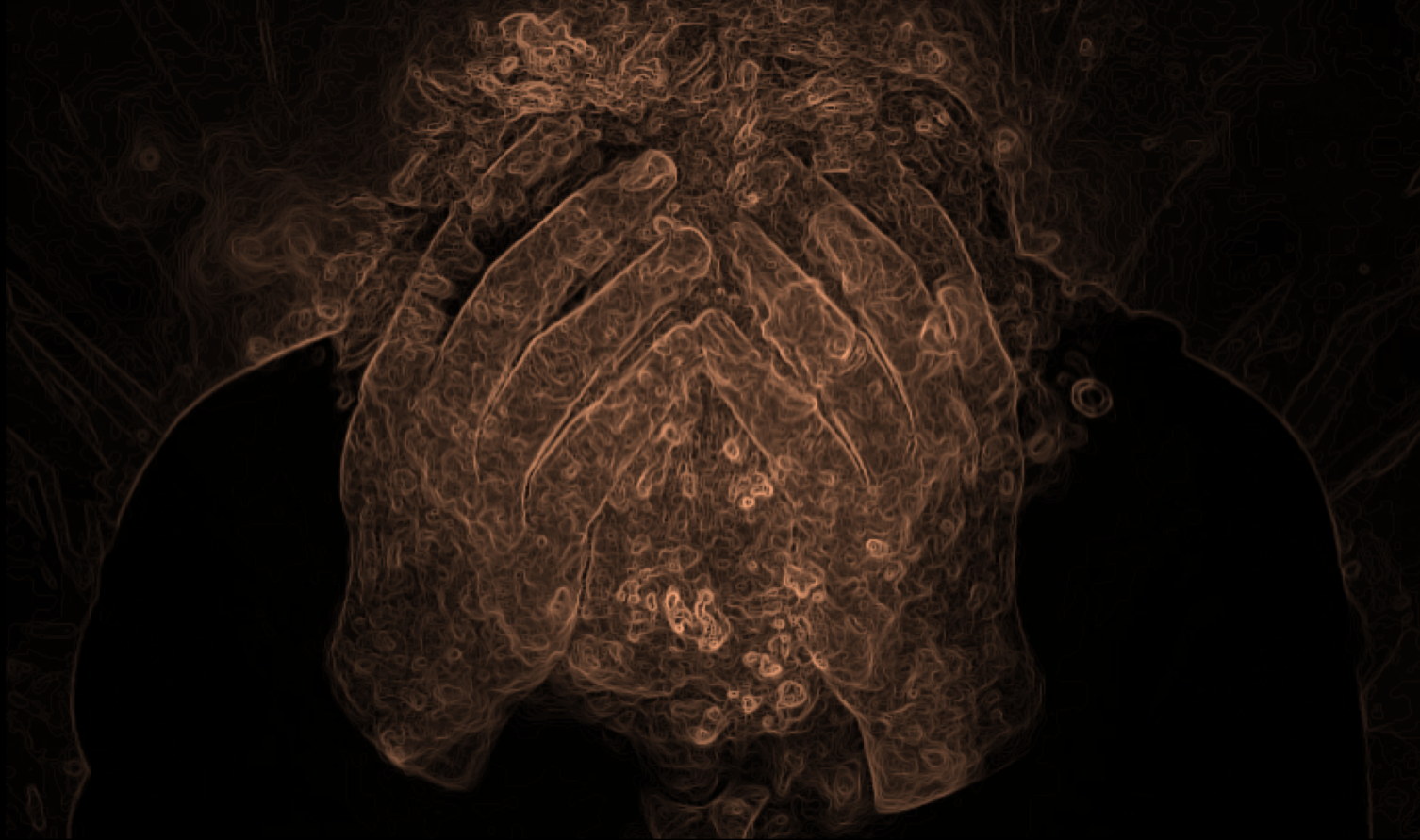


Fatigue in Aviation



FATIGUE



WHY?

We have talked about this for years...



HAVEN'T WE LEARNED ANYTHING?

Or are we facing new challenges?



Let's open a few doors and explore...



China Airlines pilot is caught SLEEPING in the cockpit while flying a Boeing 747

- Man is said to be a senior pilot for the carrier with almost 20 years' experience
- Clip shot by co-pilot mid-flight shows man slumped forward with his eyes closed
- Both the pilot and the co-pilot have received adequate punishment, airline said
- Video surfaced just days after China Airlines pilots ended a seven-day strike



22 February 2019

...over issues such as pilot fatigue and long working hours!



