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Ben Cook, CASA's human factors manager, examines the importance of fatigue risk management systems (FRMS), and looks at a best-practice implementation of FRMS by the UK-based easyJet.

From personal experience of many years of flying, it has become apparent what impact extended periods of high workload such as ground-based duties (e.g. safety officer, ground instruction, preparation for training events etc); personal issues (managing and juggling family commitments), combined with long crew duty days could have on my performance. I've worked in 'can-do' cultures where being able to push through long days is a sign of strength, and fatigue a sign of weakness to those less capable operators. Unfortunately, it's this type of culture which sets individuals and teams up for failure and has led to many serious fatigue-related incidents and accidents.

During one such flight at the end of a 12-hour crew duty day, I remember all too clearly flying an instrument landing system (ILS) approach into Wellington, and asking myself why I couldn't meet normal performance targets. I was flying the ILS like a novice; in fact, I think my first ILS when I completed instrument flying training was significantly better than this one. One error (too high on approach) would be over corrected and end up too low, horizontal tolerances were all over the place - from half scale left to half scale right.

Even more unnerving was the lack of response from the rest of the crew. I was hand flying at the time in a medium-sized transport aircraft, and salvaged the situation by reverting to automation; we coupled the approach to the autopilot from which the aircraft flew a beautiful ILS.

This was my first significant experience of understanding how fatigue had played a significant role in reducing my performance to less-than-ideal and had degraded the normal vigilance and decision-making of the entire crew. The days leading up to this trip were busy and longer than normal. We had even covered the long crew duty day in pre-flight planning, but should have spent more time while still fresh, and prior to take-off, discussing how we were going to mitigate the effects

# Managing fatigue

of fatigue. For example, we could have discussed using automated systems to fly the approach right at the start of the day, which could have supported better decision making at the end of the long day. We could have formalised a significantly improved crew rest system, but as we all believed a 12-hour crew duty day was not out of the ordinary, we didn't think the risks were significant. I still don't know why I chose to hand fly the ILS, a less than optimal decision, but one of many experiences that has reminded me the role fatigue plays in degrading normally sound decision-making.

An amendment to CAO48.0 (duty time limits and fatigue risk management systems (FRMS) will soon move to the notice of proposed rule making (NPRM) phase and it's timely to reflect on duty limits and management of fatigue risk. At a recent Aviation Fatigue Management Symposium held by the Federal Aviation Administration (FAA), some of the world's leading fatigue experts, regulators, investigators and operators met under the theme of seeking 'partnerships for solutions'. Some significant points from this symposium are as follows; (there were too many to list them all):

- ▶ The National Transportation Safety Board (NTSB) has had fatigue on its 'most wanted' list since 1990.
- ▶ Individual differences in performance impairment from sleep loss are substantial. Managing fatigue becomes even more complex, as there is no 'one-size-fits-all' solution. A pattern of work hours that might be good for me may be debilitating for you.
- ▶ There is much work to be done to improve products such as bio-mathematical models, which currently treat individuals as being all the same, based on data 'averages'. I consider these models have a place as one (non-essential) tool in a comprehensive FRMS.

Having been involved as an investigator in a number of fatigue-related incidents, I know that good fatigue management has the potential to make big improvements to the safety of our industry. I've seen the extremes of fatigue management: some organisations, from the CEO all the way down, make a dedicated commitment to managing fatigue, breeding an organisational culture where fatigue management is taken seriously and providing the resources to support the development of a mature FRMS. At the other extreme I've seen a number of 'work-arounds', e.g. managers defaulting primarily to bio-mathematical model fatigue scores to determine whether an operator should perform duties. In a number of cases, this has led to a system that looks great on paper, but actually degrades fatigue management due to misapplication of the available tools.

The United Kingdom (UK)-based easyJet provided a presentation at the FAA Symposium and was considered one of the leaders in developing and integrating a mature FRMS into its business. An extract from an article by easyJet follows and will be one of many we hope to publish on the issue of FRMS, which draw upon industry experiences of their efforts to better manage fatigue. It provides an insight into the European and United Kingdom system and has many parallels with our own industry.

If you are operating under an FRMS, CASA would like to hear about your experiences. Has your FRMS improved the management of fatigue? What are the lessons you (and/or your organisation) could share with

other operators to help them improve fatigue management? Please send any responses to Mike Higgins, CASA FRMS program manager email: [humanfactors@casa.gov.au](mailto:humanfactors@casa.gov.au).

And some final broad advice before reading the easyJet article: if someone offers you what appears to be a simple solution for what is a complex problem – it's likely to be wrong!

