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Transportation Research Board

Commercial Truck & Bus Safety Synthesis Program (CTBSSP) Project MC-04

performed under subcontract to: MaineWay Services Inc.
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Project Officers

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Major Interacting Risk Factors Affecting Crash Involvement

- Environmental Risk Factors: (e.g., weather, roadway)
- Personal Constitutional Risk Factors: (e.g., healthy physical skill, personality)
- Personal Situational Risk Factors: (e.g., hours driving, sleep the night before)
- Vehicle Risk Factors: (e.g., brakes, tires)
- Behavior/Responses
- Risks created by other drivers and traffic

~ Driving Transportation With Technology ~
Illustrative Example:
FMCSA/ VTTI
Local/ Short Haul Driver Fatigue Study

~ Driving Transportation With Technology ~
Study Parameters:

FMCSA/ VTTI

Local/ Short Haul Driver Fatigue Study

- 42 drivers observed for one week each
- 28,000 total miles
- 249 total critical incidents
- 77 truck driver-initiated CIs
- 285 drowsiness episodes
Truck Driver CrIs/ Hour

Frequency Distribution:
Driver Critical Incidents/Hour

<table>
<thead>
<tr>
<th>Critical Incident/Hour Groupings</th>
<th>Number of Drivers (N=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>.01-.05</td>
<td>10</td>
</tr>
<tr>
<td>.06-.10</td>
<td>6</td>
</tr>
<tr>
<td>.11-.15</td>
<td>2</td>
</tr>
<tr>
<td>.16+</td>
<td>4</td>
</tr>
</tbody>
</table>

~ Driving Transportation With Technology ~
CI Frequency/ Risk

Exposure: Hours of Driving

- 12% (High-Risk)
- 25% (Moderate Risk)
- 63% (Low Risk)

Risk: Critical Incidents

- 38% (High-Risk)
- 46% (Moderate Risk)
- 16% (Low Risk)
High-Drowsy Episodes

Frequency Distribution:
Driver High-Drowsiness Episodes

- Number of Drivers (N=41)

High Drowsiness Episodes/Hour Groupings:
0, 0.01-.25, 0.26-.50, 0.51-.75, 0.76+

~ Driving Transportation With Technology ~
Drowsiness Frequency/ Risk

Exposure: Hours of Driving
- 7%
- 29%
- 64%

Risk: High-Drowsiness Epochs
- High Risk: 39%
- Moderate Risk: 47%
- Low Risk: 14%
L/ SH Study: Additional Findings

- Risk/exposure odds ratios between best and worst drivers:
  - CIs: 12.5
  - Drowsy episodes: 25.5
- Correlation CIs & fatigue: +0.15
- Only 1 of 6 highest CI drivers was among 4 highest-fatigue drivers
- Strongest predictor of CIs: driver age.
Questions

- Are L/SH findings representative?
- How *enduring* are individual differences? (trait or state?)
- What are the principal *causes* and *correlates* of driver risk?
- What are effective *interventions*?
Study Methods & Topics

- Survey of carrier safety managers & other experts
- Review of:
  - Risk concepts
  - Risk factors (correlates)
  - Management methods
- Identification of research needs.
Project Survey

- One page (front & back)
- Seven parts:
  - Problem importance
  - Driver factors
  - Hiring practices
  - Driver evaluation
  - Driver management
  - Comments
  - Respondent Info
- Parallel forms for safety managers (N=178) & other experts (N=67).
- Convenience sample
- Average respondent experience: ~20 years
## Survey Results: *Disproportion of Risk*

<table>
<thead>
<tr>
<th>Worst 10% of problems</th>
<th>Safety Managers</th>
<th>Other Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>20%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>30%</td>
<td>14%</td>
<td>19%</td>
</tr>
<tr>
<td>40%</td>
<td>15%</td>
<td>21%</td>
</tr>
<tr>
<td>50%</td>
<td>59%</td>
<td>54%</td>
</tr>
</tbody>
</table>
**Survey Results:**

**Consistency of Individual Differences**

<table>
<thead>
<tr>
<th></th>
<th>Safety Managers</th>
<th>Other Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk can change dramatically</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>“Some tendency” to stay the same, but can change</td>
<td>25%</td>
<td>35%</td>
</tr>
<tr>
<td>Risk stays about the same</td>
<td>65%</td>
<td>65%</td>
</tr>
</tbody>
</table>
Safety Manager Survey Results:
Top 6 of 16 Driver Risk Factors

1. Aggressive/angry
2. Impatient/impulsive
3. Inattentive
4. Inexperienced (new CMV driver)
5. Unhappy with job/company
6. Young driver (< 25)
Individual Differences in Fatigue Susceptibility

- Several studies reviewed; similar findings
- High, moderate, and low risk groups apparent
- Up to 25-fold difference in fatigue risk
- Cannot be explained solely by sleep disorders
- When people are repeatedly sleep deprived:
  - Large differences between different people
  - Individual responses stable and consistent.
- Level of susceptibility to fatigue appears to be an enduring personal trait.
Van Dongen et al. (2004): “Trait-Like” Individual Differences

- 21 subjects sleep-deprived for 36 hours three separate times.
- 13 different “neurobehavioral” tests, including PVT.
- Pronounced differences observed between individuals.
- Striking similarities observed within individuals.
- Across 13 tests, 68% to 92% of variance related to individual differences.
- On specific tests, many subjects performed almost identically during 3 sessions.
- Controlling for pre-deprivation sleep duration did not reduce individual differences.
- Conclusion: “… Interindividual differences in neurobehavioral deficits from sleep loss constitute a differential vulnerability trait.”
Van Dongen et al. (2004): Comparison of PVT Lapses for 18 Subjects in 1\textsuperscript{st} & 2\textsuperscript{nd} Deprivation Sessions

Systematic Inter-Individual Differences in Psychomotor Vigilance Task (PVT) Performance during 36 Hours of Sleep Deprivation ($n=18$)
Other Topics in Report

- Concepts of crash risk & “accident proneness”
- Factors; e.g.,:
  - Age & gender
  - Driving history
  - Medical conditions & health
  - Personality traits
  - Sensory-motor performance
- Other transport modes
- Selection tests
- Management job aids
  - Recruiting/selection/hiring
  - Performance evaluation & coaching.
Some R&D Needs

- Verify & extend findings: delineate driver traits and states
- Implications of above:
  • Traits → improve driver selection
  • States → improve situational management
- Determine quantitative relations between specific driver personal factors and crash risk for the same group of drivers.
- Validate selection tests & other tools
- “Soup-to-nuts” R&D on On-Board Safety Monitoring
- Pilot tests of Behavior-Based Safety and other safety management interventions.
Thanks for your attention!

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Report pdf available at:  