

IMPROVING SAFETY: FATIGUE RISK MANAGEMENT

Prof Philippa Gander

NZAAA Conference 25/7/2017

Outline



- What is fatigue?
- Is fatigue a safety issue in general aviation?
- Causes of fatigue in general aviation
- Managing fatigue in your operation(s)
 - ▣ What are you required to do?
 - CAA
 - Health and Safety at Work Act (2015)
 - ▣ Practical ways of going about it
 - How complicated does it need to be?

What is Fatigue?

- Fatigue is

A physiological state of reduced mental or physical performance capability
resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity)
that can impair a person's alertness and ability to work safely and efficiently

International Civil Aviation Organisation (ICAO) 2011



***Because of the way the human brain and body
are designed to function***

GA Accidents 2005-2014

US National Transportation Safety Board

- Fatigue cited as causal or a factor in:

- 361/10,030 (3.6%) airplane accidents
- 70/1076 (6.5%) helicopter accidents



Figure 3. Wreckage of a Weatherly 602B airplane.

- For NTSB aviation investigations in 2012, GA accidents accounted for

- 95.8% of all accidents (1471/1537)
- 97.5% of fatal accidents (273/280)
- 98% of fatalities (440/449)
- Aerial application operations accounted for
 - 4.5 % of GA accidents (67/1487)
 - 4.2% of fixed-wing GA accidents (53/1250)
 - 9.0% of helicopter accidents (14/155)



Figure 5. Wreckage of a Bell 206B that struck power lines (left) and the severed lines (right).

*If you don't investigate the role of fatigue,
how do you know?*

Special Investigation Report on the Safety of Agricultural Aircraft Operations, NTSB (2014)

- No maximum flight and duty time limits
- Causes of fatigue
 - ▣ seasonal peak in demand
 - ▣ very long working days
 - ▣ multiple short flights, high total flight hours per day
 - ▣ continuous, repetitive, low altitude, high attention demands = high workload
 - ▣ lack of breaks for eating, drinking, toilet stop
- Recommendations
 - ▣ model scheduling practices on FTD limits in commercial and military operations with repetitive low altitude flights
 - ▣ streamline administrative work to minimise duty day
 - ▣ need for specific guidance materials for ag operators and pilots, addressing fatigue, fatigue management strategies, and scheduling practices
 - to reduce fatigue, hunger, dehydration, and other physiological factors that can negatively affect a pilot's concentration, decision-making, and performance.

<http://www.nts.gov/investigations/AccidentReports/Reports/SIR1401.pdf>

Review of 78 accidents in 2013

Biological causes of fatigue

□ Fatigue is

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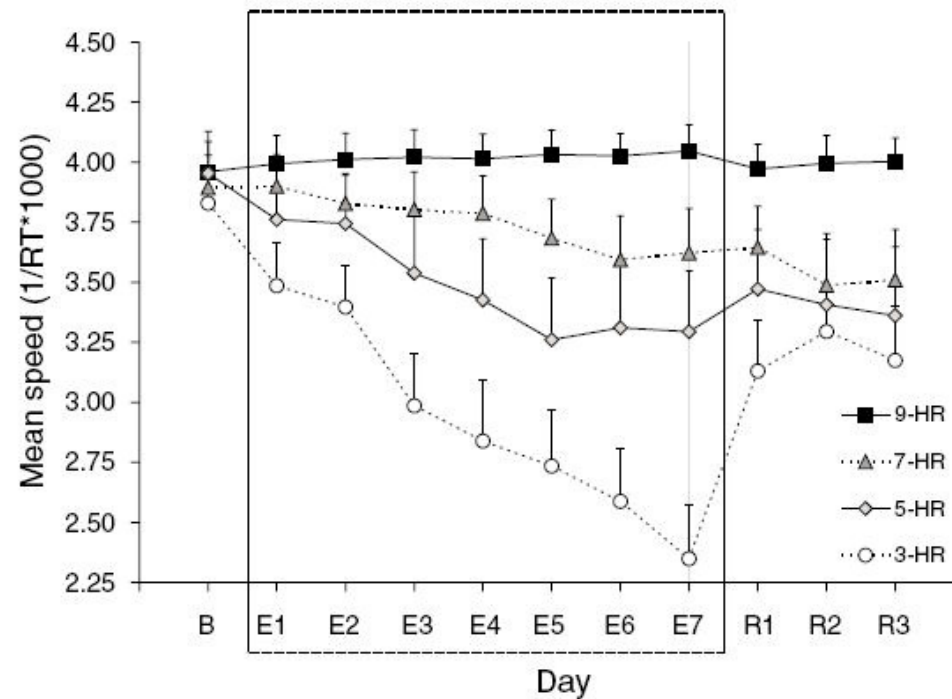
Why sleep?

