CUMULATIVE DRIVER FATIGUE

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SAFETY REASONS FOR THE STUDY

- HOS rules attempt to do a better job of regulating the driver’s hours behind the wheel to *manage fatigue*
- Oil & Gas Industry motor vehicle fatality rate is 8x that of all industries, and is similar to the Transportation Industry [1]
SAFETY REASONS FOR THE STUDY

Here are the Average Stats from the study [1] conducted by NIOSH & VTTI (with Cartasite providing IVMS Technology) for the small O&G Service Company:

- **Combined** daily working time: **15.4 hrs**
  - Commute, daily time: **2.9 hrs**
  - On-Duty, daily time: **12.5 hrs**
- **Commute**, daily distance: **147.6 miles** (including Home to Yard)

There appears to be more to fatigue management:
- It’s not just how much time you spend driving
- It’s how much you’ve been working [including driving], your sleeping hours and habits, and so forth.
FATIGUE CAN CAUSE DISTRACTION

- A fatigued individual has a reduced ability to focus on the task of driving, and can, therefore, be considered a distracted driver.
- Unlike the distractions of cell phones, food, or navigation systems which can all be put away or delayed, it is not possible for a driver to ignore the *internal distraction* of fatigue.
RESEARCH FOCUS

Identify the *cumulative* effect of “all” activities [including driving] that individuals are involved in while being away from their ‘Homebase’ to determine if:

- The *cumulative* effect of “all” activities:
  - Has measurable effect(s) on the individuals’ driving behavior/performance
  - Could be qualified as *Cumulative Driver Fatigue*
- Measurable effect(s) could be used as predictive indicators for the *Cumulative Driver Fatigue*
RESEARCH FOCUS

Definitions, for the purposes of this study:

- *HomeBase*: the location where an individual was:
  - Most likely to rest and to sleep for extended periods of time
  - Where the individual spent midnight of local time.
- *Time Away From HomeBase (AFHB)*: the time away from one’s *HomeBase*
- *Time Away From HomeBase* is the **DIMENSION** on which this study is focused
METHOD

Subset of Cartasite fleet customers selected for the study:

- Ten Customers:
  - Three Upstream O&G Companies (Large size)
  - One Midstream Oil & Gas Company (Large size)
  - Four Oil & Gas Field Services Companies (2 Large size, 1 Mid-size, 1 Small size)
  - One Utilities Services Company (Mid-size)
  - One Construction Company (Large size)

- Light, small & medium size trucks [or equivalent cars & SUV’s]
METHOD

- **Data collected** over a **12 month** period (Oct 2015 – Oct 2016)
- **Initial Data Set (IDS):**
  - 2637 Drivers
  - 3,967,303 - hourly intervals of being Away From HomeBase (AFHB)
  - No more then 16 hourly intervals AFHB per day of the workweek
- **Filtered IDS** [Includes only the drivers - and their corresponding AFHB hourly intervals - who (1) started their workweek on Monday, after spending midnight at their HomeBase, (2) worked no further then Friday of the same week, (3) worked 5 or less days that week]:
  - 2551 Drivers
  - 2,245,804 - Hourly intervals of being AFHB
  - 52,791 – weeks of driving processed
METHOD

- **Speeding Events:**
  - Minor Speeding Event [ $6 \text{ mph} \leq (\text{Speed} - \text{Speed Limit}) < 11 \text{ mph}$]
  - Moderate Speeding Event [ $11 \text{ mph} \leq (\text{Speed} - \text{Speed Limit}) < 20 \text{ mph}$]
  - Severe Speeding Event [ $(\text{Speed} - \text{Speed Limit}) \geq 20 \text{ mph}$]

- **Speeding Units:**
  - 1 Minor Speeding Event = 1 Speeding Unit
  - 1 Moderate Speeding Event *is equivalent to* 2 Minor Speeding Events = 2 Speeding Units
  - 1 Severe Speeding Event *is equivalent to* 3 Minor Speeding Events = 3 Speeding Units
METHOD

Hard Braking Events:
- Minor Hard Braking Event \[ 5.4 \text{ mph/sec} \leq \text{ABS( Deceleration )} < 10 \text{ mph/sec} \]
- Moderate Hard Braking Event \[ 10 \text{ mph/sec} \leq \text{ABS( Deceleration )} < 15 \text{ mph/second} \]
- Severe Hard Braking Event \[ \text{ABS( Deceleration )} \geq 15 \text{ mph/second} \]

Hard Braking Units:
- 1 Minor Hard Braking Event = 1 Hard Braking Unit
- 1 Moderate Hard Braking Event *is equivalent to* 2 Minor Hard Braking Events = 2 Hard Braking Units
- 1 Severe Hard Braking Event *is equivalent to* 3 Minor Hard Braking Events = 3 Hard Braking Units
RESULTS & DISCUSSION
Daily Basis: Average [per Hr AFHB] Driver Performance

- Average of Hard Braking Units Per Hr AFHB
- Average of Speeding Units Per Hr AFHB
DAILY STATS: DRIVER PERFORMANCE AND NUMBER OF DRIVERS

Daily Basis: Average [per Hr AFHB] Driver Performance

- Average of Hard Braking Units Per Hr AFHB
- Average of Speeding Units Per Hr AFHB
- Average Count of Unique Drivers per Hr AFHB
- Average Count of Unique Drivers Who Drove per Hr AFHB
DAILY STATS: DRIVER PERFORMANCE AND HOURLY AFHB INTERVAL DRIVING TIME

Daily Basis: Average [per Hr AFHB] Driver Performance

- Average of Hard Braking Units per Hr AFHB
- Average of Speeding Units per Hr AFHB
- Average of Interval Driving Time (mins) per Hr AFHB
High volume of the Speeding Units per Hr AFHB and Hard Braking Units per Hr AFHB during 1st hour AFHB:

