



In-Vehicle Monitoring Systems – On and Off Duty: Evaluating Driver Performance and Schedules in a Small Well Servicing Fleet

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No Pictures or Video Recording

- Videos that we will show are from actual studies, but these participants have agreed to let me show you
- BUT, no cameras, PLEASE!



Video #1, part a

Videos removed for protection
of participant identity.



Video #1, part b

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Video #1, part c

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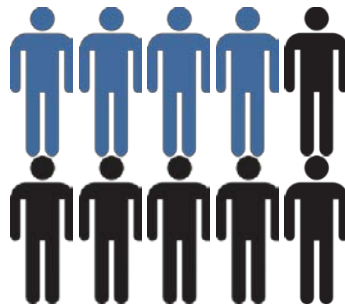


Did you know?

Motor vehicle crashes are the leading cause of death at work for oil and gas extraction workers.

Within O&G Industry

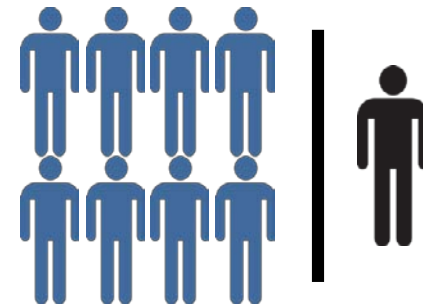
41%



4 in 10 O&G work-related deaths involve a MV, not including off-duty or commuting deaths

