
Advance Technologies to Improve Safety and Productivity



Correlation of Close Proximity Events and Operator Alertness

Haulage & Loading 2013

May 20, 2013

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Correlation of Close Proximity Events & Operator Alertness

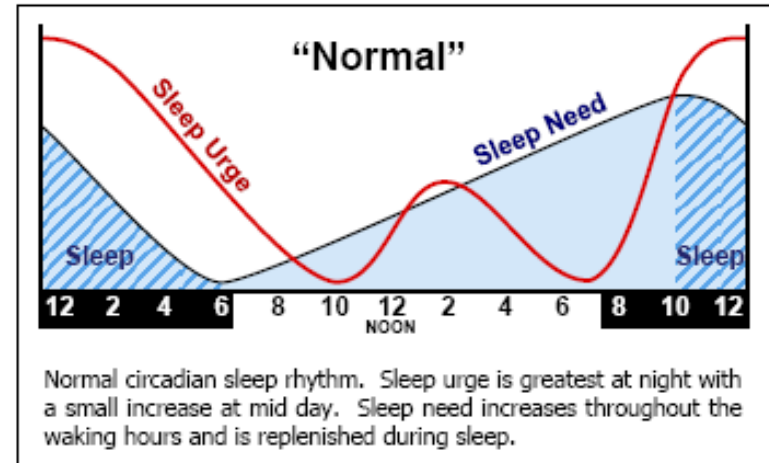
Agenda

- Introduction
- Symptoms of fatigue
- Highlights of Fatigue Research which correlates fatigue & performance
- What happens in the “real world”.
- Describe technology which can gather data to link fatigue and proximity
- Conclusion
- Questions

Fatigue in the Mining Industry

- **The mining industry has become much more focused on the issue of Fatigue.**
 - 12 hour, rotating shifts
 - Working against the Circadian Rhythm
 - Significant commute times to remote locations.

- **“The times, they are a changin’ ”**
 - On average, we are sleeping 1 hour less per night than we did a decade ago.



Symptoms of Fatigue Summary - I

- **Concentration**
 - Forgetfulness
 - Difficulty concentrating

- **Decrease in Performance**
 - Slower mentally
 - Slower physically
 - Poor Short Term memory

- **Emotional**
 - Withdrawn Depression
 - Increased stress levels Decreased tolerance
 - Reduced motivation Irritability
 - Lacking energy Anxiety

Symptoms of Fatigue Summary - II

- **Drowsiness**
- **Mental Exhaustion**
 - Burnout
 - Stress
 - Manifest in mental, physical emotional & behavioral symptoms
- **Reaction Time**
 - Poor Judgment
 - Poor Performance
 - Slower Reaction times

Fatigue Research – Increased Risk Taking

“Sleep-deprived subjects are less concerned with negative consequences when faced with high rewards on the ‘overall loss’ desk. “

“Kilgore (2006) reported that total sleep deprivation impairs the ability to weigh immediate short-term benefits against long-term penalties.”

“The work suggests that individuals may be willing to take more risk during sleep deprivation than they would when well rested.”

The Effects of One-Night of Sleep Deprivation on Known-Risk and Ambiguous-Risk Decisions.

McKenna, Benjamin., David L. Dickinson, Henry Orff, and Sean P.A. Drummond (2007) Journal of Sleep Research, vol. 16, no. 3: pg 245-52. Published by Wiley-Blackwell.

Poor Risk Perception?



Fatigue Research – Impact on Higher Level Performance

“Sleep deprivation is known to impair various aspects of cognitive performance of which monotonous, attention demanding, long and machine-paced tasks are most sensitive.”

“Performance impairments have been found in speed, accuracy, and overall stability.”

“Effects of task repetition, e.g. boredom and fatigue, could in some cases be additional causes, or interact ‘positively’ with sleepiness.”

