer LSTs each.

2.23 We note that while a large proportion of the companies are general hauliers, some of their operations are associated with long term contracts for major retailers.

2.24 The 'Other' category includes cases with very few data points, or specialist trailers.

Figure 3: LST trial participants by fleet and company size (source LST Trial data)

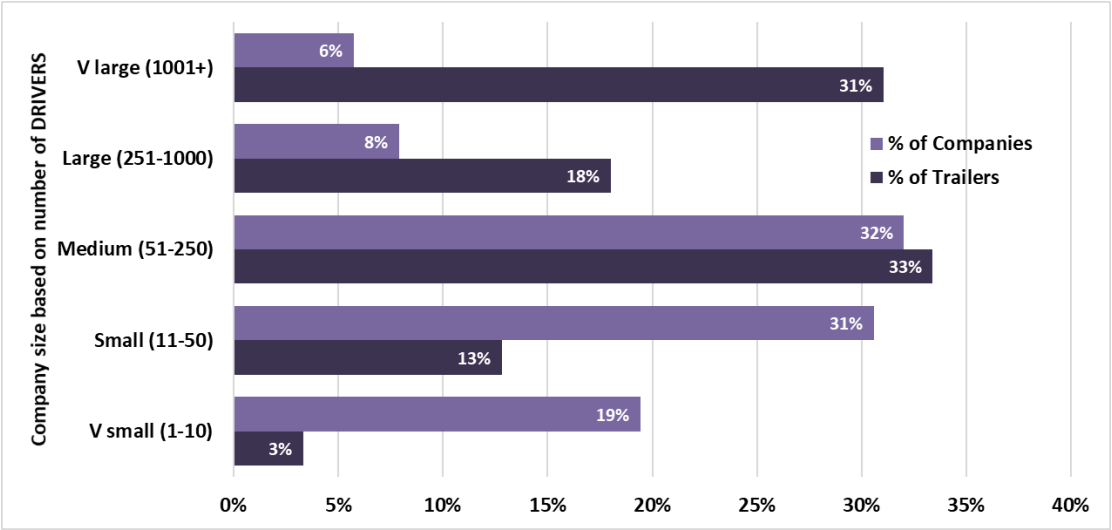
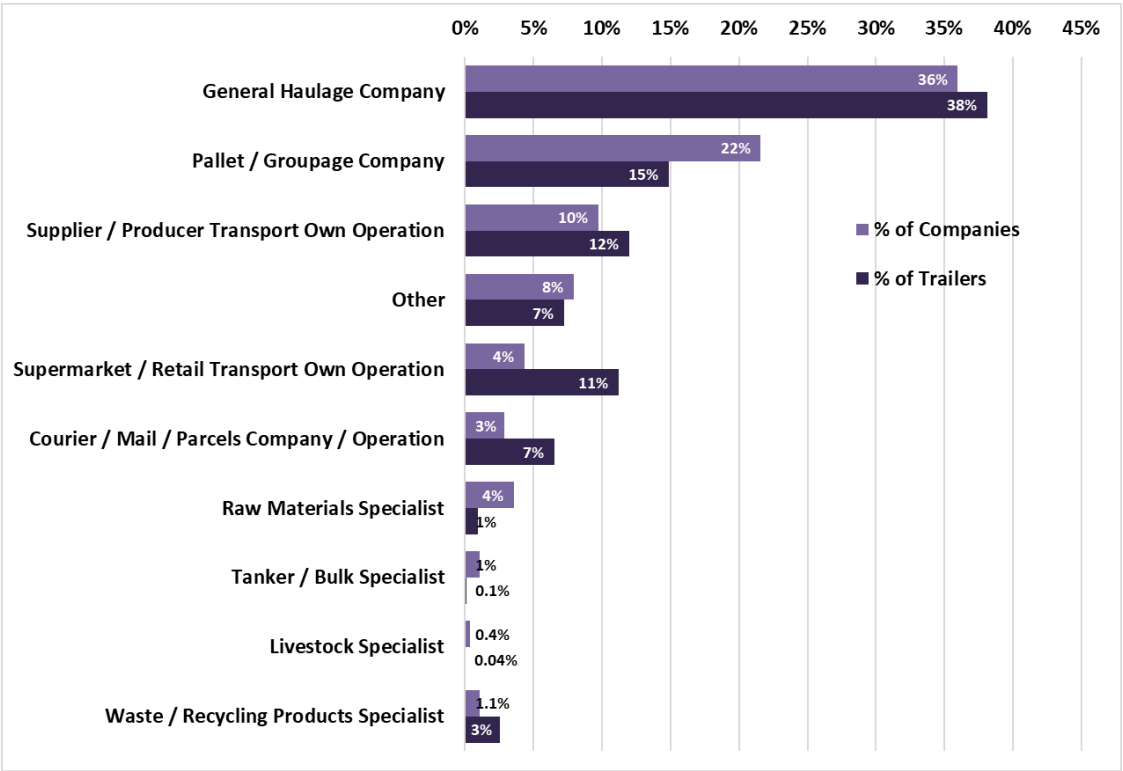


Figure 4: LST trial participants by nature of operation (source LST Trial data)



Change in company size profile

2.25 It is clear that the change in the nature and size of the companies joining the trial in late 2019 and throughout 2020 has changed the company size profile for the trial.

2.26 During 2020 we saw a net increase of 64 operators participating on the trial, compared with 13 in 2019, giving an increase of almost 30% in the number of trial participants in 12 months. This scale of increase was last seen in 2017-18 when DfT increased the number spaces on the trial to 2800.

2.27 Figure 5 shows the change in the percentage of participating companies by their number of drivers, from AR2018 to AR2020.

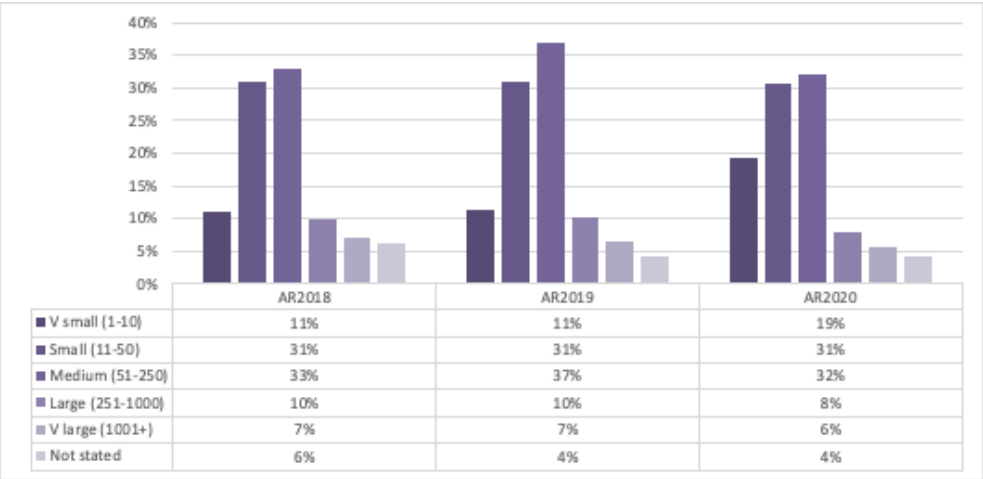
2.28 The key change to note is the increase in 'Very Small' companies, defined on the trial as having 1-10 drivers. This change was forecast in AR2019 (Paragraph 2.30).

2.29 We can make some observations about this increase based on:

- Our direct contact with all new operators in setting them up for data collation
- Our monitoring of the movement of trailers between operators (as they move VSO)
- The underlying data on numbers of trailers per operator and goods types carried.

2.30 There are several factors that have led to the number of operators rising faster than the number of trailers.

- Increase in smaller operators open to LST operations
- Growth in the second hand LST market
- Straw movement by LSTs



	AR2018	AR2019	AR2020
V small (1-10)	11%	11%	19%
Small (11-50)	31%	31%	31%
Medium (51-250)	33%	37%	32%
Large (251-1000)	10%	10%	8%
V large (1001+)	7%	7%	6%
Not stated	6%	4%	4%

Figure 5: LST Operator Sizes (by number of drivers) as % of companies

Increase in smaller operators open to LST operations

2.31 When new operators join the trial we usually have a phone conversation with them to assist them in preparing for the data submissions, especially for smaller companies who may have limited IT skills or data systems. As part of this we often discuss their motivation for joining the trial and planned use of the trailer. These conversations are private but they are captured in our trial management system.

2.32 For smaller companies, we often hear statements of the sort:

- "The trial seems to be going well so I thought I'd look into it"
- "I know xxx of company yyy well and they suggested I might use one for my work"
- "My competition has started using an LST and I need to do the same"

2.33 A combination of these motives will have contributed to the number of very small operators coming into the trial at this stage, who did not consider it seriously in earlier years.

Growth of second hand LST market

2.34 When significant fleets of LSTs are released back to their leasing company, they are often purchased in small numbers by SMEs who do not have the capital or the revenue stream to support purchase of a new trailers.

2.35 There is a similar effect with trailers owned by the original operator, where they have sold them on to other companies. However, this tends to be a slower process with trailers being traded in small numbers from one operator to just one or two others, usually identified through existing contact networks rather than formal advertising.

2.36 **The net result is that over time, a block of existing LSTs originally associated with a single operator, reappear on the trial spread across several new operators**.

Straw movements by LST (new and second hand)

2.37 The third factor worth noting has been the rapid expansion of the use of LSTs to transport straw bales either between farms or for the very particular movement of bales to power stations as fuel. The latter is particularly taking place in the East of England where there are several power stations fed by straw products when in season.

2.38 These operators are moving low volumes of straw products from their own farms, or from a small group of farms, and so **only purchase one or perhaps two LSTs**.

2.39 While it is not always possible to classify a company as solely using the LST for this purpose, we can see that perhaps 15 of the new operators who joined the trial in 2020 are involved in the movement of straw, mainly to power stations, usually using a single LST.

2.40 There are several other interesting characteristics to note about this sector:

- This potential use of LSTs was not identified in the pre-trial feasibility studies
- Although the initial impetus may have come from a few individual farmers asking if they could bring straw to the power station on an LST in place of the more common draw-bar combination, conversations with operators reveal that some of the power station operators have since **requested** the use of LSTs. This may be because the grouping of bales on the deck means a full load can be picked off the trailer in fewer crane movements than with a drawbar combination.
- This work only takes place in the months when straw is being produced as a by-product of arable farming – usually in the summer and early autumn.
- Some of the operators have wider haulage interests and so have work for the trailer at other times of the year, but for many the LST is used solely for this purpose, and it remains static the rest of the time.

2.41 The early adopters of this use of LSTs bought new flatbed trailers, built for the purpose and were able to carry the capital cost based on the prices they were getting for straw.

2.42 Operators have also told us that this market has changed, with prices for straw-for-power falling, in part as new entrants have taken advantage of the emerging second hand LST market, giving them a capital cost advantage over those using new trailers.

Implications for the trial

2.43 The change in the mix of operators on the trial does not have a large effect on the overall trial results as these small operators hold a relative small number of the total fleet of LSTs. It should not greatly affect the overall efficiency or safety outcomes.

2.44 The increase in very small operators may make the trial slightly more representative of the national articulated trailer fleet as whole.

2.45 There are some practical impacts on the trial management and data submission processes as these increasingly need to be adjusted to accommodate:

- A higher overall number of operators requiring support and engagement.
- An increased number of small data submissions requiring processing (with the time required not being proportional to the number of trailers in a file)
- A higher number of operators requiring support due to limited data/IT skills
- More robust processes for tracking LSTs which move off a VSO, into the second-hand market, and then reappear with a new operator (see next section).

Implications beyond the trial

2.46 As has been noted in past annual reports, there was no intention to make the trial operator mix a representative sample of the national haulage sector, but rather to simply seek operators of all sizes. The stratification of data to create a nationally representative sample is carried out as part of the Scaling Model (see Section 8).

2.47 What can be said, is that the trial has shown that if the nature of the work is such that an LST may offer efficiency gains, then operators of all sizes appear to be willing to consider their use, especially where a smaller operator can access second-hand units.

LST designs in operation

2.48 LST designs have emerged from manufacturers or from the bespoke requirements of users. The numbers of each design have been driven by market demand.

2.49 Most LSTs are box or curtain sided designs with a single deck. Figure 6 to Figure 9 show a summary of the LST fleet mix by major design features. (Note: Further details of the design mix categorisation and the history around the choices of steering arrangement can be found in earlier trial annual reports.)

2.50 The only change of note compared with last year is the small increase in the number of flatbeds on the trial (up from 5% of the fleet to 7%), which is partly due to the increased use of LSTs for moving straw between farms and customers, including power stations. Some of these are new trailers; others are ex-curtain-siders sold through the second-hand market and ‘cut down’ to create flatbeds.
(Note: We note that DVSA are looking into the use of flatbeds for straw carriage and some of these trailer modifications, to check they comply with the relevant regulations. However, this is outside the direct remit of the trial evaluation.)

Figure 6: LST body design mix (source LST Trial data)

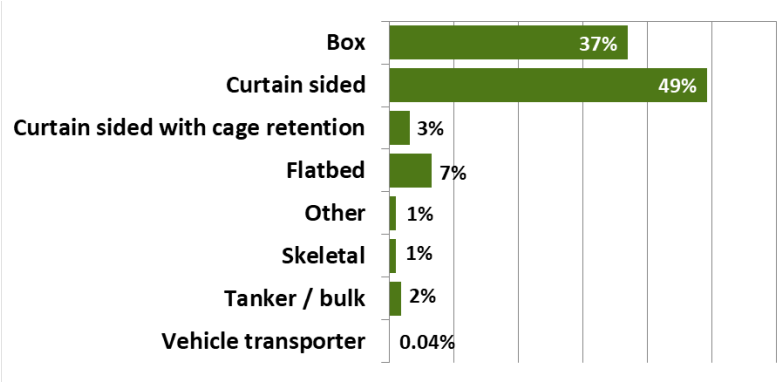


Figure 7: LST deck layout mix (source LST Trial data)

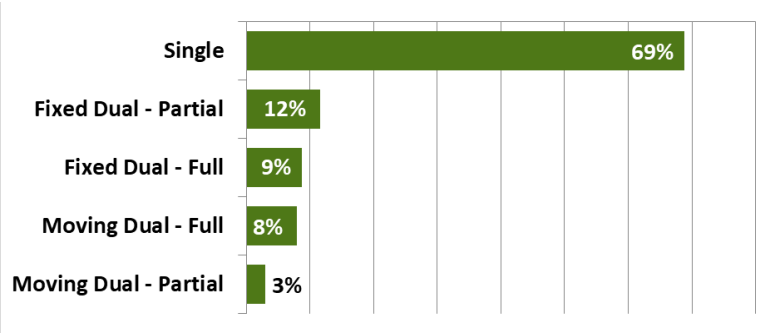


Figure 8: LST steering design mix (source LST Trial data)

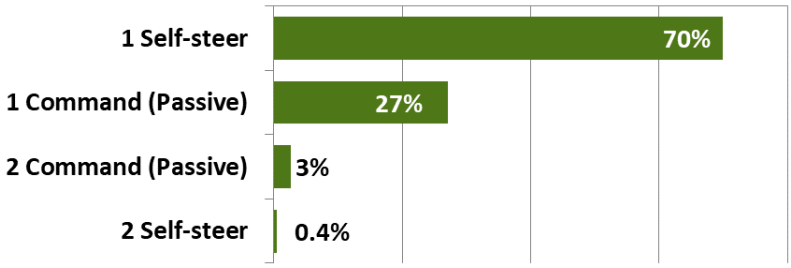
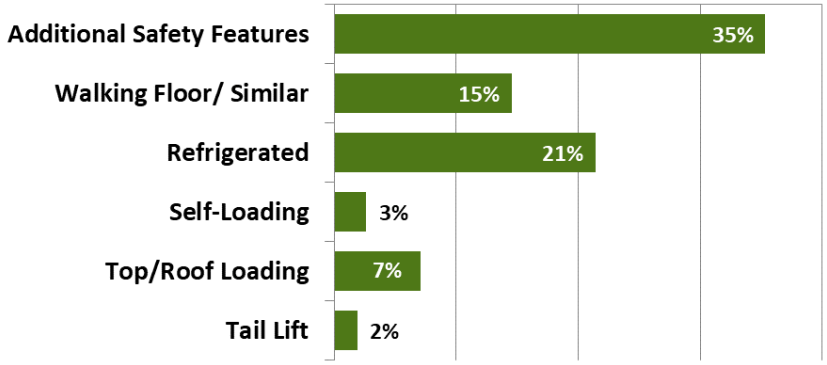


Figure 9: LST other features mix (source LST Trial data)

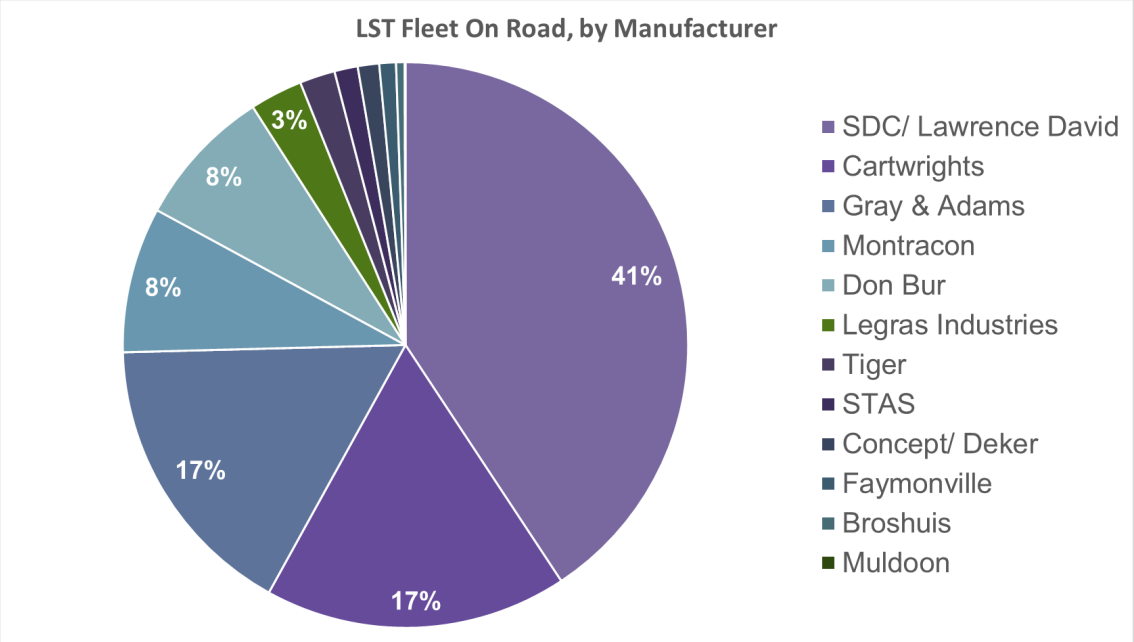


Manufacturers

2.51 By the end of 2020, 12 manufacturers had designed LSTs and had them cleared by VCA for use on the trial (Figure 10).

