A review of fatal accidents involving agricultural vehicles or other commercial vehicles not classified as a goods vehicle, 1993 to 1995

Prepared for Commercial Vehicle Safety, Department of the Environment Transport and the Regions

I Knight
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Executive Summary

TRL Limited has been researching commercial vehicle accidents on behalf of the Department of Environment, Transport and the Regions for many years. The programme of research aims to assess the effectiveness of current vehicle designs, the potential for proposed changes in design and to identify areas where cost-effective safety improvements might be possible. The majority of the work has concentrated on accidents involving Heavy Goods Vehicles (vehicles in excess of 3,500 kg gross vehicle weight, referred to as HGVs) but this report considers fatal accidents involving those vehicles classified by STATS 19 as ‘Other Motor Vehicles’ or OMVs. This is a broad category that includes vehicles such as agricultural tractors, emergency vehicles, refuse collectors, road sweepers, mobile cranes, and recovery vehicles. This report describes an analysis of police reports of 102 fatal accidents involving at least one vehicle identified by STATS 19 as an ‘OMV’ that occurred between 1993 and 1995 inclusive. There were no additional sampling criteria applied. The report concentrates on accidents involving agricultural vehicles because of the larger numbers of such accidents found on the database.

The database contains information on 102 fatal accidents involving 103 OMVs, and 123 fatalities. Forty percent of the fatalities were car occupants, 17% were motorcyclists, and 16% were OMV occupants. Of the 103 ‘other motor vehicles’ in the sample, 40% were agricultural tractors.

Two-thirds of all motorcyclists killed in a collision with an OMV were in fact in an accident involving an agricultural tractor. Although the sample is small, tractors are only involved in 40% of OMV accidents. This tends to suggest that tractors present a higher risk to motorcyclists than do other types of OMV.

Fifty-nine percent of all accidents involving tractors occurred on an ‘A’ road, with a further 20% on unclassified roads, 17% on a ‘B’ road, and 4% on a ‘C’ road. As would be expected there were no instances of tractor accidents on a motorway. Ninety-five percent of accidents occurred in either open countryside or rural locations.

Thirty-seven percent of tractor drivers, 81% of other vehicle drivers, and 80% of the pedestrians involved in agricultural vehicle accidents were considered to be at least partly to blame for the cause of the accident. A lack of attention was the most common factor.

Twelve percent of the agricultural vehicles in the sample had a serious defect that was considered to be contributory to the accident. There were two major trailer coupling defects that led to trailer detachment in service and directly caused the death of one pedestrian and one car occupant in two separate incidents. Lighting defects were the most common type, accounting for nine faulty vehicles. However, only two of these defects contributed to the cause of the accident but all were potentially dangerous. Further research and/or legislative action to improve the roadworthiness of agricultural vehicles should be considered.

Sixty-three percent of collisions between a tractor and a car, and a further 50% of collisions between a tractor and a motorcycle occurred while the tractor was making some form of right turn either from, or into, a side road or field entrance.

Four out of the seven accidents involving a tractor occupant fatality occurred when their vehicle was struck from behind by an HGV. The remaining three were single vehicle accidents. Ejection from the cab was a factor in four of the accidents and rollover played a part in five.

For each accident studied an assessment was made as to whether any changes to the design of the OMV could have prevented the accident from occurring or reduced the severity of the injuries sustained. The findings in respect of the main accident types were as follows.

It was estimated that improving the lighting and/or conspicuity of agricultural tractors could have saved the lives of 20% of the car occupant fatalities, 15% of the motorcyclists’, and 15% of the tractor occupants themselves. These figures include the benefits of ensuring current lighting systems are properly maintained at all times.

Fitting and using seat belts would have been of substantial benefit to the tractor occupants in this sample. Lap belts could have potentially saved the life of around one-third of them and three-point belts might have saved up to two-thirds.

Fitting intelligent distance sensors or collision avoidance systems to HGVs may have saved the life of four out of the seven tractor occupant fatalities. It is likely that three car occupants could have been saved if systems were installed that enabled traffic lights to give automatic priority to emergency vehicles when they are on call.
## 1 Introduction

TRL Limited has been researching commercial vehicle accidents for many years. The programme of research aims to assess the effectiveness of current vehicle designs, the potential for proposed changes in design and to identify areas where cost-effective safety improvements might be possible. The majority of the work has concentrated on accidents involving Heavy Goods Vehicles (vehicles in excess of 3,500 kg gross vehicle weight, referred to as HGVs) but this report will deal with fatal accidents involving those vehicles classified by STATS 19 as ‘Other Motor Vehicles’ or OMVs. This is a broad category that includes vehicles such as agricultural tractors, emergency vehicles, refuse collectors, road sweepers, mobile cranes, and recovery vehicles.

The analysis will concentrate on accidents involving agricultural vehicles, emergency vehicles, and electric vehicles as these are of particular interest to the Department of Environment, Transport and the Regions (DETR). A separate TRL report (Simmons et al., 1997) prepared for the DETR deals in detail with accidents involving recovery and ‘special types’ vehicles.

