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PPR413

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The relationship between driver fatigue and rules limiting hours of driving and work

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Transport Research Laboratory

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The relationship between driver fatigue and rules limiting hours of driving and work

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The Relationship Between Driver Fatigue and Rules Limiting Hours of Driving and Work

Client: **Department for Transport, Freight and Logistics Division**

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Executive summary

Fatigue impairs the driver's cognitive and motor performance by slowing reaction times, reducing attention to the external driving environment, and disrupting steering skills. A fatigued driver's ability to respond effectively to unusual, unexpected, or emergency situations is reduced, and occurrences of these factors pose a risk to the safety of the drivers themselves and to other road users. Crashes that are related to sleepiness are more severe than other crashes and a higher proportion of them are fatal.

Research has highlighted the contribution of fatigue to driving accidents, but it is much less clear about the relationship of fatigue to driving hours. This report draws out the evidence from the existing scientific literature and considers how this may inform a review of existing UK domestic drivers' hours rules and any possible relaxations of those rules that might be deemed necessary in exceptional circumstances.

It must be recognised that the road transport industry is highly competitive and it is common to find extremely low operating margins, requiring employers to seek the maximum from their available resources, including drivers and vehicles. A careful balance is required within the regulatory framework that promotes both road safety and the operational requirements of the freight and passenger movement industries, whilst also allowing the sector to remain competitive.

The aims of this project were to:

- review existing UK and international research and other published material in order to:
    - determine what links exist between long driving or working hours and driver fatigue, and the extent to which limits on hours of driving or work help to prevent fatigue related accidents for drivers.
- establish:
    - whether other EU Member States have drivers' hours rules for goods and passenger vehicles that are exempt from, or outside, the EU Regulation on drivers' hours (domestic legislation within each Member State);
    - the methods Australia, Canada and the United States use to tackle driver fatigue (similar restrictions on drivers' hours and working time and/or other fatigue management systems).
- identify what, if any, risks occur if certain requirements of the EU and UK domestic drivers' hours rules are relaxed in exceptional circumstances.

To accomplish these aims a review of drivers' hours rules in the UK has been conducted within the context of relevant scientific literature (chapter 2), an analysis of relevant GB accident databases (chapter 3), a detailed review of domestic legislation around Europe (chapter 4), and an examination of practice in the USA, Canada and Australia (chapter 5).

This report is designed to provide information to inform the ongoing review of the domestic drivers' hours legislation in the UK and initial conclusions drawn from this review and future recommendations are presented in chapter 6.

Background research

There are three important contributing factors that explain how and why sleep related accidents occur: time-on-task, time of day and sleep and rest deprivation.

It is logical that a human's continuous performance on a task will, after a certain time, begin to deteriorate. However, Brown (1994, p310) stated:

> "Time on task *per se* appears to have a relatively small effect on accident risk when daily work periods are shorter than 11 h, especially when driving is restricted to normal daily work times. However, accident risk may double when duty periods exceed 12 hours."

This is an important consideration in discussion of possible relaxation of restrictions during emergency or exceptional situations.

In quantifying what constitutes a dangerous lack of sleep, Naitoh, (1992) reported that less than four hours per night severely impairs driving performance and less than five hours of sleep per night increases the chance of being involved in a sleep-related crash by five times (Stutts et al., 2003).

While the number of driving hours is relevant to fatigue, it is not sufficient to consider this as a sole reason for sleep-related accidents. If the driver is chronically sleep-deprived, or suffering from sleep inertia, or in poor health, or may be eating the wrong foods at the wrong times, fatigue onset and hence the increased risk of an accident can occur almost immediately.

Completed in 1996, the Driver Fatigue and Alertness Study (DFAS) was, at the time, the largest and most comprehensive study of driver fatigue in North America (FMCSA, 1996). Data for around 4,000 hours of driving were collected from instrumented vehicles which recorded vehicle characteristics (e.g. speed and lane position), continuous video monitoring and physiological measurement of the drivers. Drivers were also required to complete self-report questionnaires.

The authors report that *hours of driving* was not a strong or consistent predictor of fatigue on any objective measure.

A further field study from the USA also provides insight into the role of driving hours and fatigue for truck drivers (Hanowski et al., 2008). This study was a result of changes in US regulation which increased the number of hours a driver could drive in a shift from ten to eleven hours. The study sought to establish driving risk per hour from the first to the eleventh hour to establish if there was a significant difference for drivers driving for an extra hour. The study analysed 2.3 million miles of driving data.

The results of the study suggested that there was no driving performance difference between the tenth and eleventh hour of driving. In fact, there was no difference between any hour from the second to the eleventh signifying that time-on-task was having no effect on driver performance, similar to the results of FMCSA (1996). The authors therefore conclude that time-on-task is a poor predictor for crashes and critical-incidents related to fatigue.

A surprising finding from the research was that driving performance (measured by critical incidents) in the first hour was significantly poorer than in the eleventh hour, which is opposite to what was expected. This result is clearly of significance to this review as it provides a suggestion that an extension by an hour of driving time under exceptional circumstances is likely to have little effect on overall traffic safety.

GB evidence

In addition to the review of existing research literature, this report considered existing accident databases and how they might inform the picture of fatigue related accidents. TRL manage and hold, on behalf of the Department for Transport (DfT), a number of accident research databases. These contain unique data on the causes and consequences of road traffic collisions, with each focusing on different aspects and types of accidents.

At the request of the police, VOSA inspectors undertake detailed examinations of vehicles involved in road traffic accidents, in order to identify if they had a defect at the time of an incident. These inspections are undertaken using standardised collection

forms, but it is important to note that not all vehicles involved in accidents are inspected.

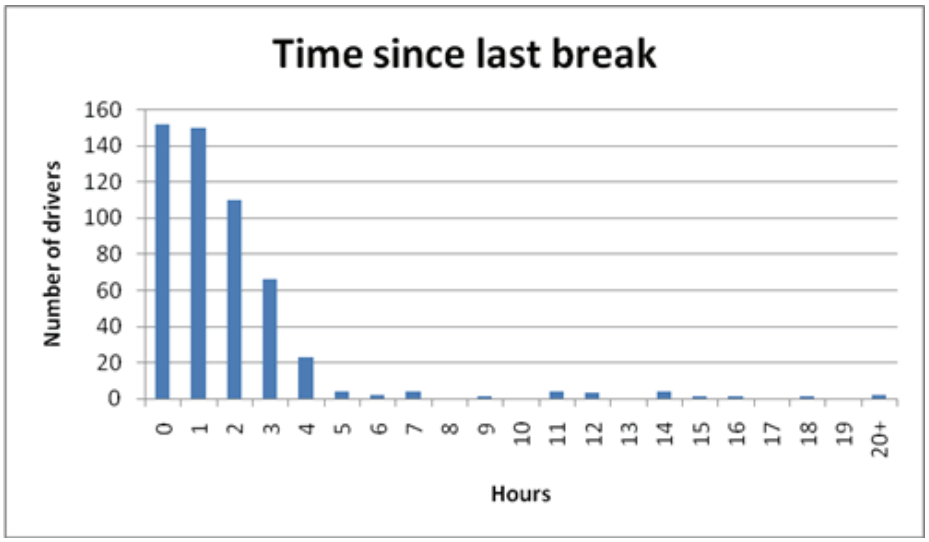

Figure 1 - Time since last break

Of the 590 cases looked at, it can be seen that the distribution is heavily skewed towards the lower end of the scale. From this data alone we cannot say anything directly about fatigue distribution because we do not know if our sample reflects the whole population of drivers, nor has any measure of fatigue been taken. However, it is interesting to note that the majority of collisions happened within two hours of the drivers' last break.

The HVCIS Fatal Accident Database is managed and populated by TRL on behalf of the Transport Technology and Standards (TTS) division of DfT. The sources of the data are the comprehensive police reports produced as part of a fatal accident investigation. These reports can include police reconstructions, scale plans of the scene, accident investigators and expert witness reports, eye witness statements, post mortem reports and photographs.

The following analysis has been based on a total of 2,947 fatal accidents, involving 5,355 vehicles (including non-case vehicles such as cars) and resulting in 3,252 fatalities. Overall, the high proportion of cases included in HVCIS relative to the GB total means that the sample is broadly representative of the GB situation.

For each driver in the accident (including the non-case vehicles such as cars and motorcycles), behavioural factors that could have been contributory to the cause of the accident are coded. The two driver behaviour factors of interest in this study are *fatigue* and *excess hours*. Table 1 shows the number and proportion of drivers and how their behaviour contributed to the accidents.

Table 1 - Driver behaviour factors

	Vehicle Type			
Drivers	**HGV**	**LCV**	**PSV**	**All**
All	1851 (100%)	745 (100%)	473 (100%)	5355 (100%)
Without behavioural factors	1160 (62.7%)	360 (48.3%)	332 (70.2%)	2603 (48.6%)
With behavioural factors	691 (37.3%)	385 (51.7%)	141 (29.8%)	2752 (51.4%)
Fatigue	*76 (4.1%)*	*41 (5.5%)*	*5 (1.1%)*	*213 (4.0%)*
Excess hours	*36 (1.9%)*	*3 (0.4%)*	*0 (0.0%)*	*43 (1.6%)*
Fatigue & Excess hours	*18 (1.0%)*	*1 (0.1%)*	*0 (0.0%)*	*21 (0.4%)*

When considering only those drivers considered to be at least partly at fault for the cause of the accident in which they were involved then the fatigued drivers represent 11% of HGV and LCV drivers and 4% of PSV drivers.

EU domestic legislation

The review of European domestic legislation proved complex. Some countries had well-defined legislation, which was well set out and publicised, but in others it was not possible to identify clear rules.

A total of over 100 contacts were made in the following countries:

- Austria
- Belgium
- Bulgaria
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Luxembourg
- Netherlands
- Norway
- Poland
- Slovak Republic
- Slovenia
- Portugal
- Spain
- Sweden

One key finding of the study was that there are many exceptions to the working time and break rules and scope for collective or union agreements in several of the countries examined

The research focussed on the rules which are in place for drivers of two major sectors in the road transport industry who are exempt from the EU Drivers' Hours Rules ((EC) No. 561/2006): buses on regular routes where the route does not exceed 50km and goods vehicles with a total mass not exceeding 3.5 tonnes.

The research highlighted a common trend across many Member States to use some or all of the provisions contained within existing European Legislation, in particular the main working time directive (2003/88/EC), 2002/15/EC or by extending the Regulation (EC) No. 561/2006 to cover drivers of exempt vehicles.

Although it was not possible to obtain or interpret rules for every Member State, substantial information was nevertheless attained. However, the details should not be relied on for legal purposes or if accuracy is critical.

Rules for bus drivers servicing routes less than 50km

The daily driving limit ranges from 8 hours (Austria) to 11 hours (Ireland) with the most common limit across Member States being 10 hours.

Some Member States have weekly driving time limits which range from 40 hours in countries such as Greece and Sweden, to 60 hours in Poland. It should be noted that weekly working time is commonly limited to 48 hours and that the 60 hour limit that Poland has in place is very high. Where rules governing fortnightly driving are in place, there is a limit of 90 hours.

Most Member States have break requirements for bus drivers servicing a route of less than 50km. Breaks should be taken between four hours (Austria) and, more commonly, 6 hours of driving. The duration of the break across most Member States is 30 minutes which can often be broken down into shorter periods. However, the minimum break length in Austria is 45 minutes.

The majority of Member States specify that the daily rest requirement is eleven hours. In the Czech Republic and Spain, this requirement is increased to twelve hours. Weekly rest durations are also specified by most Member States. The shortest weekly rest requirement is 24 hours and the highest is 45 hours.

Rules for goods drivers with a total mass not exceeding 3.5 tonnes

The majority of Member States specify both the daily and weekly driving limits. Other Member States have an additional fortnightly driving limit.

The daily driving limit varies across Member States with the tightest restrictions of eight hours occurring in Austria. With a daily driving limit of up to eleven hours, Ireland has the least restrictive rules. Other Member States tend to limit driving time to nine or ten hours per day. The weekly driving limit ranges from 39 hours (France) to 48 hours (Austria, Poland, etc.).

A number of Member States allow weekly working time to be extended to 60 hours per week provided that an average of 48 hours per week is not exceeded over a four month period.

Where provided, fortnightly driving time is limited to 90 hours. This is also a requirement of the Regulation (EC) No. 561/2006.

Most Member States have specified the maximum time before a driver of a goods vehicle with a total mass not exceeding 3.5 tonnes must take a break. This requirement ranges from four hours in Austria and Estonia to 5.5 hours in the Netherlands. For the Member States who indicated that rules in the Directive 2002/15/EC have been extended to cover drivers of goods vehicles with a total mass not exceeding 3.5 tonnes, the maximum time before a driver must take a break is 6 hours.

The minimum break length is typically 30 minutes across Member States. Ireland has made provisions for a 15 minute break after 4.5 hours of driving and a 30 minute rest period after 6 hours.

The majority of Member States have daily rest requirements for drivers of goods vehicles with a total mass not exceeding 3.5 tonnes that are similar to the daily rest requirements for bus drivers. The majority specify that the daily rest requirement is eleven hours. In Spain, this requirement is increased to twelve hours. Weekly rest durations are also specified by most Member States. The shortest weekly rest requirement is 24 hours in Ireland and the Slovak Republic with the longest being 45 hours per week.

Examples of best practice outside the EU

Australia

Traditionally, the driving regulations for heavy vehicles, commercial bus and coach drivers have differed from state to state/territory in Australia. In September 2008 these regulations changed, with the introduction of the Heavy Vehicle Driver Fatigue Reform (HVDFR). This is a set of national rules and regulations intended to help manage fatigue in the industry.

However, Western Australia and The Northern Territories are large areas that are sparsely populated and the rules are impractical for the terrain and size of the states. Instead, drivers within Western Australia and Northern Territories operate under a Fatigue Management Code of Practice. There is a model fatigue management system (FMS) which operators can choose to follow or they can develop their own plan. Note that no examples were found of the development and use of such FMS in EU countries.

The new national laws apply to all trucks with a gross vehicle weight over 12 tonnes or truck and trailer with a gross train weight of over 12 tonnes, and commercial buses with 12 or more adult seats including the driver. Plant equipment, motor homes and mini buses for private use are not covered. The following three schemes are available:

- Standard Hours;
- Basic Fatigue Management (BFM);
- Advanced Fatigue Management (AFM).

There is also a separate Standard Hours (Buses) option. The BFM and AFM schemes apply to both trucks and buses. They allow a greater degree of flexibility in the hours in return for improved fatigue management systems. The new regulations make all parties in the 'chain of responsibility' responsible for fatigue management. The parties are:

- Driver;
- Employer of the driver;
- The prime contractor of the driver;
- The operator of the vehicle;
- The scheduler of goods or passengers for transport by the vehicle and also the scheduler of its driver;
- The consignor of the goods being transported;
- The consignee of the goods being transported;
- The loading manager;
- The loader and un-loader of the goods.

All parties in the chain are required to work together to ensure that the driver is not fatigued and is not under pressure to break the regulations to finish a job. Reasonable steps should be taken to prevent driver fatigue. Reasonable steps include, but are not limited to:

- Developing an industry code of practice;
- Use of accreditation schemes;
- Review business practices;

- Adopting a risk management approach.

United States of America (USA)

In the USA the driving hours for commercial motor vehicles (governed under the Hours of Service (HOS)) are the same for all interstate drivers. Intrastate driving regulations are set state by state but they are usually identical or very similar to the HOS regulations. The latest versions of the HOS rules came into force on 1st October 2005. The regulations apply to all vehicles requiring a Commercial Drivers Licence (CDL) and are split into long haul and short haul.

Vehicles are split into property carrying commercial motor vehicles and passenger-carrying commercial motor vehicles (CMV). The long haul regulations are the same for all states except Alaska which has slightly different terms. The regulations are summarised in the table below:

Criteria	**States except Alaska**		**Alaska**	
	Property-carrying CMV	Passenger-carrying CMV	Property-carrying CMV	Passenger-carrying CMV
Total driving time allowed in one day	11 hours	10 hours	15 hours	15 hours
Time after coming on duty after which cannot drive	16 hours	15 hours	20 hours	20 hours
Maximum time allowed on duty in 7 consecutive days	60 hours	60 hours	70 hours	70 hours
Maximum time allowed on duty in 8 consecutive days	70 hours	70 hours	80 hours	80 hours
Minimum break before restarting a period of 7 consecutive days	34 consecutive hours	N/A	N/A	N/A
Minimum break before restarting a period of 8 consecutive days	34 consecutive hours	N/A	N/A	N/A

In cases where a driver is helping with emergency relief efforts the laws are relaxed.

There are two systems for short haul drivers. The set of regulations a driver has to follow is determined by the type of vehicle and the distance driven from the driver's base.

Canada

The Commercial Vehicle Drivers Hours of Service Regulations regulate the use of heavy vehicles in Canada. Commercial Vehicles are defined as:

- A truck, tractor, trailer or any combination thereof that exceeds 4500kg gross vehicle weight;
- A bus designed and constructed to carry at least 10 seated passengers – including the driver.

In Canada, the national regulations are different for driving north and south of the 60°N line of Latitude which means different sets of rules for different states. The Canadian rules are summarised in the table below:

South of 60°N	North of 60°N
Cannot drive for more than 13 hours in one day	Cannot drive for more than 15 hours
Cannot work for more than 14 hours each day	Cannot work for more than 18 hours a day
The driver must take at least 8 consecutive hours off-duty after accumulating 13 hours driving time or 14 hours working time before driving again	The driver must take at least 8 consecutive hours rest after accumulating the maximum driving or working time
Cannot drive after 16 hours have elapsed since the last break of 8 consecutive hours	Cannot drive after 20 hours have elapsed since the last break at least 8 hours
A driver must take at least 10 hours of off-duty time each day	A driver must take at least 8 hours of off duty time
Off-duty time other than the 8 consecutive hours must be taken in blocks of at least 30 minutes	

Conclusions

Fatigue Risk Management (FRM) programmes can be more flexible than an approach centred on prescribed working hours.

An advantage of a working hours directive is that it is clear, unambiguous, and has the intention of providing protection for employees. In contrast, the specific criteria for hours are somewhat arbitrary, and may be seen by both employers and employees alike more as targets to be attained, rather than limits on actions. Working hours also set a universal framework that may not sufficiently accommodate the practicalities of some particular operating environments. Further, when considering working hours it must be remembered that they are only one component of fatigue and hence, accidents.

Our review of scientific studies showed that fatigue and sleepiness can be a function of the quality and quantity of prior sleep, the immediate demands of the work schedule, and the time of day. Employment factors also play a key role; opportunities for meaningful rest, the workload itself and the work environment, and the reward structure will all affect the driver in addition to rostering factors such as; predictability (so that social life can be managed appropriately), timing and duration. It must be remembered that other key determinants of driver sleepiness are factors outside the focus of the employer.

Individual drivers will respond differently to any particular work regime due to whether they naturally perform better at certain times of the day than others, and history of sleeping problems or disorders (like sleep apnoea), or the influence of any illness or medication. Life style factors that include activities engaged in during leisure time and adequacy of sleeping arrangements are also of high importance.

A detailed review of alternative FRM systems is beyond the scope of this review, but interesting examples have been described in Chapter Five taken from Australia, and show the outline of both basic and advanced fatigue management. Such examples need to be considered further within the context of the UK operating environment.

Any changes to current drivers' hours rules, both EU and UK domestic would need very careful consideration. The question of potential relaxation in exceptional circumstances, must first consider the evidence for a direct link between driving duration and accident

rate. Neither the research literature nor the GB accident databases considered in this review, have revealed a strong link between hours driven and accidents.

1 Introduction

Fatigue has long been recognised as a particular safety problem in the road freight and passenger transport industries. Detailed studies of the general driving population have estimated that up to 20% of all UK motorway accidents can be attributed to driver sleepiness (Horne and Rayner, 1995), and that all drivers are 10 times more likely to be involved in an accident if on the road between 0400 and 0600 hours (Horne 1992). Though reported statistics stating the prevalence of fatigue related accidents vary considerably, it is widely accepted that many estimates derived from national statistics are too conservative, as there is widespread underreporting. Horne goes on to suggest that accidents that might have been caused by sleepiness are often classified as *inattention*, *failures to look or see* and *misjudged speed and distance*.

In the particular case of truck drivers, six common factors of fatigue have been identified:

- Lack of prior sleep;
- Quality of sleep;
- Medical conditions;
- Sleep apnoea, which is a particular issue for Large Goods Vehicles (LGV) drivers;
- Time of day;
- Time on task.

Any of these alone, or in combination, could contribute to a driver suffering the symptoms of fatigue. These can include the subjective experience of sleepiness, reduced arousal and alertness, and a decreased ability to maintain attention and to respond quickly.

The human body functions using a number of neurobiological rhythms. The circadian rhythm includes two "low points", where alertness is naturally low and a person's wish to sleep is increased. These two periods are the early-mid afternoon (around 1400 to 1600 hours) and the very early morning (typically 0400 to 0600 hours, Horne, op.cit.). Some Industrial and work place accidents have been shown to be common during these periods, as are motor vehicle accidents (Mahowald, 2000).

Considerable resources are directed to enforcement of professional drivers' hours rules by authorities in the UK and abroad; however, there is substantial research and anecdotal evidence that indicates that fatigue is still a major problem for such drivers (ETAC, 2003). It must be recognised that the road transport industry is highly competitive and it is common to find extremely low operating margins, requiring employers to seek the maximum from their available resources, including drivers and vehicles. A careful balance is required within the regulatory framework that promotes both road safety and the operational requirements of the freight and passenger movement industries, whilst also allowing the sector to remain competitive.

The road transport industry is subject to a wide range of highly detailed regulations, designed to prevent overwork and fatigue amongst drivers of commercial and passenger carrying vehicles. Current legislation limits driving and working times, and sets minimum requirements for break and rest periods. The rules that apply depend on the type of vehicle being driven, and in the UK are set through both EU and domestic legislation. This is also the case in other Member

States, where the regulations followed can depend on the type of vehicle being driven, the activity in which it is engaged and the distance travelled.

The aims of this project were to:

- review existing UK and international research and other published material in order to:
    - determine what links exist between long driving or working hours and driver fatigue, and the extent to which limits on hours of driving or work help to prevent fatigue related accidents for drivers.
- establish:
    - whether, and to what extent, other EU Member States have drivers' hours rules for goods and passenger vehicles that are exempt from, or outside, the EU Regulation on drivers' hours (domestic legislation within each Member State);
    - the methods Australia, Canada and the United States use to tackle driver fatigue (do they have similar restrictions on drivers' hours and working time and/or other fatigue management systems?).
- identify what, if any, risks occur if certain requirements of the EU and UK domestic drivers' hours rules are relaxed in exceptional circumstances.