Compared to Other Industries*

8x

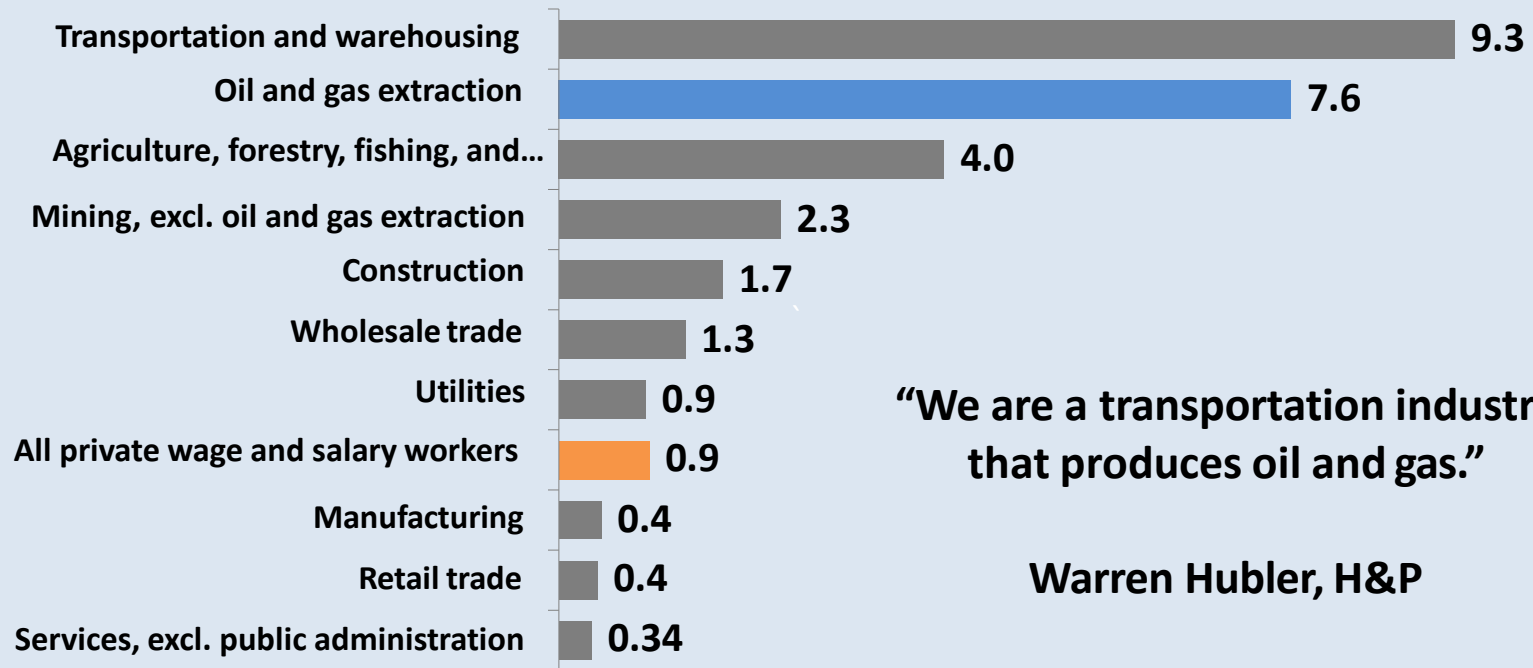


O&G MV fatality rate is 8x that of all industries, and is similar to the transportation industry



What is the risk to drivers in the oilfield?

