ALPA WHITE PAPER
AIR LINE PILOTS ASSOCIATION, INTERNATIONAL
1625 Massachusetts Avenue, N.W., Washington, D.C. 20036
703-481-4440 ▪ MEDIA@ALPA.ORG ▪ WWW.ALPA.ORG

Fatigue Risk Management Systems

Addressing Fatigue Within a Just Safety Culture

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Executive Summary

Fatigue is a constant companion for many flightcrew members in today's operating environment. The current regulations, both domestic and international, do not adequately address fatigue issues. The International Civil Aviation Organization (ICAO), national aviation authorities, and individual airlines are espousing use of a new type of tool called a fatigue risk management system (FRMS) for addressing fatigue in flight operations. An FRMS is a scientifically based, data-driven process used to continuously monitor and manage fatigue risks.

An FRMS is intended, but not required, to be implemented within an organization's safety management system (SMS). It will have essential components similar to those of an SMS, including an accountable executive, a "just" safety culture including non-punitive employee reporting, and investigation of reported deficiencies and problems. The intent of an FRMS is to allow operational efficiency while also mitigating fatigue-inducing factors.

Although some authorities have suggested that FRMS may one day replace prescriptive regulations, ALPA and the International Federation of Air Line Pilots Associations (IFALPA) maintain that FRMSs are best implemented only as an adjunct to, and not as a replacement for, baseline, prescriptive flight- and duty-time limitations. When used in conjunction with a baseline regulatory scheme, a properly designed FRMS should enhance safety and reduce pilot fatigue while allowing a defined, but limited, degree of flexibility from the regulations. However, the fundamental purpose of FRMSs is, and must remain, to identify, reduce, and eliminate risks to pilots and passengers associated with flightcrew fatigue. FRMS is not designed or meant to be used as a scheduling tool to squeeze more "productivity" out of already overburdened flightcrew members.

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Background

Since shortly after the Wright Brothers' first successful powered flights, as aircraft reliability, range, and speed increased, fatigue has been a companion for flightcrew members. Some airliners being operated now can fly for more than 20 hours without refueling. With flights of this duration, combating flightcrew fatigue is a real and constant concern. At the other end of the operational spectrum, small jet airliners may operate for less than one hour on each flight, but their pilots may have eight or more fatigue-inducing legs during a duty day that includes eight or more hours of actual flight time. These risk-inducing situations have created the need for operators and pilots to go beyond the simple use of prescriptive limits for flight time and flight duty periods and minimum requirements for rest periods to effectively assess and manage the risks associated with fatigue.

The current prescriptive U.S. regulations regarding maximum flight time and duty periods have not been significantly changed since well before jet transports came into commercial use in the late 1950s. A change to the domestic rules made in 1985 may have corrected some shortcomings in the regulations, but the change introduced serious abuses into flight operations.

Examples of some of these abuses and inadequacies in current regulations include the following:

- Continuous-duty overnights—A flightcrew may start flying in the evening and have an extended break during their window of circadian low (identified as a time when the body is accustomed to sleep and during which performance is reduced) while still on duty, then resume flying again early in the morning. They will then be given their rest period during the hours when they are normally awake.
- Long duty days with a number of short flight legs—Frequently the emphasis is on short ground turnaround times, and flightcrews may have difficulty getting an adequate meal and be subject to increased cumulative fatigue exacerbated by poor nutrition.
- Inadequate periods between flights—The normal off-duty period, commonly referred to as a "rest" period, is nine hours. Nine hours is entirely inadequate when travel to and from a hotel, eating meals, and meeting other physiological needs are considered as part of the "rest" period. The time required to be spent in transit and performing these other functions leaves no opportunity to obtain eight hours of recuperative sleep. A reduced rest period of eight hours compounds this situation.
- Ultra-long-range flying (more than 16 hours)—The regulations did not envision and do not address these operations. Issues include crew rostering, length of layover, and providing adequate inflight crew rest facilities.

