EASA
European Union Aviation Safety Agency

Webinar: Final Study Results

Analysis, Prevention and Management of Air Traffic Controller Fatigue

Thursday 29th February 2024

Delivered in cooperation with our consortium

nlr Welbees UK Civil Aviation Authority International moving dot ECORYS Ries Simons

EASA
European Union Aviation Safety Agency

Agenda

1. Introduction from EASA's Executive Director
2. Snapshot of EU ATCOs and ATSPs
3. Evaluation of the Implementation of the EU Regulations on ATCO Fatigue
4. ATCO fatigue prevalence, causes and effects
5. ATCO fatigue management in the future
6. Questions and answers
7. Next steps and concluding remarks

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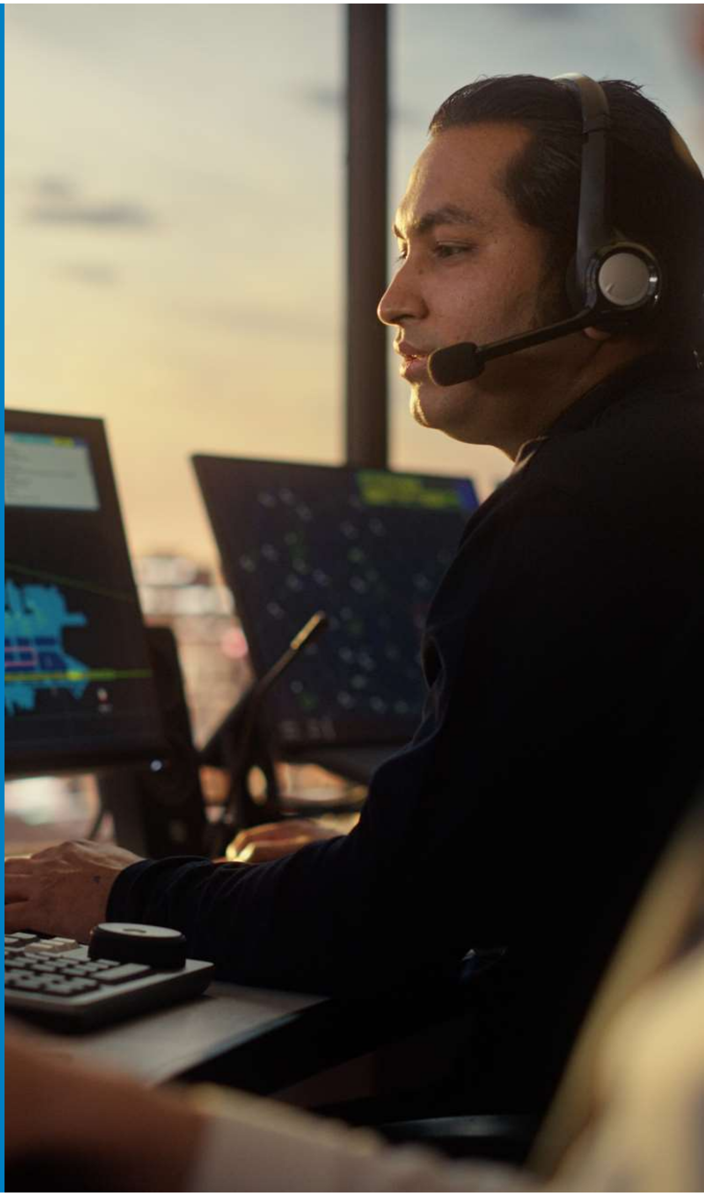
1. Introduction from EASA's Executive Directorate

Luc Tytgat
Acting Executive Director, EASA

EASA
European Union Aviation Safety Agency

2. Snapshot of EU ATCOs and ATSPs

Rombout Wever
Project Manager, NLR



Study involvement and representativeness

2,416 Work sessions analysed	**1,414** ATCO duties analysed	**236** ATCOs participated	**46** EU ATSPs received questionnaires	**36** ATSPs replied (nearly an 80% response rate)
24 Actual rosters analysed from 16 ATSPs	**22** ATSPs interviewed	**6** ATSPs participated in subjective measurements	**5** ATSPs participated in objective measurements	Surveys with ATCO representatives (ATCEUC, ETF, IFATCA) + NSAs/NAAs

Stakeholder Engagement Throughout

(Workshops, meetings, webinars)

