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EVALUATION OF SEEING MACHINES – AN ONBOARD FATIGUE AND DISTRACTION MONITORING SYSTEM

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ABSTRACT

As part of FPInnovations' and BC Forest Safety Council's ongoing evaluation of fatigue management, the driver assistance system Seeing Machines, an eye-tracking-based technology that monitors driver fatigue onboard in real time, was evaluated. In addition, distraction was monitored and evaluated. Readiband, a wristband technology with biomathematical science that monitors drivers' sleep quantity and quality, was used to correlate the band-reported fatigue score with Seeing Machines' reported fatigue events. The study findings, participants' feedback, and onboard device performance are summarized in this report.

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INTRODUCTION

The forest industry recognizes that driver fatigue is one factor in motor vehicle-related incidents. TimberWest initiated an evaluation of Seeing Machines' Guardian system,[1] an in-cab fatigue monitoring and intervention system. Two TimberWest contractors volunteered to participate in this study. TimberWest asked the BC Forest Safety Council to manage the project. FPInnovations took the lead in evaluating the fatigue monitoring technology.

One option to consider when implementing a fatigue management program is to have access to valid metrics by using onboard technologies that alert drivers and fleet managers when the system detects driver fatigue. By incorporating knowledge of fatigue management strategies, companies and drivers could implement appropriate measures to reduce the risk of fatigue-related motor vehicle incidents. Using eye-tracking technology that monitors driver fatigue in real time and wristband-based technology that monitors drivers' sleep quantity and quality will help quantify the level to which fatigue affects log truck drivers and the benefits of countermeasures and interventions in mitigating this effect. Shetty and Kohorst (2017) examined different fatigue monitoring technologies on the market and ranked them according to certain criteria. Based on feedback from TimberWest, Seeing Machines was selected for evaluation in this study.

In this study, three methods of assessing fatigue were examined: Seeing Machines' system, driver journals, and Readibands. This report focuses on the Seeing Machines' system. The system alerts the drivers in real time through an audible alarm and seat vibration when fatigue is detected and by audible alarm when distractions are detected. Additionally, managers are alerted about driver fatigue in real time when connection with the device is established as soon as the truck enters cellular range. The Readiband technology provides drivers with a tool to manage their sleep better by monitoring sleep. It uses the Fatigue Avoidance Scheduling Tool algorithm to provide current and predictive fatigue scores based on the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) model. The Readiband was used to correlate fatigue levels with Seeing Machines' data, but drivers were not provided with the additional functionality of the Readibands.

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[1] Seeing Machines is Australian company that offers a fatigue management system to fleets under the Guardian brand and offers support to North American clients through their office in Arizona.

OBJECTIVES

The objectives of this study were to:

- evaluate the use of Seeing Machines' technology in the log hauling environment, including its operational performance, effectiveness, acceptance, and usability
- evaluate whether there is a correlation between the SAFTE score and fatigue events or the Karolinska Sleepiness Scale (KSS)

METHODOLOGY

Seven drivers from two logging contractor fleets participated in this study. Suppliers supported the fleets and pilot program facilitators during the installation and training period to ensure that drivers understood the technology and that managers were able to effectively use the dashboard. Readibands and daily sleep journals were provided to drivers. The Project Coordinator conducted orientation sessions, provided training on successful data collection, and answered questions from drivers and managers about the project. Drivers completed daily sleep and activity journals, which were used to validate sleep periods, collect KSS data, record breaks, track medication/caffeine use, and document shift schedules for each driver. In addition, drivers recorded any fatigue prevention measures or countermeasures used, such as shortening shift duration, adjusting start times, taking a power nap, or drinking caffeine. The KSS was used to assess the drivers' sleepiness state at the start and end of the work shift. Table 1 shows the KSS from 1 to 9. A lower number indicates a higher level of alertness; a higher number indicates increased fatigue. In this study, participating drivers were de-identified. Fleet managers and project facilitators had access to the manager dashboard.[2] Fleet managers, at their discretion, were able to use the manager dashboard to take action when distraction or fatigue incidents were reported by the Seeing Machines' system.

Table 1. The Karolinska Sleepiness Scale (KSS)

KSS	Description
1	Extremely alert
2	Very alert
3	Alert
4	Rather alert
5	Neither alert nor sleepy
6	Some sign of sleepiness
7	Sleepy, but no effort to stay awake
8	Sleepy, some effort to stay awake
9	Very sleepy, great effort to stay awake

[2] TimberWest staff had no access to the dashboard, videos, or any personally identifiable information about the drivers.

The study consisted of a baseline establishment stage followed by an active fatigue management stage. During the baseline stage, Seeing Machines' system's alert and Readiband's score app were set to "off"; during the active fatigue management stage, the Seeing Machines' system's alerts were set to "on". The manager dashboard was visible throughout the project. Table 2 shows the monitoring elements for the test and control groups during the baseline establishment stage and the active fatigue management stage.

Table 2. Baseline establishment stage and active fatigue management stage elements

Elements	Baseline establishment stage	Active fatigue management stage
Number of drivers	7[a]	7
Onboard alerts	No	Yes
Sleep and fatigue data collected	Yes	Yes
Seeing Machines' manager dashboard	Yes	Yes
Readiband app. fatigue monitoring	No	No
Duration	4 weeks	4 weeks

[a] One driver's data (Driver #3) were removed from the Seeing Machines analysis because the camera was obstructed during the active fatigue management stage; therefore, inclusion of this truck's data in the distraction analysis could skew the data.