Pilots should undergo a 'tiredness test' before flights to stop them falling asleep in the cockpit, union says



The British Airline Pilots' Association (BALPA), which represents over 10,000 UK pilots, warned politicians that lethargy affecting captains and first officers presented the single biggest threat to plane passenger safety CREDIT: HANNAH MCKAY/PA

The Telegraph

*"Lethargy is a state of **tiredness**, **weariness**, **fatigue**, or **lack of energy**. It can be accompanied by **depression**, **decreased motivation**, or **apathy**.*

*Lethargy can be a normal response to **inadequate sleep**, overexertion, overworking, stress, lack of exercise, improper nutrition, boredom, or a symptom of an illness or a disorder.*

Lethargy often resolves with rest, adequate sleep, decreased stress, physical exercise and good nutrition. Lethargy's symptoms can last days or even months" (Wikipedia)

Karolinska Sleepiness Scale

24 December 2018





Making Every Flight a Safe Flight

- 84% of BALPA members say that it is very important for BALPA to focus on fatigue over the next 12 months
- 55% think fatigue is the biggest threat to flight safety, higher than flight time limitations (16%) and terrorism (15%)
- 79% of our members trust BALPA to maintain aviation safety, more than the regulator (48%) and the Government (17%)

(Figures from the BALPA membership survey 2017)



SAFETY

Pilots in Europe Suffering Fatigue Despite New Rules, ECA Says



By Aviation Tribune

Posted on March 5, 2019



European pilots and cabin crew are experiencing unusually high levels of fatigue, incompatible with an acceptable level of flight safety, despite recent European legislation that is supposed to counter this. **A new study reveals major shortcomings of the Flight Time Limitations (FTL)** – i.e. the rules governing how long pilots can fly, be on duty and have to rest – for night flights and duties that disrupt the human body clock.

“Replacing the hours your body needs to be asleep with the task of piloting an aeroplane carries a very high fatigue risk”, says Capt. Jon Horne, ECA President. “This may be a surprise to some but is no surprise to the thousands of pilots who fly such schedules day in, day out. This study puts the spotlight on a well-known, well-researched and now operationally confirmed safety risk. This risk must be taken seriously to prompt an immediate review of Europe’s FTL rules.”



pb capacity

24

15680

Half of airline pilots report fatigue which could jeopardise passenger safety

51% of pilots surveyed reported that fatigue was not taken seriously by their airline, and **28 %** of pilots felt that they had insufficient numbers of staff to carry out their work safely. In a further notable finding, less than **20 %** of the pilots surveyed felt that their airline company cares about their well-being

First large-scale survey of pilots' perceptions of safety within the European aviation industry. The survey was conducted by The London School of Economics and Political Science (LSE) and EUROCONTROL

7 December 2016



Technology

Asia's Travel Boom Shortage Wor

By Kyunghee Park

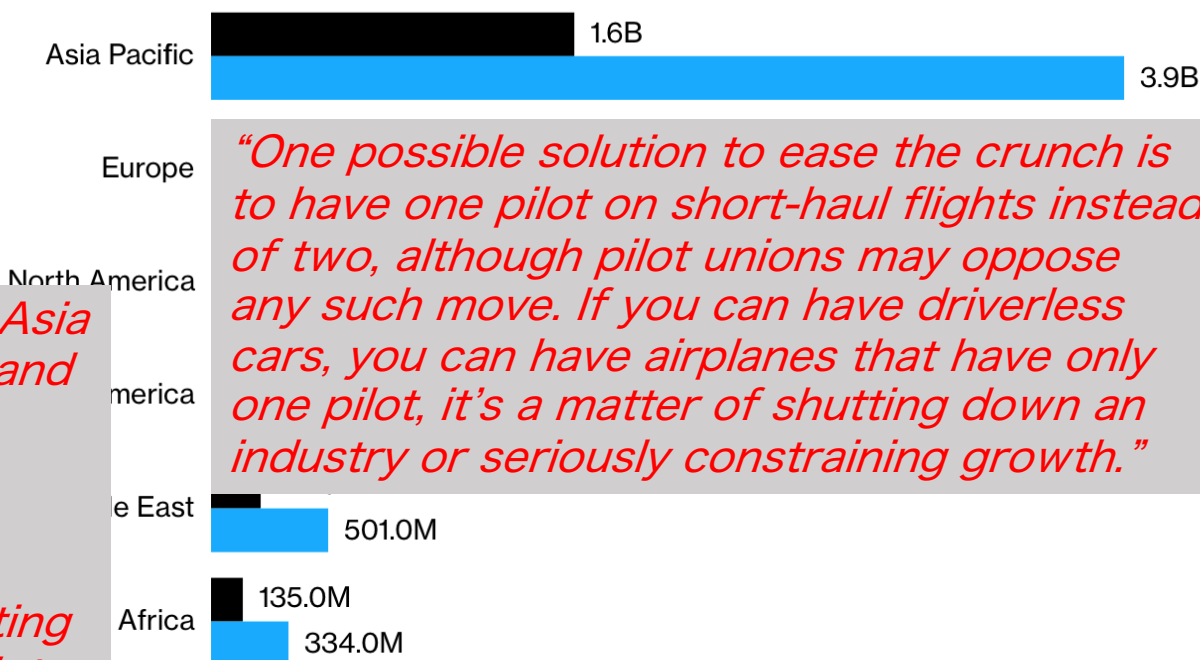
26 February 2019, 22:00 CET Updated

"An unprecedented travel boom in Asia has spawned new budget carriers and millions of first-time fliers. Complex training of pilots requires time, so the rate of supply growth doesn't meet market demand. Some airlines are also "quietly" cutting the minimum hours required for pilots to be qualified as captains as they struggle to fill positions"

Travel Boom

Asia-Pacific market to be bigger than Europe and North America combined

■ 2017 ■ 2037



"One possible solution to ease the crunch is to have one pilot on short-haul flights instead of two, although pilot unions may oppose any such move. If you can have driverless cars, you can have airplanes that have only one pilot, it's a matter of shutting down an industry or seriously constraining growth."

