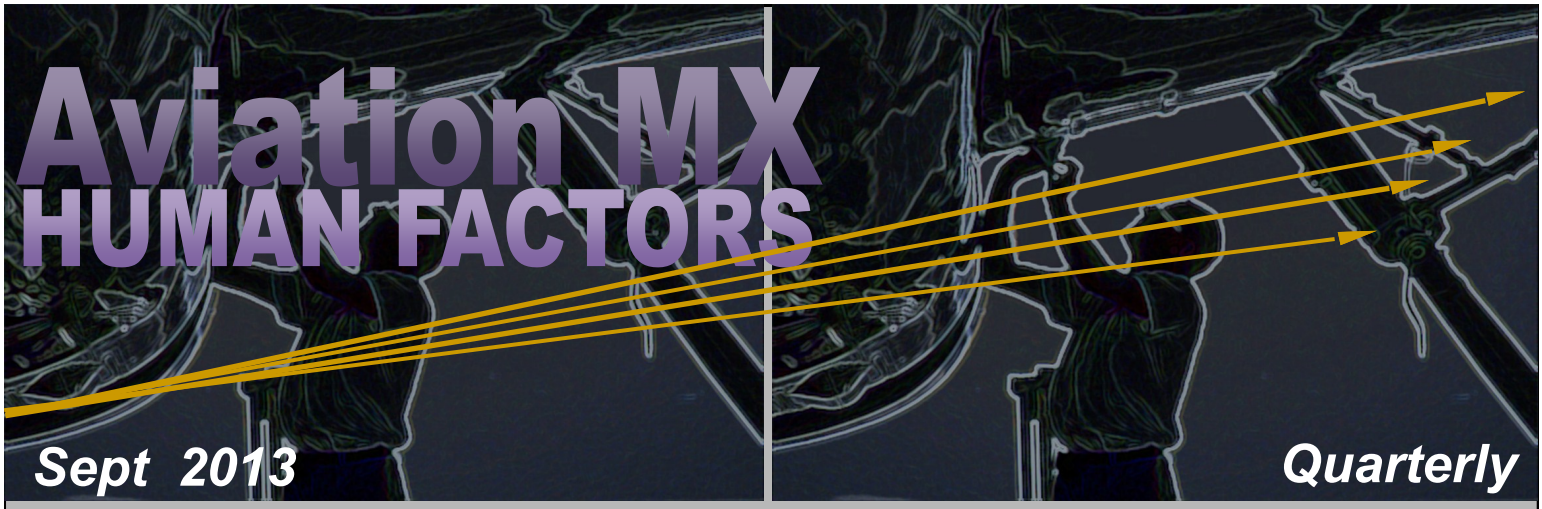


Vol 1 I Issue 3

Featured Articles

Written by maintenance human factors professionals dedicated to identifying and optimizing the factors that affect human performance in maintenance and inspection.
Past newsletters @ MXFatigue.com

BY
DAVID PATERSON

About the author: *David Paterson is a Maintenance Human Factors facilitator working in Switzerland. After a career in the Canadian Air Force, David moved into civil transport aircraft maintenance in Europe, progressed into technical training and Human Factors facilitation and eventually rose to a position in training management. He holds an EASA Part 66 B1 AML, is a member of the European Human Factors Advisory Group, and is a graduate of the IATA Professional Trainers program. He lives in Eastern France with his wife and devoted dog, Toby.*

Retaining competence as a Maintenance Human Factors (MHF) facilitator is not easy. Combining effective facilitation skills with the requisite knowledge of organizational and individual human factors issues is a challenge at the best of times. However, is there an MHF facilitator that hasn't heard some variation of the following: "good class but not realistic" or "it's not like that in the real world"? What if, however, the skilled MHF facilitator returned to the operational environment? How would she/ he cope with the reality and constraints of the operational world? The following scenario may not be as far-fetched as one might think.

The following scenario may not be as far-fetched as one might think.

