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**What is the FFAMT good for**

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# What is the Fatigue Factor Assessment and Mitigation Table good for

## About

- The idea behind it

## How to use the FFAMT

- Step by Step

## Conclusion

- Pros and Cons

## Bonus

- 3 Different Night Duties



- Difficult questions
- The idea behind the FFAMT

# About the Fatigue Factor Assessment and Mitigation Table

## General



## The FFAMT may help to answer these questions:

Can we do this duty?

What is needed to do this duty safely?

CAA:  
Show me how  
you assure your  
flights are safe?

Why is this duty so difficult?

What can be done to make this duty acceptable?



## About the Fatigue Factor Assessment and Mitigation Table (FFAMT)

The Fatigue Factor Assessment and Mitigation Table has been proposed as a „fatigue specific risk assessment methodology for a particular duty or work pattern“.

It is an example! Before using this method customisation is required since different operators are faced with different types of fatigue factors to various degrees.

It has been published to ... “inspire new methodologies” with growing FRMS experience of the industry.



## This type of methodology may be used:

- to **identify the causes of fatigue** associated with a single duty / type of shift  
(to complement the fatigue hazard identification processes)
- to give a single duty or type of shift a **specific and comparable “fatigue value”**  
(as a specific fatigue risk assessment process)
- to **identify effective mitigations** for a single duty / type of shift /work pattern...  
(to complement the fatigue risk mitigation process)



# About the Fatigue Factor Assessment and Mitigation Table (FFAMT)

- Published in ICAO Fatigue Management Guides 2015, Chapter: Fatigue Risk Assessment





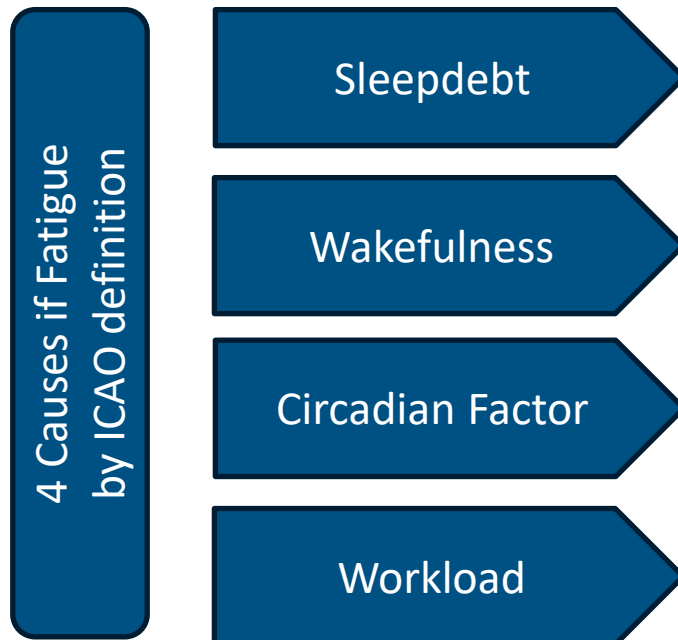
## About the Fatigue Factor Assessment and Mitigation Table (FFAMT)

- Published in ICAO Fatigue Management Guides 2015, Chapter: Fatigue Risk Assessment
- Presented at the “EASA FRMS Workshop 2015” at Cologne | Germanwings | Tritschler
- Conference paper: “Fatigue Risk Assessment Methodologies”  
EASA FRMS Workshop Cologne 2015 | Cpt. Kristjof Tritschler





# The Idea behind Fatigue Factor Assessment and Mitigation Table (FFAMT)



Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1		
	Previous nightsleep ** reduced > 4h	1		
	Reduced nightsleep > 4h before previous night ***	1		
	Previous "nightduty" ** (daysleep only)**	1		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **	(1)		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
	Sum of fatigue factors	11		
	Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable		* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
	Factors are not fully weighted! 8 Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.			
	Tritschler 2015; EASA FRMS Workshop Cologne			

The simple idea is to identify the relevant "causes of fatigue" for this duty as hazard identification. By "ticking boxes".



# The Idea behind Fatigue Factor Assessment and Mitigation Table (FFAMT)

16 relevant fatigue factors  
for this operator



Fatigue Factor Assessment and Mitigation Table			
	Fatigue Factor:	Factor Explained:	Scientific Study:
Sleep debt	Previous night sleep reduced < 4h (night: 22-08LT)	Own research showed acceptable performance after 6 hrs of sleep	Vejvoda 2014 [1] Basic sleep science, e.g.[7]
	Previous night sleep reduced > 4h	Less than 4 hours of night sleep show impairment	
	Reduced night sleep >4h before previous night ***	At least 2 consecutive nights are relevant	Dawson 2006 [8]
	Previous "night duty" (daysleep only)	Sleep during daytime is less restorative than at night	Spencer 1997 [9]
Wakefulness	Time since awake > 2h prior C/I*	Up to 2hrs is considered minimum before start of duty.	Vejvoda 2014 [1] DLR GWI Study 2009 [2]
	Time since awake > 6h prior C/I*	Own research showed acceptable performance up to 16h wakefulness	
	Time on task > 10h (FDT)	According to DLR up to 10h FDT are recommended, but only 4 duties above 10h per week (NASA short haul)	Dinges 1996 [3] Samel 1997 [4] Goode 2003 [5]
	Time on task > 12h < 14h (FDT)	According NASA & DLR more than 12hrs of FDT are not recommended	Spencer 1999 [6]
Circadian Factors	Circadian disruption > 4h	Shift-lag effect leads to circadian distr. and manifests as a decrement in performance; Effect on 1 <sup>st</sup> day in many studies	Stewart 2003 [10][11]
	Flight after 2300LT and/or last landing during darkness	Circadian effect measurable after 2300LT	Vejvoda 2014 [1] Powell 2007/08 [12] [13]
	Flighttime <2h during WOCL	Performance impairment during WOCL	Basic sleep science [14] Spencer [6] [15] [16] Gundel 2011 [17]
	Flighttime > 2h during WOCL	Strong performance impairment	Powell [13]
Workload	3 or 4 consecutive flights/sectors	Number of sectors are of important influence, own study up to 4 acceptable	Gander 1994 [18] Spencer 2005 [16] Powell 2007 [12]
	5 or 6 flights / or: 3 flights during night	More than 5 sectors per duty show impairment	Niederl 2007 [19] DLR GWI Study 2009 [2]
	Known hassles	The strongest influence on levels of fatigue at the end of a flight was the level of hassle associated with this flight (Spencer)	Bourgeois 2003 [20][21] Spencer 2005 [16] Stewart 2006 [22] Tritschler 2010 [23]
	Training flights	For training captains workload may be particularly high when commanding training and assessment duties	Stewart, 2009 [24]
Most scientific studies have investigated specific factors only. The combination of independent studies may be of conflict.			
Tritschler 2015; EASA FRMS Workshop Cologne			