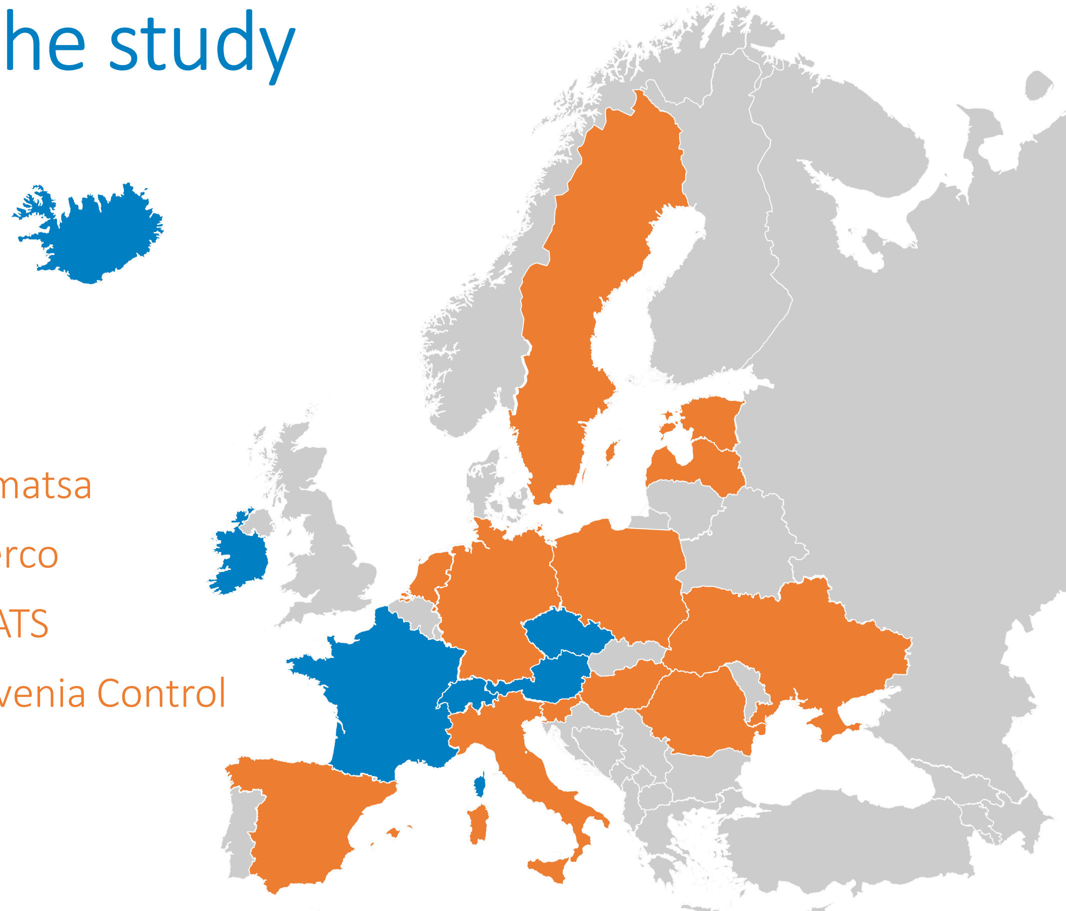
Stakeholder involvement in the study

Participated in measurements/data collection:

- AirNav Ire
- ANS CZ
- DSNA
- ISAVIA
- MUAC
- Skyguide

Other ATSPs involved:

- Aircraft Industries
- Austro Control
- DFS
- EANS
- ENAIRE
- ENAV
- HungaroControl
- LET
- LFV
- LGS
- LVNL
- PANSA
- Romatsa
- Saerco
- SDATS
- Slovenia Control



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Snapshot of ATCOs in the EU

16,400	72.9%	27.1%	75%	22%
ATCOs employed by ATSPs across EASA Member States	Male ATCOs in 2020*	Female ATCOs in 2020*	ATCOs work in state-owned ATSPs	Work for the EU's largest ATSP

** Source: EASA Aviation Social Data Report, 2022*

ATCO population in the study: representative of the global EU ATCO population

ATS landscape in the EU

46

ATSPs providing ATS in EASA Member States.

31

ATSPs provide services at both Air Traffic Control Centres and Aerodromes.

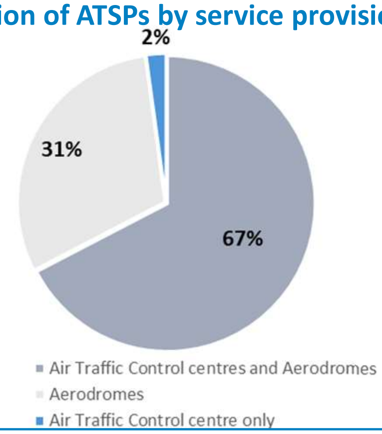
14

ATSPs provide aerodrome ATS only.

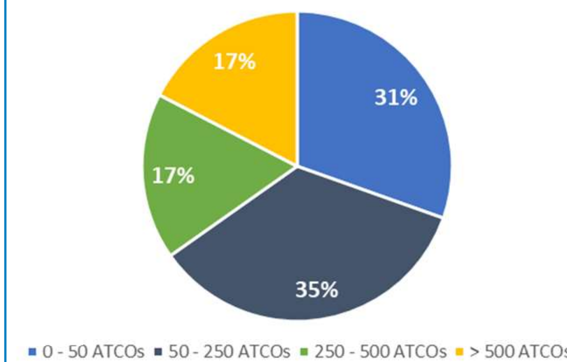
4

Of these 14 ATSPs provide ATS at more than one aerodrome.

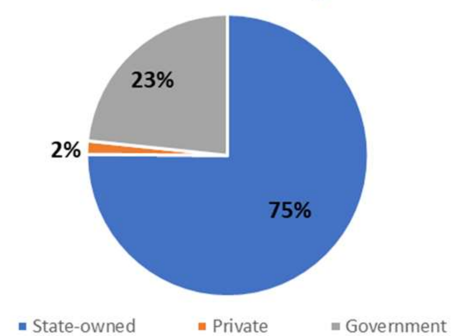
Distribution of ATSPs by service provision



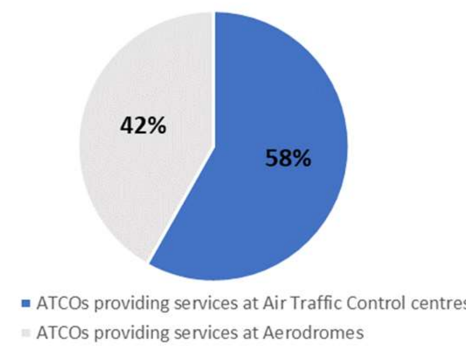
ATSPs by the number of ATCOs



Employment of ATCOs by ATSP ownership



ATCO employment by ATS service provision



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3. Evaluation of the Implementation of the EU Regulations on ATCO Fatigue

Rombout Wever
Project Manager, NLR

Successful implementation of the current regulations on ATCO Fatigue since 2017

46 ATSPs

EU Regulations successfully implemented across 46 ATSPs, benefiting 16,000+ European ATCOs.