The parameters for creating an event record are presented in Table 3. Prolonged blink was classified as drowsiness; very long closure and small eyelid opening was classified as microsleep. Yawning generally occurs when a person is under stress and is tired; thus, this was categorized in fatigue-related events in this report. Yawning as an early sign of fatigue is still a subject of research. Thompson (2014) has tried to study the link between yawning, fatigue, and cortisol levels. However, concrete scientific evidence still does not exist.

Seeing Machines' back end staff reviewed event records and reclassified the events based on qualitative assessment, and alerted the fleet manager, if required. "Eyes off the road but not closed for more than 1.5 seconds" events that were identified as fatigue events were reclassified as distracted driving. Figure 1 illustrates driver distraction elements and the position of Seeing Machines' components.

Table 3. Event recorded conditions

Event	Duration (s) longer than:	Vehicle speed (km/h) greater than:
Fatigue events (either drowsiness[a] or microsleep[b] state)	1.5	24
Distraction events indicated by head movement, such as glance away or glance down	4	30
Distraction events indicated by eye movement, such as attention off road	1.5	30
Other events, such as cell phone use	Classified regardless of duration	Classified regardless of speed
Obstructed view	600	24

[a] A state of quiet wakefulness that typically occurs before sleep onset (AASM 2001).

[b] An episode lasting up to 30 seconds during which external stimuli are not perceived (AASM 2001).

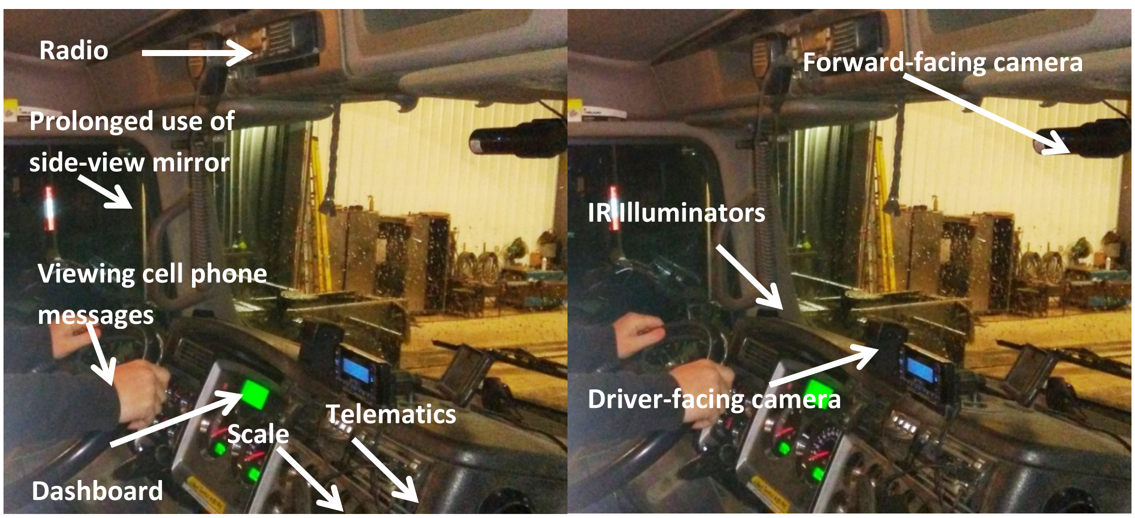

Figure 1. Distraction elements within the cab (left), and Seeing Machines' device components (right).

Baseline stage: Fatigue and distraction data were collected from seven drivers for four weeks using Readiband and Seeing Machines' units.

Active fatigue management stage: The same group of drivers was monitored for another four weeks during which real-time driver alerts were activated. In-cab audio and seat vibration alerts were activated for events identified by the system as fatigue detection. System-detected distraction events initiated an in-cab audio alert.

Readiband sleep and fatigue data were collected to determine if there was a correlation between fatigue events and predictive fatigue levels. Figure 2 presents SAFTE thresholds correlated to blood alcohol content (BAC). A SAFTE score of 70 is equivalent to 22 h awake, which is equivalent to 0.08 BAC (legal limit in Canada); a score of 77 is equivalent to 17 h awake, which is equivalent to 0.05 BAC (legal limit in British Columbia). A score of 77 or lower is considered as fatigue impaired.

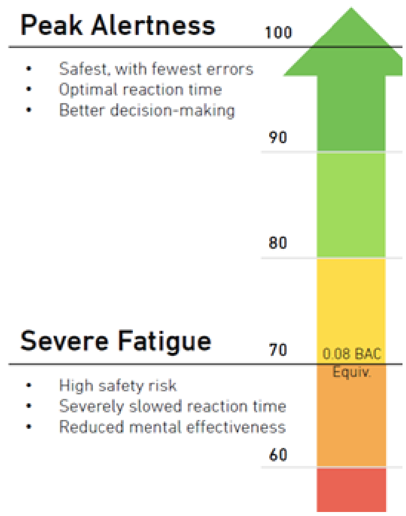

Figure 2. Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) threshold (BAC: blood alcohol content) (Image source Fatigue Science – All rights reserved).