## FATIGUE RISK MANAGEMENT AT EASYJET

Simon Stewart & Derek Brown – easyJet

In 2006, easyJet became the first European airline to implement an FRMS. The key benefit of managing fatigue risk is the prevention of accidents; however it is too simplistic to view fatigue risk management as merely a safety initiative. It is in the commercial interests of managers to understand the nature of fatigue risk. In recognising this, easyJet have incorporated the FRMS into their core business model. Knowing operational risk exposure enables managers to ensure that short-term profitability is considered simultaneously with brand protection.

### PURPOSE OF EASYJET'S FRMS

'To maintain an acceptable level of safety, through the application of scientific principles, based on human physiology and knowledge, determined from data collection, risk investigation and analysis. In doing so it allows greater operational flexibility of crew scheduling, in comparison with prescriptive limitations of flight and duty time. The FRMS forms an integral part of easyJet's established safety management system (SMS).

Fatigue risk management applies standard management control principles in order to mitigate fatigue risk in airline operations, through processes based on shared responsibility amongst management and crew members acting within a just culture.

### FUNCTIONING

The objective of the FRMS team is to facilitate the airline's commercial success through enhanced productivity, delivered within a risk-controlled environment. The FRMS team also add financial value to the company, based

on achieving a lowered risk profile, leading to a significant reduction in insurance premiums; together with lower levels of crew attrition and sickness costs through maintaining sustainable rostering practices, whilst minimising the risk of serious incidents.

In such a complex operating environment, focusing on simple compliance with FTL requirements (i.e. 900 hours productivity per year) cannot be justified, or assumed to provide adequate legal protection against safety risks for easyJet, as the following demonstrates.

In April 2005, easyJet became the first major airline to be granted alleviation from flight and duty time limitation (FTL) by the UK CAA, based on the results of a safety case report of a six-month roster trial. The trial roster exceeded the FTL (CAP 371) limit of three consecutive early duties. However, easyJet presented a safety case which demonstrated that, compared to the 6/3 roster (three early duties, three late duties, three days off) in operation at the time, the proposed 5/2/5/4 roster (five early duties, two days off, five

roster would reduce fatigue by decreasing the number of days worked consecutively; and increasing the amount of time off provided for the changeover from early to late duties.

Evidence collected in the HFMP® showed, compared to the 6/3 roster, that fatigue risk was reduced during the 5/2/5/4 roster trial. Some of these HFMP® findings underpinning the safety case presented to the CAA, are:

- ▶ An assessment using predictive fatigue modelling software found that while 1.8 per cent of duties on the 6/3 roster were associated with a 'high to very high fatigue risk', only 0.7 per cent of 5/2/5/4 roster duties fell into these categories.
- ▶ Line operations safety audit (LOSA™) observers recorded crew threat and error management on both rosters, with a mean error rate of 5.2 per sector for the 6/3 roster, and a significantly reduced 2.6 on the 5/2/5/4 roster.
- ▶ The implementation of the 5/2/5/4 roster, after approval by the CAA, was subject to the vote of crew who were members of the British Airline Pilots Association (BALPA). Of the members participating in the voting process, 91 per cent agreed that they felt less tired/fatigued on the 5/2/5/4 roster, with 93 per cent voting for the new roster.

In such a complex operating environment, focusing on simple compliance with FTL requirements (i.e. 900 hours productivity per year) cannot be justified, or assumed to provide adequate legal protection against safety risks for easyJet, as we have demonstrated through our previous experience.

*The high levels of crew utilisation now being achieved has led to concerns that the degree of protection against fatigue offered by basic compliance with those quantitative FTL provisions specified in CAP 371 Annex A is no longer sufficient for larger companies. CAA Draft FODCOM 2008*

The FRMS team must establish a full and robust safety case, supported by scientific research, incident investigations, metrics, and reporting in order to identify risk, prior to implementing each and every roster constraint to the business.

After identifying the risk, that safety case is put before the FRMS safety advisory group (SAG) made up of the relevant post-holders. It is these post-holders who own the risk and

## ...leading to a significant reduction in insurance premiums; together with lower levels of crew attrition and sickness

late duties, four days off) was associated with a significant reduction in fatigue risk and flight deck error. The 5/2/5/4 roster is now operational network-wide at 14 bases.

A human factors monitoring program (HFMP®, Stewart and Abboud, 2005) was developed in recognition of the potential fatigue risk associated with low cost carrier operations and the limitations of simple adherence to FTL. The HFMP® assesses flight crew fatigue, rostering practices and human error, and the interactions between these. The HFMP® is multi-layered, mining data from existing safety management system (SMS) databases; for example, flight data monitoring (FDM); and also includes additional measurements, such as predictive modelling of the work-hours fatigue and objective sleep measurement.

