How shift scheduling practices contribute to fatigue amongst freight rail operating employees: Findings from accident investigations

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Human Factors and Macro Analysis Group
Outline

- Background
- Method
- Report themes
- Example occurrences (2)
- Conclusions
Role of TSB vs. Transport Canada

**TSB** – Independent agency...
- Conducts independent investigations,
- Identifies safety deficiencies,
- Makes recommendations,
- Reports publicly.

**Transport Canada** – Federal regulator...
- Promotes safe and secure, efficient and environmentally responsible transportation system.
Background

- Fatigue... poor concentration, easily distracted, impairs problem-solving, ↑ mistakes, ↑ risk-taking
- Slows reaction time to safety alarms (Hidebrandt et al., 1974)
- Impairs conformance to train driving requirements (Dorrian et al., 2007)
- Pervasive...
  - 7 to 8 hours of sleep per night to feel well-rested... 30% of Canadians report < 6 hours of sleep per night (Morin et al., 2011)
  - 60% report feeling tired “most of the time”
Background

Fatigue in railway operating employees:

- TCRC (union) web survey - 2014:
  - 85% of ~1,100 freight operating employees reported having felt so tired that work was affected
  - 76% reported having “drifted into sleep” while working

Shift scheduling practices can contribute to fatigue by:

1. restricting opportunities to obtain sleep;
2. requiring extended periods of wakefulness;
3. disrupting daily (circadian) rhythms.
Background

Transport Canada’s Railway Safety Management System (SMS) regulations (2015):

- requirements to apply principles of fatigue science to shift scheduling practices.
- currently auditing railways’ SMS before taking further measures to manage railway crew fatigue
- audits scheduled up to 2021
Background: Investigating for fatigue
Background: Investigating for fatigue

- ~1,200 to 1,400 railway occurrences reported to TSB each year under mandatory reporting
- Only ~1% of these are investigated fully and result in published TSB report
- Difficult to estimate prevalence of fatigue-related accidents
- Review of investigations where fatigue played a role can improve understanding
Method

- TSB database search of reports from 1995 to 2014
  - Also reviewed anonymous reports (2011-2014)
- 18 reports → fatigue of freight rail operating employees was causal, contributing, or risk finding
- Represents ~20% of rail investigations where human factors issue was primary cause
- Findings / recommendations explored & grouped according to theme
1. Disruption of normal sleep cycle;
2. Insufficient rest periods between shifts;
3. Extended periods of continued wakefulness due to shift length;
4. Pressures on crews not to refuse shifts;
5. Varied and unpredictable railway shift scheduling;
6. Ineffective fatigue countermeasures; and
7. Cumulative effects of working extended hours over long-term.

Results - Report themes:
Occurrence R03W0169 (Carlstadt, ON)

Report themes (3):

1. Disruption of normal sleep cycle;
2. Insufficient rest periods between shifts;
3. Extended periods of continued wakefulness due to shift length;
4. Pressures on crews not to refuse shifts;
5. Varied and unpredictable railway shift scheduling;
6. Ineffective fatigue countermeasures; and
7. Cumulative effects of working extended hours over long-term.
Occurrence R03W0169 (Carlstadt, ON)

- 19 October 2003 at 2318
- Freight train travelling from Coquitlam, British Columbia to Toronto, Ontario on main track
- Locomotive engineer and conductor → met fitness for duty requirements, familiar with territory
- Train movements supervised by rail traffic controller (RTC)
- Shift scheduling system based on Work/Rest Rules for Rail Operating Employees (2002)
- Crews typically called 2 hours prior to shift
- Crews typically avoid booking rest at ‘away terminal’
Occurrence R03W0169 (Carlstadt, ON)
Occurrence R03W0169 (Carlstadt, ON)

2035
Crew called

2110
Took control of train

Departed

Passed Xing

HBD 1 – no alarm

Did not sound whistle

HBD 2 – no alarm

Radio frequency change to RTC call in channel

Required to contact RTC

Crew attempt to change radio back to stand-by channel

Mis-keyed and error not detected

HBD3 – alarm condition

Not detected by crew

Did not note absence of voice report when passing HBD

2318
Train suffers BOJ and derails
## Sleep-Wake History

**Key:**  
- **AD** = awake and on duty  
- **A** = awake and off duty  
- **S** = main sleep period  
- **SN** = nap

### Event Details
- **Home Base Time ->**
- **Occurrence** R03W0169 (Carlstadt, ON)

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Occurrence R03W0169 (Carlstadt, ON)

- 3 crew errors were “consistent with fatigue-related performance impairment” (e.g., decreased vigilance, disregard of warning signs)

2 Findings as to risk:

- The Work/Rest Rules for Rail Operating Employees permit consecutive hours of wakefulness in excess of 18 hours with no scheduled rest, which increases the risk of fatigue-related errors and accidents.
- The nature of rail operations requires crew members to work variable, unpredictable schedules, often for their entire working lives. Unpredictable schedules increase the probability that train crews will be working in a chronically fatigued state, which can lead to errors associated with fatigue.
Occurrence R07E0129 (Peers, AB)

Report themes (3):
1. disruption of normal sleep cycle;
2. insufficient rest periods between shifts;
3. extended periods of continued wakefulness due to shift length;
4. pressures on crews not to refuse shifts;
5. varied and unpredictable railway shift scheduling;
6. ineffective fatigue countermeasures; and
7. cumulative effects of working extended hours over long-term.
Occurrence R07E0129 (Peers, AB)
Occurrence R07E0129 (Peers, AB)
Occurrence R07E0129 (Peers, AB)

- 27 October 2007 at 0505
- Locomotive engineer → very familiar with territory
- Conductor → first trip
- Engineer had worked 15 shifts in 12 days; shifts on accident train were typically daytime
- Engineer called the crew office at least twice on day for ordering time
  - provided two (very different) estimates
  - not able to plan effective nap.

Organizational factors:
- Alertness on duty’ is shared (company / employee) responsibility
- Railway had recently prohibited booking unfit
- En route napping not permitted
- Countermeasures:
  - education program (but not applied system-wide) and
  - specific trains
Finding as to Causes and Contributing Factors:

- Train 417’s crew was insufficiently rested to be engaged in safety-critical tasks.

Finding as to Risk:

- From time to time, fatigued train crews will feel compelled to report for work without adequate rest, creating the risk of an accident.

Other Finding:

- Despite previously-acquired knowledge on fatigue, the countermeasures the railway had in place were ineffective.
Conclusions

1. Management of fatigue and shift-scheduling in freight rail ops is complex issue → often not conducive to circadian rhythms and sleep need

2. Current shift scheduling & fatigue management practices may be insufficient to mitigate risk

3. Transport Canada is currently auditing railways’ SMS before taking further measures to manage railway crew fatigue → audits scheduled up to 2021, but limited resources / auditors

4. Review of railway fatigue management systems required by SMS regulations needs to be expedited, and further actions taken, to improve scheduling practices and mitigate risk of fatigue
2016 TSB Watchlist issue – Fatigue management systems for train crews
Thank you!

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