## 2 The accident sample

The UK national accident database, STATS 19, contains information on all injury accidents reported to the police. The types of vehicle involved in each accident are recorded in one of fifteen categories such as ‘car’ or ‘PSV’. The category ‘Other Motor Vehicle’, or OMV, is one of these and includes such vehicles as agricultural tractors, emergency vehicles, refuse collectors, and recovery vehicles. According to STATS 19 there were 195 fatal accidents involving at least one OMV between 1993 and 1995. TRL has obtained the detailed police reports relating to 116 (59%) of these incidents. The police reports for fatal accidents usually contain witness statements, vehicle examiners’ reports, police summaries, post-mortem reports, photographs, accident investigators’ reports, and other expert evidence.

A preliminary analysis of the 116 accidents revealed that 14 were either incorrectly coded as OMV, incorrectly coded as fatal, the OMV was not directly involved in the major impact of the accident, or there was strong evidence that the ‘accident’ was in fact a deliberate suicide by the victim. These accidents have been removed from the sample and the remaining 102 are shown in Table 1, divided by road user type killed. It should be noted that some accidents involved fatalities from more than one road user group.

The proportions shown in Table 1 generally reflect those in STATS 19 well but pedestrians are under-represented by around 10 percent and PSV occupants are over-represented by around 10%. The reason for the over-representation of PSV occupants is that this sample includes the M40 minibus crash in 1993 (13 fatalities). The minibus collided with the rear of a block vehicle used in mobile lane closure operations, which was coded in STATS 19 as an HGV.

### Table 1 Accident and fatality types within the sample

<table>
<thead>
<tr>
<th>Road user type killed</th>
<th>Number of accidents</th>
<th>Number of fatalities (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car occupant</td>
<td>45</td>
<td>49 (40%)</td>
</tr>
<tr>
<td>Motorcyclist</td>
<td>18</td>
<td>21 (17%)</td>
</tr>
<tr>
<td>OMV occupant</td>
<td>20</td>
<td>20 (16%)</td>
</tr>
<tr>
<td>PSV occupant</td>
<td>2</td>
<td>14 (12%)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>11</td>
<td>11 (9%)</td>
</tr>
<tr>
<td>Pedal cyclist</td>
<td>4</td>
<td>4 (3%)</td>
</tr>
<tr>
<td>Light commercial occupant</td>
<td>4</td>
<td>4 (3%)</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
<td>(100)</td>
</tr>
</tbody>
</table>

Under-representation of pedestrians is likely to be because TRL have been unable to acquire information from the Metropolitan police force, which has a high proportion of pedestrian accidents. This is due to the way in which this particular police force stored their data in the past. Data from the Metropolitan police are now collected by TRL as part of the on-going fatal database, but the large back-log of files to be catalogued and coded means that it is not yet possible to isolate particular accident types for the years covered by this report.

There were a total of 103 OMVs in the sample because one accident involved two such vehicles. Table 2 shows what vehicle type the 103 OMVs actually were in more detail.

### Table 2 Types of OMV in the sample

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Number in sample</th>
<th>Vehicle type</th>
<th>Number in sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural tractor</td>
<td>41</td>
<td>Military vehicle (other)</td>
<td>2</td>
</tr>
<tr>
<td>Refuse collector</td>
<td>9</td>
<td>Military vehicle (HGV)</td>
<td>1</td>
</tr>
<tr>
<td>Mechanical digger</td>
<td>7</td>
<td>Military vehicle (jeep)</td>
<td>1</td>
</tr>
<tr>
<td>Ambulance</td>
<td>6</td>
<td>Agricultural Machine</td>
<td>1</td>
</tr>
<tr>
<td>Recovery vehicle (cars)</td>
<td>6</td>
<td>Forklift</td>
<td>1</td>
</tr>
<tr>
<td>Fire tender</td>
<td>5</td>
<td>Hydraulic platform</td>
<td>1</td>
</tr>
<tr>
<td>Road sweeper</td>
<td>5</td>
<td>Recovery vehicle (HGVs)</td>
<td>1</td>
</tr>
<tr>
<td>Construction machinery</td>
<td>4</td>
<td>Mobility buggy</td>
<td>1</td>
</tr>
<tr>
<td>Mobile crane</td>
<td>3</td>
<td>Camper van</td>
<td>1</td>
</tr>
<tr>
<td>Milk float</td>
<td>3</td>
<td>M/way maintenance block vehicle</td>
<td>1</td>
</tr>
<tr>
<td>Horsebox</td>
<td>2</td>
<td>White line painting vehicle</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It can be seen that agricultural vehicles are by far the most common (40%) vehicle type in the sample. Unfortunately, it is not possible to check if this is representative of the national situation because STATS 19 gives no further information on vehicle type when they are categorised as OMV.

## 3 Agricultural vehicle accidents

There were 42 accidents involving agricultural vehicles in the data sample. These involved 41 agricultural tractors, one combine harvester, 32 other vehicles, and 43 fatalities. Combine harvesters are a very different vehicle type to tractors and for that reason the single accident involving such a vehicle will be described here and the tractor accidents will be discussed in detail in the following sections.
The combine harvester accident involved a car failing to stop at a give way sign at cross-roads in open countryside. The combine harvester was approaching the cross roads at approximately 20 mile/h, on the road with priority, from the car’s offside. When the car emerged from the junction immediately in front of the harvester it was unable to stop and crushed the car underneath its wheels, killing the driver instantly. The cause of the accident is not really known other than that the car driver was at fault. The combine harvester was an enormous vehicle in the region of 3 or 4 metres tall and would have been clearly visible to the car driver for some time. It is likely that the driver was guilty of either a chronic lack of attention, falling asleep at the wheel, or of mis-judging the junction and thinking he had right of way. It was clear from the huge size difference between the vehicles that there were no vehicle design countermeasures that would have prevented the death of the car occupant.

