European Commission

Thematic Report

Professional drivers of HGVs and buses

Mobility and Transport

This document is part of a series of 20 thematic reports on road safety. The purpose is to give road safety practitioners and the general public an overview of the most important research questions and results on the topic in question. The level of detail is intermediate, with more detailed papers or reports suggested for further reading. Each report has a 1-page summary.

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Contents

Summary

Crashes with heavy goods vehicles (HGVs) lead to 13.8% of road fatalities in the EU, i.e. 2,829 fatalities in 2023. The vast majority of fatalities and serious injuries in HGV-related crashes are incurred by the crash opponent rather than the HGV occupants. Buses and coaches account for around 2% of EU road fatalities, i.e. 462 fatalities in 2023. Again, the vast majority of these fatalities are incurred by the crash opponent rather than the bus occupants. Typical HGV crashes include rear-end collisions, particularly in traffic jams, side impact collisions at intersections as well as blind spot crashes when turning right, and unintentional lane departure. Bus/coach crashes relatively often involve crossing pedestrians.

HGV and bus drivers require specialized licenses: a C license for HGVs and a D license for buses. Additionally, professional drivers must hold a certificate of professional competence (Code 95), which needs renewal every five years. These professionals often face challenging working conditions, including tight schedules, irregular hours, and long workdays. International drivers frequently have to sleep in their vehicles. These demanding circumstances make professional drivers particularly susceptible to fatigue and distraction. Moreover, the nature of their work can lead to health issues such as obesity, which may contribute to conditions like sleep apnoea that can further compromise safe driving.

The safety of HGVs and buses is significantly influenced by road infrastructure due to their unique characteristics such as mass, manoeuvrability, and acceleration/deceleration capabilities. These vehicles require longer braking distances and are susceptible to issues like burst tires. For HGVs, overloading or unbalanced loads can further compromise safety. In addition, other road users often lack awareness of the specific challenges posed by these large vehicles, particularly their extensive blind spots. A key strategy, aligned with the Safe System approach, involves separating these heavy vehicles from other road users, especially vulnerable ones – such as pedestrians and cyclists – either in location or time. Additionally, providing professional drivers with timely warnings about hazardous or restricted road sections, through roadside signage or in-vehicle information systems, may significantly contribute to road safety. Furthermore, addressing the need for adequate and well-managed overnight parking facilities for HGVs is essential. These secure rest areas not only ensure drivers can safely complete their mandatory rest periods but also contribute to their overall well-being and alertness on the road.

The European Union's updated General Safety Regulation (GSR) 2019/2144 mandates several crucial vehicle safety measures for new HGVs and buses. Since July 2024, these vehicles must be equipped with advisory Intelligent Speed Assistance (ISA), blind spot detection systems, and driver attention monitoring technology. The regulation further stipulates that by 2029, new trucks and buses will need to meet higher direct vision standards, enhancing driver awareness of their surroundings. While Automatic Emergency Braking Systems (AEBS) have been mandatory for HGVs and buses since 2014, the GSR requires improved AEBS to be installed on all new heavy vehicles from 2028 onwards.

Enhancing driver behaviour, safety culture and safety management requires a comprehensive approach that engages all levels of a company, from top executives to individual drivers. By prioritizing safe road behaviour as a core value, organizations can create a more robust safety environment. It is crucial for company management to establish working conditions that enable drivers to adhere to driving and rest time regulations without compromise. To reinforce these efforts and ensure broader compliance, more rigorous enforcement measures should be implemented. Health promotion interventions should be considered to foster drivers' well-being by encouraging healthy lifestyle choices and addressing issues such as fatigue and stress management.

1. What is the problem?

This thematic report concerns professional drivers of heavy goods vehicles (HGVs) and buses and coaches.

1.1 Heavy good vehicles

HGVs can be defined as motor vehicles with at least four wheels, with or without a trailer, with a permissible gross vehicle weight of over 3.5 tonnes and used only for the transport of goods. HGVs are involved in 4 to 5% of police-reported road crashes in Europe (Schindler et al., 2022), but HGV crashes result in 14% of road fatalities (EC, 2024a).

Crashes involving HGVs often have severe consequences, with the majority of fatalities and serious injuries more often affecting those in the other vehicle than the HGV occupants. This occurs because HGVs are significantly heavier than most other vehicles. When two vehicles collide, the laws of physics dictate that the lighter vehicle absorbs most of the energy from the impact. As a result, the lighter vehicle sustains more damage, leading to more serious injuries for its occupants. In the EU, almost 9 out of 10 fatalities in HGV crashes were other road users, mainly car occupants (EC, 2024a).

1.2 Buses and coaches

Buses and coaches, defined as vehicles with more than 8 seats in addition to the driver's seat, designed for passenger transport, serve different purposes: buses primarily facilitate public transport, while coaches are mainly used for interurban travel and tourist trips (coach tourism). Together, they are involved in 2% of all fatalities in the EU, according to recent data (EC, 2024a).

Among those killed in bus/coach crashes, there is a high proportion of vulnerable road users, especially pedestrians (approximately 25%, EC, 2024a). which is related to the urban environment in which many buses operate. Similar to HGVs, the significant difference in mass is the primary reason for the relatively low number of casualties among bus and coach occupants (approximately 19 %, EC, 2024a).

1.3 Working conditions and environment

Driving and working times

Professional HGV and bus/coach drivers must adhere to specific EU rules on driving time and rest periods (EU, 2006). Additionally, they are subject to the broader Working Time Directive for "persons performing mobile road transport activities" (EU, 2002). Typically, these drivers are limited to 9 hours of driving per day with an exemption of twice a week when it can be extended to 10 hours, and their weekly driving time must not exceed of 56 hours per week, (EU, 2006). For transport operations involving non-EU and non-EFTA countries in Europe, including all former Soviet Union states, the rules of the AETR Agreement apply (UNECE, 2010).

