Review of Fatigue/Distraction Detection Technology

Driver fatigue and distraction are still significant factors in heavy vehicle crashes. Recent industry data suggests that one in ten heavy vehicle crashes results from heavy vehicle driver fatigue.

While minimum rest and maximum work limits are the primary protection against heavy vehicle driver fatigue—and have successfully lowered this rate—innovative approaches are needed to drive future improvements.

Driver fatigue and distraction detection technology—involving a range of electronic systems—is becoming increasingly common in the heavy vehicle industry.

The NHVR is undertaking a *Fatigue Monitoring Trial* across five phases to gain a greater understanding of the characteristics, performance and utilisation of a range of fatigue safety related technologies. This document summarises the Phase 1 research component of the trial.

Purpose of the Review

Phase 1 of the Fatigue Monitoring Trial reviewed current and commercially available fatigue/distraction monitoring/detection technologies to identify

1) technologies currently in the market,
2) how they monitor drivers for signs of fatigue and or distraction, and
3) the relative merits/disadvantages of each monitoring paradigm.

Methodology

An exploratory approach was utilised for Phase 1. A number of databases and search platforms were utilised, including academic research and commercial websites.

Key outcomes:

Fatigue and distraction detection technology can identify and address incidents before they occur.

It is claimed the concept of preventing crashes rather than looking at them post event is a challenging but unique opportunity to make a real and positive difference in safety on our roads but this has not been definitively tested.

The review categorised current technologies into six key paradigms:

- Fitness for duty tests
- Continuous operator monitoring - Oculomotor measurements
- Continuous operator monitoring – EEG - Electroencephalography
- Other continuous operator monitoring technologies
- Performance based monitoring
- Vehicle related technologies including crash avoidance technologies

Each paradigm was considered to have potential safety benefits and disadvantages, depending on the operational risks faced and the safety management approach adopted by user.

A number of current commercially available technologies, identified in Phase 1, are shown in the table overleaf.

Conclusions after the review

Oculomotor measurement devices or face monitoring systems utilising in-vehicle cameras provide real-time monitoring of driver fatigue and also driver distraction. These devices offer most value to users and are focus for Phases 2 and 3.

There is limited evidence however on the reliability and validity of fatigue and distraction detection technologies, especially from independent third party assessments.

The review indicates that devices should not be implemented as a stand alone tool for fatigue management. Rather, the technology should be used as part of a Fatigue Risk Management System.

Phase 1 of the trial is complete with further research commencing to address Phases 2-5.

For more information:
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Summary of fatigue/distraction monitoring technologies

Technology	Description	Fatigue/distraction technology devices	Effectiveness of technology devices
Fitness for duty tests	Tests are generally conducted before work to determine current alertness levels of drivers.	Variety of devices that assess worker/driver performance including vigilance or hand-eye coordination. For example, OSPAT. Not suitable for ongoing detection or monitoring driver fatigue within the heavy vehicle industry.	Not suitable for ongoing detection or monitoring driver fatigue within the heavy vehicle industry.
Continuous operator monitoring - Oculomotor measurements	Fatigue/distraction technologies based primarily on eye movements.	Optalert, CoPilot /DD850, Seeing Machines (DSS, Guardian), GuardVant (Opguard), LUCI, SafetyTrax DDM, Eye-Com, SmartEye, Blackbird Antisleep, DriveCam. Many oculomotor devices also detect driver distraction.	Many oculomotor devices also detect driver distraction. Only Seeing Machines technologies and Optalert had any third party assessments. Seeing machines (Guardian) have been implemented within the heavy vehicle industry.
Continuous operator monitoring – EEG - Electroencephalography	Fatigue detection based on brain wave activity.	SmartCap, B-Alert, WARDEN EEG type devices do not detect driver distraction.	Although evidence suggests EEG-type technologies do detect driver fatigue (albeit limited third party assessment) – EEG type devices do not detect driver distraction.
Other continuous operator monitoring technologies	Devices that continually measure physiological correlates of fatigue during work -	**Posture/head nodding** – Nap Zapper, Stay Awake, Driver Fatigue Alarm, NoNap, Dozer's Alarm, MicroNod, Travel Mate, Stay Alert. **Galvanic skin resistance** – (Engine driver vigilance telematics control system)	Although posture/head nodding type technology may be a predictor of driver fatigue, no third party assessments on the effectiveness of the technology for the heavy vehicle industry could be identified.
Performance based monitoring	Devices that monitor performance indicators that are associated with fatigue-related incidents.	**Embedded performance measures** – monitor task performance indicators associated with fatigue incidents (SafeTrak, MobilEye, AutoVue, Delphi, Maven Machines, CarVi, & Smartphone applications).	No current third party assessment of technologies. Limited assessed ability to predict driver fatigue and distraction, especially in the heavy vehicle industry.
Vehicle related technologies including crash avoidance technologies	Fitted vehicle safety technologies that aim to assist the driver to reduce the likelihood of a crash.	**Crash avoidance technologies** – Electronic Stability Control, trailer roll stability, autonomous emergency braking, electronic braking system, electronic brake distribution, adaptive cruise control, forward collision warning, lane departure warning.	Crash avoidance technologies do not provide any alert in relation to prediction of driver fatigue/distraction. Could be considered as an effective back-up to more driver predictive/monitoring technologies rather than the primary method to detect instances of driver fatigue.