Evaluation of telematics feedback to workers in “support activities for oil and gas operations” to decrease risky driving behaviors

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Justification and Need

- Motor vehicle-related roadway incidents are leading cause of work-related death in the oil and gas extraction and related industries (Bureau of Labor Statistics, accessed 2015; Retzer et al. 2013)

- ‘Support activities for oil & gas operations' industry – more than twice the national rate for transportation-related injuries severe enough to require time away from work (Bureau of Labor Statistics, accessed 2015)
Objective

• Objective to evaluate whether feedback from a commercially available in-vehicle monitoring system (IVMS) to drivers can reduce risky driving behaviors

• A reduction in risky driving behaviors may reduce collisions, death, and injury to workers that drive on the job
In-vehicle Monitoring System

- Collects two types of information
- Accelerometers in system monitor vehicle performance
- 30-second video captured inside and outside vehicle
- Coded for risky driving behaviors
Risky Driving Behaviors

Fundamental Driving Errors
Unprofessional Driving
- Unsafe Backing
- Unsafe Braking
- Unsafe Lane Change / Merging / Passing
- Unsafe Railroad Crossing
- Unsafe Turning
- Lane Departure/Straddling Lanes
- Competitive/Aggressive Driving
- Driving the Wrong Way - On Roadway
- Driving the Wrong Way - Off Roadway
- Curb Check/Jumped Curb

Vehicle Control
- Driving with Two Hands off Wheel
- Unattended Moving Vehicle

Stopping
- Incomplete Stop at Light
- Incomplete Stop at Stop Sign
- Failure to Attempt to Stop at Light
- Failure to Attempt to Stop at Stop Sign
- False Start
- Failure to Yield to Pedestrian(s)
- Failure to Yield to Vehicle(s)

Speeding
- Moderate Speeding (≤ 10 mph Over Limit)
- Excessive Speeding (> 10 mph Over Limit)
- Exceeded Maximum Fleet Speed

Situational Awareness
- Unsafe Following (≤ 1 second)
- Unsafe Following (1.25 - 2 seconds)
- Unsafe Following (2.25 - 3 seconds)
- Unsafe Following (3.25 - 4 seconds)
- Not Checking Mirrors
- Not Scanning Road Ahead
- Not Scanning Intersection

Distracted & Inattentive Driving
Distraction
- Mobile Phone - Texting/Dialing
- Mobile Phone - Talking (Handheld)
- Mobile Phone - Talking (Hands Free)
- Operating Other Mobile Device
- Reading Paperwork
- Grooming/Personal Hygiene
- Food
- Beverage
- Smoking
- Passenger(s)
- Other Task

Fatigue
- Drowsy/Falling Asleep
- Yawning

Other Unsafe Driving
Seatbelts
- Driver Seatbelt Unfastened (≤ 20 mph)
- Driver Seatbelt Unfastened (> 20 mph)
- Passenger Seatbelt Unfastened

Outcomes
Collision
- Collision with Pedestrian
- Collision with Vehicle in Transport
- Collision with Parked Vehicle
- Collision with Train
- Collision with Pedalcycle
- Collision with Animal
- Collision with Fixed Object
- Collision with Work Zone Equipment
- Collision with Other Movable Object
- Overturn (Rollover)

Outcomes
Near Collision
- Near Collision with Pedestrian
- Near Collision with Vehicle in Transport
- Near Collision with Parked Vehicle
- Near Collision with Train
- Near Collision with Pedalcycle
- Near Collision with Animal
- Near Collision with Fixed Object
- Near Collision with Work Zone Equipment
- Near Collision with Other Movable Object

Other Outcomes
- Ran off Road
- Crossed Median/Centrelane

Non-Driving Observations
Unprofessional Conduct
- Rude Gesture
- Raised Voice

Event of Interest
- Captured Passenger Incident
- Captured Roadway Incident

Equipment
Obstructed View
- Obstructed View of Driver
- Obstructed Exterior View

Tampering
- Tampering/Abusing Equipment

SmartRecorder
- Suboptimal Camera Position
- Non-Performing Camera

4 Severity Levels
Lights-only Instant Driver Feedback (IDF)

- Vehicle performance only
- Green light, yellow or red flashes
- Indicators of harsh / potentially unsafe driving
Supervisor Coaching Feedback (IDF+Coaching)