This program was applied both to the existing 6/3 roster, and to the trial 5/2/5/4 roster (at two bases). It was predicted that the 5/2/5/4

it is they who make the decision – not the FRMS team - to implement mitigating strategies in the form of roster constraints in order to maintain an acceptable level of safety.

For example, the easyJet FRMS allows our staff to report not fit for duty due to fatigue. Rather than a generic 'sick leave' process, this allows our organisation to gain more valuable insights into potential fatigue risks. This can only be achieved through a culture where our staff know they will be fully supported by easyJet to further investigate identified issues and to take positive action to address risks. It helps to capture when fatigue is creating problems, so we can proactively address this risk and monitor longer-term patterns related to fatigue. Furthermore, if one individual is experiencing a higher rate of fatigue-related effects, it may be due to aviation medical issues (e.g. sleep apnoea) and we can ensure those people are provided with the appropriate support to address any conditions which may be affecting their quality of sleep.

Although a fully-fledged FRMS is neither cheap nor easy, it does provide a systematic and objective process for managing fatigue risk, and can add significant value to the business. However, it must be a core part of the operator's operational philosophy, have the full support and the visibility of senior management, and will work only if it is continually nurtured through a 'just and open' culture.

The FRMS does not represent a 'bolt-on' compliance system that acts as a barrier to commercial viability. It represents operational flexibility and opportunity. It facilitates optimal performance and protection within evidenced safety criteria in pursuit of commercial opportunity.

In doing so it satisfies the corporate philosophy enshrined in the five values of easyJet - safety, teamwork, pioneering, passion and integrity.

## FRMS BENEFITS FOR EASYJET

The benefits of managing fatigue, as with any other risk, (within an SMS) are significant. Reasons for investing in an FRMS include not only avoiding pitfalls of FTL:

1) *Knowledge of fatigue risk exposure is a fundamental element of business* – FRMS provides this knowledge. It is in the commercial interests of operators to understand the nature of fatigue risk and manage it effectively for continued safe operation and viability in the commercial environment. Safety links to commercial via brand protection.

- ▶ Reduction in frequency of medium and high-risk events
- ▶ Reduction in oversight from the regulating authority
- ▶ Reduction in attrition
- ▶ Reduction in lost duty days and sickness incidence due to fatigue
- ▶ Increased crew morale and CRM performance

The quantification of the benefits a reduction in fatigue associated with altered work schedules has been demonstrated in the nuclear industry by Fleishman et al (2006) with the following benefits:

- ▶ Reduction in frequency of severe accidents
- ▶ Reduction in plant shutdown risk
- ▶ Improved security
- ▶ Reduction in frequency of lost and restricted work cases



good fatigue management has the potential to make big improvements to the safety of our industry


2) *New ICAO SMS legislation* (January 2009) requires airlines to implement a continuous safety monitoring program with management accountability of operational risk. EASA means that the CAA will have less oversight and airlines need internal governance (risk ownership). An internal governance program based on accountability, transparency, predictability and participation (Gardiner, 2005) supports continuous oversight of operational risk by the CAA and allows them to focus regulatory resource against audit risk areas, maximising benefit to the business.

3) *Risk signature*. Insurers and underwriters are seeking the application of proactive risk management strategies that demonstrate safety awareness and capability through mitigation of incident & accident risks. Companies which can demonstrate such risk management strategies will benefit by a decrease in airline premiums commensurate with their risk profile (Underwriter perspective-*AeroSafety World*, 2007).

4) *Corporate liability*. The message from the regulators is clear: legal duty hour limits do not necessarily ensure safety, and risk ownership and accountability lie squarely on the shoulders of the operator (CAA presentation Crew Management Conference, Brussels 2007). Corporate manslaughter legislation (effective UK Ministry of Justice, 2008) informs us that ignorance of risk is no defence - you are still accountable.

Unless the FRMS system is underpinned by accurate and timely information, information which can be processed and assimilated into a fatigue risk format for analysis, the program at worst will be ineffectual – a box-ticking exercise, and at best provide senior management with an inaccurate system overview of a key risk indicator on which operational decisions are based. These decisions may directly impinge on system fatigue risk.

The information sources for the FRMS system should be dynamic, in-effect 'real-time', so that a fatigue risk model can be developed which allows system projections on performance to be made. Armed with an accurate state of operational fatigue risk, senior management can be proactive. The FRMS then forms part of the company's commercial business plan accounting for fatigue risk to maintain operational integrity during projected expansion activities. The FRMS system must encompass an accurate assessment of network fatigue tolerance levels combined with work-related fatigue determined from hours and patterns of work.

[If you would like a full copy of the easyJet article and/or have further questions for easyJet please email [humanfactors@casa.gov.au](mailto:humanfactors@casa.gov.au). The aim is to send a consolidated list of questions back to easyJet and to publish a further article in due course] 

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