- Brain needs to go ‘off-line’ for essential recovery and maintenance
 - ▣ Ignores (mostly) inputs from the senses (light, sound, smell)
 - ▣ complex series of processes
 - dreaming (REM) and non-dreaming (non-REM)
 - memory consolidation, learning
 - emotional regulation
 - repair of tissue wear-and-tear
 - growth
 - recharge immune system
 - regulate appetite, metabolism ...
 - ▣ wake up as an updated version of yourself!



Why wake?

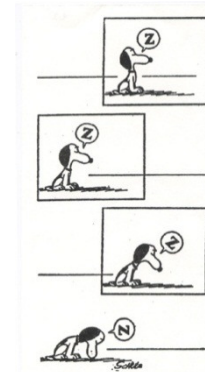
Not enough sleep



- Effects of sleep loss are:
 - ▣ cumulative
 - get progressively worse day-after-day until recovery sleep is taken
 - ▣ dose-dependent
 - shorter time allowed for sleep = faster decline in function

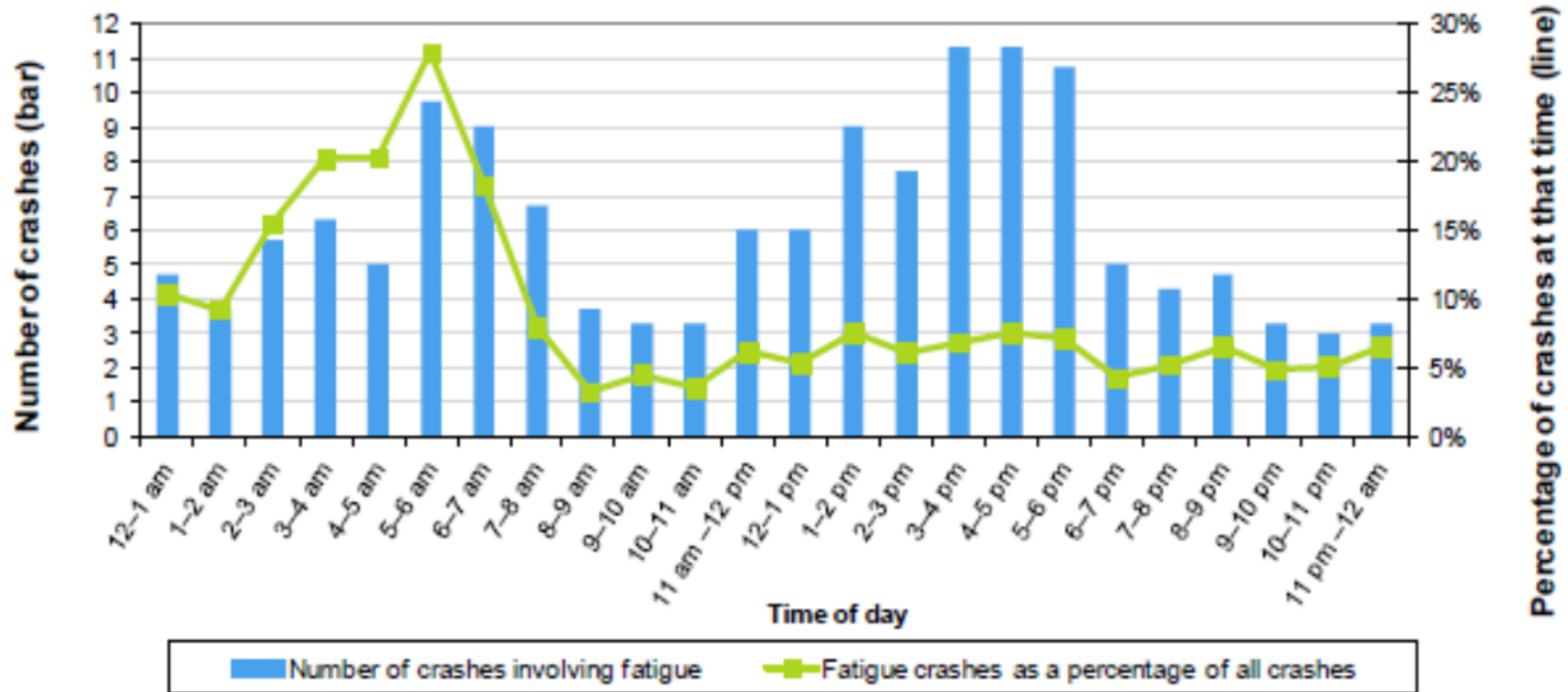
Not enough sleep

- Restricted sleep leads to:
 - ▣ feeling sleepier, irritability, degraded alertness, slower reaction times, poorer coordination, slower thinking, loss of situation awareness, less creative problem-solving
 - ▣ uncontrolled sleep
 - sleepiness → microsleeps → established sleep
- Recovering from restricted sleep
 - ▣ recovery is not hour-for-hour:
 - ▣ sleep usually gets back to normal after 2 nights of unrestricted sleep
 - **not 48 hours off**
 - ▣ recovery of waking function can take more than 2 full nights of sleep
- Pressure for sleep builds up across time awake



When are we sleepy?

Fatigue-related fatal and injury crashes on NZ roads, 2013-2015





Why do we sleep at night?