Based on 25 scientific  
references

# The Idea behind Fatigue Factor Assessment and Mitigation Table (FFAMT)

Why is this duty so difficult?

Step 1		Table	
		Checkin 1600LT, Checkout 0300LT; FbT: 11:00h	
		Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)		
	Previous nightsleep ** reduced > 4h		
	Reduced nightsleep > 4h before previous night ***		
	Previous "nightduty" ** (daysleep only)**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*		
	Time since awake prior duty start > 6h prior C/I*		
	Time on task > 10h (FDT)		
	Time on task > 12h < 14h (FDT)		
Circadian Factors	Circadian disruption > 4h **		
	Flight after 2300LT or last landing during darkness		
	Flighttime <2h during WOCL		
	Flighttime > 2 h during WOCL		
Workload	3 or 4 consecutive flights/sectors		
	5 or 6 flights / or: 3 flights during night		
	Known hassles		
	Training flights		
Sum of fatigue factors		11	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable		* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! 8 Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.			
Tritschler 2015; EASA FRMS Workshop Cologne			

It's a simple methodology to identify relevant fatigue factors

# The Idea behind Fatigue Factor Assessment and Mitigation Table (FFAMT)

Can we do this duty?

Assess

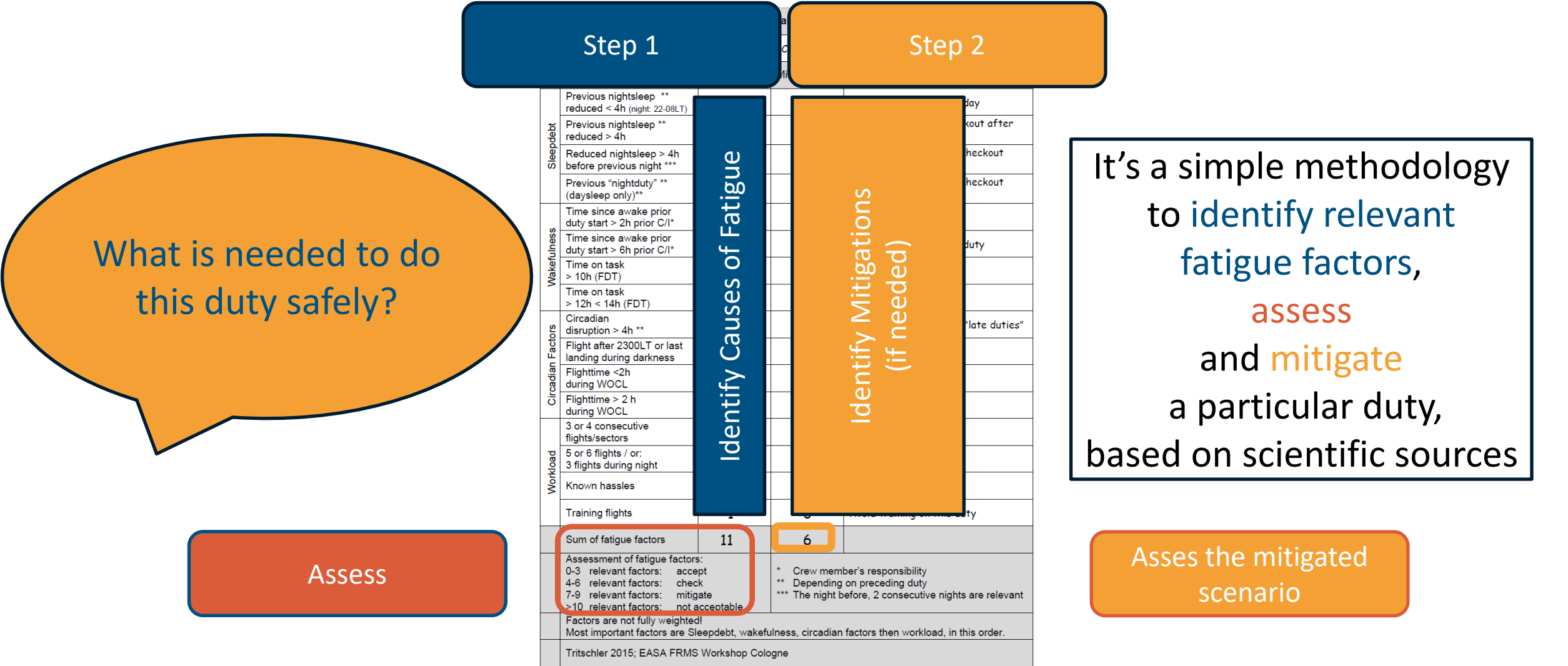
Step 1

Identify Causes of Fatigue

Fatigue Factor Assessment Table		
Checkin 1600LT, Checkout 0300LT; FdT: 11:00h		
	Mitigated:	
	Comment:	
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	
	Previous nightsleep ** reduced > 4h	
	Reduced nightsleep > 4h before previous night ***	
Wakefulness	Previous "nightduty" ** (daysleep only)**	
	Time since awake prior duty start > 2h prior C/I*	
	Time since awake prior duty start > 6h prior C/I*	
Circadian Factors	Time on task > 10h (FDT)	
	Time on task > 12h < 14h (FDT)	
	Circadian disruption > 4h **	
Workload	Flight after 2300LT or last landing during darkness	
	Flighttime <2h during WOCL	
	Flighttime > 2 h during WOCL	
	3 or 4 consecutive flights/sectors	
	5 or 6 flights / or: 3 flights during night	
	Known hassles	
	Training flights	
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Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable		* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant
Factors are not fully weighted! 8 Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.		
Tritschler 2015; EASA FRMS Workshop Cologne		

It's a simple methodology to identify relevant fatigue factors, assess

# The Idea behind Fatigue Factor Assessment and Mitigation Table (FFAMT)





# About the Fatigue Factor Assessment and Mitigation Table

- This methodology may be used to simplify fatigue risk management  
With an approved FRMS, or an “appropriate FRM”, or as a hazard in an SMS
- It is independent of regulatory limits since it is based on scientific knowledge only  
(It is not intended to be used beyond regulatory FTLs)
- The table itself is just a part of the FRM process
- The FFAMT may complement your SMS / FRMS processes for
  - (Fatigue) Hazard Identification AMC1 ORO.FTL.120(b)(4)
  - (Fatigue) Risk Assessment AMC2 ORO.FTL.120(b)(4)
  - (Fatigue) Risk Mitigation AMC1 ORO.FTL.120(b)(8)



- Step 1 Hazard Identification by Identifying Relevant Fatigue Factors “Worst Case”
- Step 2 First Assessment
- Step 2 Identifying Mitigations
- Step 2 Assessing the Mitigated Scenario (Mitigated Scenario)
- Step 3 Limiting the Exposure / Frequency

**How to use the Fatigue Factor Assessment and Mitigation Table**  
**ICAO Doc 9966 Example**

# The Fatigue Factor Assessment Table (FFAMT) ICAO Example

Fatigue Factor Assessment and Mitigation Table			
Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Previous nights sleep ** reduced < 4h (night: 2h)			

Duty: CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h

Wakefulness	Time since awake prior duty start > 6h prior C/I*			
	Time on task > 10h (FDT)			