The following criteria were used to evaluate the technology:

- ease of installation
- required training and ease of use
- driver acceptance
- technology performance
- level of support from the technology provider, and technology reliability

RESULTS AND DISCUSSION

Seeing Machines operational performance and effectiveness

Installation and system calibration occurred over a two-week pre-study period. This period was included in the study to capture fatigue-related events because only a few events occurred during the study. Table 4 summarizes fatigue-related events for both the baseline and active fatigue management stages. During the baseline stage, there were three drowsiness events (one back-to-back event was considered as one event) and five microsleep events. All microsleep events occurred on highways. Two of the three drowsiness events occurred on highways. During the active fatigue management stage, one drowsiness event was detected; it occurred while driving on a gravel road. Lane departure was observed during some of these drowsiness and microsleep events. Figure 3 shows the duration of fatigue-related events during the baseline and active fatigue management stages. Due to the low number of drowsiness and microsleep events, no statistical relationship could be established between the two stages. In the case of yawning, there was no statistical difference in duration between the two stages.

Table 4. Number of fatigue-related events

Type	Baseline stage	Active fatigue management stage	Difference
Drowsiness	3	1	2
Microsleep	5	0	5
Yawning	12	11	1

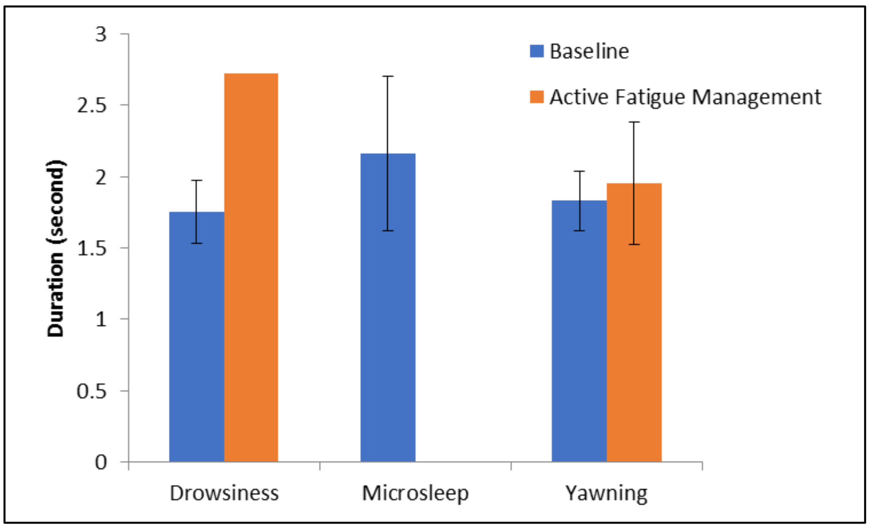

Figure 3. Duration of fatigue-related events (inclusive of the 1.5-s threshold): baseline vs. active fatigue management stages.

The number of distraction events by distraction type during the baseline and active fatigue management stages is presented in Table 5. A 79% difference in the number of distraction events was noted between the baseline and active fatigue management stages. No significant change in other distraction events was detected. Figure 4 shows the duration of “eyes off the road” during distraction events. There was no statistical difference in “eyes off the road” between the baseline and active fatigue management stages. The duration of distraction (i.e., eye glance away from the road) was greater than 3 s while glancing at scales, telematics, and communication radios.

Table 5. Distraction-related events

Type	Baseline stage	Active fatigue management stage	Difference
Other distraction events (e.g., cell phone use, smoking, eating, reaching around within cab, nail biting)	23	22	1
Glance down (instrument panel, cell phone viewing) (obstructed view)	271	56	215
Glance away, left (mirror check)	2	2	0
Glance away, right bottom (scale, telematics)	13	16	-3
Glance away, right up (communication radio)	3	1	2
Overall	312	97	

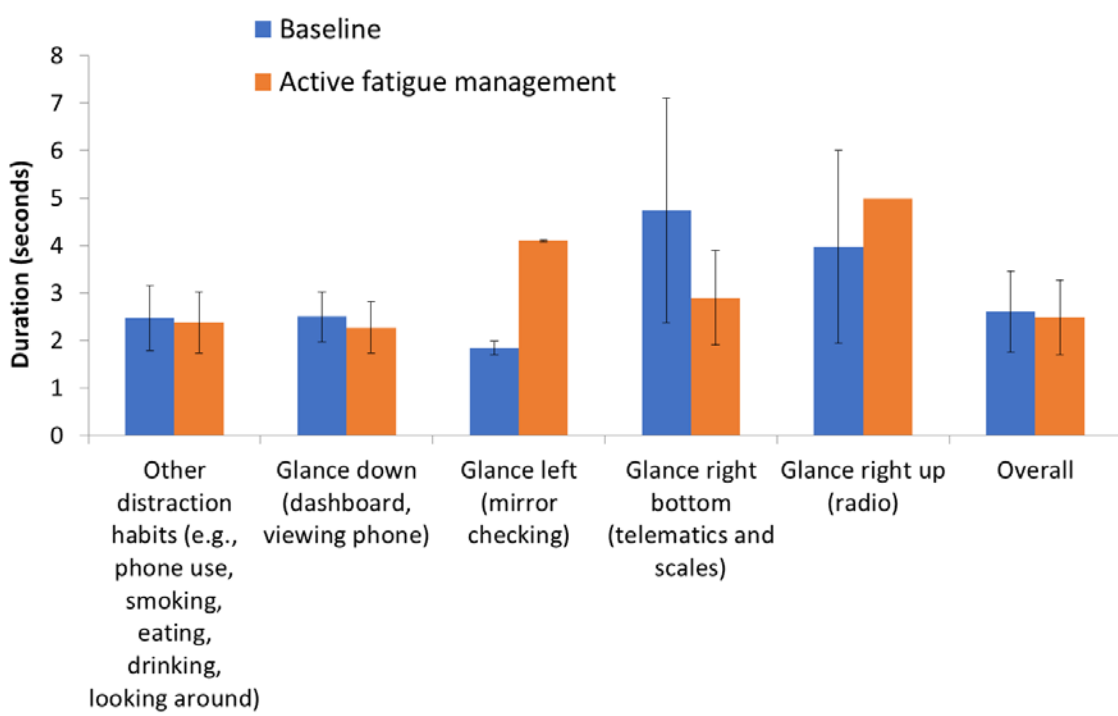

Figure 4. Distraction duration (inclusive of the 1.5 s threshold) for the baseline and active fatigue management stages.