"Are you nuts?" The thought rang like a bell through Phil's head as he motored down the highway towards the airport. Phil was distracted, but he knew the road like the back of his hand and luckily traffic was light this morning. But there was a distinct difference compared to Phil's normal working day; instead of going to the training center, Phil was going to work in the hangar.

All the stars had lined up to create this situation; the company was in dire financial straits, there was a staff shortage and Ops had overflown 3 jets due to operational difficulties leaving a backlog in heavy maintenance that had to be cleared quickly. With no margin to pay temporary staff, the search was on internally for qualified help, and no stone was left unturned.

Phil held a valid A&P, and despite having been in training and development for over 10 years, he was one of the first selected. "Report to Oliver the Hangar Chief on Monday for tool and safety equipment issue" was the order received directly from the Maintenance VP. And like the faithful employee he was, Phil reported for work at 07h00 sharp, silently hoping he could still cope.

Oliver was slightly embarrassed; Phil had been a manager when Oliver started in the company years ago, but Phil quickly put Oliver at ease. "Give me the most difficult job you've got, and let's get rolling" Phil added, and Oliver breathed a sigh of relief. "Maybe this will work out after all" Oliver noted to himself, who had been skeptical that old warriors and especially human factors "weenies" like Phil, long away from the operational world could still be effective technicians.

Phil began by disassembling a mechanism in the lavatory area, and then settled into his inspection tasks. "Just like riding a bicycle; some things you just don't forget," Phil thought, pleased that things were going along, as Michael Collins had wrote in his book about the Apollo 11 mission, so "swimmingly".

"trouble was not far away"

But trouble was not far away; as Phil was finishing his first inspection cards, Oliver called out to him: "Phil, we've got to move a jet at the back of the hangar and we need your help" Phil, wanting to fit into the team, checked his tools and took his place with the rest of the towing team members. Oliver barked some commands and then pointing, turned

What If? (con't).

to Phil and asked dryly "Can you move those stands out of the way?" Phil replied "Sure" and then pausing asked Oliver: "Do you have a brakeman for the push back?"

Oliver eyed Phil skeptically and replied coldly, "Brakeman for what?"

Phil, sensing he may have overstepped his bounds, spoke in a low voice, "The procedures call for a brakeman in the cockpit"

Oliver, forgetting that Phil had once been instrumental in his promotion, exploded: "Do you think this company is rich enough to have people standing around doing nothing during a simple towing manoeuver? This isn't the time, Phil, and we are certainly not in the classroom now"

Phil replied sharply: "OK, but in the past 24 months at this airport alone, there have been 3 cases of tow bar failures, and airplanes have been damaged, one severely. You're taking a big risk"

Oliver sneered at Phil: "Well how many of those accidents happened in this company?"

Phil knew the answer: "None Oliver, but that doesn't mean it can't happen here. Moving an aircraft is a maintenance procedure, and we're in a congested area. A full crew of six is called for, including the brakeman". Oliver cut Phil off: "Thanks Phil I'll take it from here, can you get that lavatory inspection finished before lunch?"

Phil was just climbing into the aircraft when he

heard a loud bang followed by a scraping noise, then somebody yelling for chocks. The ramp area outside the hangar had been modified a few years earlier after the hangar door rails were replaced; there was a steep incline, and under certain conditions aircraft being pushed out of the hangar overstressed the shear pin in the tow bar.

The night shift had already experienced 2 tow bar failures, but that information had remained within their teams. Oliver secured the aircraft and, following internal company procedures, called the Quality Department signaling that an incident had happened. While waiting for the investigators to arrive, Oliver noticed Phil in the background. He walked over to Phil, and bit into his lip as he stopped a couple of feet away. "What should I do now?" Oliver asked tentatively.

Phil responded calmly, "Be honest with yourself and the investigators. You're a good supervisor Oliver, and you normally make appropriate decisions. But this time, your judgment was flawed. Quality needs to uncover the circumstances that made you believe you were doing the right thing at the time, and make some adjustments. In any case, the scraping noise was just the tow bar; luckily the aircraft was not damaged". Oliver looked at Phil and added, visibly embarrassed, "OK, but next time I'll take the "lav" job and you move the jets."