	Time on task > 12h < 14h (FDT)			
Circadian Factors	Circadian disruption > 4h **			
	Flight after 2300LT or last landing during darkness			
	Flighttime <2h during WOCL			
	Flighttime > 2 h during WOCL			
Workload	3 or 4 consecutive flights/sectors			
	5 or 6 flights / or: 3 flights during night			
	Known hassles			
	Training flights			
	Sum of fatigue factors			
	Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable	* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
	Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.			
	Tritschler 2015; EASA FRMS Workshop Cologne			





# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

## Step 1

Fatigue Factor Assessment and Mitigation Table				
Type of Shift/Specific Duty:		CGN-TES-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
Fatigue Factor:		Worst case		Comment:
Sleepdebt	Previous nightsleep reduced < 4h (night: 22:00LT)			
	Previous nightsleep ** reduced > 4h			
	Reduced nightsleep > 4h before previous night ***			
	Previous "nightduty" ** (daysleep only)**			
Wakefulness	Time since awake prior duty start > 2h prior C/I*			
	Time since awake prior duty start > 6h prior C/I*			
	Time on task > 10h (FDT)			
	Time on task > 12h < 14h (FDT)			
Circadian Factors	Circadian disruption > 4h **			
	Flight after 2300LT or last landing during darkness			
	Flighttime <2h during WOCL			
	Flighttime > 2 h during WOCL			
Workload	3 or 4 consecutive flights/sectors			
	5 or 6 flights / or: 3 flights during night			
	Known hassles			
	Training flights			
Sum of fatigue factors				
Assessment of fatigue factors:				
0-3 relevant factors: accept		* Crew member's responsibility		
4-6 relevant factors: check		** Depending on preceding duty		
7-9 relevant factors: mitigate		*** The night before, 2 consecutive nights are relevant		
>10 relevant factors: not acceptable				
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

“worst case scenario” under existing conditions means:  
What duty can be planned before the duty of interest?  
In this example we assume the previous duty has been a similar type of night flight.



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

Step 1

Fatigue Factor Assessment and Mitigation Table				
Type of Shift/Specific Duty:		CGN-TES-CGN: Checkin 1600LT, Checkout 0300LT; FBT: 11:00h		
Fatigue Factor:		Worst case		Comment:
Sleepdebt	Previous nightsleep reduced < 4h (night: 22:00LT)			
	Previous nightsleep ** reduced > 4h			
	Reduced nightsleep > 4h before previous night ***			
	Previous "nightduty" ** (daysleep only)**			
	Time since awake prior duty start > 2h prior C/I*			

present (1) , absent (--) or already mitigated (0)

Workload	Circadian	Flighttime > 2 h during WOCL			
	Workload	3 or 4 consecutive flights/sectors			
		5 or 6 flights / or: 3 flights during night			
		Known hassles			
		Training flights			
		Sum of fatigue factors			
	Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable		* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.					
Tritschler 2015; EASA FRMS Workshop Cologne					



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

## Step 1

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TF5-C6N: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)			
	Previous nightsleep ** reduced > 4h			
	Reduced nightsleep > 4h before previous night ***			
	Previous "nightduty" ** (daysleep only)**			
Wakefulness	Time since awake prior duty start > 2h prior C/I*			
	Time since awake prior duty start > 6h prior C/I*			
	Time on task > 10h (FDT)			
	Time on task > 12h < 14h (FDT)			
Circadian Factors	Circadian disruption > 4h **			
	Flight after 2300LT or last landing during darkness			
	Flighttime <2h during WOCL			
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Workload	3 or 4 consecutive flights/sectors			
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Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

Why is this duty so difficult?



