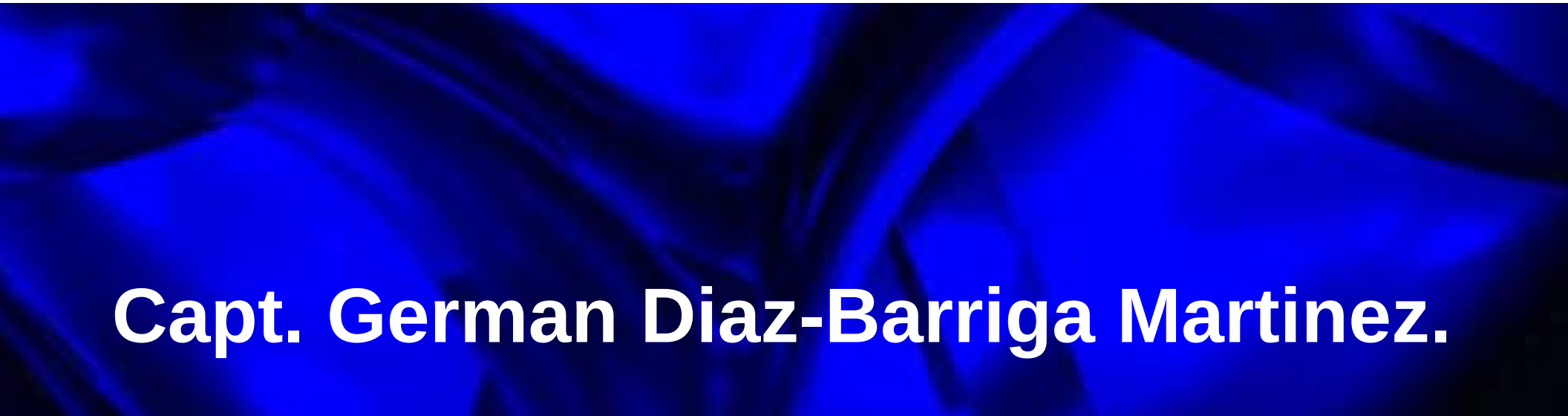
Fatigue Management from a Pilot´s Perspective



Capt. German Diaz-Barriga Martinez.

Charles A. Lindbergh

he nose is down, the wing low, the plane
ing and turning. I've been asleep with
en eyes... I kick left rudder and pull the
ck back... My eyes jump to the
meter...I'm at 1600 feet. The turn-indicat
ns over the left - the airspeed drops - th
l rolls quickly to the side...My plane is
tting out of control!”

Is Fatigue a Concern in Flight Operations?

ncidents

- About 20 percent of reported incidents to NASA Avia Safety Reporting System (ASRS) mention factors tha are fatigue-related

ccidents

- Hard to document, but NTSB cited fatigue as a facto 1993 DC8 accident
- American 1420 at Little Rock
- Colgan Air

esearch

Can we measure fatigue ?

atigue, per se, can not be measured.

ertness and degradation to alertness, on the other ha
n be measured, by response time in visual
atchfulness, complex reactions and lost reactions

ney can be compared to:

- Blood alcohol content
- Karolinska scale of sleep
- Samn-Perelli fatigue scale.