Driver 1 had the highest number of distraction events, which may have skewed the results for the whole population. Hence, the number of events and duration for the overall fleet were also presented with driver 1 excluded (Figure 5). A 38% improvement in distraction was observed for the fleet overall with exclusion of driver 1. No significant difference was observed in “eyes off the road” duration between the two stages.

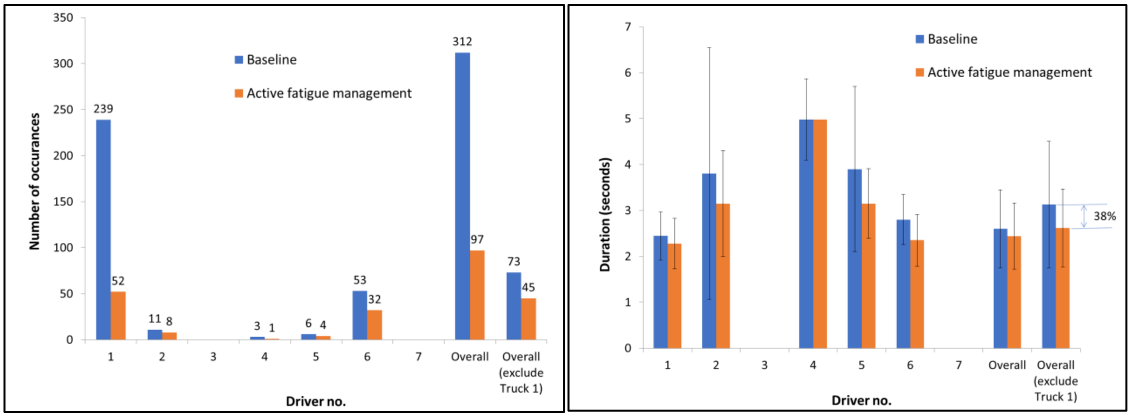

Figure 5. Number and duration (inclusive of the 1.5 s threshold) of distraction occurrences per driver.

The longer the duration of an “eyes off the road” event, the higher the likelihood of incidents. Liang et al. (2012) and Simons-Morton et al. (2014) showed that the odds of a crash and near-crash event is 3.8 times higher for a duration greater than 2 s of “eyes off the road” during all secondary tasks (tasks subordinate to driving activity, such as eating and drinking, reaching for objects in the vehicle, adjusting the radio and other equipment on the steering wheel or centre console, and operating devices such as the window control, seat belt, or sun visor), and 5.5 times higher for a duration greater than 2 s during wireless secondary task engagement (use of a cell phone—i.e., talking, dialing, and texting while driving—which is against the law). Figure 6 presents the frequency distribution of distraction (i.e., “eyes off the road”) duration during the baseline and active fatigue management stages. The frequency of distraction for a duration greater than 2.5 s was significantly less during the active fatigue management stage.

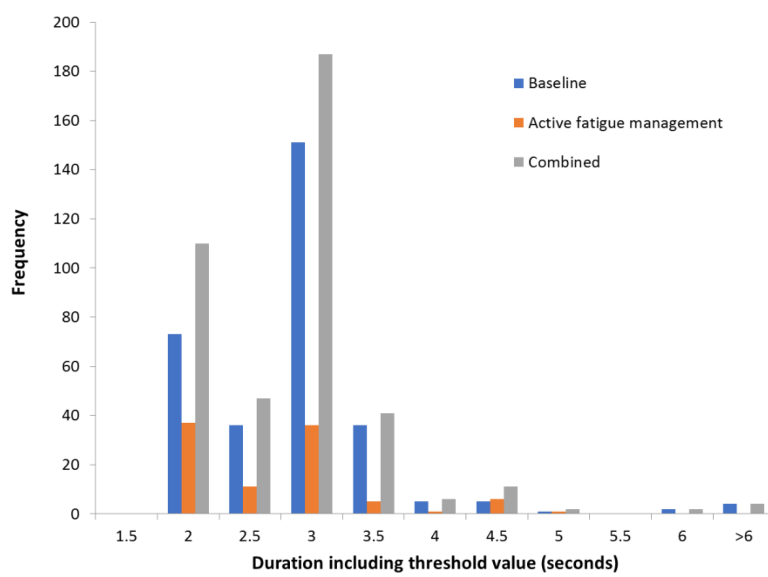

Figure 6. Frequency of distraction; i.e., eyes off the road.

Drivers received real-time alerts, whereas managers were alerted after Seeing Machines' backend staff verified the events. Table 6 shows the reclassification of false positive alerts; i.e., distracted driving events that alerted drivers of a fatigue event but which were reclassified as distraction events by Seeing Machines' staff. Some discrepancies were noted in driver-reported alerts (journal entry) and Seeing Machines' system alerts. Some switching of trucks may have occurred during the study, which could contribute to the discrepancies.