International Air Transport Association
Passenger figures are for travel to, from and within each region; Bloomberg calculated 2017 numbers from data provided by IATA

ot



Qantas Wants Pilot Duty Tim

by Simple Flying Content Team · May 5, 2019

Current 'duty time' limit for pilots is topped at 20 hours

The flights between Sydney and London will require an estimated 23 hours duty time to make this historic service happen

Qantas pilots wants the airline to do more research, consider more training, use more experienced pilots and change what they say is a flawed fatigue reporting system

Only two hurdles now remain for [Qantas](#) to overcome as it looks to provide a record-breaking 21-hour non-stop flight between Sydney and London. The airline is seeking approval from both Australia's aviation regulator and their pilots to agree to unprecedented duty times.



Facts on Fatigue

- Inadequate sleep **deactivates** brain regions for cognitive performance and alertness
- Reduced performance margin between task demand and human performance capability can lead to **impaired judgement, decision making** and/or **fixation**
- Fatigue impairment is progressive, meaning that;
 - Focus of attention can narrow/tunnel
 - Integrating information, even routine information, can degrade and stop
 - Diminishing of ability to self-assess whether safety and/or productivity can be maintained



Facts on Fatigue

Physical Symptoms

- Yawning repeatedly
- Heavy eyelids or microsleeps
- Eye-rubbing
- Nodding off or head drooping
- Headaches, nausea, or upset stomach
- Slowed reaction time
- Lack of energy, weakness, or light headedness

Mental Symptoms

- Difficulty concentrating on tasks
- Lapses in attention
- Failure to communicate important information
- Failure to anticipate events or actions
- Making mistakes even on well-practiced tasks
- Forgetfulness
- Difficulty thinking clearly
- Poor decision making

Emotional Symptoms

- More quiet or withdrawn than normal
- Lack of motivation to do the task well
- Irritable or grumpy with colleagues, family, or friends
- Low morale
- Heightened emotional sensitivity

Fatigue



Fatigue defined by ICAO

Symptoms

A physiological **state of reduced mental or physical performance capability**

Causes

resulting from **sleep loss, extended wakefulness, circadian phase, and/or workload** (mental and/or physical activity)

Consequences

that can **impair** a person's **alertness** and **ability to perform safety related operational duties!** (ICAO Doc 9966)





EASA ORO FTL 2016

- 60 h pr. 5 days, max 900h a year
- Fatigue to be reported as any other incident or occurrence
= a reporting system **must** be in place
- No requirement to have Fatigue Risk Management System (FRMS) – however...
- In case of a dispensation from ORO FTL, a FRMS **must** be established, including a Fatigue Risk Manager



Fatigue Risk Management System

Fatigue Risk Management System (FRMS)

“A data driven means of continuously **monitoring** and **managing fatigue related safety risks**, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness”
(ICAO 9966)

In practice, an FRMS is a **holistic risk management approach** that includes hazard identification, risk assessments, mitigation strategies, training and education programs, **fatigue monitoring systems**, and continual adaptation processes for reflecting changing circumstances and feedback. Operationally it may also be viewed from a prevention, prediction, detection, and intervention perspective (Civil Aviation Safety Authority, 2010).



2 examples



- 160.000 annual flights
- 450 Pilots & 350 cabin crew
- Max 90 h pr. 7 days = more consecutive duty, however this is followed by a longer rest period (7 days - or min. 36 h)



- FRMS established in 2015 due to deviation from EASA ORO FTL (2016)
- Approximately 100 fatigue reports in 2018 (slightly increasing)



