COMPARISON OF AVIATION INDUSTRY FATIGUE REPORTING FORMS AS ESTABLISHED IN FATIGUE RISK MANAGEMENT SYSTEMS (FRMS)

Thomas E. Nesthus, Ph.D.
Civil Aerospace Medical Institute

Introduction

In 2010, the 111th Session of Congress passed H.R. 5900 to improve airline safety. Under TITLE II—AIRLINE SAFETY AND PILOT TRAINING IMPROVEMENT, Sec. 212. Pilot fatigue, (b) FATIGUE RISK MANAGEMENT PLAN stipulates: SUBMISSION OF FATIGUE RISK MANAGEMENT PLAN BY PART 121 AIR CARRIERS. The contents directs carriers to develop and use a methodology that continually assesses the effectiveness of the program, including the ability of the program—(i) to improve alertness; and (ii) to mitigate performance errors.

Also in 2010, a Notice of Proposed Rulemaking for Flightcrew Member Duty and Rest Requirements was released as 14 CFR Parts 117 and 121. Associated with the NPRM was FAA Advisory Circular 120-103: Fatigue Risk Management Systems (FRMS) for Aviation Safety.

This AC outlines a "system" that aircraft operators can use to mitigate fatigue risk: a Fatigue Risk Management System (FRMS).

- A FRMS should be data-driven and scientifically-based
- Once initiated, it should enable continuous monitoring and management of safety risks associated with fatigue-related error and hazards.
- Procedures for measuring, modeling, managing, mitigating, and reassessing fatigue risk – along with schedule assessment, data collection, and systematic analysis – should provide scientifically guided fatigue mitigations – both proactive and reactive.

This approach has the potential to provide a cooperative and flexible means of monitoring and mitigating fatigue during flight operations when the prescriptive approach does not fit the circumstances. An FRMS should include four practical procedures:

1) fatigue-related data acquisition
2) analysis
3) identification of fatigue risk
4) application and management of fatigue mitigation strategies

The basis for this poster presentation is to focus on the collection of fatigue-related data, in both a proactive and reactive manner. Since FRMS is relatively new and immature, few programs are currently operational in the aviation industry, so the number of proactive reporting forms is low.

- Proactive forms are those routinely completed to monitor ongoing operations to identify fatigue-related trends involved in certain shift schedules, rosters, or industry operations.

- Reactive reporting forms are more common and solicit (generally mandatory) information after significant events, errors, or accidents that may involve fatigue-related factors.

With generally identical physiological and cognitive responses to fatigue across various work activities, the question posed by this study is to determine whether there are common features of the fatigue reporting forms that should be considered essential for a standardized implementation across the aviation industry.

Method

Several aviation industry-related fatigue reporting forms were collected and evaluated to determine if their content included common critical questions and analysis procedures relevant for mitigating fatigue within an FRMS. The industry-developed forms that were included in this assessment came from those for flight crewmembers (6), aviation maintenance technicians (3), ramp personnel (1), and air traffic controllers (1).

A content analysis was performed with the fatigue reporting forms to identity commonalities in the type of questions asked and the type of data that could be used to determine fatigue-related events and point to practical mitigation procedures.

Results

A frequency index was computed. Although format and specific workforce questions varied, all forms requested very similar information.

The information requested in the fatigue reporting forms, closely followed recommendations found in numerous FRMS program documents, including those found on the FRMS Forum Web site (http://www.frmsforum.org/) and Transport Canada's Fatigue Risk Management System Toolbox for the Canadian Aviation Industry Web site (http://www.tc.gc.ca/eng/civilaviation/standards/sms-frms-menu-634.htm)

Included in the list of common questions among the fatigue reporting forms were requests for specific information on:

1. Date & location of event:
   - time of year, geographic location
2. Time of event:
   - circadian component—daytime/nighttime
3. Time on task:
   - how long was the individual on duty when the event occurred?
4. Duty details:
   - work start-end times
   - duty length
5. Schedule information:
   - days into workweek
   - shift details (rotating/straight, etc.)
6. Work task details, e.g.:
   - phase of flight
   - level of task difficulty
   - physically or mentally demanding
   - complicated
   - monotonous
7. Work location/environmental factors, e.g.:
   - flight deck, cabin
   - inside/outside
   - weather/climatic conditions
8. Contributing factors, e.g.:
   - commute, delays, health, home issues, insufficient rest, late finish, long duty time, long-term (cumulative) fatigue
9. Physical, mental, emotional signs, e.g.:

Physical Symptoms	Mental Symptoms	Emotional Symptoms
• Yawning repeatedly • Heavy eyelids or micro sleeps • Eye-rubbing • Nodding off or head drooping • Headaches, nausea, or upset stomach • Slowed reaction time • Lack of energy, weakness, or light headedness	• Difficulty concentrating on tasks • Lapses in attention • Failure to communicate important information • Failure to anticipate events or actions • Making mistakes even on well-practiced tasks • Forgetfulness • Difficulty thinking clearly • Poor decision making	• More quiet or withdrawn than normal • Lack of motivation to do the task well • Irritable or grumpy with colleagues, family, or friends • Low morale

10. Estimated alertness when event occurred
    - various sleepiness/alertness scales employed, e.g.:

Stanford Sleepiness Scale (SSS)

Degree of Sleepiness	Scale Rating
Feeling active, vital, alert, or wide awake	1
Functioning at high levels, but not at peak; able to concentrate	2
Awake, but relaxed; responsive but not fully alert	3
Somewhat foggy, let down	4
Foggy; losing interest in remaining awake; slowed down	5
Sleepy, woozy, fighting sleep; prefer to lie down	6
No longer fighting sleep, sleep onset soon; having dream-like thoughts	7

11. Sleep information/history/quality:
    - 24/48/72 hr, e.g.:

General Description of Work and Sleep History
(* indicates 'required' items)

Describe your work / sleep history prior to the work task, even if the problem was not related to work hours / sleep history.

			Hr		Min	
Length of commute to work:*						
			Start		End	
Work schedule (Local Military Time):*	day of task		(mm/dd 00:00)		(mm/dd 00:00)	
	1 day prior		(mm/dd 00:00)		(mm/dd 00:00)	
	2 days prior		(mm/dd 00:00)		(mm/dd 00:00)	
	3 days prior		(mm/dd 00:00)		(mm/dd 00:00)	
	4 days prior		(mm/dd 00:00)		(mm/dd 00:00)	
		Go to sleep		Wake up		
Typical sleep period (Local Military Time):*			(mm/dd 00:00)		(mm/dd 00:00)	
Sleep period in the 24 hrs prior to work task (Local Military Time):*			(mm/dd 00:00)		(mm/dd 00:00)	
1st nap in the 24 hrs prior to work task (Local Military Time):*			(mm/dd 00:00)		(mm/dd 00:00)	
2nd nap in 24 hrs prior to work task (Local Military Time):*			(mm/dd 00:00)		(mm/dd 00:00)	

12. Summary of circumstances/event details:
    - open comment text box provided

All included narrative descriptions of critical events or incidents, but factors associated with situational awareness, physiological and health issues, diet and hydration, medication or drug use, mood, and industrial or systemic concerns were requested differentially across forms.

Discussion

The potential for excessive fatigue is not solely based on extensive work hours but can result from other factors, such as stressful working conditions, sleep disorders, accumulation of sleep debt, and the disruptions of circadian rhythms associated with work schedules, environmental factors, or personal issues. Development of an FRMS to manage and monitor safety risks associated with fatigue-related hazards has definite potential for the prevention of operational errors, incidents, and accidents within the aviation industry.

A non-punitive culture and a reporting system that permits employees to report subjective fatigue is critical to FRMS. Reports of adverse events that might be fatigue-related can serve as a first-step for obtaining relevant information regarding fatigue risk-factor contributions. At a minimum, reports and investigations must be objective and obtain key elements necessary to trace causal factors, especially when coupled with conditions that might have contributed to fatigue, such as work/rest schedules, personal factors, and operational demands.

Summary

Standardization of fatigue reporting tools and shared experiences should be considered across the aviation industry to:

- develop a better understanding of fatigue-related incidents

- track the effectiveness of fatigue mitigation strategies

From this study's results, it is clear that a natural standardization has already occurred, for the most part, in the development of the various aviation industry forms assessed.

Since operational FRMS programs are still relatively immature, standardizing the procedures and, perhaps, even the metrics should be established for successful implementation.

Presently, the International Civil Aviation Organization (ICAO) is poised to release detailed FRMS Policy and Documentation guidelines. ICAO's products are reviewed and approved by 192 international member states. The U.S. is a participating member of ICAO and has supported their efforts to harmonize the proposed FRMS procedures worldwide.