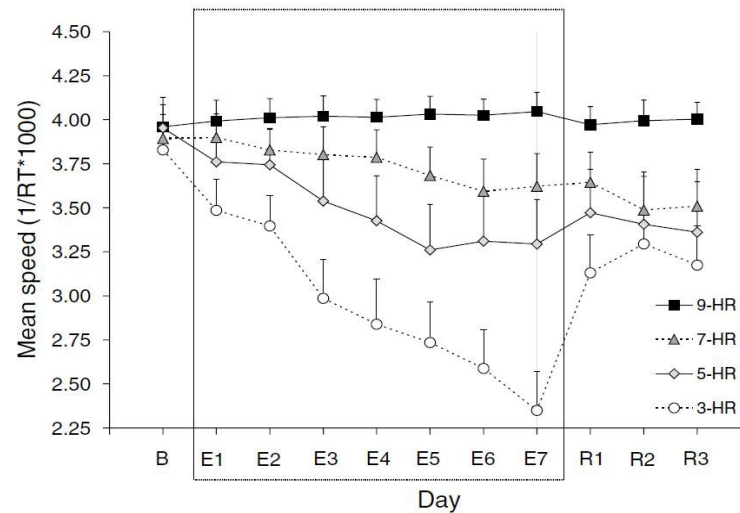
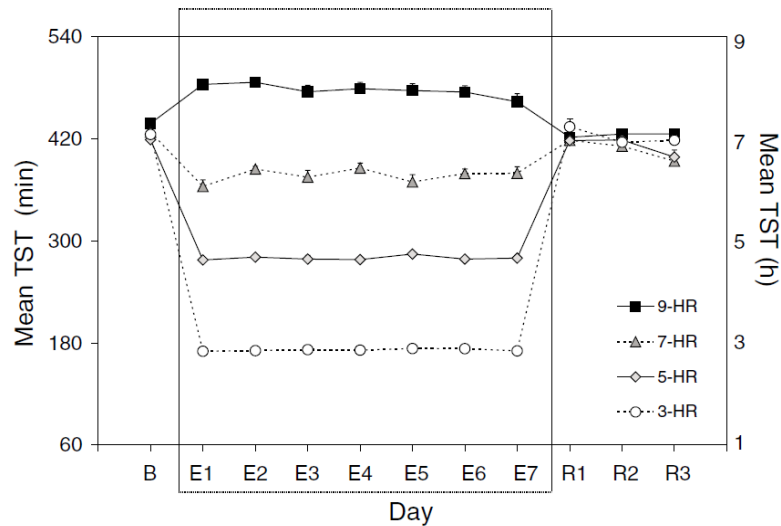
Less Effective Executive Functioning After One Night’s Sleep Deprivation

JENS P. NILSSON , MARIE SODERSTROM, ANDREAS U. KARLSSON, MATS LEKANDER, TORBJORN AKERSTEDT, NINA ERIXON LINDROTH and JOHN AXELSSON, Journal of Sleep Research, Vol. 14 no. 1.

Cognitive Performance?



Fatigue Research – Performance Degradation



Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study

GREGORY BELENKY, NANCY J. WESENSTEN, DAVID R. THORNE, MARIA L. THOMAS, HELEN C. SING, DANIEL P. REDMOND, MICHAEL B. RUSSO and THOMAS J. BALKIN, Division of Neuropsychiatry, Walter Reed Army Institute of Research, Silver Spring, MD, USA, Journal of Sleep Res. (2003) 12, 1–12

Reduced Cognitive Throughput?



“Historically, the focus of sleep loss studies has been the effects of total sleep deprivation on generally simple tasks (eg, reaction time). More recent evidence has suggested that executive functions (eg, risk taking and moral reasoning) are also negatively impacted by sleep loss.”

“From these studies, general characteristics of sleep loss-mediated performance decrements have been gleaned. These include findings that, for example, sleep loss tends to result in the following:

- (1) slowed response times;*
- (2) a narrowing of attention, and, not surprisingly;*
- (3) an increased propensity to initiate sleep.”*

Sleep Loss and Sleepiness: Current Issues

Thomas J. Balkin, PhD; Tracy Rupp, PhD; Dante Picchioni, PhD, and Nancy J. Wesensten, PhD.

