



## IN THIS ISSUE

A Management View of Fatigue Challenges....p1

Fatigue in the Hangar....p2

It Really Works!....p3

Workload and Scheduling Tools....p4

# MX Fatigue focus

## A MANAGEMENT VIEW OF FATIGUE CHALLENGES

by Doc Garrett

*About the Author: Doc Garrett has been with Continental Airlines since 1984 and is currently the Manager of Maintenance Human Factors with responsibilities of development and implementation of Maintenance Threat Error Management, Human Factors, and Fatigue Risk Management programs in the Technical Operations Division. Doc is an FAA Licensed A&P Technician and Pilot.*

Major air carriers are responsible for providing the flying public safe flight and a safe working environment for their employees. This large task involves many factors that come together to create a complex safety equation. The human factor, as the old saying goes; "Too err is human," further complicates an already complex equation.

Let's look at the human factor of this safety equation. When we, as humans, perform our jobs, whether it be in the cockpit, office, or hangar floor, we bring to our work environment certain human factors: one of which is fatigue. Fatigue is a feeling of tiredness, exhaustion, or lack of energy. Fatigue is listed as one of "The Dirty Dozen." Gordon Dupont, who introduced the Dirty Dozen, claims that fatigue is the root cause of many of the other most common causes of human error. We will never eliminate the Dirty Dozen in our work environment no matter how hard we try. However, if we learn to recognize, these threats, we can mitigate their impact thus reducing the possibility of the threat leading to an error.

Fatigue in the work place has been around since man started working at tasks. It is not something new and until recently has never really gotten the attention it deserves. Fatigue Risk Management System (FRMS) is a new concept emerging in many industries, including aviation. FRMS is a system that involves awareness, training, management, and fatigue

research to minimize the effect of fatigue in the work place. Everyone – from the individual, to management, to labor, to the regulator – has a piece of this Fatigue equation.

Let's look at the current regulatory requirements for aviation maintenance technicians (AMT's).

Title 14, Code of Federal Regulations  
Sec. 121.377 - Maintenance and preventive  
maintenance personnel duty time limitations.

Within the United States, each certificate holder (or person performing maintenance or preventive maintenance functions for it) shall relieve each person performing maintenance or preventive maintenance from duty for a period of at least 24 consecutive hours during any seven consecutive days, or the equivalent thereof within any one calendar month.

When you look at this regulation, it is vague regarding how many hours a day and how many consecutive days an AMT can work. Based on this rule, it would be difficult for a company to design safe shift schedules. With overtime, trade days, commuting hours, and normal work schedules, this could build up into a tremendous fatigue threat.

In the absence of a clear regulation, what can be done to address the risks of fatigue in the maintenance workplace?

Many airlines have already voluntarily begun the process of tackling fatigue issues in partnership with the labor representation and employees.

Some language has been written into work rules and/or contracts that limit duty days and hours. This is a step in the right direction, but falls short of what we need as an aviation industry for our professional AMT's. Pilots and Flight Attendants already have duty time limitations that were driven by safety concerns and quality of life issues, so why shouldn't our professional AMT's be afforded the same? We need regulation set forth not only for AMT duty time limitations, but for a required FRMS that takes on fatigue research, fatigue risk assessment, fatigue awareness, fatigue training, fatigue tools, fatigue management processes, and shift start and stop times. We are in the process of developing a recognized Safety Management Systems (SMS) within our organizations.

Why not take this opportunity to encourage defined regulations that complement our SMS programs with a FRMS firmly embedded in our processes and procedures? Let's look to Transport Canada for the regulations that they have put in place with regards to FRMS in the aviation industry. The NTSB has been on record for many years with recommendations of science-based duty time limits for maintenance personnel. We all have a piece of this Fatigue Threat problem. The individual AMT, air carrier management, the FAA, Labor, academia, and science all play extremely important roles in the management of the Fatigue Threat. Working together, we can reduce the Safety Errors and improve the quality-of-life for all of our aviation personnel.

**In the absence of a clear regulation, what can be done to address the risks of fatigue in the maintenance workplace?**

## Fatigue in the Hangar: An Example of One Company's Efforts

*About the Author: Mr. Kent Stauffer is the Maintenance and Ground Safety Manager at Flight Options in Ohio. He is an experienced aviation safety professional with a background in both aircraft maintenance and flight. He has created and taught hundreds of learning modules, documents, and presentations related to aviation safety and security. Mr. Stauffer participates in numerous industry work groups including maintenance fatigue, Safety Management Systems, FAA Rulemaking Committees, Human Factors, and Aviation Safety Action Program groups.*

**by Kent Stauffer**



As the Maintenance and Ground Safety Manager for a large 135 operator, I am keenly aware of the many challenges that our maintenance technicians face in their jobs daily. If you've defined the challenge, you can address it head on. However, the challenges that are undefined and personal to our technicians are the ones that are the most daunting - fatigue is one of those.

