Working Hours and Fatigue in Aviation Maintenance
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Fatigue: A European Industry Perspective

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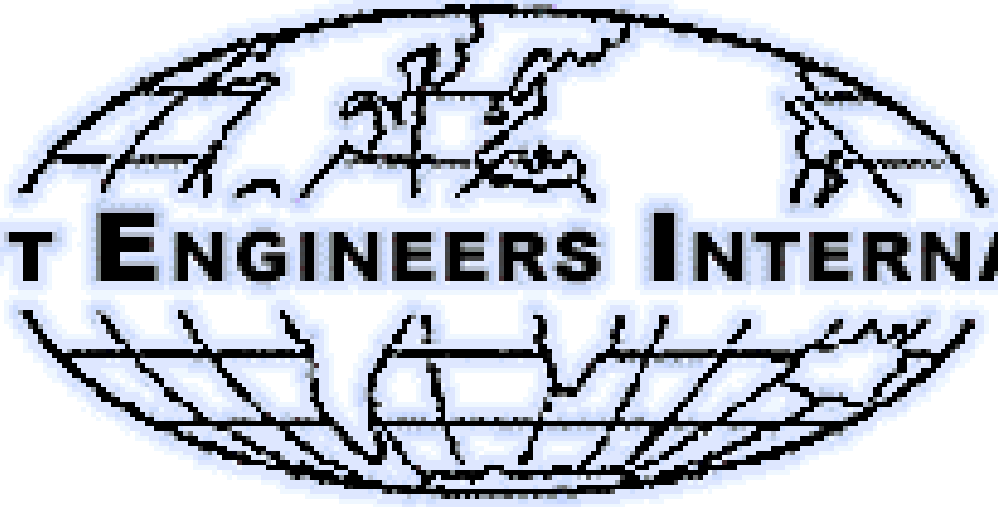
Outline of the presentation.

- A few words about Aircraft Engineers International
- A story
- Fatigue basics
- Regulatory effort by the JAA
- Is fatigue a major problem for aviation maintenance?
- Duty time limitation
- Managing fatigue



AIRCRAFT ENGINEERS INTERNATIONAL

we keep them flying safely

Aircraft Engineers International (AEI)

- A professional organization representing Aircraft Maintenance Engineers
- Has members organizations from around the world
- A non-profit, non-political organization
- Promotes Aviation Safety and Aircraft Engineering Profession
- Represents Aircraft Engineers in several bodies such as:
  - The JAA JSA and the MST
  - The JAA Human Factors Steering Group
  - The JAA Maintenance Human Factors Working Group
  - GAIN (Global Analysis and Information Network)

Cyprus
Finland
France
Germany
Greece
Iceland

Ireland
Italy
The Netherlands
Norway
Portugal
Slovenia

Spain
Sweden
Switzerland
United Kingdom
Yugoslavia
Turkey

Bangladesh
India
Kuwait
Russia

Australia
Fiji
New Zealand

Nigeria
South Africa
Zimbabwe

Fatigue Basics

Causes

-Excessive hours of work
-Bad planning of work
-Insufficient personnel
-Bad shift schedule
-Insufficient out-of-work rest/sleep
-Insufficient drinking of water
-Temperature, humidity, noise

Fatigue

Effects

-Human errors – Safety
-Affected performance
-Stress
-Health problems
-Depressed mood
-Driving-home accidents

Managing Fatigue

-Design of working schedules
-Duty time limitations
-Napping strategies
-Individual attention to out-of-work rest
-Awareness, Training
-Availability and drinking of water
-Better planning of work
-Dealing with shortage of engineers

Regulatory effort by the JAA Maintenance HF Working Group

- In Jan 1999 the WG was formed in order to address HF issues in the area of aviation maintenance
- The WG produced NPA12 which was a proposal on amending requirements of JAR145 (Approved Maintenance Organisations)
- The final form of these amendments has been adopted by the JAA
- This final form contains very little on fatigue and nothing on duty time limitation

Maintenance Human Factors Working Group (MHFWG)
Table of HF issues as accepted by the MC in Dec 99