Chest 2008; 134; 653-660 DOI 10.1378/chest.08-1064

Higher Decision Making Processes ?



Fatigue Research – Effects of Distraction

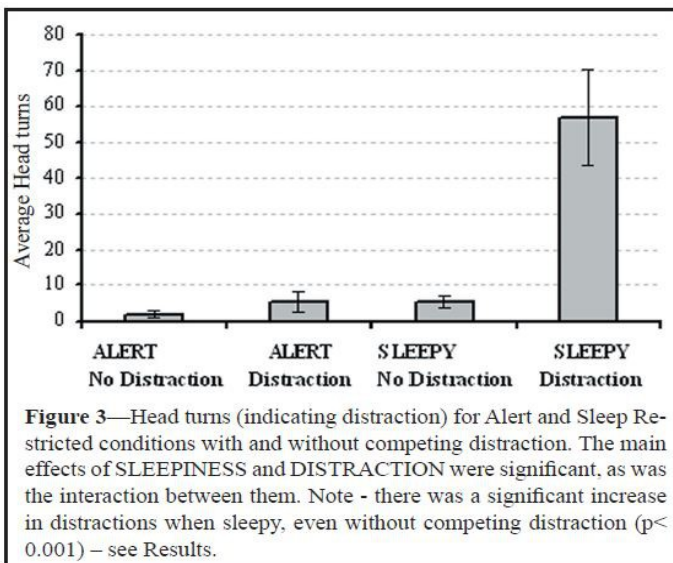


Table 1—Number of Head Turns per Minute as a Function of Time on Task. Data are presented as mean \pm SEM. Note the clear effect of distraction on sleepiness throughout the duration of the test, even during the first 10 minutes of testing.

Condition	Time on Task, min		
	0-10	11-20	21-30
ALERT			
No Distraction	0.11 \pm 0.01	0.08 \pm 0.01	0.07 \pm 0.01
Distraction	0.39 \pm 0.03	0.32 \pm 0.02	0.14 \pm 0.01
SLEEPY			
No Distraction	0.11 \pm 0.01	0.25 \pm 0.04	0.27 \pm 0.04
Distraction	1.85 \pm 0.09	2.20 \pm 0.09	2.51 \pm 0.12

“Conclusion: Distractibility is an important aspect of sleepiness, which has relevance to safety in the real world, eg, sleepy driving.”