Many of the tractors involved in fatal accidents were towing some sort of trailer at the time. Figure 1 shows the proportions of each vehicle combination.

![Figure 1 Types of tractor/trailer combination](image)

It can be seen that the majority of tractors were towing some kind of agricultural trailer (e.g. slurry tanker or hay wagon) at the time of the accidents. Forty five percent of the trailers in the sample were unladen, 17% were partly laden, and 38% were fully laden.

Table 3 shows the number of each road user type killed in accidents involving agricultural tractors.

<table>
<thead>
<tr>
<th>Road user type killed</th>
<th>Number of fatalities (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car occupant</td>
<td>16 (37%)</td>
</tr>
<tr>
<td>Motorcyclist</td>
<td>14 (33%)</td>
</tr>
<tr>
<td>Tractor occupant</td>
<td>7 (16%)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>5 (12%)</td>
</tr>
<tr>
<td>Pedal cyclist</td>
<td>1 (2%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43 (100%)</strong></td>
</tr>
</tbody>
</table>

Although the proportions shown in Table 3 are generally very similar to those in Table 1 it is worth noting that the percentage of motorcyclist fatalities in the tractor accident sample is almost double that of the sample as a whole. Although the sample is small, 14 (67%) of the 21 motorcyclists killed in accidents involving an OMV are in fact killed in accidents involving agricultural tractors. Tractors are only involved in 40% of OMV accidents, therefore this tends to suggest that agricultural tractors present a higher risk to motorcyclists than do other types of OMV.

3.1 Accident environment

Fifty-nine percent of all accidents involving tractors occurred on an ‘A’ road, with a further 20% on unclassified roads, 17% on a ‘B’ road, and 4% on a ‘C’ road. As would be expected there were no instances of tractor accidents on a motorway. Ninety-five percent of accidents occurred in either open countryside or rural locations.

The distribution of tractor accidents by time of year is shown in Figure 2.

![Figure 2 Time of year for tractor accidents](image)

Tractor usage is seasonal, therefore it would not be unreasonable to expect peaks for accidents to follow seasonal use. Figure 2 does show a number of peaks but the low number of accidents in the sample makes it difficult to draw any firm conclusions from this. Statistical tests (chi-square) would suggest that this is in fact a random sample.

The distribution of accidents by the time of day is as may be expected for a vehicle working primarily on farms. No accidents occurred between midnight and 7.00 am and 88% happened between 8.00 am and 8.00 pm. As would
be expected from this distribution, the majority, 76%, of the accidents occurred in daylight, 19% in darkness, 2.5% at dusk, and 2.5% under streetlight conditions.

3.2 Accident cause

In this section the number of individual causes in any category may add up to more than the total number of accidents or drivers because it is possible, or even likely, that each accident or driver will have more than one associated causation factor.

Sixteen (39%) of the 41 tractor drivers in the sample were considered to be at least partially responsible for causing the accident. Lack of attention was a factor for seven of the tractor drivers, five were guilty of some error of judgement, one had an element of excessive speed for the conditions, one allowed a passenger to ride on the trailer coupling, one failed to couple the trailer to the tractor correctly, and one stopped unnecessarily in a dangerous place in the carriageway. It is worth noting that the above analysis does not include the onus on the driver to maintain his/her vehicle. If driving a vehicle with a contributory defect is considered as a driver behaviour factor then 19 (46%) of the tractor drivers were considered to be at least partially responsible for the accident in which they were involved.

Drivers of the 32 other vehicles involved in collisions with tractors were even more commonly at fault with just six (19%) adjudged to be completely blameless. A lack of attention was again the most common factor with 15 guilty drivers. A further eight were driving at an excessive speed, six made some error of judgement, three were considered to be inexperienced, two suffered some illness or disability, one was suffering fatigue, and one drove recklessly. Again, maintaining the vehicle has not been included as a behaviour factor. However, the six ‘blameless’ drivers were all in vehicles that had no contributory defects.

Five of the agricultural tractor accidents involved a pedestrian fatality and just one of these pedestrians was considered to be completely innocent with respect to the cause of the accident. In this case the pedestrian was walking along the pavement when the trailer from a passing tractor became detached, mounted the kerb and crushed the pedestrian against a hedge. Of the remaining four pedestrians, two involved some error in judgement, and two were walking along the road.

Adverse weather conditions contributed to just two (5%) of the accidents and poor site conditions such as a defective road surface or a very steep hill, contributed to five (12%).

Thirty-nine percent of the tractors involved were suffering from some kind of defect. Sixteen tractors or tractor/trailer combinations had a total of 20 defects, five of which were considered to have contributed to the cause of the accident. Lighting defects were the most common type with seven non-contributory and two contributory faults all due to a lack of proper maintenance. Two of the accidents were caused by defects in the coupling between tractor and trailer which allowed a complete trailer detachment to occur whilst in motion.

Although the sample is small, the number of defects found on agricultural vehicles tends to suggest that roadworthiness could be a problem. Consideration should be given to further research to define more accurately the extent of the problem and/or to establishing the means to enforce roadworthiness more effectively.

