
Summary:

Fatigue in operators of land- and sea-based transport forms in Norway. Risk Profiles

Fatigue in Transport Report IV.

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29 per cent of a sample of Norwegian transport operators report at least one episode of sleeping or nodding off while operating in the course of a three-month period. Based on retrospective ratings of the most recent operating period, alertness is found to decrease rapidly towards the final hour of operation, for most types of operator. Levels of sleepiness for the final hour of operating are highest for rail operators, followed by maritime watch officers and then professional drivers of road vehicles. Profiling risks using a fatigue-risk trajectory, it is clear that operators face different sets of fatigue-related challenges, depending on the transport branch in which they work.

Professional operator fatigue is thought to contribute to substantial shares of accidents and dangerous incidents. In Norway, however, we know relatively little about the causes, prevalence and effects of fatigue in transport operators. This report is the last in a series of four reports attempting to address this problem. By surveying transport operators, this final report aims to build a profile of comparative fatigue risks in the Norwegian road, rail and sea transport sectors.

There is increasing recognition that an effective way for organisations to control fatigue is to manage it as a risk alongside other major risks within a safety management system. To encourage this practice, fatigue risks can be mapped along a Fatigue Risk Trajectory (FRT) using the following hazard levels:

0. Framework conditions and fatigue-awareness culture
1. Work characteristics
2. Recovery from work
3. Fatigue-related symptoms
4. Fatigue-related errors
5. Fatigue-related accidents and incidents

Transport safety management systems should include the monitoring and mitigation of fatigue risks at each of these hazard levels if they are to be effective.

This report profiles mainly at Hazard Levels 0, 1, 2 and 3 for land- and sea-based operators. With the help of different transport unions, we used two internet survey waves to ask operators about the various fatigue risks. The first survey wave included questions about framework conditions and culture, general work characteristics, recovery from work, and fatigue levels for the preceding three months. The first survey included standard measures of workload (NASA Task Load Index), job demands/resources and fatigue (Epworth Sleepiness Scale, Checklist Individual Strength). The second survey wave asked operators to report on sleep and fatigue for their most recent operating period, and included ratings on the Swedish Occupational Fatigue Index (SOFI), Samn-Perelli and Karolinska Sleepiness (KSS) scales. We received a total of 1776 valid responses to the first survey wave, from the

following: maritime watch officers working on a range of vessel types (n=794); train operators (n=155); and professional drivers of trucks, buses and taxis (n=917). About one third of operators participating in the first wave also participated in the second wave.

Analysis of survey responses resulted in the following findings for all transport operators.

- 29 per cent had slept or nodded off in the 3-months preceding the first survey.
- 4 per cent reported getting less than five hours sleep in the 24 hours preceding their most recent operating period.
- 14 per cent reported getting less than 12 hours sleep in the 48 hours preceding their most recent operating period.
- One in four of all transport operators report excessive daytime sleepiness (score over 10 on Epworth Sleepiness Scale).
- Over 70 per cent of transport operators reported being overweight (BMI > 25), compared to an average for Norwegian adults of 44 per cent.

Structuring fatigue risks using the FRT, we found the following on comparing operators in road, rail and maritime sectors.

Hazard Level 4. Fatigue-related errors

Falling asleep while operating was used as a proxy for fatigue-related errors. Rail operators reported the highest prevalence of sleeping while operating, with 63 per cent of cargo and 52 per cent of passenger train operators having nodded off or slept at least once in the three months preceding the survey. The corresponding share for maritime watch officers was 29 per cent, and for bus and truck drivers 26 per cent.

Hazard Level 3. Fatigue-related symptoms

Rail operators reported the highest retrospective ratings of fatigue for their most recent operating period. Average sleepiness for the final hour of operating was 5.7 on a 9-point scale (Karolinska Sleepiness Scale, KSS), versus 5.1 for watch officers and 4.3 for road operators. Prevalence of severe sleepiness (KSS 8 or 9) for the final operating hour was 16 per cent for rail operators, ten per cent for watch officers and 4 per cent for road operators. Differences in acute fatigue levels were not found to generalise to life beyond the working period, although there were some indications of broader fatigue in rail operators.

Hazard Level 2. Recovery from work

Rail operators report an average of 1.23 hours of sleep debt on a work day, road operators report 1.16 hours and watch officers 1.04 hours. Rail operators report poorer sleep quality (12.96 out of 20) than road operators (13.92 out of 20), especially in the cargo branch. Relative to other road operators, truck drivers have the highest sleep debt (1.47 h) and report the poorest sleep quality. Maritime watch officers are least able to detach psychologically from work during non-work time.