2.52 The main UK manufacturers have been responsible for construction of most LSTs. As the fleet has grown, some other EU and smaller manufacturers have introduced LST designs. Often these offer specialist features such as walking floors.

Figure 10: LST fleet by manufacturer (to end 2020) (source LST Trial data)



Operational data

Note on methods and sources of data

2.53 The outputs below are derived from data submitted by operators every four months. Prior to 2018 this was based on the detailed journey leg data submitted by operators. During 2018 we introduced a new simplified journey summary sheet) which only requires an aggregated view of the operations of each trailer for each permutation of leg type, goods type and MOA on which that trailer was used. In 2019, an even simpler format was introduced for operators who had already met a threshold of continuous accepted data. These changes in the data collection framework are summarised in AR2019.

2.54 Journeys are expressed as legs in the data, meaning a single point-to-point trip without loading or unloading stops *en route*. Any multi-drop journeys with fewer than five loading/unloading points are recorded as individual legs for each part of the journey. Prior to 2018, where there were five or more drops, the journey was recorded as a single record in the data, with the number of drops noted. Post 2018 the detail on number of drops is no longer recorded.

Distance covered by LSTs

2.55 Table 2 shows the total distance recorded in the data for LSTs at the end of each year.

Table 2: LST total km and legs (source LST Trial data)

LST distance & leg count totals	To end 2020	To end 2019	To end 2018	To end 2017	To end 2016
Total vehicle km recorded	899 million	739 million	587 million	443 million	319 million
Number of recorded legs	7,186,726	5,870,664	4,691,852	3,589,290	2,647,018
Average leg distance	125 km	126 km	125 km	124 km	121 km

2.56 We note that the figures given for each year are the values cited in the relevant annual report, based on the dataset frozen for analysis in that year. Past years totals are not updated here to show additional data submitted too late to be included in the relevant annual report. So, for example, the change in the cumulative total between 2018 and 2019 is largely due to data for LSTs operations in 2019, but ALSO includes delayed 2018 data for 15 companies. This represents approximately 10,000 legs and 1 million km of delayed data from 2018 appearing in the 2019 cumulative total, which is not a significant proportion of the totals shown above. If the updated 'data-in-year' figures are required later for a particular analysis, we can provide them on request.

Operation by nature of operation and MOA

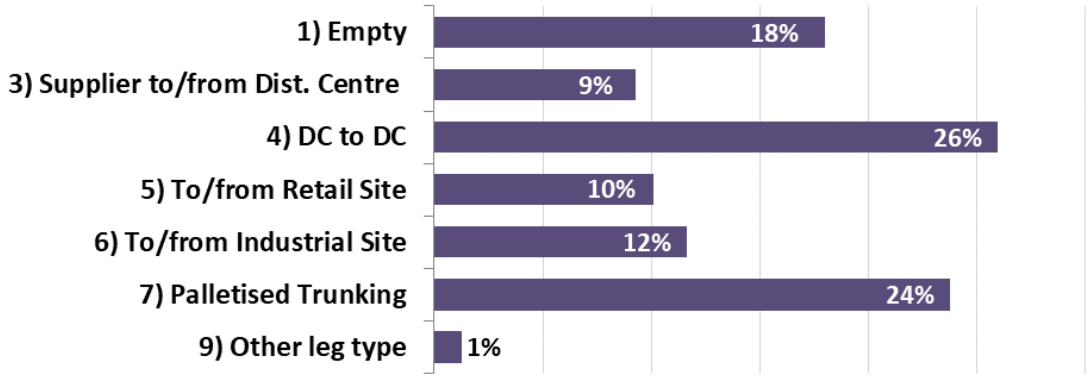
2.57 Figure 11 shows that the primary uses of the LSTs continues to be largely in the areas anticipated in the DfT Impact Assessment. This is a direct comparison of the percentage swaps since the table relates to assumed transfers of loads across the entire market. Although distribution centre (DC) to DC trunking dominates the operations, as predicted before the trial, we do note the significant use of LSTs in delivery both to larger retail sites and in industrial goods movements from suppliers. (Note: Page 31 and Page 40, Table 5 of the impact assessment lists the categories of journeys which were assumed to see transfer of loads from regular 13.6m trailers to LSTs, were the longer trailers to be generally available.)

2.58 The categories '3) Supplier to Distribution Centre (DC)', '4) DC to DC', '6) To/from industrial site' and '7) Palletised trunking' all relate to journeys between sites that might be considered industrial - based on site access and the location of such sites in areas with lower public movement or limited public access. These legs represent 71% of all loaded distance covered and, we can assume, a proportion of all the empty distance

2.59 In contrast, '5) To/from Retail Site' is the only leg type where we might expect operations in areas of high public movement and potential public access (on entry routes to the site). This leg type represents 10% of the loaded distance, but by the nature of retail delivery operations, many of the return legs will be empty.

2.60 The nature of the transported goods is shown in Figure 12 and the mode of appearance (MOA) is shown in Figure 13. These are dominated by fast moving consumer goods (FMCG) and other goods moved in cages or on pallets.

Figure 11: LST km by journey type (source LST Trial data)



Journey types 2) and 8) only appeared in the pre-2017 trial data framework

Figure 12: LST km by goods type (source LST Trial data)

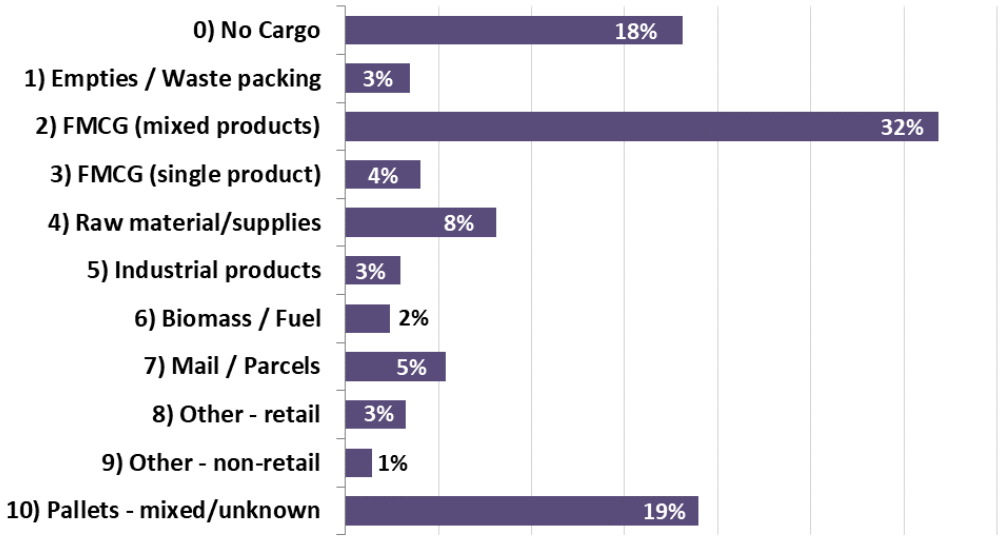
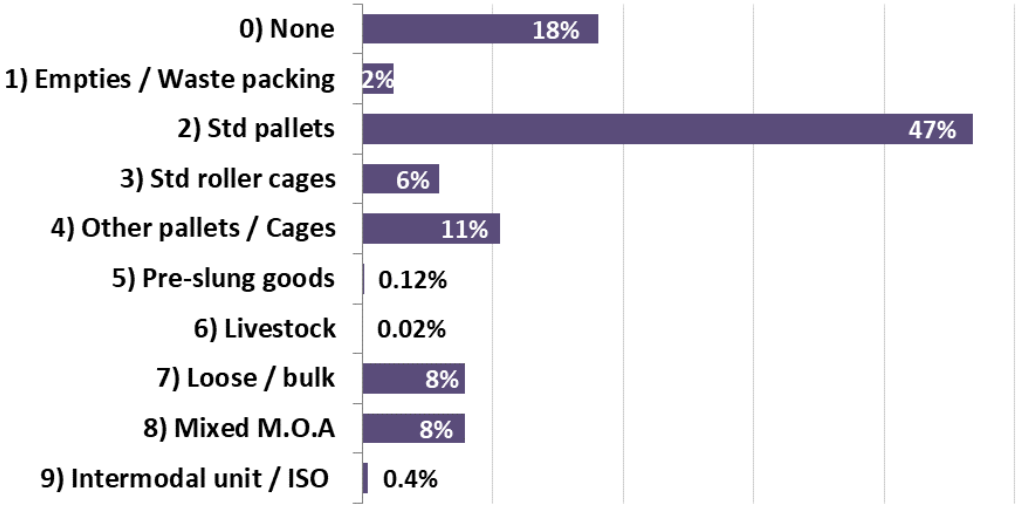


Figure 13: LST km by mode of appearance (MOA) (source LST Trial data)



Empty running

2.61 The LSTs ran empty for around 18% of the total distance they covered, considerably lower than the figure of around 30% for all GB articulated HGVs in 2019.

2.62 The level of empty running has been steady across the years of the trial and reflects the extent to which the trial participants are placing the LSTs on operations where they know they have good utilisation and hence see the opportunity to make the best use of the LSTs. These are often operations where the routes are familiar to the planners and drivers, are most easily pre-assessed as being suitable for LSTs, and where the return on investment for the additional cost of an LST can be most clearly demonstrated.

2.63 This pattern is evidence that many trial operators have work where they can deploy the LSTs efficiently, making use of the additional length on both outbound and return legs.

Utilisation measures

2.64 In the new 2018 data format, utilisation data is gathered only by deck % by trailer, grouped into legs/distance run (a) 100% Full (b) Empty and (c) Part-Filled. For the Part-filled legs an average Deck% is estimated by the operator. (Note: Prior to 2018, data was gathered for every leg by both Deck% and Volume%. We also noted when a journey was 'weight limited' so that we could identify where the deck or volume was not being fully used because no additional weight could be added, rather than because no further goods were available. In the trial to end 2017, only 2.6% of legs were noted as being weight limited, which is consistent with the view that LSTs are primarily of interest to those hauling lower density – higher volume goods.)

2.65 With the new aggregated format, we do not produce an overall Deck% histogram, but the overall performance can be seen later, in the operator savings chart - Figure 16. Where operators have been moved on to the 2019 'Short-DSF' their total leg and distance figure for each trailer is used as a reference value which is then expanded pro-rata to create 2018-style complete data for full/empty legs etc, using the proportions found in their last year of full format data. (See AR2019).

LST patterns of movement

2.66 During 2015 through to 2017 we developed a method of modelling routes, using the start and end postcodes provided by operators for 2017. We validated the model route selection using a large sample of GPS data for a mix of LST and non-LST operations by trial participants (DfT judged it would be unreasonable to ask operators to fit GPS equipment as a condition of the trial, as it would limit participation to larger companies). While GPS use is now more common, our research suggested fewer than 50% of the trailers were fitted with GPS tracking.

2.67 From this work we were able to generate estimated patterns of LST movement by each of the major GB road classification systems, as show in the chart here.

2.68 A key result of this 2017 work was the comparison of the LST use of different road types to that published for the GB Articulated HGV fleet as a whole. As Figure 15 shows, the split of road types used by the LSTs is very similar to that of the standard length trailers.

2.69 This is an important conclusion of the trial since it shows that contrary to some pre-trial assumptions, the LSTs operations are not any more weighted towards Motorways and SRN A Roads than the standard GB artic fleet. This aligns with the major use of LSTs by the retail sector to deliver to large stores, rather than solely for trunking between national distribution centres.

Figure 14: LST distances by different road classification systems

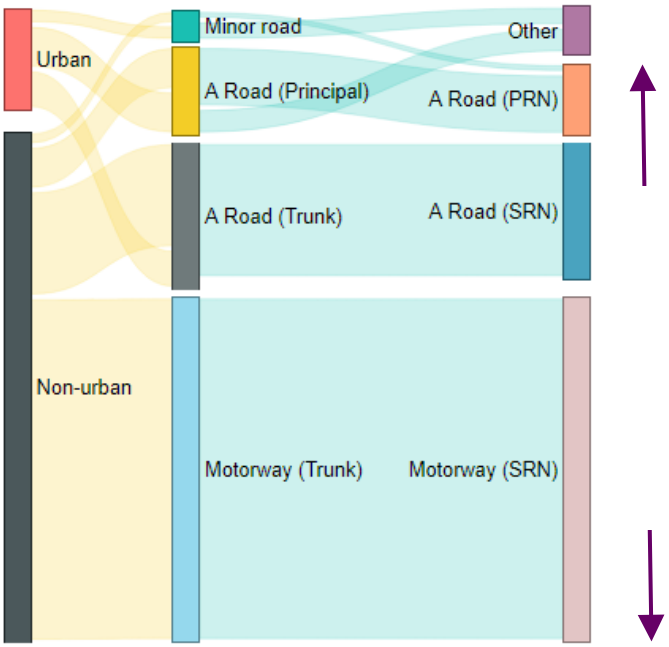
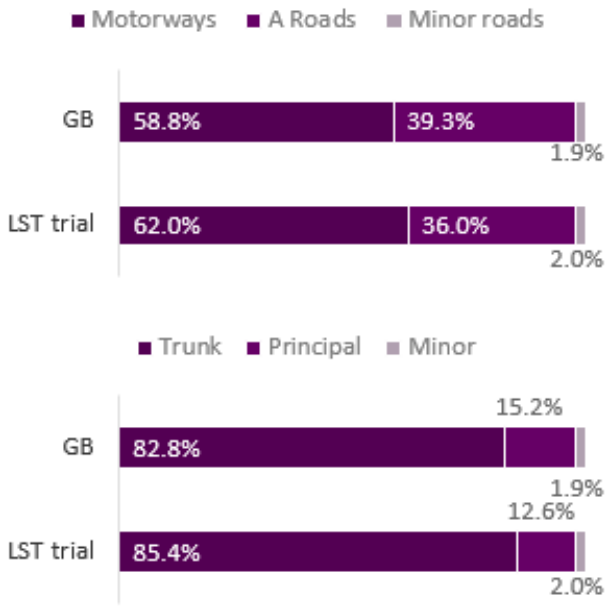


Figure 15: LST comparison with national HGV fleet by road class and road type



2.70 In the 2018 Annual Report we presented two additional analyses of LST movement patterns:

1. An analysis of journey end point activity by Local Authority (LA), reported in the form of heatmaps and tables of values, and
2. An analysis of the flow of LSTs and goods within and between regions (NUTS1), reported in the form of a table of values.

2.71 The results can be found in the full AR2018 annual report.

3 TRIAL OUTPUTS: DISTANCE AND JOURNEYS SAVED

3.1 **The analysis of potential savings in journeys and distance travelled being realised in real operations is central to the trial, as this is what drives potential societal benefits in terms of safety gains and emissions savings.** Beyond the trial, these savings are also what would determine the economic case for operators adopting LSTs.

Methods and source of data

3.2 The fundamental measurement in the analysis of how efficiently the LSTs are operating is whether the additional length is being used, based on the declared 'Deck%' data reported by operators in their data submissions. The deck% data is adjusted to reflect the individual trailer length when calculating potential savings from using LSTs.

3.3 The distance and journey savings calculation process is described in detail in our previous Annual Reports (specifically, the 2014 report, Annex E). The distance saving is estimated by comparing the actual distance travelled by the LSTs to an estimate of the distance that would have been travelled if the same quantity of goods (measured by the Deck% utilised) had been transported on standard 13.6m trailers making more journeys. Savings are 'claimed' only for legs where some/all of the extra trailer length is used.

3.4 As in previous years, we have estimated two values for the savings:

- The upper estimate takes account of some empty return journeys also being saved due to saving of whole round trips – loaded out and empty returns – but only where we have data to match the empty returns to the loaded leg data.
- The lower figure considers only loaded legs and is a more conservative estimate.
- Prior to 2018, the matching was performed by checking the sequencing of start-end locations of individual legs in the journey log. From 2018 onward, the matching is done using those legs where all legs of the same combination of Leg Type, MOA and Goods Type are either 100% full or entirely empty, usually accompanied by narrative of "full out/ empty back" or similar. This is an underestimate as no empty running returns for part-loaded legs are taken into account, as with the new data format these would be difficult to estimate, and they are a small part of the data.