€16M

Low-cost impact overall, and no social unrest associated with implementation.

10 Years

No accidents or major incidents attributed to ATCO fatigue in the EU in the past decade.

Improved working conditions

Potential improvements for ATCOs on some roster elements.

Limited Fatigue Risk

Limited fatigue risks in current work practices.

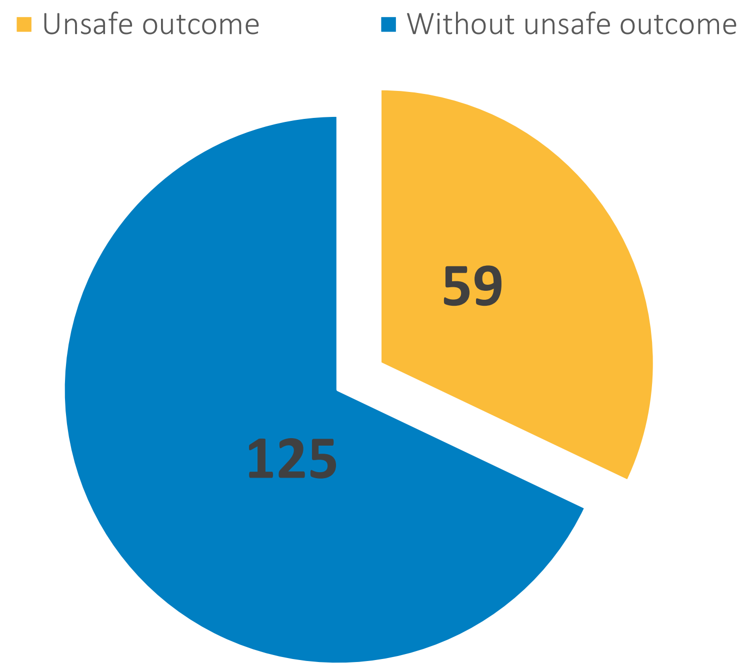
Low cost and social impact of implementation

Total cost	Total costs for the ATSPs in the 2020–2022 period are estimated at €16 million.
Recruitment	An estimated 30 additional ATCOs were recruited across EASA Member States to comply with the ATCO fatigue regulatory requirements.
Direct costs	80% of ATSPs did not experience any substantial change in direct costs for the organisation because of ATCO fatigue regulations.
Social impact	Surveyed ATCO associations noted a smooth implementation of the regulatory requirements.

No accident or serious incident

- No ATCO fatigue-related accidents or serious incidents have been reported in the last ten years in EASA MS (incl. UK until 2020).
- Only 184 occurrences related to ATCO fatigue reported (2013-2022).
- Excessive workload, work schedule, and lack of rest are the most frequently reported causes of ATCO fatigue.

European Central Repository (ECR) 2013-2022:



Current work practices and fatigue risks in EU ATSPs

Our roster analysis predicts a low to moderate risk of fatigue (15% of shifts associated with a high risk of fatigue).

Average values and standard deviation for roster elements (2023)	ACC Average	ACC Standard deviation	TWR Average	TWR Standard deviation
Maximum consecutive working days with duty	5.9	1.4	5.8	1.7
Maximum hours per duty period	9.2	3.0	10.5	2.7
Maximum time providing ATS service without breaks (mins)	90	38	154	89
Minimum duration of rest periods (hours)	11.6	5.3	12	5.1
Maximum consecutive duty periods encroaching the night-time	2.3	1.0	2.9	1.2
Minimum rest period after a duty period encroaching the night-time (hours)	22.5	19.5	17.8	15.5
Minimum number of rest periods within a roster cycle	3.7	2.0	3.7	4.5
Ratio of duty period to breaks	0.69	0.10	0.72	0.10

Overview: Opportunities for improvement

1. Absence of data	Few previous studies in EU on ATCO fatigue.
2. ECR reporting	Insufficient reporting to the ECR.
3. Variance across ATSPs	No level playing field across EU ATSPs. Absence of recommended or prescribed values in the Regulation for rosters and other work practices.
4. Terminology	Some terminology to be clarified.

1. Absence of data for the EU

- First study of this kind - Scientific literature on ATCO fatigue in EU is limited.
- Systematic review of peer-reviewed and grey literature. Key findings included:

Level of fatigue in USA/Asia

Studies from Asia and the US found that mean fatigue levels during shifts are moderate.

Evidence of fatigue factors

Most evidence regarding ATCO fatigue causes reflects work-related factors.

Lack of evidence on effects

Concerning the effects of fatigue in ATCOs on errors/incidents. Fatigue is found to be related to decreased performance.

Published Mitigations

Napping during breaks and optimal shift scheduling has been shown to be able to mitigate fatigue.

2. ECR Reporting

- Insufficient detailed information to analyse occurrences on fatigue risk management practices.
- ECR data sample for ATCO fatigue-related occurrences lacks a good quality of reporting and completeness and includes biases in reporting. For example:

Incomplete reports

Some reports are not complete or truncated.

No analysis

Some offer preliminary information with no analysis.

No detail

Concerning causes, contributing factors, context or effects.

