THALES
Building a future we can all trust

"The need for evolution in FRMS tools and processes"

Webinar FRMS EASA

1st Webinar on Fatigue Risk Management in Cargo and On-Demand Operations March 15th, 2021

Table of content

1 – Thales Avionics activities

Make the sky safer and more effective

- Secured natively connected systems
- Crew and mission at the heart of the design
- Higher efficiencies through on-board data-driven, intelligent operations

Employees

10,000

Global presence

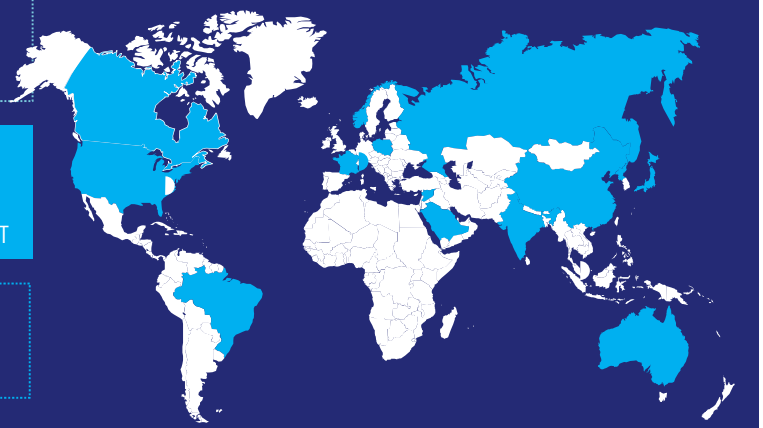
30+ Sites

#3 worldwide

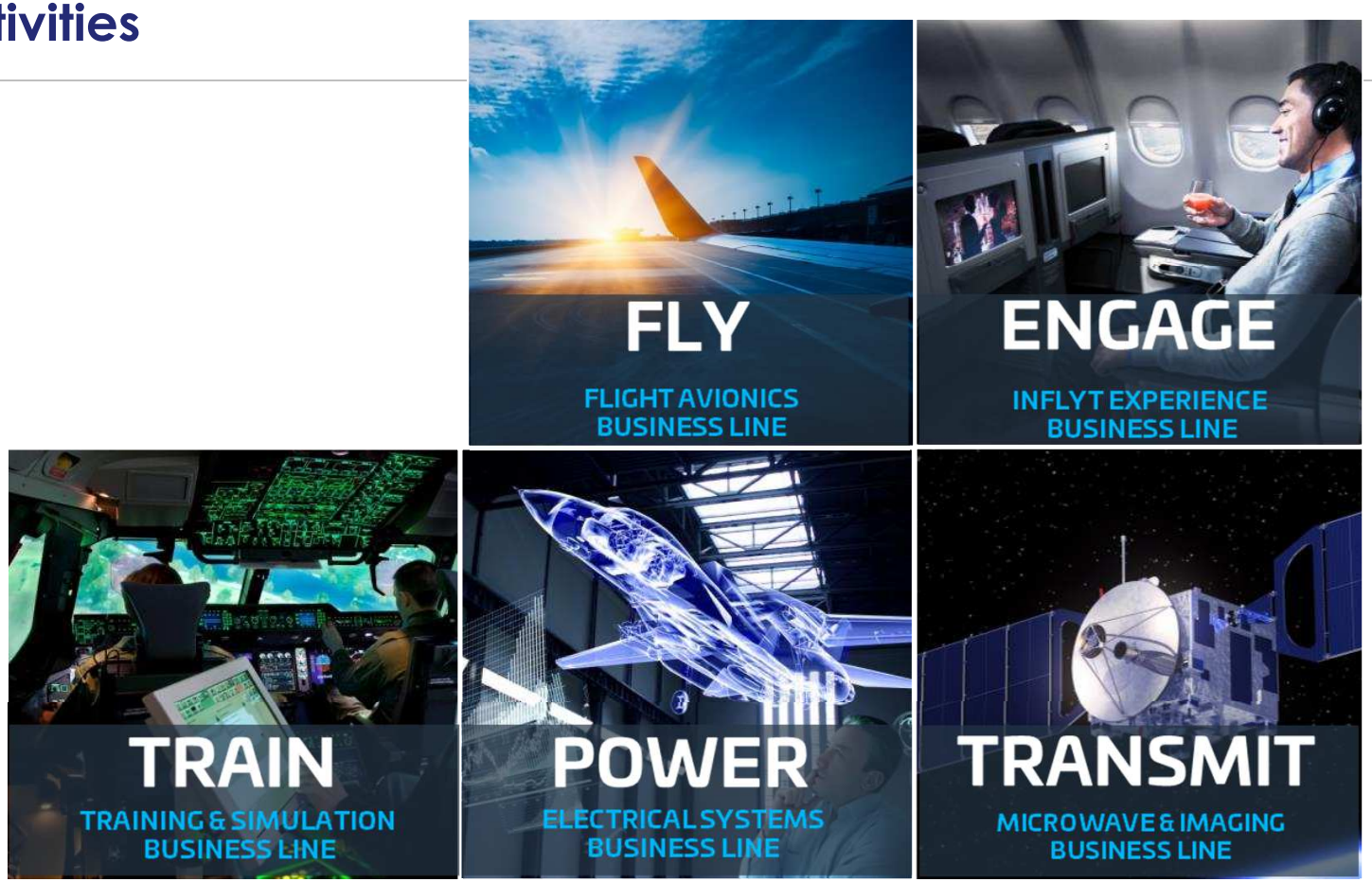
#1 Europe

2 OUT OF **3** AIRCRAFT
IN THE WORLD TAKE OFF AND LAND USING THALES EQUIPMENT

> 1,300 aircraft equipped per year



1 – Thales activities



FLIGHT OPERATIONS FUNCTIONS & SERVICES

- → Flight Management System
- → Autopilot
- → Avionics Functions
- → World Open Functions

INTEGRATED AVIONICS

- → Full Avionics Suite
- → Cockpit Display System

AVIONICS PLATFORMS

- → Computers
- → Displays & Tablets
- → Flight Controls

FLIGHT AVIONICS PRODUCT LINES OVERVIEW

NAVIGATION & LOCALISATION

- → Sensors
- → GNSS
- → Inertial Systems
- → Air Data Systems

CONNECTIVITY & CYBERSECURITY

- → Cockpit Services
- → Digital services
- → Cybersecurity

REF 2021 03 Rev 05 P 4991 – Mach 15th
Thales Avionics / template : 8721168-DOC-GRP-EN-005

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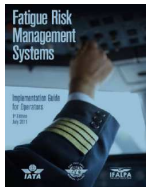
2 – Fatigue Context FTL (Flight Time Limitations) & FRMS

Until 1990', the flight time regulations were national

In 2000, regulations were harmonized by regions (Europe, America, Asia…)