Motor Vehicle Fatality Rate per 100,000 Workers, 2003-2009

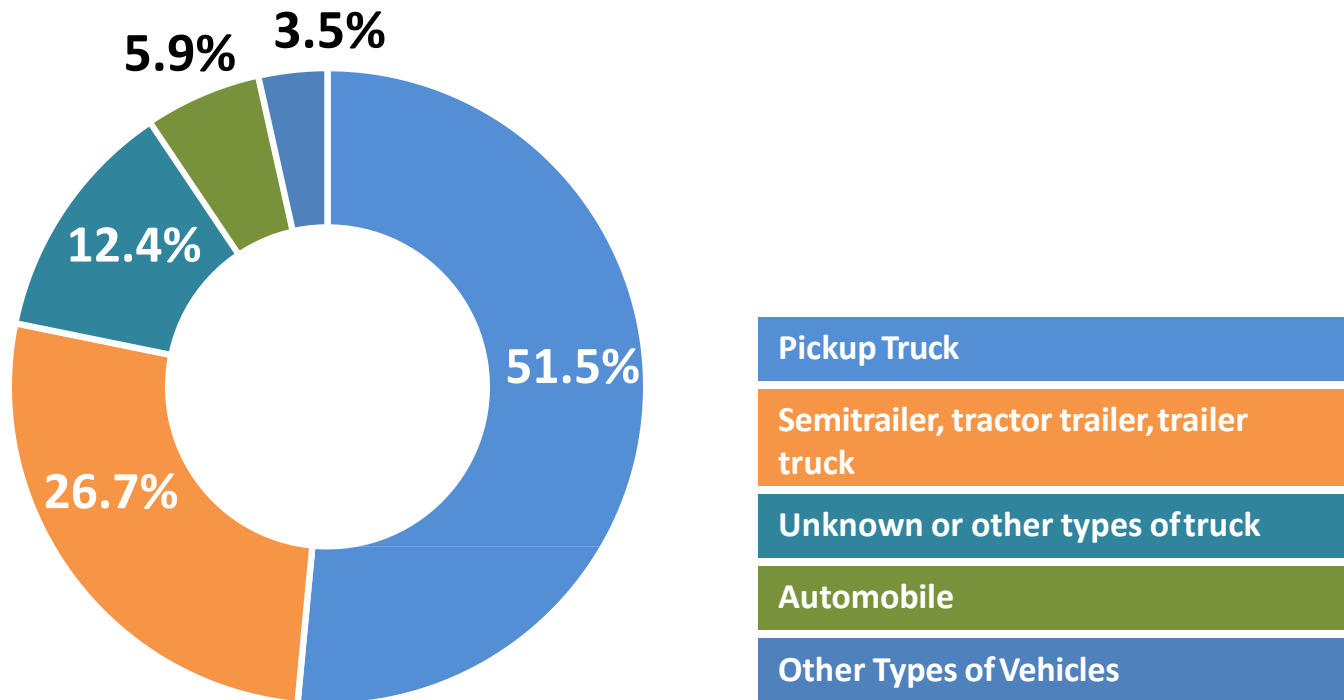


**“We are a transportation industry
that produces oil and gas.”**

Warren Hubler, H&P



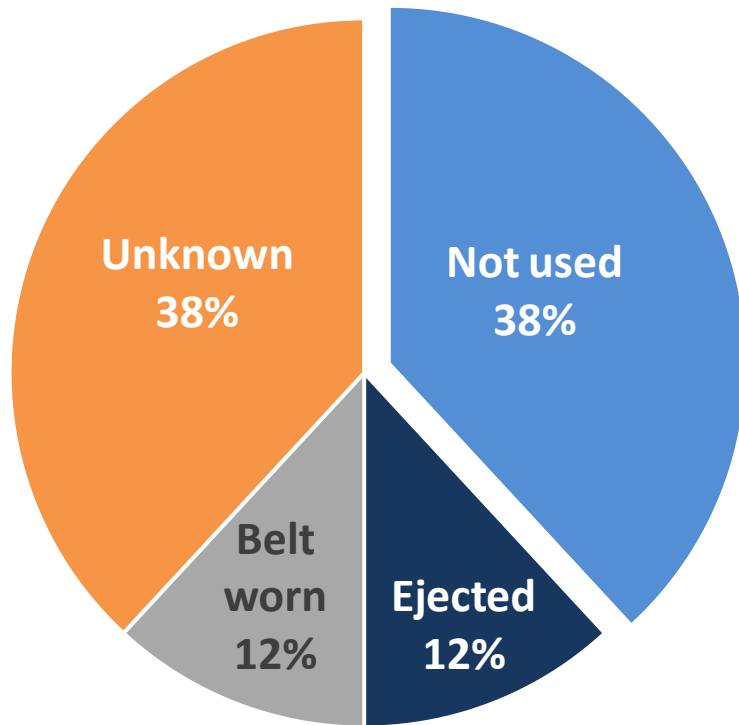
Light-duty vehicles most commonly involved in fatal oil and gas crashes



Motor Vehicle Fatalities by Vehicle Type,
U.S. Oil and Gas Extraction Industry, 2003-2009



At least half of all fatal oil and gas crashes involve unbelted workers



Motor Vehicle Fatalities by Safety Belt Status, U.S. Oil and Gas Extraction Industry, 2003-2009



Other factors related to fatal motor vehicle crashes

Company Type:

Well Servicing (62%)

Drilling Contractors (23%)

Experience:

<1 year with employer (32%)

Company Size:

Small companies* 4X the risk
as large companies

Fatigue?

Oncoming collision (21%)

Roadway departure (17%)