3.5 Although we continue to cite both the upper and lower estimates, we have reviewed the process for detecting 'empty-returns' related to loaded legs and our view is that the inclusion of these savings is justified and may still be a slight underestimate of the true figure. **On this basis, later modelling (emissions etc.) uses the upper estimate data, including empty return legs as the more realistic of the two.**

3.6 To help validate the findings on savings, we asked operators to consider whether our estimates of their savings from use of the longer trailers agreed with their own experiences and expectations. This work, reported in the 2016 Annual Report and continued through the operator conversations reported in AR2019, has confirmed that in calculating savings in this way, we do not appear to be over-estimating the savings compared to the operator's own experience or analysis.

Distance and journey savings results: trial to date

3.7 Table 3 shows the cumulative vehicle kilometres saved during the trial.

3.8 Since the start of the trial, **the use of LSTs has removed between 66 and 73 million vehicle kilometres of freight traffic from the roads of Great Britain.**

Table 3: Cumulative vehicle km saved by using LSTs (source LST Trial data)

Distance saved (million vehicle km)	At end 2020	At end 2019	At end 2018	At end 2017	At end 2016	At end 2015	At end 2014	At end 2013
Loaded Legs Only	65.6	53.8	41.1	29.3	20.9	12.3	6.0	2.1
Loaded Legs plus 'matched' empty return legs	72.8	59.9	45.8	32.9	23.5	14.2	7.1	2.4

Journeys saved – trial to date

3.9 The vehicle kilometres saved shown in the tables above can be converted into a simple estimate of the number of journeys saved by dividing by the 125km average leg length recorded by vehicles in the trial and rounding the results (Table 2, page 25).

3.10 On this basis, **we estimate that 525,000 to 582,000 journeys were removed from GB roads because of the trial to the end of 2020** (rounded figures).

Distance and journey savings results by operator and by trailer

3.11 Figure 16 shows the distribution of percentage distance savings by operators participating in the trial for 2018 to 2020. Figure 17, shows the same data, but weighted to show the number of *trailers* owned by the operators in each savings group.

3.12 The savings percent indicates the km savings as a percentage of the total km that would have been required had 13.6m trailers been used to deliver the same cargo:

Savings % = km saved divided by (Total LST km + km saved)

3.13 Note that the mean of the savings values for each operator are not quite the same as the mean across the whole trial. Also, these charts are not based on the entire trial as:

- the data is for 2018 to 2020 only – the change in data gathering format makes a cumulative calculation with pre 2018 data problematic
- the basis of the calculation for 2018 to 2020 is slightly different than for previous years due to differences in the data template and identification of empty return legs.

3.14 This has some merit, since it means for this detailed view, we are looking at the most current operations of the LSTs and their efficiency.

3.15 Further details of the utilisation calculation can be found in AR2019 (Annex 3).

Proportion of distance and journeys saved by using LSTs – trial to date

3.16 We can also express the saving in the form '1 in X' (km or journeys), which we have found useful in articulating the benefit gained from operating LSTs to a wider audience.

3.17 Over the whole fleet and across the trial we estimate **that the average percentage distance saving by operator including empty return legs is 8.3%, which equates to around 1 in 12 journeys.**

3.18 The most efficient operators achieve the maximum **percentage distance saving by operator including empty return legs of 13.5%, which equates to 1 in 7.5 journeys.**

3.19 Behind this average figure there are considerable differences in efficiency of operation and levels of loading across the range of operators taking part in the trial, so we also look at the savings for each operator.

Figure 16: Distribution of % distance saved using LSTs with and without return empty savings (2018 - 2020) – COUNT OF OPERATORS (source LST Trial data)

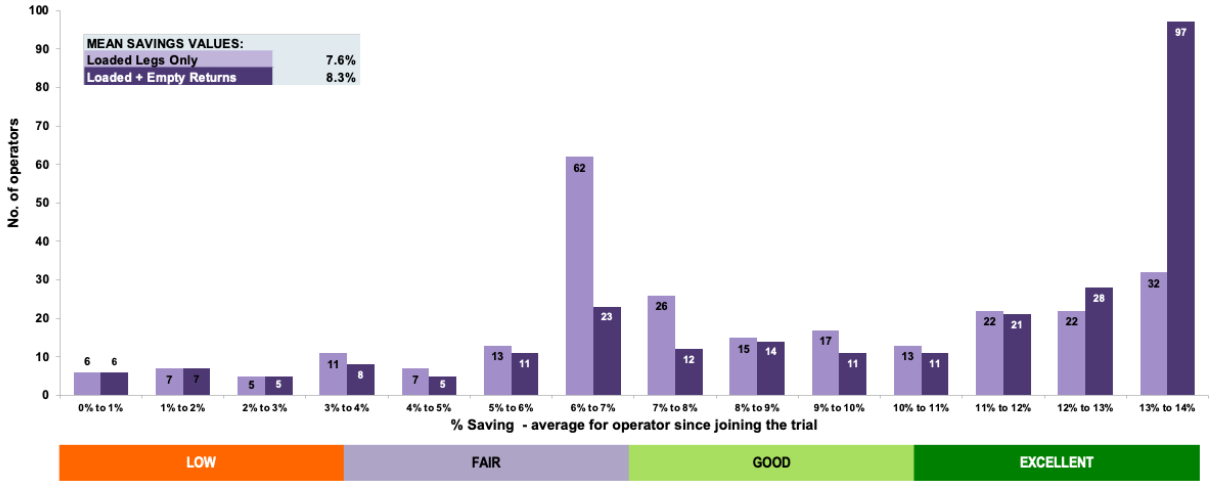


Figure 17: Distribution of % distance saved with and without return empty savings included (2018 -2020) – COUNT OF TRAILERS IN OPERATOR FLEET (source LST Trial data)

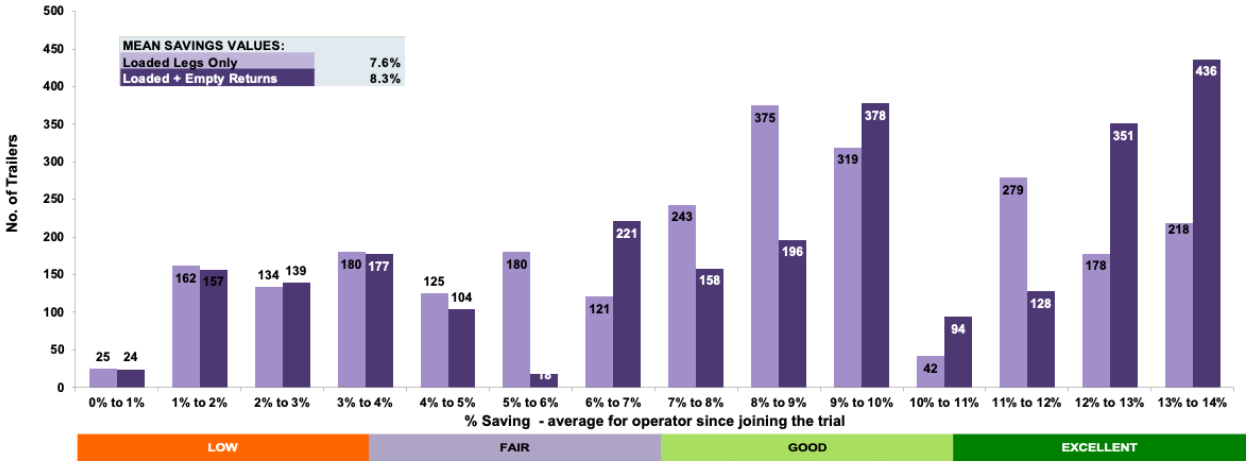


Figure 18: 2020 Savings bands by operator (source LST Trial data)

LST savings performance summary by operator (2019)	Lowest Savings Group (0-5% Saving)	Average Savings Group (>5-10% Saving)	Highest Savings Group (>10-14% Saving)
% of operators	12%	27%	61%
% of trailers	23%	38%	39%

Notes: Based on the savings % for each operator INCLUDING any matched empty return legs. % of trailers based on the number of trailers registered to the operators falling into each savings group

3.20 In Figure 18 we identify three savings groups:

- ***Highest savings group:* Almost two thirds of operators are making savings of over 10% from using LSTs**. If we consider this savings group as being the operation of trailers at or near their maximum efficiency, then there are 157 operators on the trial operating 1009 trailers, at this level of performance. This accounts for almost two thirds of the operators on the trial, and almost 40% of all the trailers.
- ***Lowest savings group:* About 12% of operators are making savings of less than 5% from using LSTs**. In the lowest saving group, we find 31 operators (12%), operating 601 trailers (23%). These operators would appear to be making little or no quantifiable benefit from using the LSTs. Indeed, once the additional capital cost of trailers and any fuel use penalty (estimated before the trial at 1.8%) – some of these operators may have a net disbenefit from running their LSTs.

  That said, we are aware that some of the operators in this group have had disruptions in their contracts which have meant they have not seen the benefits they originally planned from using LSTs or they find less easily quantified benefits from having their LSTs available. Overall, outside of trial conditions and with a more active open market for LSTs, we would question whether these operators would have held on to their trailers.
- ***Average savings group:* About a quarter of operators are making savings of 5-10% from using LSTs**. It is also notable that some of the largest retail sector fleets on the trial are operating within the 7-9% efficiency range according to our calculations (see Figure 17), reflecting the highly variable demand for cargo movement in their business. For these large fleets, a large portion of their business is moving retail goods either from national to regional depots or onward to larger retail stores. In both cases, there is an inherent 'retail' flow effect, where goods are predominantly being moved 'one way' and the fill level of vehicles is substantially dependent on a demand led supply chain working on fairly short turn-around times.

3.21 In Figure 17, the uneven distribution of trailers across the intervals can be explained by the distribution of larger and smaller fleets amongst the operators within the trial. There are a small number of larger fleets operating within 1-5% efficiency bands, with many journeys being operated without, apparently, using the extra length.

3.22 A more detailed study of the business types of operators appearing at the lower half of the range of savings (not just the 0-5%) shows that there are possibly two groups:

- **Operators with complex operational patterns**: where the operation involves large numbers of 'out-full/back-empty' movements but we have not been able to include these in our upper savings calculation as they are part of more complex operational patterns and are not picked up by the empty-return algorithm. A more refined analysis of the operational patterns of operators could allow the upper estimate calculation to be applied to these operators.
- **Operators unable to operate the trailers efficiently in some periods**: operators who do not appear to be making use of the additional length of their LSTs often had periods of efficient operation, with gaps in between where the trailers were not used at all, or were being used with low loading levels. Where we have spoken to operators this has commonly been due to loss of a contract for which the LST were originally purchased (and on which they were used efficiently), with a period of time passing before another contract could be found on which the additional trailer length could be used effectively

4 TRIAL OUTCOMES: EMISSIONS SAVED

4.1 **The possibility of reducing the emissions contribution from large HGVs by replacing them with LSTs was a primary focus of the LST trial.**

4.2 In this section we report the updated results of the 2017 emissions modelling, carried out to estimate the potential emissions savings from using LSTs in place of standard-length trailers when carrying the same cargo over the same duty cycle, particularly in terms of carbon dioxide (CO_2e) and oxides of nitrogen (NOx), important environmental pollutants.

Note on methods and sources of data

4.3 The estimate of emissions is based on modelling described in the 2017 annual report (AR2017, Chapter 6), and described in full in Project Note E2: LST Emissions Savings (both reports are available on the DfT web site). That work showed the individual results for emissions by road class and proximity to areas of special interest.

4.4 The modelling estimated emissions based on the actual LST designs that have been adopted and the duty cycles recorded in the trial data during 2017, for which we have the greatest detail in terms of locations and modelled routes for the LSTs.

4.5 The modelling results are shown in Table 4. These results are reproduced from AR2018, with the exception of the last row which was added in AR2019. The final row gives emissions savings expressed as kg (of emissions) per million trailer km SAVED by using LSTs in place of standard trailers, calculated from the 2017 data. This allows us to derive emissions savings from the distance saving for any year of the trial.

Table 4: LST Emissions savings factors (2017 data - uncongested flow and Euro V)

2017 [tonnes emissions]	CO	CO2e	NOx	PM Exhaust	VOC
LST	49.8	81,278	412	4.44	9.60
Non-LST	53.7	87,772	445	4.79	10.35
Emission Saving	**3.9**	**6,494**	**32.6**	**0.38**	**0.744**
% Emission Saving	*7.2%*	*7.4%*	*7.3%*	*7.3%*	*7.2%*
*Emission saving **kg** per million LST km TRAVELLED*	***38***	***63,565***	***319***	***3.4***	***7.3***
*Emission saving **kg** per million standard (13.6m) trailer km SAVED*	***459***	***774,030***	***3,882***	***41***	***89***

Notes: This is based on the routing and emissions modelling dataset only, not the whole trial to date. The key values in 2017 were:

***LST km travelled** = 102,163,128*

***Non-LST km to move same cargo** = 110,552,411 and hence*

***non-LST km saved =** 8,389,284.*

Some figures above are rounded.

4.6 In 2017 and 2018, the savings factors were applied inside a version of the original emissions model. The factors have now been integrated into the trial Scaling Model (which is designed to provide long term projections of the potential impact of LSTs under different scenarios- see Section 8). The Scaling Model was developed during 2019 and the results presented here are generated from that model. The calculation performed is unchanged.

4.7 Two types of results are generated:

1. Total savings as a percentage of the emissions that would be produced if the same goods were carried in standard length trailers
2. Total emissions savings for the trial in tonnes:
    c. Actual savings to end of the latest trial year
    d. Projected savings to end 2021 – the final year of the original 10-year trial period
    e. Projected savings to end 2026 – the final year of the trial as extended in 2017.

4.8 The modelling makes three key assumptions:

- We have assumed vehicles are travelling at speeds consistent with uncongested flow. This is because, for the specific purpose of this modelling, it is the prudent choice. The absolute emissions impact for a vehicle is higher in congested traffic, but here we are interested in the comparison between the emissions from an operation running LSTs and one moving the same goods using 13.6m trailers.
- This approach assumes that previous and future years have operational patterns that are not grossly different to 2017. Risk Solutions' wider analysis of the trial data provides assurance that this is a reasonable assumption, based on the fact that key indicators such as the average journey leg length, loading percentages and calculated savings have been relatively stable for all years, once the first 1-2 trial data periods were completed.
- The results reported up to and including AR2019 were modelled assuming EURO V engines across the fleet, to provide results that are comparable to the pre-trial impact assessment, where the same assumption was made.

Engine class extension for EURO VI

4.9 As part of further development of the Scaling Model this year (See Section 8), we have re-run the Emissions Model to provide a new set of results that assume EURO VI engines are used across the whole fleet. This gives reduced values for all air quality emissions.

4.10 The results in Table 5 show the expected reduction in the absolute emissions affecting air quality (e.g. NOx) if we assume the use of the EURO VI engines, which primarily reduce air quality impacts compared to EURO V. The percentage saving from CO2e using LSTs, compared with standard trailers, remains the very similar.

Table 5: LST emissions savings factors (2017 data - uncongested flow & Euro VI)

2017 [tonnes emissions]	CO	CO2e	NOx	PM Exhaust	VOC
LST	12.9	79,021	15.4	0.394	2.85
Non-LST	13.9	85,333	16.4	0.425	3.07
Emission Saving	**1.0**	**6,312**	**1.2**	**0.031**	**0.22**
% Emission Saving	*7.2%*	*7.4%*	*7.3%*	*7.3%*	*7.2%*
*Emission saving **kg** per million standard (13.6m) trailer km SAVED*	***199***	***752,412***	***140***	***4***	***26***

Notes: This is based on the routing and emissions modelling dataset only, not the whole trial to date. The key values in 2017 were:

***LST km travelled** = 102,163,128*

***Non-LST km to move same cargo** = 110,552,411 and hence*

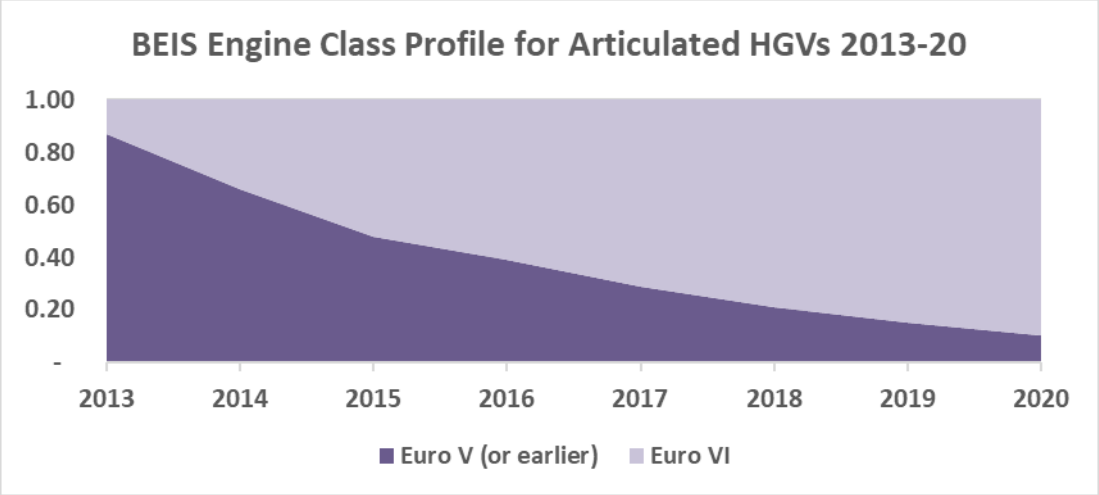
***non-LST km saved =** 8,389,284.*

Some figures above are rounded.