NASA Fatigue Countermeasures Program

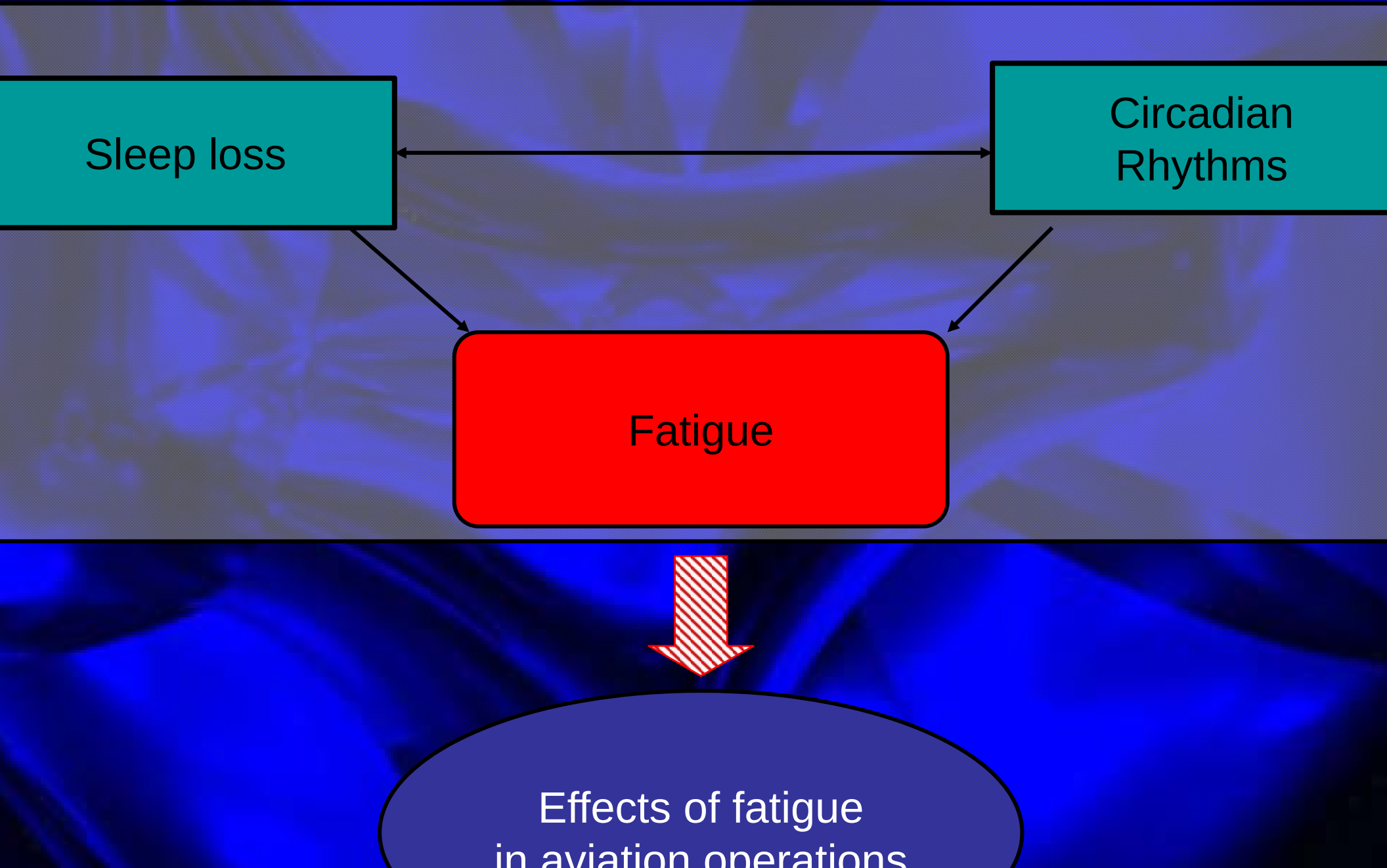
- Since 1980, research on fatigue, sleep, and circadian rhythms
  - evaluated over 500 pilot volunteers
  - line operations, simulations, laboratory
- Now providing feedback to the aviation industry
  - "Alertness Management in Flight Operations"

Primary Physiological Causes of Fatigue

Sleep loss

Circadian rhythm disruption

igue's affect on operations



leep and Sleep Lo

Charles A. Lindbergh

y mind clicks on and off... I try letting one
elid close at a time when I prop the other
en with my will. But the effort's too much
eep is winning. My whole body argues du
t nothing, nothing life can attain is quite
sirable as sleep. My mind is losing
solution and control."

What Research Shows

Sleep is a vital physiological function

Sleep loss is cumulative

Sleep loss and sleepiness can degrade essentially every aspect of human performanc

Sleepiness should be taken seriously

Sleep loss can affect performance like alcoho

fter being awake for 18 hours, mental and hysical performance on many tasks can be like aving a blood-alcohol content (BAC) of 0.05.

fter being awake for 23 continuous hours, peo erform as badly as people who have a BAC of .12.