Issue	Criticality	Justification	Action	Regulation affected
Design : • manufacturer's documentation • maintainability • no Maintenance Manual validation	1	• Manuals not followed or difficult to follow because of poor quality • Cross connections and other design deficiencies have been major contributing factors in past accidents and incidents • Note: B777 did have its manuals validated and over 1000 changes were needed	Maintenance organisations should ensure that design issues are relayed to the manufacturers, in the hope that they will feed back into the design of new aircraft / components. Side action : co-ordinate with Human Factors Steering Group actions for design/certification	JAR 145.45 'Approv data' & AMC
Fatigue	1	• **Long hours worked increases vulnerability to error.** · **Several maintenance incidents had a contributing factor fatigue due to excessive hours of work (refer to reports by CHIRP in 'Feedback' issues 46, 47, 50**	**-Adequate staffing number and qualification.** **-Take into consideration circadian rhythms when designing and planning work. (pending availability of additional studies and organisa-tional models)** **-Consideration be given to duty time limitation (pending JAA MC action)**	**-JAR 145.30 Personnel requirements - new JAR 145. on "planning"** **-new JAR 145.y on 'duty time limitation"**
Safety culture	1	To reduce maintenance errors is essential to determine why errors occur and what can be done to improve the reliability of the maintenance system. This is the aim of an Error reporting and analysis system	Develop guidance material for Error reporting/analysis system. The regulation should address the need for a Human error reporting/analysis system. AMC material should spell out the elements of such a system and promote the interest of non punitive culture.	-new JAR 145.zz o "reporting/analysis system"
Inspection	1	History has shown double inspection helps	Develop a requirement for double inspection.	JAR-OPS 1&3.910

JAR 145 Section 1
New (Current) Requirement

JAR 145.47 Production Planning

(See AMC & IEM 145.47)

(b) The planning of maintenance tasks, and the organising of shifts, must take into account human performance limitations.

JAR 145 Section 2 - Jan 2001 – Preliminary Form

IEM 145.47(b) Maintenance Planning See JAR 145.47(b)

- Limitations of human performance, in the context of planning and shiftwork, refers to the upper and lower limits, and variations, of certain aspects of human performance (eg. alertness, memory, information processing, etc) which planners should be aware of when planning work and shifts.
- Factors that may affect performance include circadian rhythms (24-hours body cycles), the nature of the shift patterns, work/rest/sleep patterns and durations, irregular work schedules, fatigue, poor sleep, stress, diet and lifestyle.

JAR 145 Section 2 - Jan 2001 – Preliminary Form

IEM 145.47(b) Maintenance Planning See JAR 145.47(b) (Continued)

- Reduced alertness and error-prone behaviour may occur at circadian ‘lows’, during fatigue, in association with boring, repetitive tasks, etc.
- Some of these performance characteristics can be mitigated by the adoption of shiftwork and fatigue coping strategies by individuals; however, such strategies will only be of limited effectiveness, and planning should take into account times when reduced performance of personnel is more likely to occur.

JAR 145 Section 2
New Requirement

IEM 145.47(b)

Production Planning

See JAR 145.47(b)

Limitations of human performance, in the context of planning safety related tasks, refers to the upper and lower limits, and variations, of certain aspects of human performance (Circadian rhythm / 24 hours body cycle) which personnel should be aware of when planning work and shifts.

Proposal by Aircraft Engineers International Jan 2002 – for NPA 12

IEM 145.47(b)

Production Planning

- **The organisation should establish a program for controlling shiftwork in such a way that personnel performance is affected by fatigue, as little as possible. The program should specify shift patterns, duty time limitations, night work limitations, rest periods etc.**

Proposal not adopted

Is Fatigue a major problem?

- The proper approach to evaluate the extend of the problem of fatigue is to assess the risk of working under fatigue, the frequency and the level of fatigue that maintenance personnel are subjected to.
- The excellent recent research studies (which are presented today) provide us with enough information to accomplish the required risk assessment.
- It can easily be concluded that fatigue is causing high safety risk to aviation maintenance operations today

- Another way (less appropriate) to assess the problem of fatigue is to examine data on accidents and incidents.

Is Fatigue a major problem?

- Some examples of incidents and accidents which were caused by maintenance error, having fatigue as one of their contributing factors, have been reported to:
  - The CHIRP (Confidential Human Factors Incident Reporting Program)
  - The AAIB (UK Air Accidents Investigation Branch)
  - The ASRS (NASA Aviation Safety Reporting System)
  - The NTSB (USA National Transportation Safety Board)

Is Fatigue a major problem?