4.11 The Scaling Model then provides the DfT with the opportunity to input different profiles for the rate of take up of EURO VI engines and produce hybrid results by interpolating between the EURO V and EURO VI emissions factors from the tables above.

4.12 As part of their work using the scaling model, the DfT have used the profile from BEIS (Department for Business, Energy & Industrial Strategy). The profile for 2013-2020 is shown in Figure 19.

Figure 19: Euro V / VI mix for articulated HGVs outside London 2013-2020 (Source BEIS)



Since the profiled results are now available and are to be used in the DfT trial impact assessment, we are updating the headline emissions savings in this report from the EURO V only figures (used in the past to be comparable to the pre-trial estimates) to the EURO V / VI profiled results. These were produced by combining the emissions savings per km saved factors for each engine class (Table 4 and Table 5) with the savings in each year (derived from Table 3) and apportioned using the profile above.

4.13 The effect can be seen in Figure 20 and Figure 21, which show back-calculated emissions estimates for the trial fleet, cumulatively year on year for CO2e and NOX (the charts for CO, PM and VOC are similar to NOx)

Figure 20: Cumulative emissions saved due to use of LSTs assuming different engine class profiles: CO2e

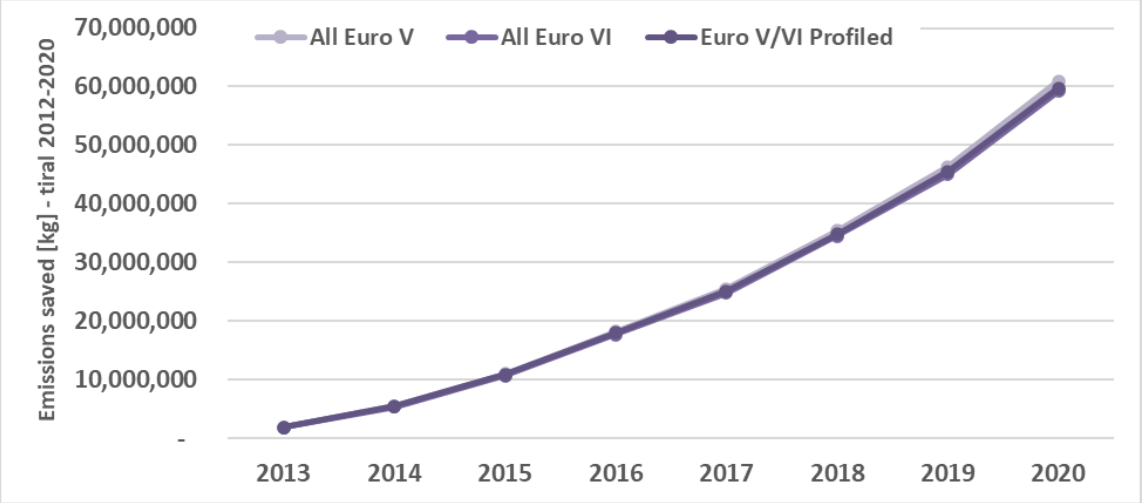
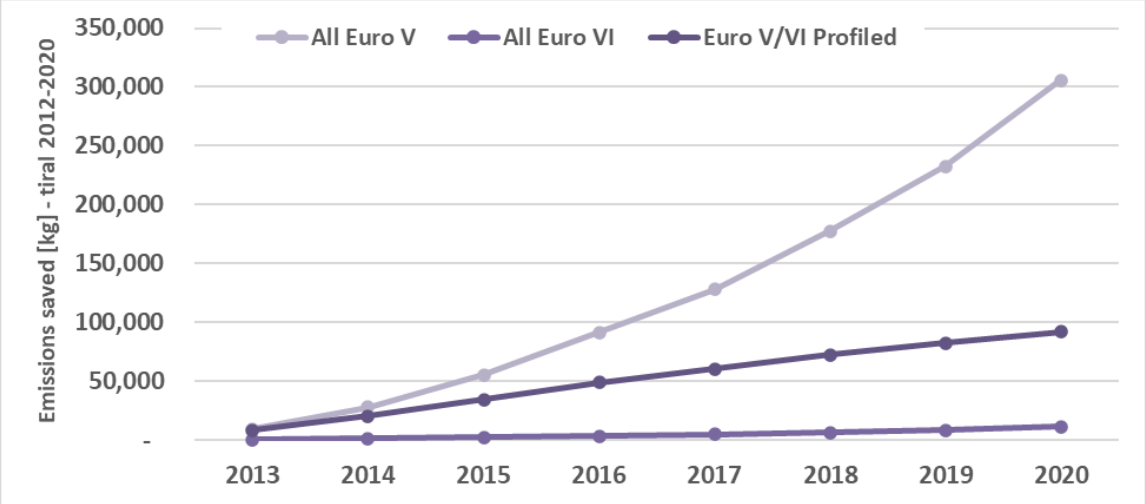


Figure 21: Cumulative emissions saved due to use of LSTs assuming different engine class profiles: NOX



4.14 The new cumulative totals for each emission for the trail to date, adjusted by the engine class profile, are given in Table 6, with the all Euro V and all Euro VI values for comparison.

4.15 It is worth noting that backdating this change of calculation to reflect a gradual change from Euro V to Euro VI engines means that the headline figures for emissions saved on the trial cited in AR2019 (to the end of that year) are reduced from 48,000 to 45,500 tonnes CO2e and 241 to 82 tonnes NOx.

Table 6: LST Emissions savings 2012-2020 - adjusted for Euro V/VI engine profile

Emissions Saved [tonnes emissions]	CO	CO2e	NOx	PM Exhaust	VOC
Based on all Euro V	**36.2**	**60,994**	**306**	**3.2**	**7.0**
Based on all Euro VI	**9.4**	**59,290**	**11**	**0.3**	**2.0**
Euro V / VI mixed fleet (BEIS Profile)	**16.7**	**59,758**	**92**	**1.1**	**3.4**

LST Trial fleet growth assumptions

4.16 A projection of the growth of the trial LST fleet over future years of the trial is needed for both the Emissions Model and the Scaling Model mentioned above.

4.17 We estimate the growth by looking at both the number of LSTs added to the trial in the most recent year and also the number of allocations which are already on live VSOs at the time we do the modelling. The difference between these two provides an indication of the broad rate of growth as the VSO figure is a reasonable predictor of trailers likely to join the trial in the coming year.

4.18 In addition, we look at whether the DfT has made any changes to the allocation system or other announcement to the industry that might lead to a higher or lower growth rate in coming years.

4.19 In Section 2 we discussed the fact that the rate of growth of the LST fleet appears to have reduced significantly since late 2019 (see Figure 2 on page 16). On this basis we have adjusted the anticipated fleet growth for the remaining trial years slightly, although with the total fleet already being at 90% of the 2,800 ceiling, this has had a marginal effect on the overall emissions savings projections.

2020 Emissions savings results

4.20 The total emissions at the three key time points in the trial described above, are shown in Table 7, derived by applying the emissions factors above (Table 4 and Table 5) pro-rata, to the total LST distances covered in each year from the estimated total fleet distance.

4.21 These figures all now reflect the Euro V / VI engine class profiling described earlier and are based on v2-2 of the Scaling Model (discussed in Section 8 – page 63)

4.22 **The total emissions saving from LSTs from the start of the trial, now incorporating the BEIS EURO VI engine adoption profile, to the end of 2020 is estimated as 60,000 tonnes of CO2e and 92 tonnes of NOx** (rounded figures).

4.23 **The projected saving in CO2e, if the trial were to run to 10 years (2021) or 15 years (2026) and now incorporating the BEIS EURO VI engine adoption profile,are around 68,000 tonnes and 128,000 tonnes respectively. The figures for NOx are 96 and 113 tonnes respectively** (rounded figures).

4.24 It is important to note that this change in the basis of our calculations largely affects the headline values for the air quality emissions saved during the trial, rather than CO2e. However, for those air quality emissions, this means that the total savings being given for the trial are LOWER than reported in earlier years as they are based on a different

calculation. This does mean that any comparison to the pre-trial estimates should be treated with caution.

Table 7: Total LST trial emission savings projection – Profiled for Euro V /VI

A. TRIAL OPERATIONS

Trial operational parameter	Unit	To End 2020 (actual)	10 year Trial end 2021	Extended Trial end 2026
LSTs on road	number	2,621	**2,727**	2,800
Total journey	millions	7.2	**8.4**	15.1
Total distance covered	million kms	899	**1,066**	1926

B. EMISSIONS SAVINGS (Mixed EURO V/VI fleet profile)

Emission	Unit: tonnes	To End 2020	10 year Trial end 2021	Extended Trial end 2026
Carbon Monoxide	CO	16	**18**	28
Carbon Dioxide equivalent	CO2e	59,758	**68,149**	127,795
Oxides of Nitrogen	NOx	92	**96**	113
Particulate Matter (Exhaust)	PM Exhaust	1.1	**1.2**	1.6
Volatile Organic Compounds	VOC	3.4	**3.7**	5.9

Note: Carbon dioxide equivalent or CO2e is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO2e signifies the amount of CO2 with an equivalent global warming impact. Figures here are based on EURO V Engine emissions data to provide a direct comparison to the pre-trial emissions projections. Emissions modelling for LSTs looking at future years will need to account for migration to EURO VI engines.

5 TRIAL OUTCOMES: SAFETY IMPACT

5.1 The analysis of personal injury incidents is vital to establish whether there are any indications that LST operations are increasing safety risk (relative to traditional trailers), particularly to other road users and vulnerable groups.

5.2 The primary focus of incident data analysis throughout the trial is to assess whether there is any emerging evidence about the relative safety risk performance of LST operations compared with standard length trailers.

5.3 The low incidence of road traffic collisions involving LSTs on the public highway (both anticipated and actual) is one of the reasons the DfT planned that the trial would need to collect data for an extended period. This is necessary to allow the analysis of trends or contributory factors in a statistically meaningful way, to inform future policy decisions.

5.4 Most of this section of the report deals with the quantitative and qualitative analysis of the incidents that have been reported on the trial and the comparison to the equivalent rate of injury incidents in the national fleet of semi-trailers. However, before addressing those questions, we first need to note the inherent positive effect on safety of taking fewer HGV trips by operating LSTs.

LST Safety Outcomes 1: Benefits from saved journeys

5.5 As described in Section 3, the additional capacity of the LSTs has been calculated to have travelled 899 million vehicle kilometres and have removed between 65.6 and 72.8 million vehicle kilometres from GB roads.

5.6 These vehicle kilometres would have otherwise been operated by the standard-length HGV articulated fleet. It is therefore reasonable to calculate the additional incidents and casualties that would have been expected to occur if the trial had not taken place, by considering how many incidents and casualties the standard-length fleet would have incurred over those additional vehicle kilometres.

5.7 This saving is independent of any difference in the actual incident rate per km of LSTs vs standard trailers, addressed in the next report section.

5.8 The results in Table 8 show that **the elimination of large HGV trips by the operation of the relatively small fleet of LSTs on the trial to date may have eliminated 9 to 10 injury collisions with a reduction of 13 to 14 casualties** (rounded figures).

Table 8: Estimated collisions and casualties removed from GB roads over the trial period through reduction in vehicle km operated

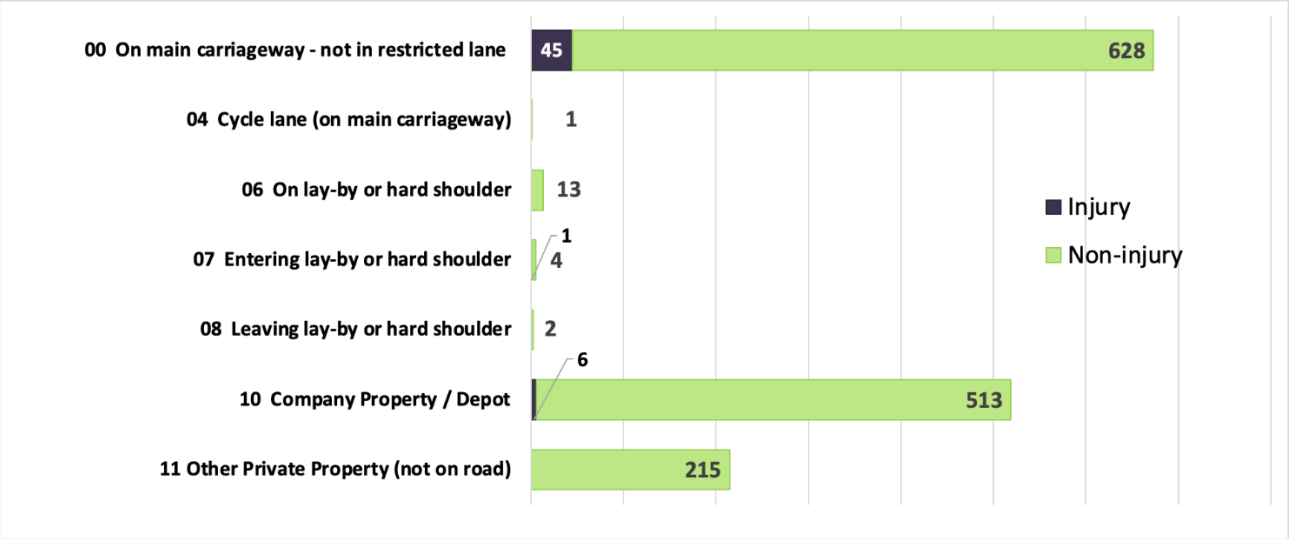
Injury incidents Public access locations	GB Artic HGV rate 2012-2019 per million vehicle km	Million vehicle km removed from operation by LST use	Calculated incident reduction
Collisions	**0.135**	**65.6 – 72.8**	**9 - 10**
Casualties	**0.192**	**65.6 – 72.8**	**13 - 14**

Sources: LST utilisation and vehicle km reduction from trial data. GB Arctic rate from STATS19 and TRA3105 2012-2019.

LST Safety Outcomes 2: Incidents involving LSTs

5.9 There have been 52 injury incidents involving an LST reported of which 46 took place on the public highway. Figure 22 provides a summary of these incidents involving LSTs, by the road location reported by the operators.

Figure 22: Incidents reported involving LSTs (Summary to end 2020 – source LST trial data)



Note: The injury events are marked in dark purple. There were 45 on main carriageways + 6 events on private land, there is then 1 further injury in category 07 – Entering or leaving a layby or hard shoulder which has been counted as occurring on the public highway.

5.10 For the events that occurred on the public highway or in other public locations, a detailed analysis of the incident data and resulting casualty figures is reported in this section, along with a review of the circumstances of each injury incident (Table 10).

Note on analysis methods and terms

5.11 As in past reports, we analyse the safety impact of the LSTs in the trial by:

- Estimating the absolute saving in injuries arising from the reduction in journeys
- Comparing the per km incident and casualty rates for LSTs with that published for the GB fleet of articulated HGVs as a whole. We analyse the incident rates nationally and then also for 'urban operations' and by road type.

5.12 In calculating the road type urban/rural and motorway/major/minor splits, we have assumed that the 2017 vehicle km percentage splits from the detailed route analysis carried out for the 2017 annual report apply in all years.

5.13 We present the data on injuries that occurred in all locations, whether on the road or on private land (depots etc.). However, the primary analysis focuses on incidents which took place on the public highway or in areas with public access, such as service stations.

5.14 We also review the LST injury incidents qualitatively. We examine not only the narrative given by the operator in their submission file, but in many cases, we ask for further information or documents from the operator to ensure we understand the circumstances of the incident. We use this to form a view on the degree to which the incident may have been related to the trailer being an LST. However, this judgement is purely used for

discussion – events that may not have been related to the presence of an LST are still included in all the primary analysis and statistical significance checks.

Injury incident and casualty numbers

5.15 Above we noted that there have been 52 injury incidents involving LSTs since the trial began. Table 9 expands on this to show the casualties associated with these events, classified by injury severity, the nature of the location, and whether the event was judged to be LST related - a judgement discussed later in this section. (Note: An incident is marked as LST related if it is judged that the incident occurred, or might have occurred, because the trailer was an LST and would not or might not have occurred had the trailer been a standard length.)

Table 9: Casualties from incidents involving LSTs reported to the trial: 2012-20

Injury Collisions from Trial Logs	Total Collisions	Total Casualties	Fatal	Serious	Slight
All Injuries (including depots etc.)	**52 (46)**	**64 (57)**	2 (2)	12* (11)	50 (44)
All Injuries in Public Road/Place	**46 (40)**	**58 (51)**	2 (2)	11* (10)	45 (39)
All Injuries judged LST related (any location)	**9 (9)**	**9 (9)**	0 (0)	1 (1)	8 (8)
All injuries LST related AND in public place	**4 (4)**	**4 (4)**	0 (0)	0 (0)	4 (4)

Figures in (brackets) show the totals at the end of 2019. The injury incident analysis in this report is based on all public incidents, i.e. the figures in the second row of data (outlined in the shaded box).
* The additional serious injury in the table is a reclassification of a 2019 incident.