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

Step 1

Sleepdebt

Identify Causes of Fatigue

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***			
	Previous "nightduty" ** (daysleep only)**			
Wakefulness	Time since awake prior duty start > 2h prior C/I*			
	Time since awake prior duty start > 6h prior C/I*			
	Time on task > 10h (FDT)			
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Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

The first 2 lines assume that the opportunity to sleep at night (between 2200LT and 0800LT) is reduced.

Line 1: By more than 4h resulting in less than 6h of night-sleep.

Line 2: By more than 6h resulting in less than 4h of night-sleep.

In this example:  
both need to be counted (!)  
When less than 4h of sleep are relevant!



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

Step 1

Sleepdebt

Day before

Identify Causes of Fatigue

Fatigue Factor Assessment and Mitigation Table					
Type of Shift/Specific Duty:		CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h			
Fatigue Factor:		Worst Case:	Mitigated:	Comment:	
Wakefulness	Continuous nightsleep **	1**			
	Reduced nightsleep < 4h (night: 22-08LT)	1**			
	Reduced nightsleep > 4h before previous night ***				
	Previous night duty (daysleep only)**				
	Time since awake prior duty start > 2h prior C/I*				
	Time since awake prior duty start > 6h prior C/I*				
	Time on task > 10h (FDT)				
	Time on task > 12h < 14h (FDT)				
	Circadian Factors	Circadian disruption > 4h **			
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Flighttime <2h during WOCL					
Flighttime > 2 h during WOCL					
Workload	3 or 4 consecutive flights/sectors				
	5 or 6 flights / or: 3 flights during night				
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	Training flights				
Sum of fatigue factors					
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.					
Tritschler 2015; EASA FRMS Workshop Cologne					

The third line addresses the night sleep opportunity “before the last rest period”.

It is marked by \*\*\*



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

Step 1

Sleepdebt

Identify Causes of Fatigue

Fatigue Factor Assessment and Mitigation Table				
Type of Shift/Specific Duty:		CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
Fatigue Factor:		Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**			
Wakefulness	Time since awake prior duty start > 2h prior C/I*			
	Time since awake prior duty start > 6h prior C/I*			
	Time on task > 10h (FDT)			
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Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

The third line addresses the night sleep opportunity "before the last rest period".

If it is reduced, the sleep debt cumulates before starting the duty to be assessed.

In our example the 3<sup>rd</sup> factor is counted as well.



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

Step 1

Sleepdebt

Identify Causes of Fatigue

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*			
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	Time on task > 10h (FDT)			
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Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

Since the previous night-flight causes primarily sleep during daytime (less restorative sleep),

the 4<sup>th</sup> factor is additionally counted in this example.



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

## Step 1

### Identify Causes of Fatigue

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*			
	Time since awake prior duty start > 6h prior C/I*			
	Time on task > 10h (FDT)			
	Time on task > 12h < 14h (FDT)			
Circadian Factors	Circadian disruption > 4h **	(--)**		
	Flight after 2300LT or last landing during darkness			
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Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

The previous duty has a direct effect on the sleep opportunity, sleep duration and possible shift changes.

Factors that depend on the preceding duty are marked by \*\*





# Step 1: Hazard Identification by Identifying Relevant

Step 1

Identify Causes of Fatigue

Wakefulness

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **			
	Flight after 2300LT or last landing during darkness			
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Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

The point of time when a crewmember wakes up needs to be estimated, based on typical sleep duration after the preceding duty and the present duty.

In this example we estimate the wake up time at 10LT.  
This results in a time since awake prior duty of:

Line 5: more than 2h

Line 6: more than 6h

Both need to be counted.

Marked by \* because the individual sleep- and wake strategy of the crewmember is relevant.



# Step 1: Hazard Identification by Identifying Relevant Fatigue Factors

## Step 1

Identify Causes of Fatigue

Circadian Factor

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FbT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian	Circadian disruption > 4h **	(1)**		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors			
	5 or 6 flights / or: 3 flights during night			
	Known hassles			
	Training flights			
Sum of fatigue factors				
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

A circadian disruption may be expected with 4 or more time-zones or a shift in wake-up time by more than 4h.

The first shift-leg occurs on the first day of duty for early start.

The circadian downswing has to be expected after 23LT for late and night duties.

Darkness leads to melatonin production, but is no strong factor itself.



# Step1: First Assessment

## Step 1

Identify Causes of Fatigue

Workload

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FdT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **	(1)**		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
	Sum of fatigue factors	11		
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

Workload:  
In this example the duty only contains 2 sectors,  
The destination is  
no demanding airport  
but training could be planned  
under existing regulations of this  
airline.



# Step1: First Assessment

## Step 1

Fatigue Factor Assessment and Mitigation Table			
Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FBT: 11:00h		
Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
Previous nightsleep **	1**		

The FFAMT follows the trivial idea of counting relevant fatigue factors and assess if the number of factors is acceptable  
(This is a fatigue- score, value, weight or severity of this duty)  
However, factors are not fully weighted!