Mandatory & voluntary reports

Mix of mandatory and voluntary reports

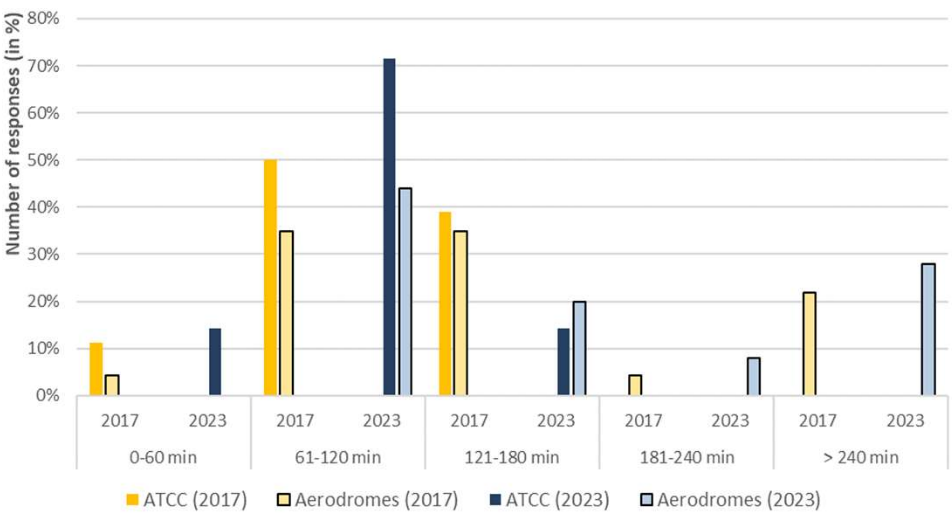
Fatigue report concentration

Reports clustered: Only select locations covering specific periods

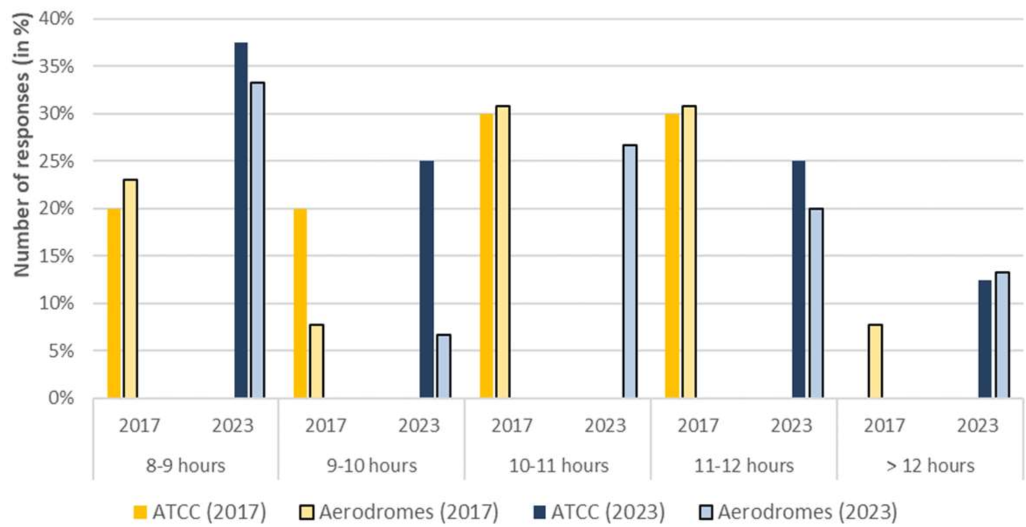
3. Variance across ATSPs

→ National regulations and local practices influence variations in roster elements, preventing harmonisation across EASA Member States. Examples include:

Maximum time providing air traffic control service without breaks



Minimum duration of the rest period



4. Terminology

- → Some stakeholders look for more guidance concerning reference values for rosters and working time
- → Clarify the definition in guidance material of:

Rest periods and breaks

Night time

Working hours

Shift type

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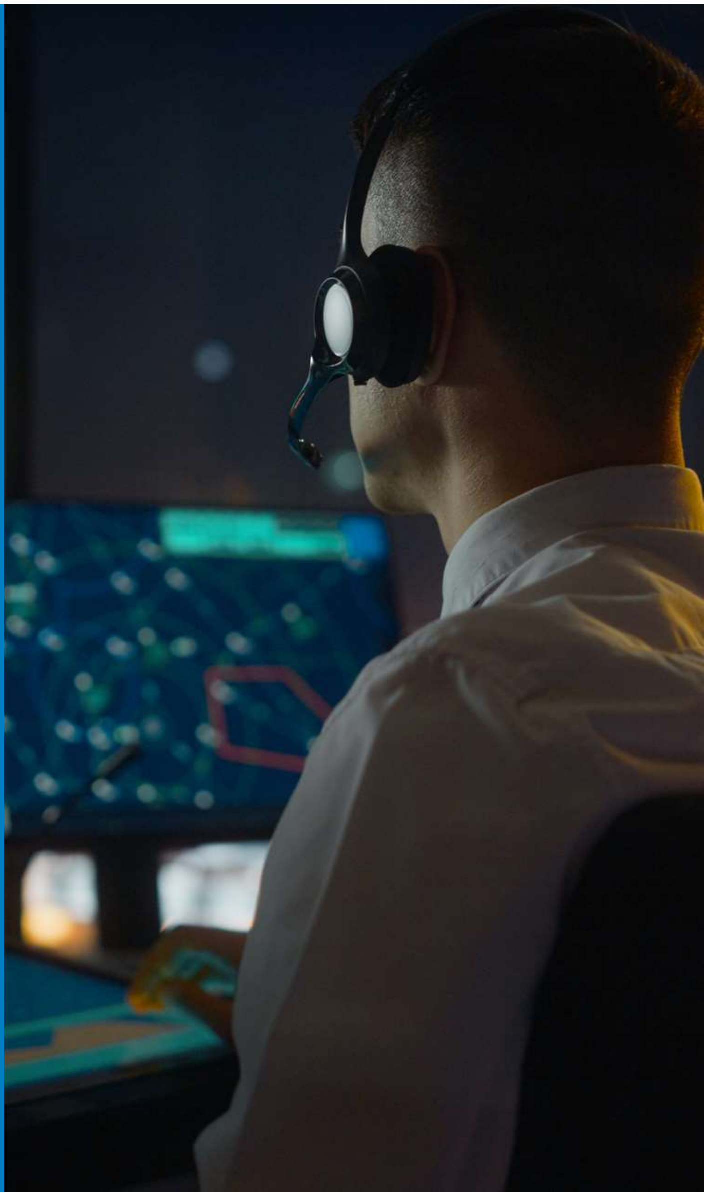
4. ATCO fatigue prevalence, causes and effects