5.16 From this table and the data that underpins it, we can note the following findings:

- **There have been 6 additional personal injury incidents involving LSTs in public locations during 2020, resulting in 7 casualties.**
- **All the 2020 casualties were slight injuries. One casualty from 2019 has been reclassified from slight to serious.**
- **None of the 2020 incidents were judged to have been LST related**

Fatal incidents in 2019

5.17 As reported in last year's annual report there have been two fatal incidents on the trial, both of which occurred in 2019. We have received no further information on these to that reported last year and we understand that the related court proceedings may have been delayed due to Covid 19 in both cases. The information we provided last year is repeated in the following paragraphs.

5.18 Given the serious nature of these events, we have provided the DfT with the incident report received from the operator, along with further emails and documents where available. There was nothing in the documents Risk Solutions have seen to indicate that the LST contributed to the incident in a way that would have been different to a standard 13.6m trailer.

5.19 The DfT have taken responsibility for further investigation of these events, using their access to the police forces that attended the incidents. We have consulted with the Department for Transport to further assess whether there was any LST specific contribution to the event.

5.20 The DfT have provided this statement.

"In May 2019, there was a fatal accident involving a longer semi-trailer resulting in the death of the lorry driver. Investigation by the DVSA found that this incident was unrelated to the condition or extra length of the longer semi-trailer.

"There was a second fatality in August 2019 which resulted in the death of a cyclist. With the evidence the Department currently possesses, it is not believed that this was related to the longer length of the trailer.

"The department will continue to check to see if there are issues related to either incident which require further consideration in the context of the trial."

All injury incidents in public locations - discussion

5.21 The personal injury incidents in public locations are summarised in Table 10. Note that:

- Locations are identified by the operator and checked manually using Google Maps.
- Casualty severity is determined by the operator, based on the STATS19 (police data) injury classes but are reviewed by Risk Solutions and, on occasion, adjusted based on further information provided by the operator.
- Whether the incident is LST-related or not is a judgement made initially by the operator. Where appropriate, we have reviewed specific event records with the operator and adjusted the original classifications **upwards** i.e. classified an incident as LST related where the operator had formerly identified it as not LST related. No incidents have yet been reclassified down to be not LST related.
- The incident summary shown here is a simplified and cleansed version of events designed to convey the main points without identifying the operator.
- In around 70% of cases, for events up to the end of 2019, the STATS19 record for the same event can be identified from the event details the year after it occurs, allowing us to further inform our understanding of the events and to compare incident locations to the STATS19 location data.
- The national STATS19 data for 2020 had not been published by the DfT at the time the incident analysis was performed and so our formal process of matching the LST injury events to STATS19 incidents was not completed.
- **All statistical analysis is based on all events listed in the table above, whether or not they are judged to be LST related**. This is a prudent approach adopted because whether an incident would have occurred at all, or whether it would have developed in the same way if the trailer had not been an LST, is a matter of judgment.

Events judged to be not LST related

5.22 The events judged not to be related to the fact the trailer was an LST fall into four general groups, broadly defined as:

- A 3rd party (vehicle or person) came into contact with the trailer or the tractor unit with no apparent contribution relating to the trailer design.

- The LST driver ran into the rear or side of another vehicle, other than when turning, (often in slow moving traffic) and there was no contribution from the trailer length or steering.
- LST driver hit something or lost control of the vehicle with no apparent contribution from the trailer design, but there was no other party involved.
- LST driver fatigue / error / illness / loss of concentration

Potentially LST Related Events:

5.23 In general, if the LST was manoeuvring and the impact is with the rear corner of the trailer, the default assumption has been to classify it as LST related, even if this was not completely clear.

5.24 **None of the 6 events added in 2020 were judged to be LST related**

5.25 In earlier years, events 8 and 17 were classified as LST related, with events 2 and 32 noted as having the LST possibly contributing to the event.

5.26 In event 32 the driver was on a roundabout and misjudged his turn, locked up the trailer brakes, resulting in a trailer sideways slide. The slide may not have been materially different with a fixed tri-axle13/6m trailer, but we have prudently marked the event as 'Maybe LST Related'.

Table 10: Description of all reported LST injury incidents in public locations (source LST Trial logs)

The allocation to fatal, serious or slight injury is based on STATS19 police category definitions

[Incident No.] and Year	Road type & urban or rural	No. of Fatalities	No. of Serious Injuries	No. of Slight Injuries	Incident summary including the judgement of whether the incident was LST related or not
[1] 2012	Minor (urban)	**0**	**0**	**1**	LST driver turning left on mini-roundabout. A taxi entered the roundabout during the LST manoeuvre and struck the trailer. Taxi driver slight injury. **Not LST related.**
[2] 2012	Trunk (rural)	**0**	**0**	**1**	Early in the trial, LST being delivered from manufacturer to VCA for testing, before delivery to operator. Agency driver misjudged roundabout at motorway junction and overturned trailer. Driver slightly injured - no other vehicles involved. Agency drivers generally not used on the trial. **Maybe LST related.**
[3] 2013	Motorway	**0**	**1**	**0**	LST slowing down on motorway. Driver behind failed to brake and hit back of trailer and was injured. **Not LST related.**
[4] 2014	Trunk (rural)	**0**	**0**	**1**	LST travelling on rural section of A-Road at night. Another road user ran into rear of the LST at high speed and was injured. **Not LST related.**
[5] 2014	Motorway	**0**	**1**	**0**	LST encountered previous incident on motorway that had resulted in a jack-knifed vehicle partially blocking lane 1. It was night, motorway section unlit and damaged vehicle was unlit. LST driver was unable to avoid hitting it and was injured. **Not LST related.**
[6] 2014	Motorway	**0**	**1**	**0**	LST travelling in lane 1 of motorway at night. Car driver approached from behind and hit the trailer. Car driver injured. **Not LST related.**
[7] 2014	Trunk (rural)	**0**	**0**	**1**	LST travelling on rural section of A-Road when driver lost control - vehicle left the road and overturned, injuring the driver. No other vehicles involved. Investigation attributed event to driver fatigue resulting from stress factors outside work. **Not LST related.**
[8] 2015	Minor (urban)	**0**	**0**	**1**	LST on driver assessment route making a turning manoeuvre in an urban location reported to have hit a pedestrian with the tail end of the trailer. Police did not attend scene but gathered information from pedestrian report and interviews with operator involved. The route is no longer used for driver assessment. **LST related (see discussion in 2015 Annual Report page 27 para 5.12-5.18)**
[9] 2015	Motorway	**0**	**0**	**1**	LST travelling on motorway in middle of the day. Vehicle left the road on nearside but did not overturn. No other vehicle involved. Investigation attributed event to driver fatigue. **Not LST related.**

[Incident No.] and Year	Road type & urban or rural	No. of Fatalities	No. of Serious Injuries	No. of Slight Injuries	Incident summary including the judgement of whether the incident was LST related or not
[10] 2015	Motorway	**0**	**0**	**1**	LST travelling on motorway mid-morning. Vehicle left the road on offside and overturned. No other vehicle involved. Investigation attributed event to driver fatigue. **Not LST related.**
[11] 2015	Motorway	**0**	**1**	**5**	LST travelling on motorway in middle of the day. Traffic congestion resulted in a stationary queue. LST driver failed to react quickly enough and collided with the rear stationary vehicle. There were 1 serious and 5 slight injuries. **Not LST related.**
[12] 2016	Principal (urban)	**0**	**1**	**0**	Driver hit cyclist from behind when moving from slip road to dual carriage way. **Not LST related.**
[13] 2016	Motorway	**0**	**0**	**1**	LST travelling on inside lane of motorway when a third-party vehicle crossed from outside lane and hit rear offside of the trailer at speed. **Not LST related.**
[14] 2016	Motorway	**0**	**0**	**1**	LST travelling on motorway, collided with rear of another vehicle which then ran into a second vehicle. **Not LST related.**
[15] 2016	Motorway	**0**	**1**	**0**	LST following another HGV in roadworks on motorway. The HGV made an emergency stop to avoid another vehicle swerving across the lanes. LST unable to stop in time and collided with rear of HGV. **Not LST related.**
[16] 2016	Motorway	**0**	**1**	**0**	3rd party vehicle collided with rear of LST on motorway. Near side right under-run bar snapped. **Not LST related.**
[17] 2016	Motorway	**0**	**0**	**1**	LST travelling on inside lane of motorway, drifted onto rumble strip and just over hard shoulder line. Driver observed a vehicle parked in hard shoulder. Steered to right to avoid the vehicle, but rear of trailer hit offside of parked vehicle. Although the role of the steering axle in this event is not clear, we have treated it as **LST related (see discussion in 2016 Annual Report, page 40, para 6.24 onwards)**

[Incident No.] and Year	Road type & urban or rural	No. of Fatalities	No. of Serious Injuries	No. of Slight Injuries	Incident summary including the judgement of whether the incident was LST related or not
[18] 2016	Motorway	**0**	**0**	**1**	LST travelling on motorway, driver did not react in time to changing road conditions and collided with rear of another vehicle. **Not LST related.**
[19] 2017	Principal (rural)	**0**	**1**	**0**	LST travelling on A Road, approaching split with another major A Road, skidded and hit central reservation. Investigation recorded that driver lost control of his vehicle (cause unknown). Nothing indicating trailer design contributed. **Not LST related.**
[20] 2017	Trunk (rural)	**0**	**1**	**4**	LST travelling on major A Road, collided with rear of one vehicle and then a side impact (tractor unit and then trailer) with a second vehicle. Company investigation concluded the cause was driver error (following too closely). Nothing to indicate trailer design was a contributory factor. **Not LST related.**
[21] 2017	Motorway	**0**	**1**	**0**	LST travelling on motorway, collided with rear of two HGVs that had been involved in a previous accident and had not cleared their vehicles from Lane 1. Detailed report and photos from Operator suggest driver inattention. Judged to be **Not LST related.**
[22] 2017	Trunk (rural)	**0**	**0**	**1**	LST travelling on major dual A Road at night. Driver reported that he swerved to avoid an animal and lost control. Contact was made with the LH and RH barriers causing the vehicle to land on its side, causing extensive damage to the trailer. No other vehicles involved. **Not LST-related.**
[23] 2018	Motorway	**0**	**0**	**1**	LST travelling on motorway, infringed soft verge at left hand edge of inside lane. Driver steered away to the right but lost control and collided with central reservation. Trailer overturned, and ruptured fuel system caused a fire that engulfed tractor and trailer. **Not LST related.**
[24] 2018	Motorway	**0**	**0**	**1**	LST travelling on motorway, did not see slower moving third party vehicle ahead when changing lanes to the left. Skidded and collided with rear of the vehicle, spinning it into the path of a third vehicle. **Not LST related.**
[25] 2018	Trunk (rural)	**0**	**0**	**1**	LST travelling on major A Road, approaching slight right-hand bend when nearside front wheel infringed soft verge. Lost control of vehicle, which overturned onto its left-hand side and slid off the road down an embankment. **Not LST related.**
[26] 2018	Motorway	**0**	**0**	**1**	LST travelling on motorway, changed lanes to overtake a slower vehicle and collided with rear of a third vehicle which then spilled some of its load. Two further vehicles involved attempting to avoid the spilled load. **Not LST related.**
[27] 2018	Minor (rural)	**0**	**0**	**1**	Third party claimed that LST hit his car while it was reversing into a lay-by for overnight parking, causing a minor injury. LST driver is disputing that a collision occurred, referred to the insurers. **Not LST related.**

[Incident No.] and Year	Road type & urban or rural	No. of Fatalities	No. of Serious Injuries	No. of Slight Injuries	Incident summary including the judgement of whether the incident was LST related or not
[28] 2018	Motorway	**0**	**0**	**2**	LST exiting motorway on a slip road, travelling too fast on approach to roundabout due to driver error. Trailer overturned on nearside. **Not LST related.**
[29] 2018	Motorway	**0**	**0**	**1**	LST travelling on motorway approaching exit, rear end collision with third party vehicle. **Not LST related.**
[30] 2018	Motorway	**0**	**0**	**1**	LST travelling on motorway when the driver blacked out at the wheel. Vehicle collided with crash barrier and came to rest. **Not LST related.**
[31] 2018	Motorway	**0**	**0**	**1**	LST travelling on motorway, indicated left to move into inside lane, did not see third party vehicle travelling at faster speed in inside lane (undertaking). Collided with rear offside corner of the third-party vehicle. **Not LST related.**
[32] 2018	Principal (rural)	**0**	**0**	**1**	LST approached major A Road roundabout too fast due to driver error. Driver braked hard and the brakes locked, then the rear of the trailer swung out hitting a vehicle on the other side of the carriageway. The trailer was empty at the time. A standard- length trailer might have behaved in a similar manner. **Maybe LST related.**
[33] 2018	Motorway	**0**	**0**	**1**	Third party vehicle hit by another vehicle causing vehicle to spin and hit the LST following behind in heavy motorway traffic. **Not LST related.**
[34] 2019	Principal (rural)	**0**	**1***	**0**	LST was pulling out of a layby at the side of an A Road. Third party vehicle approaching from behind braked but was struck by a following vehicle and shunted into the side of the LST tractor unit. **Not LST related.**
[35] 2019	Motorway	**0**	**0**	**1**	LST was travelling on the motorway when the driver suffered a medical incident. Tractor unit and trailer ran off road on nearside and came to a stop in a field. **Not LST related.**
[36] 2019	Motorway	**1**	**0**	**0**	Legal proceedings pending - see DfT Statement in 5.20 **Not LST related.**
[37] 2019	Motorway	**0**	**0**	**1**	LST collided with a third party vehicle as both vehicles attempted to merge onto a motorway main carriageway from a motorway link road. **Not LST related.**
[38] 2019	Trunk (urban)	**1**	**0**	**0**	Legal proceedings pending - see DfT Statement in 5.20 **Not LST-related.**

[Incident No.] and Year	Road type & urban or rural	No. of Fatalities	No. of Serious Injuries	No. of Slight Injuries	Incident summary including the judgement of whether the incident was LST related or not
[39] 2019	Motorway	**0**	**0**	**2**	LST was travelling on a motorway, indicated left to move into inside lane, did not see third party vehicle travelling at faster speed in inside lane. Collided with the third party vehicle, causing it to spin into barrier. **Not LST related.**
[40] 2019	Motorway	**0**	**0**	**1**	LST travelling downhill on a motorway, lost control overtaking another vehicle, causing the tractor unit and trailer to overturn and collide with a third party vehicle in the outside lane. **Not LST related.**
[41] 2020	Motorway	**0**	**0**	**1**	LST at roundabout after exit from motorway, straddling both lanes in order to turn right. Third party vehicle tried to squeeze into inside lane and was pushed into kerb and scraped by offside of LST as driver pulled away. **Not LST related.**
[42] 2020	Principal (rural)	**0**	**0**	**1**	LST overturned on straight section of road after two bends. No sign of excess speed. Most likely cause was near side wheel caught in soft verge. **Not LST related.**
[43] 2020	Motorway	**0**	**0**	**1**	LST entering motorway from slip road. Driver felt trailer hit on offside under run bar by a third party vehicle, caused by a separate incident between two third party vehicles. **Not LST related.**
[44] 2020	Minor (urban)	**0**	**0**	**1**	LST turning right at roundabout before final delivery point, when trailer overturned. Investigation concluded that driver was travelling too fast entering the roundabout. **Not LST related.**
[45] 2020	Minor (urban)	**0**	**0**	**1**	LST turning right from minor road into industrial estate delivery location. Driver noticed a number of youths “messing about”, touching the side of the trailer. One youth was clipped by trailer as it turned. **Not LST related.**
[46] 2020	Motorway	**0**	**0**	**2**	LST stationary on motorway, third party vehicle ran into the back of the trailer. **Not LST related.**

Sources: LST data, Operator communications and STATS19 data for validation (except 2019 – at the time of writing the STATS19 data has not been released.) The Road Type definitions adopted here are the same as those used in the DfT table TRA3105 (the source for the vehicle km data for the GB artic. Population):

Motorway = all roads with road class M or A(M).

Trunk = all major A roads managed by Highways England and their equivalents in Wales and Scotland

Principal = all other A roads managed by local authorities

Minor = all other road classes

* Incident no. 34 reclassified from slight to serious injury since 2019 annual report was published

LST Safety Outcomes 3: Comparison of national injury incident rates

5.27 **Aside from the review of LST incident patterns and causes, a key outcome required from the trial was analysis of the incident data to assess whether the LST operations posed an additional risk to other road users, when compared with the GB articulated HGV fleet (which includes the LST fleet) on a per km basis.**

5.28 Our analysis focuses on the comparison of LST incidents in **public locations** (public highway, services areas etc.) as the best comparison to the background STATS19 data published for all personal injury road traffic collisions that take place on the public highway.

LST Incident Summary

5.29 There have been 46 personal injury incidents involving an LST in public locations in 899 million vehicle km travelled from when the trial began in 2012 to the end of December 2020.

5.30 Of these 46 public personal injury incidents, only 4 events (resulting in 4 slight injuries) were determined to be, or possibly be, LST-related.

5.31 This equates to:

- **1 injury event in a public place for every 19.5 million vehicle km travelled by the LSTs**
- **1 LST related injury event in a public place, in every 225 million vehicle km travelled**.

GB Articulated HGVs summary

5.32 Table 11 summarises the number of collisions, vehicle km and casualties for the period 2012-2019 for the GB Articulated HGV fleet.