U.S. Oil and Gas Extraction Industry, 2003-2009



Driving differs from other work assignments



Less Supervision

Changing due to telematics and IVMS



Less Controlled Environment

Actions of other motorists affect workers

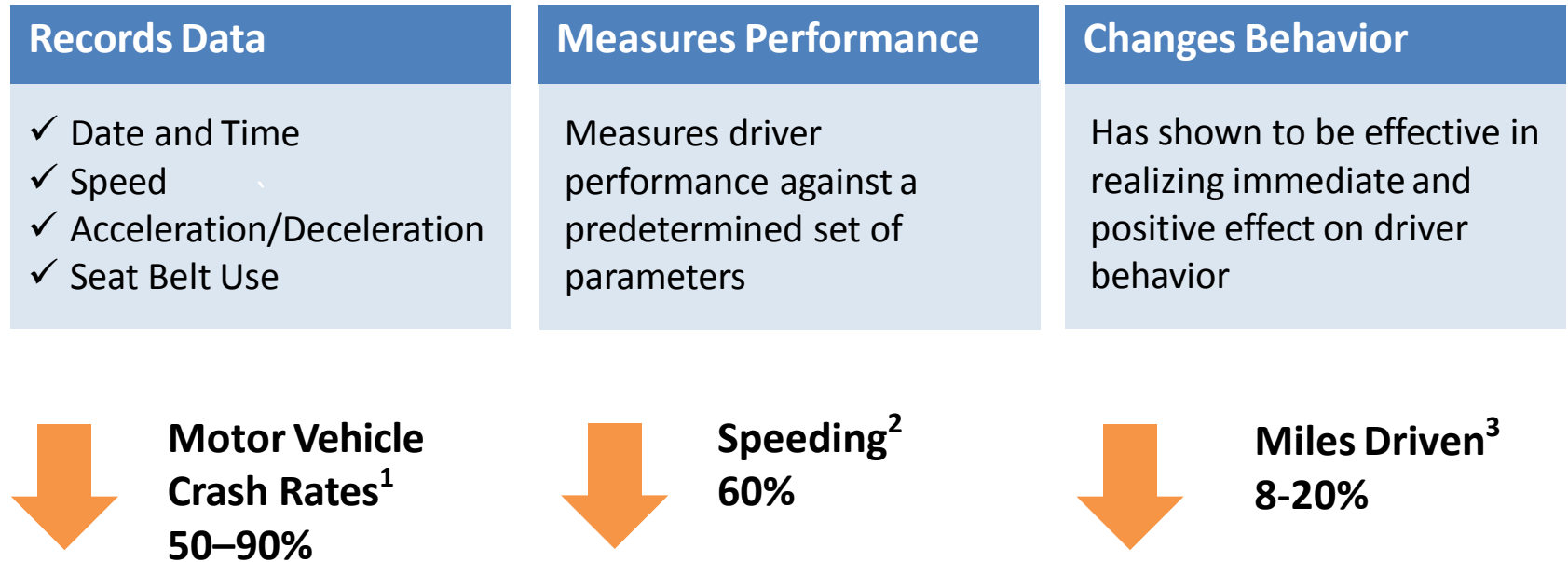


Constant Change

Operating conditions change constantly

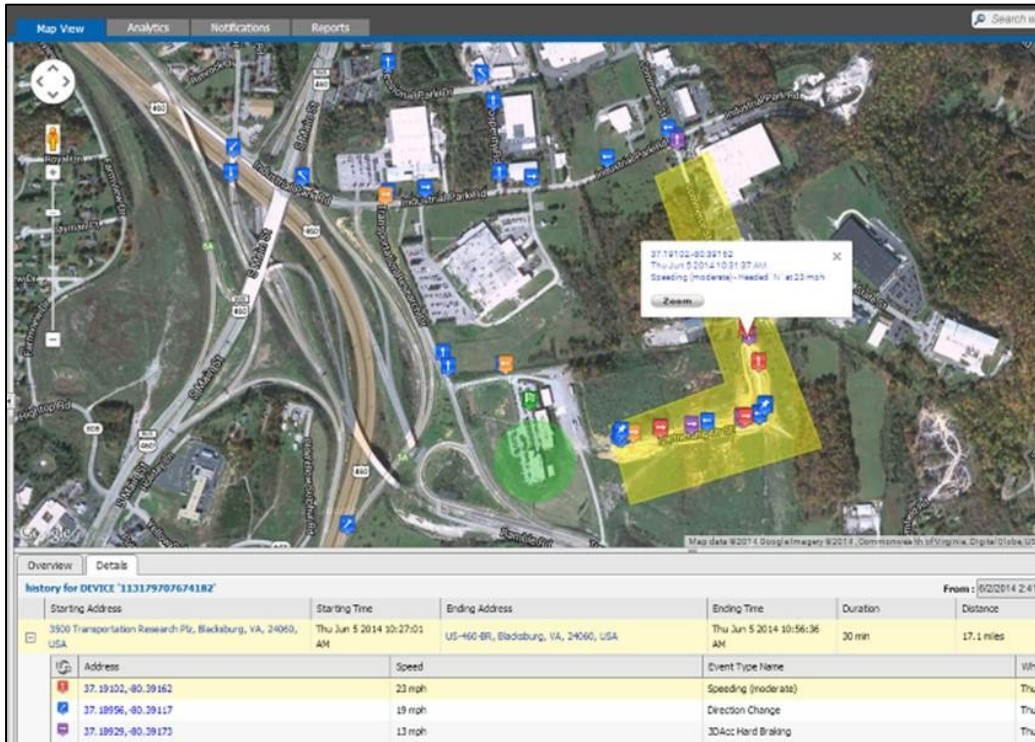


In-Vehicle Monitoring Systems (IVMS)



¹ Gale et. al, 2012, Mora et. al, 2010, Velasquez, et. al, 2010, Matusalen, et. al, 2006, Ballard et. al, 2004, Jutten et. al, 2002, Cocianni & Taviansky, 1998); ² Twilhaar, 2000; ³ Lopez, 2006, Twiilar, 2000.