No foolproof regulatory scheme exists that can address all flight operational situations. Flight operations today in both the United States and Canada may be scheduled so that they are legal, but they are not necessarily safe from the perspective of human fatigue or

risk mitigation. In recognition of this unsatisfactory situation, a new concept in flightcrew operational scheduling, the fatigue risk management system, has been developed. ICAO, national aviation authorities, and individual companies are promoting FRMS in an effort to allow operational efficiency while minimizing operational fatigue. The fundamental principle guiding any FRMS is that every flightcrew member should be adequately rested immediately before flight duty and will be provided adequate in-flight rest opportunities to remain alert when appropriate. Flightcrew members must remain sufficiently alert during the entire flight duty period and be able to achieve a satisfactory level of operational performance and safety in both normal and abnormal situations.

A properly structured FRMS can be used in conjunction with existing or prescribed flight and duty regulations to provide both operational efficiencies and an enhanced level of safety.

The Relationship Between FRMS and SMS

The U.S. Federal Aviation Administration (FAA) is developing a requirement for safety management systems (SMS) for airline operators, maintenance and repair stations, airports, and the FAA itself. SMS requirements are being implemented in Canada. In theory, a properly structured SMS increases safety in all phases of an airline's operations.

ALPA has established a policy that lists the essential elements of a properly structured SMS program. These elements include the following:

- A documented, clearly defined commitment to the SMS from the CEO. The statement must show commitment to:
  —continued improvement in the level of safety,
  —management of risk, and
  —a strong safety culture.
- Documented lines of safety accountability.
- Active involvement of the affected employees in a nonpunitive reporting system and a commitment to a "just" safety culture.
- A documented, robust safety risk management (SRM) program, which must include employee participation in hazard identification and the development of risk mitigation strategies.
- A documented process for collecting and analyzing safety data and implementing corrective action plans.
- A documented method for continuous improvement of the SMS.

An FRMS should be an integral part of an operator's established SMS, but having an SMS is not a prerequisite. An FRMS applies SMS principles and processes to proactively and continuously manage fatigue risk through a process requiring shared responsibility among management and employees. Because flightcrew member feedback and nonpunitive reporting are essential elements of an FRMS, a "just" safety culture must be integral to any FRMS.

Fatigue Risk Management Concepts

Fatigue results from an interaction of sleep loss, circadian phase (i.e., individual body clock time), and workload. An FRMS is designed to combat both transient and cumulative fatigue by recognizing the need to do the following:

- Manage flightcrew workload, flight duty periods, and breaks with the aim of preventing both types of fatigue.
- Manage the duty period in which additional tasks are performed immediately before a flight or at intermediate points during a series of flights in such a way as to prevent cumulative fatigue.
- Limit total duty time and flight time during specified periods to prevent cumulative fatigue.
- Provide flightcrew members with adequate sleep opportunity to recover from fatigue before starting the next flight duty periods.
- Take into account other related tasks that flightcrew members may be required to perform to guard particularly against cumulative fatigue.

Using an FRMS can improve operational efficiency by giving an airline more flexibility to respond to changing operational requirements. An FRMS is a data-driven, ongoing, adaptive process that can detect fatigue risks and develop and evaluate mitigation strategies to manage any emerging operational risks. Because an FRMS is based upon scientific principles and knowledge combined with sound methods of data collection and analysis, the FRMS should be able to maintain an acceptable, equivalent level of safety while allowing greater operational efficiency.

An FRMS does not need to apply to all flight operations. An airline may choose to limit its application to specific types of operations, such as ultra-long-range flying.

FRMS Elements

An FRMS is composed of a number of essential components intended to provide structure and guidance to ensure that fatigue risk management (FRM) is implemented effectively and that regulatory oversight is accomplished in a reliable and verifiable manner.