The other vehicles involved in the accidents were maintained in a better condition than the tractors with eight (25%) vehicles suffering eight defects. Just one of these defects was considered to be contributory and since this was a seatbelt defect it contributed to the severity of the injuries sustained rather than the cause of the accident.

3.3 Accidents involving car occupant fatalities

Accidents involving a collision between a car and an agricultural tractor, where at least one car occupant was killed accounted for 16 (39%) of all tractor accidents in the sample, and resulted in 16 (37%) car occupant fatalities. The following section will describe in detail how the accidents happened and whether anything could be done either to prevent the accident from occurring or reduce the severity of the injuries sustained.

3.3.1 Accident mechanisms

Ten (63%) of the collisions between tractors and cars involved the tractor making a right turn just prior to impact. Correspondingly most of the impacts occurred between the car and the side of the tractor with four striking the nearside, six hitting the offside, four hitting the rear, and two colliding with the front of the tractor.

The single most common type of car to tractor accident occurred when a car attempted to overtake a slow moving tractor ahead just as the tractor attempted to turn right from a major road into a side road or farm entrance. This resulted in collisions between the front nearside of the car and the offside of the tractor. The responsibility for the cause of these accidents was usually shared between the two drivers with the car driver failing to notice, or ignoring, the tractor signalling and the tractor driver failing to check mirrors or look behind before manoeuvring.

A further two cars collided with the offside of a tractor when the tractor attempted to turn right from a side road onto a major road with a car approaching from the right. In one of these cases the visibility from the junction was poor and when the tractor commenced its manoeuvre the car was not in sight. The junction had been improved by the time the police report was finalised. The second accident occurred when a car was indicating left to turn into a side road. Observing this, a tractor pulled out from the side road onto the major road. Unfortunately the car driver had accidentally left his indicator on for several miles because of lack of attention and had no intention of turning left.

Three accidents occurred when a tractor attempted to turn right from a major road into a minor road across the path of an oncoming car, resulting in the car colliding with the tractor nearside. These were the result of errors of judgement or lack of attention by the tractor driver although one of the car drivers could have stopped in time but thought that the tractor would complete the manoeuvre in time having failed to notice that it was towing a trailer.
One further accident was categorised as a nearside impact although the tractor itself was untouched. This involved the trailer becoming detached and coming to rest blocking the carriageway for oncoming vehicles. It was dark, the trailer was unlit, and although the first car to approach the scene managed to avoid an accident, the second collided with its nearside.

Collisions with the nearside of a tractor accounted for four of the car occupant fatalities. Three of these were due to car drivers failing to notice a slow moving or stationary tractor ahead and colliding with its rear. The fourth accident involved a tractor that was parked and unattended on a grass verge several metres away from the carriageway. However, a car negotiated a bend, lost control, mounted the verge, and collided with the rear of the tractor.

The final two accidents involved a collision between the tractor and the front of a car. The first was a head-on collision where the car simply drifted to the offside for no apparent reason. The second again involved the tractor turning right from the major road into a side road with an oncoming car a very short distance away. The tractor had only just commenced its turn when the collision occurred, therefore the car collided with the front rather than the nearside.

3.3.2 Potential countermeasures

For each accident studied an assessment was made as to whether any improvements to the design, maintenance, or use of the tractor could have either prevented the accident from occurring, or reduced the severity of the injuries caused.

When making this decision, many factors were taken into account such as, road conditions, speed of vehicles, age of fatality, exact cause of death (when a post-mortem was available), and the use or otherwise of seatbelts or other safety systems. Despite these considerations the assessment remains a subjective one, albeit based on experience, and in many cases, test results from previous research. To ensure a good estimate is made a probability scale is used. This means that any countermeasures assessed are judged to definitely, probably, or possibly prevent a fatality. Probabilities of 1.0 are assigned to the ‘definites’, 0.75 to the ‘probables’, and 0.25 to the ‘possibles’. This produces a ‘best estimate’ of the likely savings from any particular countermeasure.

Firstly, tractor-based countermeasures that could have prevented the accident from occurring (i.e. primary safety features) were assessed. For eight (50%) of the accidents it was considered that no practical countermeasure would have been capable of avoiding the accident.

Improving lighting and/or conspicuity such that vehicles are more readily identified in the dark, and direction signals are more easily seen was considered likely to have saved around one in five of the car occupant fatalities, using the best estimate method described above. This category also includes the benefits of maintaining the existing lighting such that correct operation at all times is ensured.

Improving the side and rear visibility from the tractor such that overtaking cars might be more easily seen by the tractor driver is estimated to be capable of reducing car occupant fatalities by one or two. Preventing trailer detachment would definitely have avoided one accident and one fatality.

There were very few tractor-based countermeasures identified that were considered to be capable of reducing the severity of car occupant injuries given that an accident had occurred. For 13 (81%) of the 16 fatalities, it was considered that no practical measure would have saved their life. It was felt likely that rear underrun protection of a construction that was stronger and lower than that typically found on heavy goods vehicles, would ‘probably’ have saved one of the car occupants and ‘possibly’ have saved a further one. Side impact protection that was stronger with less ground clearance than typically found among HGV sideguards, was rated as a ‘possible’ countermeasure for just one of the fatalities in the sample. These numbers are already very small, therefore it is not appropriate to apply the ‘best estimate’ probabilities to these countermeasures.