Philippe Cabon
Technical Lead, Welbees

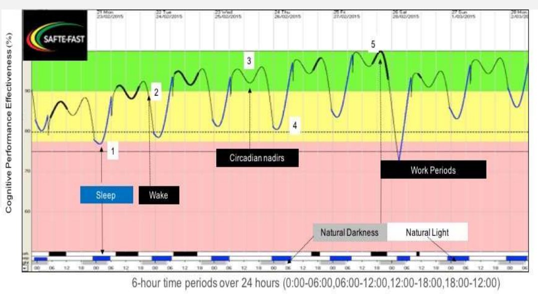


Methodology

Validate subjective measurements

Roster Analysis

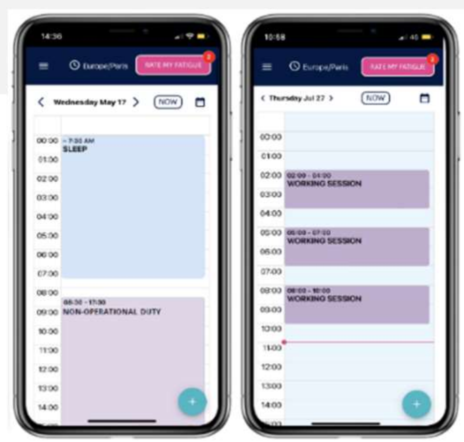
Involving 16 ATSPs and 24 actual rosters.



	0 points	1 point	2 points	4 points	8 points
Total hours over 7 days	≤ 36 h	36.1h – 43.9h	44h – 47.9h	48h – 54.9h	≥ 55h
Longest duty	≤ 8h	8.1h – 9.9h	10h – 11.9h	12h – 13.9h	≥ 14h
Shortest rest between duties	≥ 16h	15.9h – 13h	12.9h – 10h	9.9h – 7.9h	≤ 8h
Night work over 7 days	0h	0.1h – 8h	8.1h – 16h	16.1h – 23.9h	≥ 24h
Rest days	> 1 in 7 days	≤ 1 in 7 days	≤ 1 in 14 days	≤ 1 in 21 days	≤ 1 in 28 days

Data Collection (Subjective)

On fatigue and sleep for at least 10 days involving 6 ATSPs and 216 ATCOs.