GUESS A GENERATION

WILLINGNESS TO REPORT



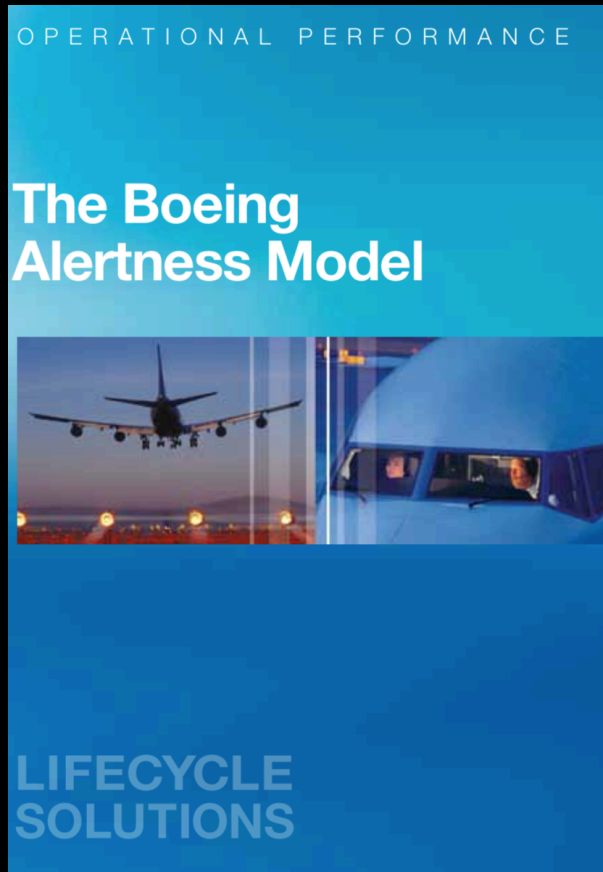
FRMS



- Fatigue Risk Manager (FRM) working full-time, reporting to the Safety Manager
- All reports are handled by Head of Crew Planning (HCP)/FRM
- Coordination meetings between union and crew planning
- Action group - FRM, HR manager, HCP, HSEQ & authorities
- All crew and managers receive **yearly recurrent training**
- The programming tool is based on Boeing Alertness Model



Boeing Alertness Model (BAM)

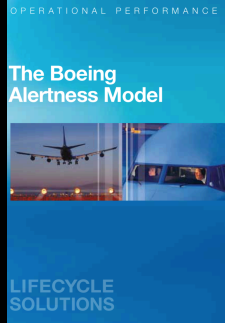


- Biomathematical models like BAM are tools for predicting crewmember fatigue levels, based on a scientific understanding of the factors that contribute to fatigue
- They are an **optional** component of a broader FRMS
- All biomathematical models have **limitations** that must be understood to ensure their appropriate use within an FRMS



BAM

- Can be used to **control alertness** in the construction phase of crew scheduling and provide inputs to the FRMS
- **Supports** the crew scheduling process, from time-table planning to day-of-operation
- Enables operators to **provide data** requested by regulators when discussing Flight Time Limitation alleviations
- Has a build-in mechanism to **learn** from collected data and is designed to autotune and validate predictions

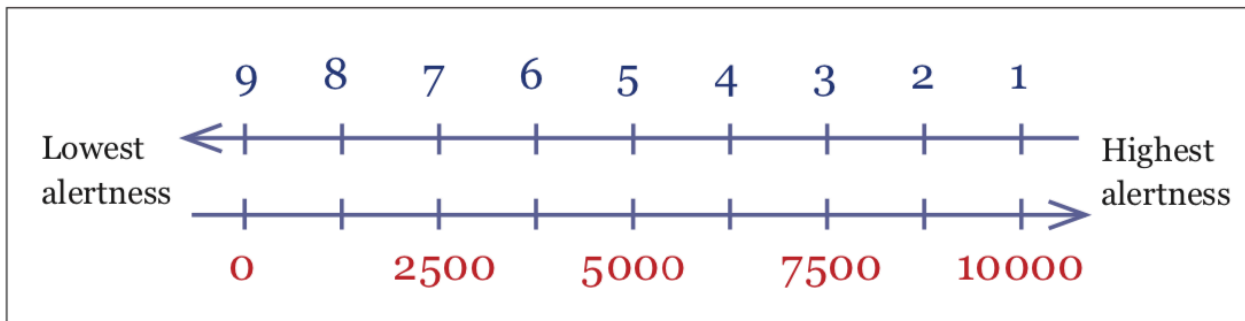


BAM

- Takes the **realities** of the operation into account and can consider commuting times, diurnal tasks, habitual sleep length and other individual factors affecting alertness
- Crew is informed of **Actual** Flight Duty Period and **Max** Flight Duty Period at check in - (can dispense 2 hours, commander's discretion only)



Karolinska Sleepiness Scale



KAROLINSKA SLEEPINESS SCALE (KSS)	
KSS	Description
1	Extremely alert
2	Very alert
3	Alert
4	Rather alert
5	Neither alert nor sleepy
6	Some signs of sleepiness
7	Sleepy, no effort to stay awake
8	Sleepy, some effort to stay awake
9	Very sleepy, great effort to keep awake, fighting sleep

Figure 2. The KSS scale on the top with the corresponding Common Alertness Scale (CAS) used by CAPI below.



Does the system work?

030417	03:35	04:20	BOO	SVJ	04:45		DH1	DH1KB	L	FO
		05:00	SVJ	SKN	05:20		DH1	DH1KB	L	FO
		05:35	SKN	BOO	06:10		DH1	DH1KB	L	FO
		06:30	BOO	SVJ	06:55		DH1	DH1KB	L	FO
		07:10	SVJ	BOO	07:35		DH1	DH1KB	L	FO
		08:10	BOO	RET	08:35		DH1	DH1KB	L	FO
		08:50	RET	LKN	09:15		DH1	DH1KB	L	FO
		09:30	LKN	BOO	09:55		DH1	DH1KB	L	FO
		12:35	BOO	OSL	14:00	14:00	738	738B	D	FC



Does the system work?