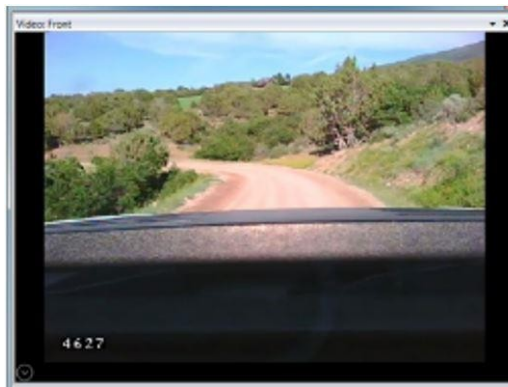
Field Practice Research

Virginia Tech Transportation Institute (VTTI)



Field Research

- What is Naturalistic Data collection?
 - Study drivers and vehicle for extended periods
 - Captures driver behavior in full context
 - Video, vehicle network, and other sensors



Research Partnership

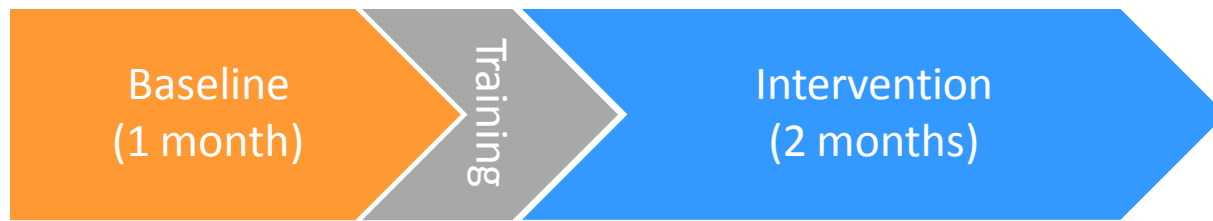
- National Surface Transportation Safety Center for Excellence
 - Established in 2005 to share advanced transportation safety techniques and innovations in rural and urban sectors
- Objectives
 - To develop and test transportation devices and techniques that enhance driver performance
 - To evaluate the roadway environment and infrastructure-based safety systems
 - To address mobility for vulnerable road users
 - To examine driver impairment issues

- Stakeholders



Study Overview

- Industry and research partnership to collect IVMS and Naturalistic Data.
 - Baseline: No manager feedback or driver reports, 1 month
 - Transition: Driver and manager training period, 2-3 weeks
 - Intervention: Manager and driver reports active, 2 months
- Goals:
 - Determine if IVMS impacted driver performance
 - Discover site workers typical schedule over 3 months
 - Discover IVMS and environmental challenges from video/vehicles.



Fleet and Technology

- Fleet
 - Oil and gas well servicing site crew pickup trucks
- IVMS Technology: Cartasite[®] ROVR[™] (21 vehicles anonymously)
 - Connects to vehicle OBDII; Measures braking, acceleration, speeding, idling and night driving time; Provides drivers and manager scorecards, urgent or emergency events
- Research Technology: VTTI MiniDAS & ROVR (4 vehicles)
 - Connected to vehicle OBDII; Windshield-mount, forward-road/driver-face video, and GPS data; Pre- and post-questionnaires for drivers