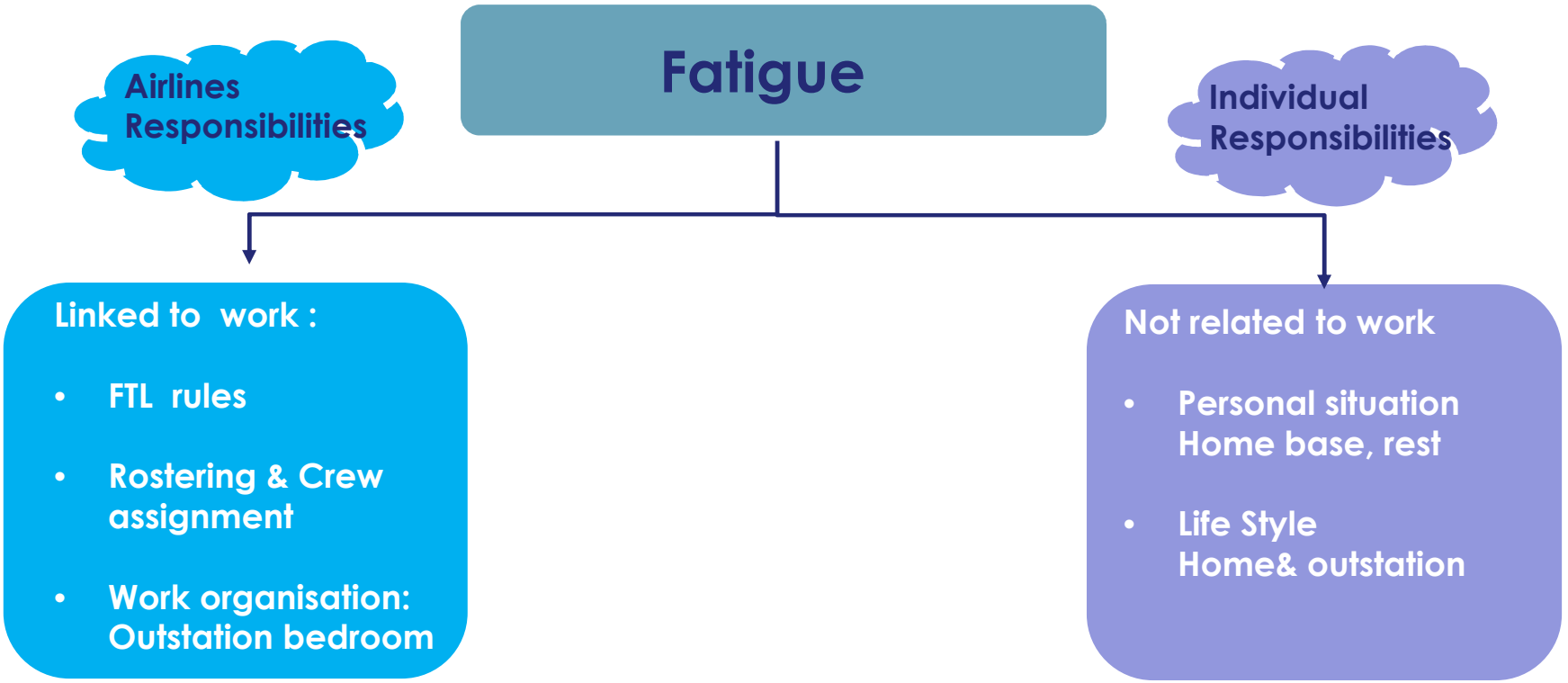


FRMS guide for Operators was introduced in 2011 (ICAO-IFALPA-IATA)
FM Guide for Operators was updated in 2015 (ICAO-IFALPA-IATA)
FRM was implemented by EASA for European Airlines in 2016 (Part ORO.FTL)

Since 2010, authorities are more and more active on the subject & involve all actors (Workshop EASA 2014 & 2018)