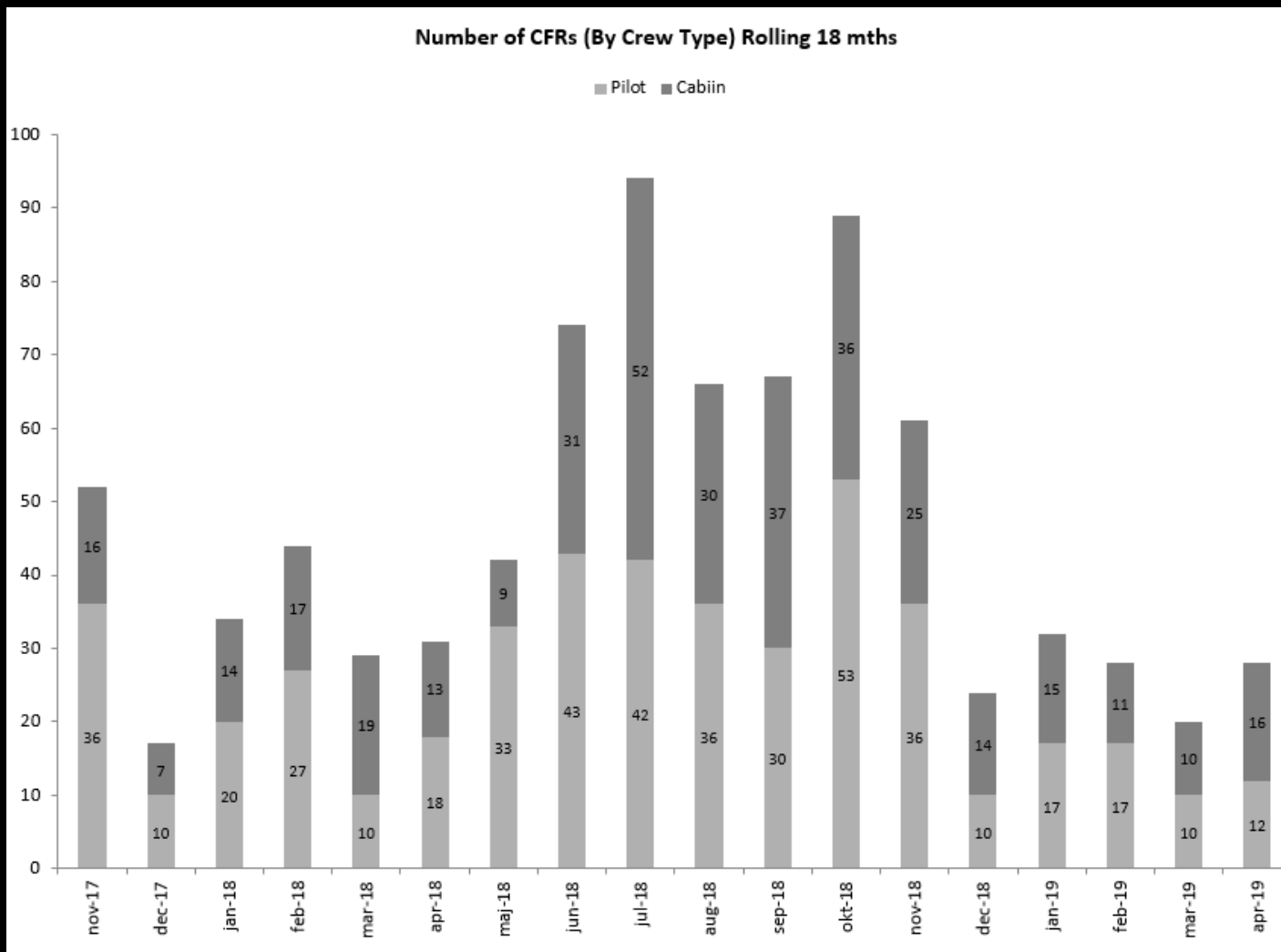
030417	03:35	04:20	BOO	SVJ	04:45		DH1	DH1KB	L	FO
		05:00	SVJ	SKN	05:20		DH1	DH1KB	L	FO
		05:35	SKN	BOO	06:10		DH1	DH1KB	L	FO
		06:30	BOO		06:55		DH1	DH1KB	L	FO
		07:10	SVJ		07:35		DH1	DH1KB	L	FO
		08:10	BOO		08:35		DH1	DH1KB	L	FO
		08:50	SKN		09:15		DH1	DH1KB	L	FO
		09:30	BOO		09:55		DH1	DH1KB	L	FO
		12:35	BOO	OSL	14:00	14:00	738	738B	D	FC
101218	03:55	04:40	BOO	SVJ	05:05		DH1	DH1KB	I	FC
		05:20	SVJ	SKN	05:40		DH1	DH1KB	I	FC
		05:55	SKN	BOO	06:30		DH1	DH1KB	I	FC
		08:10	BOO	RET	08:35		DH1	DH1KB	I	FC
		08:50	RET	SVJ	09:15		DH1	DH1KB	I	FC
		09:30	SVJ	BOO	09:55	10:25	DH1	DH1KB	I	FC