To accomplish these aims a review of driving hour rules in the UK has been conducted within the context of relevant scientific literature (chapter 2), an analysis of relevant UK accident databases (chapter 3), a detailed review of domestic legislation around Europe (chapter 4), and an examination of practice in the USA, Canada and Australia (chapter 5).

This report is designed to provide information to inform the ongoing review of domestic drivers’ hours legislation in the UK and initial conclusions drawn from this review and future recommendations are presented in chapter 6.

2 Review of scientific literature relevant to driving hours and fatigue

Psychological fatigue has proved difficult to define (Brown, 1994). It can include both physical and mental fatigue, can be task dependent, and is not necessarily commensurate with sleepiness (Thiffault & Bergeron, 2003; Brown, 1994). However, for the purpose of this review it is considered adequate to define fatigue as 'a general term which relates to both physiological and psychological processes. Generally speaking, fatigue reflects a decreased capacity to perform.' (Thiffault & Bergeron, 2003, p381).

Smiley (1998) details three main factors that determine whether humans can continue performing work at an acceptable level:

1. The number of hours of continuous work; otherwise known as time-on-task;
2. Time of day;
3. Sleep and rest.

This chapter will explore literature pertinent to driving hours and fatigue under these topic headings.

Sleep-related vehicle accidents account for around twenty percent of all accidents reported to the police in the south of the UK (Horne and Reyner, 1995). Fatigue is related to a person's current need for sleep along with task demands and conditions that reduce their ability to deal with those demands (Matthews, 2000). It includes feelings of sleepiness, being tired, the inability to concentrate, deterioration of attention and feeling mentally slowed (Feyer and Williamson, 1995).

Fatigue impairs the driver's cognitive and motor performance by slowing reaction times, reducing attention to the external driving environment, and disrupting steering skills (Friswell and Williamson, 2008). A fatigued driver's ability to respond effectively to unusual, unexpected, or emergency situations is reduced. Occurrences of these factors pose a risk to the safety of the drivers themselves and to other road users. Crashes that are related to sleepiness are more severe than other crashes and a higher proportion of them are fatal (Åkerstedt and Haraldsson, 2001).

The relationship between fatigue and drivers' work time or length of drive is complex and it would be a mistake to assume that all drivers respond in the same way, or even that any individual driver is entirely consistent from one day to another. This review will show a surprisingly weak relationship between driving time and accident rates. The review shows that drivers are affected by factors outside their working time, including prior sleep patterns and health and diet regimes.

Research has highlighted the contribution of fatigue to driving accidents, but it is much less clear about the relationship of fatigue to driving hours. The remainder of this chapter draws out the evidence from the existing scientific literature and considers how this may inform the review of the existing domestic drivers' hours rules and any possible relaxations of those and the EU rules that might be deemed necessary in exceptional circumstances.

2.1 Length of Continuous Work (Time-on-Task)

Richter, Marsalek, Glatz and Gundel (2005) report that fatigue levels increase as a function of time-on-task and that time-on-task effects on fatigue are greater for

monotonous tasks. It is noteworthy that motorway driving is considered a monotonous task (Brown, 1994; Horne and Reyner, 1995). Horne and Reyner (1995) analysed accidents in the UK using police data and other objective measures, and concluded that around twenty percent of motorway accidents were sleep related. Maycock (1996) had previously reported that fifteen percent of UK motorway accidents were sleep related. Horne and Reyner (2001) suggest that the two figures are complementary when it is considered that Maycock's (1996) work was based on self-report data and included 'minor' accidents where the police may not have been present.

Sagberg (1999) compared self-report data for drivers in the USA and Norway and found that there was a higher prevalence of 'drowsy driving' in the USA. It is thought that this is due to the difference in road geometry, design and environment whereby the USA has a higher prevalence of long, straight, roads with low traffic volume. Nelson (1997) states that straight, flat roadways with little variation in landscape can cause a stimulation deficiency which can result in inattention and drowsiness. In an experimental comparison of monotonous versus non-monotonous road scenarios in a simulator, Thiffault and Bergeron (2003) found that significantly larger variations in steering wheel movement were apparent on the monotonous road after only 20-25 minutes of driving. Unfortunately, the drives in Thiffault and Bergeron's (2003) study only lasted for forty minutes, hence analysis of longer term effects are not reported.

It may be with a consideration for monotony that European Union regulations limit truck drivers and bus or coach drivers to 4.5 hours of continuous driving (i.e. without a break). However, Horne and Reyner (2001, p290) write:

> "To our knowledge there are no convincing data on which to base any premise that 4.5 hours is generally a safe duration of time for a lorry driver to drive, especially on monotonous roads."

Literature does not offer a precise definition of a safe duration for a driver to be driving before taking a break, due to the multitude of factors involved in fatigue and driver performance; sections 2.3 and 2.4 will discuss other influences in more depth.

Despite a lack of evidence for an exact number of safe driving hours, it is not uncommon to find reports in the literature of restrictions on the length of time a truck driver can drive. For example, in the USA, truck drivers could drive for up to 11 hours in a day (Hanowski, Olson, Bocanegra & Hickman, 2008) and in Israel they could drive for up to 12 hours in a day (Sabbagh-Ehlich, Friedman & Richter, 2004).

Though such restrictions on driving time exist, Arnold et al. (1997) state that the effectiveness of specific driving hours restrictions for the control of fatigue and resultant crashes is not clear.

However, there is evidence that driving time impacts on safety. Hertz (1988) reported that 41 per cent of heavy truck crashes occurred after 16 or more hours on duty. Arnold et al. (op.cit.) determined, from self-report data of Australian truck drivers, that crash risk was 2.5 times higher when driving for more than fourteen hours compared with driving less than ten. These drivers were operating in a state that at the time of the survey did not restrict hours for its heavy haulage drivers. Away from driving literature, Suwazono et al. (2007) sought to determine the critical number of working hours before fatigue impacts on worker performance and health. Based on self-report data from 715 male workers in a chemical factory (performing various jobs) in Japan, Suwazono et al. (2007) calculated that around 11.5 hours per day is the limit, as can be seen in Figure 2. (Dotted lines represent a benchmark of working hours at 11.5 hours preceded by the lower 95% confidence limit at 11.2 hours).

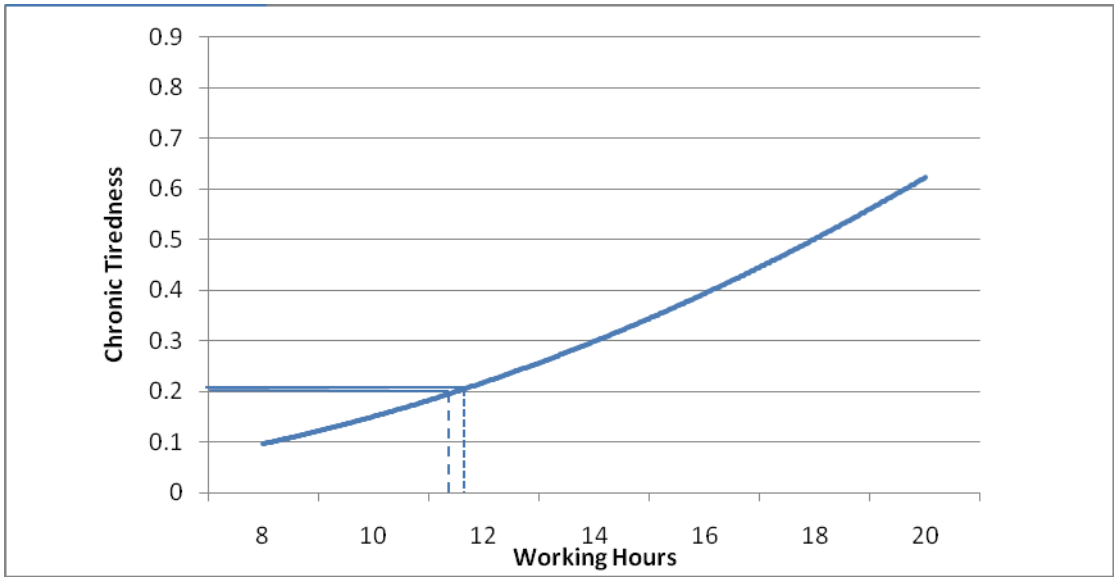

Figure 2 - Fatigue curve by working hour as calculated by Suwazono et al. (2007).

Suwazono et al. (2008) repeated this work at a Japanese steel company with almost 3,500 respondents which included 412 female workers. It is reported that the limit for chronic tiredness for men was around 9-10 hours and for women was around 8-9 hours. Although this work is a novel and rare attempt to establish a critical time limit for fatigue in a working environment, it must be appreciated that the data has come from self-reported questionnaires. The validity of self-reported retrospective fatigue has been questioned as it may not be an accurate reflection of true fatigue (Brown, 1994). Further, it is unknown how well this work can be applied across occupational settings and cross-culturally.

Historically, there is some driver related literature which discusses the number of driving hours and crash risk. Mackie and Miller (1978) found that driving performance started to decline after five hours of driving for drivers with irregular work schedules, and after eight hours for drivers with regular work schedules. Meanwhile, Harris et al. (1972) found that the risk of being involved in a crash increases after four hours of continuous driving. While this work suggests that time-on-task could be a significant factor in crash risk, more recent work suggests a wider perspective may be required.

Completed in 1996, the Driver Fatigue and Alertness Study (DFAS) was, at the time, the largest and most comprehensive study of driver fatigue in North America (FMCSA, 1996).

The study involved eighty male truck drivers split into four groups of twenty. The four groups worked on different schedules which enabled comparison of four different conditions:

- Condition 1: 10-hour "baseline" daytime

  10-driving-hour turnaround route, starting at about the same time (10:00am) each morning for 5 consecutive days.

- Condition 2: 10-hour "operational," or rotating

10-driving-hour turnaround route, starting about 3 hours earlier each subsequent day for 5 days. The first trip began at about 10:00am.

- Condition 3: 13-hour night time start

  13-driving-hour turnaround route, starting at about the same time (11:00pm on average) each night for 4 consecutive nights.

- Condition 4: 13-hour daytime start

  13-driving-hour turnaround route, starting about the same time each day (13:00 on average) for 4 consecutive days.

Data for around 4,000 hours of driving were collected from instrumented vehicles which recorded vehicle characteristics (e.g. speed and lane position), continuous video monitoring and physiological measurement of the drivers. Drivers were also required to complete self-report questionnaires.

Comparison of the ten-hour and thirteen-hour daytime drives found no notable differences from the vehicle recording equipment. In fact, the authors report that *hours of driving* was not a strong or consistent predictor of fatigue on any objective measure (FMCSA, 1996). In tests of cognitive performance drivers performed better in the ten hour drive, although a reaction time task was performed better in the thirteen hour condition. Hand-eye coordination tests did not differ between the conditions.

Interestingly, although no objective measure found differences in fatigue level by time-on-task, drivers self-report of fatigue levels did correlate positively with time-on-task. In other words, whilst there was no evidence of drivers' performance deteriorating, even in the thirteen hour condition, the drivers were indicating that they were feeling more fatigued with time.

A further field study from the USA also provides insight into the role of driving hours and fatigue for truck drivers (Hanowski et al., 2008). This study was a result of changes in US regulation which increased the number of hours a driver could drive in a shift from ten to eleven hours. The study sought to establish driving risk per hour from the first to the eleventh hour to establish if there was a significant difference for drivers driving for an extra hour.

Ninety-eight drivers (97 male) drove instrumented vehicles similar to that described for the FMCSA (1996) study. Driver performance was measured through the occurrence of predefined 'critical incidents' which included crashes, near-crashes and crash-relevant conflicts. The study analysed 2.3 million miles of driving data.

The results of the study suggested that there was no driving performance difference between the tenth and eleventh hour of driving. In fact, there was no difference between any hour from the second to the eleventh signifying that time-on-task was having no effect on driver performance, similar to the results of FMCSA (1996). The authors therefore conclude that time-on-task is a poor predictor for crashes and critical-incidents related to fatigue.

A surprising finding from the research was that driving performance (measured by critical incidents) in the first hour was significantly poorer than in the eleventh hour, which is opposite to what was expected. This result is clearly of significance to this review as it provides a suggestion that an extension by an hour of driving time under exceptional circumstances is likely to have little effect on overall traffic safety.

A spike in critical incidents during the first hour was found across all drives. The assumption of the time-on-task effect is that increased fatigue over time will result in poorer driving performance; that the opposite of this was found by

Hanowski et al. (2008) is intriguing. While the result may appear unusual at first, other research provides some support for these findings. Horne and Reyner (1995) reported that all the early morning sleep-related accidents they analysed in the UK had occurred within the first two hours of the journey. Similarly, Summala and Mikkola (1994) observed that sixty percent of fatal sleep-related accidents in Finland occurred within the first hour of driving. In an experimental laboratory setting, Thiffault and Bergeron (2003) report a peak impact of fatigue on performance after 20–25 minutes, although the experiment only lasted for forty minutes in total.

Given the complementary nature of the finding that critical incidents are more prevalent early in a journey, it seems necessary to explore this further. One possible reason for critical incidents being more likely at the beginning of journeys could be sleep inertia (Hanowski et al., 2008). Sleep inertia is the impairment of alertness and performance suffered immediately from waking from sleep. This has been shown to impair a variety of tasks including short-term memory, cognitive functioning and reaction time (Bonnet & Arand, 1995; Dinges, 1990; Mullington & Broughton, 1994). It may be that truck drivers who sleep in berths in their truck would be more affected by sleep inertia due to a likely reduction in time between waking and starting to drive. This may indicate that some form of safety guide for professional drivers is required.

Another explanation may be that traffic density and road type at the beginning of journeys might be more conducive to the occurrence of critical incidents and crashes. The beginning of a journey is more likely to be on smaller, local roads rather than motorway. Hickman et al. (2005), using an earlier version of the data reported in Hanowski et al. (2008), found that drivers were almost five times as likely to be involved in a critical incident on an undivided highway compared to divided highways (e.g. motorway). This could suggest that drivers are more likely to be involved in accidents when on smaller roads and when interacting with more vehicles; however, it does not explain why the same effect is not reported for the final hour of the journey.

Hanowski et al., (2008) suggest another explanation for the finding which is that time-of-day is more influential on drivers' fatigue than time-on-task. Although their data did not suggest that critical incidents were linked with circadian high and low times during the day, the time-of-day was predictive of driver fatigue (which will be discussed in more depth in the next section). They therefore conclude that it is likely that the spike in critical incidents during the first hour is likely to be due to a combination of the three reasons detailed here: sleep inertia, traffic density and type of road, and time-of-day. It is further concluded that time-on-task is not a good predictor of fatigue and that it does not appear to be a significant factor when considering critical-incident risk.

2.2 Time of Day

Wylie, Shultz, Miller, Mitler and Mackie (1996) also reported that time-on-task was a poor predictor of crashes and safety-related events, meanwhile suggesting that time-of-day was the strongest and most consistent predictor of fatigue. The time-of-day effect is usually associated with commercial or shift-work drivers who work through the night. However, the effect is also discussed as an outcome of the biological circadian rhythm of the body (Dinges, 1995). Circadian rhythms are regular changes in mental and physical characteristics that occur naturally in the course of a day. It is proposed that drivers with irregular shift patterns, and those who work through the night, may have to work against their natural circadian rhythm, and this has been shown to be related to increased crash risk (Hertz, 1988).

In the UK, there are clear time-of-day effects for sleep related accidents (Horne & Reyner, 1995). Peaks are present between 0200–0600 hours and 1400–1600 hours. Similar sleep related accident peaks have been reported in the USA, Israel, Finland and France (Pack et al., 1995; Zomer & Lavie, 1990; Summala & Mikkola, 1994; Philip et al. 1996). In the UK, peak accident periods for sleep related traffic accidents are distinct from peak overall accident periods which are related to commuting periods around 0800-0900 hours and 1700-1800 hours. Horne and Reyner (1995) found that the propensity for a driver to fall asleep at the wheel was twenty times greater at 0600 than at 1000 hours. Similarly, at 1600 drivers are around three times more likely to fall asleep compared to 1000 or 1900.

From the FMCSA (1996) study outlined above, it was found that while continuous driving time failed to display any significant differences between the four experimental conditions, the amount of night time driving did show differences. Driving alertness, as measured by driving performance and physiological feedback, was shown to be related to the amount of night time driving undertaken by the driver. Whilst these findings may relate simply to time-of-day, other influences cannot be discounted. For example, the amount of sleep a driver has had in the last 24 hours, or even week, or the length and quantity of rest breaks from continuous driving. These factors will now be explored.

2.3 Sleep and Rest

Dawson and Reid (1997) found that cognitive performance impairment after 17 hours continuously awake was equivalent to the performance impairment of people with a Blood Alcohol Content (BAC) of 0.05 per cent. This is the prescribed legal alcohol limit for drivers in many EU countries (although in the UK, a BAC of 0.08 per cent is the legal limit). After 24 hours of sustained wakefulness, the performance impairment of the forty participants increased to that similar to impairment caused by a BAC of 0.10 per cent. This study demonstrates the effect that lack of rest and sleep could potentially have on a person's ability to drive safely, and has practical implications for the availability of suitable rest areas and facilities for drivers. It is therefore worth considering the influence of sleep and rest breaks from driving.

An NTSB (1995) project analysed sleep related single vehicle truck crashes and concluded that an irregular sleep pattern was the most important contributory factor. This finding is supported by previous work which found that sleep of less than four hours per night severely impairs driving performance (Naitoh, 1992), and that getting less than five hours of sleep per night can increase the chance of being involved in a sleep-related crash by five times (Stutts, Wilkins & Vaughn, 2003). Likewise, work by Sweeney et al. (1995) found that the two main factors that distinguish sleep-related and non-sleep related crashes were duration of last sleep and amount of sleep in the last twenty-four hours; it could be assumed that these variables would often have similar values.

In the USA, changes in legislation increased the legal rest time between shifts for truck drivers to ten hours from eight. Follow up research reported that drivers may have benefited from longer breaks between shifts by getting more sleep during their time off (6.28 hours per day) compared to under the previous ruling (5.18 hours per day) (Hanowski, Dingus, Sudweeks, Olson & Fumero, 2005). Unfortunately, though the drivers took the opportunity for increased sleep, we do not have evidence that this was reflected in changes to driver performance.

The importance of adequate rest between shifts was highlighted by Tilley, Wilkinson, Warren, Watson and Drud (1982) who conducted a study of train drivers. It was noted that train drivers reaction time performance deteriorated as a function of the number of days into the roster they were, and that this

performance would deteriorate at night. Meanwhile, as noted earlier, Mackie and Miller's (1978) reported that for drivers who have irregular shift patterns, performance deteriorates after five hours of driving, whereas for drivers with regular schedules, performance deteriorates after only eight hours of driving. This emphasises the importance of quality of sleep and the lifestyle of the driver away from work, in addition to the load imposed by work itself. In terms of the sectors covered by GB domestic legislation, it is likely that the driver will have the potential for sufficient restful sleep e.g. vans under 3.5t and drivers with regular day time shift patterns. The potential for restful sleep is however no guarantee that it will be obtained.

Away from driving research, a Swedish occupational health study (Akerstedt and Haraldsson 2001) involving 6,000 participants, found that involuntary falling asleep at work was related to three independent factors: *shift work*, *solitary work* and *disturbed sleep*. These three factors can all be applied potentially to the work of a professional driver. It seems clear that sleep duration, sleep quality and the impact of shift work can all be detrimental to the performance of a driver and are likely to be linked with the risk of being crash involved.

Drivers of all vehicle types seem to agree that the most successful way to overcome fatigue while driving is to take a nap (short periods of sleep). There are two forms of naps. *Recuperative* napping (up to around 20 minutes) has benefits for alertness and performance on night work. *Recuperative* naps, which are usually taken at night or during the early hours as a response to sleep pressures, take place when alertness and performance have already dropped; whilst *prophylactic* (preventative) naps take place before any sleep deficit is accrued. Macchi *et al.,* (2002) have shown the advantages that *prophylactic* napping has for night time truck drivers. A three hour nap in the afternoon, between 2pm and 5pm, alleviated the effects that fatigue has on night shift drivers' alertness and performance. Both subjective and physiological measures of fatigue indicate that fatigue is significantly reduced when preventative napping is implemented. Drivers had faster and more consistent reaction times, reduced crash risk, and higher night time alertness. Due to the vast improvements that such naps had on fatigue related performance up to 14 hours later, they argue that this countermeasure for fatigue is more successful than recuperative napping on the job. Truck drivers also state that getting a good sleep prior to their journey is a good way to manage driving fatigue (Arnold *et al.,* 1997).

So, drivers are able to identify when they are sleepy and they recognise that taking a break to sleep when fatigue sets in is the best way to overcome it. Nevertheless, there is still a tendency to continue to drive. Nordbakke and Sagberg (2007) conducted a survey to determine the reasons why people continue to drive even though they are aware that their performance has deteriorated due to fatigue. Time pressures are the chief reason that drivers are willing to compromise their own safety and the safety of others by continuing their journeys although feeling fatigued. They found that on short-haul operations, or when remaining distances are short, drivers prefer to continue with their journeys to get home from work or to finish their trip at a more reasonable hour. For short-haul operations, the driver is often less able to organise breaks from driving when feeling fatigued since they have several deliveries to make and must keep to a tight schedule (Oran-Gilad and Shinar, 2000). Such findings may have particular relevance to domestic rules and to van drivers.

2.4 Countermeasures

The best countermeasure to fatigue is to stop driving and rest although alternative advice has often advocated other behaviours such as opening the window or turning up the volume on the car radio. Horne and Reyner (1999)

suggest that there is no scientific evidence that these behaviours counter fatigue and at best will only be partially effective for around fifteen minutes. Another common method to fight fatigue is to have a caffeinated drink like coffee.

Horne and Reyner (1996) compared the effectiveness of a fifteen minute nap, with 150 mg of caffeine and a caffeine placebo in a double-blind experiment. Drivers undertook an afternoon drive having been restricted to five hours sleep the previous night. Having a thirty minute break alone (the placebo condition) was found to only be effective on driving performance for fifteen minutes. The fifteen minute nap and the caffeine combined were found to have a beneficial effect on driving performance for the whole of the one hour drive.

In a review of minimal sleep rests to maintain performance, Naitoh (1992) suggests that four minutes is a minimum, while twenty minutes is a maximum. It is even reported that fifteen minute naps taken every six hours during a 35 hour period of no sleep have been shown to be effective in maintaining performance (Naitoh, op.cit.). It cannot be concluded however that this schedule of rest would suffice for a driver.

2.5 Conclusions

Research has demonstrated a link between fatigue and accidents, and these accidents are more serious when they involve larger vehicles (Brown, 1994). Whilst fatigue can affect all drivers, professional drivers and shift-work drivers are most at risk of being involved in an accident (Horne and Reyner, 2001). Research has summarised that there are three important contributing factors that explain how and why sleep related accidents occur: time-on-task, time of day and sleep and rest deprivation.