Sleepiness Enhances Distraction During a Monotonous Task

Clare Anderson, PhD; James A. Horne, PhD

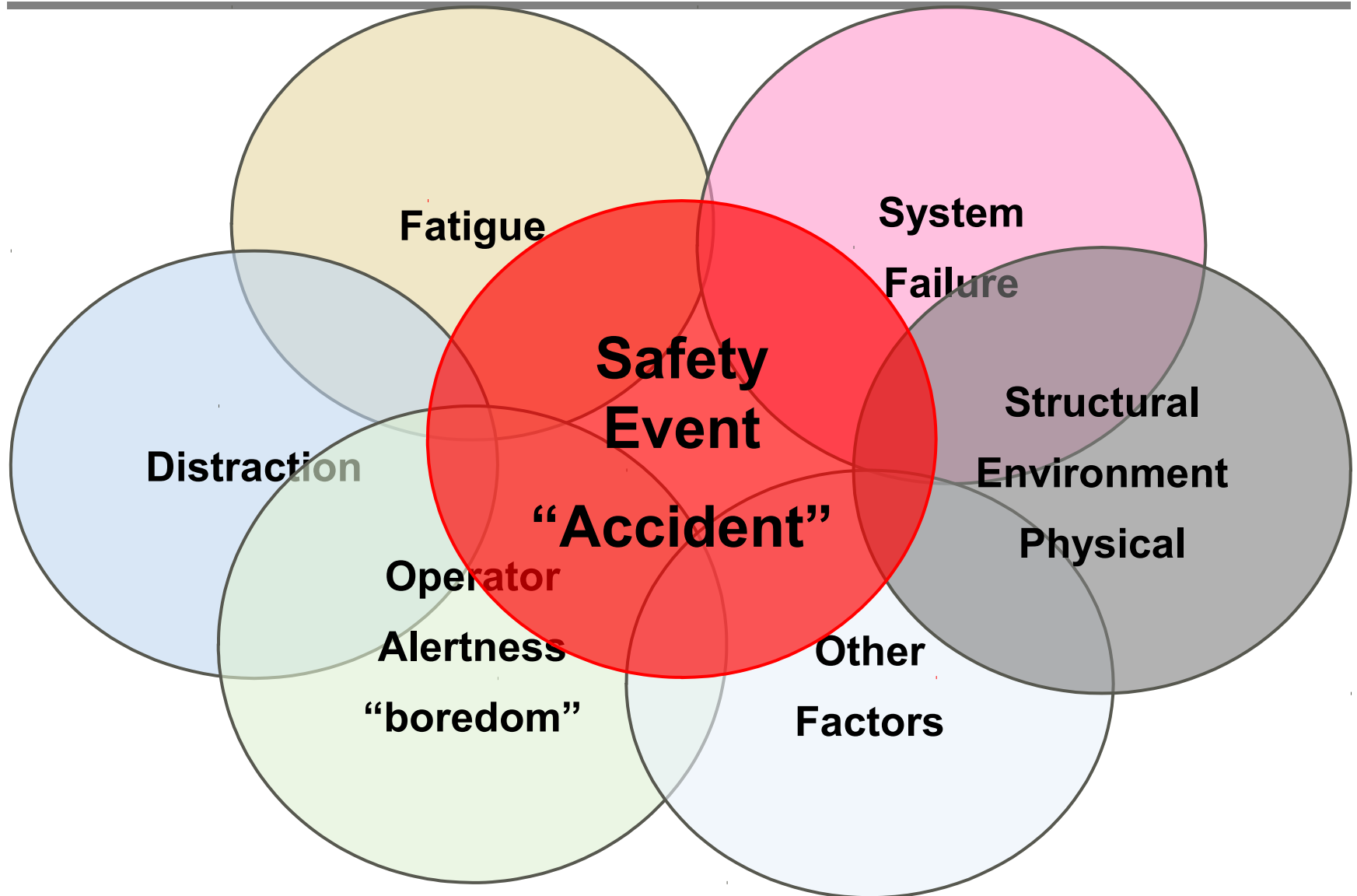
Department of Human Sciences, Loughborough University, Loughborough, Leicestershire, United Kingdom.

SLEEP 2006; 29(4): 573-576

Fatigue or Distraction? Or Both?