Work and working conditions

In 2020, 10.8 million people aged over 15 were employed in transport occupations in the EU (Eurostat,2021).. According to Eurostat, 3.2 million were employed as HGV (Eurostat, 2022; cited in IRU, 2023a), about 900.000 persons as bus and coach drivers in Europe (Eurostat, 2021; cited in IRU, 2023b). According to the IRU reports, 7% of HGV positions and 10% of the bus/coach positions remained unfilled in 2023.

Professional HGV and bus drivers face several specific demands and constraints that make their roles particularly challenging. These include long and irregular working hours, often requiring them to be on the road for extended periods, which can lead to fatigue and stress. The nature of their work also demands strict adherence to safety regulations, such as limits on driving hours and mandatory rest periods. Additionally, drivers must navigate various road conditions, manage tight delivery schedules, and handle the physical demands of loading and unloading cargo or assisting passengers. Furthermore, they are often away from home for long stretches, which can impact their personal lives and well-being. These challenges and demands outlined above, often coupled with low pay, highlight some of the key reasons behind the current significant shortage of drivers in the profession. The European Transport Workers' Federation (ETF) recommends increasing driver wages, improving their working conditions and strengthening enforcement in order to attract new drivers, including women, to compensate for retiring drivers.

Health and working environment

Professional drivers face numerous health challenges that can significantly impact their performance and safety on the road. Physical health issues, such as musculoskeletal disorders, obesity, hypertension, and diabetes, are prevalent among this population. (Chung & Wong, 2011, Rasheed, et al., 2023). A recent systematic literature review, Cendales et al., 2024) highlights the fact that a substantial proportion of bus drivers are affected also by mental health issues, including anxiety and depression amongst other issues. All these health problems are often exacerbated by the nature of their work, which involves prolonged sitting, irregular schedules, and exposure to whole-body vibrations (Rasheed, et al., 2023). Additionally, lifestyle factors such as poor diet, lack of physical activity, and high rates of smoking contribute to the overall poor health status of many professional drivers (Peters et al., 2021).

Exposure

Determining the average distance covered by an individual Heavy Goods Vehicle (HGV) or bus driver in the EU is challenging due to limited availability of specific data. However, some industry reports provide insights, with varying exposure ranges depending on the transport type. For instance, an IRU report (IRU, 2017) mentions an average annual driving distance per vehicle of around 130,000 km in the long-haul sector. In contrast, Earl et al. (2018) cite a somewhat lower exposure of approximately 110,000 km annual mileage for long-haul trucks. Compared to the average exposure of private car drivers, this increased mileage is a risk factor in itself, as it heightens the likelihood of encountering hazardous situations, adverse weather conditions, and other high-risk scenarios on the road.

2. Professional drivers and road safety

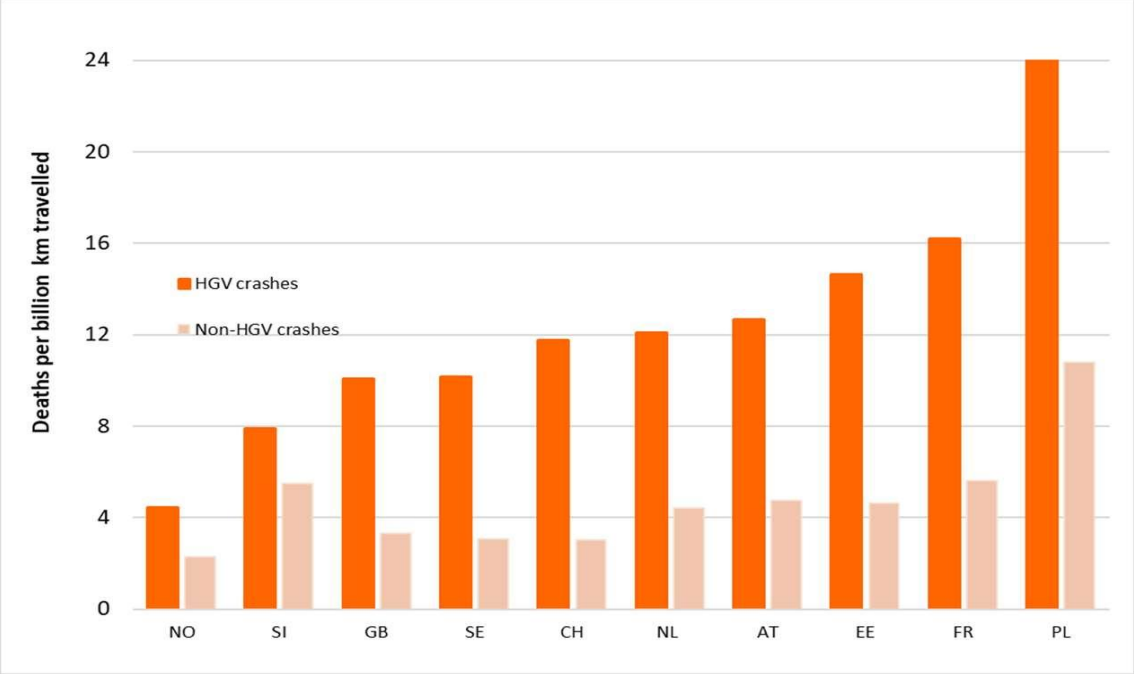
This chapter explores the critical role of professional drivers in the transportation sector, focusing specifically on HGVs and buses/coaches. The analyses shown focus on various studies and statistical data to illustrate the associated crash risks. Furthermore, the chapter examines the factors contributing to these risks, including driver behaviour, vehicle characteristics, and road environment.

2.1 Fatal crash risk

Accurate exposure data[1] is essential for assessing risks in road safety. Unfortunately, calculating the crash risk for HGVs and buses/coaches at EU level is not feasible due to a lack of comprehensive exposure data from several member states. However, some individual countries maintain these statistics, revealing a higher probability of fatal injuries in crashes involving HGVs or buses/coaches compared to the overall fatality rate in those countries.