Changes or improvements other than to the tractor were also considered. At least 38% of the fatally injured car occupants were not using the seat belts already fitted to their vehicles and the best estimate suggests that approximately half of these people would have lived if they had worn their belts. Approximately 15 percent of the accidents in the sample could potentially have been prevented if the junction design had been improved, and a little less than 10% of fatalities might have lived if anti-lock brakes had been fitted to their cars.

3.4 Accidents involving motorcyclist fatalities

The database contains information on 12 accidents involving a collision between a motorcycle and an agricultural tractor. These accidents resulted in the death of 14 motorcyclists (12 riders and 2 pillion passengers).

3.4.1 Accident mechanisms

Six (50%) of the collisions between a motorcycle and an agricultural tractor involved the tractor making a right turn just prior to impact. Four motorcyclists were killed in a collision between their bike and the offside of a tractor, four in collision with the nearside, four with the front, and a further two in collision with the rear of a tractor.

Impacts with the front of a tractor involved three accidents with four fatalities. The first accident occurred when a motorcyclist lost control on a left-hand bend due to excess speed, and collided with a tractor approaching from the opposite direction. Another accident was due to a tractor pulling out of a field and turning left but allowing the front of the vehicle to cross into the wrong side of the road and into the path of an oncoming motorbike. The third accident occurred when a motorcycle successfully negotiated a bend to be confronted by stationary vehicles on both sides of the road. The drivers had stopped to talk to each other and the motorcycle had no space to avoid an impact.

All three accidents and four fatalities involving an impact with the nearside of a tractor occurred when the motorcycle negotiated a bend to be confronted by a tractor turning right across its path. A combination of high motorcycle speed, low tractor speed, and short distances between bend and junction tends to be responsible.
Collisions with the offside of a tractor involved four accidents resulting in four motorcyclist fatalities. Two accidents occurred when a tractor pulled out from a side road in order to turn right onto the main road across the path of an approaching motorcycle. One occurred when a motorcycle attempted to overtake a slow moving tractor just as it commenced a right hand turn into a side road. The last accident occurred when a motorcycle attempted to overtake a tractor but misjudged the available space, sustained a glancing collision with an oncoming car, fell off the motorcycle and was run over by the tractor.

Impacts with the rear of a tractor accounted for two of the fatalities and both occurred when a motorcycle negotiated bends to be confronted with slow moving tractors ahead. In both cases the motorcycles were travelling at a speed at which they could safely negotiate the bend without losing control but at which they were unable to stop within the distance that they could see to be clear.

### 3.4.2 Potential countermeasures

For each accident studied an assessment was made as to whether any improvements of the design, maintenance, or use of the tractor could have either prevented the accident from occurring, or reduced the severity of the injuries caused. The method used to assess these countermeasures was described in section 3.3.2.

The only tractor-based accident avoidance countermeasures identified were those improving tractor lighting/visibility/conspicuity. It was considered that the most effective measure would be to fit and use amber beacons with the ‘best estimate’ method suggesting that two of the motorcyclists could have been saved.

As might be expected there were not many practical tractor-based measures identified that could have reduced the severity of the unprotected motorcyclist injuries from fatal to non-fatal. In one case, fitting rear underrun protection with a lower ground clearance than would be typical for an HGV was rated as ‘possibly’ saving the motorcyclist’s life but this is fairly tenuous and not a very practical measure for an off-road vehicle.

The greatest benefits achievable in accidents involving motorcyclists and tractors would appear to come from changes not relating to the tractor itself. For example, fitting ABS to all motorbikes would be likely to have saved three of the fatalities and changing the road or junction layout may also have saved three lives.

### 3.5 Accidents involving tractor occupant fatalities

The database contains information on seven accidents involving seven tractor occupant fatalities.

#### 3.5.1 Accident mechanisms

Four of the seven accidents involved a Heavy Goods Vehicle travelling on a dual carriageway, failing to notice a slow moving tractor ahead, and colliding heavily with the rear of it. In all of these cases the tractor driver was ejected, or partially ejected from the vehicle, two through the rear windscreen and two via an unknown route. Three of the four accidents involved tractor rollover at some point during the impact, none of the occupants were wearing seat belts (three of the four tractors did not have them fitted and in one, fitment was not known). All of the vehicles were fitted with Rollover Protective Structures (ROPS). All of the tractors had obligatory amber beacons fitted, three were definitely using them at the time, and use was unknown for the fourth. However, the rest of the lighting on the fourth vehicle was known to be poor so there is some doubt over the correct operation of the beacon. Hence, at least three of these accidents must be considered to be the fault of the HGV driver through lack of attention or fatigue.

The remaining three accidents were single vehicle accidents. One involved a tractor that was carrying a passenger illegally on the coupling between tractor and trailer. The passenger fell off as the vehicle travelled over a bump in the road and was run over by the rear wheels of the trailer. A second accident involved a tractor negotiating a sharp right-hand bend at an excessive speed for its loading condition. The trailer rolled over and left the carriageway dragging the tractor with it and both fell some distance down an embankment. The third accident was very similar to this but left the road, still on its wheels, for no apparent reason before rolling over on its way down an embankment. Both of the drivers in the these accidents remained in their cabs and in the second accident there was a child in a special passenger seat in the cab who was also not ejected but survived with only slight injuries.