Dawson and Reid, as reported in Reason's "Managing Maintenance Erro

BAC = Blood Alcohol Content

BAC Chart

# Drinks in 1 Hour	Body Weight in US Pounds								Individual percentages may vary. Based on .0 legal Blood Alcohol lim
	100	120	140	160	180	200	220	240	
1	.03	.02	.02	.01	.01	.01	.01	.01	.00% - .03% Drive With Caution
2	.07	.06	.05	.04	.03	.03	.03	.02	
3	.12	.10	.08	.07	.06	.05	.05	.04	.04% - .07% Driving Impaired
4	.16	.13	.11	.10	.08	.07	.07	.06	
5	.20	.17	.14	.12	.11	.10	.09	.08	.08% and UP Intoxicated!
6	.25	.21	.17	.15	.13	.12	.11	.10	
7	.29	.24	.21	.18	.16	.14	.13	.11	

In Mexico

El Artículo 100 del Reglamento de Tránsito del Distrito Federal, establece que "ninguna persona podrá conducir vehículos por la vía pública si tiene una cantidad de alcohol en la sangre superior a 0.8 gramos por litro, o de alcohol en aire expirado superior a 0.4 miligramos por litro.

How Sleepy Are You?

It is difficult for most people to accurately estimate their own fatigue level and alertness

– It may actually be worse than you think

Sleep Changes with Age

Amount of sleep and structure of sleep change as a person gets older

- Less deep sleep, and more disrupted sleep
- Daily percentage sleep loss is 3.5 times great in long-haul pilots aged 50-60, compared tha pilots aged 20-30

Quality versus Quantity

8 hours of disrupted sleep can be like getting very little sleep

The "Body Clock"

- Programmed for two times of maximal sleepiness during a 24-hour period
  - 3-5 AM and 3-5 PM
- Performance and alertness can also be decreased
  - 2 AM to 6 AM

According to NASA

- "Sleep loss and sleepiness can decre physical, psychomotor, and mental performance, and negative mood can increase and positive mood can decrease"
- “It can lead to a reduced safety margi and increased potential for operationa incidents and accidents."

lertness Managemer Strategies

hat crews can do to minimize the effects fatigue

Go to FSF AeroSafety World

Fatigue Countermeasures in Aviation

John A. Caldwell, Melissa M. Mallis, J. Lynn Caldwell, Michel A. Paul, James C. Miller, and David F. Neri
for the Aerospace Medical Association Fatigue Countermeasures Subcommittee of the Aerospace Human Factors Committee

Caldwell JA, Mallis MM, Caldwell JL, Paul MA, Miller JC, Neri DF, Aerospace Medical Association Aerospace Fatigue Countermeasures Subcommittee of the Human Factors Committee. *Fatigue countermeasures in aviation.* Aviat Space Environ Med 2009; 80:29–59.

Pilot fatigue is a significant problem in modern aviation operations, largely because of the unpredictable work hours, long duty periods, circadian disruptions, and insufficient sleep that are commonplace in both civilian and military flight operations. The full impact of fatigue is often underappreciated, but many of its deleterious effects have long been known. Compared to people who are well-rested, people who are sleep deprived think and move more slowly, make more mistakes, and have memory difficulties. These negative effects may and do lead to aviation errors and accidents. In the 1930s, flight time limitations, suggested layover durations, and aircrew sleep recommendations were developed in an attempt to mitigate aircrew fatigue. Unfortunately, there have been few changes to aircrew scheduling provisions and flight time limitations since the time they were first introduced, despite evidence that updates are needed. Although the scientific understanding of fatigue, sleep, shift work, and circadian physiology has advanced significantly over the past several decades, current regulations and industry practices have in large part failed to adequately incorporate the new knowledge. Thus, the problem of pilot fatigue has steadily increased along with fatigue-related concerns over air safety. Accident statistics, reports from pilots themselves, and operational flight studies all show that fatigue is a growing concern within aviation operations. This position paper reviews the relevant scientific literature, summarizes applicable U.S. civilian and military flight regulations, evaluates various in-flight and pre-/postflight fatigue countermeasures, and describes emerging technologies for detecting and countering fatigue. Following the discussion of each major issue, position statements address ways to deal with fatigue in specific contexts with the goal of using current scientific knowledge to update policy and provide tools and techniques for improving air safety.