- 11.000 annual flights
- 240 Pilots & 700 cabin crew
- No approved FRMS, Fatigue Management is an integrated part of the SMS

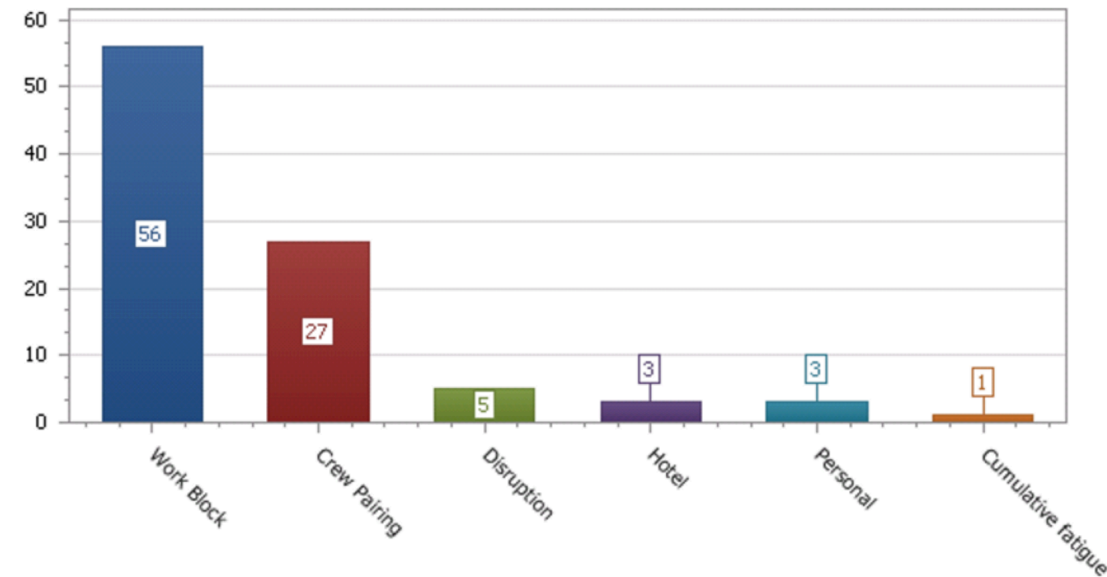


Crew Fatigue Reports

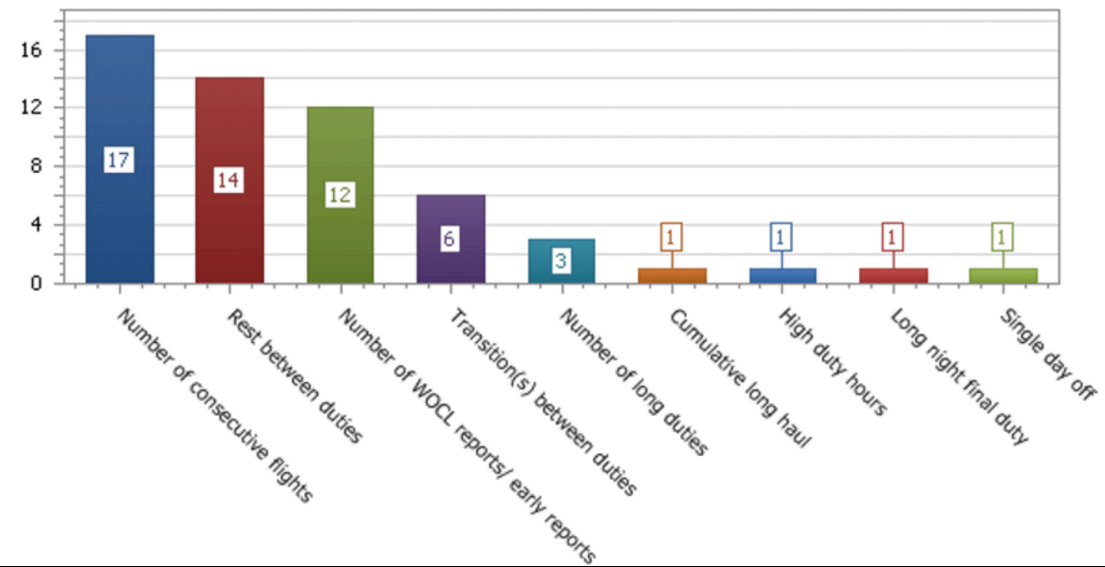


Quantifying Fatigue

Fatigue Top Descriptors