It is logical that a human's continuous performance on a task will, after a certain time, begin to deteriorate. The time-on-task effect has been extensively studied and while studies have reported driver performance detriment over time, more recent research has suggested that other factors are also important determinants of crash risk. Brown (1994, p310) summarises:

> "Time on task *per se* appears to have a relatively small effect on accident risk when daily work periods are shorter than 11 h, especially when driving is restricted to normal daily work times. However, accident risk may double when duty periods exceed 12 hours."

This is an important consideration in discussion of possible relaxation of relevant restrictions.

Naturalistic research from the USA (FMCSA, 1996; Hanowski et al., 2008) suggests that both time-of-day effects and sleep related effects (e.g. a lack of sleep, or irregular sleep patterns) may be larger contributory factors on sleep related crash risk than time-on-task. One of the most surprising findings from Hanowski et al. was that most critical incidents occurred during the first hour of driving; a finding supported by earlier research (Horne & Reyner, 1995; Summala & Mikkola, 1994). Reasons for this were considered and may involve sleep inertia (impairment of alertness and performance suffered immediately from waking from sleep), road type and traffic density encountered at the start of a journey (i.e. smaller urban roads), and time of day.

The time-of-day effect is influenced by night driving and the body's natural circadian rhythm. It is reported that sleep related accident peaks in the UK, and other countries, are relatively clear suggesting a time of day effect either related to working through the night or from disturbed or deprived sleep patterns (Horne & Reyner, 1995).

Sleep deprivation may be one of the most influential factors on driver crash risk. There is evidence that drivers in sleep related vehicle accidents were sleep deprived from the previous 24 hours (NTSB, 1995). In quantifying what constitutes a dangerous lack of sleep, it has been reported that less than four hours per night severely impairs driving performance (Naitoh, 1992) and less than five hours of sleep per night increases the chance of being involved in a sleep-related crash by five times (Stutts et al., 2003).

In conclusion, research literature suggests that while the number of driving hours is relevant to fatigue, it is not sufficient to consider this as a sole reason for sleep-related accidents. The research literature does not provide a clear picture of the most beneficial regime (pattern and duration) of rest breaks.

Although there is a lack of research to determine the safe number of driving hours in a single day or shift, Hanowski et al. (2008) have reported no greater critical incident risk up to eleven hours; in fact the first hour was the most likely to involve a critical incident. It would appear that time-of-day and sleep deprivation are critical contributors to fatigue and drivers who are sleep deprived and/or driving through at night will be at greater crash risk after fewer hours of driving. Any restrictions on the number of driving hours should look to appreciate these factors.

There is a role for education of employers and employees in the significance of factors that affect fatigue and alertness, their responsibilities, and of potential ways to manage fatigue appropriately.

For the typical well-rested driver, capping duty time to around 11 to 12 hours seems appropriate. The key term here however, is well-rested. If the driver is chronically sleep deprived, or suffering from sleep inertia, or in poor health, or may be eating the wrong foods at the wrong times, fatigue onset and hence the increased risk of an accident can occur almost immediately.

3 Examining the link between driving hours and accidents

This chapter examines the potential of existing research databases to provide new information that sheds light on the specific aspect of driving duration and collision potential. In doing so the aim is to look wider than just HGV drivers, as they are not the only group of professional drivers who contribute to the total of traffic collisions, nor the only group subject to regulation of working practice. The intention is to inform discussion of domestic drivers' hours rules with data that can extend the picture that emerged from the literature review.

However, at the outset it must be recognised that existing datasets have not been created with the primary purpose of addressing the issue of driver hours and accidents. Some provide part of the picture; some have potential for further future tailoring; none provide all the answers of interest at the current time.

Data on Drivers' hours

TRL manage and hold, on behalf of the Department for Transport, a number of accident research databases. These contain unique data on the causes and consequences of road traffic collisions, with each focusing on different aspects and types of accidents.

For drivers who are subject to EU or AETR drivers' hours rules, an approved tachograph should be installed in the vehicle. In addition to recording the drivers' hours, tachographs record the speed of a vehicle throughout its journey. This information provides a useful insight into the driver's journey prior to the accident. Clearly not all the classes of vehicle of interest have such a requirement, and where this is not the case, direct evidence is very limited. For drivers who are not subject to the EU or AETR drivers' hours rules, it is extremely difficult to collate and verify information on their hours spent driving prior to an accident. The information can only be collected by either interviewing the driver or undertaking a detailed forensic investigation of each driver's activities prior to collision, for instance by review of delivery schedules.

The following gives a brief overview of the databases held and interrogated by TRL, which contain different types of information relevant to this study.

3.1 On The Spot Accident Investigation Project (OTS)

The OTS project started in October 2000 and is currently in its third phase (October 2006 to October 2009). The project enables expert investigators to attend the scene of an incident at the same time as the emergency services, with the aim of improving the understanding of the causes and consequences of road traffic accidents. The OTS teams are based at TRL (Transport Research Laboratory) and VSRC (Vehicle Safety Research Centre, Loughborough University). Together they investigate five hundred crashes in-depth, per year. The project has been jointly commissioned by Department for Transport (TTS and RS Divisions) and the Highways Agency. Much of the information necessary to understand complex road safety questions can only be collected at the scene of a road traffic accident, and includes:

- the speed of the vehicles prior to the impact;
- the dynamics of road users during impacts, and
- the effects of new vehicle and highway safety features on the causes and consequences of accidents.

The OTS investigators also interview drivers and witnesses at the scene to establish each road user's behaviour prior to the impact. The information collected at the scene and from additional enquiries is then collated and recorded in a relational database, to enable accident trends to be identified. The accidents are sampled within a defined geographic region to create a representative sample of all injury severity accidents, including damage only.

A link has now been established between the OTS and STATS19 databases. STATS19 reports are completed by the attending police officer at the scene of an accident and detail the vehicles involved, all passengers and other road users, and it also allows a structured format for the recording of causation factors. These factors are identified by the officer based on an initial assessment of the situation, not on a detailed forensic examination of scene evidence. This link enables comparisons to be made between the information recorded by the Police and OTS teams for all injury road traffic accidents.

The majority of the information collected by the project is gathered at the scene and through follow-up postal questionnaires. Information relating to drivers' hours can therefore only be collected from one of three sources: interviews with driver at the scene of the accident, review of a vehicle's tachograph (if fitted) or by the driver returning a questionnaire.

The OTS teams do not have any powers to seize or review tachograph information, so it is not possible for the team to interrogate these devices in every case. Information relating to breaches of drivers permitted hours is typically only available if an attending police or VOSA officer reviews the device and informs the OTS team.

The project has routinely sent questionnaires out to drivers who have been involved in accidents investigated by the teams (drivers involved in fatal or accidents in which someone received life altering injuries are not sent questionnaires for ethical reasons).

Questionnaire items were reviewed related to:

- 'Expected travelling time'; and
- 'Time into journey before crash'.

Unfortunately, analysis of these questions will not confirm if a driver had taken a break during their journey, or if they had been driving prior to the commencement of this journey, and therefore analysis of these questions will not provide useful information regarding specific drivers' hours.

Currently, within the OTS database it is not possible to identify which drivers would be subjected to EU or AETR driving hour rules. Therefore, the following analysis has been restricted to accidents involving Heavy Goods Vehicles only.

The latest release of the database contains information on about 3,725 accidents involving 6,942 vehicles, of which 358 incidents involved at least one HGV.

Although the database does not hold sufficient information to review drivers' hours, the database does contain a summary of each of the investigations conclusions regarding which factors contributed to the cause of the accident. This information is recorded using the 2005 Contributory Factors system.

Using this system it has been possible to identify that fatigue was recorded as a factor in 23 of the 358 accidents, and that this factor was assigned to the HGV driver in 12 of these (only around 3% of the total involving HGV drivers).

3.2 Vehicle and Operator Services Agency (VOSA) Accident Database

At the request of the police, VOSA inspectors undertake detailed examinations of vehicles involved in road traffic accidents, in order to identify if they had a defect at the time of an incident. These inspections are undertaken using standardised collection forms, but it is important to note that not all vehicles involved in accidents are inspected.

The objective of the VOSA Accident Database is to establish if there are patterns of defects to vehicles involved in road traffic accidents and to establish if these defects contribute to the causes and consequences of the accidents.

The database is compiled from the results of structured, in-depth examinations. It also contains information regarding the fitment and condition of safety devices fitted to the vehicle. It contains details of all vehicle types, but is heavily biased towards the heavier, larger types, including Heavy Goods Vehicles (HGVs, with associated trailers), Large Passenger Vehicles (LPVs) and Light Commercial Vehicles (LCVs), although the single largest category by volume is cars. There is also a bias towards fatal accidents.

As part of the examination, VOSA inspectors may choose to examine and record information from the vehicle's tachograph. Currently, the standardised inspection forms only request that the inspectors record "*Time since driver's last break*" and "*Time since driver's last daily rest".*

There are some concerns about the integrity of the data[1] if used for any form of aggregate analysis. The "*time since driver's break"* and "*time since last daily rest"*, are recorded on an optional form. There are 590 records where one or other of the fields has been completed, out of around 12,500 vehicle examination records (many of these vehicles may not have tachographs).

It is not possible to determine why a VOSA inspector may have chosen to complete these fields. For instance, there may be a tendency to complete the fields only when there is a suspicion that the driver was over hours. If this is the case, the sample becomes biased and aggregate analysis of the fields will give a misleading answer.

The primary purpose of the VOSA collection forms is to provide inspectors with a structured mechanism for recording information for use in possible court proceedings. The fact that the data is entered into a database is secondary to their main purpose, and therefore the database is not complete.

[1] For example, there are five drivers who have been recorded as not having a daily rest for 120 hours. The inspector may have meant to record minutes rather than hours, but we have to treat the data as outliers. Hence, in the table we have grouped all such entries as 25+

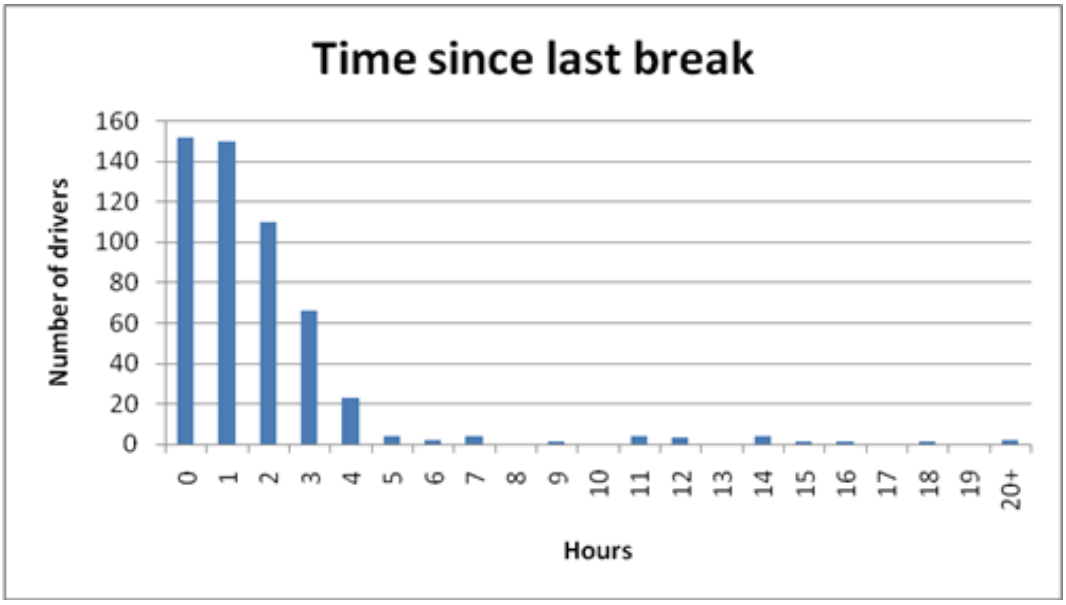

Figure 3 - Time since last break

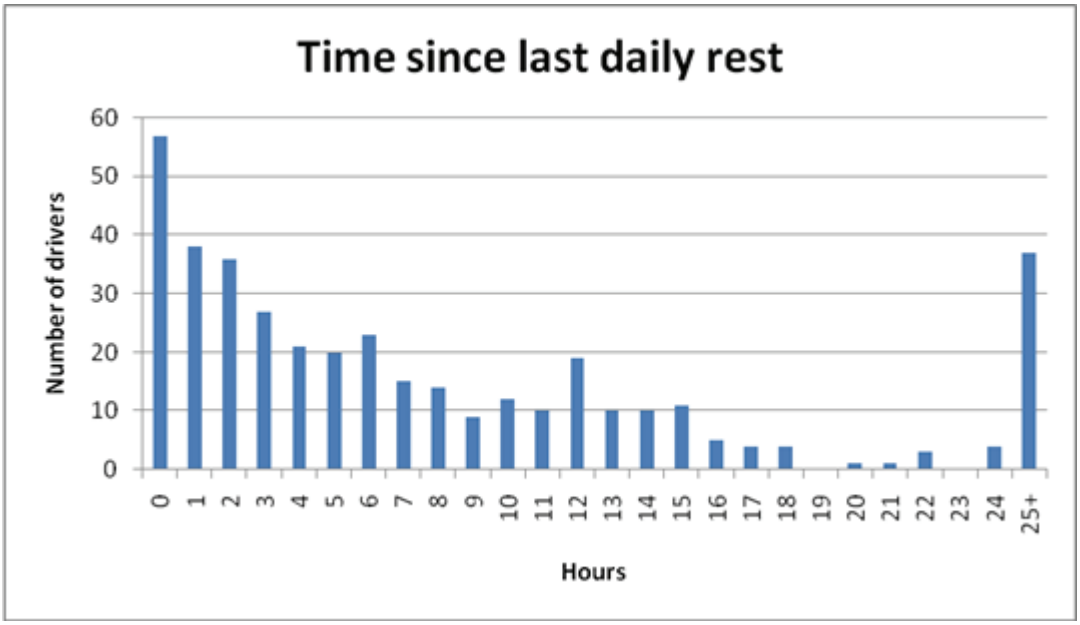

Figure 4 - Time since last daily rest

Of the 590 cases looked at, it can be seen that the distribution is heavily skewed towards the lower end of the scale. From this data alone we cannot say anything directly about fatigue distribution because we do not know if our sample reflects the whole population of drivers, nor has any measure of fatigue been taken. However, it is interesting to note that the majority of collisions happened within two hours of the drivers' last break.

As already noted, it is likely that inspectors completed the optional additional records based on tachograph evidence because they may have suspected a fatigue problem. As such, the data suggests a disconnect between time on task (i.e. time since last break) and the likelihood of involvement in a collision. The

VOSA database has not been able to provide any answers, or any great insight to the relationship between fatigue and working hours, but has raised issues for further consideration. This supports findings in chapter 2 that suggested (e.g. Hanowski et al) the early hours of a driving shift being the most associated with accident risk.

In future to review the relationship between the information recorded about drivers' hours in the VOSA database and an assessment of drivers' fatigue (as assessed by the attending police officer), it will be necessary to establish a link with STATS19 records. This would provide further clarity about the strength of any relationship between the fatigue state of the driver and hours of continuous driving. In addition, in future it may also be possible to enhance the VOSA collection forms to request examiners to record more information regarding the drivers' hours, if this is available from examination of the vehicles tachograph, for all vehicles when fitted. For example by establishing whether the assessed vehicle had a tachograph (with details) and consequently, whether the driver was operating within relevant rules.

Currently the only way that a link between the VOSA Database and STATS19 records can be achieved is through comparing appropriate fields in the two data sets, for example, date and time, (and from September 08) road class and road number. These variables however are not unique identifiers, and linking the two databases in such a way would be less than perfect. Processing procedures of STATS19 records mean that it is very unlikely that a VOSA inspector or the Police will know an accident's STATS19 reference number at the time of an inspection. The field is only included in the database, and on the forms, if a link is established at a later date.

A possible alternative would be to use the Vehicle Registration Number (VRN), but this is only recorded against the STATS19 number whilst that STATS19 data is being processed. DfT uses the VRN to link the vehicle to the DVLA database to retrieve make and model data. Once that data has been extracted, and placed with the STATS19 record, the VRN is deleted (due to data protection). Therefore, currently there is the potential to link VOSA inspection for accidents that occurred in 2008 with 2008 STATS19 records, but such a link could not be made for older records for retrospective analysis, as the VRN will have been deleted.

In summary, the VOSA database is a key asset in the investigation of the contribution of vehicle defects to collisions, but as a stand-alone source, it cannot give direct evidence of the relationship between fatigue and driver hours. The limited picture that we are able to derive is in line with other findings that collisions for commercial drivers tend to occur within the first two hours after a break, but this in itself does not tell us about the presence or otherwise of fatigue.

3.3 Analysis of STATS19 data

The STATS19 system is the national system used in Great Britain by the police to record details of road accidents that involve personal injury. The database is maintained by the Department for Transport, and an annual report presents analyses of the data as well as details of the system (see e.g. Department for Transport, 2008). The Transport Research Laboratory maintains a copy of the STATS19 database for research purposes and the results presented below have been prepared using this asset.

In 2005, the STATS19 system was extended to include coding of suspected *contributory factors*. These being the key actions and failures that led directly to the actual impact. They show why the accident occurred and give clues about how it may have been prevented. The system includes 77 factors, with factor 503

being "Fatigue". Some factors are in effect duplicates, e.g. 501 is entered if a driver or rider is impaired by alcohol, while 806 is entered if a pedestrian is impaired by alcohol. The STATS20 manual (Department for Transport, 2004) includes a series of explanatory notes which provide guidance to police officers about the use of these codes. The guidance for the fatigue factor is "Driver/rider was so tired that they could not drive effectively or were unable to perceive hazards."

The contributory factors are largely subjective and depend on the skill and experience of the investigating officer to reconstruct the events which led directly to the accident. Identifying whether driver fatigue may have contributed to an accident can be difficult, but the data collected by the police are an important resource. Some STATS19 reports are compiled from information supplied by the public. In order to achieve the greatest reliability, however, the analysis will be restricted to those accidents where a police officer attended the scene and obtained the details that were used to compile the STATS19 report.

The STATS19 system uses 5 vehicle types that are relevant to this study:

- Minibus (8-16 passenger seats);
- Bus or coach (17 or more passenger seats);
- Goods vehicles not exceeding 3.5 tonnes mgw;
- Goods vehicles over 3.5 and under 7.5 tonnes mgw;
- Goods vehicles 7.5 tonnes mgw and over.

Table 2 shows the number of drivers recorded in the STATS19 database to whom contributory factors had been attributed ("Drivers with contributory factors"), that is, the number of drivers that the police thought had been wholly or partly responsible for the accidents in which they had been involved. It also shows the proportion of these drivers whose fatigue was judged to have contributed to the accidents ("% with fatigue"). The third item is the rank of fatigue in the list of factors reported for these drivers. The rank shows the relative importance of this factor: a rank of 1 for a group of drivers would mean that fatigue was the most frequently reported factor, while a rank of 77 would mean that it was the least frequently reported.

Table 2 – Incidence of the contributory factor "fatigue", 2005-2007

Accident severity		Minibus	Bus or coach	Goods< 3.5t mgw	Goods 3.5-7.5t mgw	Goods >7.5t mgw
Fatal	Drivers with contributory factors	22	80	327	86	392
	% with fatigue	4.5%	2.5%	5.5%	7.0%	11.2%
	Rank of fatigue	8	23	11	6	4
Serious	Drivers with contributory factors	167	843	2535	465	1567
	% with fatigue	4.2%	0.8%	3.4%	4.3%	5.4%
	Rank of fatigue	15	30	14	12	10
Slight	Drivers with contributory factors	1198	6881	18406	3515	10862
	% with fatigue	1.5%	0.3%	1.5%	1.4%	2.4%
	Rank of fatigue	27	42	29	27	16

Table 2 shows that fatigue is a relatively common contributory factor among drivers of lorries (goods vehicles of at least 3.5t mgw) involved in fatal accidents, but somewhat less common among the other three groups of drivers. The incidence of fatigue is lower in serious accidents, and lower still in slight accidents. Differences between the groups of drivers are greater in fatal accidents than in non-fatal accidents. This shows that the consequences of fatigue generated accidents are more severe than the general population of accidents.

The three contributory factors that rank above fatigue among lorry drivers involved in fatal accidents are "Failed to look properly", "Loss of control" and "Careless, reckless or in a hurry".

The analysis of Table 2 can be developed with respect to any of the STATS19 variables, and the most obvious is time of day. Table 3 divides the day into four periods, and presents the proportion of drivers with contributory factors who were reported to be fatigued in each period. In order to maintain suitable numbers of drivers in each cell of the table, minibus drivers have been combined with drivers of buses and coaches, also fatal and serious accidents have been combined. Predictably, the proportion of drivers whose fatigue contributed to accidents was much higher at night than during the day.

Table 3 - Incidence of the contributory factor "fatigue" by time of day, 2005-2007

Accident severity		02:00 - 07:59	08:00 - 13:59	14:00 - 19:59	20:00 - 01:59	All day
Fatal and Serious	Minibus, bus or coach	7.5%	1.4%	0.7%	0.8%	1.5%
	Goods<3.5t mgw	9.4%	1.6%	2.7%	5.0%	3.6%
	Goods 3.5-7.5t mgw	14.3%	3.6%	1.1%	9.8%	4.7%
	Goods >7.5t mgw	15.3%	3.3%	2.9%	12.6%	6.5%
Slight	Minibus, bus or coach	2.5%	0.4%	0.2%	0.9%	0.5%
	Goods<3.5t mgw	5.1%	0.7%	1.1%	2.5%	1.5%
	Goods 3.5-7.5t mgw	5.5%	0.5%	0.9%	5.1%	1.4%
	Goods >7.5t mgw	8.5%	0.9%	1.3%	7.0%	2.4%

It should be noted that these figures show where fatigue is seen as a contributory factor, but not necessarily the most important one.

3.4 HVCIS Fatal Accident Database

The HVCIS Fatal Accident Database is managed and populated by TRL on behalf of the Transport Technology and Standards (TTS) division of DfT. The principal aim of the project is to provide information on the causes and consequences of accidents involving commercial vehicles. The main emphasis is on information relevant to assessing the performance of current and potential future vehicle designs and safety features but other information is also collected and used to identify issues in the wider safety field. The vehicles considered to be within scope are:

- Heavy Goods Vehicles (HGVs) – goods vehicles with a gross weight in excess of 3.5 tonnes;
- Buses, coaches and minibuses (generically referred to as PSVs) – passenger vehicles with more than 8 seats;
- Light Commercial Vehicles (LCVs) – goods vehicles with a gross weight not exceeding 3.5 tonnes but excluding car-derived vans;

- Agricultural Vehicles; and
- Other Motor Vehicles (OMVs) – A STATS19 category to cover all other powered vehicles not included in separate categories of their own. Typical examples include:
    - Refuse collectors;
    - Recovery vehicles;
    - Emergency Vehicles (fire/ambulance);
    - Military vehicles;
    - Plant (e.g. diggers, dump trucks etc);
    - Horseboxes.