Identify Causes of Fatigue

Assess

Circadian	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
	Sum of fatigue factors	11		
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable		* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

In this example the sum of relevant fatigue factors / the fatigue score is 11.



# Step1: First Assessment

## Step 1

Identify Causes of Fatigue

Assess

Fatigue Factor Assessment and Mitigation Table				
Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h			
Fatigue Factor:	Worst Case:	Mitigated:	Comment:	
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **	(1)**		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
Sum of fatigue factors		11		
Assessment of fatigue factors:				
0-3 relevant factors: accept				* Crew member's responsibility
4-6 relevant factors: check				** Depending on preceding duty
7-9 relevant factors: mitigate				*** The night before, 2 consecutive nights are relevant
>10 relevant factors: not acceptable				
Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

Can we do this duty?

In this example the sum of relevant fatigue factors / the fatigue score is 11.



# Step1: First Assessment

## Step 1

Identify Causes of Fatigue

Assess

Fatigue Factor Assessment and Mitigation Table			
Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FBT: 11:00h		
Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**	
	Previous nightsleep ** reduced > 4h	1**	
	Reduced nightsleep > 4h before previous night ***	1**	
	Previous "nightduty" ** (daysleep only)**	1**	
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1	
	Time since awake prior duty start > 6h prior C/I*	1	
	Time on task > 10h (FDT)	1	
	Time on task > 12h < 14h (FDT)	--	
Circadian Factors	Circadian disruption > 4h **	(1)**	
	Flight after 2300LT or last landing during darkness	1	
	Flighttime < 2h during WOCL	1	
	Flighttime > 2 h during WOCL	--	
Workload	3 or 4 consecutive flights/sectors	--	
	5 or 6 flights / or: 3 flights during night	--	
	Known hassles	--	
	Training flights	1	
Sum of fatigue factors		11	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			
* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant			
Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.			
Tritschler 2015; EASA FRMS Workshop Cologne			

In this example the sum of relevant fatigue factors / the fatigue score is 11.

The box below is outlined on the next page

# Fatigue (Risk) Assessment

Table 5-4. Example Categories for Assessment of Fatigue Factor Scores under Existing Conditions (Step 1)

Assessment of Fatigue Factors under Existing Conditions (Step 1):		
Relevant factors	Acceptability	Action
0-3	Accept	No mitigation required
4-6	Check	Identify mitigations to reduce relevant fatigue factors
7-9	Mitigate	Identify mitigations to reduce the remaining fatigue factors to the minimum
> 9	Not Acceptable	Identify mitigations to reduce the remaining fatigue factors to an acceptable minimum. If not possible this duty is not permissible

11

Assess

Circadian	Flight time during night	--		
Workload	3 flights/se	--		
	5 or 6 flights	--		
	3 flights	--		
	Known	--		
	Training	1		
Sum of fatigue factors		11		
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable				
* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant				
Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				



# Fatigue (Risk) Assessment

Table 5-4. Example Categories for Assessment of Fatigue Factor Scores under Existing Conditions (Step 1)

Assessment of Fatigue Factors under Existing Conditions (Step 1):		
Relevant factors	Acceptability	Action
0-3	Accept	No mitigation required
4-6	Check	Identify mitigations to reduce relevant fatigue factors
7-9	Mitigate	Identify mitigations to reduce the remaining fatigue factors to the minimum
> 9	Not Acceptable	Identify mitigations to reduce the remaining fatigue factors to an acceptable minimum. If not possible this duty is not permissible

11

11 relevant fatigue factors are not acceptable for this operator.  
Mitigation in the next step is required to schedule this duty.





## Step 2: Identifying Mitigations

Fatigue Factor Assessment and Mitigation			Step 2	
Type of Shift/Specific Duty:	CGN-TFS-CGN			
Fatigue Factor:	Worst Case:		Identify Mitigations (if needed)	
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**		
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **	(1)**		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
Sum of fatigue factors		11		
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

What is needed to do this duty safely?



## Step 2: Identifying Mitigations

present (1)  
absent (--)  
avoidable /  
mitigated (0)

### Step 2

Identify Mitigations  
(if needed)

Fatigue Factor Assessment and Mitigation			Step 2	
Type of Shift/Specific Duty:	CGN-TFS-CGN			
Fatigue Factor:	Worst Case:			
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**	Identify Mitigations (if needed)	
	Previous nightsleep ** reduced > 4h	1**		
	Reduced nightsleep > 4h before previous night ***	1**		
	Previous "nightduty" ** (daysleep only)**	1**		
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **	(1)**		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
Sum of fatigue factors		11		
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				



## Step 2: Identifying Mitigations

### Step 2

Identify Mitigations  
(try to avoid relevant factors)

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1	1	Not relevant if 1 <sup>st</sup> duty day
	Previous nightsleep ** reduced > 4h	1	0	Avoid previous day checkout after midnight
	Reduced nightsleep > 4h before previous night ***	1	0	Avoid any previous day checkout after midnight
	Previous "nightduty" ** (daysleep only)**	1	0	Avoid any previous day checkout after midnight
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1		
	Time since awake prior duty start > 6h prior C/I*	1		
	Time on task > 10h (FDT)	1		
	Time on task > 12h < 14h (FDT)	--		
Circadian Factors	Circadian disruption > 4h **	(1)		
	Flight after 2300LT or last landing during darkness	1		
	Flighttime <2h during WOCL	1		
	Flighttime > 2 h during WOCL	--		
Workload	3 or 4 consecutive flights/sectors	--		
	5 or 6 flights / or: 3 flights during night	--		
	Known hassles	--		
	Training flights	1		
Sum of fatigue factors		11		
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

Since lack of night-sleep has been the most dominant cause of fatigue due to the preceding similar night-flight the mitigation is to provide a longer sleep opportunity by avoiding checkout after midnight on the previous day.