Hazard Level 1. Work characteristics

Almost all rail operators work irregular hours (rosters), and high shares report that they work shifts known to be associated with elevated levels of fatigue. However, rail operators work the least in terms of working hours, with an average work day of 8.9 hours, of which 6.5 hours is spent operating the train. The work of a rail operator is characterised by a high level of mental demand (NASA Task Load Index)

corresponding with a highly dominant sustained vigilance task. There is little control over how the work is done. Relative to other operators, rail operators report that they most frequently experience physical discomfort from poor air or temperature, and cargo operators report the most frequent discomfort from noise and vibrations.

Road operators drive for 6.8 hours on a typical work day lasting on average 9.4 hours. Truck drivers work the most, reporting an average work day lasting 10.6 hours. Many truck drivers spend considerable time on physical tasks in addition to driving. The dominant secondary activity of taxi owner-driver is waiting. Taxi owner-drivers report working the most hours per week, with half of them working six or seven days a week, but the length of the average working day was still reported as 9.9 hours. The main challenges for local bus drivers are high shares working early starts and split shifts, high psychological demands, and low job support with little say about how their work is done.

Bridge watch is the main activity for watch officers, and paperwork appears to be a dominant secondary activity for many. At least one in two officers in several branches say they are often alone on the bridge during a watch. While there is variation according to branch, overall job demands (cognitive demands, goal conflicts) are higher than for operators in land-based sectors. Officers report spending an average of 11.1 hours on watch and working 12.6 hours on a normal working day. The 6-on/6-off watch system is the most prevalent, even though researchers regard it as one of the more fatiguing systems.

Hazard Level 0. Framework conditions and fatigue-awareness culture.

A higher share of watch officers (23 per cent) than land-based officers say they have to work even though they are too exhausted to do so. Framework conditions, measured using items assessing pay, violations, training and planning, are also rated worse. Between 20 and 38 per cent of watch officers report violating working time regulations at least once a week, depending on branch (excludes ferry officers). In comparison 11 per cent of truck drivers report exceeding the driving and resting regulations at least once a week. Very few of the rail operators report working time violations.

Despite the poorer framework conditions, the culture for fatigue-awareness is rated positively by maritime watch officers relative to land-based operators. Relatively higher shares of maritime watch officers tell someone should they become fatigued, and between 30 and 51 per cent of those who tell anyone tell a line manager. A culture of fatigue-awareness is less prevalent in the rail sector, where cargo operators agree less than any other type of operator that their employer treats fatigue as a serious risk. Despite this, fewer rail operators report that they often have to work when they feel too exhausted to do so.

We have profiled the following main operator fatigue risks, according to sector, based on a comparison of sectors.

Rail

- Culture in which there is relatively low awareness of fatigue as a risk, but framework conditions are positive and shares reporting that they often have to drive when too exhausted are relatively low.
- Work is dominated by a sustained vigilance task, little task variety, low levels of control. The time of day of the work task and sleep opportunity is more problematic than the amount of work.

- Relatively high sleep debt and poor sleep quality may impede recovery from work, and may be associated with signs of slightly elevated general fatigue.
- Levels of acute sleepiness towards the end of an operating period are higher than for other operators.
- Highest reported prevalence of sleeping while operating.
- Highest acute fatigue levels while operating even though fewer say they have to operate when exhausted – this implies that acute fatigue experienced by rail operators is sudden and unpredictable.

Road

- Framework conditions rated less positively than in the rail sector. Greater shares in the road than rail sector need to drive even though they are too exhausted to do so, and there are more violations of laws designed to limit time spent driving and working.
- The nature of fatigue-related work challenges and the extent to which irregular hours and challenging shifts are worked varies widely according to branch. Job support is low overall.
- Truck drivers report the highest levels of sleep debt and poorest sleep quality, and more drivers sleep away from home when working.
- Fatigue in truck drivers is more physical in nature. More bus drivers report that they lack energy after work.
- Relative to the maritime and rail operators in this study the reported incidence of sleep while operating is low, but no less concerning in terms of absolute levels and since the chance of having an accident due to drowsy operating is higher.

Sea

- Framework conditions, including working time violations and having to work while exhausted, are worse than they are for land-based operators.
- Operators work the longest hours day after day (although most have extended periods to recover from tours at sea). Many often work alone on the bridge and many work at night. Many watch systems curtail sleep lengths, and mean that operators must sleep at times of day when it is difficult. Cognitive job demands are high.
- Acute sleepiness towards end of a watch can approach that of rail operators in some branches. Officers score higher on concentration fatigue and burnout than road operators overall.
- Relative to road operators, incidence of falling asleep while operating (on watch) is high.

The study has not attempted to assess the relative contribution of the different risk factors to fatigue, nor controlled for the fact that operators have rated fatigue for recent work periods at different times of day. When considering these results, we also should consider the varying demographics of operators responding, as well as the extent to which they represent the different populations of transport operators in Norway. The results presented here will nevertheless be useful, both for researchers wishing to compare fatigue and risk factor levels among different samples, and for managers wishing to measure and mitigate fatigue as part of a Safety Management System.