Table 6. Reclassification and false positive alerts during the active fatigue management stage

	Fatigue alert (audio and vibration)		Distraction alert			
Truck no.	True	False positive reclassified	True	Fatigue events	Total distraction events	Driver-reported alerts (journal entries)
1	1	52	0	1	52	54
2	0	0	8	0	8	0
4	0	0	1	0	1	15
5	0	3	1	0	4	0
6	0	32	0	0	32	8
Total	**1**	**87**	**10**	**1**	**97**	**77**

Seeing Machines acceptance and usability

DRIVERS' ACCEPTANCE

Drivers were surveyed at the end of the study to provide their feedback on system operation and its effectiveness in managing fatigue and distraction. The driver survey form used in the study is presented in Appendix A. Table 7 summarizes feedback received from five drivers. The feedback indicated that they considered the system to be too sensitive. However, they thought the system was effective in managing fatigue and distraction.

Note that video footage from in-cab cameras indicated that several of the drivers did not react favourably to alerts. For drivers' acceptance, reduction in the high number of false positive alerts needs to be addressed.

Table 7. Drivers' feedback

Category	Average feedback
1. Effectiveness in managing distraction	Effective
2. Effectiveness in managing fatigue	Moderate to very effective
3. Technology rating	Moderate to very effective
4. Privacy infringement	40% felt their privacy was infringed upon; 60% did not feel their privacy was infringed upon
5. Distraction	60% of the drivers thought device alerts were distracting
6. Feedback adequate	60% of the drivers found the feedback was adequate
7. Change in driving habit	No
8. Incident avoidance	No
9. Break encouragement	No
10. Improved safety	No
11. Recommend	No
12 Improvement and general comments	The unit was too sensitive; the system was not suitable for logging

FLEET MANAGERS' ACCEPTANCE

Feedback was also solicited from the two fleet managers (Table 8). The survey form used in the study is presented in Appendix B. The managers found deployment, training, and use to be easy, and system performance and reliability to be moderate. The cameras were mounted for temporary use, and on one truck, the camera was displaced due to vehicle vibration. Permanent installation will be required in the future to alleviate this issue. Identification of drivers' non-compliance, such as cell phone use and not wearing seat belts, was found to be very valuable. Both fleets supported the use of this system. However, successful implementation would require industry-wide acceptance. Some tweaking will be required for the system to be adopted in logging operations.

Table 8. Fleet managers' feedback

Category	Average feedback
1. Ease of deployment and maintenance	Moderate to very easy
2. Training required	Very minimal
3. Ease of use	Very easy
4. System performance and reliability	Moderate
5. Ease of data management	Moderate
6. Level of tech provider's support	Moderate to high
7. Safety improvement	Moderate impact
8. Technology rating	Moderate to highly liked
9. Satisfaction level	Moderate to high
10. Corrective action taken	Yes
11. Resistance from driver	Some
12. Implement technology	One fleet will implement the technology, and another will if the benefit is proven
13. Comments	Needs some tweaking to adapt to the logging industry

Correlation between the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) score and fatigue events

Table 9 presents the conditions under which fatigue events were recorded by Seeing Machines. Most of the events occurred at high speed on highways in the morning; two events occurred at low speed on gravel roads in the afternoon.

Table 9. Fatigue events recorded by Seeing Machines

Event no.	Driver no.	Stage	Event type	Road type	Speed (km/h)	Duration[a] (s)	Time
Ev 1	1	Baseline	Microsleep	Highway	87	1.57	4:21 a.m.
Ev 2	4			Highway	70	2.58	8:42 a.m.
Ev 3	1		Drowsiness	Gravel	31	2.00	2:41 p.m.
Ev 4	1			Highway	107	1.58	7:30 a.m.
Ev 5	1			Highway	109	1.67	9:43 a.m.
Ev 6	1	Active fatigue management		Gravel	27	2.72	12:42 p.m.

[a] Includes threshold value.

All the Seeing Machines' reported fatigue events were correlated with the SAFTE score at the time of the fatigue event. The SAFTE alertness scores are hourly averages. A score below 70 indicates there is high chance of fatigue impairement; higher scores indicate a driver is at peak alertness during the measured hourly period. Figure 7 shows the comparison between the SAFTE alertness score scale at the time of a fatigue event and Seeing Machines' recorded fatigue events. Event (Ev) 3 and Ev 4 occurred in the yellow zone of SAFTE alertness; four events occurred in the green zone of SAFTE alertness. Based on the recorded fatigue events, there was not a direct correlation between the SAFTE alertness score and the fatigue events.

