FATIGUE RISK MANAGEMENT SYSTEMS IN AVIATION: CONSIDERATIONS

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Aircrew Fatigue

To maintain round the clock operations, members of an aircrew often have to sleep when their circadian clock dictates wakefulness and to fly when their clock dictates sleep. During night hours fatigue increases and vigilance decreases more markedly with ongoing duty hours than during the day (Simons & Spencer, 2007). Scientific investigations show that night duty hours are especially vulnerable to severe fatigue (Samel et al, 1997b; Spencer & Robertson, 1999) and there is also evidence that pilots take involuntary naps and micro-sleeps on the flight deck (Samel et al, 1997a; Wright & McGown, 2001). The detrimental effects of sleep deprivation, time since sleep, and the window of circadian low on alertness lead to severe fatigue with increasing time on task.

Short haul aircrew are often faced with irregular work schedules, early morning departures, and late arrivals, resulting in impaired sleep and in-flight sleepiness (Simons & Valk, 1998; Gander & Graeber, 1987). Long haul operations are characterized by rapidly alternating time-zone transitions and night flying (e.g. Graeber et al. 1986). Layovers are often too long to keep sleep and activity patterns anchored to home time and too short for complete circadian adaptation to the local environment. The unique combination of shifted time and shifted work results in compound circadian disruptions. Consequences, such as impaired and reduced sleep, lowered alertness, and fatigue may affect flight safety and health (e.g. Carskadon & Dement, 1981; Samel et al. 1993; Åkerstedt, 2000; Valk et al. 2003; Eriksen & Åkerstedt, 2006; Jackson & Earl, 2006; ICAO, 2010).

In the context of flight safety, it is important to consider that acute as well as cumulative fatigue may lead to:

- channelling of attention: focus on a task which may be of minor importance
- lowered levels of alertness
- missing of warning signals
- underestimation of danger or seriousness of a situation
- tendency to choose risky options
- ignorance of normal checks and procedures
- unawareness of impaired performance
- increased irritability, which may lead to bad team work

Because all of the above effects of fatigue may increase flight safety risks, aircrew fatigue should be prevented as much as possible.

Fatigue Risk Management

The common control for fatigue risk utilized in aviation is compliance with flight time limitations (FTL). However, there is a problem faced by all FTL schemes that set prescriptive limits across a comprehensive range of issues. The deficiency of a prescriptive FTL scheme is that it provides a limited and static approach to fatigue risk which does not account for the differing scheduling and operating conditions specific to an individual airline and does not enable actual workforce fatigue to be measured or predicted. It is clear that FTL regulations have not enabled operators to manage the safety risk from fatigue in a completely acceptable manner. It is also well recognized that prescriptive limitations can severely limit operational flexibility. Even within prescriptive flight time limitations it may be possible to construct

schedules where a combination of factors gives rise to high levels of fatigue, discontented aircrew, or high sick leave rates. Yet at the same time, the FTL limits may prohibit perfectly acceptable and safe schedules, because they make no allowance for circadian factors and human physiology (Stone et al., 2008). It is for this reason, among others, that approaches based on a Fatigue Risk Management System (FRMS) are now becoming more widespread.

FRMS is a scientifically-based, data driven flexible alternative to prescriptive flight and duty time limitations that forms part of an operator's Safety Management System and involves a continuous process of monitoring and managing fatigue. In contrast to traditional safety approaches, the FRMS applies controls and safety resources in a risk-based manner. Thus, rather than acting as a barrier to commercial viability, the FRMS adds value by enabling the company to pursue flexibility and crew resource utilization within acceptable and defined risk boundaries.

Use of a FRMS by operators and authorities is recommended by ICAO (ICAO, 2010) and is also considered by EASA. According to ICAO guidelines, the State of the Operator may allow an operator to adopt prescriptive fatigue management regulations, a FRMS, or both, consistent with the nature and complexity of particular flight operations. Recently EasyJet received dispensation to use a FRMS from U.K. Civil Aviation Authority after reporting the results of a six-month trial of the FRMS approach at two of their bases.

Guidance material for implementation of a FRMS has been published by ICAO (ICAO, 2010). ICAO defines that a FRMS should include the following essential components:
- a fatigue risk management policy;
- education and awareness training programmes;
- a crew fatigue reporting mechanism with associated feedback;
- procedures and measures for monitoring fatigue levels;
- procedures for reporting, investigating, and recording incidents that are attributable wholly or in part to fatigue;
- processes for evaluating information on fatigue levels and fatigue-related incidents, undertaking interventions, and evaluating the effects of those interventions.

(detailed guidance material can be found in ICAO State letter SP 59/5.1-10/33 at https://www.transportstyrelsen.se/Global/Regler/Remisser/Luftfart/ICAO%20remiss%20SL%202010-33.pdf)

Fatigue can be predicted with reasonable accuracy by mathematical models incorporating sleep/wake history and the modulating effects of the circadian clock (Achermann, 2004). By using a predictive model, fatigue levels encountered in specific schedules and rosters can be evaluated and the effects of fatigue countermeasures can be assessed. In the context of a FRMS, a model which is tailored to the operational needs of an individual airline is a useful means to minimize fatigue-related incidents and to evaluate crew fatigue reports.

Conclusion and Recommendation

The Advisory Board of ESAM supports further development and implementation of Fatigue Risk Management Systems in airlines, because it provides the opportunity to better match operational needs and fatigue-related flight safety considerations. It stimulates collaboration of management and crew, who share the responsibility for an optimal balance of operational criteria and performance criteria in pursuit of commercial objectives.

A FRMS can be used within the envelope of prescriptive flight and duty time limitations or as an alternative to such prescriptive rules that provides at least an equivalent level of safety.

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