Vehicles such as passenger cars, motorcycles and pedal cycles are only included when involved in collision with at least one of the "case" vehicles described above.

The sources of the data recorded on the HVCIS Fatal Accident Database are the comprehensive police reports produced as part of a fatal accident investigation. These reports can include police reconstructions, scale plans of the scene, accident investigators and expert witness reports, eye witness statements, post mortem reports and photographs. Although the quality of information varies from case to case these reports typically provide considerable detailed information and insight for each accident which is relevant to both accident avoidance and injury severity reduction measures. Typically TRL will receive from police forces the reports relating to between around 30% and 60% of all relevant GB accidents recorded on STATS19, thus representing a large sample size.

The information contained in the police file is coded by TRL analysts onto a standard category based form and entered into a Microsoft Access database for future analysis.

3.4.1 The data sample

The HVCIS database is continuously populated throughout the duration of the project (typically 3 years), with each project constituting a phase of the database. The database is compiled and "released" every quarter. The following analysis has been based on the latest release 2i of the HVCIS database. It contains data on a total of 2,947 fatal accidents, involving 5,355 vehicles (including non-case vehicles such as cars) and resulting in 3,252 fatalities. Overall, the high proportion of cases included in HVCIS relative to the GB total means that the sample is broadly representative of the GB situation. However, this is influenced by sample size. For example, HGV accidents are much more numerous nationally than accidents involving the other types of vehicle and the sample is very closely representative for this type. It becomes less representative for less numerous accident types such as agricultural vehicles, where low numbers can mean quite large proportional variations. Conclusions from analyses of accidents involving HGVs can therefore be scaled to the national data with confidence whereas for agricultural vehicles caution is required. Other accident types lie between these extremes.

The accidents all occurred between 1995 and 2007, inclusive, distributed as shown in Table 4[2], below.

[2] Many police forces will only release the reports to TRL three to six years after the date of the accident when any legal obligations have expired, therefore there are a smaller number of files available for the most recent years. HVCIS phase 1

Table 4 - Total number of HVCIS accidents per year

Year	Number of accidents
1995	126
1996	115
1997	213
1998	324
1999	368
2000	244
2001	260
2002	355
2003	343
2004	269
2005	180
2006	134
2007	16
Total	2947

The distribution of accidents involving different types of case vehicle is shown in Table 5, below.

Table 5 - Number of accidents divided by type of case vehicle involved

Case vehicle type	Number of accidents involved in
HGV	1,691
LCV	731
PSV	469
Agricultural/OMV	282

Note that the sum of accidents in Table 5 exceeds the total number of accidents on the database because some accidents involve more than one type of case vehicle (e.g. HGV collides with PSV) and are, thus counted in both categories.

only coded Light Commercial Vehicle (LCV) accidents as a pilot study (unless they were involved in accidents with other case vehicles) for accidents between 1995 and 1998, which explains the lower number of accidents for the earlier years. HGV accidents were coded from 1997 onwards with PSVs and OMV (including agricultural vehicle) from 1999.

3.4.2 Driver behaviour factors

For each driver in the accident (including the non-case vehicles such as cars and motorcycles), behavioural factors that could have been contributory to the cause of the accident are coded. This assessment is based upon the information that is available in the police report including witness statements and police accident investigation reports. Driver behaviour factors may be recorded even if there is no prosecution of the driver. The two driver behaviour factors of interest in this study are fatigue and excess hours. Table 6 shows the number and proportion of drivers and how their behaviour contributed to the accidents.

Table 6 - Driver behaviour factors

	Vehicle Type			
Drivers	**HGV**	**LCV**	**PSV**	**All**
All	1851 (100%)	745 (100%)	473 (100%)	5355 (100%)
Without behavioural factors	1160 (62.7%)	360 (48.3%)	332 (70.2%)	2603 (48.6%)
With behavioural factors	691 (37.3%)	385 (51.7%)	141 (29.8%)	2752 (51.4%)
Fatigue	*76 (4.1%)*	*41 (5.5%)*	*5 (1.1%)*	*213 (4.0%)*
Excess hours	*36 (1.9%)*	*3 (0.4%)*	*0 (0.0%)*	*43 (1.6%)*
Fatigue & Excess hours	*18 (1.0%)*	*1 (0.1%)*	*0 (0.0%)*	*21 (0.4%)*

Table 6 shows that the proportion of HGV and PSV drivers that had behaviour that was considered contributory to the accident was lower than those where it was not. However for LCV drivers, the proportion of drivers recorded with behavioural factors was slightly higher than those without and was a similar level to all the drivers included in the database.

PSVs had the lowest proportion of drivers that were recorded as suffering from fatigue when compared to the HGV and LCV drivers (and all drivers in the database). A higher proportion of LCV drivers were recorded as suffering fatigue when compared to HGV drivers.

A lower proportion of HGV drivers were recorded as having worked excess hours compared to those recorded as being fatigued, approximately half. There were no cases where PSV drivers were recorded as having worked excess hours and also the proportion of LCV drivers recorded with excess hours was low. Identification of hours infringements is not necessarily as clear for PSV and LCV drivers because a lower proportion of vehicles in these categories are required to fit tachographs, and the examination of drivers' hours logs for these vehicles are not as frequently reviewed as tachograph charts.

When considering only those drivers considered to be at least partly at fault for the cause of the accident in which they were involved then the fatigued drivers represent 11% of HGV and LCV drivers and 4% of PSV drivers.

For just 31 of the fatigued HGV drivers there were no other contributory factors recorded. An additional 31 were coded as a combination of fatigue and lack of attention. In these cases it is quite likely that the lack of attention could have

been caused by the fatigue, although other sources of distraction (e.g. using phone, reading directions) could have been a factor. This suggests that on the occasions that fatigue is a contributory factor for HGV drivers it could be the primary or even sole cause of the accident. Similar patterns are seen for LCV drivers and PSV drivers.

The severity of an accident is judged by the number of fatalities that occur in each accident. Table 7 compares the number of fatalities per accident for all accidents involving the vehicle of interest (HGV, LCV or PSV) with those where the driver of the vehicle of interest (VOI) was fatigued.

Table 7 - Fatality rate per accident, comparison of all accidents with fatigue related accidents

	HGV	LCV	PSV
A) All accidents involving vehicle of interest	1691	731	469
B) All fatalities involving vehicle of interest	1875	819	522
Fatalities per accident (A/B)	1.11	1.10	1.11
C) Accidents involving fatigued driver of vehicle of interest	76	41	5
D) Fatalities involving fatigued driver of vehicle of interest	96	45	10
Fatalities per accident involving fatigued driver of vehicle of interest (C/D)	1.26	1.10	2.00

For HGV accidents, the data suggests that the severity of the accidents is greater when the driver of the HGV is fatigued, with 1.26 fatalities per accident compared to 1.11 fatalities per accident for all accidents involving HGVs. For LCVs, there appears to be no difference in severity. The greatest difference in severity is for PSVs, however the sample of fatigue related accidents/fatalities is small and therefore sensitive to a small variation in the number of fatalities or accidents, for example the addition of one accident with four fatalities would increase the fatality rate to 2.3.

3.4.3 Tachograph use and analysis

The HVCIS data records whether a tachograph is required, fitted, used and analysed after the accident. Table 8 summarises the use of tachographs for HGVs, LCVs and PSVs.

Table 8 - Tachograph use in HGV accidents

Tachograph status	Number of vehicles (Proportion of all vehicles with known status)		
	HGV	LCV	PSV
Not required	23 (1.4%)	410 (94.7%)	199 (55.6%)
Not fitted	65 (3.9%)	12 (2.8%)	96 (26.8%)
Used but not analysed after the accident	213 (12.9%)	1 (0.2%)	13 (3.6%)
Used and analysed after the accident	1,346 (81.8%)	10 (2.3%)	50 (14.0%)
Total	1,647 (100%)	433 (100%)	358 (100%)
Status Unknown	204 (N/A)	312 (N/A)	115 (N/A)

It can be seen that the vast majority of HGV drivers did use a tachograph and that in most cases this was analysed as part of the investigation. The proportion of LCVs that were fitted with tachographs was lower than for both the HGVs and the PSVs, but this is to be expected because they are less likely to be required to use a tachograph. The proportion of PSVs using tachographs is higher than for LCVs but lower than for HGVs, but again, this is to be expected based on legal requirements to use tachographs in these vehicles.

3.4.4 Prosecutions

Another source of information relating to drivers hours and tachographs is the data recorded on prosecutions. The main categories for prosecutions relate to careless driving (driving without due care or attention), dangerous driving (death by dangerous driving) or manslaughter. Drivers' hours or tachograph offences could be included in these categories, or could also be classified as "other" offences. It is only possible to identify drivers who were prosecuted for drivers' hours or tachograph infringements by reviewing the comments made on the database.

Table 9 summarises the frequency of prosecutions for the three vehicle types, identifying those where the prosecution included tachograph or drivers hours infringements.

Table 9 - Prosecutions by vehicle type

Prosecutions	Number of vehicles (Proportion of all vehicles with known status)		
	HGV	LCV	PSV
Not prosecuted	1,336 (80.1%)	520 (78.0%)	365 (82.4%)
Prosecuted	331 (19.9%)	147 (22.0%)	78 (17.6%)
Offence included tachograph/drivers hours infringements	*34 (2.0%)*	*0 (0.0%)*	*0 (0.0%)*
Total	1,667 (100%)	667 (100%)	443 (100%)
Prosecution unknown	184 (N/A)	78 (N/A)	30 (N/A)

Prosecutions relating to tachograph or drivers hours offences were only identified for HGV drivers. Almost 20% of HGV drivers were prosecuted over the period 1995-2007, with one in ten of the prosecutions including drivers' hours or tachograph offences. It should be noted that the prosecutions for drivers' hours or tachograph offences could relate to offences committed prior to the day of the accident; thus a very small number of drivers are prosecuted for tachograph violations.

3.4.5 In-depth study of tachograph offences

In addition to the data described above that is recorded on the HVCIS database, most of the original police reports used to generate that data remain available for a more detailed analysis. This process was restricted to an analysis of accidents where tachograph offences were recorded for HGV drivers. The aim was to gain greater understanding of the infringements and the length of time that had been driven prior to the accident. The detailed police reports were available for 25 out of the relevant 34 HGV accidents.

In the 25 accidents during the 12-year period of analysis, there were a total of 29 fatalities. Eleven of the fatalities (40%) were drivers of the HGVs.

The offences committed were numerous and covered all aspects of the regulations. Many of the drivers committed more than one offence (25 cases revealed 44 separate offences) on the day of their incident and most had a history of driving hours and tachograph offences. The number of times each offence was committed are shown in Figure 5 and Figure 6. For the purpose of this analysis offences such as falsifying a tachograph chart, failure to complete the centre field of the chart and removal of the chart when moving are all counted as tachograph inaccuracies rather than individual offences.

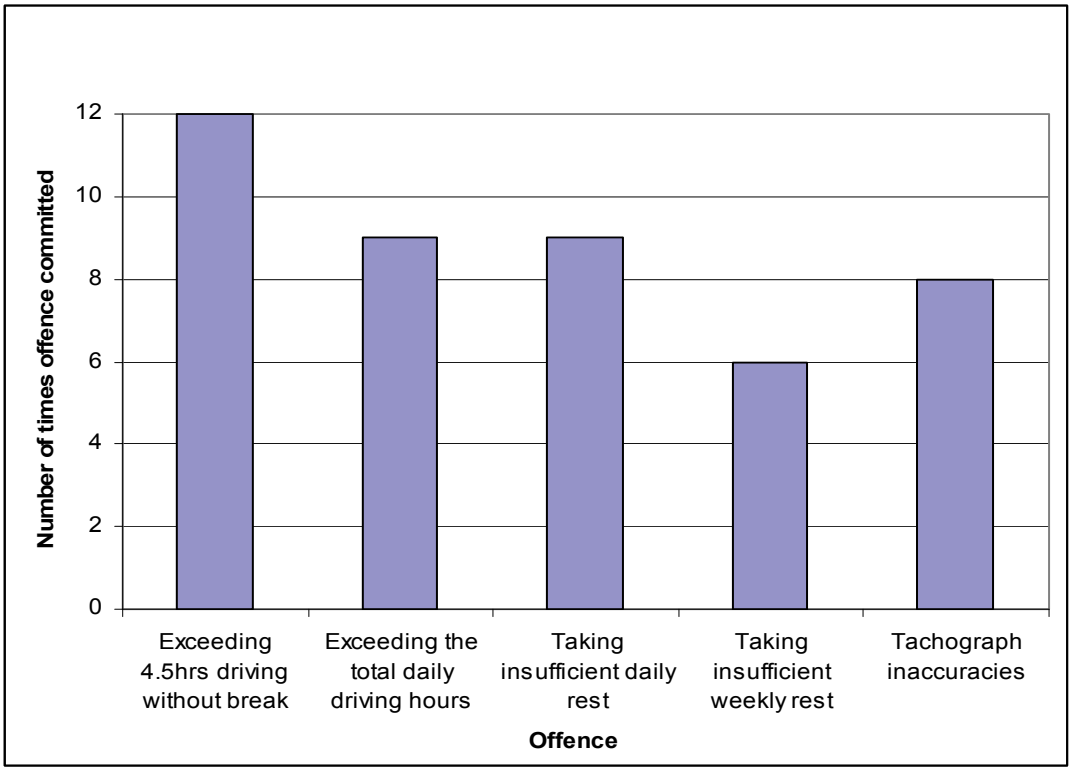

Figure 5 - Offences committed on the day of incident

Figure 5 shows that the most common offence on the day of the incident was exceeding the 4.5 hours driving limit without taking a break. Nearly half of the drivers had committed this offence. There were nine occurrences each for exceeding the total daily driving hours and taking insufficient daily rest. There were less incidences of taking insufficient weekly rest, though it wasn't always possible to verify if sufficient weekly rest had been taken because the tachograph records or the examination of tachograph were not always available in the police file. The tachograph inaccuracies were mainly the driver not filling in the centre field of the chart correctly, if at all.

On the day of their incidents, the 25 drivers committed 44 offences. Only six of the drivers committed one offence meaning the remaining 19 drivers committed 38 offences (an average of 2 per driver). This accumulation of drivers' hours offences could lead to higher levels of fatigue.

Where it was possible to examine previous tachographs and log books, a history of drivers' hours offences became apparent. A total of 84 offences were recorded, though it must be noted that in several cases the exact number of offences was not recorded, it was only noted in the files that there was a history of offences committed, so the exact number is most likely much higher. The time period covered by the police investigations varied from only a few days to several months, therefore it is not possible to make direct comparisons between drivers. If all of the drivers had been required to submit several months of tachograph charts, it is likely that the number of offences would have been much higher. Figure 6 summarises the offences committed prior to the day of the incident.

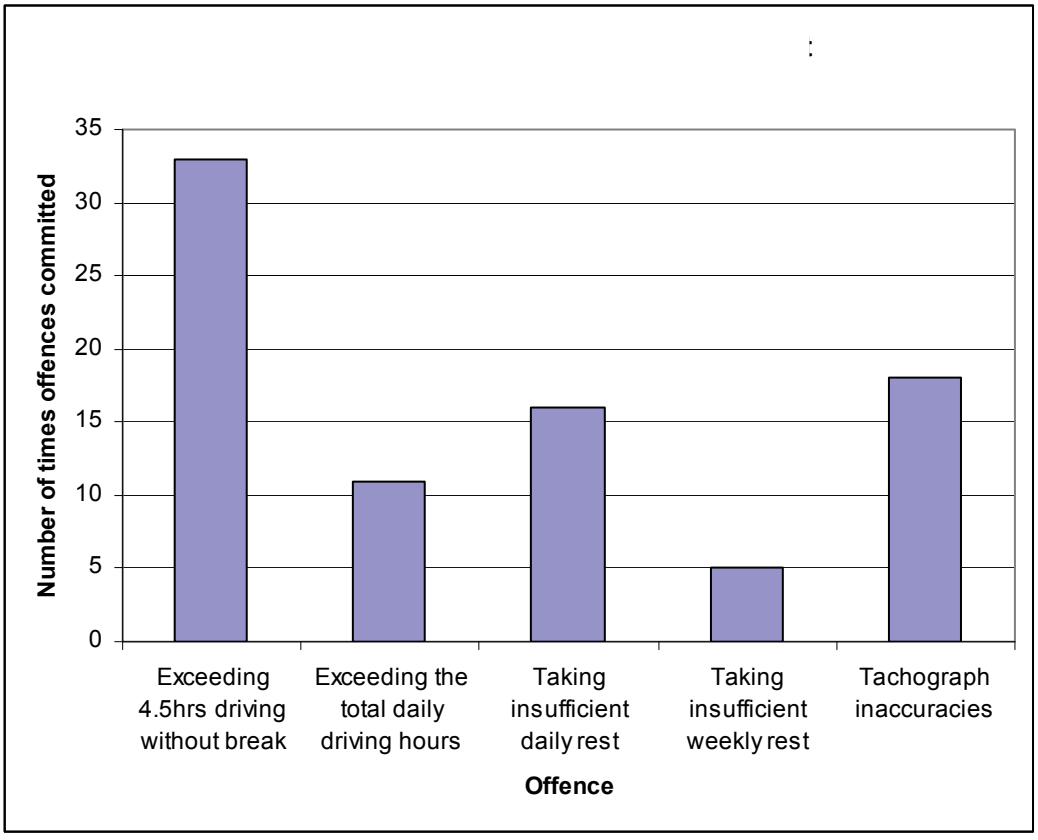

Figure 6 - Offences committed prior to the day of an incident

Figure 6 shows that exceeding 4.5 hours of driving time without a break was the most frequent offence prior to the day of the incident, with almost twice as many incidents as any other offence.

Of the fourteen drivers that survived their incidents, twelve were charged with a criminal offence. For some this was the driving hour regulations or tachograph offences, for others it was Death by Dangerous Driving or Driving Without Due Care and Attention.

The total number of hours worked on the day of the incident was known for 22 drivers. Figure 7 shows the cumulative distribution of the hours worked by each driver.

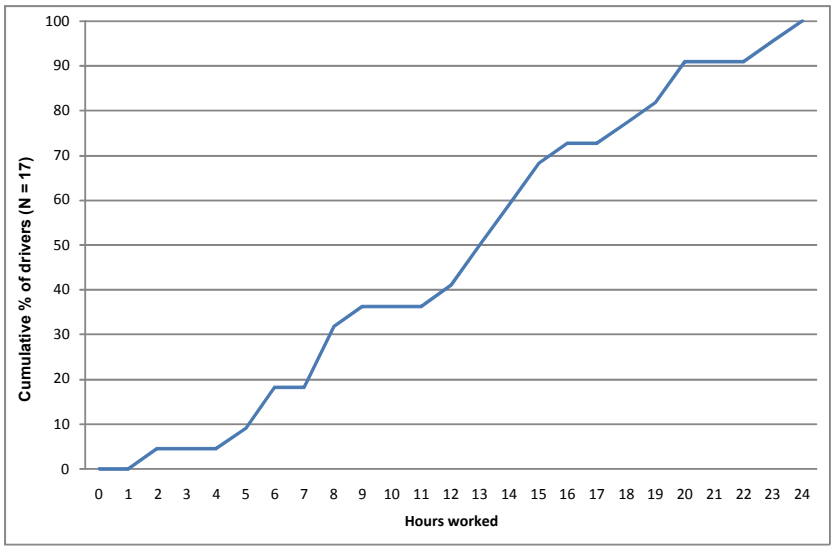

Figure 7 - Total number of hours worked on the day of the incident (fatal accident analysis)

As would be expected in an analysis of drivers hours offences, most drivers (approximately 65%) had been working (i.e. total duty time, rather than purely driving time) for more than 9 hours at the time of the accident. However, the median number of hours worked was 13 hours (i.e. half the drivers had worked less than 13 hours and half had worked more than 13 hours). The data shows that one driver had been working for 24 hours at the time of the incident.

The time for which the drivers had actually driven prior to the incidents was known in 17 cases. Figure 8 shows the cumulative distribution of hours driven for the 17 drivers.

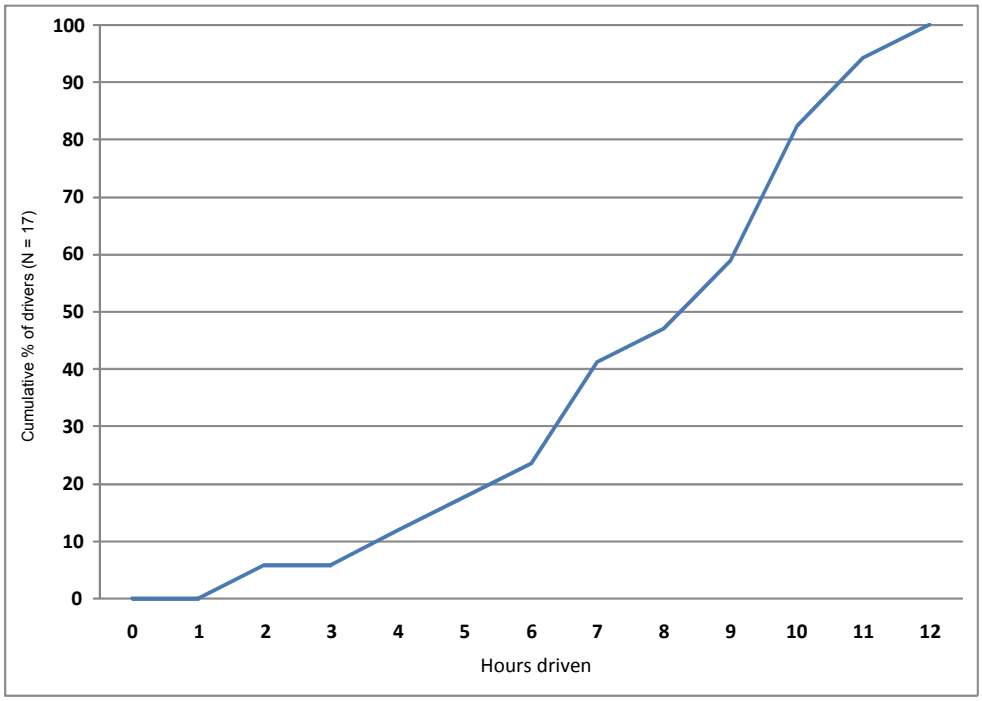

Figure 8 - Cumulative hours driven at the time of collision (fatal accident analysis)

Over half of the drivers that had committed a tachograph offense had actually been driving for a cumulative time of more than seven hours on the day of the incident. The legal limit for total driving time in any 24 hour period is nine hours, which can be extended to ten hours twice a week. Nine of the drivers are known to have been driving for more than nine hours at the time of their incident; seven had been driving for more than ten hours. Only eight of the drivers were known not to have broken the total daily driving limit.