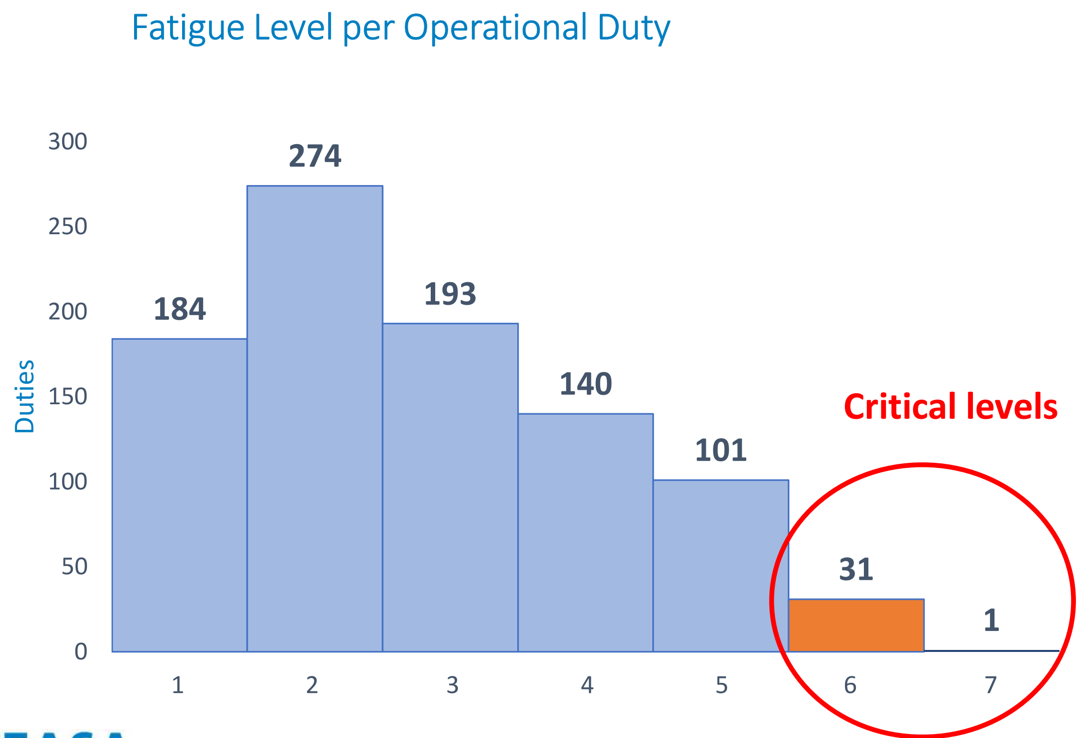


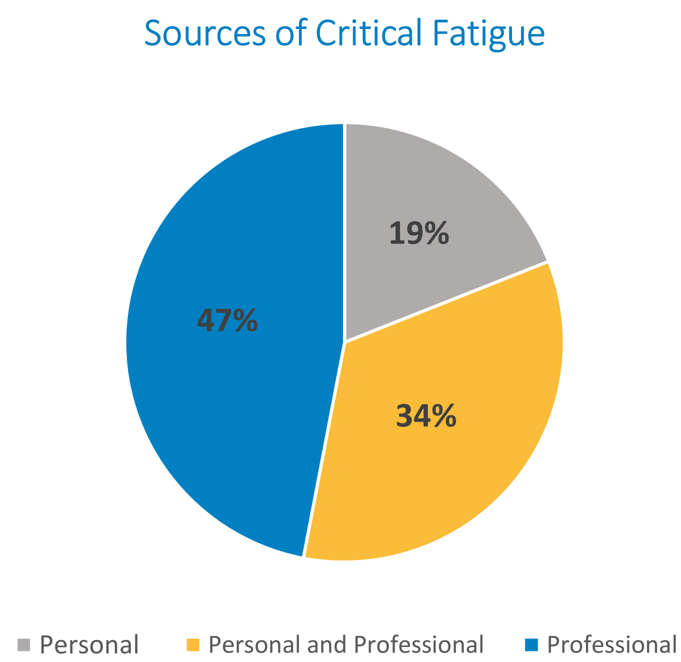
Data Collection (Objective)

Using objectives measurements - Continuous eye tracking and a pre- and post-duty performance during shifts involving 5 ATSPs and 20 ATCOs.

Fatigue levels observed during operational duties

Critical levels of fatigue were observed for 5.6% of the duties.

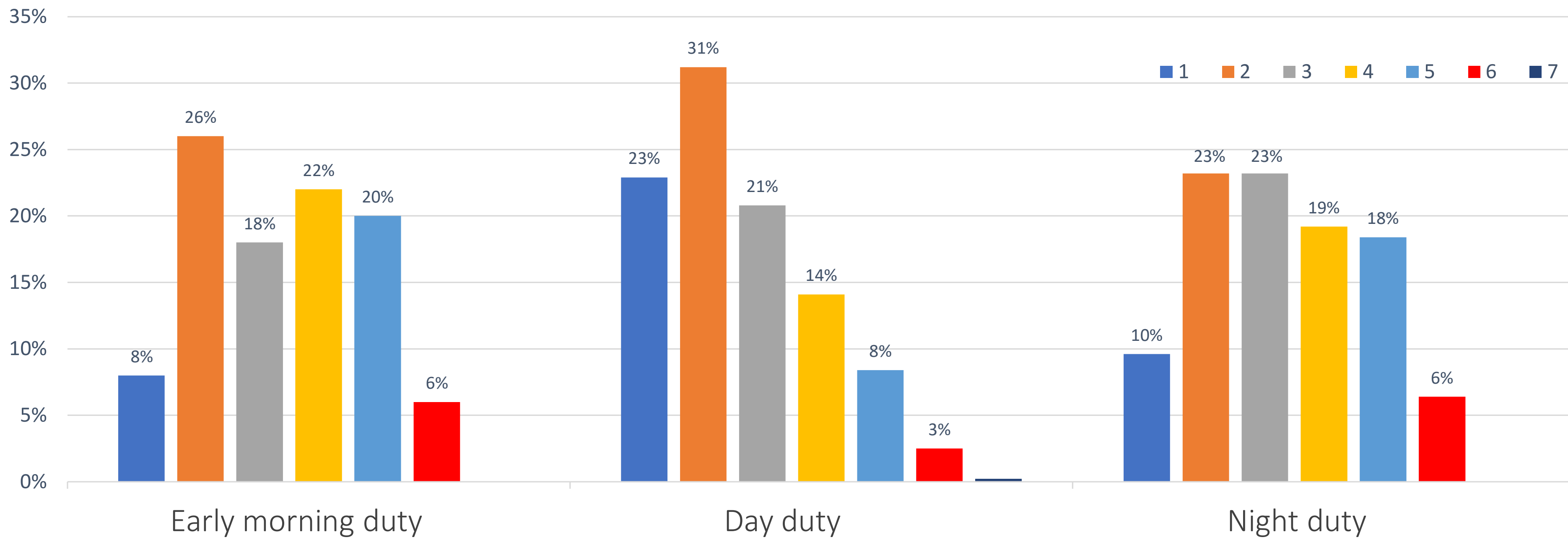




Fatigue levels observed by duty time

Total morning duties	53
Total day duties	702
Total night duties	141

Fatigue level results from ATCOS in the app



Starting between 0200 and 0600

Starting after 0600 and ending before 0200

Ending between 0200 and 1100

Understanding fatigue levels

The data analysis quantifies fatigue risk level associated with each contributing factor in two ways:

Average fatigue level	The effect on the average fatigue level on the total sample. Gives the contribution of each factor expressed in number of points on the Samm Perelli scale.
Critical fatigue level	The risk for each factor to produce a critical fatigue level (>6 on the Samm Perelli Scale). Expressed in % of increased risk compared to the average 5.6%.

Fatigue risk factors and related fatigue index

Individual/demographic factors		Variation risk of critical fatigue (%)
Age, gender, job position, experience		No effects observed in the collected data.
Perception of work environment	• Quality of equipment • Quality of the working environment • Quality of the rest facilities • Technologies support of the working position	Has a small but significant effect on fatigue.

Fatigue risk factors and related fatigue index (Cont.)