- Video response center
- Supervisor coaches driver on Severity 3 and 4 events
- Reinforce company policy and safe driving
- “Going over game films to improve performance”
Group feedback

Severity 3 and 4 Event Trend for Site #1240

Miles Driven Between Severity 3 and 4 Events

- 257.8
- 316.2
- 515.7
- 311.4
- 377.8
- 473.0
- 350.0
- 322.5
- 537.2
- 735.9

Dates:
- 03/02/2013
- 03/09/2013
- 03/16/2013
- 03/23/2013
- 03/30/2013
- 04/06/2013
- 04/13/2013
- 04/20/2013
- 04/27/2013
- 05/04/2013
Industry Partner

• Maintenance and ‘Support activities for oil and gas operations’ (NAICS 213112)

• Pick-up trucks

• Work-related and personal-use driving
Methods – O&G Support

• 13 sites in 7 states (PA, OK, LA, TX, CO, UT, CA)
  • 10 intervention sites – received the 2 interventions (IDF and coaching)
  • 3 control sites - events recorded but no feedback

• All trucks equipped with OVRS
  • 144 installed at start of study

• Events collected on a per vehicle per 24-hour day basis

• Single driver assigned to each vehicle in the study

• Company records to link vehicle to driver assignments
## Timeline

### 18-Month Study

<table>
<thead>
<tr>
<th>Intervention Phases</th>
<th>2013</th>
<th>2014</th>
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</thead>
<tbody>
<tr>
<td><strong>Intervention Group 1</strong>&lt;br&gt;(5 sites, 53 trucks w/ IVMS)</td>
<td></td>
<td></td>
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<tr>
<td>Baseline</td>
<td></td>
<td></td>
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<tr>
<td>Program with IDF only</td>
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<tr>
<td>Program with Coaching &amp; IDF</td>
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<tr>
<td><strong>Intervention Group 2</strong>&lt;br&gt;(5 sites, 37 trucks w/ IVMS)</td>
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<td></td>
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<tr>
<td>Baseline</td>
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<td></td>
</tr>
<tr>
<td>Program with Coaching &amp; IDF</td>
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<td></td>
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<tr>
<td>Program with IDF only</td>
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<td></td>
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<tr>
<td><strong>Control Group 3</strong>&lt;br&gt;(3 sites, 54 trucks w/ IVMS)</td>
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<tr>
<td>Baseline</td>
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</tbody>
</table>
Preliminary Data Analysis

Rate:

\[
\frac{\sum \text{Number of risky driving behaviors observed per vehicle day}}{\sum \text{Hours of driving time per vehicle day}}
\]

Rate per 100 driving hours:

\[
\text{Rate (as seen above) } \times 100
\]

Poisson regression adjusted for repeated measurements on the same vehicles over time (PROC GENMOD in SAS)
Preliminary Results

18-month observation period

- 5 month baseline
- 5 months first treatment
- 5 months second treatment
- 3 months second treatment

Total Recorded Events

- 205,069

Obstructed Camera View

- 38,834
- 19%

Non-Obstructed Camera View

- 166,235
- 81%

Final Dataset
# Frequency of risky driving behaviors

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Speeding</td>
<td>29,156</td>
<td>47</td>
</tr>
<tr>
<td>Distractions (smoking, eating, drinking)</td>
<td>11,813</td>
<td>19</td>
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<tr>
<td>Driving unbelted</td>
<td>9,812</td>
<td>16</td>
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<tr>
<td>Unsafe stopping</td>
<td>4,225</td>
<td>7</td>
</tr>
<tr>
<td>Handheld device use</td>
<td>3,610</td>
<td>6</td>
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<tr>
<td>Fatigue</td>
<td>1,803</td>
<td>3</td>
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<tr>
<td>Vehicle control</td>
<td>726</td>
<td>1</td>
</tr>
<tr>
<td>Unprofessional driving</td>
<td>475</td>
<td>&lt; 1</td>
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<tr>
<td>Situational awareness</td>
<td>370</td>
<td>&lt; 1</td>
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<tr>
<td>Hands-free device use</td>
<td>277</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Other events</td>
<td>22</td>
<td>&lt; 1</td>
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</tbody>
</table>
Coaching Frequency

- Drivers were coached only for severity 3 and 4 events
- At least one coaching session