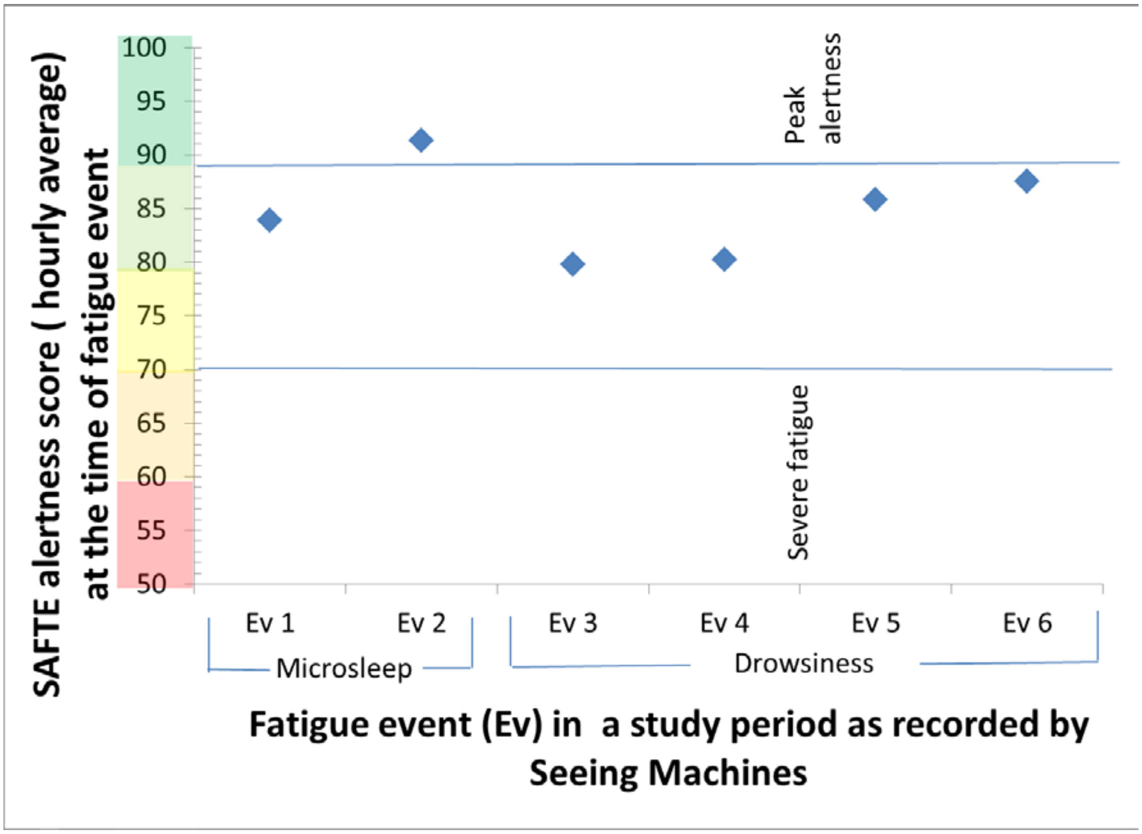

Figure 7. Comparison of Seeing Machines' recorded fatigue events and the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) score.

The SAFTE alertness score is an objective alertness scale with a range from 0 to 100, whereas KSS is a subjective sleepiness 9-point Likert-type scale. The correlation between these two scales was examined with 30 observations (Figure 8). The data showed a decreasing trend with very low regression value. As the SAFTE's alertness scores dropped below 82, the alertness scores were in the sleepy zone of the KSS scale. However, due to variability in score correlation, it is possible for the driver to be fatigue impaired at higher alertness score.

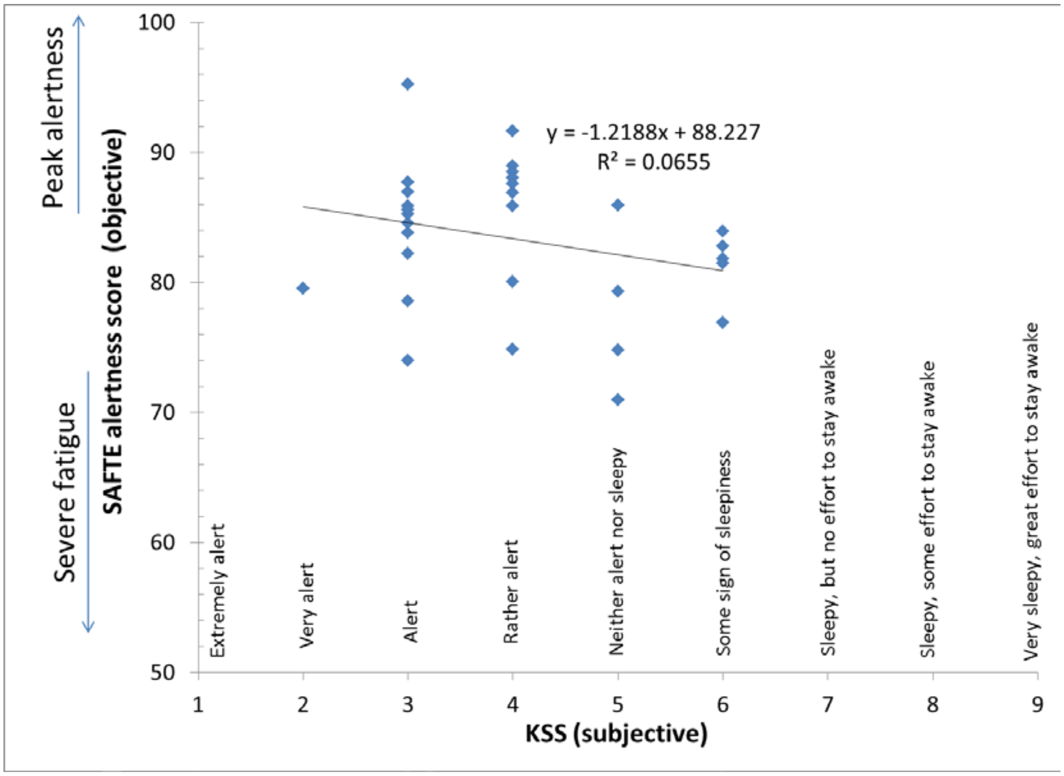

Figure 8. Correlation between the Sleep, Activity, Fatigue and Task Effectiveness (SAFTE) alertness score and Karolinska Sleepiness Scale (KSS).