It's important to note that most fatalities in HGV and bus/coach crashes are other road users, while the occupants of these larger vehicles face a relatively low fatality risk. The ETSC has compiled data from 10 countries, illustrating the risk of fatalities in HGV and non-HGV crashes (Figure 1). This comparison highlights large variations between countries in terms of road safety outcomes involving these vehicle types.

***Figure 1**. The number of fatalities in crashes involving HGVs per billion km travelled by HGVs and the number of fatalities in crashes not involving HGVs per billion km travelled by non-HGVs in 10 European countries (period 2016-2018). Source: ETSC, 2020.*



1 In the context of road safety, exposure data refers to the amount of time or distance that drivers spend on the road.

A publication from 2013 by the ETSC (ETSC, 2013) also reported on the relative risk of fatal injury for buses, coaches and trolley buses (Figure 2).

***Figure 2**. The number of fatalities in crashes with a bus, coach or trolley per billion kilometres travelled by those vehicles and the corresponding rate for all vehicles in nine European countries (period 2009-2011, PL 2008-2009). Source: ETSC, 2013.*

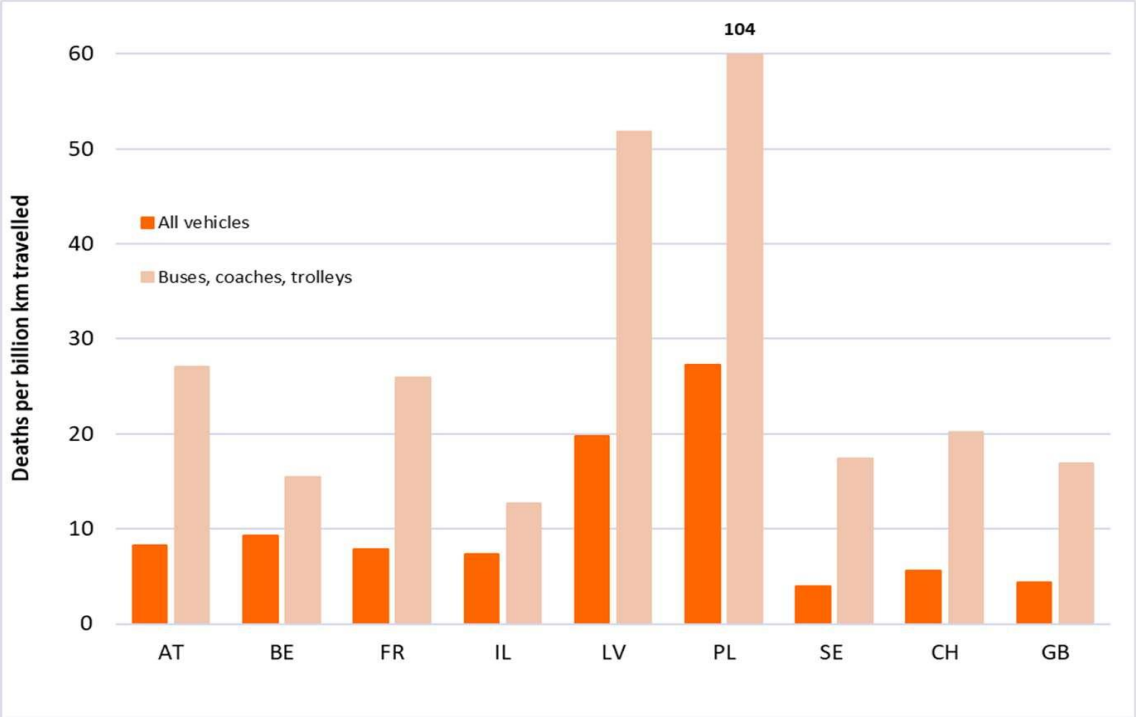


Figure 2 illustrates that fatality rates for buses and coaches are notably higher than those for HGVs. While this difference might be partially attributed to variations in the time periods studied, data from Belgium corroborate this trend. In the period 2010-2017, the average fatality rate across all vehicle categories in Belgium was 7.7 fatalities per billion vehicle-kilometres. For HGV crashes, the rate was 14 fatalities per billion vehicle-kilometres, while for bus/coach crashes, it was 19.8 fatalities per billion vehicle-kilometres (Meunier, 2020).

The elevated fatality risk per distance travelled for buses and coaches compared to HGVs can be largely explained by their more frequent operation in urban areas (as detailed in Section 2.3). This urban presence leads to more interactions with other vehicles and, crucially, with vulnerable road users, such as cyclists or pedestrians.

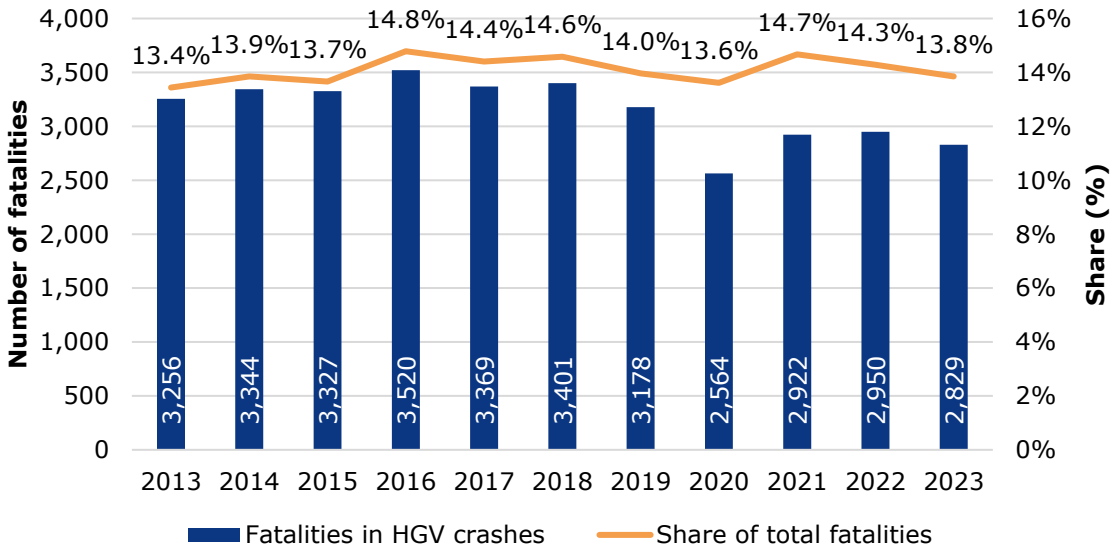
It's important to note, however, that despite the higher risk per kilometre, the absolute number of fatalities in bus/coach crashes is significantly lower than in HGV crashes. This is due to the smaller number of buses and coaches on the roads and their lower total kilometres travelled. Annual fatalities amount to approximately 500 for bus/coach crashes, compared to around 3,000 for HGV crashes (further information available in Section 2.3).