### Intervention Group 1

<table>
<thead>
<tr>
<th>Site</th>
<th>Ratio of Drivers Coached</th>
<th>Percent of Drivers Coached</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>6:6</td>
<td>100.0</td>
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<tr>
<td>2</td>
<td>19:20</td>
<td>95.0</td>
</tr>
<tr>
<td>3</td>
<td>12:14</td>
<td>85.7</td>
</tr>
<tr>
<td>4</td>
<td>9:11</td>
<td>81.8</td>
</tr>
<tr>
<td>5</td>
<td>7:7</td>
<td>100.0</td>
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</table>

### Intervention Group 2

<table>
<thead>
<tr>
<th>Site</th>
<th>Ratio of Drivers Coached</th>
<th>Percent of Drivers Coached</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8:10</td>
<td>80.0</td>
</tr>
<tr>
<td>2</td>
<td>3:3</td>
<td>100.0</td>
</tr>
<tr>
<td>3</td>
<td>2:2</td>
<td>100.0</td>
</tr>
<tr>
<td>4</td>
<td>22:22</td>
<td>100.0</td>
</tr>
<tr>
<td>5</td>
<td>4:4</td>
<td>100.0</td>
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</table>
## Coaching Commentary

<table>
<thead>
<tr>
<th>Subject of Coaching Comments</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Unsafe stopping</td>
<td>37</td>
</tr>
<tr>
<td>Speeding</td>
<td>27</td>
</tr>
<tr>
<td>Handheld device use</td>
<td>7</td>
</tr>
<tr>
<td>No hands on wheel</td>
<td>4</td>
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<tr>
<td>Lesser distractions</td>
<td>2</td>
</tr>
<tr>
<td>Driving unbelted</td>
<td>1</td>
</tr>
<tr>
<td>Obstructed view</td>
<td>1</td>
</tr>
<tr>
<td>General driving</td>
<td>21</td>
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</tbody>
</table>
INTERVENTION RESULTS
Rate of Overall Risky Driving (severity 3&4 events) per 100 Hours of Driving Time

- Intervention:
  - Baseline: 26% Dec*
  - IDF-only: 51% Dec*
  - IDF+Coaching: 16% Dec

- Control:
  - Baseline: 25% Dec*
  - End Baseline: 2% Inc
Rate of Driving Unbelted per 100 Hours of Driving Time

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline</th>
<th>IDF-only</th>
<th>IDF+Coaching</th>
<th>End Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>54% Dec*</td>
<td>80% Dec*</td>
<td>49% Dec*</td>
<td>62% Dec*</td>
</tr>
<tr>
<td>2</td>
<td>23% Dec*</td>
<td>49% Dec*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rate of Exceeding Maximum Fleet Speed per 100 Hours of Driving Time (includes obstructed and unobstructed view events)

- Intervention:
  - Baseline: 21% Dec*
  - IDF-only: 44% Dec*
  - IDF+Coaching: 31% Dec*

- Control:
  - Baseline: 13% Dec
  - Baseline: 15% Inc

Legend:
- Baseline
- IDF-only
- IDF+Coaching
- End Baseline
Limitations – Coaching Feedback

- Coaching frequency (80-100%)
- Variation in coaching quality and content
- Supervisor coaching narrative provides some insight (stopping, mobile handheld device, driving unbelted)
Limitations – Camera obstructed view – 19% of events
Summary

• Supervisory coaching plus lights feedback highly effective in reducing risky driving behaviors of key interest to fleet managers
  - overall risky driving (51% ↓ Coach+IDF vs 25% ↓ Ctrl)
  - driving unbelted (80% ↓ Coach+IDF vs 61% ↓ Ctrl)
  - hand-held device use (63% ↓ Coach+IDF vs 42% ↓ Ctrl)
  - unsafe stopping (54% ↓ Coach+IDF vs 27% ↓ Ctrl)
  - exceeding maximum fleet speed (44% ↓ Coach+IDF vs 13% ↓ Ctrl)
• Lesser distractions did not show significant declines during coaching (eating, drinking, smoking)
• Supervisory coaching plus lights feedback had a greater impact on reducing risky driving behaviors than light-only feedback alone
• Withdrawal of feedback was correlated with a return of risky driving behaviors
Contact Information

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