Example of an Airline

- The following is a list with some of the incidents/accidents that an airline (with a fleet of 12 a/c) suffered for the last 10 years all of which have fatigue as one of the contributing factors.
  - Extensive structural damage to the aft fuselage of an aircraft due to wrong jacking of the a/c
  - Structural damages resulting from collision of a wing of one a/c with the tail of another, during towing
  - An aircraft engine placed on a serious risk when a tool was left inside the engine compartment
  - Three engineers seriously injured staying away from work for several months due to road accident when driving home from work

Some Facts

- There is lack of awareness on the issue of fatigue between maintenance community in Europe including regulators, workers and management
- Lack of awareness appears in topics such as the extend of effects, coping strategies, managing shift planning

"Sometimes technicians work up to 18-42 hours !

Technicians often believe that such working hours do not affect their fatigue or performance"

ADAMS Research Project (European Union) 1999

Duty Time Limitation

Working excessive hours is like driving fast in public roads...

Driving Fast

- Driving fast increases dramatically the chance of making an error – causing an accident
- Roads need to be properly designed
- We can reduce the problem by educating the drivers on the effects of driving fast

We can positively control fast driving ONLY by applying Driving Speed Limitations

Excessive Hours

- Working excessive hours increases dramatically the chance of making an error – causing an accident
- Work need to be properly designed
- We can reduce the problem by educating the workers on the effects of working excessive hours

We can positively control excessive hours of work ONLY by applying Duty Time Limitations

Why Duty Time Limitation is essential

- It is the only way to control excessive hours of work
- With no limitations organisations will continue to seek the easy way out to attend work demands by expecting maintenance personnel to work excessive hours

Working excessive hours of work is not to the Companies' benefit

- Increased possibility to make an error
- Reduced performance
- Increased overtime pay – Paying someone in a higher than usual rate to work with reduced performance

A variety of Duty Time Limitations exist in European Aviation industry

- Some of these are state regulations and some are company's procedures or labour agreements
- Some of the state regulations are stricter than EU Directive (e.g. Netherlands's) and some are more lenient (e.g. Greece’s)
- Some of them (e.g. Netherlands's and Greece’s) provide a normal limit as well as a negotiable limit
  For example: In the Netherlands there is a state regulation on the maximum number of night shifts per year. The normal limit is 100 whereas the negotiable limit is 120

Opposition to duty time limitation by:

- The Regulators – due to bad experience with flight crew requirements
- Airlines/MO – due to shortage of maintenance personnel, bad experience with the flight crew requirements, traditional perceptions on working hours
- Maintenance Personnel – due to financial implications – reduction on overtime pay

EU Working Time Directive

- The EU Directive will not apply to the countries non-members of the EU
- A lot of the maintenance on the EU countries registered aircraft is carried out in non-EU counties - We therefore do not seek the same standards from these. So we do not seek in these cases the main objective which is aircraft safety

- To cover these cases it would be necessary to introduce these to the JAR145 (or the ECAR-145 of EASA)

Managing Fatigue

Fatigue Basics

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Managing Fatigue

Research

Regulation

Organisation

Individuals

Managing Fatigue

- Research: Come up with data/figures, such as financial cost and contribution to accidents/incidents, to assist the promotion of fatigue programs.
  Fatigue management program guidelines
  Fatigue training guidelines
- Regulation: Requirement for shift work scheduling and duty time limitation. Requirement for the Organisation to have a program to control shiftwork and fatigue.
- Organisation: Apply regulatory requirements and available research recommendations for shiftwork and provide appropriate training to its personnel
- Individuals: Apply sensible rest habits in sleep and rest periods between duty calls
  Also apply recommendations on fatigue during working periods

Conclusion

- Fatigue is a major safety issue for the aviation maintenance industry
- To face the problem of fatigue, we need to have
  - A combined effort by the different aviation parties as well as
  - A systematic approach based on general research recommendations and specific case analysis
- Duty time limitation is an essential measure to control fatigue

We need to make every effort in order to protect all of them

The Aircraft

The Engineer

Yourselves - The Flying Public

Thank You!!!