	Roster-related factors	ACC Average	TWR Average	Variation risk of critical fatigue (%)
8 Roster Elements	Maximum consecutive working days with duty (days)	5.9	5.8	Every additional working day increases the risk of critical fatigue by 27%.
	Maximum hours per duty period (hours)	9.2	10.5	No effects observed in the collected data.
	Maximum time providing ATS service without breaks (mins)	90	154	Every additional hour in one work session increases the risk of critical fatigue by 33%.
	Minimum duration of rest periods (hours)	11.6	12	No effects observed in the collected data.
	Maximum consecutive duty periods encroaching the night-time (days)	2.3	2.9	No effects observed in the collected data.
	Minimum rest period after a duty period encroaching the night-time (hours)	22.5	17.8	No effects observed in the collected data.
	Minimum number of rest periods within a roster cycle	3.7	3.7	Each additional day of rest following a duty encroaching nighttime reduces the risk of critical fatigue in the next duty by 43%.
	Ratio of duty period to breaks	0.69	0.72	No effects observed in the collected data.
Other Factors	Duty type	-	-	Night duties significantly increase the risk of critical fatigue by 253%.
	Sleep debt	-	-	For each 10% of sleep debt, increases the risk of critical fatigue by 80%.
	Non-operational duties	-	-	No effects observed in the collected data.

Slide 25

PC0 @Stuart I was wondering if we could highlight a bit more the significant items ?
Philippe Cabon, 2024-02-26T16:58:58.096

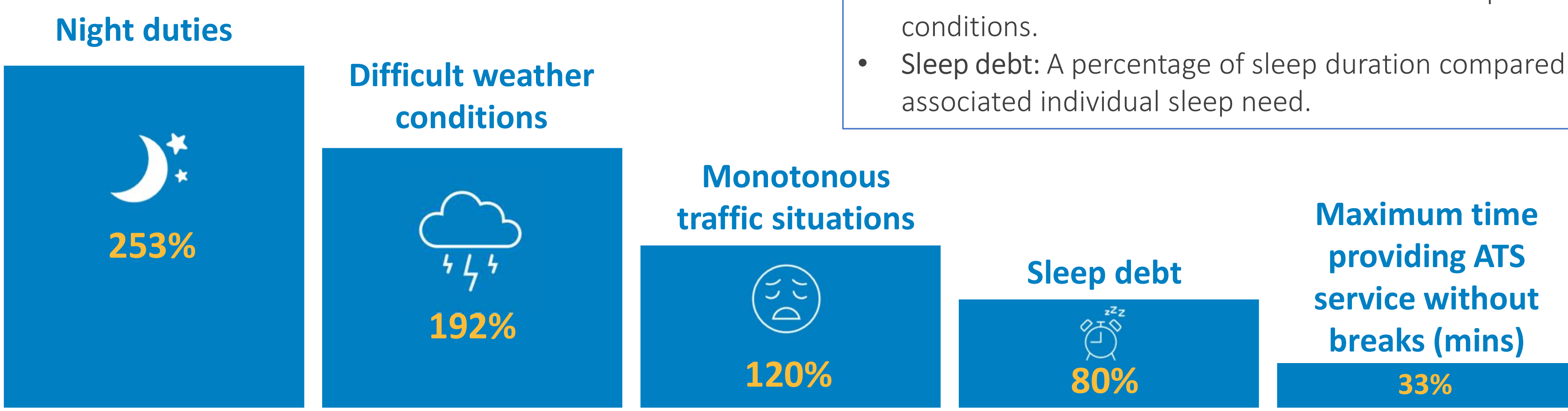
SC0 0 Done
Stuart Coates, 2024-02-28T09:39:38.472

Fatigue risk factors and related fatigue index (Cont.)

Non-roster-related factors		Variation risk of critical fatigue (%)
Workload		Increases fatigue moderately.
Factors encountered during the duty	Difficult weather conditions	Increases the risk of critical fatigue by +192%.
	High traffic density	No effects observed in the collected data.
	High traffic complexity	No effects observed in the collected data.
	Low traffic volume	No effects observed in the collected data.
	Uneventful, monotonous traffic	Increases the risk of critical fatigue by +120%.
	Difficult or much coordination with colleagues or other centres	No effects observed in the collected data.
	Coordination with management	No effects observed in the collected data.
	One of several specific flights	No effects observed in the collected data.
	Traffic unpredictability	No effects observed in the collected data.
	Sector opening/closing	No effects observed in the collected data.
	Issues with tools and/or equipment	No effects observed in the collected data.
	Time pressure/delays	No effects observed in the collected data.
	Unexpected events	No effects observed in the collected data.
	The absence of all these factors	No effects observed in the collected data.

Top 5 contributing fatigue factors

- Difficult weather conditions: Low ceilings, limited visibility, high or gusty winds, or thunderstorms.
- Monotonous traffic situations: Uneventful or repetitive work conditions.
- Sleep debt: A percentage of sleep duration compared to the associated individual sleep need.



Significantly increase the risk of critical level fatigue by 253%.

Increases the risk of critical level fatigue by 192%.

Increases the risk of critical level fatigue by 120%.

Increases the risk of critical fatigue by 80% for each 10% of sleep debt.