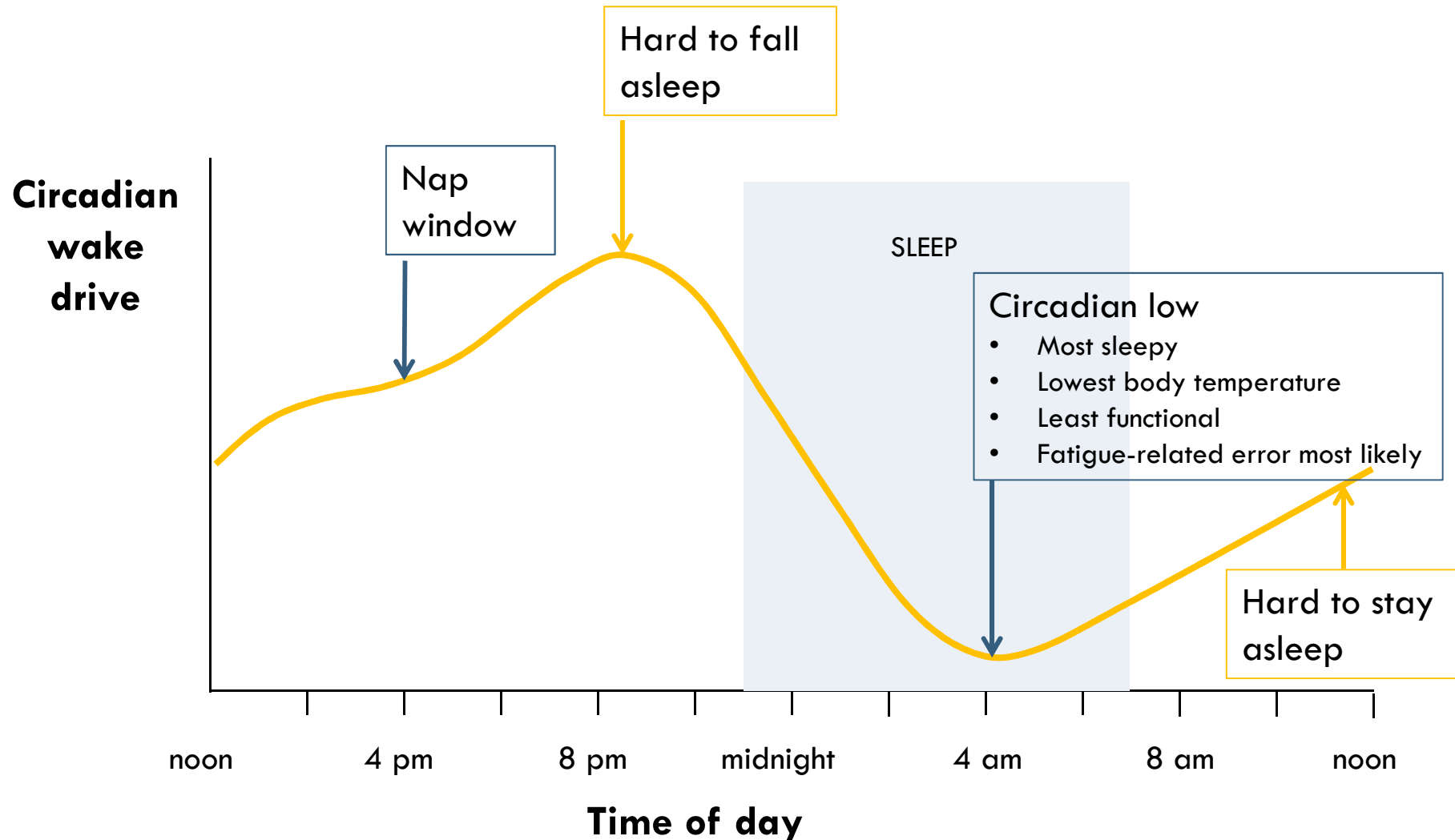
Circadian body clock

- Pacemaker in the brain that drives daily cycles (circadian rhythms) in
 - How you function
 - body functions - hormones, heart rate, digestion ...
 - ability to do physical and mental work
 - How you feel
 - mood, sleepiness, fatigue ...
- Tracks light intensity even through closed eye lids
 - designed to keep us in step with the day/night cycle
 - connected to sleep-promoting centres and wake-promoting centres in the brain

A feature of life on earth

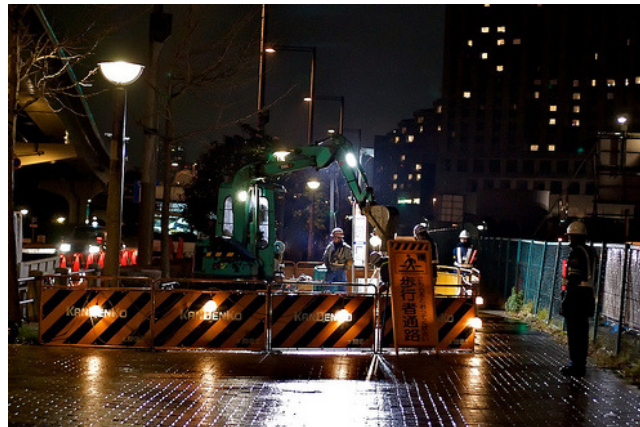


Circadian rhythm basics



Social time versus biological time

Light sensitive circadian body clock
doesn't adapt to shift work



- Trying to work when least functional
- Eating at physiologically inappropriate times
- Trying to sleep when primed for wake
 - ▣ other time demands, noise, light, heat ...

Fatigue versus safety risk

- Risk depends on
 - ▣ What a fatigued person is doing
 - ▣ Other hazards present
 - ▣ Safety defences present



Solo helicopter pilot
manoeuvring to avoid power
lines, 15th load since 1-hr nap
14 hours ago, around midnight



Airline pilot in 4-pilot crew
In-flight sleep in crew bunk
Mid-cruise versus landing