202X FRMS with individual data & objective data

2- Fatigue Context Shared Responsibilities

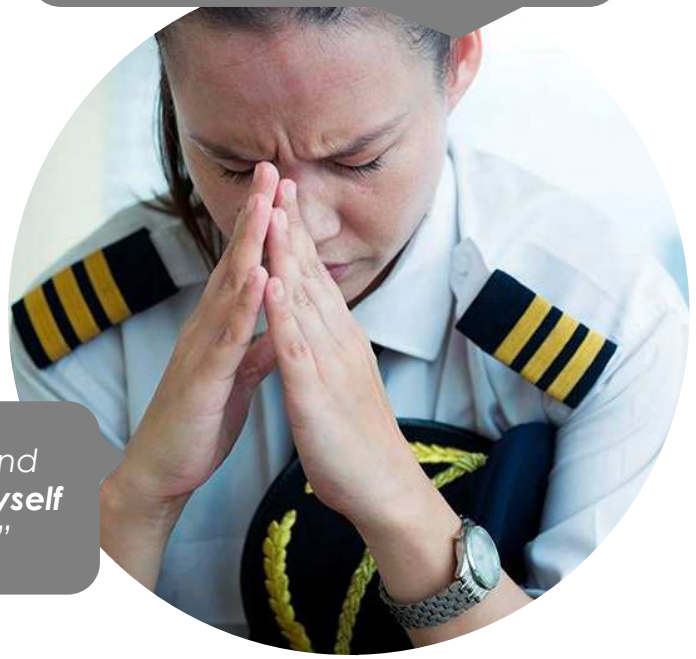


2 – Fatigue Context

"FRMS is a system to say that fatigue is being addressed ... ***It doesn't necessarily help"***

Problem statement

"Fatigue is insidious and is not easily recognizable in the early stages*, which is where you might start making mistakes"*



"I ***manage*** *and* ***mitigate by myself*** *my fatigue"*

OPEN

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3 – Limits of current FRMS (Tools, bio math, weakness)

- Use of FRMS as a justification only "**Box Ticking Exercise**"
  Lack of customization, objective is to manage global crew rostering & assignment
  Heavy analysis processes and hard maintenance of FRMS tools (Data –driven)

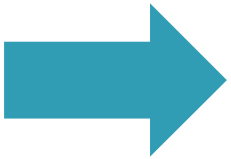
- **"Disproportion of the use of bio mathematical modelling"** as a validation tool
  Model Sleep don't reflect actual sleep
  Bio mathematics very theoric "**One size fits all**" but genre ? age ? early bird or night owl ?
  Workload during flight not taken into account (only number of sectors)

No user centric FRMS
No management of Individual variability
No regular fatigue report

Today, no individual objective fatigue measurement, and no alertness level are provided during flight

4 - Tomorrow FRMS

From Generic	
General solution	Bio Math Models
Declarative	Fatigue Report Subjective
Forecast	Fatigue level



To Individual & Objective	
Individual	Sensor
Continuous	Real Time Data
Measured data	Objective Undisputable

202X FRMS

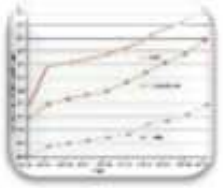
Current system should evolve taking into consideration
- the use of actual and **individual** data.
- the setting and sharing of **impartial** and **unbiased key indicators and models**

Benefits for all stakeholders, leading to better rostering and crew engagement.

5 - Perspective Crew Monitoring Data Chain
Measure and interpret a physiological and behavioural state

- As in other domains, medical health care, automotive, trains, the concept of Human Monitoring is emerging in aeronautic

- Crew Monitoring System (CMS) is based on
  - sensors that capture some physiological & cognitive parameters
  - models that permit the analysis
  - contextual data's that enable to reconstitute the real flight

Sensors	Data Base Extraction	Models	Functions	Context Filter	Usage Exploitation
				Individual filter Mission	Physiological Behaviour

All analysis needs to be in real time in order to be able :
- To anticipate early fatigue signs to take mitigation actions
- To react / alert in case of heavy drowsiness

5- What can be monitored ?

- **Fatigue**
  - Hypo vigilance
  - Drowsiness
- **Attentional Tunnelling** — Fascination, Focus