Real-World Inter-related Causations



The Industry Question

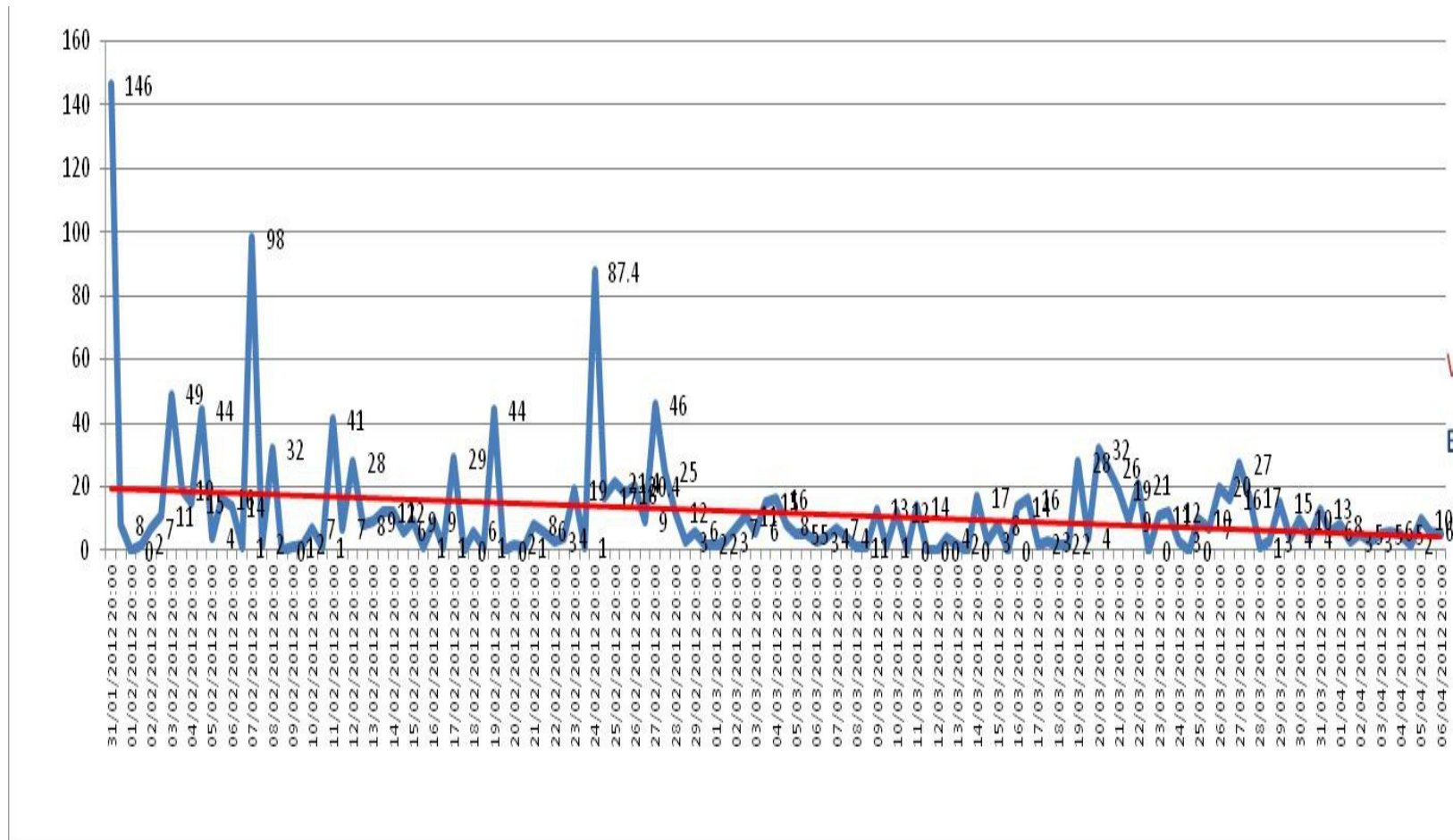
In the case of mobile equipment, think about:

- Bent ladders
- Scrapped paint
- Broken mirrors
- Cut tires

Do real-world observations correlate with data collected on:

- The number of fatigue events
- The number of proximity events
- The number of Heavy Equipment related incidents?

Average Number of Events by Haul Truck by Shift



- Positive trend attributed to the installation of OpGuard system. 75% Decrease
- Does this correspond to a proportional reduction in fatigue related incidents?

In southern Africa, GuardVant has just installed the 1st ever integrated fatigue monitoring and proximity detection system.