NTSB: hazards in ag operations

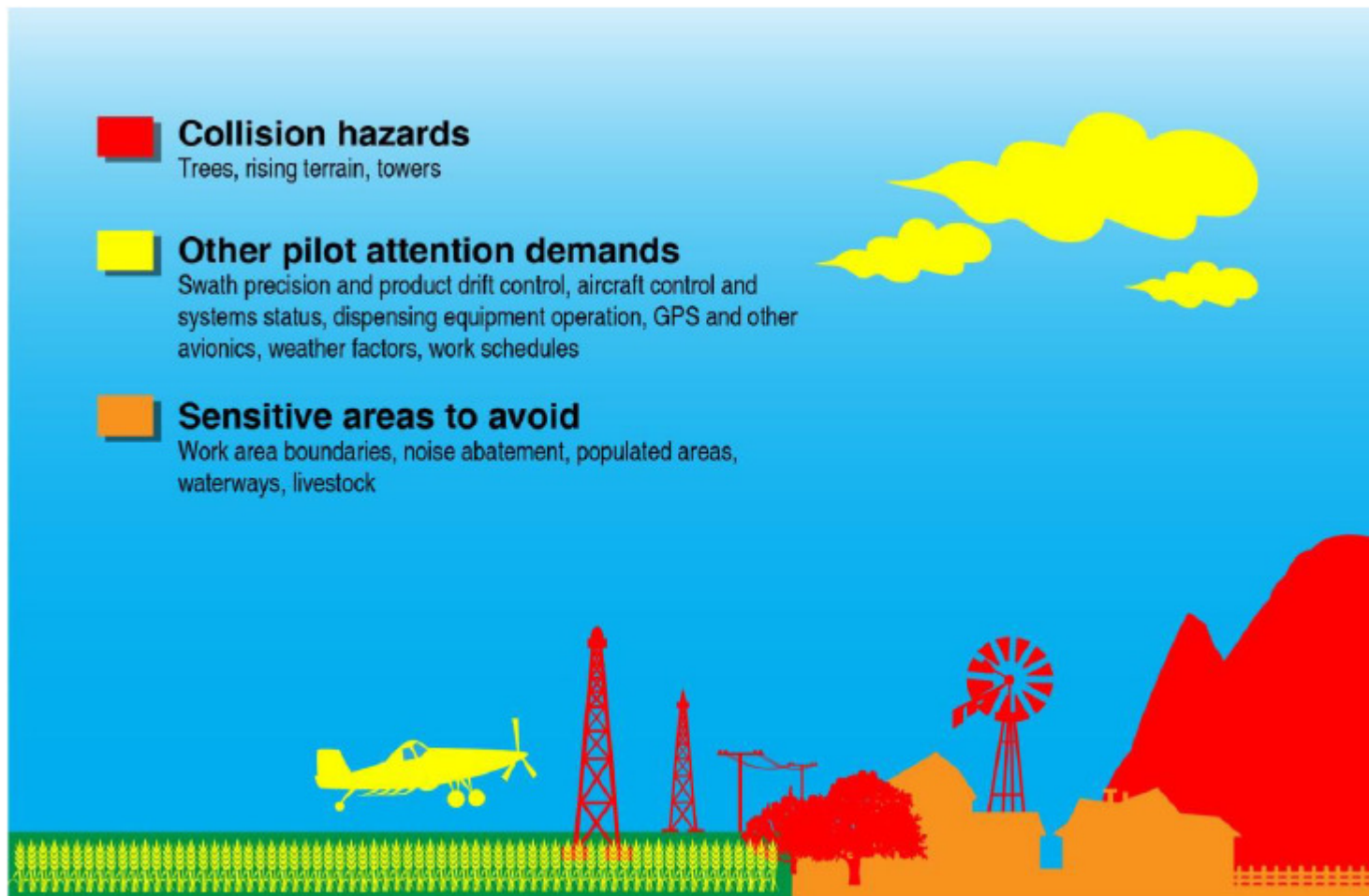



Figure 1. Hazards, constraints, and pilot attention demands common to ag operations.