The following should be considered minimum components of an FRMS:

- A fatigue risk management policy, which should be an integral part of an airline's safety management system. The policy describes the operator's commitment, responsibility, and governance.
- Education and awareness training programs for management and flightcrews, with knowledge of the science related to fatigue and understanding of the FRMS concept.

- Processes for identifying, reporting, and investigating fatigue risk, including analyzing sources of information on fatigue. These processes should be based on objective operational data and should enable the airline to develop and evaluate the effectiveness of both reactive and proactive interventions—such as modifying trip and crew scheduling and rest periods—designed to reduce and manage fatigue risk.
- Processes for monitoring fatigue in flightcrews, including collecting and analyzing non-punitive, self-generated reports from flightcrew members.
- Processes for reporting, investigating, and recording incidents that may be attributable in whole or part to fatigue.
- Acceptable policies, processes, and protections for the use of data and managing of databases.

Policies and Procedures

An operator's FRMS policy must ensure commitment from the highest levels of the organization (the accountable executive) and a specified line of accountability for fatigue risk management, education, and training within the organization. All affected personnel within the organization should share joint ownership of the FRMS. The work groups and operations covered by the FRMS must be clearly spelled out. Also needed are clear policies and procedures for detecting and helping employees who are fatigued to the extent that they may pose a safety risk.

A non-punitive reporting program for all employees is essential to the success of an FRMS. Reports need to be thoroughly investigated and, if necessary, actions taken to correct identifiable deficiencies. Employees should not be exposed to discipline or enforcement for submitting voluntary safety reports. Communication and trust are essential elements of an FRMS so that the employees will continue to report perceived deficiencies and problems. The organization needs to communicate with employees about issues and corrective actions.

To operate both an SMS and an FRMS effectively, an organization must have a just safety culture. The additional level of safety performance monitoring that can be provided by an FRMS within a just safety culture can generate substantial benefits beyond those provided by simple compliance with flight- and duty-time regulations. For the airline and its pilots, the term "safety performance monitoring" is used to cover the internal reporting mechanisms associated with SMS activities, including an FRMS, while "safety oversight" refers specifically to the activities of the regulatory agency.

According to ICAO, SMS and FRMS are internal processes intended to operate above and beyond the safety oversight function of the regulator. Internal safety monitoring, as is provided by an FRMS, thus provides an effective, non-regulatory method for proactively finding hazards, validating the effectiveness of safety actions taken, and continuing to evaluate safety performance.

While an FRMS may offer an effective, alternative means of evaluating and managing risk when compared to a purely prescriptive scheme, its true value is to be considered synergistic rather than as a replacement for federal regulatory oversight. **Thus, in ALPA's view, FRMS should always be used in conjunction with a defined prescriptive scheme.** An airline may conform to the baseline regulatory scheme with or without an FRMS in place. However, if an airline uses an FRMS, the airline may be allowed a limited *but specifically prescribed* alternative to the baseline scheme under certain conditions set by the regulator. Ultra-long-range (ULR) operations are one area in which FRMS is being considered to allow safe supplementation of the baseline regulatory scheme.

Airlines and their employees are used to operating in a very structured environment with guidance such as Federal Aviation Regulations (FARs) or Canadian Aviation Regulations (CARs), operations specifications, and flight operations manuals. A natural concern when entering into such an apparently unstructured environment as an FRMS is the potential for abuse, whether from the airline's management, the employees at whatever level, or both. Accordingly, early in the process, due consideration must be given to managing data generated by voluntary safety performance monitoring activities such as an FRMS. Pilots and airlines both have ownership interests and rights in the FRMS data, which may include pilots' personal physiological information. Regulators and third parties may wish to assert or be granted access rights to data generated by an FRMS.

FRMS and SMS data must be protected by a robust set of policies and rules that will prevent misuse of safety reports and data. Given past misuse of safety data that has been compiled specifically for the purpose of advancing aviation safety, and the potential for misuse in the future, database management must begin with protecting the data while preserving access for those who can advance aviation safety.