Fatigue can be hard to define, even more difficult to quantify, yet everyone knows what it is. Further confusion results from experts disagreeing over causes, effects and countermeasures. In our company, we have attempted to combine up to date research results with proven human factors concepts in building an effective education campaign. While we do not know what works best for each individual employee when it comes to fatigue and sleep management, we can expect them to use the information we provide to aid them in finding effective fatigue countermeasures - the ones that work for them. We want them to be fit for duty in every respect when they arrive for work.

Over the last year, we have provided guidelines, research and information to help technicians navigate through fatigue management. Some of the things we focused on in 2009 include:

- ◆ **We facilitated interactive Human Factors training with all of our 300 maintenance employees, in small-group settings, emphasizing the physiology of fatigue and fatigue management:** While teaching this section, I was struck by how intently people were focused on the material. It was obvious that many of them were concerned about sleep and were open to ideas. Afterwards, several technicians commented on a specific section regarding sleep abnormalities and disorders. As we went over the signs and symptoms of sleep disorders, I could see them recognizing the similarities in their lives. As a technician with severe sleep apnea myself, I was able to discuss these issues with several of them in private and offer some guidance in seeking a diagnosis. It can be difficult for technicians to admit that they may have a sleep issue, especially since so many have worked counter-circadian schedules most of their lives. Fatigue has become who they are and there are no rules to guide them. Feedback from our technicians after the course indicates that some of the most helpful tips for them have been:

1. Keep your bedroom conducive to sleeping. Don't put the home office or gym in your bedroom. Keep it dark and quiet. Don't expect to use the phrase "I can sleep through anything".
2. Meditate or read before bed. Don't use the TV to get to sleep.
3. Short naps are GOOD! There is no such thing as a long nap - go to bed.
4. Night shifters – consider splitting your sleep schedule.
5. If you think you may have a sleep problem, **go get it checked out!**



- ◆ **We revised our road crew duty policy, limiting consecutive work days to 7 with a mandatory 24 hrs off after, and including a fatigue assessment after 18 hours of duty.**
- ◆ **We distributed to all mx employees the fatigue calendar, the web links to the FAA and Transport Canada's fatigue toolboxes, the Shiftwise document and the group's maintenance fatigue newsletters.**
- ◆ **Monthly, the safety office distributes sleep or fatigue management articles for use in weekly toolbox talks.**
- ◆ **The last two editions of our in-house maintenance safety newsletter, "Safety Wire", featured articles on sleep, fatigue management and errors contributed to by fatigue.**
- ◆ **We now complete a post-incident supplemental fatigue form with any maintenance incident investigation, and analyze the data for trends and identifiers:** Through this data we learned that the average nightly sleep for those technicians involved in an incident is around 6.6 hours. While we cannot assume that they are all sleep deprived, we can assume that since many of us need between 7 and 8.5 hours of sleep per night, some of these technicians may not be getting the sleep they require. Since we don't usually know why this is, we have focused specifically on sleep, sleep management, sleep disorders and healthy lifestyle choices.

We believe that solid education is a key first step in effective fatigue management. A prerequisite to any corrective action is recognizing the problem. We are hopeful that through the maintenance fatigue work group, CAMI, the FAA and others, we can continue to provide useful information to our technicians in identifying and mitigating fatigue in the workplace.



## **It Really Works!** by Joy Banks

*About the Author: Joy Banks, M.A. works as a Psychology Technician in the Human Factors research lab at the FAA's Civil Aerospace Medical Institute. She is also a Licensed Professional Counselor in Oklahoma City and gives free mental health and substance abuse counseling to individuals in the local community. Mrs. Banks is a retired U.S. Air Force Senior Master Sergeant, wife, mother, and grandma.*

When our workgroup was tasked with researching and developing fatigue educational materials for Aviation Maintenance Technicians (AMTs), my focus was helping others stay safe. I didn't anticipate getting helped in the process. I learned through personal experience that our own advice really works.