Managing fatigue risk

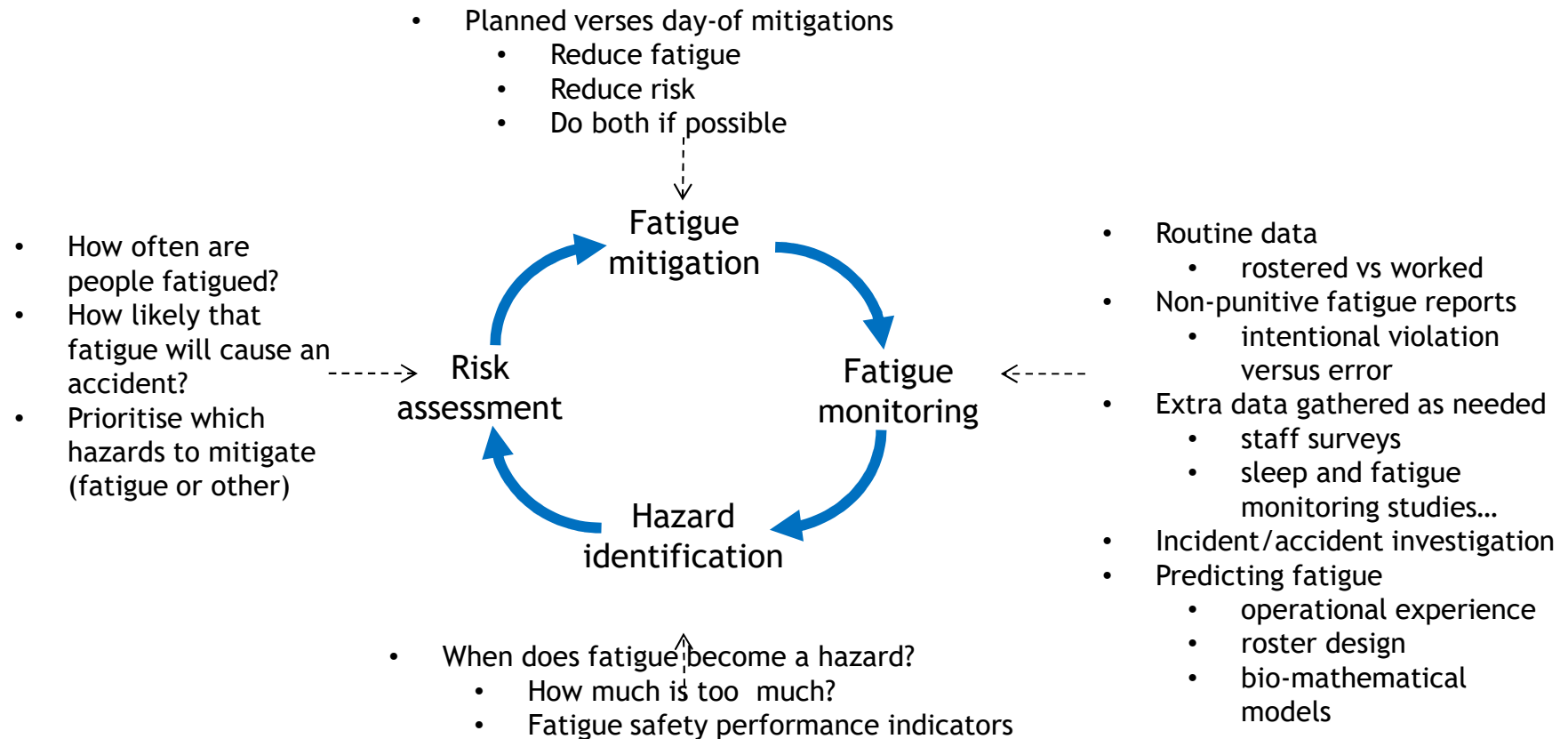
- Traditional approach - prescriptive limits on:
 - ▣ Maximum work hours
 - ▣ Minimum breaks within and between shifts
 - ▣ Frequency of 24-h breaks
 - ▣ Total work hours (weekly, monthly, annually)
- Prescriptive limits in USA transport sector
 - ▣ Rail, 1907
 - ▣ Trucking, 1937
 - ▣ Aviation, 1938
- 2016 National Transportation Safety Board's most wanted safety improvement list
 - ▣ *Still includes reduce fatigue-related accidents across all modes of transport*
- Prescriptive limits
 - ▣ Don't incorporate latest fatigue science
 - cumulative effects of sleep loss
 - need for two nights unrestricted sleep to recover from sleep loss
 - circadian variation
 - ▣ Don't address risk



Managing fatigue risk: what is required?