## Step 2: Identifying Mitigations

### Step 2

Identify Mitigations  
(try to avoid relevant factors)

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FbT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**	1**	Not relevant if 1 <sup>st</sup> duty day
	Previous nightsleep ** reduced > 4h	1**	0	Avoid previous day checkout after midnight
	Reduced nightsleep > 4h before previous night ***	1**	0	Avoid any previous day checkout after midnight
	Previous "nightduty" ** (daysleep only)**	1**	0	Avoid any previous day checkout after midnight
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1	1	
	Time since awake prior duty start > 6h prior C/I*	1	(1)	Recommend nap before duty
	Time on task > 10h (FDT)	1	1	
	Time on task > 12h < 14h (FDT)	--	--	
Circadian Factors	Circadian disruption > 4h **	(1)**	0	Previous duties shall be "late duties"
	Flight after 2300LT or last landing during darkness	1	1	
	Flighttime <2h during WOCL	1	1	
	Flighttime > 2 h during WOCL	--	--	
Workload	3 or 4 consecutive flights/sectors	--	--	
	5 or 6 flights / or: 3 flights during night	--	--	
	Known hassles	--	--	
	Training flights	1	0	Avoid training on this duty
Sum of fatigue factors		11	6	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

A nap before duty is only needed if the crewmember had to get up early (e.g. children) after his late duty.  
If the crewmember has slept long, a nap before this duty is quite impossible



## Step 2: Identifying Mitigations

### Step 2

Identify Mitigations  
(try to avoid relevant factors)

Fatigue Factor Assessment and Mitigation Table				
Type of Shift/Specific Duty:		CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FbT: 11:00h		
Fatigue Factor:		Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**	1**	Not relevant if 1 <sup>st</sup> duty day
	Previous nightsleep ** reduced > 4h	1**	0	Avoid previous day checkout after midnight
	Reduced nightsleep > 4h before previous night ***	1**	0	Avoid any previous day checkout after midnight
	Previous "nightduty" ** (daysleep only)**	1**	0	Avoid any previous day checkout after midnight
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1	1	
	Time since awake prior duty start > 6h prior C/I*	1	(1)	Recommend nap before duty
	Time on task > 10h (FDT)	1	1	
	Time on task > 12h < 14h (FDT)	--	--	
Circadian Factors	Circadian disruption > 4h **	(1)**	0	Previous duties shall be "late duties"
	Flight after 2300LT or last landing during darkness	1	1	
	Flighttime <2h during WOCL	1	1	
	Flighttime > 2 h during WOCL	--	--	
Workload	3 or 4 consecutive flights/sectors	--	--	
	5 or 6 flights / or: 3 flights during night	--	--	
	Known hassles	--	--	
	Training flights	1	0	Avoid training on this duty
Sum of fatigue factors		11	6	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

The key mitigation in our example:  
A late duty shall be planned before this night-flight.  
The previous late duty helps the crewmember to adopt slightly towards evening-type and to sleep longer in the morning before the night duty

# Step 2: Identifying Mitigations

Step 2

Identify Mitigations  
(try to avoid relevant factors)

Fatigue Factor Assessment and Mitigation Table				
Type of Shift/Specific Duty:		CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FDT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**	1**	Not relevant if 1 <sup>st</sup> duty day
	Previous nightsleep ** reduced > 4h	1**	0	Avoid previous day checkout after midnight
	Reduced nightsleep > 4h before previous night ***	1**	0	Avoid any previous day checkout after midnight
	Previous "nightduty" ** (daysleep only)**	1**	0	Avoid any previous day checkout after midnight
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1	1	
	Time since awake prior duty start > 6h prior C/I*	1	(1)	Recommend nap before duty
	Time on task > 10h (FDT)	1	1	
	Time on task > 12h < 14h (FDT)	--	--	
Circadian Factors	Circadian disruption > 4h **	(1)**	0	Previous duties shall be "late duties"
	Flight after 2300LT or last landing during darkness	1	1	
	Flighttime <2h during WOCL	1	1	
	Flighttime > 2 h during WOCL	--	--	
Workload	3 or 4 consecutive flights/sectors	--	--	
	5 or 6 flights / or: 3 flights during night	--	--	
	Known hassles	--	--	
	Training flights	1	0	Avoid training on this duty
Sum of fatigue factors		11	6	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

The avoidance of training during this night-flight is easy



## Step 2: Assessment of the Mitigated Scenario

### Step 2

Identify Mitigations  
(try to avoid relevant factors)

Fatigue Factor Assessment and Mitigation Table				
	Type of Shift/Specific Duty:	CGN-TFS-CGN: Checkin 1600LT, Checkout 0300LT; FbT: 11:00h		
	Fatigue Factor:	Worst Case:	Mitigated:	Comment:
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1**	1**	Not relevant if 1 <sup>st</sup> duty day
	Previous nightsleep ** reduced > 4h	1**	0	Avoid previous day checkout after midnight
	Reduced nightsleep > 4h before previous night ***	1**	0	Avoid any previous day checkout after midnight
	Previous "nightduty" ** (daysleep only)**	1**	0	Avoid any previous day checkout after midnight
Wakefulness	Time since awake prior duty start > 2h prior C/I*	1	1	
	Time since awake prior duty start > 6h prior C/I*	1	(1)	Recommend nap before duty
	Time on task > 10h (FDT)	1	1	
	Time on task > 12h < 14h (FDT)	--	--	
Circadian Factors	Circadian disruption > 4h **	(1)**	0	Previous duties shall be "late duties"
	Flight after 2300LT or last landing during darkness	1	1	
	Flighttime <2h during WOCL	1	1	
	Flighttime > 2 h during WOCL	--	--	
Workload	3 or 4 consecutive flights/sectors	--	--	
	5 or 6 flights / or: 3 flights during night	--	--	
	Known hassles	--	--	
	Training flights	1	0	Avoid training on this duty
Sum of fatigue factors		11	6	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant	
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.				
Tritschler 2015; EASA FRMS Workshop Cologne				