Keywords: alertness, sleep, hypnotics, stimulants, flight time regulations, duty time regulations, sustained operations.

FATIGUE COUNTERMEASURES IN AVIATION: OUTLINE OF CONTENTS

I. DESCRIPTION OF THE PROBLEM

Pilot fatigue is a significant problem in modern aviation operations, largely because of the unpredictable work hours, long duty periods, circadian disruptions,

This Position Paper was adopted by the Aerospace Medical Association. It was prepared by a special subcommittee of the Aerospace Human Factors Committee chaired by Dr. David Neri and consisting of the authors. The paper is intended to review the relevant literature, describe fatigue-related issues and challenges, summarize applicable regulations, and present the Association's position with respect to fatigue countermeasures.

This manuscript was received and accepted for publication in September 2008.

Address reprint requests to: J. Lynn Caldwell, Ph.D., Air Force Research Laboratory, Human Effectiveness Directorate, Wright-Patterson

Alertness Management Strate

Preventive strategies

- Used before duty and on layovers to reduce adverse effects of fatigue, sleep loss, and circadian disruption

Operational strategies

- Used in-flight to maintain alertness and performance

Preventive Strategies

- egin a trip as rested as possible
- t home
  - Maximize sleep 1-2 days before departing on trip
- ayovers, too

- trategic napping can be very effective
  - 45 minutes or less, if just before duty

Preventive Strategies

- Alcohol consumption can have “major disruptive effects” on sleep quality
- Exercise regularly, but avoid just before bedtime
- If you can’t fall asleep in 30 minutes, get and engage in some relaxing activity
  - Don’t just lay in bed and be frustrated

Operational Strategies

- Strategic caffeine consumption
  - Best not to constantly drink caffeine before, during and after duty
  - Use it to best increase alertness
  - Don’t use it when already alert (start of duty o after a nap)
  - Avoid caffeine near bedtime
- Sensible nutrition and stay hydrated

how your Caffeine Content

Ounce Coffee Beverage

- Instant 25 – 102 milligrams
- Drip 115 – 250
- Brewed 80 – 135
- Expresso (4 ounce) 120 - 200
- Decaf 2 – 10

Ounce Tea Beverage

- Instant 15 – 30
- Brewed 25 - 83
- Iced Tea 10 – 50
- Decaf 1 - 5

how your Caffeine Content

Ounce Soft Drinks

Cola	35 - 47 milligrams
Orange Soda	40
Mountain Dew	55
Jolt	71

d

Frozen Desserts	8 - 85
Chocolate	5 - 31
Yogurt	1 - 45

Stay Active In-flight

- Engage in conversations with other crewmembers
- Frequent stretching helps, too

NASA Recommends

- Sleepiness can have severe consequenc
  take it seriously
- People are different - tailor this informatio
  o your own needs
- There is no one single answer - find out
  what works for you

Safety Regulation Group

CAA PAPER 2005/04

Aircrew Fatigue: A Review of Research Undertaken on Behalf of the UK Civil Aviation Authority


International Federation of Air Line Pilots' Associations
IFALPA
The Global Voice of Pilots
ICAO • OACI • ИКАО

ICAO Annex 6 Operation of Aircraft

gue. A physiological state of reduced mental or
ysical performance capability resulting from sle
ss or extended wakefulness and/or physical acti
at can impair a crew member's alertness and ab
safely operate an aircraft or perform safety relat
ties.

ga. Estado fisiológico de capacidad reducida de
sempeño mental o físico resultado de la perdida
eño o vigilia de sueño extendida y/o actividad fí
e puede deteriorar la vigilancia y habilidad de
erar una aeronave o desempeñar trabajos

ICAO Annex 6 Operation of Aircraft

6 Flight time, flight duty periods, duty periods an
st periods for fatigue management

For the purpose of managing fatigue, the State
e Operator shall establish regulations specifying
e limitations applicable to the flight time, flight du
eriods, duty periods and rest periods for flight cre
embers. These regulations shall be based upon
ientific principles and knowledge, where availab
th the aim of ensuring that flight crew members
erforming at an adequate level of alertness.