As our workgroup gathered more and more information about fatigue, I became more aware of fatigue and, like any good wife, I focused on my husband's fatigue issues. I noticed his concentration and memory were getting worse, and he was easily agitated. He often complained of not getting enough sleep at night and had several nights a week that he'd wake up in the middle of the night and couldn't get back to sleep. He finally went to the doctor for help. The doctor prescribed sleeping pills.



**"Houston, we have a problem."**

My husband is very health conscious; eats healthy and body builds. I can barely get him to take an aspirin for a headache, so when I saw the Lunesta prescription bottle on the nightstand, I was concerned. Gradually, his occasional use of the pills evolved into more regular use. I really started to get worried when he went back to the doctor to get more sleeping pills. One night after a very stressful day at work and anticipating another stressful day ahead, he reached for the sleeping pills, saying he'd get a good nights sleep tonight with the help of his "little buddies." I thought, "Houston, we have a problem."

I voiced my concerns that he was becoming psychologically dependent on sleeping pills and insisted he stop taking the pills and get scheduled for a sleep study. He agreed to schedule a sleep study and tried to reassure me that he didn't need the sleeping pills.

I said, "Prove it and stop," so he stopped and his sleep problems got worse.

I thought that all the fatigue information we gathered must be good for something, so I started putting our own advice to use. First, we got an accurate count of his sleep hours. I developed an easy to use [sleep log](#) so he could enter his bedtime and wake times. It automatically calculates his actual sleep hours daily and provides a weekly average. After the first week he averaged about 4 hours per night with 2-3 awakenings. The [sleep log](#) was helpful in bringing our attention to his actual sleep hours and his lack of a standard bedtime. There's something about seeing things in black and white that makes all the difference. Since we advise AMTs to stick to the same bedtime and follow a bedtime routine, we made the adjustment by giving him a set bedtime and routine (see example).

My husband's weekly sleep average increased to 5-6 hrs, but he still lacked sleep quality because he continued to wakeup throughout the night thinking about what happened that day or what he needed to do the next day. We advise AMTs to write down concerns and make a To-Do list for the next day as part of their bedtime routine, so the next week, we added making a To-Do list as part of his bedtime routine. The list worked like a charm, his multiple awakenings decreased because he was able to empty

his mind of all the things he needed to accomplish the next day. In less than 1 month, he began getting 6-8 hours of sleep on average **without** the use of sleeping pills. After a month, he was consistently getting better sleep than me, so I started taking my own advice and stopped watching TV in bed, lowered the temperature of the bedroom, put up blackout curtains, and started getting out of bed to read when I couldn't fall asleep right away.

My husband completed the sleep study, they reported he did not have sleep apnea - which was a relief. Funny thing - the overnight sleep study cost over 2K and they basically told him to do the same things we're telling AMTs to do for free. Bottom line, save yourself some money and begin improving your sleep habits, it really works!

Bedtime Routine Example  
(Bedtime: 2030, Wake time: 0500)

- Start preparing for bed 30-45 minutes before actual bedtime
- Set out work and gym clothes for next day
- Pack healthy lunch, light snacks, and protein shake
- Make a To-Do list for the next day
- Wash face
- Brush teeth
- Put on pajamas
- Lights out



## Workload and Scheduling Tools: How Can You Use Them to Minimize Fatigue?

by Lauren Blackwell & Thomas Nesthus

*About the Author: Lauren Blackwell, M.S. is a graduate student researcher in the Human Factors Research Lab at the Civil Aerospace Medical Institute. Her areas of research include occupational health and safety, organizational behavior, and employee well-being. She is currently conducting a comprehensive review of fatigue modeling and workload scheduling tools.*

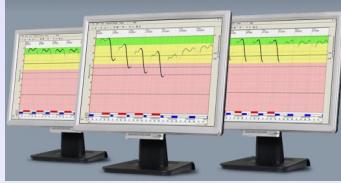
*About the Author: Thomas E. Nesthus, Ph.D. is an Engineering Research Psychologist with the Federal Aviation Administration, Civil Aerospace Medical Institute. His principle research activities include the evaluation of fatigue and other aerospace stressors on operational performance of Maintenance Technicians, Pilots, Flight Attendants, Air Traffic Controllers and Technical Operations employees. He currently participates on numerous fatigue-related inter-agency and Department of Transportation working groups and provides human performance consultation as requested by the National Transportation Safety Board.*

For aviation maintenance workers, experiencing fatigue on duty is all too common. Imagine any mechanic who works a rotating schedule. The mechanic performs job tasks in the middle of the night, often after being awake for more than 17 hours and without a full eight hours of sleep the night before. His body rhythms and natural wake/sleep cycles are out of whack with one another. Sounds like a recipe for safety disasters, right? A mechanic might feel able to "tough it out," but when the body says it's time to sleep at 4 am, you can almost guarantee that some details are missed or errors are committed while struggling to stay awake. Fatigued workers not only perform less effectively, but they also have a reduced ability to foresee the risks and consequences that might result from poor performance.