Asses the mitigated  
duty



# Acceptability of Fatigue Factors after Mitigating Actions

Table 5-5. Example Categories for Acceptability of Fatigue Factor Scores after Mitigating Actions (Step 2)

Acceptability of Fatigue Factors after Mitigating Actions (Step 2):		
Relevant factors	Fatigue Impairment	Acceptability
0-3	Low	Acceptable, no further mitigation required
4-6	Increased	Acceptable, but keep remaining fatigue factors as low as reasonably practicable. Monitor operation
7-9	Significant	Acceptable if remaining fatigue factors are kept at the minimum (all avoidable fatigue factors are avoided). The number of times this duty can be scheduled is limited per crew member per time-period. Monitoring of this work period required
> 9	High	Not acceptable

6

6 relevant fatigue factors are acceptable for this operator.





## Identification of effective mitigations: Avoid and Limit

What is needed  
to do this duty  
safely?

Avoid  
relevant  
factors

The FFAMT follows the concept of mitigation by avoiding factors.  
Since each listed factor is a relevant cause of fatigue,  
its avoidance can be considered effective (with limitations!).



## Identification of effective mitigations: Avoid and Limit

What can be done to make this duty acceptable?

Avoid  
relevant  
factors

The FFAMT follows the concept of mitigation by avoiding factors. Since each listed factor is a relevant cause of fatigue, its avoidance can be considered effective (with limitations!).

Limit the  
frequency of  
exposure

The FFAMT Matrix uses the mitigation through limiting the number of duties for an individual crewmember (severity x frequency)



## Step 3: Limiting the Exposure / Frequency

Table 5-6. Example Risk Assessment Matrix for Cumulative Fatigue

Number of fatigue factors per duty as severity	Frequency of Exposure per Crew Member per Working Period (week)				
	Relevant fatigue factors	May be scheduled every day	May be scheduled twice per week	May be scheduled once per week	Unexpected circumstances
	0-3	low	low	low	low
	4-6	moderate	moderate	low	low
	7-9	high	moderate	moderate	moderate
> 9	high	high	high	high	high

6

Step 3

The FFAMT Matrix uses the mitigation through limiting the number of duties for an individual crewmember (severity x frequency)

Refer to ICAO Doc 9966 5.3.2 and/or EASA EU FTL AMC1 ORO.FTL.120(b)(4)



- Pros and Cons of the FFAMT
- Considerations

## Conclusions



## Pros and Cons of the FFAMT

- Simple and quick methodology
  - Takes into account the preceding duty (as cause or mitigation)
  - Shows why this duty is at high or low fatigue risk
  - Corresponds with Bio-Mathematical Fatigue Models (may explain model results)
- 
- Requires customisation
  - Not all factors are listed
  - Factors are not fully weighted
  - Some fatigue competence required



# Considerations

## ICAO Doc 9966 5.3.3. Risk Assessment

Thorough research and informed operational input is essential to the identification of a meaningful list of fatigue factors and critical to the successful use of this methodology. By using customised lists generated for the specific circumstances of the service provider, this methodology can be adopted to any operations.



- Three Different Subtypes of Night Duties

Why is each duty so difficult?

## Bonus Material

These are night duties by definition of EU FTL. What's the difference?

### 3 Different Subtypes of Night Duties

- In this table we compare 3 different night duties, each 9h long
- 1. Checkin 0300 – Checkout 1200LT
  - 2. Checkin 1900-Checkout 0400LT
  - 3. Checkin 2130- Checkout 06:30LT

The fatigue score is in the worst case in brackets.  
In the best case scenario below

Fatigue Factor Assessment and Mitigation Table					
	Type of Shift/Specific Duty:	AAA-DDD-AAA: FDT: 09:00h dominating factors			
	Fatigue Factor:	:CI 0200LT CO 1200LT	CI 1900LT CO 0400LT	CI: 2130LT CO: 0630LT	
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1	(1)	(1)	
	Previous nightsleep ** reduced > 4h	1	(1)	(1)	
	Previous nightsleep > 4h before previous night ***	(1)	(1)	(1)	
	Previous "nightduty" ** (daysleep only)**	(1)	(1)	(1)	
Wakefulness	Time since awake prior duty start > 2h prior C/I*	--	1	1	
	Time since awake prior duty start > 6h prior C/I*	--	1	1	(Nap required)
	Time on task > 10h (FDT)	(1)	(1)	(1)	
	Time on task > 12h < 14h (FDT)	--	--	--	
Circadian Factors	Circadian disruption > 4h **	(1)	(1)	(1)	
	Flight after 2300LT or last landing during darkness	--	1	1	
	Flighttime <2h during WOCL	1	1	1	
	Flighttime > 2 h during WOCL	(1)	(1)	1	
Workload	3 or 4 consecutive flights/sectors	(1)	(1)	(1)	
	5 or 6 flights / or: 3 flights during night	(0)	(0)	(0)	
	Known hassles	(1)	(1)	(1)	
	Training flights	(1)	(1)	(1)	
	Sum of fatigue factors In worst case	(11)	(13)	(14)	
	Best Case	3	4	5	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.					
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### 3 Different Subtypes of Night Duties

Duties starting very early (0200 – 0500LT) are dominated by reduced night-sleep prior duty.

Duties starting very late are dominated by high time since awake.