2.2 General trend in the number of fatalities

In 2023, crashes involving Heavy Goods Vehicles (HGVs) accounted for 14% of all road fatalities in the European Union (EU27). On average, one out of every seven road deaths in Europe are related to an HGV crash. Specifically, 2,829 people lost their lives in HGV-involved crashes across the EU27 in 2023. This represents a slight decrease from 2013, when the number of fatalities in HGV crashes stood at 3,256 in terms of absolute numbers.

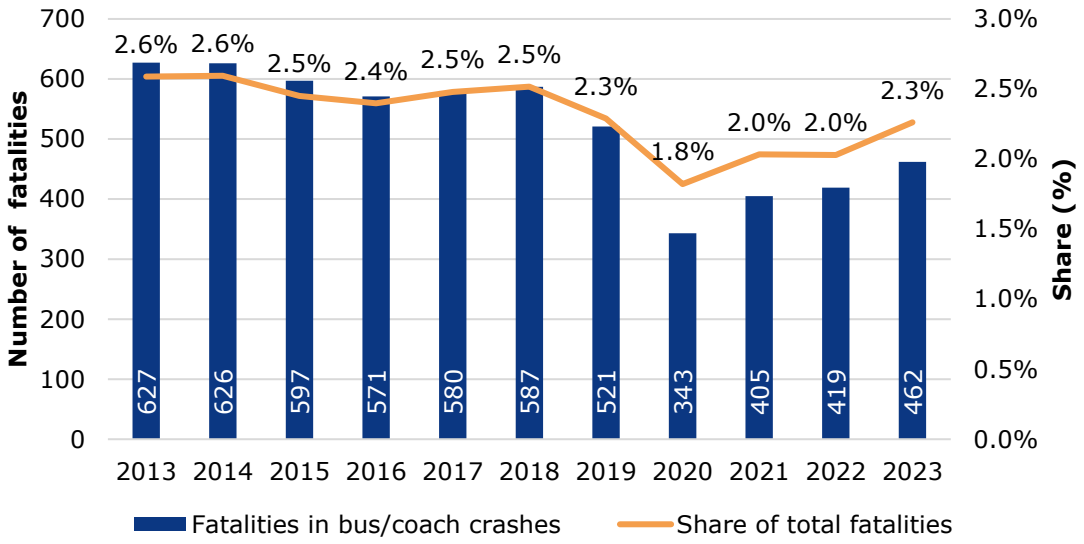
Despite this modest downward trend in the absolute number of HGV-related fatalities, the share of these crashes in the overall road death toll has actually increased slightly, rising from 13.4% in 2013 to 13.8% in 2023 (Figure 3).

***Figure 3**. Annual number of fatalities in crashes involving HGVs and their share in the total number of fatalities in the EU27 (2013-2023). Source: CARE.*



The overall yearly trend in fatalities of crashes involving buses and coaches remains relatively stable. In 2023, bus and coach crashes accounted for approximately 2% of all road deaths in the EU27. This proportion has remained nearly consistent over the past decade, from 2013 to 2023 (Figure 4).

***Figure 4**. Annual number of fatalities in crashes involving buses/coaches and their share in the total number of fatalities in the EU27 (2013-2023). Source: CARE*

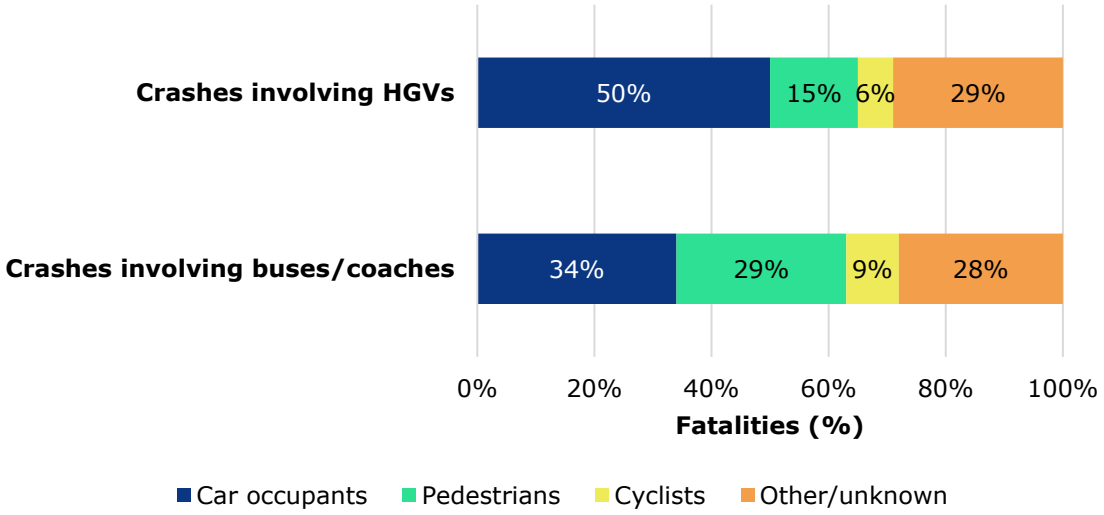


2.3 Crash characteristics

A key characteristic of crashes involving Heavy Goods Vehicles (HGVs) and buses/coaches is that the majority of fatalities occur among other road users rather than the occupants of these vehicles. Specifically, about 90% of fatalities in HGV crashes and approximately 80% in bus/coach crashes involve individuals who are not occupants of these vehicles, such as pedestrians, cyclists, and other road users.