Fatigue Countermeasures Training available at MXFatigue.com—https://hfskyway.faa.gov/HFSkyway/FatigueCBT.aspx

New Human Factors Training Materials From Down Under

BY
DR. BILL JOHNSON

About the Author: *Bill Johnson is the Chief Scientific Technical Advisor for Human Factors in Maintenance Systems for the FAA. He is a pilot and an aviation maintenance technician.*

HF Training Background

Maintenance training organizations have been delivering human factors training for nearly twenty five years. It all started, in 1991, at Continental Airlines. US Airways started their HF programs about that same time. Additional programs emerged quickly. International companies established HF training by the mid-nineties with companies like British Airways and Lufthansa German Airlines in UK/Europe and Singapore Airlines, Singapore Technologies, and HAECO in Asia.

There were a number of factors that affected the industry acceptance of the maintenance human factors concepts. US Congress passed the Aviation Safety Act of 1988. That Act earmarked money specifically for maintenance human factors. During the nineties FAA sponsored human factors maintenance conferences as often as 2 times per year. At the same time there were a variety of applied R&D products developed for industry use. FAA was extremely diligent about publishing conference proceedings and R&D software, first as books (1988), then CD-ROM (1992), and finally to the current hfskyway.gov website (1996). By 2000 the semi-annual meetings turned to annual events and were rotated among FAA, CAA-UK, and Transport Canada. There has not been a meeting since 2011.

The Boeing Company created the Maintenance Error Decision Aide (MEDA) in the mid-nineties. Boeing and the MEDA process had significant influence on the propagation of maintenance human factors programs throughout the world. They have trained nearly 1,000 airlines/MROs on MEDA, Human Factors, and now have added SMS training.

During the nineties we saw the introduction of the human factors "learning aides" like Swiss Cheese (Reason), Dirty Dozen (Dupont), and PEAR (Johnson & Maddox). Those concepts/model are justifiably still in use today.

The first decade of maintenance human factors progress was driven solely by safety and the quest for efficiency. The early programs were primarily about lowering the error rate. That was an admirable goal that remains today. In the early 2000s regulations on human factors training emerged, first as an ICAO recommendation. The Joint Aviation Authority (now the European Aviation Safety Agency (EASA)) had the initial rules in the late nineties. They became European Union rules in 2001. The rest is history. Many national aviation authorities adopted the EASA rules. The rules became mandatory for EASA Repair Stations making them nearly a world maintenance human factors training standard.

Training Materials

There are a variety of maintenance human factors training support materials available today. In the past few years FAA has posted materials to include: the Maintenance Human Factors Presentation System, the Fatigue Awareness Training Program, and the Fatigue video entitled "Grounded." Universities and commercial providers also offer courses to train the trainer. The *AMT Magazine* article discusses considerations regarding selection of the right training

to match to your organization needs. Obviously, one size does not fit all.

The CASA Training Package

I am delighted to write about the latest package of training support materials. The Australian Civil Aviation Safety Authority (CASA) Safety Promotion team has set a new international standard for human factors training support. CASA calls it *Safety Behaviours – Human Factors for Engineers*. It is the answer to a trainer's wish list for modern materials.

Figure 1. The CASA *Safety Behaviours: Human Factors for Engineers* kit.

The *Safety Behaviors* kit is a substantial package. It includes: a 200-Page *Resource Guide* for engineers; a student workbook; a facilitator's guide; a packed DVD with a superb video portrayal of a maintenance organization, as well as observations by human factors specialists; and a CD-ROM containing materials produced by CASA, and other National Aviation Authorities, including the FAA. See Figure 1 for a view of the materials, which are available for download free of charge at: www.casa.gov.au/hf. International individuals/ organizations can obtain a hard copy of the kit, with DVD and CD included, at www.casa.gov.au/ onlinestore. The cost about $100 USD, including postage and handling.

The content for the CASA training package is more than a repackaging of old ideas. The developers added value to the Dirty Dozen, to Dr. Jim Reason's models of error and to the PEAR Model that I created with Dr. Mike Maddox. They enhanced the **P**eople, **E**nvironment, **A**ctions and **R**esources in many ways leaving us asking "Why we didn't think of that?"