- *OpGuard* - Operator Fatigue and Distraction Monitoring
- *ProxGuard* - Proximity Awareness and Object Detection
- *Central Analytics Server* with **common** systems Database

OpGuard Fatigue Monitoring



ProxGuard Proximity Awareness & Object Detection



Guardvant Mobile Server (GMS) - On-board Computer

Supports OpGuard, ProxGuard and other applications



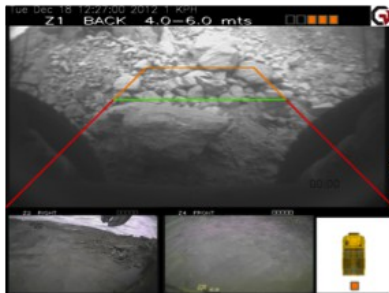
Operator Fatigue
Monitoring Systems



Fleet Management &
Health Systems



Biometric Systems



Proximity Awareness
& Object Detection

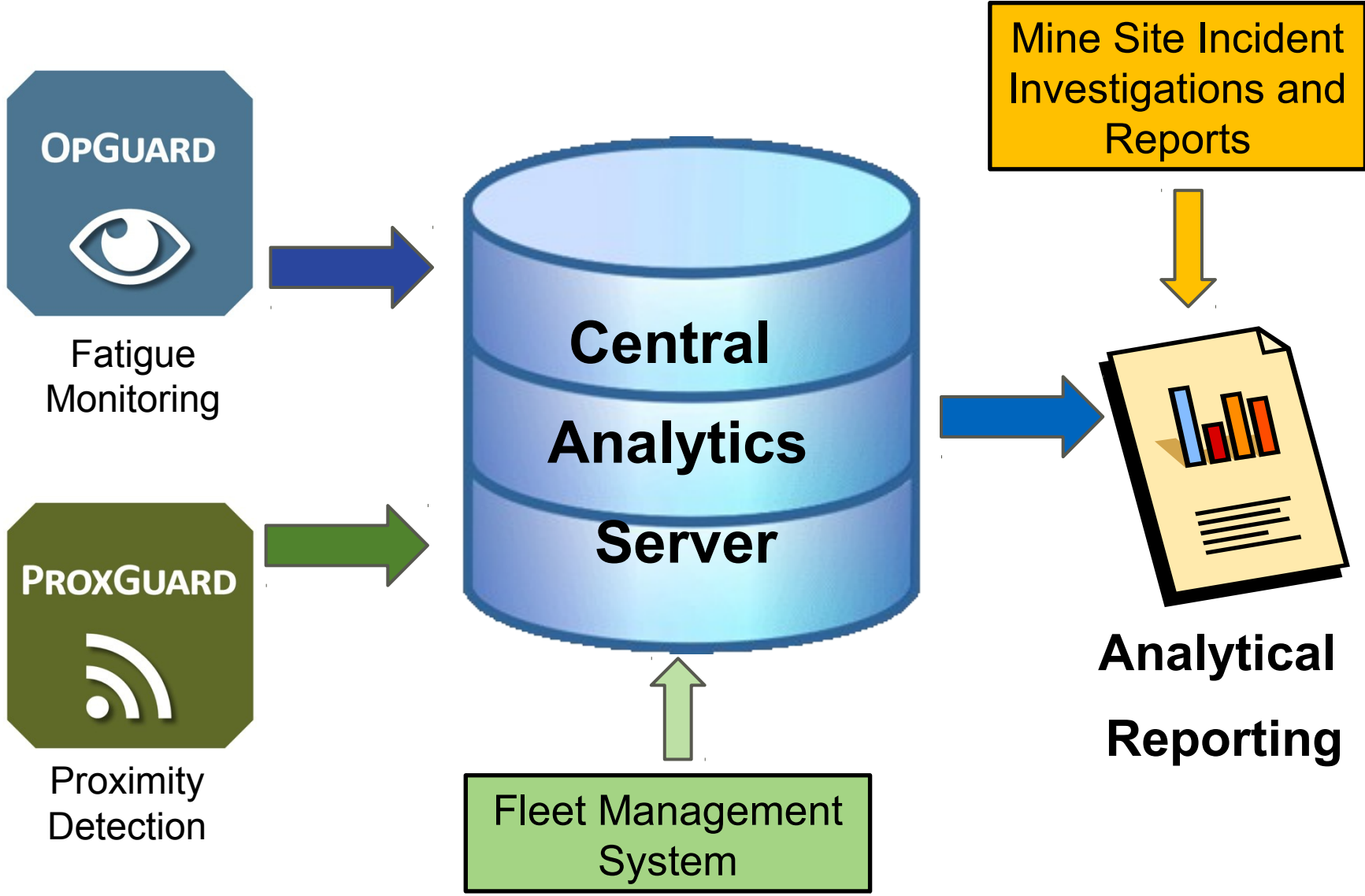


Guardvant Mobile Server (GMS)