In crashes involving HGVs, car occupants account for the majority of fatalities, representing about 50% of deaths. Pedestrians follow at approximately 15%, while cyclists comprise around 6% of the fatalities. Bus and coach crashes show a more balanced distribution of fatalities: car occupants represent 34% of deaths, closely followed by pedestrians at 29%. Notably, cyclists account for about 9% of fatalities in bus crashes, slightly higher than their representation in HGV-related deaths. These figures underscore the substantial impact of heavy vehicle collisions on vulnerable road users (Figure 5).

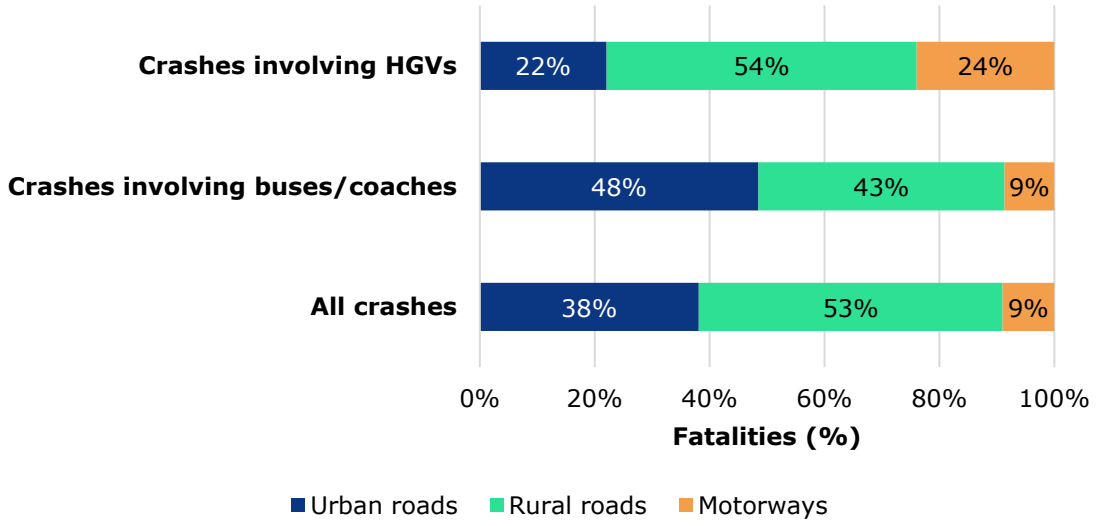
***Figure 5**. Distribution of fatalities by road type in crashes involving HGVs, buses/coaches and all crashes in the EU27 (2023). Source: CARE*



An analysis of crash locations reveals distinct patterns for fatal HGV and bus/coach crashes. As illustrated in Figure 6, the majority of fatal HGV crashes occur on rural roads, with a significant number also taking place on motorways. In contrast, fatal bus and coach crashes are more likely to happen in urban areas, with a smaller proportion occurring on rural roads.

This highlights the different operational environments for these vehicle types, with HGVs more frequently involved in fatal incidents on higher-speed roads and buses/coaches more often involved in fatal incidents in urban settings (Figure 6).

***Figure 6**. Distribution of fatalities by road type in crashes involving HGVs, buses/coaches and all crashes in the EU27 (2023). Source: CARE*



2.4 Typical crashes

Most research on typical crashes primarily focuses on Heavy Goods Vehicles (HGVs), with limited information available regarding crashes involving buses and coaches.

There is a strong consensus among various studies (Temmerman et al., 2016; SWOV, 2020; Volvo Trucks, 2022; Schindler et al., 2022) regarding the most common types of HGV crashes, which include:

- rear-end collisions, in particular in traffic jams
- side impact collision at intersections
- blind spot crashes when turning right (or left in left-driving countries)
- unintentional lane departure
- crashes due to overtaking errors
- crashes with crossing pedestrians

Additionally, a comprehensive analysis of HGV crashes reveals that most crashes in Europe occur under clear weather conditions, during daylight, on dry roads, outside urban areas, and on non-highway roads (Schindler et al., 2022).

As regards research on the types of crashes involving buses and coaches, a literature review conducted by Albertsson and Falkmer in

2005 identified three primary types of crashes involving such vehicles in Europe. These include collisions between buses or coaches and cars, incidents where vulnerable road users, such as pedestrians and cyclists are hit by a bus or coach, and roll-over accidents.

A recent study by Nævestad et al. (2023) shed light on an important aspect of bus passenger safety that extends beyond traffic crashes. The research revealed that a significant number of injuries occur in non-collision situations, such as passengers falling while on board the bus (e.g. due to harsh acceleration or braking manoeuvres) or during boarding and alighting processes.

2.5 Causation factors

Crashes involving professional drivers are often attributed to a combination of factors, which can be broadly categorized into three groups: human factors, vehicle factors, and infrastructure factors. However, it's crucial to highlight that crashes are rarely caused by a single factor; rather, they result from a complex interplay of multiple factors. As outlined earlier, the majority of available research and the data presented in the following sections focus on crashes involving HGVs, with relatively limited information available on bus and coach crashes.

2.5.1 Factors related to road users

All human factors that influence crash risk also apply to professional drivers. These factors include excessive and inappropriate speed, driving under the influence, tailgating and more. However, professional drivers are more susceptible to issues such as fatigue and distraction compared to non-professional drivers.