5.33 Collision and casualty data is taken from STATS19 for all personal injury collisions involving articulated goods vehicles of 7.5 tonnes and over. Vehicle km data is taken from the DfT statistics table TRA3105 for articulated goods vehicles with 3 or more axles.

5.34 Table 12 then summarises the data in Table 11 as a three-year average for the period 2017-19. This allows us to compare the rates of incidents and casualties for the GB fleet with the rate for the LST trial fleet, as described in the next section.

Table 11: Number of collisions, vehicle km and casualties for the period 2012-2019 for the GB Articulated HGV fleet

Number of Collisions		2012	2013	2014	2015	2016	2017	2018	2019	Total
Motorways		723	741	831	795	625	521	482	418	**5,136**
Non-motorways by Major-A & Minor roads	Major A-roads (Trunk & Principal)	1,189	1,187	1,250	1204	1,090	933	809	757	**8,419**
	Minor roads	310	265	286	265	236	213	219	187	**1,981**
Non-motorways by Rural & Urban roads	Rural roads	1,025	1,027	1,077	994	921	736	671	629	**7,080**
	Urban roads	474	425	459	475	405	410	357	315	**3,320**
Total Collisions		**2,222**	**2,193**	**2,367**	**2,264**	**1,951**	**1,667**	**1,510**	**1,362**	**15,536**

Vehicle Kilometres (billions)		2012	2013	2014	2015	2016	2017	2018	2019	Total
Motorways		7.5	7.8	8.1	8.3	8.5	8.7	8.8	9.0	**66.7**
Non-motorways by Major-A & Minor roads	Major A-roads (Trunk & Principal)	5.2	5.2	5.4	5.6	5.8	6.1	6.3	6.3	**45.8**
	Minor roads	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	**2.3**
Non-motorways by Rural & Urban roads	Rural roads	4.7	4.7	4.8	5.1	5.2	5.6	5.7	5.8	**41.6**
	Urban roads	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	**6.5**
Total Vehicle Kilometres (billions)		**13.0**	**13.3**	**13.7**	**14.3**	**14.5**	**15.1**	**15.4**	**15.6**	**114.9**

Number of Casualties	2012	2013	2014	2015	2016	2017	2018	2019	Total
Fatalities	116	117	111	125	133	124	132	103	**962**
Serious injuries	355	443	410	430	394	374	382	334	**3,124**
Slight injuries	2,650	2,547	2,878	2,733	2,232	1,942	1,528	1,434	**17,947**
Total Casualties	**3,121**	**3,107**	**3,399**	**3,288**	**2,759**	**2,440**	**2,042**	**1,871**	**22,033**

Source STATS19 and TRA3105 2012-2019 (2020 STATS19 not yet published).

Further notes to Table 10

Rural roads (Excluding motorways) include one incident where its STATS19 code for rural/urban status is 3 (=unknown). It has been allocated to rural for the purposes of this calculation, to maintain equal numbers of total non-motorway events when split between Major/Minor and Urban/Rural segmentations of the data. The event was on a road which is predominantly rural. The rural event count is, in any case, only a balancing figure in this table - without which the sub-totals would not match for the two non-motorway road split types. It does not affect any later calculations.

Vehicle km figures may not balance due to rounding.

Table 12: Three-year averages (2017-19) for collisions, casualties and vehicle km for the GB Articulated HGV population, public locations

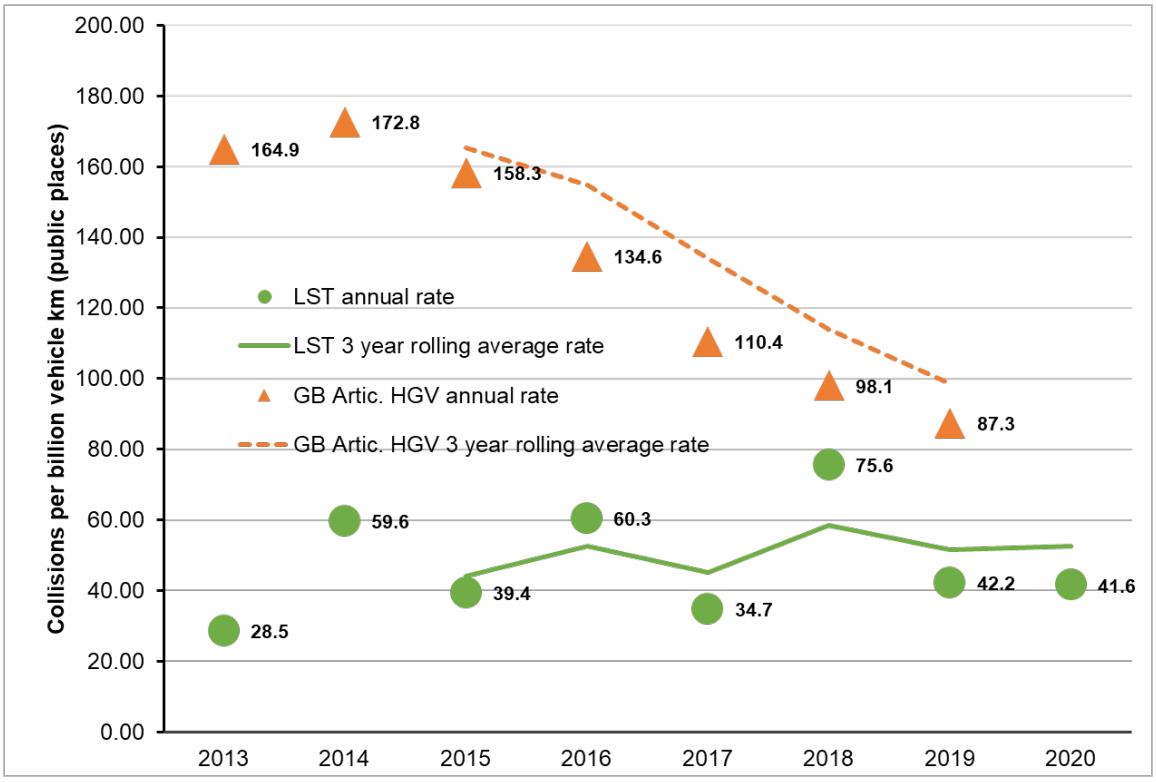
GB Articulated HGV three-year averages 2017-2019	Collisions per year	Casualties (All killed or injured) per year	Billion vehicle km per year
1) Motorways	474	713	8.8
2) Major A-roads (Trunk and principal)	833	1152	6.2
Minor roads	206	252	0.3
3) Rural roads (excluding motorways)	679	960	5.5
Urban roads (excluding motorways)	361	445	0.8
Total *(1) Motorway + (2) or (3) rounded figures*	**1,513**	**2,118**	**15.4**

Source STATS19 and TRA3105 – annual average 2017-2019 (2020 STATS19 not yet published).

LST comparison to the GB articulated HGV 3 year rolling average

5.35 In the early annual reports, we compared figures for individual years of data. Once the trial had been running for over four years, we also included the trend in annual incident rate and a three-year rolling average for LSTs (calculated from Table 11) and the GB fleet (calculated from Table 12), which helps to smooth out any natural variation in the data from year to year. This is shown in Figure 23 below.

Figure 23: Annual incident rate and three year rolling averages, 2013-2020



5.36 The LST incident rate and three-year rolling average rate have remained fairly constant compared with 2019. The GB articulated HGV rate has continued its downward trend.

5.37 Subject to a positive statistical significance test, the overall incident rates for LSTs appear to continue to be lower than those of the GB articulated HGV fleet as a whole. Significance testing is the subject of the next section.

Statistical significance testing

5.38 To establish whether the difference between the LST and GB Artic. Injury rates per km are real, rather than due to normal statistical 'noise' in the data, we calculate the **mean rate ratio.** This is defined as the LST incident rate (per billion vehicle km) divided by the incident rate for the background population of all GB articulated HGVs. If the mean rate ratio is equal to 1.0, then the rates are the same. If the ratio is not equal to 1.0, we apply a statistical test to determine if the difference from 1.0 is statistically significant. More details on the tests used can be found in past annual reports and the detailed analysis by road type is discussed later in this section.

5.39 Table 13 shows that the national incident and casualty rates for LSTs are substantially lower than those of the standard fleet. The ratios in the table are less than 1.0 and are statistically significant.

5.40 **For the public access location comparison, per km operated, LST incidents are occurring at a rate of 53% of the GB articulated HGV fleet.**

5.41 The difference in incident rates has narrowed over time due to the downward trend in the background data. However, the difference in rates is still statistically significant.

Table 13: Summary comparison of LST public road collision and casualty three year rolling average rates (2018-20) vs. GB articulated HGVs (2017-19)

Injury incidents Public access locations	LST Rate per billion vehicle km	GB Artic HGV Rate per billion vehicle km	Mean Rate Ratio LST to GB-HGV
Collisions	53	98	**0.53**
Casualties	59	138	**0.43**

Sources: LST from trial data. GB from STATS19 and TRA3105 – all 2017-2019 (2020 not yet published) – all figures rounded. Both ratios shown to be statistically significant at the 5% confidence level.

LST Safety Outcomes 4: Comparison of injury incident rates by road type AND key vulnerable user groups

5.42 There is a valid question over whether LST operations in urban locations or on minor roads, where LSTs would be expected to perform most high angle turns, could pose a threat to vulnerable road users such as pedestrians, cyclists, and powered two-wheeler users, as well as to other drivers. The analytical question is whether such an effect might be 'hidden' by the dominance of motorway and trunk road operations in the national average calculations given above.

5.43 In this section, we update the analysis by road type. A separate analysis – new this year at the DfT's request – of the actual statistics for pedestrians and cyclists is covered in the next section.

Injury incidents by Road Type

The source for LST injury incidents on urban roads and minor roads

5.44 The detailed data for the injury incidents noted in Table 10 and taken from trial data have been analysed and the incidents classified in Table 14 using the tailored data splits highlighted above.

Table 14: Number of personal injury collisions for LSTs (whole trial to end 2020)

Number of collisions in each location type		Public & private locations	Public locations only
Motorways		29	29
Non-Motorway – by Road Type	Major A-roads (Trunk and Principal)	12	12
	Minor roads	5	5
	Depots etc.	6	0
Non-Motorway – by Urban or Rural	Rural roads	11	11
	Urban roads	12	6
Total		**52**	**46**

The source for LST vehicle kilometres split

5.45 The trial data submissions do not contain detailed data on LST journeys by urban or rural environments or by road type. We therefore made an estimate of LSTs distance travelled on different road types in 2017 using route mapping (see the 2017 annual report for details). From the mapping work we produced breakdowns of the LST distance operated, using the different approaches used in the DfT national statistics:

- LSTs ran on roads in urban areas (excluding motorways) for 13.1% of their total operating distance, as against 86.9% on rural roads and motorways.
- LSTs spent 62.0% of their operating distance on motorways; 36.0% on major A-roads; and 2.0% on minor roads.
- LSTs spent 85% of their operating distance on Trunk Roads (the motorways and A roads on the SRN), 13% on Principal Roads and 2% on minor roads.
- In the analysis that follows we assume that the same percentages apply to all years during the trial period.

LST incidents involving vulnerable road users (pedestrians and cyclists)

5.46 Vulnerable Road Users (VRU) are defined by EU Intelligent Transport Systems as "non-motorised road users, such as pedestrians and cyclists as well as motor-cyclists and persons with disabilities or reduced mobility and orientation".

5.47 VRU are considered an important group for analysis because they are disproportionately represented in statistics on injuries and road traffic casualties. An analysis of the risk posed to this group from LSTs was first introduced in AR2019.

5.48 There have been four incidents on the trial where pedestrians or cyclists have been involved, including one fatality in 2019. They are events 8, 12, 38 and 45 in Table 10.

Pedestrian standing at edge of curb [Event 8]

5.49 In 2015 an LST on a driver assessment route turned in an urban location and was reported (by a member of the public) to have hit a pedestrian with the rear of the trailer.

5.50 The pedestrian self-reported as slight injury. Police did not attend the scene but gathered information from the pedestrian's report and interviews with the operator involved.

5.51 **The fact that the trailer was an LST was a part of the cause of this incident,** since the manoeuvre being performed involved a very high turn angle (almost 120 degrees). The route is no longer used for driver assessment. A more detailed assessment of this incident drawing police records and the internal investigation can be found in AR2015 (page 26).

Cyclist hit from behind on dual carriageway [Event 12]

5.52 In 2016 an LST hit a cyclist from behind when moving from the slip road to a dual carriageway, which forms part of a bypass around a major town.

5.53 The driver reported checking mirrors before moving forward but was dazzled by the evening sun and so only saw the cyclist when they were about 2 metres in front of the vehicle. The driver braked hard but collided with the cyclist from behind. The Police and Ambulance attended and the cyclist was taken to hospital with serious injuries.

5.54 **The fact that the trailer was an LST was not part of the cause of this incident.**

5.55 A more detailed assessment of this incident drawing on the police record and the operator's internal event investigation can be found on page 40 of AR2016.

Cyclist fell from bicycle as LST overtook [Event 38]

5.56 Legal proceedings pending - see DfT Statement in 5.20.

5.57 **The fact that the trailer was an LST was not believed to be part of the cause of this incident.**

Pedestrian clipped by trailer as LST turned right [Event 45]

5.58 The incident took place as the LST was turning right, from a minor road into an industrial estate delivery location. The driver noticed a number of youths "messing about", touching the side of the trailer. One youth was clipped by the trailer as the driver started his turn. **The fact that the trailer was an LST was not part of the cause of this incident**.

Vulnerable Road User data and analysis

5.59 The tables below summarise the collisions recorded on public roads where an articulated HGV was involved and where one or more pedestrians or cyclists was killed or injured, between 2012 and 2020 (2019 for STATS19 data).

Table 15: Injury incident and distance data for vulnerable road user analysis

A. All articulated HGV incidents

Parameter	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Pedestrians involved	93	124	93	95	100	105	95	79		784
Cyclists involved	77	52	70	70	44	47	50	37		447
Total casualties	**170**	**176**	**163**	**165**	**144**	**152**	**145**	**116**		**1,231**
Total collisions	**168**	**161**	**158**	**159**	**137**	**149**	**139**	**114**		**1,185**
Billion vehicle km	13.0	13.3	13.7	14.3	14.5	15.1	15.4	15.6		114.9
Casualties per billion vehicle km	13.1	13.2	11.9	11.5	9.9	10.1	9.4	7.4		10.71
Collisions per billion vehicle km	12.9	12.1	11.5	11.1	9.4	9.9	9.0	7.3		10.31

B. LST incidents

Parameter	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Pedestrians involved				1					1	2
Cyclists involved					1			1		2
Total casualties				1	1			1	1	4
Total collisions				1	1			1	1	4
Billion vehicle km	0.0083	0.0351	0.0671	0.1016	0.1160	0.1153	0.1455	0.1657	0.1444	0.899
Casualties per billion vehicle km				9.8	8.6			6.0	6.9	4.45
Collisions per billion vehicle km				9.8	8.6			6.0	6.9	4.45

C. Summary comparison of LSTs and all articulated HGVs

Injury incidents Public access locations	LST Rate per billion vehicle km	GB Artic HGV Rate per billion vehicle km	Mean Rate Ratio LST to GB-HGV
Casualties	4.45	10.71	**0.42**
Collisions	4.45	10.31	**0.43**

Sources: LST from trial data. GB Articulated HGVs from STATS19 and TRA3105 All 2012-2019 (2020 not yet published) – Some figures rounded.

Further Notes to Table 14 – applicable also to Tables 15a and 17 that follow: The calculation method includes ALL casualties injured in any incident where an articulated HGV was one of the vehicles involved, not just the HGV occupants, or parties whose injuries could be related to the HGV role in the accident. The calculation normalises the number of incidents in each case using the vehicle km estimated for the LSTs/Articulated HGVs alone and does not make any attempt to take into account the vehicle km of any other vehicles involved in the accidents. This approach is applied to both the LST incidents and the STATS19 Articulated HGV incidents and provides a general metric for comparison between the two populations of trailers. This approach could not be directly expanded to address a wider set of cases – for example such as comparing LST incident rates to Cars, as this would risk either comparing unalike populations, or if multiple vehicle types were analysed and then totalled up, double counting of the same vehicle in more than one sub-group of the analysis, where more than one vehicle was involved.

5.60 The LST casualty and collision rates each year appear to be lower than the corresponding articulated HGV fleet average accident rates and the mean rate ratio is less than one in each case. However, this is based on a very small sample size. To determine if the difference is statistically significant, a statistical significance test must be carried out, this is described in the following section.

Statistical comparison of injury incident rates by road type and for vulnerable road users

5.61 The number of safety incidents involving LSTs in some segmentations of the data is low, so as with the national statistical analysis presented earlier, it is important to test whether differences in collision rates observed between the LST fleet and the GB fleet of articulated HGVs (which includes LSTs) are 'real' (statistically significant) or are just the result of natural variation (noise in the data). We do this using both a classical Poisson rate ratio test and a Bayesian comparison. The details of this approach were given in some detail in the 2015 Annual Report.

5.62 When we presented this analysis in the 2016-2019 Annual Reports examining the differences in injury incident rates by road type, the tests were statistically significant in most cases, confirming that the data sets were now large enough to reach valid conclusions. As we show below, the addition of the 2020 data has not changed the conclusions compared with the 2019 report.

5.63 Since 2019 we have presented an additional analysis looking at injury incidents involving vulnerable road users, this new analysis is included in the testing presented below.