- **Cognitive Control** — Mental workload, Capacity to collaborate

- **Stress**

- **Situation awareness**

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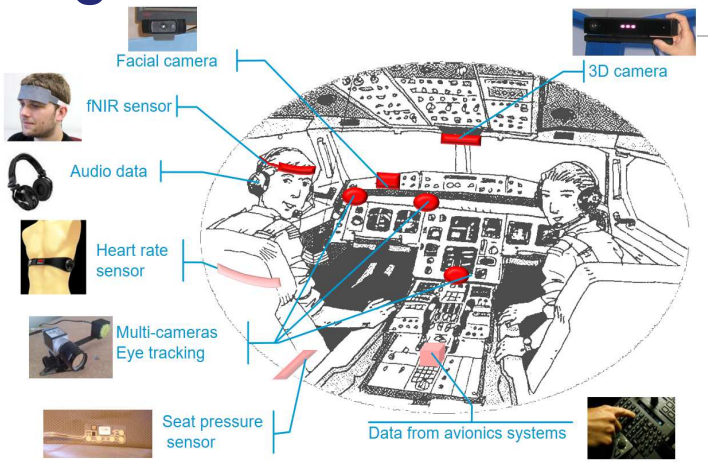
5 - CMS for Which Usages ? In Training & Design



➢**Pilot Monitoring**

Technically the use of sensors can be wide

Currently demonstrated in EU Study "Across –WP9" and CleanSky2 WP1.2.4

➢**Training (ATO):**

Enable a more efficient debriefing session

Enhanced observation tools which allow instructors to quickly identify and focus on learning needs & opportunities (EBT, CBT, …)

➢**Air Manufacturer (Part 21):**

Support the evaluation & design of new cockpit operational concepts :

- Reduce Crew Operations
- Roadmap to Autonomy

5- CMS for Which Usages ? In Airlines

➢ **In Flight usage for crew:**

- Monitor the behavior or capacities of the crew (presence, drowsiness / vigilance, incapacity, cognitive load, ability to collaborate, ...)
- Provide the crew with objective indicators for better anticipation & mitigation (margin toward fatigue, optimised inflight rest, …)
- React in case of detected deviation of operational capability

➢ **Flight Data Monitoring:**

Improve the Flight data analysis by giving some crew fatigue insights
Link SMS / FOQA with FRMS

➢ **FRMS:**

Will help crew to provide feedback with **undisputable measure of fatigue**
Give real insights from each crew at TOD
Will enable to build a **Data Driven** FRMS with tangible measures

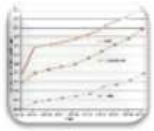
6 - CMS Functional architecture & Key values

Non Avionic solutions

Heart rate sensor

Audio data

fNIR sensor



Models

Avionic solutions

Multi-cameras
Eye tracking

CMS functional architecture allows to integrate mixed solutions within cockpit for better adaptation to operational & regulatory needs

6 – CMS Functional architecture & Key values

Thales CMS for Aero will be driven by the following key values :

- Be able to measure fatigue with **objectives (undisputable)** metrics system
- Be **accepted by users** and the aeronautical ecosystem
- Ensure **privacy of personal data** (GDPR & ethics)

7- Benefits from CMS

➢ for Airlines :

- Bring evidence of FRMS efficiency and crew condition with an objective measure of fatigue
- Have access to a common system of measurement
- Improve fatigue predictions
- Receive advice
- Roster metrics based on actual data
- Help Ops disruptions, manage aircrew fatigue in everyday Ops

➢ for Crew :

- Monitor its condition in real time
- Receive objective & reliable measures of its fitness
- Receive advice to quickly improve global well being / efficiency
- Help in detecting, alerting drowsiness & first symptoms

Neutrality of Thales Data Gate Keeper

8- Way forward

➢**Thales fully engaged in a roadmap dedicated to FRMS based on actual individual data**
Setting & Sharing impartial and unbiased key indicators/models will be beneficial to all stakeholders

➢**Contribute to the enhancement of aircrew fatigue measurement**
and management systems and therefore, propose its expertise to support EASA regulatory tasks.

➢**Thales already developing solutions such:**
Training & Simulation: Evidence Based Training
Crew Drowsiness Monitoring
…

Take Away

“The need for evolution in FRMS tools and processes”

- Predictive fatigue & modelling are needed for rostering
- FTL has been an important step for harmonized rules
- **But FRMS should also rely on objective fatigue metrics:**

Build an unbiased metric of fatigue
Use Individual metric and real time metric
Deploy new fatigue performance indicators (F-SPI)