- CAA regulations under review
 - ▣ Options
 - Status quo
 - Revised prescriptive limits
 - Allow Fatigue Risk Management Systems (FRMS)
 - 2015 ICAO guidance material
 - ▣ Operators working within prescriptive limits should manage fatigue within their SMS
 - Health and Safety at Work Act (2015)
 - ▣ Mental and physical fatigue can cause hazards
 - Hazard - 'a person's behaviour where that behaviour has the potential to cause death, injury, or illness to a person'
 - ▣ Have to monitor workplace, identify hazards, assess risk, mitigate 'as far as is reasonably practicable'
- 

Fatigue Risk Management Cycle



How complicated does it need to be?



- Depends on
 - ▣ complexity of your operations
 - ▣ level of fatigue risk
- Scheduled operations and large organisations have received most attention

ICAO FRMS: 5 components

FRMS Policy

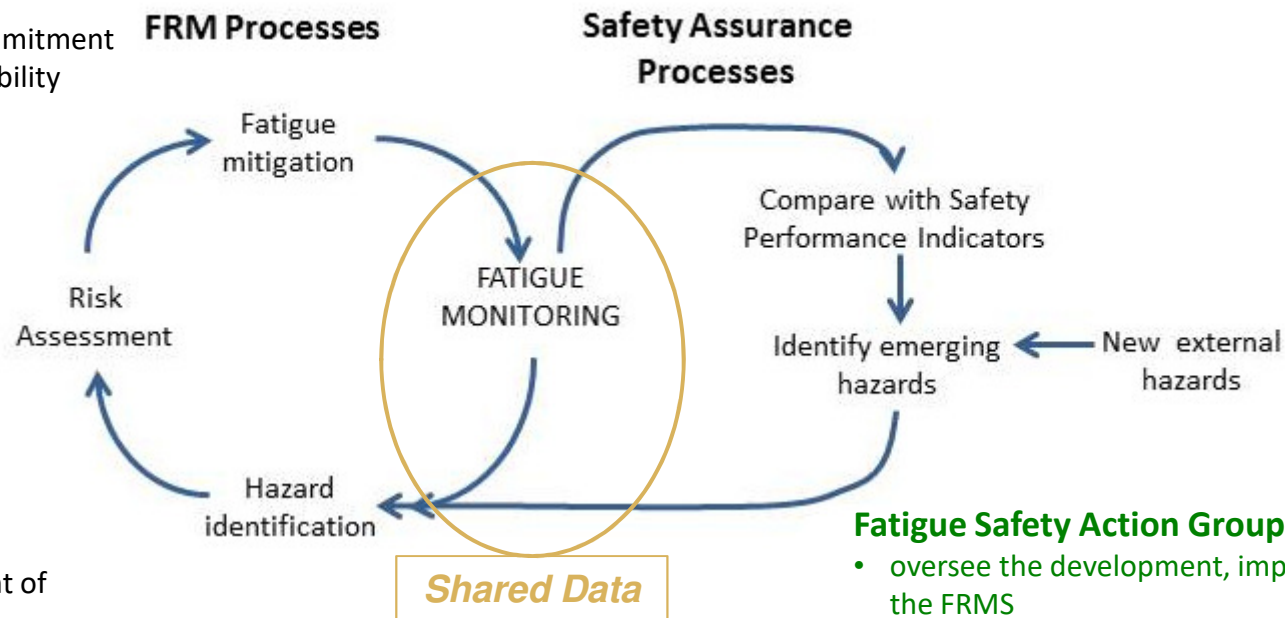
- Identifies FRMS elements
- Identifies FRMS operations (scope)
- Reflects shared responsibility
- States safety objectives
- Declares management commitment
- Identifies lines of accountability

Promotion Processes

- Training program
- Communication plan

Documentation

- Policy and objectives
- Processes and procedures
- Accountabilities, responsibilities and authorities
- Mechanism for involvement of all stakeholders
- FRMS training records
- Planned and actual times worked
- Outputs (findings, recommendations, actions)



Fatigue Safety Action Group

- oversee the development, implementation of the FRMS
- oversee the ongoing operation of the FRM processes
- contribute as appropriate to the FRMS safety assurance processes
- maintain the FRMS documentation
- be responsible for ongoing FRMS training and promotion