FAA's Airline Safety and Pilot Training Action Plan

24, 2009

ediate and Short Term Action Items (June-July 2009)

ue Rulemaking: By July 15, FAA will charter an aviation rulemaking committ
) consisting of representatives from FAA, industry and labor organizations. Th
will have until September 1, 2009, to draft recommendations to the FAA which
l inform a new, science-based notice of proposed rulemaking (NPRM) on flight
mits.

sed Inspection Initiative: Recognizing the urgency of proposals in the Call to
n, FAA has reordered priorities contained in a prior June 16 Notice to FAA
ctors and is directing that a focused program review of air carrier flight


NACA
CAPA
alpa
RANSPORT ASSOCIATION
RAA
Regional Airline Association
TEAMSTERS
AIRLINE DIVISION
Aviation
Rulemaking
Committee
FEDERAL AVIATION ADMINISTRATION
Federal A
Administ

Beyond ARC – EASA-CAP 371.....

RMS- should be implemented

LR flights

Must develop a process for a “Basic” and “ mature FR

Should develop a Central FRMS office

dvisory Circulars

FRMS

Flight Crew Rest Facilities

Fatigue Risk Management-en Españ

atigue Risk Management: Un método de dministración empresarial de la fatiga que cluya proceso de medición , mitigación y estión del riesgo de la fatiga

RMS: Un sistema de gestión basado en videncia para el control del riesgo de fatiga

FRMS ¿Qué hay de nuevo

FATIGUE RISK MANAGEMENT SYSTEM (FRMS)
IMPLEMENTATION GUIDE FOR OPERATORS

I·F·A·L·P·A IATA

EXECUTIVE LETTER

Dear Colleagues,

Air travel continues to be the safest means of transportation, but that does not allow for us to become complacent. We continually strive for improvements in our industry safety record, which is a testament to our ongoing commitment to safety.

Fatigue Risk Management Systems (FRMS) continues the move from prescriptive to performance based regulatory oversight. As in Safety Management Systems (SMS), FRMS strives to find the realistic balance between safety, productivity and costs in an organization, through collection of data and a formal assessment of risk.

Traditionally, crewmember fatigue has been managed through prescribed limits on maximum flight and duty hours, based on a historical understanding of fatigue through simple work and rest period relationships. New knowledge related to the effects of sleep and circadian rhythms provides an additional dimension to the management of fatigue risks. An FRMS provides a means of adding this safety dimension, allowing operators to work both safer and more efficiently.

This FRMS Implementation Guide for Operators is a significant milestone. It marks the successful collaboration between IATA, IFALPA and ICAO to jointly lead and serve industry in the ongoing development of fatigue management, using the most current science. The input of these three organizations has ensured that this document presents a scientifically-based approach that is widely acceptable to the operators and the crew members who will be using it. It also offers this information in an accessible and practical way to assist implementation.

We are extremely proud to mutually introduce this FRMS Implementation Guide for Operators, which will contribute to the improved management of fatigue risk, and to ultimately achieve our common goal of improving aviation safety worldwide.

FRMS – Who is responsible?

TATE – INDUSTRY – AIRLINE - INDIVIDUA

he Objective is always AN ACCEPTABLE EVEL OF SAFETY ….. still

We should capitalize on everybody's experience

Work as a team

Gather and SHARE data

Norm on a Scientific base

Use of Technology

The New York Times

/www.nytimes.com/ GLOBAL EDITION - Since 1

LACK OF FATIGUE REGULATIO
LLS 300 IN RUNWAY EXCURSI

Even after aviation authorities were gathered in a safety seminar, early this year in **LIMA, PERU**, nothing was done. There is no fatigue Regulation and no one is even worried about the increased work hours for pilots and crewmembers. Market is dictating new labor rules everyday and authorities around the world are too startled to react, or

In efforts to cut costs are asked to be mor productive, or they w jobless.

Manufacturers are suggesting bizarre s too, they are offering harnesses for passe travel standing up, a as far as proposing pilot in the cockpit d long-range flights.

¿Preguntas?

MUCHAS GRACIAS