Injury incident analysis – classical statistics

5.64 The results in Table 16 summarise the incident rate calculations for our different road type splits. In each case, we calculate a key indicator - the mean rate ratio. This is the ratio of LST collision rate to the background (GB articulated HGV fleet) collision rate. So, a mean rate ratio >1.0 would imply that the LST collision rate is higher, a value <1.0 implies that the LST collision rate is lower.

5.65 We then test whether we can be confident that any apparent difference between the two collision rates is significant (and not just noise in the data). We use the Poisson rate ratio test for all such comparisons.

5.66 In all these cases apart from for vulnerable road users the analysis shows a mean rate ratio less than 1 across the confidence interval range so we can state with a high degree of confidence that the LST incident rate is lower than the background population.

5.67 **We can conclude that the use of national averages to compare LST incident rates to the general national fleet are not masking an underlying problem of higher injury rates in urban areas or on minor roads.**

5.68 **There are too few incidents involving vulnerable road users to determine whether the incident rates are statistically different.**

5.69 We will continue to monitor and report on the urban and minor road incident rates, as well as vulnerable road users, separately as the risk of injury events in these subsets of the data will remain an area of concern for the trial.

5.70 Once the 2020 GB Fleet statistics and STATS 19 data are available we will, if required, be able to re-run the significance testing based on the years 2012-2020 for both LSTs and the GB Fleet.

Table 16: Injury incident rate analysis by different road types

A. GB Articulated HGV fleet average collision rate (STATS19 data for 2012-2019)

Data item	Urban roads (excluding motorways)	Minor roads	A-roads (trunk & principal)	Motorways	Pedestrians & cyclists (all road types)
No. of collisions	3320	1981	8419	5136	1185
Billion vehicle km travelled	6.5	2.3	45.8	66.7	114.9
Mean collision rate per billion vehicle km	510.8	861.3	183.8	77.0	10.31

B. Trial LSTs (trial data for 2012 to 2020)

Data item	Urban roads (excluding motorways)	Minor roads	A-roads (trunk & principal)	Motorways	Pedestrians & cyclists (all road types)
No. of collisions	6	5	12	29	4
Billion vehicle km travelled	0.118	0.018	0.324	0.557	0.899
Mean collision rate per billion vehicle km	50.8	277.8	37.0	52.1	4.45

C. Comparison of LST versus GB Articulated HGV fleet average collision rate

Comparison measure	Urban roads (excluding motorways)	Minor roads	A-roads (trunk & principal)	Motorways	Pedestrians & cyclists (all road types)
Mean rate ratio	0.10	0.32	0.20	0.68	0.43
95% confidence limit of rate ratio	0.04 – 0.22	0.10 – 0.75	0.10 – 0.35	0.45 – 0.97	0.12 – 1.11
p value that mean rate ratio equals 1.0	< 0.001	0.004	< 0.001	0.03	0.09
Statistical interpretation	Significant	Significant	Significant	Significant	Not significant

Significant here means significant at the 5% level. There is sufficient evidence for these road types and locations to accept the hypothesis that the rates are different.

Not significant here means not significant at the 5% level. There is insufficient evidence for these road types and locations to reject the hypothesis that the rates are the same.

Injury incident analysis – Bayesian statistics

5.71 Given the importance of the safety conclusions from the trial, we have always supplemented our classical statistical testing with a Bayesian analysis.

5.72 A Bayesian statistical analysis estimates the probability that the LST injury incident rate is higher or lower than that for the background population. This is different from the classical Poisson Test described above, which just gives a pass/fail indication at a given

confidence level. In simple terms, the Bayesian analysis gives an insight into how far away from, or inside, a robust statistical test the result falls.

5.73 We have used the Bayesian approach to consider the two data segments of most interest in terms of risk to vulnerable road users, the Urban operations and Minor roads.

5.74 The results in Table 17 shows that there is a less than 0.1% chance that the urban and minor road incident rates are higher for the LST population than for the background population and only a 2.8% chance that the vulnerable road used rate is higher for the LST population than for the background population.

5.75 **The Bayesian approach strongly supports our conclusion from the classical statistical analysis that the LST fleet does not have a higher incident rate than the average for GB articulated HGVs on urban roads and minor roads. It is also likely that the LST incident rate for vulnerable road users is no higher than the average for the GB HGV fleet.**

Table 17: LST Injury incident rate - Bayesian Analysis

Road type	Urban roads (excluding motorways)	Minor roads	Pedestrians & cyclists (all road types)
Median Collision Rate Ratio (LST / GB HGV rate)	**0.10**	**0.33**	**0.45**
Credible range	0.04 – 0.21	0.14 – 0.78	0.16 – 1.10
Probability that the LST (injury) incident rate is **HIGHER** than the background rate for all large GB articulated HGVs	**< 0.1%**	**< 0.1%**	**2.8%**
Probability that the LST (injury) incident rate is **LOWER** than the background rate for all large GB articulated HGVs	**> 99.9%**	**> 99.9%**	**97.2%**

Conclusion: Comparison of LST and other trailer injury incident rates

Statistical comparison

5.76 **At the end of 2020, based on the confirmed injury incidents, we find that the trial LSTs were operated with a significantly lower rate of injury incidents per vehicle km in public locations than the average for GB articulated HGVs, for all the location types that we have studied (urban locations, A-roads, minor roads and motorways).**

5.77 **The LST injury incident rate for vulnerable road users in all locations was also lower than that for the GB HGV fleet, but the difference in rates does not pass a classical statistical significance test.**

Safety impact outcomes expressed as 1 in 'n' kilometres

5.78 For communication with the non-technical reader, it is also useful to summarise the key incident impact results in terms of "1 event in every n km" to convey a sense of the scale of the incidents being observed with LSTs, compared with existing semi-trailers in

common use in the country. In Table 18 we present a summary of the safety incident data using this format.

5.79 The information in Table 18 relates only to incidents involving an LST, operating in a public location.

5.80 The data is presented at the national level, to be consistent with other published results. The urban operations (excluding motorways) analysis has concluded that these national results do not appear to be concealing an underlying problem of LST operations in urban areas.

Table 18: Summary of LST injury incident outcomes vs. all GB Articulated HGVs

Summary of LST-related injury incidents and outcomes after 899 million km travelled, compared with those for all GB Articulated HGVs (>7.5T)

Collisions in all public locations	GB Artic HGVs 1 in every …	LST Involved 1 in every …	Incident judged LST Related 1 in every …
All locations	**7.4 million km**	**19.5 million km**	**225 million km**
Urban only (excl. Motorways)	2.0 million km	19.6 million km	118 million km
Minor roads only	1.2 million km	3.6 million km	18.0 million km
All locations - where a pedestrian or cyclist was involved	**97.0 million km**	**225 million km**	**n/a**

Table Notes

- 'All public locations' covers all public roads and also private land where there is public access.
- 'Urban' here defined as all roads, excluding motorways, in ONS defined urban areas
- 'Minor' Roads are all roads that are classified below the level of A-Road
- GB Articulated HGVs: Based on the DfT National data for all articulated HGVs > 7.5T. 2012-2019 (TRA3105) = 114.9bn km of which 6.5bn urban non-motorway and 2.3bn minor roads. Injury incidents from STATS19 2012-19: Total collisions = 15,536 (3,320 urban and 1,981 minor roads).
- LST Involved: 46 collisions (of which 6 occurred on urban and 5 on minor roads). Any injury event in which an LST was involved, even if the trailer being an LST was not relevant – data from latest annual report table - Table 10. Non-injury (damage only) incidents are covered separately.
- LST Related: 4 collisions. Events involving an LST where the fact that the trailer was an LST rather than a standard length was considered to be at least part of the cause.
- These figures are mean values – based on analysis that concludes that the comparisons between LST incident rates shown here are statistically robust at a 95% confidence level, with the exception of the rate comparison for vulnerable road users.

6 TRIAL OUTCOMES: DAMAGE INCIDENTS

6.1 There has been no new work specifically on damage incident rates since the special study carried out in 2018, which yielded the results cited in the report headlines. In AR2019 we reported a small adjustment to the 2018 calculation to remove a small number of double counted events. The revision did not change any conclusions.

6.2 We do monitor the damage incidents reported by operators and for the most severe events or where the accident sequence seems unusual, we consult further to see if there are any specific insights for the trial to note.

6.3 This short section repeats the 2018 results for completeness of this report and provides a reference back to the original material for further reading.

Overview of LST-related damage only incidents

6.4 There were **117 incidents in 2018 involving LSTs where some damage was recorded** (either to the vehicle, or to public or private property) where this occurred in a publicly accessible location. For **46** of these, **the trailer's design was not explicitly ruled out as a contributory factor**.

6.5 **This gives estimates of damage events where an LST was involved and the trailer's design has not been explicitly ruled out as a contributory factor:**

- **1 reported damage event for every 2.9 million km travelled by the LSTs**
- **1 reported damage event for every 23,000 journey legs operated by LSTs.**

Comparison of LST and non-LST damage incident rates

6.6 Damage events, where there has been no injury, are not routinely reported for HGVs. To obtain comparable datasets we asked operators in 2018 to report damage incidents for both their LST and non-LST fleets, where the non-LST trailers were carrying out similar operations. Ninety two operators were able to provide credible data for both fleets.

6.7 To calculate incident rates for each operator we generated two distributions of the total number of incidents per million vehicle km in 2018 that occurred on the public highway or in a public area: one for LSTs and one for relevant non-LST fleets. We then carried out a series of statistical tests to compare the two distributions. The methods applied are explained further in Annex 8 of AR2018 (with the original results).

6.8 Our method allowed us to predict the mean number of incidents expected for an LST fleet and a non-LST fleet after 1 million vehicle km exposure, that is, after completing a million vehicle km as a fleet. This results in the following predictions:

LST fleet:	**0.86 incidents**
Non-LST fleet:	**6.7 incidents**

6.9 **We concluded that for the paired data sample from 92 of our trial participants in 2018, LST fleets had a much lower incident rate than non-LST fleets of the same group of operators. We therefore saw no indication that the LSTs on the trial are causing more damage than other semi-trailers.**

7 TRIAL OUTCOMES: INDUSTRY INSIGHTS

7.1 One of the seven key evaluation questions listed at the beginning of this report was "Might any special operational requirements be appropriate for LSTs?"

7.2 This question is vitally important, since the overall conclusion we have made in terms of utilisation and especially safety is that when operated under the trial conditions, operators have shown that they can operate LSTs safely and efficiently (reducing the number of journeys required). However, the trial conditions included:

- **explicit requirements** such as special LST training for drivers
- **broad requirements** that operators take appropriate measures to ensure LSTs were operated safely, with extensive discussion throughout the trial of the importance of only sending the trailers on appropriate routes
- **extensive monitoring** with an emphasis on efficient utilisation and a special focus on all incidents, even minor ones.

7.3 The DfT approach to the trial was not to presume that the special conditions required for safe and efficient operation could be pre-determined and expressed entirely in explicit requirements, but that the industry, operating under close scrutiny, would be best placed to develop good practice based on experience using the trailers.

7.4 Having established that the trailers were indeed being operated acceptably, we set out to formally 'harvest' that industry-led good practice, in two phases.

7.5 Phase 1, published in AR2018, involved face to face operator interviews focused on

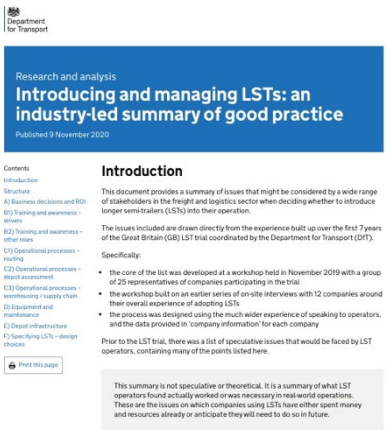
- their experience of introducing LSTs into their fleet
- their thinking behind key choices they made in selecting their LST design options, and whether this would change in light of their experiences
- their practices for driver and route selection now, including whether any changes were made as a result of the trial.

7.6 Phase 2: Having studied the themes emerging from the interviews in Part 1, we drew together a group of 29 representatives from 15 operators, together with other specialists, for a workshop to develop an initial set of summary industry insights to operators and others who may be involved in introducing LSTs into an existing operation.

Workshop objectives

7.7 The workshop objectives were:

1. To present an initial document summarising all the special measures that operators have implemented for LSTs, or, from their trial experience, they believe will be important
2. To provide a starting point for further consultation with industry to refine the issues into an agreed document as the basis for a range of potential uses.


Department for Transport

Research and analysis

Introducing and managing LSTs: an industry-led summary of good practice

Published 9 November 2020

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Print this page

Introduction

This document provides a summary of issues that might be considered by a wide range of stakeholders in the freight and logistics sector when deciding whether to introduce longer semi-trailers (LSTs) into their operation.

The issues included are drawn directly from the experience built up over the first 7 years of the Great Britain (GB) LST trial coordinated by the Department for Transport (DfT).

Specifically:

- the core of the list was developed at a workshop held in November 2019 with a group of 25 representatives of companies participating in the trial
- the workshop built on an earlier series of on-site interviews with 12 companies around their overall experience of adopting LSTs
- the process was designed using the much wider experience of speaking to operators, and the data provided in 'company information' for each company

Prior to the LST trial, there was a list of speculative issues that would be faced by LST operators, containing many of the points listed here.

This summary is not speculative or theoretical. It is a summary of what LST operators found actually worked or was necessary in real-world operations. These are the issues on which companies using LSTs have either spent money and resources already or anticipate they will need to do so in future.

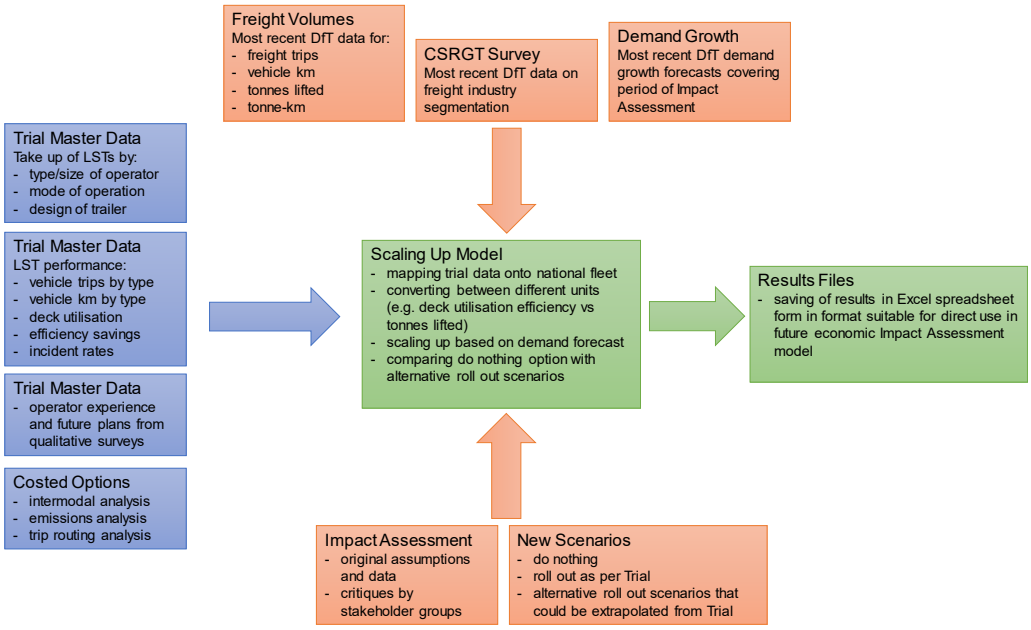
The workshop results were combined with the insights from the phase 1 interviews and were reported fully in AR2019. The results were also published as a stand-alone document called **"Introducing and managing LSTs: an industry-led summary of good practice"**, which can be found on the DFT website.

8 SCALING-UP

Purpose and place in wider project

8.1 The Scaling Model combines the results of the trial with data from the Continuing Survey of Road Goods Transport (CSRGT) and other appropriate sources, to estimate the likely take-up and impact of LSTs over the long term, if they were made widely available to the whole of the GB freight industry.

Figure 24: Scaling Model concept and data sources



8.2 This work lies at the boundary between our work as the independent trial evaluators and the DfT's role in applying the evaluation evidence to their policy thinking, specifically:

- The DfT need a method for scaling up the trial data and reporting the results in a format suitable for input into the development of policy options in relation to the future use of LSTs and the economic analysis that would be required to support any associated regulatory impact assessment.
- Risk Solutions' role at this stage is to ensure that where any policy or impact argument the DfT seeks to support from trial evidence, the claims made correctly reflect the data and information generated during the trial and do not exceed it. We may also respond to the DfT's requests for additional analysis of the trial data in response to emerging policy thinking or economic analysis.

8.3 The Scaling Model has been developed and refined from the initial version created in 2018. The version used by the DfT to model various future scenarios for their policy impact assessment is Version v2-1.

8.4 The later model versions (v2 onwards) have involved joint working with the DfT economists to ensure that the model serves their needs, while also meeting the requirement that the model makes appropriate use of the trial data.

8.5 The core model development and method were reported in full in AR2018, with an update in AR2019. Here we are reporting only the further refinements made since AR2019.

Scaling Model updates since AR2019

Core model functions and parameters

8.6 There has been no change to the core model functions or the main trial results as they are applied to the national CSRGT data to produce the national estimate.

8.7 The model inputs were updated to use the AR2019 main results for collision and casualty rates as well as the average savings results

8.8 Note that the modelling updates took place early in 2021, before the 2020 data had been processed and published in this latest annual report.