3.5 Conclusion

None of the data sets are able to provide an unequivocal picture of any link between driving time and accident rate. The potential depth of analysis is hampered by the fact that none of these datasets were created with the expressed intention of identifying any such relationship. We have relatively small numbers of cases for analysis, especially in those sectors where UK domestic rules apply. The only reliable data on driving hours being extracted from vehicles fitted with tachographs.

Of greatest interest to this review has been the analysis of VOSA data where 590 relevant cases were identified and a trend (Figure 3) established for the numbers of accidents as a function of time since last break. The importance of the trend is that it shows the majority of accidents occurring within two hours of the last break and is consistent with other large scale studies reported in chapter 2. Such data must be treated with caution however, as it tells us nothing about fatigue itself, nor about any build up of fatigue over time through any particular schedule.

In future to better establish the relationship between the information recorded about drivers' hours in the VOSA database and an assessment of drivers' fatigue, it will be beneficial to establish a link with STATS19 records. In addition, in future it may also be possible to enhance the VOSA collection forms to request examiners to record more information regarding the drivers' hours, if this is

available from examination of the vehicles tachograph, for all vehicles when fitted.

4 Review of Domestic EU legislation for goods and passenger carrying vehicles

4.1 Background

4.1.1 Regulation (EC) No. 561/2006

Most drivers of large commercial vehicles and passenger vehicles are subject to the EU drivers' hours rules defined in Regulation (EC) No. 561/2006. These rules limit driving time and require drivers to take minimum breaks and rest periods. Regulation (EC) No. 561/2006 is aimed at maintaining road safety, improving working conditions for vehicle crew and ensuring that transport operations are working to the same rules throughout the road transport sector in Europe.

The key requirements of Regulation (EC) No. 561/2006 are:

- The daily driving time should not exceed 9 hours per day, but may be extended to 10 hours per day up to twice a week;
- *Driving* time in any week should not exceed 56 hours;
- Driving time over 2 consecutive weeks must not total more than 90 hours;
- No employee shall drive for more than 4.5 hours without a break. After 4.5 hours of driving time, an employee shall take a break of 45 minutes. The break may be divided into a 15 minute break and a 30 minute break in which case one of them must be taken during the 4.5 hour period;
- In every 24 hour period, an employee must take 11 hours of rest (which may be reduced to 9 hours no more than three times a week). If an employee wishes to take the daily rest over 2 periods, one break must last for at least 3 hours with the duration of the second break lasting for at least 9 hours;
- In every 7-day period, an employee is required to have 45 hours of continuous rest. A weekly rest must be taken no later than at the end of six 24-hour periods from the end of the previous weekly rest period.

In the case of goods vehicles Regulation (EC) No. 561/2006 applies for drivers of most vehicles used for the carriage of goods on public roads (including dual purpose vehicles) where the maximum permissible mass of the vehicle, including any trailer or semi-trailer, exceeds 3.5 tonnes and where the vehicle is used within the UK or between the UK and other EU countries, those in the European Economic Area (EEA) countries and Switzerland.

Vehicles with a maximum permissible mass not exceeding 3.5 tonnes are specifically excluded within Regulation (EC) No. 561/2006 (Article 2b). Similarly Regulation (EC) No. 561/2006 does not apply to passenger carrying vehicles on regular services with a route length of 50km or less (Article 3a).

There are numerous other exceptions to the rules set out within Regulation (EC) No. 561/2006. These cover a range of vehicles such as those with a maximum speed of 40 km per hour, vehicles used for certain public service purposes, maintenance and recovery vehicles and historic vehicles.

4.1.2 Directive 2002/15/EC

The key requirements of Directive 2002/15/EC are:

- The average working week should not exceed 48 hours over a 4 month period with an absolute maximum working time in any week of 60 hours;

- No employee shall work more than 6 consecutive hours without a break. Working time shall be interrupted by a break of at least 30 minutes, if working between six and nine hours and of at least 45 minutes for working hours totalling more than 9 hours;
- Breaks may be subdivided into periods of at least 15 minutes each;
- If the work period includes night work, the work period should not exceed 10 hours in any 24 hour period. Drivers of vehicles which are excluded from Regulation (EC) No. 561/2006 are also excluded from Directive 2002/15/EC.

4.1.3 Directive 2003/88/EC

In the case of both Regulation (EC) No. 561/2006 and Directive 2002/15/EC, there are a number of excluded vehicles. Drivers of those vehicles would be covered by the general Working Time Directive (2003/88/EC).

The key requirement of Directive 2003/88/EC is:

- The average weekly working time over a specified reference period shall not exceed 48 hours.

Although Directive 2003/88/EC contains other work time and rest time rules in Articles 3, 4, 5 and 8, Article 20 states that "Articles 3, 4, 5 and 8 do not apply to mobile workers". However Directive 2003/88/EC does state that "Member States shall, however, take the necessary measures to ensure that such mobile workers are entitled to adequate rest.

Although mobile workers are excluded from the specific provisions in Articles 3, 4, 5 and 8 of Directive 2003/88/EC, several countries indicated that they use certain provisions as a template for the national measures which cover mobile workers who are excluded from Regulation (EC) No. 561/2006 and Directive 2002/15/EC. The requirements in these Articles are:

- Daily rest - a minimum of 11 consecutive hours per 24 hour period;
- Breaks - every worker is entitled to a break after working 6 hours;
- Weekly rest periods - a minimum 24 hour break each week.

Article 26 of Directive 2003/88/EC also lays down that "*not later than 1 August 2005 the Commission shall, after consulting Member States and management and labour at European level, review the operation of the provisions with regard to workers on regular urban transport services…".* That review, conducted by a questionnaire to the Member States, led to a Commission report (COM (2006) 371) on the operation of the provisions of Directive 2003/88/EC for workers employed with the carriage of passengers on regular urban transport services.

That report is available at:

http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0371en01.pdf.

Some key conclusions are:

"In general the level of protection granted to urban transport workers is higher than the minimum requirements under the Directive.

In most of the Member States regular urban transport workers are covered by collective agreements, whose scope differs from country to country. These agreements generally cover all aspects of worker-employer relations. Collective agreements apply at national, regional and/or company level, depending on the Member State.

Trade unions underline difficulties in enforcing the provisions, because they consider the applicable sanctions to be ineffective"

The overall conclusion from the Commission is:

"The Commission does not consider that any change is needed to the rules regarding organisation of working time for workers concerned with the carriage of passengers on regular urban transport services". However it does indicate that it will investigate situations where there are indications of difficulty in complying with community law.

Hence the working time and rest periods of mobile workers when driving vehicles not fully specified in Regulation (EC) No. 561/2006 and Directive 2002/15/EC should be covered by national legislation and collective agreements. The purpose of this component of the study is to determine these, as far as possible.

4.2 Data Sources

It was initially expected that that the national member Bodies for Intracommunity Liaison would provide the information required for this study. These national bodies are represented on an EU Committee established under Article 7(1) of Directive 2006/22/EC, which concerns social legislation relevant to road transport activities and deals, amongst other matters, with the arrangements for inspecting vehicles and drivers to ensure compliance with working hour regulations.

The members of the committee were contacted with a request to identify the national driving time and rest regulations for the drivers of vehicles with no specific provision in the Directives. Follow up contacts were made to a broad range of individuals in the various countries.

It proved difficult to build a comprehensive picture of the national rules and legislation governing driving. One difficulty in the contacts was that the legislation which is formulated on the basis of the Directives and Regulations, and responsibility for national legislation, often falls within different Ministries within the countries under investigation. For example responsibility for the driver hours regulations that flow from Regulation (EC) No. 561/2006 usually falls within the remit of the transport ministry whereas other working time regulations often fall within the remit of labour or social affairs ministries. Officials often had little awareness of legislation from other Departments. Also the rules were often in the form of collective agreements, and were not necessarily known to central government. There are also many exceptions, for different categories of vehicle. These issues indicated that it would be difficult to identify the full regulations governing driving hours and rest periods in many countries. In consequence it was decided that it would be best to simplify the search and focus on the driver rules for two major categories of vehicle which do not fall within the scope of Regulation (EC) No. 561/2006. The specific questions posed were:

- What are the national driver hour rules which apply for employee drivers of goods vehicles with a mass not exceeding 3.5 tonnes?
- What are the national driver hour rules for a bus driver on a regular route not exceeding 50km in length?
- Are there leaflets, posters or similar information aimed at informing the operators of these goods vehicles or buses of the driving rules? If so, can we have a copy?

The last question was included partly as a way of gaining information in a readily accessible form. The legislation in many countries is complex. By definition a leaflet or poster should present the information in a form which could be understood readily by drivers and employers.

A total of over 100 contacts were made with countries on the following list to identify the answers to those questions.

- Austria
- Belgium
- Bulgaria
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Luxembourg
- Netherlands
- Norway
- Poland
- Slovak Republic
- Slovenia
- Portugal
- Spain
- Sweden

4.3 Austria

4.3.1 Overview

Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes and drivers of buses on a regular route not exceeding 50km in length are subject to rules in the Working Time Act (AZG) and the Rest Periods Act (ARG). The provisions of these Acts apply to employed drivers. Ensuring that drivers keep to the rules is the responsibility of the employer and fines are applied if a worker is found to have broken the rules.

4.3.2 Bus drivers servicing regular routes not exceeding 50km in length

4.3.2.1 Working time/Driving Time

According to the AZG, the total daily driving time is limited to eight hours. With collective agreements or plant-level agreements, driving time may be extended to the parameters of Regulation (EC) No. 561/2006.

The total driving time for bus drivers on a regular route not exceeding 50km in length is 48 hours per week. Weekly working time may be extended to 56 hours per week with a collective agreement or plant-level agreement but accumulated driving time over any two week period must not exceed the provisions made in Regulation (EC) No. 561/2006.

4.3.2.2 Breaks and rest periods

Rules within the AZG state that for bus drivers servicing regular routes that do not exceed 50km in length, at least a 45 minute break must be taken after no more than 4.5 hours of driving. This break may be divided into several periods which may be taken over the driving time or after it if collective agreements permit.

In terms of daily rest, drivers must have eleven consecutive hours which may be reduced to eight hours up to three times a week by collective agreement or plant-level agreement according to the AZG. However, reduced rest periods must be made up within 10 days by extending another daily or weekly rest period.

The ARG states that drivers are entitled to a weekly rest period of 45 consecutive hours. This may be reduced to 36 hours per week or, with collective agreement, 24 hours. Reduced weekly rest must be compensated for by the end of the third week following the week in question. There may be no more than six days between weekly rest periods.

4.3.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.3.3.1 Working time/Driving Time

The rules for working time and driving time as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.3.3.2 Breaks and rest periods

Breaks and rest periods for drivers of goods vehicles with a total mass not exceeding 3.5 tonnes are largely the same as regulations for bus drivers servicing regular routes not exceeding 50km in length.

However, for drivers of goods vehicles with a total mass not exceeding 3.5 tonnes, at least a 30 minute break must be taken after no more than 4 hours of driving as stipulated in the AZG.

4.4 Czech Republic

4.4.1 Overview

In the Czech Republic, the drivers of vehicles who are exempt from Regulation (EC) No. 561/2006 are governed by decree č.281/2007 Coll. The information that was received was more comprehensive for rules concerning bus drivers servicing regular routes not exceeding 50km in length than for drivers of goods vehicles with a total mass not exceeding 3.5 tonnes. The rules for both types of drivers are outlined as far as possible.

4.4.2 Bus drivers servicing regular routes not exceeding 50km in length

4.4.2.1 Working time/Driving time

Drivers may not exceed nine hours of driving time in a normal day but this may be extended to ten hours no more than twice per week. Over a two week period, driving time must not exceed 90 hours.

4.4.2.2 Breaks and rest periods

After no more than four hours of driving, the driver must take a break of at least 30 minutes. This break may be divided into periods of no less than ten minutes each over the four hours.

The total daily rest must be at least twelve hours. Daily rest may be divided into two or three periods, as long as one of the rest periods is no less than eight hours.

A period of at least 24 hours must be taken as weekly rest, with the total weekly rest over a three week period totalling 105 hours.

4.4.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.4.3.1 Working time/Driving time

TRL was unable to determine the rules for working time for drivers of goods vehicles with a total mass not exceeding 3.5 tonnes.

4.4.3.2 Breaks and rest periods

The break requirements follow the template of Regulation (EC) No. 561/2006.

4.5 Denmark

4.5.1 Overview

The national driver hours and working time regulations in Denmark are partly based on those for all workers set out in the Working Time Directive (2003/88/EC), but those for public transport drivers are modified by collective agreements. The individuals in Denmark who were contacted did not know of any leaflets or similar information aimed informing operators of the driving and rest hours rules.

4.5.2 Bus drivers servicing regular routes not exceeding 50km in length

4.5.2.1 Working time/Driving time

Report Com(2006)371 indicates that urban transport driving conditions are primarily regulated by national collective agreements, except for those in Odense and Arhus, which have local agreements. The average maximum weekly driving time (not including overtime) cannot exceed 42 hours, or 37 hours per week averaged over a period of 16 weeks maximum. Overtime is normally compensated for by extra rest periods.

4.5.2.2 Breaks and rest periods

The rules in Directive 2003/88/EC have been replicated in Danish legislation but it is unclear, given the information that was received, to what extent the exact requirements of these rules have been replicated with regard to working time and rest periods.

4.5.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.5.3.1 Working time/Driving time

The rules in Directive 2003/88/EC have been replicated in Danish legislation but it is unclear, given the information that was received, to what extent the exact requirements of these rules have been replicated with regard to working time and rest periods.

4.5.3.2 Breaks and rest periods

The rules in Directive 2003/88/EC have been replicated in Danish legislation but it is unclear, given the information that was received, to what extent the exact requirements of these rules have been replicated with regard to working time and rest periods.

4.6 Estonia

4.6.1 Overview

Bus drivers servicing lines that do not exceed a 50km radius use laws established from the Regulation (EC) No. 561/2006 as a template with regard to working time. The rules regarding working hours for such bus drivers are stated in the Traffic Law (RT I 2001, 3, 6) and are summarised in section 4.6.2. All other drivers of exempt vehicles, including drivers of good vehicles with a total mass not exceeding 3.5 tonnes, are subject to the general Working and Rest Time Act (RT I 2001, 17, 78) which utilises the Directive 2003/88/EC as a template and is summarised in section 4.6.3. Other derogations for bus drivers on a regular route not exceeding 50km in length are also stated in this act.

4.6.2 Bus drivers servicing regular routes not exceeding 50km in length

4.6.2.1 Working time/Driving time

Drivers of buses on a trip that does not exceed 50km in length may not exceed a driving time of more than nine hours per day.

The weekly working time for bus drivers on a regular route not exceeding 50km from their base follows the template of 2002/15/EC. Further, weekly working time can be extended to 60 hours so long as the average working time is not more than 48 hours per week over a six month period with collective agreement.

4.6.2.2 Breaks and rest periods

Drivers may not work for more than four consecutive hours without taking a break. After working for four hours, the driver must take a break lasting at least 30 minutes.

Drivers must have a daily rest period of eleven consecutive hours and a weekly rest period of 36 consecutive hours.

4.6.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.6.3.1 Working time/Driving time

The daily working limit for drivers of goods vehicles with a mass not exceeding 3.5 tonnes is eight hours per day.

Drivers must not exceed an average weekly working time of 40 hours per week.

4.6.3.2 Breaks and rest periods

The rules for breaks and rest periods as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.7 France

4.7.1 Overview

In France working time regulations are in part determined by EU legislation but are overlaid by the French rules which set limits on the working time of all workers, not just drivers. They are defined in several Presidential Decrees. Those of particular relevance to this study are:

- Decree No 83-40 of 26 January 1983, revised 5 January 2007 – Rules Governing Work Times in Goods Transport Businesses.
- Decree number 2003-1242 of 22 December 2003, revised 07 April 2006 – Rules Governing Working Times for public transport vehicles on inter urban journeys.
- Decree number 2000-118 of 14 February 2000, revised 1 January 2009 – Rules governing Working times for public transport vehicles on urban journeys.

There is not a direct correspondence between the rules in these decrees and those set out in EU legislation. However, we have drawn on Decree 83-40 and 2000-118 in particular since these appear to correspond most closely to the coverage of the EU legislation and its exemptions.

In this section it has only been possible to give an outline of the working hours rules which apply in France. French labour law is particularly complex. There are numerous sub clauses to cover special occasions and national emergencies and night working. In addition many of the rules can be set aside or modified by workplace agreements, sometimes in exchange for extra payment.

4.7.2 Bus drivers servicing regular routes not exceeding 50km in length

4.7.2.1 Working time/Driving time

The relevant rules for buses with short trip lengths are set out in Decree 2000-118, "the Working time for Drivers of Local/Urban Public Transport". This legislation is complex and subject to variation by local agreement and modification by a range of complex labour laws. However the basic provisions are:

The average work week is a maximum of 42 hours averaged over a twelve week period. The maximum working period in a single week should not normally exceed 46 hours.

The maximum working day is ten hours.

4.7.2.2 Breaks and rest periods

The minimum rest period between the end of a shift on one day and the start of one on the next is normally eleven hours, although that can be reduced to ten hours by collective agreement.

Every employee should have a break of at least 35 hours in a week to include a break of one full day (midnight to midnight). The maximum time between such breaks is seven days.

A break of 30 minutes or less is counted as working time for the purpose of calculating the working day.

All employees working more than six hours per day are entitled to a break of at least 20 minutes.

A break for a noon day meal of at least 45 minutes is required for workers who are in service between 11.30 and 14.00.

4.7.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.7.3.1 Working time/Driving time

The relevant rules for drivers of goods vehicle with a total mass not exceeding 3.5 tonnes are set out in Decree 83-40. There are different rules for "long distance" and "short distance" vehicles, depending on the number of nights a driver must be away from home in a month. It has been assumed for this study that the vehicles of interest, i.e. likely to be less than 3.5 tonnes, are mainly likely to be in the short distance category and the rules for those have been quoted.

The normal maximum working week for "short distance vehicle" drivers is 39 hours per week with an overall maximum of 507 hours per 3 month period. However, certain categories of vehicle drivers, notably couriers and vehicles which carry cash and bullion, have a lower limit, of 35 hours per week and 455 hours per quarter.

The normal maximum working time is ten hours per day. The working time may be extended by joint agreement up to twelve hours per day for one day of each week. A second extension is also possible but this extension should only be allowed on six occasions in any twelve week period.

4.7.3.2 Breaks and rest periods

We did not identify any provision defining the number or duration of breaks in the rules. These appear to be determined by a range of agreements between employers and worker representatives.

4.8 Germany

4.8.1 Overview

In Germany the working hours rules for drivers of goods vehicles with a maximum permissible mass of 2.8 tonnes which are excluded from Regulation (EC) 561/2006 are determined by the National Working Time Regulations, Hours of Work Act (Bundesgesetzblatt), dated 6 June 1994, or by EU working time regulations, if that is more favourable to workers. The German regulation Fahrpersonalverordnung (FPersV) contains provisions for the carriage of goods by motor vehicles with a gross vehicle weight exceeding 2.8 tonnes and not exceeding 3.5 tonnes and for vehicles used for carrying more than nine people and scheduled with a trip length of up to 50km. There is some scope to modify the basic requirements by collective agreement, in general by compensating for extra time worked by allowing extra time off at another time. It has not been possible to examine such agreements to determine whether that is usual.

4.8.2 Bus drivers servicing regular routes not exceeding 50km in length

4.8.2.1 Working time/Driving time

The national law, FPersV, states that driving times are in accordance with rules set out in Regulation (EC) No. 561/2006.

4.8.2.2 Breaks and rest periods

The rules regarding rest times in Germany use the Regulation (EC) No. 561/2006 as a template. However, the national law (FPersV) makes some extra provisions regarding rest periods for bus drivers servicing regular routes not exceeding 50km in length.

When the average spacing between stops is more than 3 km, a break of at least 30 minutes must be taken after 4.5 hours of driving. The driver is permitted to divide the break time into two periods provided that both periods last for at least 20 minutes each, or three periods if each break lasts for at least 15 minutes each.

If the average spacing between stops is less than 3 km then the break time is required to be at least one sixth of total driving time.

The normal weekly rest of 45 continuous hours may be an average over two weeks. Hence, fortnightly rest must total at least 90 hours which must be taken in two continuous periods, one per week.

4.8.3 Drivers of goods vehicles with a total mass not exceeding 2.8 tonnes

4.8.3.1 Working time/Driving time

The National Working Time Regulations, Hours of Work Act (Bundesgesetzblatt), dated 6 June 1994 governs the working and rest times of drivers of goods vehicles with a total mass of less than 2.8 tonnes.

The average working time for each seven day period, including overtime, should not exceed 48 hours per week, averaged over a four month period. (Note: this is identical to the requirement from the Working Time Directive 2003/88/EC).

The average daily working time should not exceed eight hours per day, not including rest periods, averaged over a six calendar month period or 24 week period. If workers should work more than eight hours per day then the employer shall maintain records of the hours worked which shall be kept for at least two years. The daily working time should not exceed ten hours, not including rest periods.

4.8.3.2 Breaks and rest periods

Hours of work shall be interrupted by break periods, fixed in advance of the working period. The break periods follow the rules set out in Directive 2002/15/EC. The breaks may normally be subdivided into periods of no less than 15 minutes each, although collective agreements may provide for shorter breaks provided the total break time is maintained.

Workers should have an uninterrupted period of rest after their daily work of at least eleven hours. That may on occasion be reduced to ten hours, provided each reduction is compensated within a four week or one calendar month period by an increase to twelve hours in the time off on another work day.

At least 15 Sundays in each year shall be free from work. If workers are employed on a Sunday they must have a rest day as compensation, to be taken within two weeks of the day they worked.

4.8.4 Drivers of goods vehicles with a total mass exceeding 2.8 tonnes and not exceeding 3.5 tonnes

4.8.4.1 Working time/Driving time

FPersV stipulates that the working time rules for drivers of goods vehicles with a total mass between 2.8 tonnes and 3.5 tonnes are in accordance with Regulation (EC) No. 561/2006.

4.8.4.2 Breaks and rest periods

FPersV stipulates that breaks and rest periods for drivers of goods vehicles with a total mass between 2.8 tonnes and 3.5 tonnes are in accordance with Regulation (EC) No. 561/2006.

The normal weekly rest of 45 continuous hours may be an average over two weeks. Hence, fortnightly rest must total at least 90 hours which must be taken in two continuous periods, one per week.

4.9 Greece

We were unsuccessful in identifying the rules which regulate driving of the specified vehicles with any confidence in Greece. We were informed that Greek rules regarding driving hours and rest breaks for the specified vehicles are laid out in the Presidential Decree 167/2006 which is based upon Directive 2002/15/EC. However, this conflicts with the rules set out in Directive 2003/88/EC, which already covers the specified drivers. Greece has not published any documents to inform operating companies of the driving and rest hours rules.