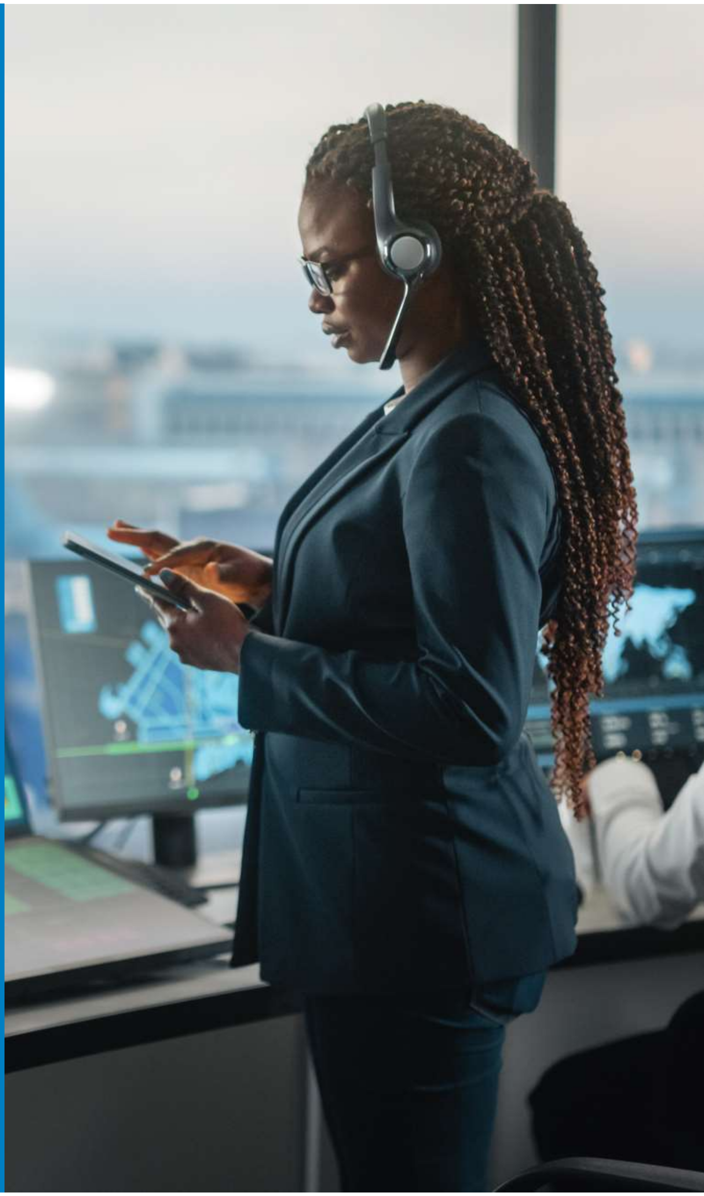
Every additional hour in one work session increases the risk of critical fatigue by 33%.

Synthesis on the results of the data collection

- The analysis of current rostering practices predicted a risk of high fatigue in 15% of duties.
- However, the data collection on a representative sample of ATCOs shows that only 5.6% of duties are actually associated with a high risk of fatigue.
- This difference can be attributed to the effectiveness of the mitigation measures implemented by the ATSPs.
- The research has enabled to identify
  - Average values for the current rostering practices in EU Member States
  - The overall level of critical fatigue risks in current practices (5.6%)
  - The most critical fatigue factors (both roster and non-roster related) and
  - The fatigue risk index for each fatigue factor
  - The fatigue factors that should be managed in priority by the ATSPs.

5. ATCO fatigue management in the future

Philippe Cabon
Technical Lead, Welbees



Recommendations

The study recommendations are organised in accordance with the four principal components of Fatigue Risk Management Systems (FRMS), per ICAO Standards and Recommended Practices.

Policy and documentation of FRMS

FRMS processes
(Predictive, proactive & reactive)

FRMS safety assurance

FRMS promotion

Predictive FRMS processes

To identify fatigue in ATCO rosters, considering factors known to affect sleep and fatigue.

Biomathematical models

Implement good practices on the use of biomathematical models – both pre- and post-roster publication.

Training of scheduling staff

Implement training programmes for roster scheduling staff.

Rostering

When developing rosters, ATSPs should refer to the relative risk identified in the project

→ Adopt harmonised measures to distinguish shift types within these boundaries

Morning duties

Starting between 0200 and 0600 local time.

Day duties

Starting after 0600 and ending before 0200 local time.

Night duties

Ending between 0200 and 1100 local time.

Predictive FRMS processes (Cont.)

Based on the outcome of the data collected in the study, and in relation to rostering:

- ATSPs to consider the average values of the various rostering parameters and related risk factors identified in the study
- ATSPs to assess the fatigue risks in their own working practices
- ATSPs to identify priority risk factors in their rosters and adapt their practices.

1
Avoid consecutive sequences of night or morning shifts

2
Avoid scheduling more than five consecutive days (in the current practices, average max of 5.8/5.9 duties)

3
Schedule sufficient rest days after night shifts

4
Avoid last-minute changes wherever possible (manage shift swaps).

5
Balance the workload as much as possible.

Proactive FRMS processes

To identify fatigue hazards by measuring fatigue levels in current operations, their potential impact on safety, implement and assess the efficiency of mitigation strategies.

→ ATSPs should also consider proactive subjective and objective data collection and adopt scientific principles.

→ Six operational measures were identified as the most effective in preventing ATCO fatigue.

1
Implement an FRMS

2
Bedrooms near the OPS room

3
Quiet rest facilities near OPS room

4
Educational programmes

5
Promote pre-duty napping

6
Promote napping during breaks

Reactive FRMS processes

To identify how the effects of fatigue could have been mitigated to reduce the likelihood of a similar occurrences in the future.

Adopt best practices on reporting a fatigue related occurrence

Incident investigation

To establish whether fatigue was a contributing factor.

Utilise data and intelligence

To assess fatigue factors, implement and monitor appropriate measures.

Thank you from the consortium

NLR

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6. Questions & Answers

Facilitated by Philippe Cabon
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Your safety is our mission.

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European Union Aviation Safety Agency

7. Next steps and concluding remarks

Nathalie Le Cam
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