For HGV drivers, long working hours and irregular shifts remain major contributors to fatigue, with drivers working over 70 hours per week being common (EC, 2023). The impact of fatigue on driving performance becomes more pronounced after 8-9 hours of driving, with crash risk increasing significantly beyond this point (Mackie & Miller, cited in EC, 2023; for more details, see the Road Safety Thematic Report on fatigue EC, 2021a). Driving during biologically inappropriate times, poor sleep quality during trips, and sleep-inducing cabin conditions such as heat, vibrations and noise further contribute to this issue. A survey by Vitols & Voss (2021) found that one-third of bus/coach drivers and over a quarter of HGV drivers reported feeling tired at least every fourth drive.

A high prevalence of overweight and obesity has been observed especially among professional drivers (Njiro et al, 2024; Rosso et al., 2015; Anderson et al. (2012). The recent systematic review (Njiro et al, 2024) highlighted data on professional drivers in low- and middle-income countries (including some European countries) where the prevalence of obesity among professional drivers was 27.2% — which was almost 3.07-fold higher than the 8.8% reported prevalence among adult males in the general population. HGV drivers' higher obesity rates increase their risk of sleep disorders like sleep apnea, further impacting driving skills: Anderson et al. (2012) reported that obese truck drivers have a 55% increased risk for heavy truck crashes compared to non-obese drivers. Another study found that truck drivers with heart disease, which is often associated with obesity, were at twice the motor vehicle crash risk compared to those with a lower risk of heart disease (Ronna et al., 2016).

Studies have highlighted the prevalence of distracted driving which seems to be more common among professional drivers (TRL et al., 2015). For example, Griffin et al. (2014) found a 39% prevalence of distraction among public transit bus drivers in the US, with passenger interactions being the most common source of distraction. For HGV drivers, most dangerous distracting activities are texting or entering a number in a mobile phone (Stavrinos et al., 2016; Hickman et al., 2014; Olsen et al., 2014).

2.5.2 Factors related to the vehicle

Vehicle-related factors contributing to crashes involving HGVs and buses/coaches include their substantial mass, which results in extended braking distances. This characteristic becomes particularly hazardous when combined with human factors such as driver inattention, distraction, or fatigue. While the latter human factors are separate crash causation elements, they can significantly amplify the risks associated with the vehicle's inherent limitations in stopping quickly.

Large blind spots are a significant vehicle-related risk factor for HGVs and buses/coaches (Pokorny et al., 2017; Schoon, 2006). These blind spots can obscure the driver's view of nearby road users, particularly pedestrians and cyclists. While dedicated mirrors and camera systems help reduce these blind spots, they don't eliminate them entirely. Moreover, the effectiveness of these systems relies on proper adjustment and active use by the drivers, the latter often not given. According to a naturalistic glance behaviour study (Jansen & Varotto, 2022) most often truck drivers did not cast a glance upon their blind

spot mirrors before as well as during their manoeuvers at an intersection.

Vehicle load also plays a crucial role in safety. Unbalanced or excessive loads can compromise vehicle stability, especially during sudden braking, sharp turns, or on steep inclines. Additionally, heavy vehicles are more prone to tyre blowouts, which can severely impact vehicle control (EC, 2023c) Such incidents not only challenge the professional driver but can also startle other road users, potentially leading to dangerous situations.

Lastly, other road users' lack of understanding about the unique characteristics of HGVs and buses contributes to risk. Many may not fully appreciate these vehicles' extended braking distances or extensive blind spots. This knowledge gap can lead to inadequate anticipation and potentially hazardous interactions on the road.

2.5.3 Factors related to the road environment

Prato and Kaplan (2013) and Meunier (2020) highlight several features of road infrastructure that are particularly critical for HGV and bus/coach safety:

- Sharp bends: These can cause truck loads to shift, altering the centre of gravity and risking tip-overs. They may also force HGVs to encroach on oncoming traffic lanes.
- Narrow driving lanes: These compel HGV drivers to use part of the oncoming traffic lane, increasing collision risks.
- Short entry and exit lanes: Short entry lanes may result in insufficient merging speeds, while short exit lanes can lead to abrupt deceleration or premature slowing on the motorway.
- Steep slopes: Ascending roads cause speed loss in HGVs, increasing speed differentials with passenger vehicles.
- High speed limits: Prato and Kaplan (2014) found that speed limits of 80 km/h or more on Danish roads were associated with a 277.2% increase in the likelihood of more severe outcomes (light injuries, severe injuries and fatalities) in bus accidents compared to lower speed limits. They also found a 42.6% increase in the likelihood of injury to bus passengers.
- Road surface conditions: The Danish study (Prato & Kaplan, 2013) revealed that slippery road surfaces increased the probability of light injuries by 8.7%, severe injuries by 13.4%, and deaths by 16.0% in bus accidents.
- Intersections: Bus drivers crossing intersections in yellow or red light (possibly due to being late and attempting to avoid further

delays) was positively related to both bus accident severity and passenger injury occurrence.

These findings underscore the importance of considering both road geometry and traffic management in enhancing safety for HGVs and buses. Authors further emphasize the need for infrastructural solutions to forgive possible driving errors as well for maintenance of road surfaces and management of traffic and shifts across the day.

3. Countermeasures

Countermeasures should take into account the implementation of a rigorous safe system approach, which implies improving infrastructure, enhancing vehicle safety, setting appropriate speeds and behaviour of all road users and adequate enforcement.

3.1 Safer road users

3.1.1 Training, education and information

Professional HGV and bus drivers in the EU must complete initial training and a five-yearly refresher course (EU, 2022). While the effects of driver training are difficult to assess objectively (Helman et al., 2017), a Norwegian study by Elvebakk et al. (2020) found positive self-reported outcomes from mandatory refresher courses, including positive learning outcomes and improved driving styles.