However, Report COM(2006)371 indicates that there is a national collective agreement which limits the maximum weekly driving time to 40 hours plus 3 hours overtime, unless a company level agreement specifies otherwise.

4.10 Hungary

In Hungary, there is no special legislation for drivers of vehicles not within the scope of Regulation (EC) No. 561/2006. This was confirmed by two sources, an individual from the Hungarian Transport Trade Association and an individual from the Transport Authority. However, it seems there are rules that bus drivers on regular routes that do not exceed 50km in length and drivers' of goods vehicles not exceeding 3.5 tonnes must follow, using Directive 2003/88/EC as a template, although the legal status of those rules is uncertain.

There are no publicly available leaflets or information widely available for operating companies. Two years ago an employee of the Trade Association prepared a summary of the driving rules, but this short document is not available for others - it functions as a handout at training. However, the Hungarian Trade Association is planning to prepare a new one, which would be available to anybody without charge. Therefore, it has been difficult to establish how rules in the Directive 2003/88/EC have been applied to bus drivers servicing regular routes not exceeding 50km in length and drivers of goods vehicles not exceeding 3.5 tonnes in Hungary.

4.11 Ireland

4.11.1 Overview

Under Irish legislation, drivers outside of the scope of the EU driving time, breaks and rest period rules are subject to the Road Traffic Act of 1961. Rules and regulations cited in the Act define a number of situations which can be classed as excessive driving. Supplementary legal provisions are contained in the Organisation of Working Time Act 1997. A leaflet aimed at informing operators of the driving rules was received for Ireland. These rules that apply to drivers of buses on a regular route that does not exceed 50km in length and drivers of goods vehicles not exceeding 3.5 tonnes are outlined in the following sections. The rules regarding driver hours were confirmed by an individual at the Transport Authority.

4.11.2 Bus drivers servicing regular routes not exceeding 50km in length

4.11.2.1 Working time/Driving time

The Road Traffic Act 1961 states that in a 24 hour period, driving time must not exceed eleven hours. Further, driving time that exceeds 5.5 hours of continuous driving is considered to be an excessive period.

The Organisation of Working Time Act states that the average working week must not exceed 48 hours averaged across four months. Exceptions are made for employees whose work is subject to seasonality, a foreseeable surge in activity or where employees are directly involved in ensuring continuity of service or production. In that case the 48 hour working week can be averaged across six months, or twelve months for employees who enter into a collective agreement with their employers which is approved by the Labour Court.

4.11.2.2 Breaks and rest periods

Rules in the Road Traffic Act 1961 say that two periods of driving must be separated by an interval lasting for at least half an hour for the driver to obtain rest and refreshment. If a break is less than half an hour, then the two periods of driving are regarded as one continuous period. Further, the Organisation of Working Time Act instructs drivers to have a 15 minute break after 4.5 hours have been worked. A 30 minute rest period must be taken after six hours have been worked, which may include the first break.

According to the Organisation of Working Time Act, drivers should have one 24 hour period of rest per week, with eleven hours of daily rest in every 24 hours. The Road Traffic Act also makes provision for eleven *consecutive* hours of rest in every 24 hour period. However, the rest period may be reduced to 9 consecutive hours in a 24 hour period if the driver is able to take 12 consecutive hours of rest in the following 24 hour period.

4.11.3 Drivers of goods vehicles with a mass not exceeding 3.5 tonnes

4.11.3.1 Working time/Driving time

The rules for working time and driving time as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.11.3.2 Breaks and rest periods

The rules for breaks and rest periods as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.12 Italy

We were unsuccessful in identifying the rules which regulate driving of the specified vehicles in Italy. However, Report COM (2006) 371 indicates that the maximum weekly working time is 48 hours for passenger road transport, including overtime. Collective agreements may establish more favourable provisions. The reference period is normally four months but may be extended to six or 12 months by collective agreement.

4.13 Latvia

We were unsuccessful in identifying the rules which regulate driving of the specified vehicles with any confidence in Latvia. We were informed that drivers of vehicles outside the scope of Regulation (EC) No. 561/2006 are covered in the General Labour legislation which uses the EU Working Time Directive (2003/88/EC) as a template. The General Labour legislation document was not received and it was not possible to determine whether there are any extensions or variations within it. It is therefore unclear to what extent the exact requirements of the Directive 2003/88/EC have been replicated with regard to working and rest hours.

However, Report COM(2006)371 indicates that the maximum weekly working time is 56 hours per week and recognises that in certain circumstances the requirements of the EU legislation are exceeded. That is due to a shortage of drivers and conductors. It was expected that this would be rectified over a transitional period.

4.14 Luxembourg

4.14.1 Overview

The working time regulations for Luxembourg for goods vehicles not covered by Regulation (EC) No. 561/2006 are contained in article 214-1 of the Code du Travail, 2007. The regulations for buses are defined in the Grand Ducal Regulation of 13/10/2006 as modified in Article 3. The requirements are summarised in sections 4.14.2 and 4.14.3. When the new rules on driving and resting were introduced, the Ministry of Transport in Luxembourg published a leaflet with the old and new rules which can be found on their website.

4.14.2 Bus drivers servicing regular routes not exceeding 50km in length

4.14.2.1 Working time/Driving time

The rules for working time of bus drivers are defined in the Grand Ducal Regulation as those given in Article 6 of Regulation (EC) No. 561/2006.

4.14.2.2 Breaks and rest periods

The rules for the break times of bus drivers are defined in the Grand Ducal Regulation are those given in Articles 7, 8 and 9 of Regulation (EC) No. 561/2006.

4.14.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.14.3.1 Working time/Driving time

The maximum working time of drivers of those vehicles is defined as an average of 48 hours per week averaged over a period of one month. The averaging period may be extended to four months on application to the Ministry of Labour and to six months by Collective or Trade Agreement.

The absolute maximum driving time in any one week is 60 hours.

4.14.3.2 Breaks and rest periods

The rules regarding break times follow the provisions made in Regulation (EC) No. 561/2006.

4.15 Netherlands

4.15.1 Overview

National legislation in the Netherlands for the vehicles excluded from EU legislation is largely based on Regulation (EC) No. 561/2006 and encompasses all transport modes. The national laws are ArbeidsTijdenWet (ATW) and Arbeidstijdenbesluit vervoer (ATBv). The laws for bus drivers are summarised in a poster that is aimed at driving operators to inform them of the rules. The following sections summarise the rules.

4.15.2 Bus drivers servicing regular routes not exceeding 50km in length

4.15.2.1 Working time/Driving time

The rules laid out in Regulation (EC) No. 561/2006 are replicated exactly in Dutch legislation.

4.15.2.2 Breaks and rest periods

After driving for a period of 5.5 hours, the driver must take a break of 30 minutes. The driver may divide the break time into two 15 minute periods. If driving time exceeds ten hours, the driver must take a break of at least 45 minutes which may be divided into periods of no less than 15 minutes each.

In terms of daily rest, provisions made in Regulation (EC) No. 561/2006 are used as a template. The daily rest can be reduced to a minimum of nine hours no more than three times between weekly rests. The rest must be completed within 24 hours of the end of the last daily or weekly rest period.

4.15.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.15.3.1 Working time/Driving time

The rules laid out in Regulation (EC) No. 561/2006 are replicated exactly in Dutch legislation.

4.15.3.2 Breaks and rest periods

The rules for breaks and rest periods as described for bus drivers servicing regular routes not exceeding 50km in length apply.

In addition, weekly rest of 45 continuous hours must be taken, which can be reduced to 24 hours provided that compensatory rest is taken.

4.16 Norway

4.16.1 Overview

Norwegian rules regarding driving and rest times for drivers of goods vehicles with a total mass not exceeding 3.5 tonnes and bus drivers servicing a regular route not exceeding 50km in length are in the Vegtrafikklovgivningen law and are summarised below.

4.16.2 Bus drivers servicing regular routes not exceeding 50km in length

4.16.2.1 Working time/Driving time

Bus drivers on a regular route that does not exceed 50km in length may not work for more than nine hours per day. Once a week, working time may be extended to ten hours per day.

4.16.2.2 Breaks and rest periods

For a bus driver on a regular route not exceeding 50km in length, a 30 minute break after no more than five hours is stipulated.

In a 24 hour period, a driver must take a daily rest period of eleven hours, which may be reduced to nine hours up to three times a week. If a daily rest period is reduced then compensatory rest must be taken by the end of the following week.

The length of the weekly rest period is in line with rules of the Regulation (EC) No. 561/2006. Weekly rest may be reduced to 36 hours if the trip is in a local district. Further, weekly rest may be reduced to 24 hours in a local district if collective agreement permits. If reduced weekly rest is taken, the driver must take compensatory rest within three weeks.

4.16.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.16.3.1 Working time/Driving time

The rules for working time as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.16.3.2 Breaks and rest periods

The rules for breaks and rest periods as described for bus drivers servicing regular routes not exceeding 50km largely apply.

Whereas, bus drivers must take a break of 30 minutes after five hours of driving, drivers of goods vehicles with a total mass not exceeding 3.5 tonnes must take a 45 minute rest after 4.5 hours of driving time. This break may be divided into periods of 15 minutes if the break is taken over the 4.5 hours.

4.17 Poland

4.17.1 Overview

The working times of drivers in Poland are defined in the National Working Time Act of 16 April 2004. That legislation is multipurpose. It transposes the relevant EU Regulations and Directives into national law and extends certain aspects of them to the drivers of the vehicles excluded from Regulation (EC) No. 561/2006. It includes regulations which govern all vehicles driven by employees, with no lower weight limit in the case of the driver hour regulations, and separate regulations for buses on regular routes that do not exceed 50 km in length. Poland provides brochures to inform operating companies of the driving laws.

4.17.2 Bus drivers servicing regular routes not exceeding 50km in length

4.17.2.1 Working Time/Driving time

The total driving time between the end of one daily rest period and the start of the next daily rest period shall not exceed ten hours.

The total driving time in any week shall not exceed 60 hours and within two consecutive weeks shall not exceed 90 hours.

4.17.2.2 Breaks and rest periods

Drivers shall have breaks totalling not less than 30 minutes when the total driving time in a day ranges from six to eight hours and not less than 45 minutes when the total daily driving time exceeds eight hours. The start time of the first break should not be more than six hours after the commencement of the driving time. The timing and duration of breaks may be adjusted to comply with timetable requirements, but at least one of them should be more than 15 minutes.

Every week a driver shall have a rest of at least 35 hours, commencing no later than the end of six 24 hour periods when work is undertaken.

4.17.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.17.3.1 Working time/Driving time

The average weekly driving time, including overtime, may not exceed 48 hours over an averaging period which should not exceed four months. The maximum working time in any week should not exceed 60 hours.

Drivers of goods vehicles should work a maximum of ten hours in any one day.

4.17.3.2 Breaks and rest periods

The Directive 2002/15/EC acts as a template for Polish rules regarding break times.

Every day a driver should have a period of eleven hours uninterrupted rest.

Every week a driver should normally have a break of at least 35 hours of continuous rest. If a shorter period is essential due to a schedule change, the minimum break should be 24 hours.

4.18 Slovak Republic

4.18.1 Overview

For drivers of vehicles exempt from Regulation (EC) No. 561/2006, rules within the Slovak Republic Act No 462/2007 on the Organisation of Working Time in Transport apply to drivers of buses on regular routes not exceeding 50km in length and drivers of vans weighing less than 3.5 tonnes and are outlined below.

4.18.2 Bus drivers servicing regular routes not exceeding 50km in length

4.18.2.1 Working time/Driving time

The weekly working time rules in Act No 462/2007 are in line with the parameters of the working time rules in Directive 2002/15/EC.

4.18.2.2 Breaks and rest periods

In relation to breaks, the rules in Act No 462/2007 are in line with the parameters of the Directive 2002/15/EC.

With regards to rest, the employee in transport must receive a minimum daily rest period of eleven hours in a 24 hour period. This may be shortened to not more than six hours in a period of 24 hours for the provable objective reasons and may not be shortened more than three times in a week.

Along with daily rest, drivers must have a weekly rest period of 24 hours.

4.18.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.18.3.1 Working time/Driving time

The rules for working time as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.18.3.2 Breaks and rest periods

The rules for breaks and rest periods as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.19 Slovenia

4.19.1 Overview

Regulation (EC) No. 561/2006 acts as a template in Slovenia for the rules that drivers of goods vehicles with a total mass not exceeding 3.5 tonnes and drivers of buses on regular route not exceeding 50km in length. There are some slight differences and the working and rest times for these drivers are presented below.

4.19.2 Bus drivers servicing regular routes not exceeding 50km in length

4.19.2.1 Working time/Driving time

Slovenian rules in relation to driving time limits exactly follow the rules of Regulation (EC) No. 561/2006.

4.19.2.2 Breaks and rest periods

Slovenian rules in relation to breaks, daily rest and weekly rest exactly follow the rules of Regulation (EC) No. 561/2006.

Additionally, collective agreements permit the rest period for bus drivers on a regular route not exceeding 50km in length to be divided into a number of breaks lasting at least ten minutes. The weekly rest period refers to any period of rest of at least 24 hours.

4.19.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.19.3.1 Working time/Driving time

The rules for driving time as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.19.3.2 Breaks and rest periods

The rules for breaks and rest periods as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.20 Spain

We were unsuccessful in identifying the rules which regulate driving of the specified vehicles with any confidence in Spain. We were informed that drivers of vans weighing less than 3.5 tonnes and drivers of buses servicing regular routes that do not exceed 50km in length are subject to the Working Time Directive (2003/88/EC) in Spain. It is unclear, given the information that was received, to what extent the exact requirements of Directive 2003/88/EC are replicated with regard to working and rest hours.

4.21 Sweden

4.21.1 Overview

In Sweden there are national laws which apply to vehicles with a mass not exceeding 3.5 tonnes and buses. The drivers of all vehicles, including buses on regular routes not exceeding 50km in length, are subject to the requirements of the Arbetstidslag (1982:673), the national working time regulations which applies for all employees. These are extended by Vilotidsfordningen (1994:1297), which applies for the carriage by road for drivers of certain vehicles, namely:

- Goods vehicles where the mass of the trailer, including any trailer or semi trailer, does not exceed 3.5 tonnes
- Taxis
- School transport
- Vehicles used to collect milk from farms.

In some cases these national Regulations may be modified by collective agreements between employers and worker representative organisations.

The extensions to the rules are complex and make it difficult to quote numbers of hours without giving full information on the options available to workers and employers and that has been included.

4.21.2 Bus drivers servicing regular routes not exceeding 50km in length

4.21.2.1 Working time/Driving time

The normal weekly working time will be not more than 40 hours each week. If necessary for operational reasons that may be varied but the average time per week should not exceed 40 hours per week averaged over any continuous four week period.

If the nature of the work means that significant amounts of time will be on call or standby, but not working, then the on call time should not exceed 48 hours in a four week period or 50 hours in a calendar month.

If there is a need for overtime, and subject to local agreements, then up to 48 hours overtime may be worked over a four week period or 50 hours in a calendar month.

Any time worked as overtime reduces the time allocation for on call/stand by the same amount.

The total working time, averaged over a four month period, shall not be more than 48 hours per week.

No more than 200 hours overtime shall be worked in a calendar year.

4.21.2.2 Breaks and rest periods

No worker should work for more than five hours without a break. The length of the break is not specified in the legislation and appears to be determined by collective agreement.

All workers should have a continuous rest period of at least eleven hours in any 24 hour period.

All workers should have a rest period of at least 36 hours during any seven day period.

A meal break is not considered as part of working time. Short breaks are included in work time.

4.21.3 Drivers of goods vehicles with a total mass not exceeding 3.5 tonnes

4.21.3.1 Working time/Driving time

The rules for working time as described for bus drivers servicing regular routes not exceeding 50km in length apply.

4.21.3.2 Breaks and rest periods

All workers should have a total rest of at least eleven hours in the 24 hour period before he commences his transport duties. This may be divided into two breaks, one of which must be at least eight hours long.

All workers should have a break of at least 36 hours during any seven day period.

No worker should work for more than five hours without a break. (Note: the length of the break is not specified in the legislation and appears to be determined by collective agreement).

A meal break is not considered as part of working time. Short breaks are included in work time.

Drivers shall record details of their working time in a personal Time Book (Tidboken, as defined in Transport Board Regulation 1008:1182). This must be carried in the vehicle and continually updated by the driver to contain records of the daily rest periods and time of starting work for the previous seven days. This must be made available for police or traffic officer inspection at any time.

4.22 Conclusion

At the start of this study it was expected that the review of European domestic legislation would be relatively straightforward, yet, as indicated in section 4.2 it proved surprisingly complex. Some countries had well defined legislation, which is well set out and publicised but in others it was not possible to identify clear rules.

A further complication may be that the Working Time Directive (2003/88/EC) merely indicates that Member States shall take necessary measures to ensure that mobile workers are entitled to adequate rest. The Directive itself has proved contentious and at the time of writing 15 Member States have applied opt-outs for certain categories of worker. It is not clear whether that has influenced enthusiasm for implementing the requirement to take the necessary measures.

Confirmation that there might be less provision to regulate the driving hours and break times of the relevant drivers than might be expected comes from Report COM(2006)371. Although Article 20 of Directive 2003/88/EC specifically excludes mobile workers from the provisions of the Directive, apart from the average weekly working time of 48 hours, it does require Member States to take necessary measures to ensure that the relevant mobile workers are entitled to adequate rest. Yet many of the responses to the 2005 survey do no more than repeat the 48 hour average requirement.

Hence, despite a fair amount of questioning of various sources in the countries studied, in some cases it was impossible to identify the national legislation and there is some uncertainty in the information that was provided. No examples were found of operating fatigue management systems, but this was not a primary focus of this section of the study. As indicated previously the information should not be relied on for legal purposes or if accuracy is critical. A substantial study, probably involving legal specialists in each of the countries, would be required if that were the case.

5 Review of legislation for Non-EU countries

To complement the examination of European domestic legislation, it was appropriate to investigate a small sample of other countries with a different heritage of regulation development, to see whether models of best practice exist that could inform this review. Australia, the United States of America and Canada are reported below.

5.1 Australian Driving Hour Rules

Traditionally, the driving regulations for heavy vehicles, commercial bus and coach drivers have differed from state to state/territory in Australia. In September 2008 these regulations changed, with the introduction of the Heavy Vehicle Driver Fatigue Reform (HVDFR). This is a set of national rules and regulations intended to help manage fatigue in the industry[3]. It will be implemented by all states except Western Australia, Northern Territories and Australian Capital Territory (ACT).

Western Australia (WA) and The Northern Territories (NT) are large areas that are sparsely populated. Their decision not to implement the new regulations is based on the fact the rules are impractical for the terrain and size of the states. The states have argued that it would be unsafe to require a driver to stop, sometimes in the middle of a plain in temperatures over 40^{oC}, simply because they have reached their driving hours limit.

Instead, drivers within Western Australia and Northern Territories operate under a Fatigue Management Code of Practice. There is a model "fatigue management system" which operators can choose to follow or they can develop their own plan. Although the Code of Practice isn't mandatory in itself, the outcomes are under the Work Health Act duty of care obligations.

For drivers in ACT it is likely that they will leave the boundaries of the state due to its small size. When crossing state borders into New South Wales (NSW) the drivers then have to comply with the new regulations (HVDFR), and fill in the new national work diary if appropriate. This means that essentially large truck drivers within ACT will have to comply with the new laws brought in for September 2008, and commercial bus and coach operators who operate services outside the confines of Canberra will have to comply with the laws.

The new national laws apply to all trucks with a gross vehicle weight over 12 tonnes or truck and trailer with a gross train weight of over 12 tonnes, and commercial buses with 12 or more adult seats including the driver. Plant equipment, motor homes and mini buses for private use are not covered. For operators with vehicles that fall into the regulated categories there are three schemes available. These are:

- Standard Hours
- Basic Fatigue Management (BFM)
- Advanced Fatigue Management (AFM).

There is also a separate Standard Hours (Buses) option. The BFM and AFM schemes apply to both trucks and buses. They allow a greater degree of flexibility in the hours in return for improved fatigue management systems.

[3] Further clarity is being sought about regulations that may affect vehicles above 3.5 tonnes and below 12.

The new laws makes all parties in the 'chain of responsibility' responsible for fatigue management. The parties are:

- Driver
- Employer of the driver
- The prime contractor of the driver
- The operator of the vehicle
- The scheduler of goods or passengers for transport by the vehicle and also the scheduler of its driver
- The consignor of the goods being transported
- The consignee of the goods being transported
- The loading manager
- The loader and un-loader of the goods

All parties in the chain are required to work together to ensure that the driver is not fatigued and is not under pressure to break the regulations to finish a job. Reasonable steps should be taken to prevent driver fatigue. If there is a breach in the regulations all parties can be held responsible. The penalties increase in severity and include demerit points on the drivers licence and fines over $50,000 (approximately £23,000).

Reasonable steps include, but are not limited to:

- Developing an industry code of practice
- Use of accreditation schemes
- Review business practices
- Adopting a risk management approach.

The new regulations do not differentiate between driving and any other tasks; they are all counted as work. Helping load and unload the vehicle, refuelling, helping passengers alight etc are all counted as work. For bus or coach drivers time spent relaxing with passengers is counted as rest.

5.1.1 Record Keeping

With the new regulations there is a big emphasis on record keeping. The record keeper is usually the driver's employer but can also be the driver himself if self employed, or if the driver is operating under a BFM or AFM scheme then the record keeper must be the accredited operator. There are certain pieces of information that need to be recorded for all drivers, though it does vary if the driver is working standard hours within 100km radius (or 200km in Queensland) from the driver's base. For drivers operating outside of the 100km radius and those on BFM or AFM schemes additional information is required.

Table 10 - Information required to be logged by a driver under Australian standard hours rules, and when driving outside standard hours

Information	Standard Hours in 100km	SH outside 100KM, BFM & AFM
Driver name	√	√
Drivers Licence number	√	√
Drivers Contact details	√	√
Registration number of each vehicle	√	X
Drivers roster and trip schedules	√	√
Drivers payment records including timesheet records	√	√
Drivers work and rest for each day and each week	√	X
Copies of the work diary daily sheets	X	√
Other information required for BFM & AFM accreditation	X	√

5.1.2 Work Diary

A new Work Diary is being introduced that replaces the existing National Log Book. Any driver travelling over 100km (or 200km in Queensland) from their base must fill in the Work Diary. If a driver travels in a state not partaking in the new regulations for less than 7 days then they must continue to use the work diary at all times. The work diary can be either in paper or electronic format.