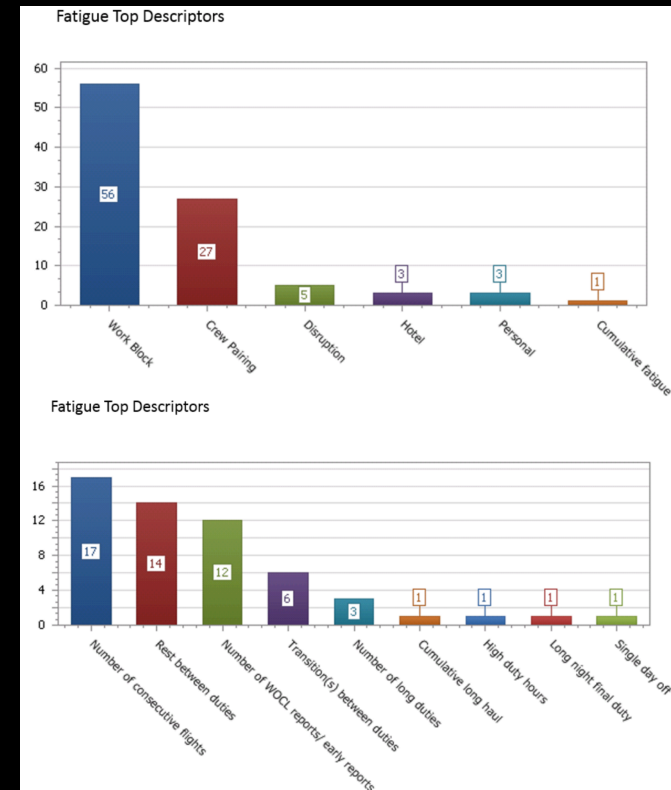
Fatigue Top Descriptors



Quantifying Fatigue

Subcategory descriptors

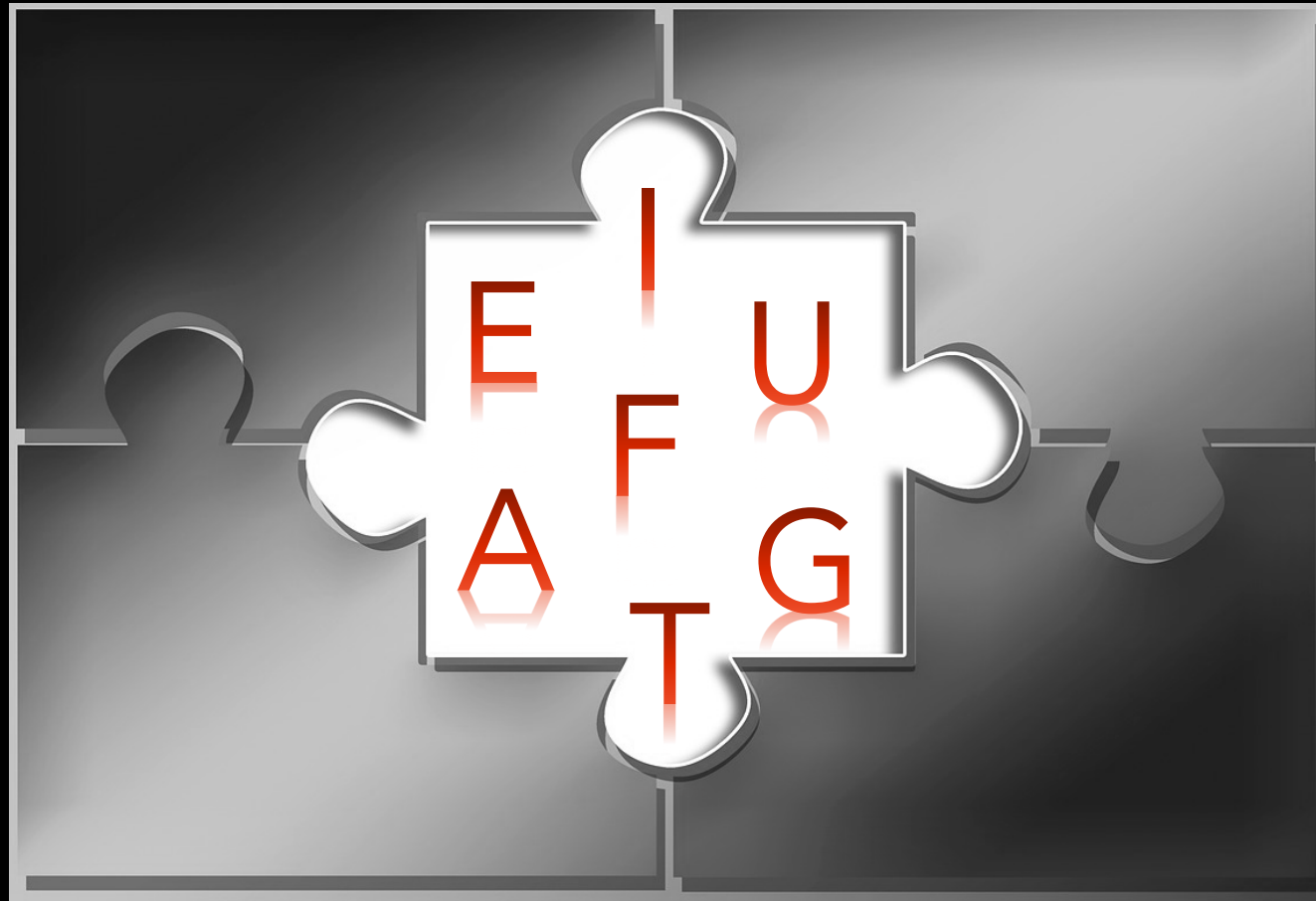
- Crew pairing = 17
- Cumulative fatigue = 5
- Disruption = 9
- Hotel = 6
- Personal = 9
- Work block = 16