- **Kyla Retzer (NIOSH) [4]:**
  - Long commutes to start shift;
  - Desire to be at home with family until last minute;
  - Sleep is low priority

- **Colonel Mark V. Trostel** (Driving Safety Advisor, Encana Oil & Gas, Inc.) [Discussions]:
  - Driver might be concerned about tasks for the day/shift rather than focused on his/her driving
  - Factor of traffic volume as more people are on the roads during “rush hour” hours
DAILY STATS: AVERAGE HRS AFHB PER EACH DAY OF WORKWEEK (AN ESTIMATE OF AVERAGE DURATION OF WORKDAY [INCLUDING DRIVING] PER EACH DAY OF WORKWEEK)

Daily Basis: Average Hrs AFHB per Day of Workweek

- Monday: 14.7 Hrs
- Tuesday: 14.3 Hrs
- Wednesday: 13.7 Hrs
- Thursday: 12.3 Hrs
- Friday: 7.6 Hrs
DAILY STATS: AVERAGE SPEEDING UNITS PER DAY OF THE WEEK

Daily Basis: Average [per Hr AFHB] Driver Performance: Speeding Units
DAILY STATS: AVERAGE HARD BRAKING UNITS PER DAY OF THE WEEK

Daily Basis: Average [per Hr AFHB] Driver Performance: HB Units

![Graph showing daily average hard braking units per hour for each day of the week. The y-axis represents hard braking units per hour, ranging from 0 to 0.25. The x-axis represents hours from 1 to 16. Each day of the week is represented with a different color: Monday (grey), Tuesday (orange), Wednesday (blue), Thursday (green), and Friday (red). The graph indicates the number of hard braking units per hour for each hour of the day.]
Findings:

- Higher volume of the Speeding Units per Hr AFHB during almost all hours AFHB on Friday and specifically during the second half of the Hours AFHB on Friday:
  - Clearly identifiable risk pattern
  - Correlates to the incident/accident data [Layman reference: https://www.theguardian.com/lifeandstyle/2013/may/29/most-dangerous-day-of-week]

- Higher volume of the Hard Braking Units per Hr AFHB during the first half of the Hrs AFHB on Friday:
  - Clearly identifiable risk pattern
WEEKLY STATS: WORKWEEK BY HOURS AFHB (MON-FRI)

- The daily trends led us to look at driving behavior during a longer period of time - during the workweek (Monday through Friday)
- Specifically, how does driving behavior change over the course of the week?
Findings:

- Upward Trends over the course of the week in *Speeding Units per Hr AFHB Weekly metric* and in *Hard Braking Units per Hr AFHB Weekly metric* are pointing out to increase of the risky driver behavior toward the end of the workweek.
- Upward Trend for the *Speeding Units per Hr AFHB Weekly metric* is more pronounced...
WEEKLY STATS: GROUPED BY VALUES OF THE MAXIMUM WORKWEEK HOURS AFHB

Weekly [Mon-Fri] Basis: Grouped by Values of the Maximum Weekly Hrs AFHB
WEEKLY STATS: GROUPED BY VALUES OF THE MAXIMUM WORKWEEK HOURS AFHB

- **Data:**
  - **Hourly Intervals AFHB:**
    - Total Number of Hourly Intervals: **2,245,804**
    - Number of Hourly Intervals between hour #26 (including) & hour #65 (including): **2,074,884**
    - % of Hourly Intervals between hour #26 (including) & hour #65 (including): **92.4%**
  - **Weeks:**
    - Total Number of Weeks: **52,791**
    - Number of Weeks between hour #26 (including) & hour #65 (including): **45,081**
    - % of Weeks between hour #26 (including) & hour #65 (including): **85.4%**

- Grouping occurred by the values of the **Maximum Weekly Hrs AFHB** attribute
Findings:

- **Speeding** Units per *Maximum Weekly Hrs AFHB*:
  - *Robust Upward Trend* starting at hour #36 and thru hour #65

- **Hard Braking** Units per *Maximum Weekly Hrs AFHB*:
  - Positive anomaly with low amplitude of approximately 0.024 Hard Braking Units Hr AFHB between hours #29 & #59
Variety of trends/patterns in the processed data were observed/identified:

- **Daily AFHB Charts:** Strong, quantifiable patterns of risky driving behavior in *Speeding Units per Hr AFHB Daily* metric and in *Hard Braking Units per Hr AFHB Daily* metric as individuals progress through their *daily* activities while *being AFHB and specifically on Fridays*.
  
- **Workweek by Hrs AFHB (Mon-Fri) Chart:**
  - Upward Trends over the course of the week in *Speeding Units per Hr AFHB Weekly* metric and in *Hard Braking Units per Hr AFHB Weekly* metric are pointing out to increase of the risky driver behavior toward the end of the workweek.
  - Upward Trend for the *Speeding Units per Hr AFHB Weekly* metric is more pronounced…

- **Grouped by Values of the Maximum Workweek Hrs AFHB Chart:**
  - *Speeding Units per Hr AFHB* metric: Robust Upward Trend starting at hour #36 and thru hour #65
What is next:

- Check for seasonal, regional and other trends/patterns in the data
- Further research/confirm the trends/patterns observed in the Speeding Units per Hr AFHB metric and Hard Braking Units per Hr AFHB metric in the processing of the 12 months of the data.
- Further qualify and quantify the Cumulative Driver Fatigue which is exhibiting itself in the individual’s driving performance metrics to introduce predictive indicator(s)
- Cartasite will be partnering with NIOSH to more closely examine this data
REFERENCES


Thank you

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