The paper diary will have carbonised pages so that copies of each page is made. The driver keeps the first page, gives the first copy to their employer and the third copy either stays in the diary, is given to a second employer if a driver works for 2 employers on the same day, or can be removed by an accreditation officer or police officer. The driver has to keep with them in the vehicle the previous 28 days daily record sheets. Within 21 days they must hand in their daily work sheet copies to their employer. The record keeper must then keep the copies of the work diary sheets for 3 years. The diary is the responsibility of the driver, and if a second job is held by the driver, they must use the same diary and pass the completed information to the correct employer.

The work diary must be filled in using a permanent black or blue pen. A driver's base must be recorded as this is important in determining how far from base they have gone and the time zone to which they operate. All times are taken from the driver's base time zone. For each day (from midnight to midnight) there is a timeline with sections for solo work, rest and two-up work. The time is split into 15 minute intervals and time should be recorded in these 15 minutes intervals. Work time is rounded up to the next 15 minute interval, rest is rounded down. As such, rests of less than 15 minutes do not count as rest at all and must be recorded as work. The activity being carried out is recorded by drawing a horizontal line through each row at the appropriate time. At the end of each row is a section to input the total hours worked and rest. A vertical line through the work and rest rows at the appropriate time indicates a change of activity. At each

change of activity the location, odometer reading and vehicle registration (if a change of vehicle occurs) are to be recorded.

5.1.3 Standard Hours

The Standard Hours scheme sets out limits for the maximum work time, and minimum rest time in set periods of time. Within Standard Hours there are 3 sub-sections;

- Standard Hours (Solo drivers)
- Standard Hours (Bus and Coach)
- Standard Hours (Two-up)

The regulations for each option are summarised in table 14 below.

The idea behind the Standard Hours option is to give the drivers more opportunities to take breaks later in a shift when they start to feel tired.

The Standard Hours Bus and Coach option has been altered to allow bus and coach drivers to recuperate fully after a tour and to accommodate school bus drivers who work low hours. Due to the night driving limitations, the bus option is a low risk option and therefore days off can be accumulated in a 28 day period rather than a 14 day period with the normal Standard Hours option. Bus drivers do have the option of operating under the normal Standard Hours regulations if they wish to undertake more night work. This is balanced by the extra days off required.

Standard Hours Two-up is a more specialised option to accommodate the unique factors involved. It is important that drivers involved in two-up driving can sleep in a moving vehicle so that they wake up as refreshed as if they had been asleep in a stationary bed. Given the extra demands of two-up driving the Standard Hours option is only for use on an in-frequent basis. Operators who regularly use two-up driving must operate under BFM or AFM.

The most noticeable difference for two-up drivers' Standard Hours option is that the driver only has to have 5 hours continuous rest in each 24 hours period, as opposed to the 7 hours continuous rest imposed by the other standard hours options.

Table 11 - Standard Hours Driving Regulations

Time Period	Maximum work time			Minimum rest time		
	SH Solo	SH Bus	SH 2-up	SH Solo	SH Bus	SH 2-up
5 ½ hours	5 ¼ hrs	5 ¼ hrs	5 ¼ hrs	15mins continuously	15mins continuously	15mins continuously
8 hours	7 ½ hrs	7 ½ hrs	7 ½ hrs	30mins in blocks of 15mins	30mins, can be blocks of 15mins	30mins in blocks of 15mins
11 hours	10hrs	10hrs	10hrs	60mins in blocks of 15mins	60mins	60mins in blocks of 15mins
24 hours	12hrs	12hrs	12hrs	7continuous hours rest time[1]	12 hours including 7hrs continuously	5 continuous hours stationary rest[1] **or** 5 hours continuous rest in an approved sleeper berth while the vehicle is moving
52 hours						10 continuous hours stationary rest time
7 days	72hrs	72hrs	72hrs	24 hours continuous stationary rest	6 nights rest in 7 days	24 hours continuous stationary rest time and 24 hours stationary rest time in blocks of at least 7 continuous hours of stationary rest time
14 days	144hrs		144hrs	2× night rest breaks[2] **and** 2× night rest breaks on consecutive days		2× night rest breaks[2] **and** 2x night rest breaks on consecutive days
28days		288hrs			4× 24 hours rest period	

1 – Stationary rest time is the time a driver spends out of a regulated heavy vehicle or in an approved sleeper berth of a stationary regulated vehicle

2 – Night rest brakes are 7 continuous hours stationary rest time taken between the hours of 10pm and 8am the next day (using the time zone of the base of the driver) or a 24 continuous hours stationary rest break

5.1.4 Basic Fatigue Management

Basic Fatigue Management allows drivers to work longer shifts in exchange for greater management of fatigue. The maximum a driver can work under BFM is 14 hours in a day. BFM has different regulations for Solo drivers and two-up drivers.

In order to be able to operate under BFM an operator must be accredited by the National Heavy Vehicle Accreditation Scheme (NHVAS). In order to gain this accreditation the operator must comply with six standards. These are:

SCHEDULING AND ROSTERING

- The operator must plan, document and review the drivers schedules and rosters to ensure they meet the regulations

FITNESS FOR DUTY

- A program must be in place to ensure that drivers are fit to work and have the required medical assessments

FATIGUE KNOWLEDGE AND AWARENESS

- All manager, drivers and supervisors must demonstrate competency in managing driver fatigue

RESPONSIBILITIES

- There must be clearly defined responsibilities that staff understand and are capable of carrying out. These must be kept up to date

INTERNAL REVIEW

- Any incidents of none-compliance with the regulations must be easily identifiable, investigated and steps taken to rectify any issues raised. A yearly internal audit is compulsory

RECORDS AND DOCUMENTATION

- Policies, procedures and instructions should be put into place and records kept to prove compliance to the regulations.

Table 12 - Basic Fatigue Management Driving hours for Solo drivers

Time Period	Maximum Work Time	Minimum Rest Time
6 ¼ hours	6 hours	15 continuous rest time
9 hours	8 ½ hours	30 minutes rest time in blocks of 15 continuous minutes
12 hours	11 hours	60 minutes rest time in blocks of 15 continuous minutes
24 hours	14 hours	7 continuous hours stationary rest time[1]
7 days	36 hours long/night[2]	
14 days	144 hours	24 continuous hours stationary rest time taken after no more than 84 hours work time and 24 continuous hours stationary rest time and 2 × night rest breaks[3] and 2 × night rest breaks taken on consecutive days

1 - Stationary rest time is the time a driver spends out of a regulated heavy vehicle or in an approved sleeper berth of a stationary regulated heavy vehicle.

2 - Long/night work time is any work time in excess of 12 hours in a 24 hour period or any work time between midnight and 6 am (or the equivalent hours in the time zone of the base of a driver)

3 - Night rest breaks are 7 continuous hours stationary rest time taken between the hours of 10 pm on a day and 8 am on the next day (using the time zone of the base of the driver) or a 24 continuous

Basic Fatigue Management (BFM) regulation introduces the 36 hour rule. This stipulates that a driver cannot drive more than 36 long and/or night hours in any 7 day period. A long hour is one worked over 12 hours in a 24 hours period. A night hour is any hour worked between midnight and 6am (using the driver's base time zone). Long and night hours are added together on each day and then accumulated over a seven day period. On the 8th day the hours from that day are added and the hours from day 1 are dropped so that it is always a rolling total and does not go back down to zero unless the driver does not work any long or night hours for seven days.

The BFM regulations for two-up drivers differ significantly from those for solo drivers. For two-up drivers there are no regulations for short rest breaks. However, the 'Guidelines for Managing Heavy Vehicle Driver Fatigue' and the NHVAS business rules do recommend short rest breaks for two-up drivers. The first time regulations for two-up drivers on the BFM scheme are at 24 hours. The table below summarises the driving hours for two-up drivers on BFM schemes.

Table 13 - Driving Hour scheme for "Two-up" driving

Time Period	Maximum work time	Minimum rest time
24 hours	14 hours	10 hours stationary rest time[1] or 10 hours rest time in an approved sleeper berth while the vehicle is moving
82 hours		10 continuous hours stationary rest time
7 days	70 hours	24 continuous hours stationary rest time and 24 hours stationary rest time in blocks of at least 7 continuous hours
14 days	140 hours	4 × 7 hours night rest breaks[2]

1 - Stationary rest time is the time a driver spends out of a regulated heavy vehicle or in an approved sleeper berth of a stationary regulated heavy vehicle.
2 - Night rest breaks are 7 continuous hours stationary rest time taken between the hours of 10 pm on a day and 8 am on the next day (using the time zone of the base of the driver) or a 24 continuous hours stationary rest

5.1.5 Advanced Fatigue Management

If Basic Fatigue Management (BFM) does not allow an operator enough freedom they may opt for the AFM scheme. Again this is different for solo and two-up drivers. AFM works in a different manner to the other two schemes. In AFM the operator sets the limits for the maximum work and minimum rest times. They also nominate a frequency for exceeding the normal operating limits they have proposed. There are however outer limits imposed.

In order to operate under AFM accreditation from the NHVAS must again be obtained. Ten standards must be adhered to in order for accreditation to be awarded.

SCHEDULING AND ROSTERING

- the operator must plan, document and review the drivers schedules and rosters to ensure they meet the regulations

FITNESS FOR DUTY

- a program must be in place to ensure that drivers are fit to work and have the required medical assessments

FATIGUE KNOWLEDGE AND AWARENESS

- all manager, drivers and supervisors must demonstrate competency in managing driver fatigue

RESPONSIBILITIES

- there must be clearly defined responsibilities that staff understand and are capable of carrying out. These must be kept up to date

INTERNAL REVIEW

- Any incidents of non-compliance with the regulations must be easily identifiable, investigated and steps taken to rectify any issues raised. A yearly internal audit is compulsory

RECORDS AND DOCUMENTATION

- Policies, procedures and instructions should be put into place and record kept to prove compliance to the regulations

HEALTH

- a health management system must be in place for the drivers. A doctor must certify their health, including an assessment for sleep disorders. This assessment must be conducted every three years, or yearly for those over 50.

WORKPLACE CONDITIONS

- arrangements must be in place to manage driver fatigue such as sleeper berth facilities

MANAGEMENT PRACTICES

- practices must be put in place to minimise driver fatigue e.g. matching drivers to the freight task

OPERATING LIMITS

- normal operating limits that minimise the impact of fatigue within all normal circumstances.

Table 14 - Advanced fatigue management (AFM) upper limits

Time Period	Outer Limit
Minimum break in a 24 hour period	6 continuous hours or 8 hours in 2 parts
Minimum continuous 24 hour period free of work	4 periods in 28 days
Minimum opportunity for night sleep (between 10pm and 8am)	2 periods in 14 days
Maximum hours work in 24 hour period	16 hours (15 hours in Victoria)
Maximum work in 14 days	154 hours
Maximum work in 28 days	288 hours

In theory there is nothing to stop an operator proposing their normal working limit as the outer limit as long as the necessary procedures were in place. As the regulations have only recently come into operation it is not possible yet to assess the ways in which it is being implemented.

The AFM outer limits are the same for two-up drivers as they are for solo drivers.

If a driver exceeds the normal operating limit then the operator must document:

- The details of the incident causing the delay;
- The breach of the operating limits;
- The actions the operator took to address the risk.

When a driver breaks one of the normal operating limits more frequently than was proposed under the accreditation a non-compliance report must be produced which then goes for external audit.

For both BFM and AFM if an operator works inter-state then the application must be sent to the Fatigue authorities Panel for advice. Before approving the application the accrediting body takes into account this advice.

Accreditation for BFM and AFM lasts for 2 years unless an audit recommends that it should be removed. Audits are conducted when the scheme is set up and then yearly to

check compliance. Additional audits can be requested by the accrediting agency at any time.

Before accreditation is awarded, members of the supply chain need to undertake recognised training courses from the Australian Quality Training Framework.

5.1.6 Two-up Drivers

Due to the nature of two-up driving extra risk management procedures need to be put in place. They are summarised in the table below.

Table 15 - Extra Risk Management procedures when using "Two-up" Driving strategies

Countermeasures	Requirements
Sleeper berth design	auxiliary air conditioning units
	separate suspension
	noise and heat insulation
	good quality mattress
	dual escape hatches
Driver selection	driver self-selection
	pre-employment screening
	ability to sleep in a moving vehicle
	married teams assessed as individuals
	probationary period with experienced driver
	periodical review of terms
Driver training	Nationally recognised training covering fatigue management, 'sleep hygiene',
	napping techniques, managing unforeseen delays and stimulant use.
Trip preparation	notify trip details in advance
	designate lead driver
	avoid work prior to a long distance trip
	prepare trip plans
Driver health	education on driver health issues (including stimulant use)
	regular driver medicals

Drivers need to be extra careful when switching between solo driving and two-up driving or vice-versa. They must operate within the legal limits of both limits at all times. Before setting off on a journey a driver must make sure they have had adequate rest for the type of driving they are about to undertake.

5.2 United States Driving Hour Rules

In the United States of America (USA) the driving hours for commercial motor vehicles are governed under the Hours of Service (HOS). The HOS are the same for all interstate drivers. Intrastate driving regulations are set state by state but they are usually identical or very similar to the HOS regulations. The latest versions of the HOS rules came into force on 1st October 2005. The regulations apply to all vehicles requiring a Commercial Drivers Licence (CDL). The vehicles are split into property carrying commercial motor vehicles and passenger-carrying commercial motor vehicles (CMV). Passenger carrying CMV are defined as a vehicle "designed or used to transport more than 8 passengers (including the driver) for compensation; or designed or used to transport more than 15 passengers (including the driver), and is not used to transport passengers for compensation". This means that a bus does not need to have passengers on it in order to be classified as a Passenger-carrying CMV for the purpose of adhering to the HOS regulations.

5.2.1 Long Haul

The long haul regulations are the same for all states except Alaska which has slightly different terms. The regulations are summarised in the table below.

Table 16 - Regulations for Long Haul USA drivers

Criteria	States except Alaska		Alaska	
	Property-carrying CMV	Passenger-carrying CMV	Property-carrying CMV	Passenger-carrying CMV
Total driving time allowed in one day	11 hours	10 hours	15 hours	15 hours
Time after coming on duty after which cannot drive	16 hours	15 hours	20 hours	20 hours
Maximum time allowed on duty in 7 consecutive days	60 hours	60 hours	70 hours	70 hours
Maximum time allowed on duty in 8 consecutive days	70 hours	70 hours	80 hours	80 hours
Minimum break before restarting a period of 7 consecutive days	34 consecutive hours	N/A	N/A	N/A
Minimum break before restarting a period of 8 consecutive days	34 consecutive hours	N/A	N/A	N/A

If a driver has a second job that is not a driving job this time still counts as being on-duty and therefore cannot count towards their rest periods.

Drivers entering the USA from Canada or Mexico must comply with US regulations. Time spent out of the USA can count towards their rest periods, as will on duty and driving time.

In cases where a driver is helping with emergency relief efforts the laws are relaxed. They come back into force once the driver has returned to base.

If a driver informs their employer that they need a break they must be given 10 consecutive hours off duty[4].

[4] Further clarity is being sought about whether this period is paid by the employer

If adverse weather conditions make it unsafe to complete the run a driver may extend their driving time for up to 2 hours in order to reach a place of safety for the passengers or load and themselves as long as the following conditions are met:

- Driver does not drive for more than an aggregate 13 hours after having had 10 consecutive hours off duty for property carrying CMVs;
- The driver does not drive after the end of the 15th hour since coming on duty (following 10 hours off) for property carrying CMV's;
- Driver does not drive for more than 12 hours following 8 hours off duty for passenger carrying CMV's;
- Driver does not drive after being on duty for 15 hours following 8 hours off for passenger carrying CMVs.

All drivers operating under the Hours of Service Regulations must fill in a Record of Daily Service (RODS). The RODS is effectively a log book of the driver's hours and all changes in duty.

Each carrier can produce their own RODS template– an example sheet is shown in Figure 9.

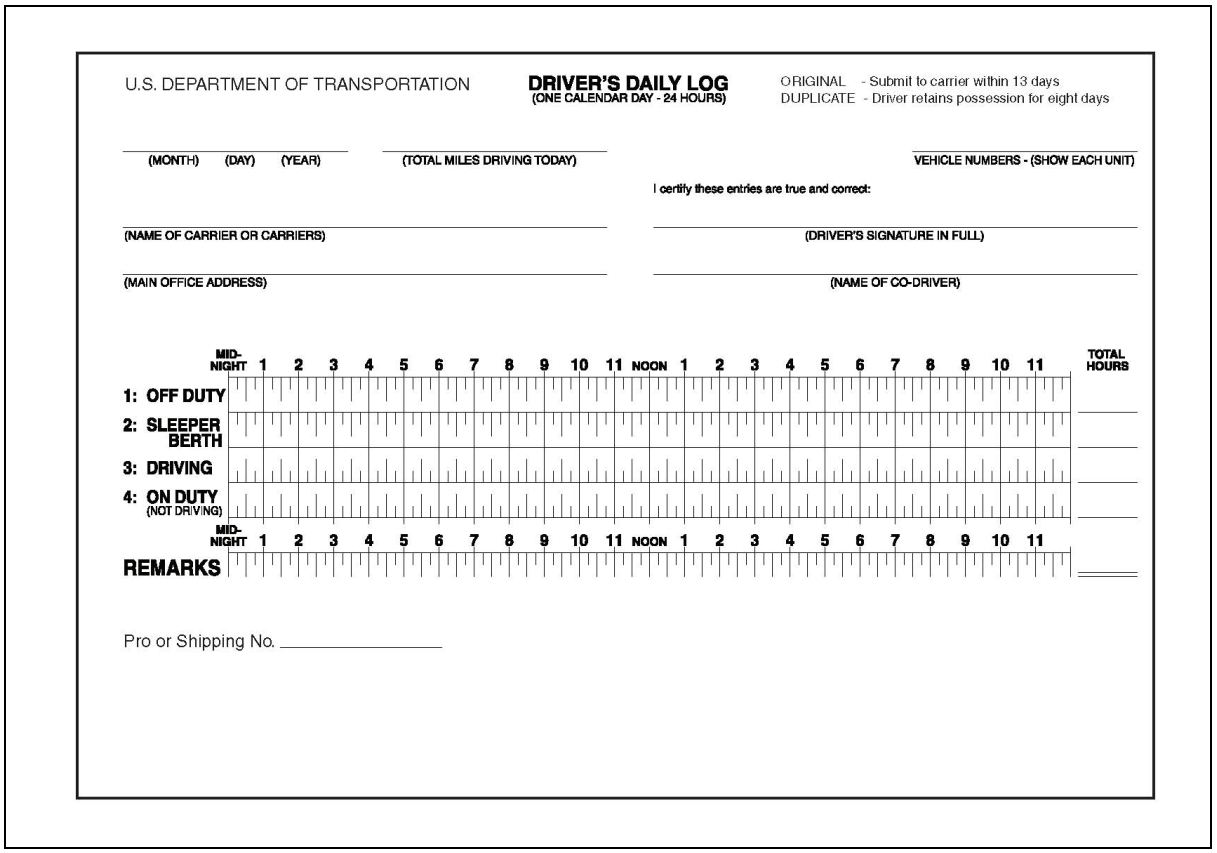

Figure 9 - Example of US DoT driving hour record sheet

The RODS is filled in by the driver by hand. It is the drivers' responsibility to ensure it is filled in as accurately as possible. This can lead to abuse of the RODS by drivers and employers who are not complying with the regulations.

5.2.2 Short Haul

There are two systems for short haul drivers. The set of regulations a driver has to follow is determined by the type of vehicle and the distance driven from the driver's base. These two systems are:

- 100 air-mile radius;
- 150 air-mile radius non CDL.

N.B: 100 air-miles = 115.08 statute miles; 150 air-miles = 172.6 statute miles

5.2.3 100 Air-Mile Radius Driver

Drivers operating a vehicle requiring a commercial driver's licence but operating solely within 100 air-mile radius of their base are governed by a different set of regulations providing the following conditions are met:

- The driver returns to the work reporting location and is released from work within 12 consecutive hours
- The motor carrier that employs the driver maintains and retains, for a period of 6 months, accurate and true time records showing
    - The time the driver reports for duty each day
    - The total number of hours the driver is on duty each day
    - The time the driver is released from duty each day
    - The total time for the preceding 7 days does not exceed 60 hours.

If these conditions are met then the following time limits for driving and on duty time are imposed:

Table 17 - Regulations for Short Haul USA drivers

Property Carrying Vehicle	Passenger Carrying Vehicle
At least 10 consecutive hours off duty separating each 12 hours on duty	At least 8 consecutive hours off duty separating each 12 hours on duty
Does not exceed 11 hours maximum driving time following 10 consecutive hours off duty	Does not exceed 10 hours maximum driving time following 8 consecutive hours off duty

5.2.4 Exceptions

Certain types of vehicle are exempt from the normal Hours of Service regulations:

- Specially constructed oil well servicing motor vehicle
    - When at a natural gas or oil well location can count the time waiting as off-duty time.
- Driver-Salespersons

A driver-salesperson is defined as a private carrier, solely delivering and selling goods or services, with no more than 50% of on-duty time spent driving. A driver-salesperson operating within 100-air miles of their base does not have to comply with the 60/70 hour rule if they do not drive for more than 40 hours in any 7 consecutive day period.

Driver-salespersons are not required to return to their work reporting location to be released from work. They may not drive after the 14th hour of coming on duty.

5.3 Canadian Driving Hour Rules

Part of the Motor Vehicle Transport Act, and was brought into force January 2007. As part of this we have the Commercial Vehicle Drivers Hours of Service Regulations, which regulate the use of heavy vehicles in Canada.

Commercial Vehicles are defined as:

- A truck, tractor, trailer or any combination thereof that exceeds 4500kg gross vehicle weight;
- A bus designed and constructed to carry at least 10 seated passengers – including the driver.

In Canada, the national regulations are different for driving north and south of the 60°N line of Latitude. In effect, this means one set of rules for British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Newfoundland and Labrador and another set for the Northwest Territories: Yukon and Nunavut.

The rules are summarised in Table 18.

Table 18 - Summary of Canadian driving hour rules

South of 60°N	North of 60°N
Cannot drive for more than 13 hours in one day	Cannot drive for more than 15 hours
Cannot work for more than 14 hours each day	Cannot work for more than 18 hours a day
The driver must take at least 8 consecutive hours off-duty after accumulating 13 hours driving time or 14 hours working time before driving again	The driver must take at least 8 consecutive hours rest after accumulating the maximum driving or working time
Cannot drive after 16 hours have elapsed since the last break of 8 consecutive hours	Cannot drive after 20 hours have elapsed since the last break at least 8 hours
A driver must take at least 10 hours of off-duty time each day	A driver must take at least 8 hours of off duty time
Off-duty time other than the 8 consecutive hours must be taken in blocks of at least 30 minutes	
At least 2 hours of the off-duty time should be taken separately from the 8 consecutive hours	

It is possible for drivers south of the 60°N line to defer up to 2 hours off-duty time to the following day if the following conditions apply:

- It is not part of the 8 consecutive hours;
- The total off-duty time for the 2 days is more than 20 hours;
- The deferred time is added to the 8 consecutive hours the next day;
- The total driving time for the 2 days does not exceed 26 hours;
- It is declared in the 'remarks' section of the daily log.