Fire Suppression
Systems

Guardvant Dataflow – Correlation of Proximity and Alertness



Sample Daily Report



Reporte de Eventos de Fatiga

Fecha Inicial
7/12/11 18:00

Fecha Final
7/13/11 6:00

Eventos Registrados

114

Distancia Total Recorrida (mts)

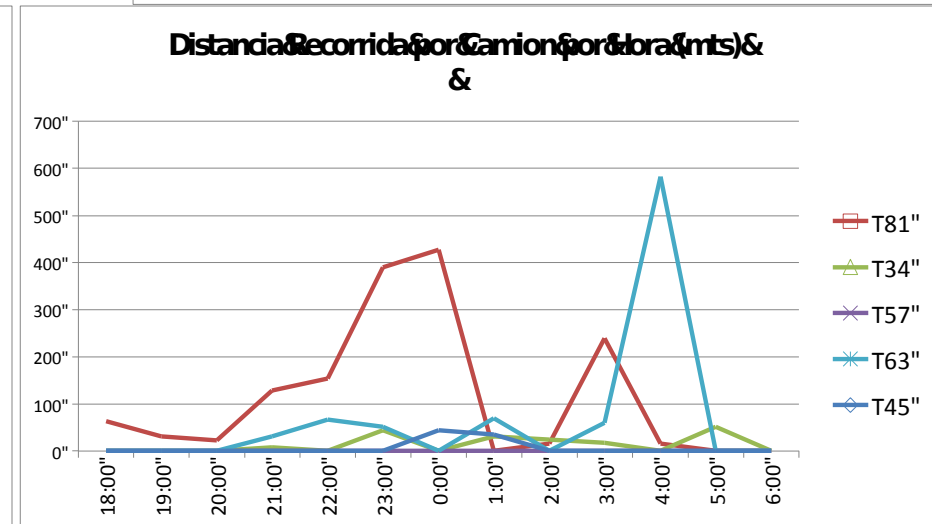
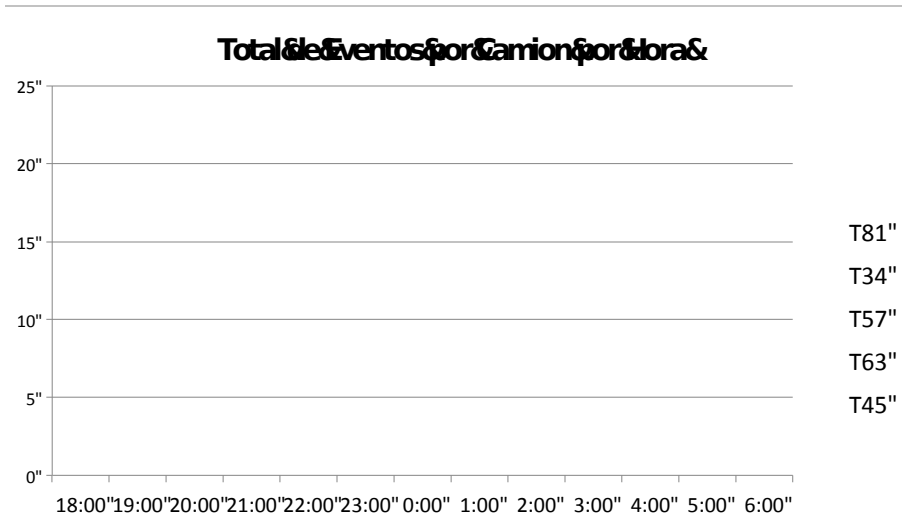
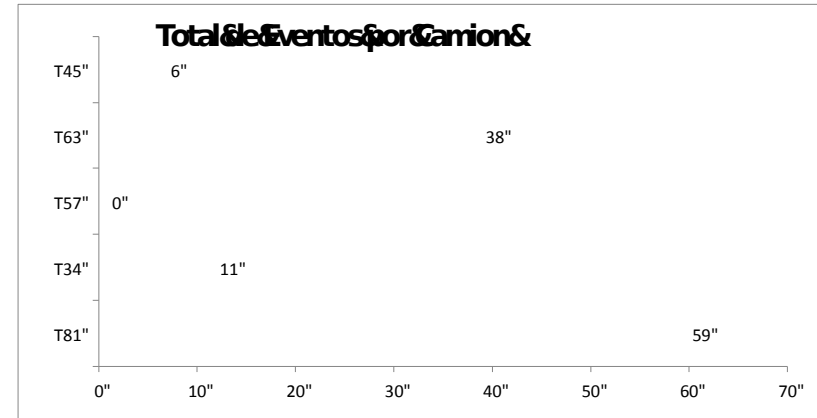
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Distancia Promedio Por Evento (mts)