The developers note that the content is in 100 per cent alignment with the training requirements recommended by ICAO, EASA, and CASA. It appears that the content and excellent graphical layout exceeds the intentions of any current regulations**.** There is too much to describe with the limited space here. Go to September '13 AMT Magazine or to the CASA website for more detail. The CASA HF training is the most comprehensive package I have ever seen. It is the new international yardstick (or metric ruler) by which other human factors training programs will be measured.

Acknowledgement

Dr. Johnson is grateful for the information provided by Ms. Margo Marchbank, Section Head Safety Promotion Communication & Managing Editor Flight Safety Australia, Civil Aviation Safety Authority. For further information contact: margo.marchbank@casa.gov.au.

(Shortened from an article that appears in* AMT Magazine*, September 2013)

The First Signs of Hearing LOSS by James W. Allen, M.D.

About the author: *Dr. Allen is a physician and FAASTeam Representative (Philadelphia region). He served as the medical officer at the Navy's shipyards and air rework facilities. Since his retirement from the navy he has focused his efforts on the health of aviation mechanics. He has written two books on this topic, an AMT course on WINGS (ALC-117) and given numerous presentations to both student and certificated aviation mechanics.*

In 1903 a mechanic invented aviation noise. It has been with aviation maintenance ever since. We should continue to emphasize its effect on hearing and fatigue.

Anyone who has worked around aviation knows the association. Those with long tenure in the industry are more likely to have difficulty hearing than newbies. These industry veterans will typically cup their hand behind their ear to hear. They turn their "good" ear to the speaker when in a conversation. In the worst case they ask "what?" or "say again" or wear a hearing aid.

The association between long tenure in the industry and hearing loss is more than a casual observation or the effects of aging. Noise causes a loss of hearing. While aging also reduces hearing, exposure to noise accelerates the process. We can't do much about the aging process. Aviation Maintenance Technicians (AMT) can protect their hearing. The first step is to understand how hearing is lost.

Noise induced Hearing Loss (NIHL) is the medical term for hearing loss that originates from workers' exposures to constant loud noises. It is epidemic among workers in all types of industry. In fact, NIHL is the most frequent compensation claim paid by the federal government. NIHL costs millions for businesses and taxpayers and reduces quality of life for many workers and retirees

Since NIHL develops over years of noise exposure, a first effect must be present. What is that first effect of noise that will eventually lead to NIHL? AMT will recognize a comparison to an engine with a connecting rod sticking through the crank case. Something occurred before the rod broke loose. Perhaps a tapping sound, increased oil temperature or a drop in RPM were the first indications of an impending disaster. Let's look at NIHL in the same manner. What occurred before the deaf AMT had to cup his ear or turn his good ear to the speaker?

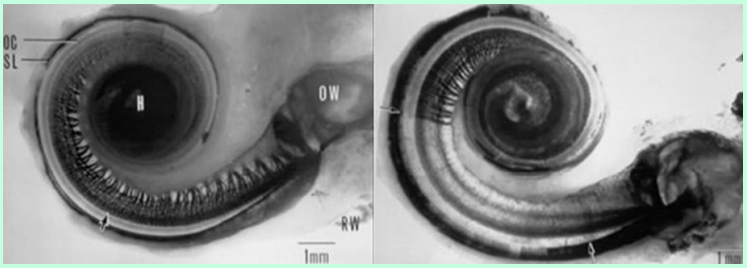
Sound is a pressure wave characterized by the amplitude and frequency. Amplitude measured as decibels (dB) reflects loudness and frequency measured as hertz (Hz) reflects pitch. Using these measures we'll focus on continuous nose, such as in aviation rather than impulse noise that is encountered on a firing range. For example, over an eight hour period baggage handlers are exposed to 84 to 97 dB(A) and mechanics slightly less at 83 to 89 dB(A). The units dB(A) is decibels measured on the A scale of the meter, the scale that most accurately reflects hearing.