Strategies to reduce fatigue

- Fatigue management education
 - ▣ Who? - everyone with a role in flight scheduling, OSH staff, ... CEO
 - ▣ What?
 - causes of fatigue and safety issues in your workplace
 - personal strategies to use at home (how to get better sleep)
 - personal strategies to use at work (strategic use of caffeine, napping, ...)
 - company policies related to fatigue management (for calling in too fatigued, how to report fatigue hazards ...)
- Reduce workload
- Improve skill level
- Healthy workforce

Planned mitigations

Work patterns to reduce fatigue

- The perfect roster is permanent day work with unrestricted sleep at night
- Better work patterns
 - adequate sleep opportunities
 - how fast is sleep debt building up?
 - how long since 2 full nights of sleep in a row?
 - limits on continuous work (time awake, time-on-task fatigue)
 - shift length
 - breaks during shifts (napping between flights?)
 - predictable work, plan for covering on-call or call back
 - knowing ahead of time helps people to arrive at work better-rested
 - getting people home safely
 - fair distribution of weekends off
 - work/life balance matters
 - Worksafe has a focus on wellness

Planned and/or day-of operations (recovery from unexpected demands)

Reducing fatigue-related risk

- What do you do about?
 - ▣ calling in fatigued
 - ▣ workplace napping (when, where, how)
 - ▣ managing staff with chronic sleep problems
 - ▣ analysis of fatigue monitoring data
 - acting on data, feedback to staff and management
 - ▣ linking fatigue management to other hazard management
 - risk assessment
 - cost of mitigations
 - who decides about the \$\$?
 - ▣ getting people home safely
 - risk to self and others on the road

Policies and procedures

Questions to Ask in Your Workplace(s)

- what are the main causes of workplace fatigue?
- what are safety risks posed by fatigued people?
- what mitigations are available to reduce fatigue?
- what mitigations are available to reduce the safety risks associated with fatigued people?

- what data do you have available for routine tracking of fatigue hazards?
- what other data might be useful?
- do you analyse for the role of fatigue in safety events? If yes, how?
- who is responsible for:
 - ▣ fatigue hazard identification?
 - ▣ fatigue risk assessment?
 - ▣ choosing and implementing fatigue mitigations?

- who checks that you are meeting your obligations
 - ▣ CAA requirements
 - ▣ under the HSE Act?

Conclusions



- Fatigue risk management requirements are basically the same for ICAO/CAA and Health and Safety at Work Act
 - workforce/management collaboration
 - whole-of-life issues
 - regulatory requirement
 - fatigue is inevitable in 24/7 operations
 - shared knowledge base
 - education/training on causes of fatigue, management strategies
 - clear communication, policies, and procedures
 - monitoring and managing actual fatigue levels in your workplace
 - pool workplace/organisational/scientific expertise to come up with better solutions
 - integration with management of other hazards
- Complexity of the system you need depends on the complexity of your operations and the level of fatigue-related risk
- Scheduled operations and large organisations have received most attention
 - an opportunity for innovation and leadership

Resources

- NASA Alertness Management in General Aviation Education module (2002)
 - ▣ http://human-factors.arc.nasa.gov/publications/B_Flight_Ops_XV_GAETM1.pdf
- FAA Pilot Brochure Fatigue in Aviation (2007)
 - ▣ https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/Fatigue_Aviation.pdf
- ICAO Fatigue Management Guide for General Aviation Operators of Large and Turbojet Aeroplanes (2016)
 - ▣ <http://www.icao.int/safety/fatiguemanagement/FRMS%20Tools/FM%20for%20GA%20Ops%20FINAL.pdf>
- ICAO fatigue management SARPS and guidance material are being developed for helicopter operations
- CAA and Worksafe - new guidance material planned
- NTSB Special Investigation Report on the Safety of Agricultural Aircraft Operations (2014)
 - ▣ <http://www.nts.gov/investigations/AccidentReports/Reports/SIR1401.pdf>
- John Sinclair 'Fatigue Risk Management Programme' draft document?



Questions?