Cartasite IVMS



VTTI miniDAS



Methods

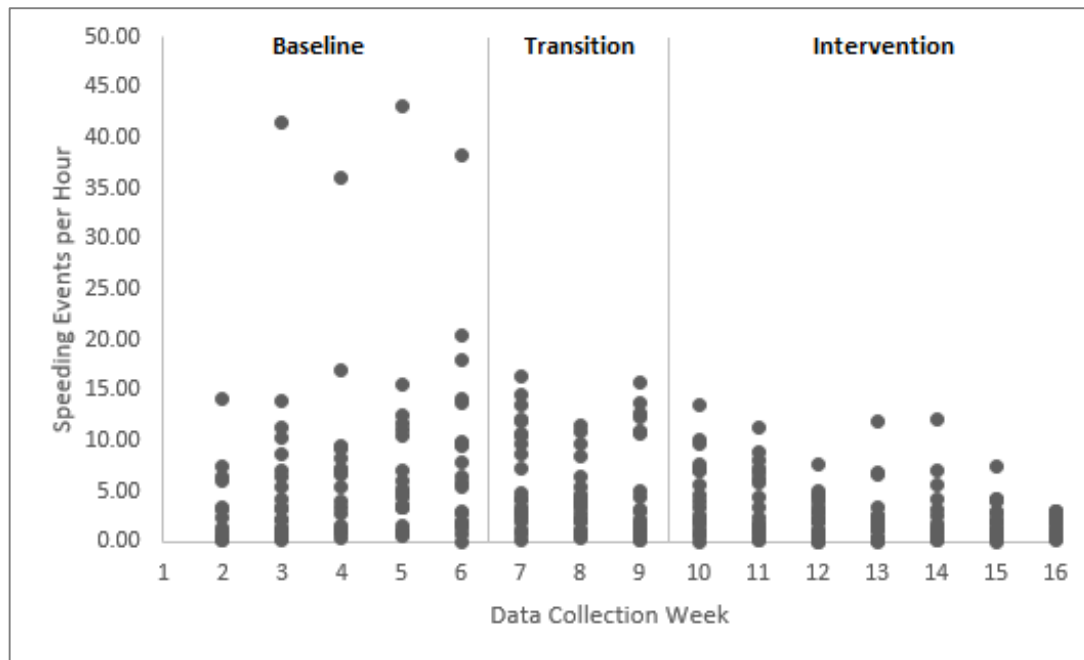
- Fleet-Wide Data
 - Matched vehicle performance (speeding, aggressive) over time from baseline to intervention (driver anonymous)
- Driver Focused Sample Data
 - Developed typical commute and schedule from traceable driver (participants) trip purpose and start/destination

Blocked Trip	IVMS Trip	Departure Location	Arrival Location
1 - Commute	1	Home	Address
	2	Address	GPS Only
	3	GPS Only	Well
2 - Commute	1	Yard	Highway
	2	Highway	Address
	3	Address	Home
3 - Site to Site	1	Well	Address
	2	Address	US Route
	3	US Route	Interstate
	4	Interstate	St. Route
	5	St. Route	Well



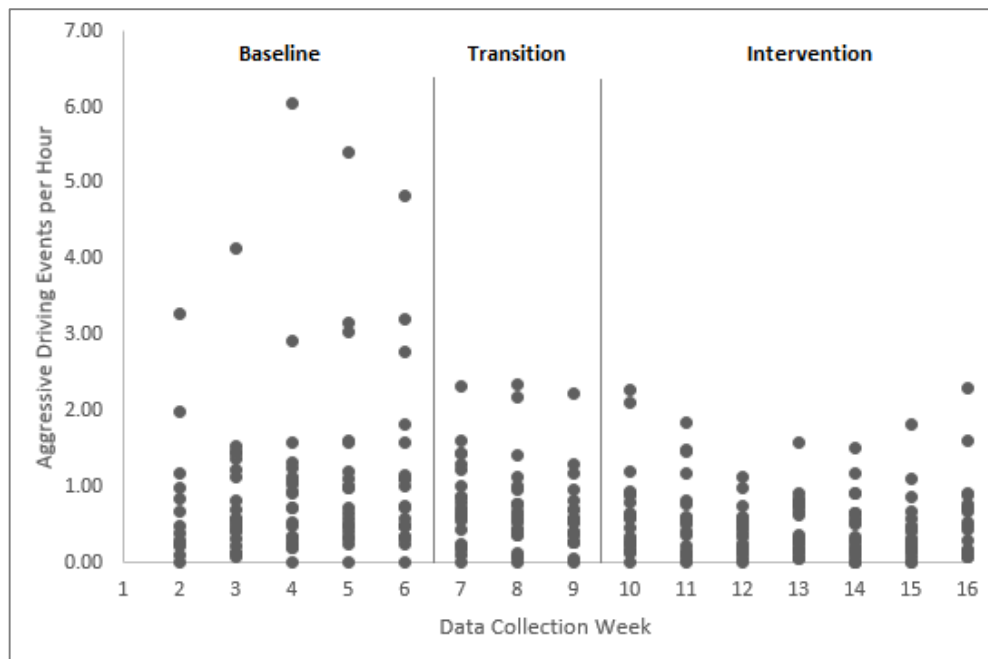
IVMS Fleet-Wide Driver Performance

- 21 vehicles, 15 weeks, over 140,000 miles applied to analysis
- **Speeding Events**
 - Baseline Avg: 6.74 events/hr. ; Intervention Avg: 2.66 events/hr.
 - * Overall Average: 4.61 events per hour