### 3.5.2 Potential countermeasures

For each accident studied an assessment was made as to whether any improvements of the design, maintenance, or use of the tractor could have either prevented the accident from occurring, or reduced the severity of the injuries caused. The method used to assess these countermeasures was described in section 3.3.2. There were not many tractor-based accident avoidance measures identified that would have been of significant benefit but it is likely that preventing rollover would have saved one life and improving the tractor lighting may have saved another.

The use of seat belts in tractors could have been of significant benefit in reducing injuries from fatal to serious. The principal benefit of seat belts in most of these cases would be to prevent ejection from the vehicle. In normal circumstances lap belts are very nearly as effective at this as three-point lap-diagonal belts. However, four of these cases involved very heavy impacts from the rear. Agricultural tractors are working vehicles and spend much of their time operating machinery being towed behind them in fields. As such the drivers spend large amounts of time looking backwards over their shoulder at the machinery operation and for this reason tractors almost always have low seat backs. This makes it more difficult to fit 3-point seat belts effectively. In addition to this it is theoretically possible that a combination of a low-seat and loosely fitted seat belt could still allow the driver to be ejected in a heavy rear impact. This is because the seat back may deform substantially and allow the driver to slide out from underneath the belt, particularly where there is substantial slack in the belt prior to impact. However, no
tests have been performed to quantify the likelihood of this occurring and none of the accidents studied involved a driver wearing a seat belt so there is no evidence of such a phenomenon in the data.

The potential for lap belts to reduce injury in these cases has, therefore, been coded very cautiously and may be underestimated if it is shown that the situation described above does not occur. Where it was considered that three-point belts could be of benefit it has been assumed that they would be used in conjunction with correct mounting points and seats with higher backs.

The best estimates were that lap belts could have saved 32% of the seven fatalities and that three-point lap-diagonal belts could have saved 64%. Improving the interior design of the cab to increase occupant protection, such as softer materials used at points of body contact, in conjunction with three-point belts may have saved a total of 68% of the fatalities.

Advances in vehicle electronics have enabled the development of intelligent distance sensors or collision avoidance systems. Although, as yet, not common in production vehicles, these systems should be capable of warning drivers that they are rapidly approaching a slow moving vehicle ahead. The most sophisticated systems will automatically apply the brakes to match the vehicle speed to that of the vehicle ahead. If such systems were fitted to all HGVs, it is likely that none of the fatalities in the two-vehicle tractor accidents would have occurred. This is because in each case the tractor was in full and direct view of the HGV for more than enough time for systems to sense that there was a slow moving vehicle ahead and reduce speed to match.

3.6 Accidents involving pedestrian fatalities
The database contains information on five accidents, each involving one tractor and one pedestrian fatality. The first accident involved a tractor towing a trailer with a faulty hitch. The trailer became detached, mounted the kerb, and collided with a child pedestrian on the pavement. Improved maintenance and safety checks may have prevented the accident happening but given that the accident occurred there was very little that could have prevented the fatality.

A second accident involved a decorated carnival float being towed by a tractor. The carnival had finished and the float had stopped in a lay-by to couple a more powerful tractor to the trailer in order to transport it more easily. While this was taking place a pedestrian started to unload equipment from the trailer without telling the driver that he was doing this. It was dark at the time and the tractor driver pulled away without noticing the pedestrian at the side of the vehicle and ran him over. Only the exercising of more care by the people involved would have realistically prevented the accident from occurring and once it had occurred there was nothing that could have reduced the severity of the injuries.

One accident happened as a tractor driver was standing outside his vehicle operating some machinery controls. The driver had neglected to apply the vehicle handbrake and it rolled forward and knocked him into a ditch. A system that prevented the use of machinery when the handbrake was not applied would be relatively simple and probably would have prevented this accident from occurring.

The remaining two pedestrian accidents happened as a result of the pedestrians walking in the road. One was in thick fog and was unseen by the tractor driver and the other, a small child, stood aside to let the tractor pass and then moved back into the road to start walking again not realising that the tractor was towing a trailer. The nearside rear wheel of the trailer struck the pedestrian as it passed. There was very little that could be done to the design of the tractor to prevent the first of these fatalities from happening and although a suitable sideguard might have prevented the second fatality it is likely that farmers would consider such a device impractical for off-road use.

3.7 Accidents involving pedal cycle fatalities
There was just one accident involving a tractor that resulted in the death of a pedal cyclist. In this case the front of a tractor collided with the rear of a pedal cycle on a 60 mile/h ‘A’ road due to a lack of attention. The accident was solely the fault of the tractor driver, therefore there was little that could be done to the tractor to help avoid the accident and likewise not much scope for reducing the severity of injuries once the accident had happened. Providing a separated cycle lane on the road in question would be the only change likely to have avoided the fatality.

4 Emergency vehicle accidents
The database contains information on 11 accidents involving emergency vehicles, five of which involved fire tenders and six involving ambulances. These accidents resulted in 13 fatalities, 11 of whom were car occupants, with one ambulance occupant, and one pedestrian.

All five fire engines were involved in accidents resulting in a car occupant fatality. Three of these were passing through traffic light controlled junctions with the lights red against them. As would be expected, all three were on their way to an emergency with blue lights and sirens activated. Each of the accidents involved a car travelling across the path of the fire engine on a green light and being struck in the side by the emergency vehicle. Some element of blame could be attributed to all of the drivers involved and it is likely that installing a system which sensed the approach of emergency vehicles on call and automatically changed traffic signals to give them priority would have avoided all three of these accidents.