Emissions Model parameters for Euro VI Engines

8.9 In Section 4 we described how we estimated trial emissions using the BEIS profile which describes the national change to Euro VI engines year by year from 2013 to a predicted complete transfer to Euro VI by 2027.

8.10 The Scaling Model applies this profile to all future years, starting from a static input for the emissions saved up to the year 2018. The most recent Scaling Model (Version 2-2) has this static figure updated from the 'All Euro V' figure used in earlier versions, replaced with the 'mixed profile' value.

8.11 Although Version 2-1 of the Scaling Model being used by the DfT in their emerging impact assessment modelling does not have this latest change to the 2018 static value, it does not affect their impact results as they are based solely on the forward years of impact.

Fleet projections

8.12 The Scaling Model includes a projection of the LST fleet size over time. This has been refined during the past year, in collaboration with the DfT, to take into account the demand for new trailer builds in each year, implied by that projection.

8.13 The DfT have then taken a view on the likely limits of the supply chain capacity and have made a judgement about the maximum growth of the LST fleet in any single year.

Separation of Take Up and efficiency modifiers

8.14 The Scaling Model allows the DfT to impose two 'modifiers' on the results to explore different policy scenarios. These modifiers alter the assumed growth in overall distance savings from LSTs to reflect:

- Higher or lower take-up of LSTs
- Higher or lower efficiency of LST utilisation

8.15 Earlier versions of the model always applied these two modifiers in series – in effect combining them into a single net modifier.

8.16 To explore some more diverse policy scenarios, DfT asked that the modifiers be separated in the model, to allow them to look at scenarios such as very low regulation, where the take up would be anticipated to be very high, but the resulting efficiency might be very low. Model version from v2-0 onwards have the modifiers separated.

9 ADDITIONAL ANALYSIS

9.1 In 2020 we carried out some additional analysis and support at the request of DfT. In this section we report on work carried out to assess the impact of COVID-19, and work we carried out in support of the DfT Policy Impact Assessment.

2020 and the impact of COVID-19

9.2 The data for 2020 reflects the unusual nature of the period, with the early news of COVID-19 starting to affect purchasing patterns in February 2020 and then operational impacts being observed from 23 March 2020 when the UK went into the first full lockdown.

9.3 We have carried out some analysis of the LST data based on:

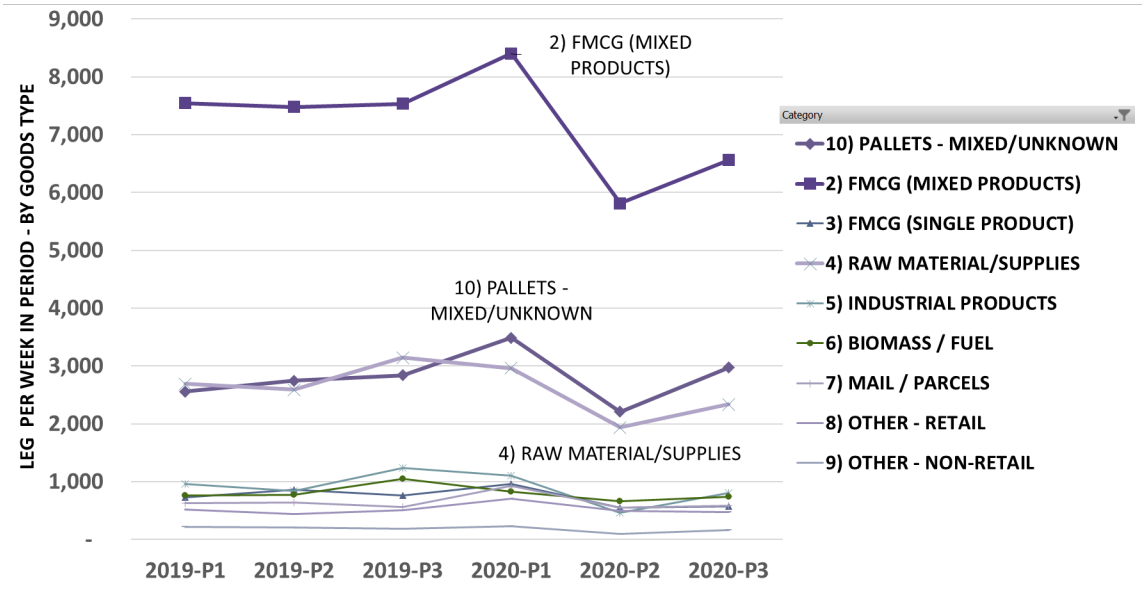
- Measurement of activity in legs by goods type, since we would expect this to best reflect changes in the choices being made by customers during the pandemic
- Analysis in units of 'legs per week', to remove the effect of 2020-P1 being shortened to end on 23 March 2020, and 2020-P2 extended to run from 24 March to end of August

9.4 Figure 25 shows the LST legs per week counts for each goods type for each period in 2019 and 2020. The first movement in the chart to note is the rise in goods type (2) FMCG Mixed Products and 10) Pallets (mixed/unknown) in 2020-P1 vs 2019-P3.

9.5 There could also have been some increase in FMCG and pallet traffic as the likelihood of COVID causing serious problems, increased. The end of 2020-P1 was February and early March 2020, when we were seeing serious pressure on supermarkets for specific FMCG products, which might fall into these two goods type groups.

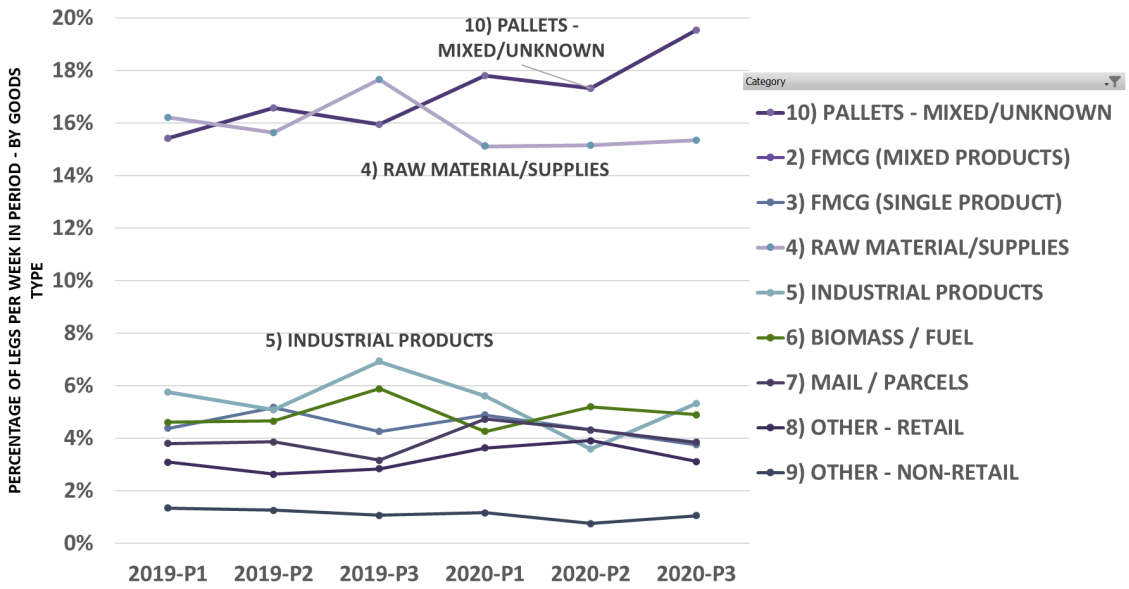
9.6 In 2020-P2 we can see the expected sudden drop in demand for a whole range of goods, including raw materials. Overall, the activity level of the LSTs changed from an average of 17,000 per week in 2019, up to 19,600 in 2020-P1, before dropping 35% down to 12,775 in 2020-P2. The recovery in 2020-P3 brings the average up to 15,200 legs per week – still below the average for 2019.

Figure 25: 2020 COVID Impact - Legs per week by goods type



9.7 Figure 26 shows the same data, but as percentages of all legs in the period, which shows some of the detail not easily extracted from Figure 25.

Figure 26: 2020 COVID Impact - % of legs per week by goods type



9.8 Here we see that the mixed pallets businesses maintained their share of the LST movements as the downturn hit 2020-P2, and then in 2020-P3 (from August -December 2020) actually increased that share.

9.9 Industrial products, which had started to increase in leg share in 2019-P3, fell away in 2020-p1 and P2 and then started to recover in P3.

Trial evaluation contribution to DfT policy impact assessment

9.10 During 2020, the evaluation team have responded to several requests for specific data insights by the DfT team developing their policy options and the associated impact assessment, first published in November 2020, with a consultation period running to the end of January 2021. We have also had the opportunity to comment on these DfT documents as they were drafted to ensure that the DfT was making correct use of the trial evidence available to them.

9.11 As the DfT have developed their thinking, we have also had the opportunity to give some input to early thinking on how each of their policy options might be implemented, based on the experience of dealing with operators and the trailer data on the trial.

9.12 In our report last year, we emphasised that **in any future operation of LSTs, the 'Industry Insights' document published alongside AR2019 and based on real world operational experience of the trailers, forms one of the most important tangible outputs from the trial as a whole**. (See AR2019 Recommendation 2019-01)

9.13 We are pleased to note that many of the industry insights included in this 2019 document have been actively discussed and incorporated into the emerging policy thinking seen in the DfT's published documents and we believe the whole industry insights document is being used as a primary source for draft guidance being developed by the department.

10 PROGRESS SUMMARY AND NEXT STEPS

Progress against evaluation questions

10.1 In the past two annual reports (AR2018 and AR2019) this section summarised:

- progress against the seven key evaluation questions
- progress against recommendations from previous reports
- options for further analysis for discussion with the DfT

10.2 This year there is no material change in the content to be presented as the seven evaluation questions had all been answered in AR2020:

10.3 The details of how the evaluation questions have been addressed will not be repeated here as they can be found in AR2019 Section 10, but will be included in an update to the trial summary report published on the DfT website.

Progress against actions in previous reports

10.4 In AR2019 we reported that all previous recommendations had been addressed by the DfT or in further analysis work.

10.5 The only firm action required in 2020 was to complete the emissions analysis update to incorporate Euro VI engines into the model, as reported in Section 4.

10.6 AR2019 also suggested the option of using the LST Scaling Model as an input to wider UK climate modelling by the Department for freight emissions. This remains an option.

LST trial insights for other 'longer / heavier vehicle discussions

10.7 In November 2020, alongside the LST consultation impact assessment, the DfT published a second paper, proposing the option of a trial of '48 for 48' – meaning an allowance of increased GVW (to 48 tonnes) for journeys to and from an intermodal interchange site (mainly railheads) where the road leg was within a limited distance (nominally, 48 miles). The argument for this allowance is that it offsets the additional weight of the skeletal trailer and the ISO container required to allow road-rail operations compete with road-only movements on an equal basis, in terms of the cargo weight per load.

10.8 In the same period, the DfT has been engaging with industry representations asking for trials of Longer-Heavier Vehicles (LHVs) similar to those operating in many mainland European countries, nominally at around 25m total vehicle length (some having two articulation points) and GVWs at around 50 or 60 tonnes.

10.9 The LST evaluation team have provided insights papers to each of the DfT policy leads for these two areas, listing the evidence and experience from the LST trial that we believe might be relevant to a trial of either of these larger vehicles.

GLOSSARY

Item	Definition
DfT	The Department for Transport
Double deck/ dual deck	A specialised trailer with two floors covering all or part of its internal length to allow for more cargo to be loaded.
DSF	Data submission file - the MS Excel workbook developed to allow operators to submit all trial data in the required format for analysis.
Flatbed	A flat trailer with no enclosure or doors. Can be loaded/unloaded from the sides or above and does not require elevated access for forklifts.
FMCG	Fast Moving Consumer Goods - products that are sold quickly and at relatively low cost. Examples include non-durable goods such as soft drinks, toiletries, over-the-counter drugs, processed foods and many other consumables.
FTA	Freight Transport Association
GVW	Gross Vehicle Weight
IA	Impact Assessment (by the DFT)
ISO	Containers meeting the international specification for intermodal transport.
Leg	A single journey from A to B.
LST	Longer Semi-Trailer - a trailer exceeding the standard length of 13.6m, towed by a tractor unit (as opposed to standard length trailers).
LST related	A judgement (on scale of options) of whether or not an incident involving an LST would have happened had the trailer been a standard length.
MOA	Mode of appearance - the physical form of the load, for example standard pallets, loose/ bulk, livestock.
Model Report	A document specifying the conformance criteria for a specific model to be licensed for use on the road, created by the VCA after testing new vehicle types.
RHA	Road Haulage Association
RST/Standard	Regular or Standard Semi-Trailer – i.e. up to a maximum length of 13.6m (not requiring a VSO) – sometimes use to refer to a GB standard length HGV trailer.
Skeletal	A skeletal trailer composed of a chassis for mounting of an intermodal trailer.
Steering: **Self-** **Command-**	**Self-Steer:** The wheel turns on a kingpin built into the assembly at each end of the axle and the angle of steer is controlled solely by the interaction of forces between the road/tyre and the axle

Item	Definition
Active-	springs/dampers. There is no physical or electronic connection to the angle of turn between the tractor and at the 5thwheel. *Some manufacturers refer to this as "Passive" steering* **Command-Steer:** The angle of steer is controlled by a direct mechanical or hydraulic link to the angle of turn at the 5thwheel. In the most common system the whole axle is mounted on a turntable under the rear of the trailer. *Note - some trailer vendors simply classify steering as "Passive" (meaning self-steer) and "Active" (meaning Command-steer). The use of the term "Active" on the trial is reserved for computer controlled steering (see category below)* **Active-Steer:** The wheels of the steering axle are controlled by a computer and the angle of steer is adjusted to make the rear of the trailer closely track the path of the tractor unit as well as other variables detected by the software. *Also called Active Command Steer by some vendors but that terminology not used on the trial to avoid confusion with the Command Steer category*
VCA	The Vehicle Certification Agency is an Executive Agency of the United Kingdom's Department for Transport and is the United Kingdom's national approval authority for new road vehicles, agricultural tractors and off-road vehicles.
VIN	Vehicle Identification Number - a unique 17-digit identifier required on all vehicles, stamped on the chassis on manufacture.
VSO	Vehicle Special Order - a certificate provided by the VCA to allow vehicles that do not conform to standard legislation in terms of dimensions to operate on roads in Great Britain under specially licensed conditions.

ANNEX 1: ROUTE MAP TO DESCRIPTION OF METHODS

Details of methods, where these have not changed from previous years, can be found in previous annual reports and published project notes as below. AR – Annual Report.

Method / Explanation	Primary Source
Evaluation / Trial Theory of Change (ToC) Programme Logic Model	Not developed before trial, so implied ToC presented in AR2013
Data Framework	AR2012 Original format: Annexes A1-A6 ALSO Published user guide on the DfT website AR2017 – Proposal for revised data framework from 2018
Formal submission compliance (missing/late) process including escalation steps	AR2014
Statistical method for analysis of injury incidents (Classical and Bayesian)	AR2013 Annex C1 and C2 and the internal DfT Project Notes. Updated in AR2014 and AR2015
Statistical method for analysis of injury incidents: Update for Urban/Rural split	AR2015
Statistical method for analysis of injury incidents: Update by road type	AR2017
Distance savings (percent) calculation	First version AR2014 Annex E Refined in subsequent years
Percent savings by operator (chart)	AR2014
Qualitative Survey Results: QSF 1 – early qualitative experience	AR2014
Qualitative Survey Results: QSF 2 – update and take-up estimates	AR2016 (+ summary in 2017)
Full format injury incident table and formal definition of 'LST-related'	AR2015
Damage event analysis: Initial small sample	AR2016
Damage event analysis: Trial scale estimates	AR2018
Route modelling	AR2017 and published PN E1
Emissions modelling	AR2017 and published PN E2 EURO VI Runs AR2020
Intermodal effects	AR2017 and published PN E3
Scaling Up	AR2019 Annex 4 and internal PN E4
Operator conversations	Part 1: AR2018 Annex 5 and internal PN E5 Part 2: AR2019 Annex 5 & 6 and internal PN E8
Trip end / flow analysis	AR2018 and internal PN E6
Special Issue: Course correction at speed	AR2017
Special Issue: Kick-Out vs Axle Design	AR2016 and AR2017
Special Issue: Model report digitisation	AR2019 and internal PN E7

List of Annual Reports

Clicking on the report title links to the web page on the DfT website where the report, and any accompanying published project notes (PNs) can be downloaded.

Although the trial has been running for eight years, this is the 10th report as there was a first evaluation report issued during the first year as well as an end of year report, and then in 2014 we published the results in two parts, either side of the 2015 general election.

The report on which DfT based their Final Impact Assessment of the trial

Longer semi-trailer trial evaluation: annual report 2019

9 November 2020

The report on which DfT based the Consultation Impact Assessment published 20 November 2020

Longer semi-trailer trial evaluation: annual report 2018

2 March 2020

Earlier reports

Longer semi-trailer trial evaluation: annual report 2017

19 September 2018

Longer semi-trailer trial evaluation: annual report 2016

21 September 2017

Longer semi-trailer trial evaluation: annual report 2015

6 September 2016

Longer semi-trailer trial evaluation: annual report 2014

30 July 2015

Longer semi-trailer trial evaluation: interim report 2014

24 March 2015

Longer semi-trailer trial evaluation: annual report 2013

19 June 2014

First year evaluation of the high volume semi-trailer trial

31 May 2013