IVMS Fleet-Wide Driver Performance

- 21 vehicles, 15 weeks, over 140,000 miles applied to analysis
- **Aggressive Driving Events** (braking, acceleration)
 - Baseline Avg: 1.04 events/hr. ; Intervention Avg: 0.52 events/hr.
 - * Overall Average: 0.72 events per hour

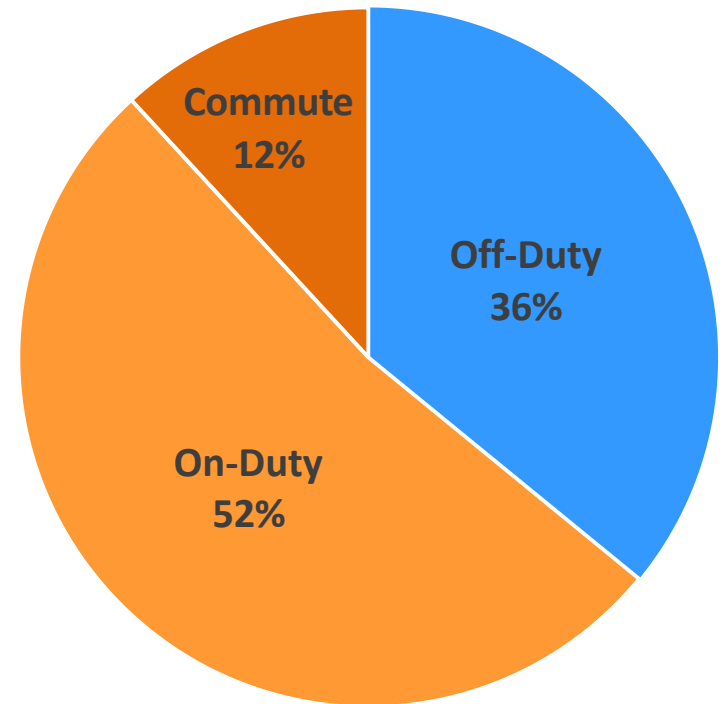


Driver Focused Sample Schedule

Averages across 3 well-site workers during 99-day period:

- On-Duty: 72 days
- Commute, daily distance: 147.6 miles (including home to yard)
- Commute, daily time: 2.9 hours
- On-Duty, daily time: 12.5 hours

Combined daily working time: 15.4 hours



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Video #2

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Video #3

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Conclusions on Fleet-Wide Data

Based on weekly reports across 21 vehicles...

- Speeding was reduced by 60%
- Aggressive driving behaviors were reduced by 50%
- During four weeks of baseline collection, one vehicle had:
 - Worst rate of speeding events (AVG: 40/hour), and
 - Worst or second-worst rate of aggressive events (AVG: 3.1 hard brakes/hour)
 - During intervention unsafe behaviors reduced by up to 80%
- Efficiency: Average idle time ~22 hours per vehicle/week



Conclusions on Focused Sample Data

- Driver questionnaires
 - Opinions on IVMS remained neutral to positive at study end
 - Drivers rated the future usefulness of receiving real-time speeding alerts very positively (statistically significant)
- Trip Activity and Schedules (well-site worker sample)
 - Nearly 3 hour daily commute on/off highway
 - Daily scheduled work activity 15.4 hours
- Naturalistic Video Sensor Analysis
 - Multiple factors lead to safety-critical events
 - Some factors are under management and driver control
 - Management needs more information to make actionable decisions



Technologies: Near and Future

- Manager Coaching Versus System Training
- Sustainable Performance by Rewards
- Driver-Vehicle Behavior
 - Vehicle kinematics; Highway lane-keeping; Eye glance; Blink rate
- Driver-Crew-Site Schedule
 - On-Duty Hours; Last month-last week-next week
- Driver-Crew Physiology
 - Sleep; Heart rate; Electrical body signals (e.g. EEG)