Tiredness versus Fatigue



SHARED RESPONSIBILITY



SHARED RESPONSIBILITY

*“Because fatigue is affected by all waking activities not only work demands, regulations for its management are necessarily predicated on the need for **shared responsibility** between the operator and individual crew members.*

So, whether complying with prescriptive flight and duty limitations or using an FRMS, operators are responsible for providing schedules that allow crew members to perform at adequate levels of alertness, and crew members are responsible for using that time to start work well-rested” (ICAO Doc 9966)



Challenges



Reporting culture



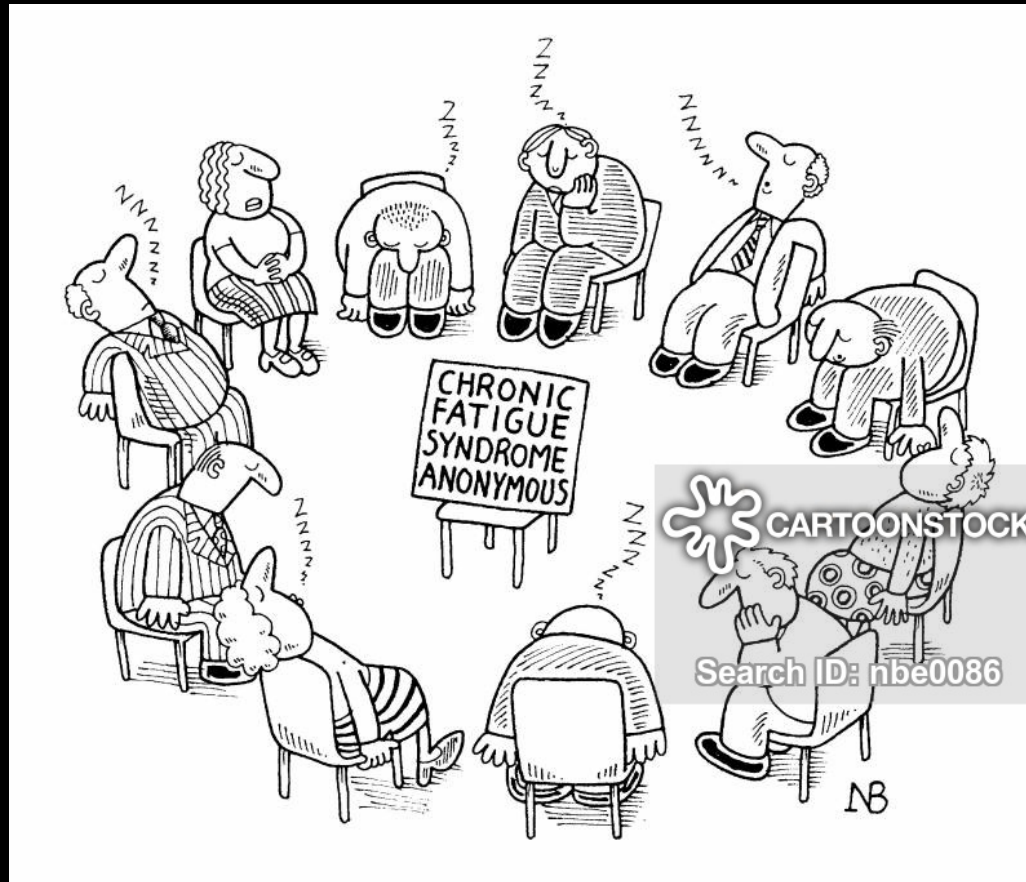
Discrepancy in the number of **official** fatigue reports received by the CAA and the general discussion amongst crew



Data collection - weak signals



Mitigating Fatigue



Fatigue self-management strategies



Pilots who routinely used daytime napping prior to overnight duties reported **significantly** lower levels of general fatigue

(Symptoms of Fatigue and Coping Strategies in International Pilots, K.J Petrie & A.G Dawson)



Wrist activity



A study showed that **4–5 min** of wrist inactivity can be associated with loss of alertness and the early stages of sleep

(Vigilance on the civil flight deck: incidence of sleepiness and sleep during long-haul flights and associated changes in physiological parameters, N. Wright & A. McGown)



Conclusion

- Fatigue is multifaceted and **NOT** very tangible and easy to grasp
- Difficult to identify the **effects** of fatigue due to the influence of other factors
- A Fatigue Risk Management System can provide guidance via tools like biomathematical models and risk assessments, however this can **NOT** replace the importance of ensuring an open dialogue concerning the boundaries of **shared responsibility**
- A good reporting culture is vital to **collect data** that can provide insight of **weak signals** and anticipate potential challenges
- **Self-assessment** according to **KSS** could perhaps be investigated? – Contact me if you want to be part of a study!





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