22.86

Velocidad Promedio/ Evento (kph)
28.8

Camiones en Mantenimiento
Camiones con camara Obstruida

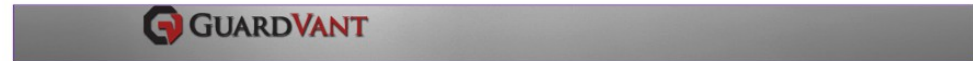


Real-Time Fatigue Events / Production Reports

Events By Hour

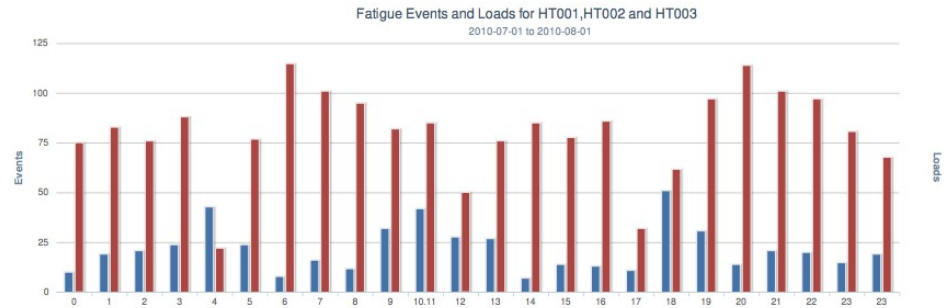
http://localhost:3000/truck_load_by_hour_days?ut

- Truck Reports
- Loads per hour per truck
- Fatigue events per hour per truck

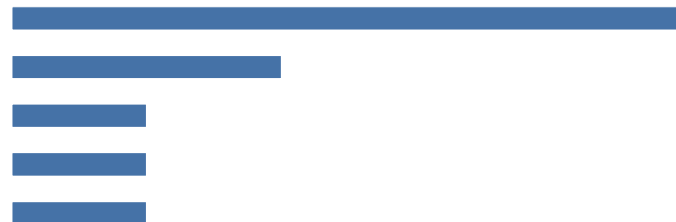


Home Reports

Start: 2010 July 1
End: 2010 August 1 Reload



- Fatigue events per logical route



Summary

- Fatigue is a major safety and performance issue
- Symptoms of fatigue manifest themselves in many forms:
 - Drowsiness
 - Slow reaction times
 - Inability to evaluate risk
 - Emotional
- Academic Sleep Research shows strong relationship between fatigue and performance
- Guardvant has developed technology to assist drivers with both fatigue and proximity
- Technology has the ability to record in a single database the events for both fatigue and proximity and determine correlation.
- 1st such system has recently been installed in Southern Africa.

THANK YOU...

Questions?

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