If a driver has to take a ferry crossing that is longer than 5 hours it can count towards the 8 hour break if the time spent waiting to board the ferry is spent in a sleeper berth, the time spent in rest accommodation aboard the ferry and at a rest stop not more than 25km from the ferry terminal add up to at least 8 hours. This time should be recorded in the daily log as off-duty in sleeper berth. The driver is also required to keep all receipts for the crossing and the accommodation.

5.3.1 Teams of drivers

If there are a team of drivers aboard a vehicle they can split their off-duty time into no more than 2 blocks as long as:

- No period of off-duty time is less than 4 hours;
- The total of the two periods is at least 8 hours;
- The off-duty time is spent in the sleeper berth;
- All the other normal regulations are met.

5.3.2 Cycles

A driver must follow either cycle 1 or cycle 2.

Cycle 1 – in which on duty time is accumulated over a 7 day period

Cycle 2 – in which on duty time is accumulated over a 14 day period

For either cycle a driver cannot drive if they have not taken at least 24 consecutive hours off duty in the in preceding 14 days.

Cycle 1

After accumulating 70 hours of on duty time during any 7 day period a driver must stop. (80 hours for north of 60^{o}N)

In order to reset the cycle a driver can take at least 36 consecutive hours off-duty. To switch from cycle 1 to cycle 2 a driver must take at least 36 consecutive hours off

Cycle 2

A driver cannot drive after accumulating 120 hours on duty during any 14 day period, or accumulated 70 hours of on-duty time without having taken at least 24 hours continuous rest.

A new cycle can begin if a driver takes off at least 72 continuous hours. To switch from cycle 2 to cycle 1, a break of at least 72 consecutive hours must be taken.

5.3.3 Special Permits

Special permits can be issued for certain types of vehicles under certain circumstances. These are usually issued for research or pilot projects, and temporary but significant changes in load or passenger numbers. The special permit allows 2 deviations from the Regulations:

- A reduction of the 2 hours daily off-duty time if the vehicle is south of 60oN;
- An increase in driving time and on duty time of up to 2 hours.

Oil well service vehicles also operate under a special permit. The rules of the permit state that:

- The driver must take at least 3 periods of off-duty time, each at least 24 hours long in any period of 24 days. They can either be taken together or separately;

- Take at least 72 consecutive hours of off-duty time after ending driving under the provision of the permit and beginning driving under the normal regulations;
- Waiting time and standby time at an oil or natural gas well site or ancillary facility shall not be included as on-duty time if the driver performs no work, records the time in the log book, and the time is not included in the minimum 8 consecutive hours of off-duty time;
- None of the off-duty time shall be deferred to the next day;
- Emergencies and Adverse Weather Conditions.

In an emergency or where adverse weather conditions prevent a driver reaching their destination in the time allowed under the regulations they may extend the driving time by up to 2 hours, as long as the trip would have been completed in the time had the situation been normal. All other requirements must then be met, e.g. the 8 consecutive hours off-duty.

5.3.4 Daily Logs

All drivers operating more than 160km radius from their home terminal are required to fill out a daily log. The daily log must contain:

- The date;
- Start time (if not midnight);
- Name of the driver;
- Names of co-drivers if applicable;
- Cycle that the driver is on;
- Licence plate or unit numbers of vehicle;
- Odometer reading;
- Name and address of the home terminal and principal place of business of employer;
- Time on and off-duty for previous 14 days if a log was not recorded for those days;
- Statement of deferring off duty time if applicable;
- Change in status and the position;
- Total hours and distance for each duty.

The daily log can either be in paper form or electronic form as long as the records for the previous 14 days can be produced on request. The records for the previous 14 days must be with the driver whenever they are driving.

Within 20 days a driver must hand the original daily log to their home base. If the driver has more than one employer then they must send the original to the first employer they worked for that day and then copies to any other employer they worked for on that day. The employer must keep the logs for at least 6 months.

See Figure 10 for an example day log sheet.

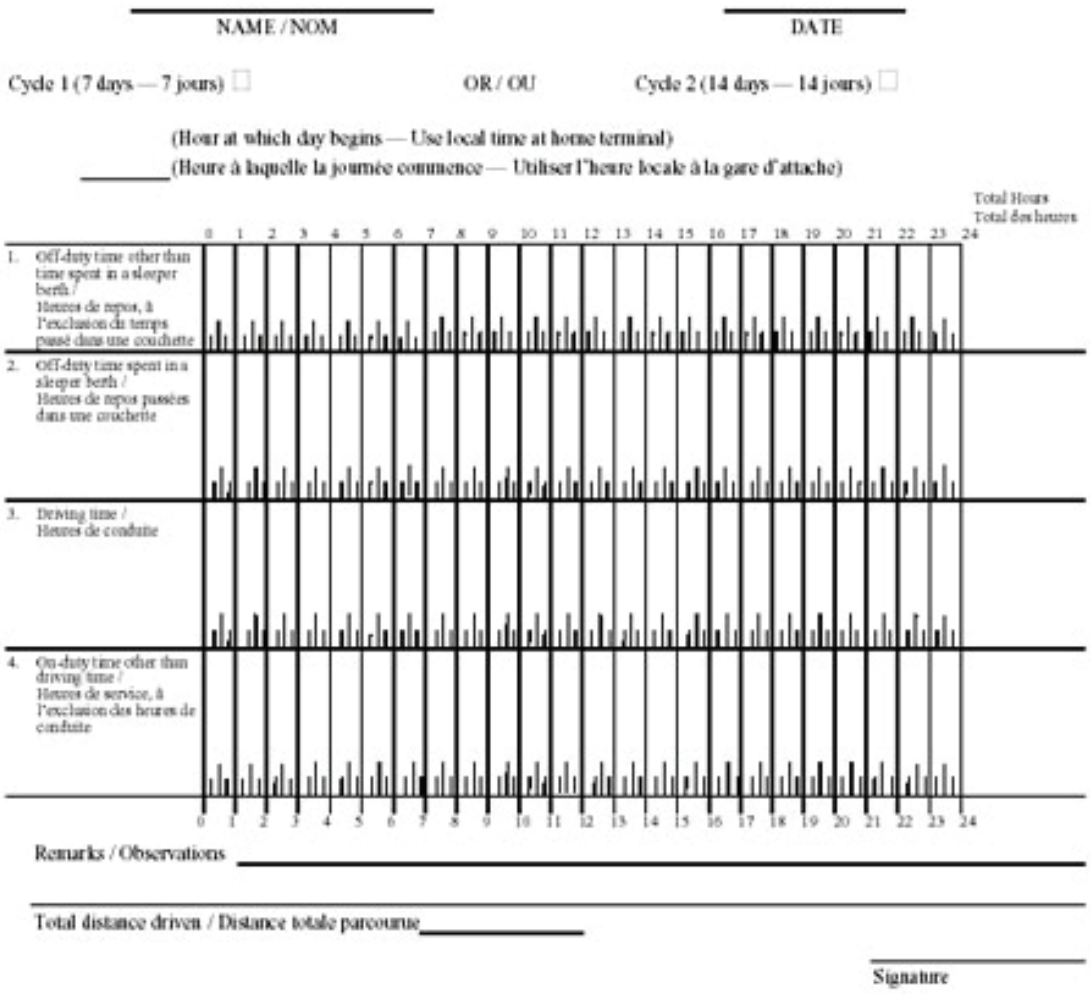

Figure 10 - Example of Canadian driving hour record sheet

5.3.5 Exceptions

- A 2 or 3 axle commercial vehicle being used to transport the primary products of a farm, forest, sea or lake, if the driver is the producer of the products (and the return trip)
- An emergency vehicle
- A vehicle providing relief in the case of a public welfare emergency
- A bus that is part of the public transit service that is provided in a municipality, in contiguous municipalities or within 25km of the boundary of the municipality or contiguous municipalities in which the public transit service is provided
- A commercial vehicle when driven for personal use for less than 75km per day.

6 Report Conclusions

Fatigue impairs the driver's cognitive and motor performance by slowing reaction times, reducing attention to the external driving environment, and disrupting steering skills. A fatigued driver's ability to respond effectively to unusual, unexpected, or emergency situations is reduced, and occurrences of these factors pose a risk to the safety of the drivers themselves and to other road users.

The aims of this report were to review existing UK and international research and other published material in order to determine the links that exist between long driving or working hours and driver fatigue, and the extent to which limits on hours of driving or work help to prevent fatigue related accidents for drivers.

There are three important contributing factors that explain how and why sleep related accidents occur: time-on-task, time of day and sleep and rest deprivation.

It is logical that a human's continuous performance on a task will, after a certain time, begin to deteriorate. However, Brown (1994, p310) summarised the emerging driving research well when he stated:

> "Time on task *per se* appears to have a relatively small effect on accident risk when daily work periods are shorter than 11 h, especially when driving is restricted to normal daily work times. However, accident risk may double when duty periods exceed 12 hours."

This is an important consideration in discussion of possible relaxation of restrictions during emergency or exceptional situations.

Subsequent research from the USA (FMCSA, 1996; Hanowski et al., 2008) suggests that both time-of-day effects and sleep related effects (e.g. a lack of sleep, or irregular sleep patterns) may be larger contributory factors to sleep related crash risk than time-on-task. One of the most surprising findings was that most critical incidents occurred during the first hour of driving; a finding supported by earlier British and Finninsh research (Horne & Reyner, 1995; Summala & Mikkola, 1994).

In quantifying what constitutes a dangerous lack of sleep, it has been reported that less than four hours per night severely impairs driving performance (Naitoh, 1992) and less than five hours of sleep per night increases the chance of being involved in a sleep-related crash by five times (Stutts et al., 2003).

In conclusion, while the number of driving hours is relevant to fatigue, it is not sufficient to consider this as a sole reason for sleep-related accidents.

A key issue here is the quality of rest a driver is able to enjoy in addition to the driving duties. If the driver is chronically sleep-deprived, or suffering from sleep inertia, or in poor health, or may be eating the wrong foods at the wrong times, fatigue onset and hence the increased risk of an accident can occur almost immediately.

The report also sought to establish whether other EU Member States have drivers' hours rules for goods and passenger vehicles that are exempt from, or outside, the EU Regulation on drivers' hours (domestic legislation within each Member State).

The provisions of EU Regulation (EC 561/2006) on drivers' hours are well understood, and complemented by the sector specific EU Road Transport Working Time Directive (2002/15/EC). The review of European domestic legislation proved surprisingly complex. Some countries had well-defined legislation, which was well set out and publicised, but in others it was not possible to identify clear rules.

A further complication may be that the Working Time Directive (2003/88/EC) merely indicates that Member States shall take necessary measures to ensure that mobile workers are entitled to adequate rest. The Directive itself has proved contentious and at the time of writing 15 Member States have applied opt outs for certain categories of worker.

It was important to review the methods Australia, Canada and the United States use to tackle driver fatigue. Best practice in these countries includes the Fatigue Risk Management (FRM) programmes found to operate in Australia. Here the approach is to require employers to manage the risk that they put employees under. This can be more flexible than an approach centred on prescribed working or driving hours.

Though a working or driving hours directive or regulation sets very clear boundaries and has the clear intention of providing protection for employees, in contrast, the specific criteria for hours are somewhat arbitrary, and may be seen more as targets than limits by both employers and employees alike (Jackson 2009). Working hours also set a framework that may not sufficiently accommodate the practicalities of some operating environments. It is important to acknowledge that working or driving hours is only one component of fatigue and hence, accidents.

The evidence gathered was intended to identify what, if any, risks occur if certain requirements of the EU and GB domestic drivers' hours rules are relaxed in exceptional circumstances.

Our review of scientific studies showed that fatigue and sleepiness can be a function of the quality and quantity of prior sleep, the immediate demands of the work schedule, and the time of day. Employment factors also play a key role; opportunities for meaningful rest, the workload itself and the work environment, and the reward structure will all affect the driver in addition to rostering factors such as predictability (so that social life can be managed appropriately), timing and duration.

Other key determinants of driver sleepiness are factors outside the locus of control of the employer. Individual drivers will respond differently to any particular work regime due to their whether they naturally perform better at certain times of the day than others, and history of sleeping problems or disorders (like sleep apnoea), or the influence of any illness or medication (Jackson op.cit). Life style factors that include the activities engaged in during leisure time and adequacy of sleeping arrangements are also of high importance.

Current drivers' hours rules, both EU and UK domestic, provide a level of protection for the employee across a large range of operating circumstances. Any changes would need very careful consideration. The question of potential relaxation in exceptional circumstances, must first consider the evidence for a direct link between driving duration and accident rate. Neither the research literature, nor the GB accident databases considered in this review, have revealed a strong link between hours driven and accidents.

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Appendix A Glossary of terms and abbreviations

Table 19 - Glossary of Terms (Australian Rule Specific)

Advanced Fatigue Management (AFM)	A risk management approach to managing fatigue, rather than prescribing work and rest hours. Operators must have an AFM fatigue management system and be accredited.
Basic Fatigue Management (BFM)	Provides more flexible hours than Standard Hours, including the ability to work 14 hour work when an operator has a BFM fatigue management system and is accredited.
Chain of Responsibility	All those that use road transport as part of their business can be held liable if their actions, inactions or demands, cause or contribute to road safety breaches unless all reasonable steps have been taken to prevent a breach.
Consignee	The person named or identified as the consignee or the person who receives the load.
Consignor	The person who commissions the carrying of a load or passengers by road.
Driver	The person employed to drive a heady vehicle
Driver Base	The place where the driver usually works and receives instructions; or the garage address of the heavy vehicle; or the place where records are kept.
Employer	The person who engages someone to drive a vehicle under a contract of employment.
Loader	The person who places or restrains the load on a vehicle.
Loading Manager	The person responsible for the operation of a site where 5 of more vehicles are loaded or unloaded. It also includes those who supervise loaders or un-loaders.
Operator	The person who runs a business which controls the use of a vehicle.
Prime Contractor	The person who engages someone else to drive a vehicle under a contract for services
Reasonable Steps	Parties to the Chain of Responsibility must take all reasonable steps to prevent driver fatigue. Reasonable steps include the identification and assessment of the risks involved and the management of these risks.
Rest	All activities not defined as work
Record keeper	The person that employs the driver, including labour hire companies Owner-driver, where the driver is self-employed BFM or AFM accredited operator, where the driver or subcontractor driver is operating under BFM or AFM accreditation.
Scheduler	The person who schedules a driver's work time or rest time, or schedules the transport of goods or passengers
Standard Hours	The minimum rest and maximum work hours not linked to accreditation (12 working hours).

Standard Hours (Bus Sector)	The minimum rest and maximum work hours for those driving a bus or coach not linked to accreditation.
Work	All driving and tasks related to the operation of a heavy vehicle

Appendix B – Body for intracommunity liaison

Member State	Name of body	Address	Contact person	Telephone (with prefix)	Fax (with prefix)	e-mail
AUSTRIA	Federal Office for Transport	Trauzlgasse 1 A-1210 Wien	Walter NISSLER	+43 1 27760 9100	+43 1 27760 9099	walter.nissler@bmvit.gv.at
BELGIUM	Service public federal Mobilite et Transport Direction generale Transport terrestre Service de Controle du transport routier	City Atrium, Rue du Progres 56 1210 Bruxelles	Evelyne COPS, Attache	+32 2 27 3768	+32 2 277 4042	Evelyne.cops@mobilit.fgov.be
BULGARIA	Executive Agency Road Transport Administration within the Ministry of Transport	5 Gourko Street 1000 Sofia Bulgaria	Ivan LERINSKY	(+359 2) 988 54 95	(+359 2) 930 88 59 (+359 2) 932 51 62	ilerinski@mt.government.bg ilerinski@rta.government.bg
CYPRUS	Labour Inspection Department - Ministry of Labour & Social Insurance	Department of Labour Inspection, Nicosia 1493,	Emilios ANTONIOU	+ 357 22 405630	+ 357 22 663788	director@dli.mlsi.gov.cy
CZECH REPUBLIC	Ministry of Transport Road Transport Department	Nab. L. Svobody 12	Pavol BARAN	+420/225131641	+421/225131117	pavol.baran@mdcr.cz

DENMARK	Rigspolitiet The National Commissioner of Police	Polititorvet 14 1780 Copenhagen V Denmark	Frank Lunde DAVIDSEN	+45 33 14 88 88 (extension 7569)	+45 33 43 01 66	rpchi@politi.dk
FINLAND	art. 7.1a and 7.1c Road Transport: Liikkuva Poliisi otherwise: Sosiaali- ja terveysministeriö, Työsuojeluosasto	Viljatie 1; 00700 Helsinki Uimalankatu 1, Tampere	Erkki VIKMAN Mikko ÖRN	+358 9 189 7361 +358 9 1607 2539	7385 2511	erkki.vikman@lp.poliisi.fi mikko.orn@stm.fi
FRANCE	Ministère de l'Ecologie, du Développement et de l'Aménagement Durables Direction générale de la mer et des transports Direction des transports maritimes, routiers et fluviaux Sous-direction des transports routiers	La Grande Arche 92055 La Défense	Nicole LHOMME Yves MARCHADOUR	+33 1 40 81 14 24 +33 1 40 81 16 89	+33 1 40 81 10 66	nicole.lhomme@equipement.gouv.fr yves.marchadour@equipement.gouv.fr
GERMANY	Bundesministerium für Derkehr, Bau und Stadtentwicklung	Robert Schuman Platz 1, 53175 Bonn	Mr PERNUTZ and Mr RABENSCHALG And for Art.7. 1 (b), (c) Mrs WEBER	+49 221 576 1200 / 1201	+49 221 576 1004	Posteingang.referat12@bag.bund/de Ref-S36@bmvbs.bund.de

GREECE	Art &.1 (a), (c) Ministry of Transport and Communications Passenger Transport Directorate Freight Transport Directorate Art. 7.1.(b) Ministry of Employment and Social Protection Working Conditions Directorate	Art &.1 (a), (c) Anastaseos 2 & Tsigande, Papagou 10191, Greece Art. 7.1.(b) Pireos 40, Athens 10182, Greece	Art &.1 (a), (c) Ms Christiana PASCHALI Mr Athanasios KOUTSONIKAS Art.7.1(b) Ms Triandafilia TOTOU Ms Evangelia KRASADAKI	+30 2106508512 +30 2106508446 +30 2105295407 +30 2105203563	+30 2106508491 +30 2106508451 +30 2105295187 +30 2105203563	c.paschali@yme.gov.gr a.koutsonikas@yme.gov.gr mylxor@otenet.gr mylxor@otenet.gr
HUNGARY	National Transport Authority	H-1066 Budapest, Teréz krt. 38 H-1389 Budapest 62, Pf. 102	Árpád GORDOS	+3613731469	+3613326532	gordos.arpad@nkh.gov.hu
IRELAND	Road Safety Authority	Clonfert House, Bride Street, Loughrea, Co. Galway, Ireland	Liam DUGGAN	+353 91 872632	+ 353 91 872660	liamduggan@rsa.ie
ITALY	Ministry of Transport, Directorate General for Road Transport	Via Caraci 36 Rome - 00157	Mr De NISCO Ms CAPPELLA	+39 0641584302 +39 0641584222	+39 0641584312 +39 0641584217	Giampiero.denisco@infrastrutturetrasporti.it Stella.cappella@infrastrutturetrasporti.it

LATVIA	Autotransporta inspekcija (Road Transport Inspectorate)	Firsa Sadovnikova iela 39 Riga LV-1003	Guntars VIZIŅŠ	+371 7216445	+371 7216446 +371 7216464	ati@ati.gov.lv www.ati.gov.lv
LUXEMBOURG	art. 7.1b + c : Ministère des Transports – Commission de coordination art 7.1a : Administration des Douanes et Accises	19-21, boulevard Royal L-2938 Luxembourg 26, place de la Gare P.Box 1605 L-1016 Luxembourg	Mr. Guy STAUS Mr. José PISCITELLI	+352 247-84437 +352 290191-241	+352 228201 +352 290191-500	guy.staus@tr.etat.lu jose.piscitelli@do.etat.lu
MALTA	Malta Transport Authority Legal Unit	Triq Sa Maison Floriana FRN 1612 Malta	David SUTTON Carmel CALLUS	+356 2560 8000	+356 2125 5740	david.sutton@maltatransport.com carmel.callus@maltatransport.com
NETHERLANDS	Inspectorate of the Ministry of Transport, Public Works and Water Management Passengers Transport Inspectorate	Nieuwe Uitleg 1 2514 BP Den Haag PO Box 90653 2509 LR The Hague	Mr Hans DRIJER	+31 70 456 2845	+31 548 540783	Hans.drijer@IVW.NL
POLAND	Główny Inspektorat Transportu Drogowego	Ul. Chałubińskiego 4 00-928 Warszawa Polska	Tomasz POŁEĆ	+48 22 630 1370	+48 22 630 1389	tpolec@gitd.gov.pl

ROMANIA	Romanian Road Authority	Bd. Dinicu Golescu, Nr. 38, Sect. 1, Bucuresti	Mr. Sorin SUPURAN	+ 4021 318 21 00	+ 4021 318 21 00	office@arr.ro web: www.arr.ro
SLOVAK REPUBLIC	National Labour Inspectorate	Masarykova 10, 040 01 Kosice	Jan TRCKA	+421 79 79 922	+421 79 79 904	jan.trcka@ip.gov.sk
SLOVENIA	Transport Inspectorate of the Republic of Slovenia	Tržaška 19/a, p.p. 355, Sl-1001 Ljubljana	Mr. Ervin TOMŠIČ	+386 1 478 8177	+386 1 478 81 49	mzp.pirs@gov.si ervin.tomsic@gov.si www.gov.si/mpz
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The relationship between driver fatigue and rules limiting hours of driving and work

Research has highlighted the contribution of fatigue to driving accidents, but it is much less clear about the relationship of fatigue to driving hours.

The aims of this project were to review existing UK and international research and other published material in order to determine any links that exist between long driving or working hours and driver fatigue, and the extent to which limits on hours of driving or work help to prevent fatigue related accidents for drivers.

To accomplish these a review of drivers' hours rules in the UK has been conducted within the context of relevant scientific literature (Chapter 2), an analysis of relevant GB accident databases (Chapter 3), a detailed review of domestic legislation around Europe (Chapter 4), and an examination of practice in the USA, Canada and Australia (Chapter 5).

This report is designed to provide information to inform the ongoing review of the domestic drivers' hours legislation in the UK and initial conclusions drawn from this review and future recommendations are presented in Chapter 6.

Any changes to current drivers' hours rules, both EU and UK domestic would need very careful consideration. The question of potential relaxation in exceptional circumstances, must first consider the evidence for a direct link between driving duration and accident rate. Neither the research literature nor the GB accident databases considered in this review, have revealed a strong link between hours driven and accidents.

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