Managing fatigue and distraction are complex issues. The study results indicated that driver alertness decreased as the week progressed. Recovery was achieved and alertness level increased with greater sleep over the weekend. Figure 9 shows the trend for the participating fleets. There was no statistical difference in alertness level between fleet A and B.

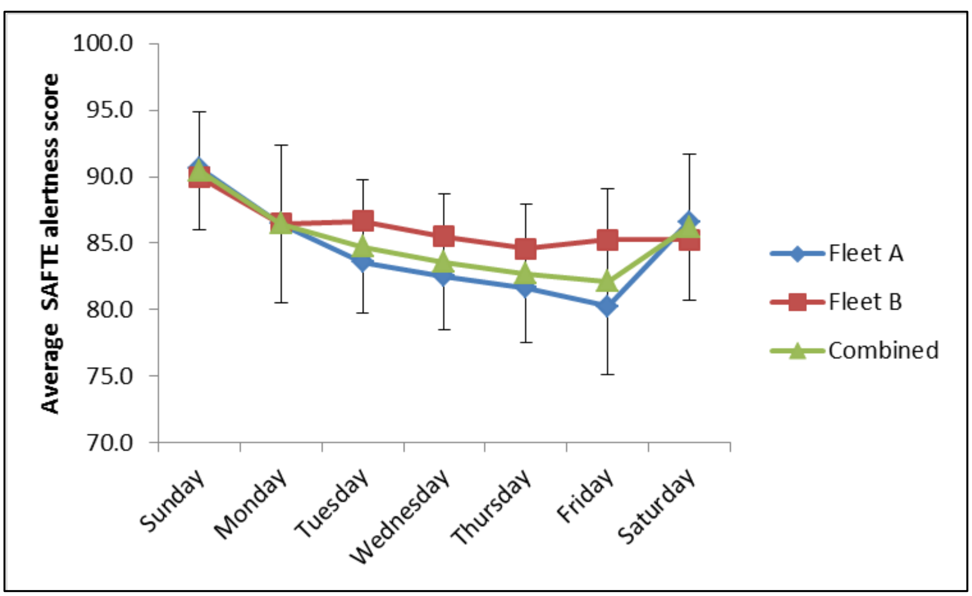

Figure 9. Average Sleep, Activity, Fatigue and Task Effectiveness (SAFTE) alertness score during weekends and weekdays.

The KSS score showed a similar trend (Figure 10) based on subjective feedback. Drivers self-reported that they were less alert at the end of the shift during the middle of the week.

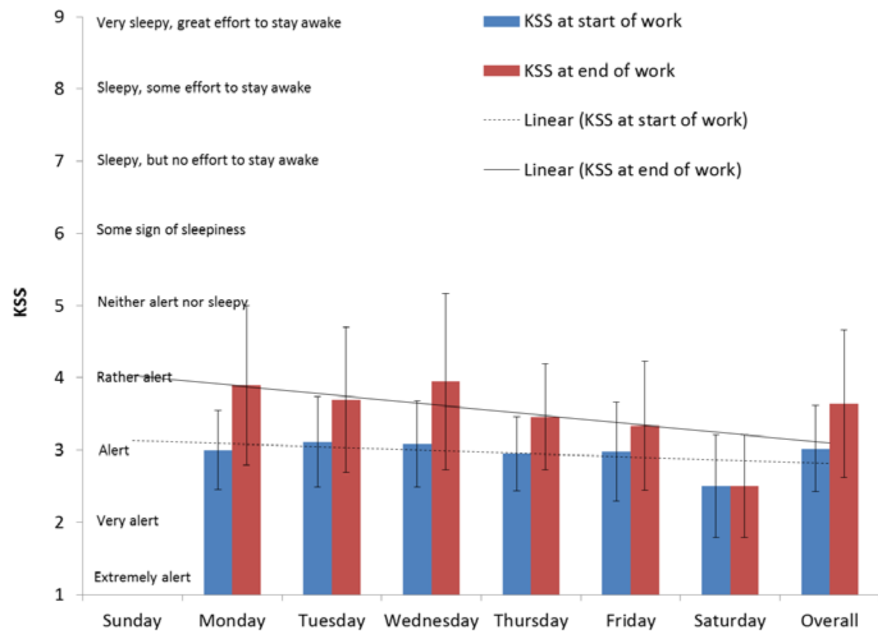

Figure 10. Comparison of the Karolinska Sleepiness Scale (KSS) at the start and end of work throughout the week during the baseline and active fatigue management stages.

The average sleep duration was 6.3 hr, with a minimum duration of 4.3 hr and a maximum duration of 14.5 hr. Drivers who had fatigue events indicated that they took breaks and power napped 75% of the time to manage fatigue, while some drivers reported not taking any breaks during this study.

CONCLUSION

Distracted driving was observed in almost all of the drivers who participated in the study. Some restricted behaviours (cell phone use, lack of seat belt use) were observed in this study. Vehicle lane departure was observed during some distraction and fatigue events.

During the short study period, the Seeing Machines' system identified six fatigue events. A direct correlation between the Seeing Machines' reported fatigue events and the SAFTE alertness score could not be determined, but the data were very limited. Based on the correlation between the SAFTE alertness score and KSS, it is quite possible to have fatigue impairment at the higher alertness score as well.

Some improvement was observed between the baseline and active fatigue management stages. The distraction duration of more than 2.5 s was considerably reduced during the active fatigue management stage. Reduction in distraction duration was likely due to in-cab alerts.