Some companies offer safety courses focusing on specific topics like driver fatigue, distraction, or interaction with vulnerable road users or a company's safety culture (see Paragraph 3.1.3). However, the effectiveness of these standalone measures still has to be shown more clearly yet, as e.g. Pylkkönen et al. (2018) found no positive effect from an alertness-management training program, Vitols & Voss (2021) concluded that fatigue-focused courses often fail to improve driver alertness as they don't address underlying causes.

3.1.2 Safety culture and safety management

The EU Directive 89/391/EEC on health and safety of workers requires every employer in all EU Member States to undertake a risk assessment according to the principle of prevention.[2]

[2] https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/the-osh-framework-directive-introduction

Typically, organisations tend to have a reactive approach following an increase in collisions demonstrated by insurance data, their own reported collision data, or telemetry. However, an effective risk assessment should also involve participants in assessing their own needs, as Framework Directive 89/391/EEC expressly requires employers to consult workers and/or their representatives and allow them to take part in discussions on all questions relating to safety and health at work. Proactive organisations consult their drivers from the outset to know whether they feel they ought to receive training, and what their training requirements are. The outcomes should be fed back to operational managers and drivers through discussion. This can take place within workshops, toolbox chats, debriefs, intranets, notice boards, newsletters and with the support of handbooks (ETSC, 2010).

The ISO standard 39001 on Traffic Safety Management System, uses a Plan, Check, Do and Act process framework.[3] Elements include the requirements for an organisation to a) adopt the Safe System goal and decide on targets and objectives for the interim and b) consider for use a range of measurable safety performance factors covering areas within the organisation's sphere of influence that are known to reduce the risk of fatal and serious injury. The aim is both to guide organisations through a process of continual improvement in road safety performance towards zero death and long-term injury and support the transfer of knowledge about successful activity.

A company's safety culture refers to the shared safety values and standards within the organisation (Vlakveld et al., 2014). In the transport organisation, developing a strong safety culture is a collaborative effort involving the company management, planning department, and drivers (Grinerud, 2022). Research indicates that improving the safety culture often leads to safer driving behaviours among the company's drivers (Vlakveld et al., 2014).

In companies with a prominent safety culture, there are clear rules and policies related to key safety aspects, such as speeding, seatbelt use, and mobile phone usage. In-vehicle monitoring systems (IVMS) can play a useful role in enforcing and monitoring compliance with these policies.

Fatigue management is another crucial component of safety culture. This involves not only educating drivers about the risks and causes of fatigued driving, but also implementing realistic time planning to ensure drivers can comply with driving times and rest periods at all times.

[3] https://www.iso.org/standard/44958.html

Based on a survey and interviews conducted in 17 Norwegian companies, Nævestad, Blom & Phillips (2020) identified 11 practical requirements for effective safety management. These include implementing policies on speed, driving style, and seatbelt use, providing regular feedback to drivers on their driving behaviour as well as empowering drivers to postpone assignments if they deem it unsafe to proceed.

3.1.3 Regulation and enforcement

Driving time and rest period regulations are crucial for professional drivers (see also Section 1.2), aiming to enhance road safety by mitigating driver fatigue. These rules set limits on driving time and mandate breaks and rest periods. However, enforcement levels vary across countries, sometimes falling short. In the EU, 3.03 million offences were detected between 2021 and 2022, according to Member State reports (EC, 2024b).

Assessing the impact of these regulations is challenging, as most countries have long-standing versions of such rules. For instance, Europe first adopted driving period and break regulations in 1969 (EEC, 1969). Research, primarily from the United States, suggests that enhanced monitoring and enforcement of existing regulations lead to improved compliance and favourable safety outcomes (Hickman et al., 2016; Mohlman, 2013 cited in Goldenbeld, 2017).

3.1.4 Driver health promotion

Professional drivers' health and well-being are closely linked to their ability to drive safely (Batson et al., 2022; Crizzle et al., 2017; Hickman et al., 2020; Peters et al., 2021). Poor health can lead to increased fatigue, reduced alertness, and diminished driving performance. The demands of the job expose drivers to various risk factors, including long working hours, shift work, sleep deprivation, noise, vibration, physical inactivity, unhealthy diets, and exposure to diesel fumes. These factors significantly increase the risk of developing cardiovascular diseases, obesity, and sleep apnea (Crizzle et al., 2017). Evidence suggests that health promotion interventions for HGV drivers can be beneficial (Ng et al., 2014). Promising initiatives include structured multicomponent programs (e.g. behavioural self-monitoring, weight loss competition, computer-based training, etc.) that are ideally accessible remotely, utilising mobile health care technology (Olsen et. al,2009; Snyder et al., 2023) and incorporating wearable devices. These include electronic monitors contain sensors, storage systems or capacity to track individuals' health behaviours and physical activities - such as smart watches. (Greenfield et al., 2016).

It's worth noting that the EU has recognized the importance of driver health and well-being in its regulatory framework. Directive (EU) 2022/2561, which covers the initial qualification and periodic training of professional drivers, includes specific objectives related to physical and mental health. The directive requires training on ergonomic principles, physical fitness, the importance of physical and mental ability, healthy eating, and the effects of fatigue, stress, and substances that can affect behavior (EC, 2022). This mandatory training both aligns with and supports the health promotion interventions discussed in the mentioned literature.

3.2 Safer vehicles

3.2.1 Vehicle General Safety Regulation

The EU Vehicle General Safety Regulation (GSR) 2019/2144 (EC, 2022a), mandates a range of safety features for new vehicles, including HGVs and buses.

The new General Safety Regulation mandates different safety features for various vehicle types. For trucks and buses/coaches specifically, the mandatory features include:

1. Detection and warnings to prevent collisions with pedestrians or cyclists
2. Tyre pressure monitoring systems
3. Improved direct vision to better see cyclists and pedestrians (from 2026)
4. Event data recorders

The following features are required for all road vehicles, including trucks and buses/coaches:

1. Intelligent speed assistance
2. Reversing detection with camera or sensors
3. Attention warning in case of driver drowsiness
4. Emergency stop signal
5. Cybersecurity measures

Additionally, advanced driver distraction warning systems will be required for all new vehicle types from January 2026 and for all new vehicles from January 2029. While these regulations represent significant progress, some road safety organisations (e.g. ETSC, 2020) advocate for further improvements, such as mandatory alcohol interlocks for all professional drivers and non-overridable ISA systems.