Fatigue Factor Assessment and Mitigation Table					
	Type of Shift/Specific Duty:	AAA-DDD-AAA: FDT: 09:00h dominating factors			
	Fatigue Factor:	:CI 0300LT CO 1200LT	CI 1900LT CO 0400LT	CI: 2130LT CO: 0630LT	
Sleep debt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1	(1)	(1)	
	Previous nightsleep ** reduced < 4h (day: 08-18LT)	1	(1)	(1)	
	Reduced nightsleep > 4h before previous night ***	(1)	(1)	(1)	
	Previous "nightduty" ** (daysleep only)**	(1)	(1)	(1)	
Wakefulness	Time since awake prior duty start > 2h prior C/I*	--	1	1	
	Time since awake prior duty start > 6h prior C/I*	--	1	1	(Nap required)
	Time on task > 10h (FDT)	(1)	(1)	(1)	
	Time on task > 12h < 14h (FDT)	--	--	--	
Circadian factors	Circadian disruption > 4h **	(1)	(1)	(1)	
	Waking up after 2300LT or last landing during darkness	--	1	1	
	Flighttime <2h during WOCL	1	1	1	
	Flighttime > 2 h during WOCL	(1)	(1)	1	
Workload	3 or 4 consecutive flights/sectors	(1)	(1)	(1)	
	5 or 6 flights / or: 3 flights during night	(0)	(0)	(0)	
	Known hassles	(1)	(1)	(1)	
	Training flights	(1)	(1)	(1)	
Sum of fatigue factors In worst case		(11)	(13)	(14)	
Best Case		3	4	5	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.					
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### 3 Different Subtypes of Night Duties

Duties starting very early (0200 – 0500LT) are dominated by reduced night-sleep prior duty.

One strategy could be to facilitate early bed time

Duties starting very late are dominated by high time since awake.

One strategy is the pre-duty nap

Fatigue Factor Assessment and Mitigation Table					
	Type of Shift/Specific Duty:	AAA-DDD-AAA: FDT: 09:00h dominating factors			
	Fatigue Factor:	:CI 0300LT CO 1200LT	CI 1900LT CO 0400LT	CI: 2130LT CO: 0630LT	
Sleep debt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1	(1)	(1)	
	Previous nightsleep ** reduced < 4h (day: 08-18LT)	1	(1)	(1)	
	Reduced nightsleep > 4h before previous night ***	(1)	(1)	(1)	
	Previous "nightduty" ** (no sleep only)**	(1)	(1)	(1)	
Wakefulness	Time since awake prior duty start > 2h prior C/I*	--	1	1	
	Time since awake prior duty start > 6h prior C/I*	--	1	1	(Nap required)
	Time on task > 10h (FDT)	(1)	(1)	(1)	
	Time on task > 12h < 14h (FDT)	--	--	--	
Circadian factors	Circadian disruption > 4h **	(1)	(1)	(1)	
	Flight after 2300LT without landing during darkness	--	1	1	
	Flighttime during night	1	1	1	
	Flight time > 2 h during WOCL	(1)	(1)	1	
Workload	More than 4 consecutive flights/sectors	(1)	(1)	(1)	
	5 or 6 flights / or: 3 flights during night	(0)	(0)	(0)	
	Known hassles	(1)	(1)	(1)	
	Training flights	(1)	(1)	(1)	
Sum of fatigue factors In worst case		(11)	(13)	(14)	
Best Case		3	4	5	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.					
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# 3 Different Subtypes of Night Duties (Short Haul Comparison)

Night Duties starting very early fly into the “circadian upswing” (after 6LT and sunrise)

All 3 subtypes encounter the WOCL (02-06LT)

Night Duties landing very early fly into the “circadian low”

Fatigue Factor Assessment and Mitigation Table					
	Type of Shift/Specific Duty:	AAA-DDD-AAA: FDT: 09:00h dominating factors			
	Fatigue Factor:	:CI 0300LT CO 1200LT	CI 1900LT CO 0400LT	CI: 2130LT CO: 0630LT	
Sleepdebt	Previous nightsleep ** reduced < 4h (night: 22-08LT)	1	(1)	(1)	
	Previous nightsleep ** reduced > 4h	1	(1)	(1)	
	Reduced nightsleep > 4h before previous night ***	(1)	(1)	(1)	
	Previous "nightduty" ** (daysleep only)**	(1)	(1)	(1)	
Wakefulness	Time since awake prior duty start > 2h prior C/I*	--	1	1	
	Time since awake prior duty start > 6h prior C/I*	--	1	1	(Nap required)
	Time on task > 10h (FDT)	(1)	(1)	(1)	
	Time on task > 12h < 14h (FDT)	--	--	--	
Circadian Factors	Circadian disruption > 4h **	(1)	(1)	(1)	
	Flight after 22:00h prior last landing during darkness	--	1	1	
	Flighttime <2h during WOCL	1	1	1	
	Flighttime > 2 h during WOCL	(1)	(1)	1	
Workload	3 or 4 flights	(1)	(1)	(1)	
	5 or 6 flights / or: 3 flights during night	(0)	(0)	(0)	
	Known hassles	(1)	(1)	(1)	
	Training flights	(1)	(1)	(1)	
Sum of fatigue factors In worst case		(11)	(13)	(14)	
Best Case		3	4	5	
Assessment of fatigue factors: 0-3 relevant factors: accept 4-6 relevant factors: check 7-9 relevant factors: mitigate >10 relevant factors: not acceptable			* Crew member's responsibility ** Depending on preceding duty *** The night before, 2 consecutive nights are relevant		
Factors are not fully weighted! Most important factors are Sleepdebt, wakefulness, circadian factors then workload, in this order.					
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[smartshiftwork.com](https://smartshiftwork.com)

**be alert – be safe**

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