ICAO has published detailed guidance on data ownership and protection issues. Protection considerations include the following:

- Adequacy of access to information laws.
- Organizational policies to protect the data.
- Deidentification by removing details that might allow a third party to identify particular flightcrew members.
- Security of information systems, data storage, and communications networks.
- Limited access based on need-to-know.
- Prohibitions on unauthorized use of FRMS (and SMS) data.
- Protections against misuse of FRMS (and SMS) data for purposes of discipline or enforcement.

To date, while some Canadian airlines have implemented SMS by regulation, no U.S. airline has fully implemented an SMS or an FRMS. In 2006, the FAA published an advisory circular that outlines the basic elements of an SMS. However, the FAA guidance is not mandatory and does not address data ownership and protection issues. Recent attempts to implement

SMS by law in Canada have stalled over data-protection provisions in the proposed law. Airlines and pilots should insist that proper data-protection rules and policies be in place before FRMS programs are implemented, in accordance with the ICAO standards.

Pilots should cooperate with airlines and regulators in implementing an FRMS but should also resist efforts to convert SMS and FRMS from effective data-driven safety programs into something less or different merely to serve the data, oversight, or other needs or desires of the public, governmental agencies, management, or third parties. These programs are most effective when safety information is used for its intended purpose: advancing safety.

Even without an SMS, however, the essential FRMS elements can be put in place if the airline is willing to operate within a just safety culture. This willingness to operate within a just culture can provide the necessary safeguards to ensure that the FRMS will be effective as intended. Management support must come from the highest level. Non-punitive employee reporting must be encouraged, and management must thoroughly investigate employee reports and take appropriate corrective action related to the reports. Even beyond employee reporting, the FRMS must be subject to constant scrutiny and adjustments by those within management responsible for oversight.

Education and Training

Any time an organization embarks on such an innovative program as an FRMS, everyone involved must understand the program and their responsibilities within it. In addition, everyone must understand the physiological issues regarding fatigue and its mitigation.

An operator's FRMS education and awareness training program should include the following:

- A full description of the operator's FRMS, including operator and crewmember responsibilities.
- Physiological effects of fatigue and individual fatigue recognition.
- Causes of fatigue and how to recover from it.
- Mitigation and countermeasure strategies.
- Planning rest and sleep.
- Circadian rhythms, including operating at circadian low, and how to mitigate effects.
- Diet and exercise, use of prescription medication, and family/lifestyle issues.
- Education on how to properly submit safety reports and to use and protect FRMS data.

Summary and Conclusion

The current U.S. Federal Aviation Regulations and the Canadian Civil Aviation Regulations are not effective in mitigating fatigue in the current airline operating environment. Especially onerous fatigue-inducing operations are occurring in the ultra-long-haul flight and in short-haul, multiple-flight-segment regimes. The regulations are very difficult to change, and the process is extremely time-consuming. Also, the regulations do not specifically or adequately address all flight operations and may not apply well in the case of new or different operations.

A properly structured FRMS holds promise to allow operational efficiency and prevent fatigue or adequately address it when it occurs.

Recommendations

Pilot groups should work with their respective airlines to do the following:

1. Develop a comprehensive safety management system and a just safety culture, using FAA Advisory Circular 120-92, Introduction to Safety Management Systems for Air Operators, ICAO guidance, and ALPA's SMS Manual.

2. Develop acceptable data-handling and -protection policies, processes, and model agreements that adequately address use of and access to SMS and FRMS data and protect the interests of pilots.

3. Develop a fatigue risk management system after mature guidance on FRMS is published.

4. Provide training to flightcrews on fatigue factors, their implications, and countermeasures using NASA's Technical Memorandum 2001-211385 (DOT/FAA/AR-01-01), Crew Factors in Flight Operations X: Alertness Management in Flight Operations Education Module.

5. Develop crew scheduling guidelines using NASA Technical Memorandum 110404, Principles and Guidelines for Duty and Rest Scheduling in Commercial Aviation.