The latter being systems which cannot be turned off or overridden by the driver, ensuring that the vehicle always adheres to the speed limit – without the possibility of manual deactivation.

3.2.2 AEBS

Advanced Emergency Braking Systems (AEBS) have been mandatory in the European Union for all new trucks and coaches since 1 November 2015 (EC, 2024c). While exact figures on the road safety impact of AEBS are not available for trucks, theoretical models and real-world data suggest positive effects (Mettel, 2018). The German Road Safety Council (DVR) estimated that current "optimal" AEBS types could potentially prevent up to 488 accidents, 98 fatalities, and 671 serious injuries on German motorways alone (DVR, 2016). However, challenges remain, including the reliability of obstacle detection (Van Hattem et al., 2017) and driver deactivation of systems (Berg & Petersen, 2018, cited in Mettel, 2018).

Recent regulatory developments have addressed these issues and expanded AEBS capabilities. The United Nations Economic Commission for Europe (UNECE) adopted strengthened provisions for UN Regulation No. 131 on Advanced Emergency Braking Systems (AEBS) for heavy vehicles. These provisions, which entered into force on February 21, 2023 significantly enhance the scope and capabilities of AEBS. These improvements are expected to significantly reduce crashes and fatalities, particularly in traffic jam situations. Improved AEBS will be required on all new HGVs and buses/coaches in the EU, incorporating the latest technological advancements and addressing previous limitations (EC, 2024b) from 1 September 2025 to new models and from 1 September 2028 to all new trucks and coaches (UNECE, 2022b). 2022b).

3.3 Safer roads

3.3.1 Separating heavy vehicles from other traffic

Spatial or time separation of buses and HGVs from other traffic, in particular away from unprotected road users such as cyclists and pedestrians, is a very effective safety measure for both road sections and junctions and both urban and non-urban roads (SWOV, 2018). Due to the great difference in mass between buses and HGVs and most other road users, collisions involving these vehicles generally result in very serious injuries or death. This measure reflects one of the central elements of the Safe System approach: “ensure that crash impact forces remain below levels that will cause death or serious injury” (ITF, 2022, page 13). Concrete examples of achieving separation of heavy

vehicles from other road users are: dedicated bicycle/pedestrian facilities with conflict-free traffic lights, dedicated HGV/bus lanes, and restricted inner-urban distribution times and routes. The UK's Health and Safety Executive (HSE) also stresses the importance of complete segregation through further measures such as footbridges, subways, and clearly marked routes with protective barriers since 2007 (HSE, 2007).

3.3.2 Overtaking bans for HGVs

Overtaking bans for HGVs on the motorway network can help reduce speed differences between HGVs and lighter and faster passenger cars and other light vehicles. Many countries have already implemented overtaking bans for HGVs on some motorway stretches (sometimes for specific periods of the day). TRL (2010) concludes that the overall safety benefits can be expected to be small. Most benefits can be expected on sections with uphill gradients and with junctions spaced at least 3 km apart.

In Austria, a 2013 expert report from the Austrian Road Safety Board led to a ban on HGVs using the third and fourth lanes of motorways, addressing the disproportionate involvement of trucks in accidents: while HGVs accounted for only 11% of the total distance travelled on Austrian expressways and motorways, they were involved in 22% of crashes resulting in personal injury (BMVIT, 2013). Poland's 2023 regulation introduced a more flexible approach, allowing overtaking only when the overtaken vehicle is moving significantly slower than the speed limit and if the overtaking manoeuvre can be safely performed. While these measures aim to improve safety and traffic flow, their effectiveness and compliance remain subjects of ongoing evaluation and debate within the transport industry.

3.3.3 Avoiding or warning for infrastructure bottlenecks

HGVs and buses/coaches have specific operational attributes. Their drivers could benefit from special safety messages and signs about road characteristics that take these attributes into account. Such signs can include warning of limited clearance at bridges, warning of truck rollover risk due to geometric conditions, warning of long and steep grades, and curve and ramp warnings (US DOT, 2017). Specific HGV navigation systems prevent HGV drivers from taking routes which enter residential areas and lead them to avoid too narrow rural roads or too small overhead clearances.

3.3.4 Sufficient safe and facilitating HGV parking

Adequate overnight parking and rest areas are crucial for international HGV drivers, providing secure spaces with facilities for rest and refreshment. However, Europe continues to face a shortage of quality parking areas for HGVs (Poliak & Poliakova, 2020). In response, the EU has taken significant steps to address this issue. A study, commissioned by the EC, made a series of recommendations for ensuring a denser network of safe and secure truck parking areas (De Leeuw van Weenen et al., 2019). Subsequently, the European Commission published new standards for safe and secure truck parking areas (SSTPAs) for trucks and commercial vehicles, along with procedures for their certification (EC, 2022b). These standards define four security levels (Platinum, Gold, Silver, and Bronze) and set minimum service requirements, including gender-friendly sanitary facilities, food and beverage options, internet connectivity and power supply. As regards the Trans-European Transport Network (TEN-T), the EU has adopted a revised regulation in June 2024 which sets a specific target for the development of SSTPAs. By 2040, safe and secure truck parking areas are to be established on the core and extended core road networks of the TEN-T, with an average spacing of every 150 km (EC, 2024d).

However, industry organisations, including the European Transport Workers' Federation (ETF), the International Road Transport Union (IRU), and the European Secure Parking Organisation (ESPORG), argue that the current number of safe and secure truck parking areas (SSTPAs) is inadequate. They urge the European Commission to modernise existing facilities and develop new, sustainable, and connected SSTPAs, with continued EU co-funding from 2025 to 2027 (IRU, 2024).

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