The remaining two accidents involving a fire engine occurred as a result of vehicles driving across their path at other junctions. One attempted to turn right into a side road directly in front of an oncoming fire engine that was overtaking a line of cars that had pulled over to allow it access. In the second case the car pulled out from the side road in front of the fire engine. In both cases it could be argued that the emergency vehicle driver was travelling at excessive speed but it has to be remembered that they were attempting to attend to an emergency (sirens active) where
time could have been desperately important. Both car drivers had ample time to see the approach of the fire engine and give way to it. In the first case, where the car turned right across the path of the fire engine, the driver was very inexperienced and it was suggested that the right turn might have been a panic reaction to try and get out of the way of the fire tender.

There were four accidents involving an ambulance and a car, resulting in six car occupant fatalities. In contrast to those accidents involving fire engines only one ambulance was on emergency call at the time of the accident. In this accident the ambulance was overtaking a line of slow moving traffic at a speed of around 85 mile/h when a car at the head of the queue turned right into a side road. The ambulance braked and skidded to a speed of around 35 mile/h before colliding with the offside rear of the car just prior to it completing its turn. Although it could be argued that the car driver should have checked his mirrors and seen the ambulance prior to making the turn, the ambulance driver should not have been travelling 60 to 70 mile/h faster than the queue of traffic he was overtaking. It is likely that the accident could have been avoided if anti-lock brakes were fitted to the ambulance as it was skidding for a significant amount of time before impact and there would have been space to steer around the back of the car had steering control been retained.

The remaining three accidents involving an ambulance and a car occurred when the ambulance was not attending an emergency situation. One involved a car failing to stop at a give way sign and colliding with an ambulance approaching from the right, and the remaining two involved cars with drunk drivers’ travelling at excessive speed. One lost control of the car on a straight road and slid into the opposing lane where it collided with an oncoming ambulance. The other involved an ambulance turning right across the path of an oncoming car but the car was travelling around a sweeping bend and could not be seen when the emergency vehicle commenced its turn. The accident may still have been avoided had the car driver reacted to the presence of the ambulance as soon as it came into view but the driver was significantly impaired by alcohol and reacted late. It is estimated that the car was still travelling at approximately 80 mile/h at the point of impact resulting in the total destruction of both vehicles. Three car occupants were fatally injured but, somewhat surprisingly, the five ambulance occupants survived although they did sustain serious injuries.

The database contained information on one accident involving the death of an ambulance occupant. This accident occurred when an ambulance on an emergency call lost control on a left-hand bend. This was due mainly to an adverse camber in conjunction with diesel contamination of the road surface. The vehicle slid to its offside and collided with a fence at the side of the road before rolling over to its nearside. Both the driver and front seat passenger were ejected through the door of the vehicle but the front seat passenger survived. It is almost certain that had the occupants been wearing seat belts they would not have been ejected from the vehicle and since neither the crush to the vehicle nor the deceleration undergone by it were particularly severe, it is highly likely that both would have survived.

The single accident involving an ambulance and a pedestrian fatality occurred when an elderly person crossed the road despite the fact that the pedestrian crossing used was displaying green for vehicle traffic and an ambulance was approaching the scene at speed with blue lights and sirens activated.

5 Electric vehicle accidents

The database contains information on four accidents involving electric vehicles. Three of these vehicles were milk delivery floats and one was a single-seat electric mobility vehicle for the use of people with disabilities.

The milk-float accidents involved a head-on collision with a car resulting in the death of the car driver, a collision between a motorcyclist and a milk-float which had turned right across its path, and an instance where children were riding on the float and one fell off and was run over. The mobility vehicle was driven by an elderly lady and rolled over for unknown reasons (no witnesses). None of the accidents involving electric vehicles occurred as a result of the quiet nature of these vehicles.

6 National estimates of benefits

Other parts of this research project have used the same methodology to analyse fatal accidents involving HGVs (Knight, 2000). In the analyses of HGV accidents the data from the police fatal accident reports have been combined with data from STATS 19 to provide estimates of the number of lives that could be saved nationally if in the future various countermeasures were implemented. This type of estimate is very difficult to perform for OMV accidents for the following reasons.

The STATS 19 database does not distinguish between different types of OMV so that it is not possible to separate accidents involving an agricultural tractor and those involving a fire tender, refuse collector or milk float. This means that it is not possible to compare the types of vehicle in this sample of data, to the types of vehicle in the UK data. These different vehicles are involved typically in very different accident types and have very different countermeasures. It is important, therefore, that the sample data fairly reflects the national data. This sample contains information on almost 60% of all such accidents in the UK during the relevant time period (1993-95) so it seems likely that it will be reasonably representative of the UK as a whole. However, this cannot be demonstrated. In addition to this, agricultural vehicles, which form a large proportion of this sample, tend to be concentrated in a few specific geographical areas rather than spread more generally around the country. This also makes it difficult to assume that the sample is representative of the UK as a whole.