When the pressure wave of sound enters the ear it moves the ear drum. The three smallest bones in the body connect the ear drum to the cochlea. Surrounded by the bones of the skull, the location of the cochlea is behind the ear drum. It's a snail-shaped tube that is filled with fluid. Lining the tube are specialized cells called hair cells. The physical movement of the drum becomes a fluid movement inside the cochlea.

The First Signs of Hearing Loss Con't.

The cochlea is sensitive to frequency. Fluid movement deflects the hair cells resulting in the tone that we hear. Consider the arrangement of the hair cells within the cochlea similar to the arrangement of keys on a piano. Low frequency tones are at one end of the tube and high frequency tones at the other.

With this background in anatomy, the effect of NIHL becomes more understandable. The figure below shows two snail shaped cocholea magnified from its normal size. The cochlea on the left shows the normal membrane containing a uniform distribution of the hair cells along its entire length. Compare this normal cochlea with the one on the right. Hair cells on a portion of it are all removed. These cells were destroyed by external noise resulting from the relentless fluid movement in the cochlea. They will not regenerate. For the audiologist, the figure on the right is equivalent to the AMT looking at an engine with a rod sticking through the crank case.



Effects of Noise on a Human Cochlea. Left: Relatively normal cochlea. Right: Cochlea damaged by noise (ref: www.niosh.gov/occupationalnoise)

To reach the severity shown on the right, unprotected nose exposures had to have an initial effect. Let's ask what occurred before reaching this severity. Noise destroys hair cells but not uniformly along the cochlea. The first effect is on those hair cells that respond to 3,000 to 6,000 Hz with the most intense damage to those hair cells responding at the 4,000 range. These cells die and will not regenerate. Hearing is lost forever in the 3,000 to 6,000 Hz range but most intensely at about 4,000 Hz. NIHL is well on its way.

The reason the first effects of NIHL are not obvious to us is because we can function with a hearing limitation from 3,000 to 6,000Hz. Consider the frequencies that we use in everyday life. Typical speech is from 500 Hz to 3,000 Hz. Middle "C" on the piano is 256 Hz. With the early effect of NIHL on high frequency sounds the AMT still responds to conversational voice and functions at work. With this focus on hearing the lower frequency ranges, the first effects of NIHL are usually not recognized

The message to the AMT is that NIHL starts in a very subtle manner. As an example, consider a transient noise exposure, perhaps a static engine run-up, that causes a ringing sensation in the ears. At first it clears quickly but with repeated exposures the ringing sensation takes longer to clear. This first effect could easily be overlooked. The astute AMT who recognizes subtle changes in hearing can start wearing hearing protection. The goal is to protect the hair cells before the cochlea looks like the engine with a rod though the crank case.

In the next issue we'll discuss the audiogram, obtained during hearing testing in a booth. Understanding your audiogram provides addition insights into the status of your hearing.

USE OF EVENT REPORT DATA TO IMPROVE SAFETY

by Brenda Wenzel, Ph.D.

About the author: *Dr. Brenda Wenzel is an engineering psychologist in the Human Factors Research Division at the FAA Civil Aerospace Medical Institute in Oklahoma City. She is a member of the maintenance human factors research team that co-hosted the workshop. Her research background includes evaluation of intelligent tutoring systems, simulators, and virtual reality trainers used by military aviation maintenance technicians and pilots.*

The 4th annual Maintenance Human Factors (MX HF) workshop titled, "The Transition from Event Reports to Measurable Organizational Impact," was held June 25-26 at the FAA Southern Region Office, College Park, GA. The FAA's Chief Scientific and Technical Advisor for HF in Aircraft Maintenance Systems and the HF Research Division at the Civil Aerospace Medical Institute co-hosted the event, which focused on how to use data from voluntary event reports to continuously improve organizational safety policies, processes, programs, training, and technical manuals and procedures.

It was a successful collaboration among domestic and international representatives from government agencies and aviation industry segments, reporting system programs, as well as HF practitioners. The success is partly due to relying on proven group processes and the mix of attendees' expertise and experience.