Technology like Seeing Machines could play an important role in fatigue and distraction management by creating awareness of driver behaviours. In-cab alerts can potentially reduce the risk of incidents where fatigue or distraction is the root cause.

The Seeing Machines' Guardian system seems to be a promising tool for improving safety in the fleet. However, the barriers to driver acceptance, primarily false positive fatigue alerts, need to be addressed.

KEY POINTS

- Evaluation of eye- and face-tracking in-cab fatigue and distraction monitoring technology in logging operations was found to be useful in identifying high-risk behaviours.
- Low prevalence of fatigue-related events, such as microsleep and drowsiness, and high prevalence of distraction events were observed in a day shift operation during the study.
- Industry needs to address fatigue and distraction collaboratively.
- The frequency of distraction for durations greater than 2.5 s was considerably reduced during active fatigue management.
- Drivers rated the technology high; however, they found the system was too sensitive for the log-hauling environment.

NEXT STEPS

Further work should be conducted with Seeing Machines' personnel to reduce false positives in order to achieve driver acceptance of the technology. Discussion and awareness regarding driver distraction needs to continue in consultation with industry, fleet owners, and drivers.

Industry needs to develop strategies that reduce the risk of fatigue- and distraction-related incidents. Technology is a component of a program but is not the complete solution in managing fatigue and distraction within the fleet.

This study was conducted in 12-hr shift operations in which there is only a day shift. It is recommended that further trials be conducted in other British Columbia log hauling operations in which there are longer duty hours and night shift operations in order to better understand the effectiveness of Seeing Machines' technology.

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APPENDIX A DRIVER SURVEY FORM

FPInnovations

June 2018

Driver Survey Form

Evaluation of Seeing Machines fatigue/ distraction monitoring system in log-hauling fleets

1. How effective do you consider the Seeing Machines' system in preventing distracted driving?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Not effective at all ------Moderately ineffective-------Effective----------Moderately effective-----------Very effective

2. How effective do you consider the Seeing Machines' system in preventing fatigue related incidents while driving?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Not effective at all ------Moderately ineffective-------Effective----------Moderately effective-----------Very effective

3. Do you feel that fatigue/distraction infringed on your privacy? ☐Yes ☐ No

4. Did the Seeing Machines system alerts distract you while driving? ☐Yes ☐ No ☐ N/A

5. Were the systems' warning signals and feedback adequate? ☐Yes ☐ No ☐ N/A

6. Have your driving habits changed as a result of use of this system? ☐Yes ☐ No

7. Were there situations when having the system installed helped to avoid an incident? ☐Yes ☐ No

8. Did you take breaks when this system indicated that you were fatigued? ☐Yes ☐ No

9. Are there improvements that you would recommend to the system? If so, what?

10. Rate this technology for monitoring and preventing fatigue/distraction from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Highly disliked----------Moderately disliked------Somewhat liked--------Moderately liked---------→ Highly liked

11. Did this technology improve your safety while driving? ☐Yes ☐ No

12. Would you recommend this system to others? ☐Yes ☐ No

13. Do you have any other comments or feedback regarding the Seeing Machines system?

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APPENDIX B FLEET MANAGER FEEDBACK FORM

June 2018

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Fleet Manager Survey Form

Evaluation of Seeing Machines fatigue/distraction monitoring system in log-hauling fleets

1. Rate ease of deployment and maintenance for this technology from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Very difficult --------Moderately difficult----------Easy----------------Moderately easy------------- -→Very easy

Comments: ____

____

2. Rate the training required for this technology from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Intensive training ------------Moderate training--------Minimal training-------- Very minimal -------→No training required

Comments: ____

____

3. Rate this technology in ease of use from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Very difficult ------Moderately difficult -------------Easy-------------Moderately ease-------------→Very easy to use

Comments: ____

____

4. Rate this system's performance and reliability from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Highly unreliable ----------Unreliable---------Somewhat reliable----------Moderately reliable------→ Highly reliable

Comments: ____

____

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5. Rate the ease of data management for this technology from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Very difficult----------Somewhat difficult--------------Easy---------------Moderately easy---------→ Very easy

Comments: ____

____

6. Did you or your staff take corrective action when critical alert messages where emailed to you? ☐Yes ☐ No

7. What has been the general reaction from operators? Was there a resistance to using the system from drivers? If so, why?

____

____

8. Rate the level of support received from the technology provider during pilot test

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

No support -------Minimal support-----------Some support-------------Moderate support-------→ High support

Comments: ____

____

9. Did this technology improve safety of your trucking operations? Rate the impact from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

No impact ----------------------Some impact-----------------------Moderate impact-------------→ High impact

Comments: ____

____

10. Rate this technology for monitoring and managing fatigue and distraction from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Highly disliked----------Moderately disliked------Somewhat liked--------Moderately liked---------→ Highly liked

Comments: ____

____

11. Rate your satisfaction level for this technology from 1 to 10

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Unsatisfactory ----Somewhat unsatisfied-------Satisfied -------Moderately satisfied----------→ Highly satisfied

Comments: ____

____

12. Would you implement this technology in your fleet? ☐Yes ☐ No

13. If the answer to question 12 is no, then please specify reasons for not implementing (select all that apply)

☐ Cost ☐ Driver rejection ☐ No impact ☐ Difficult to manage ☐ Technology not ready

☐ Intensive training required ☐ No support ☐ Difficult to deploy ☐ Others ________________________

14. Do you have any other comments or feedback regarding the Seeing Machines' Guardian fatigue and distraction monitoring system?

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