In the analyses of fatal HGV accidents, the effects of any variations between the types of accidents in the sample data and the national data are limited by expressing the benefits of countermeasures as the percentage of fatalities from a
specific accident type that are likely to be saved. For example, front underrun protection benefit is expressed as a percentage of people that may be saved in collisions between a car and the front of an HGV. To estimate the national benefit of these, the STATS 19 database is interrogated to establish how many people were killed in this type of accident in the whole of the UK. The percentage for the countermeasure is then applied to the number of fatalities nationally to establish an estimate of the national benefits of the countermeasure. Again this cannot be done for OMV accidents because it is not possible to differentiate between different types of OMV in STATS 19.

If it is assumed that the sample of data analysed for this report does accurately reflect the distribution of accidents and vehicles in the national data then some tentative estimates can be made. However, it must be stressed that as described above this assumption may not be correct.

The sample contained information on 116 (59.5%) of the 195 OMV accidents that occurred in the UK between 1993 and 1995 inclusive. If the proportion of vehicle and accident types in the national data is identical to that in the sample then it is likely that 24 of the accidents would be incorrectly coded or suicide, 69 accidents (71 fatalities) would involve agricultural tractors and 18 accidents (22 fatalities) would involve an emergency vehicle.

If the ‘best estimate’ of lives saved in the sample is then expressed as a percentage of total killed in accidents involving the relevant vehicle type then the estimated national benefits of certain principal countermeasures are as follows. Improving tractor lighting and conspicuity would be expected to prevent approximately nine fatalities per year, provided the lighting was maintained 100% defect free at all times. If all ROPS-equipped tractors were fitted with three-point seat belts and high backed seats it would be expected to prevent around seven fatalities per year provided the usage rate was 100%. Installing a system to give priority to emergency vehicles at every traffic light controlled crossroads would be expected to save around five lives per year.

Whilst these estimates are likely to be indicative of the benefits of the countermeasures, they should be treated with considerable caution. For this reason the conclusions of this report relate to the number of deaths in the sample that may have been prevented and not the annual national benefits.

7 Conclusions

1 Car occupants (40%), motorcyclists (17%), and ‘other motor vehicle’ (OMV, e.g. agricultural tractors dustcarts, emergency vehicles etc.) occupants (16%) are the most common fatality groups in accidents involving at least one OMV.
2 Forty percent of the 102 accidents involving OMVs studied were accidents involving agricultural tractors. A further 11 involved emergency vehicles.
3 The majority (78%) of agricultural tractors in the sample were towing some kind of trailer over half of which were at least partly laden.
4 It would appear that agricultural tractors are considerably more hazardous for motorcyclists than other types of OMV. Fourteen of the twenty-one motorcyclists killed in accidents involving an OMV were actually killed in collision with a tractor.
5 Drivers of agricultural vehicles are far less likely to be responsible for the cause of an accident than the other parties involved in the same accident. Sixteen (39%) of the 41 tractor drivers in the sample were at least partially responsible for the accident they were involved in compared with 26 (81%) other vehicle drivers and four (80%) pedestrians. The most common factor was a lack of attention.
6 Sixteen (39%) of the 41 agricultural vehicles in the sample had some kind of defect and five (12%) had a serious defect that was considered to be contributory to the accident. There were two major trailer coupling defects that led to trailer detachment in service and directly caused the death of one pedestrian and one car occupant in two separate incidents. Lighting defects were the most common type, accounting for nine faulty vehicles. However, only two of these defects contributed to the cause of the accident but all were potentially dangerous. Further research and/or legislative action to improve the roadworthiness of agricultural vehicles should be considered.
7 Sixty-three percent of collisions between a tractor and a car (10 accidents) and a further 50% of collisions between a tractor and a motorcycle (6 accidents) occurred while the tractor was making some form of right turn either from, or into, a side road or field entrance.
8 Four out of the seven accidents involving a tractor occupant fatality occurred when their vehicle was struck from behind by an HGV. The remaining three were single vehicle accidents. Ejection from the cab was a factor in four of the accidents and rollover played a part in five.
9 It is estimated that improving the lighting and/or conspicuity of agricultural tractors may have saved the lives of three (20%) of the car occupant fatalities, two (15%) of the motorcyclists’, and one (15%) of the tractor occupants themselves. These figures include the benefits of ensuring current lighting systems are maintained 100% defect-free at all times.
10 Fitting and using seat belts would have been of substantial benefit to the tractor occupants in this sample. It is estimated that lap belts could have saved the life of two of them and three-point belts could have saved four. It should be noted that the estimate of the benefits of lap belts was very cautious due to a concern that the low seat back typically fitted to tractors could potentially allow a belted occupant to be ejected in a heavy rear impact, particularly if the belt was loosely worn. When assessing three-point belts it was assumed that they would be fitted with an appropriate high backed seat.
Fitting intelligent distance sensors or collision avoidance systems to HGVs may have saved the life of four out of the seven tractor occupant fatalities studied.

It is considered likely that the lives of three of the car occupants in this sample could have been saved if systems were installed that enabled traffic lights to give automatic priority to emergency vehicles when they are on call.

8 References


Abstract

This report describes a review of fatal accidents, occurring between 1993 and 1995 inclusive, that involved at least one vehicle classified by STATS 19 as ‘other motor vehicle’. This classification commonly includes agricultural vehicles, emergency vehicles, recovery vehicles, construction machinery, and refuse collectors. The study identifies the most common accident types, provides information on accident cause, and attempts to evaluate potential vehicle design changes in order to provide evidence to support possible legislative action and/or further research.

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