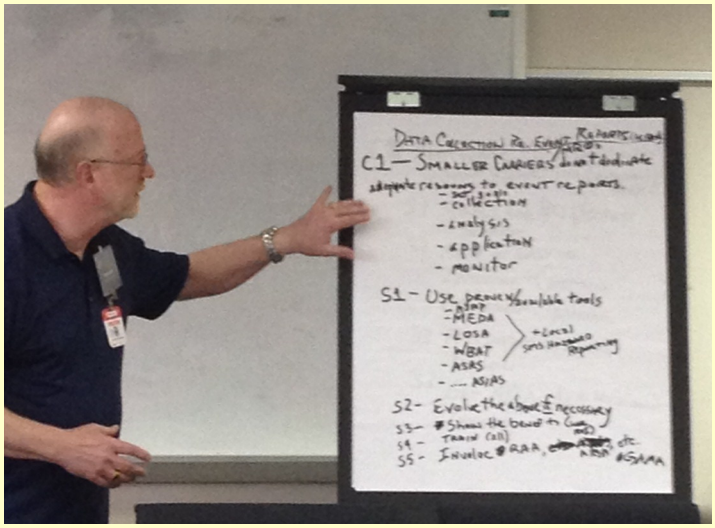
The agenda for the first day and a half involved multiple sessions of invited speakers from the air carriers, maintenance repair and overhaul (MRO) organizations, reporting system programs, and government agencies. The speakers presented the ways in which their organizations utilize data from event reports to improve flight safety. They shared experiences and lessons learned in collecting and analyzing the data, reporting and applying outcomes (predictively and proactively), and monitoring and assessing the effects of the report-driven change.

The keynote speaker, Mr. Simon Roberts, SMS Programme Manager, Chair of European HF Advisory Group, UK CAA, spoke to the group via video teleconference. He presented evidence that the same type of maintenance errors have been occurring at comparable rates for over a decade, making a strong case for collecting the "why" along with the "what" in event reports. He followed with the example of embedding tips on avoiding procedural errors in e-work cards as a safety intervention that evolved from knowing the contributing factors (why) to persistent maintenance errors.

The agenda for the afternoon of the second day involved a work session. Attendees joined one of four small workgroups assigned to address (1) organizational culture, (2) data collection, (3) data analysis, or (4) results and implementation. Each workgroup tackled the hard questions of: What challenges are limiting our effective use of event reporting to realize safety benefits and cost

savings? and How can we meet those challenges? In other words, what is required of a maintenance organization to successfully:

- calculate expected safety benefits and cost savings of report-driven change,
- integrate voluntary event reporting into its work culture,
- set standards for data collected in event reports,
- translate event reports into meaningful organizational change, and
- evaluate and sustain the benefits of implemented change.



The work session culminated with a spokesperson from each small group presenting the challenges and solutions generated in their assigned area to the large group. Common solutions pointed to the importance of establishing a just and fair culture that openly supports voluntary event reporting, training and education, and assessment of return on investment.

Below are example challenges and corresponding solutions from each workgroup, in lieu of listing all 18 challenges and 54 solutions.

Challenge	Solution
build individual trust [of reporting practices]	show report-driven change within the workplace, company, and industry
motivate MRO participation in event reporting	support from the FAA and involvement of professional associations
achieve efficient use of data from different sources and in different formats	standardize [report] output
overcome the lack of combined knowledge of HF and task expertise to interpret data analysis	use a team approach

The final tasks assigned the attendees were to turn in a "top five" list of challenges in order of priority and to provide feedback on their workshop experience.

A workshop proceedings report is being prepared and will be available in the near future on this website. The report will contain information on how voluntary reporting is and should be used to continuously improve safety policies, processes, programs, training, and technical manuals and procedures. In the meantime, consider the safety benefits to the flying public and your organization if use of event reports was a standard business practice.

If you have a story to tell that will help enhance aviation safety, please email katrina.avers@faa.gov or bill-dr.johnson@faa.gov. The editorial staff will help writers with layout and graphics.

If you would like to be added to our quarterly distribution list, please email joy.banks@faa.gov