What can be done to ensure that workers are performing their duties with high alertness, while minimizing their fatigue? Luckily, science has provided several options in the form of predictive fatigue models and scheduling tools that can inform workers and organizations about "circadian-smart" schedules for combating fatigue. Fatigue modeling tools can forecast the risk of placing sleep-deprived and fatigued workers on the line during periods of reduced alertness. For example, the U.S. Air Force effectively employed fatigue modeling tools for mission planning during the Iraq war to schedule continuous flight missions lasting more than 40 hours.

The FAA is currently using fatigue modeling tools to assess risks of Ultra-Long-Range flight operations (that is, flight times greater than 16 hours) before granting approval for city-pair operations. In a recent study, fatigue modeling tools were used to show the “reality” of the flight schedule and its impact on crewmembers. These procedures were used to recommend schedule changes in onboard sleep during the effected city-pair flights.

## **Fatigue modeling tools may offer solutions**



Dr. Steven Hursh, a well-known fatigue researcher, recently described three important advantages provided by fatigue modeling:

1. It condenses scientific knowledge about sleep and fatigue into a user-friendly schedule evaluation tool.
2. Modeling objectively considers many relevant interacting factors, such as sleep/wake times and time of day, when predicting fatigue.
3. Modeling tools use a consistent, performance-based method to evaluate fatigue risk of proposed work schedules but allow organizational employees and management to make the final decision. This flexibility keeps with the spirit of fatigue risk management.

Consider a company that recognizes their current schedules are generating fatigued workers and high error rates. There are several fatigue modeling tools that may offer solutions, for example the Sleep,

Activity, Fatigue, and Task Effectiveness (SAFTE), Fatigue Audit InterDyne (FAID), Circadian Alertness Simulator (CAS), Interactive Neurobehavioral Model, System for Aircrew Fatigue Evaluation (SAFE), and the Three Process Model of Alertness. Each model considers a unique set of factors, allowing the organization to choose the best fatigue modeling tool for its specific needs. Users enter factors like sleep history, workload, fatigue countermeasures, and work schedules to receive information about fatigue risk levels during different points in their schedules. Modeling tools also provide organizations with information about the fatigue risk associated with new or proposed work schedules. Managers can test many work schedules to determine an optimum roster and establish a schedule that fits their needs, while minimizing levels of workforce fatigue. As part of a safety management system, the organization can use the data acquired from workers’ new schedules to monitor the effectiveness of changes and continue adjusting schedules until improvements are documented.

Altering operating practices and schedules based on suggestions from fatigue modeling tools is an important step in safety management and, more specifically, fatigue risk management. Some modeling tools are freely available for use and others are commercial products requiring licensure agreements. As Dr. Bill Johnson would attest from his return-on-investment newsletter column, an investment in fatigue risk management is an investment in safety and cost reduction. Fatigue modeling tools may ultimately save a company money and energy that would otherwise be “wasted” on damage control after a fatigue-related mishap.

**For more information about fatigue modeling tools, visit:**

**<https://hfskyway.faa.gov/HFSkyway/FatigueLinks.aspx#SCHEDULINGSOFTWARE>**

### **This Newsletter is the product of a Multi-Disciplinary Maintenance Fatigue Workgroup:**

Katrina Avers  
Joy Banks  
Erica Hauck  
Tom Nesthus  
Bill Johnson  
Jay Hiles

Rich Bourque  
John Goglia  
Terry von Thaden  
Alan Hobbs  
Bobby Gless  
Rudy Quevedo

Kent Stauffer  
Dave Supplee  
Bill Rankin  
Roger Hughes  
Ernie Kiss  
Scott Paine

Jackie Booth-Bourdeau  
Doc Garrett  
Hans Van Dongen  
Ed MacAskill  
Guy Minor

**Please visit the MX Fatigue Website at [MXFatigue.com](https://hfskyway.faa.gov/HFSkyway/FatigueHome.aspx)**  
**or**  
**<https://hfskyway.faa.gov/HFSkyway/FatigueHome.aspx>**