

Aviation Mx

HUMAN FACTORS

QUARTERLY

Human Factors in Aviation Maintenance



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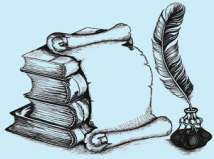
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Dr. Bill Johnson, a frequent contributor to this

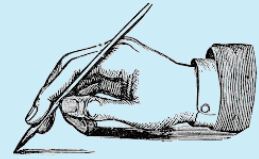


newsletter, is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. His comments are based on nearly 50 years of combined experience as a pilot, mechanic, airline engineering and MRO consultant, professor, and FAA scientific executive.

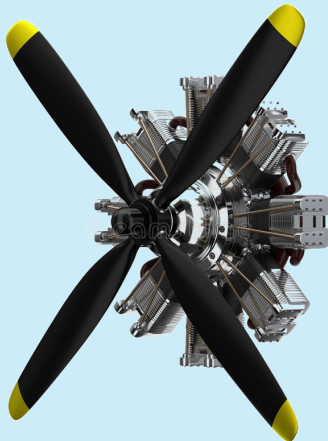




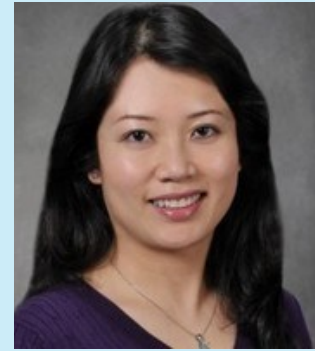
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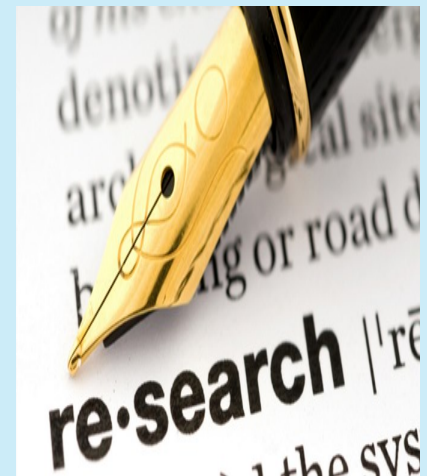
Doug Neufeldt is a manager for safety management systems (SMS) and regulatory programs. His aviation career began in the U.S. Air Force as a KC-135R Crew Chief. After 15 years of repairing aircraft, he changed direction and took a role as an Aircraft Maintenance Planner. Neufeldt received his degree in Aircraft Maintenance Management and began in Quality Assurance as an Airworthiness Directive Compliance Auditor, then as a lead in mitigating inadvertent slide deployments in Technical Operations, reducing deployments by 90% within a year post mitigation implementation.



Crystal Maguire is an Executive Director of the Aviation Technician Education Council. Under the sole proprietorship Maguire Law, Maguire provides management services to trade associations, including the Aviation Technician Education Council and the Aerospace Maintenance Council, a non-profit group that raises awareness about aviation maintenance technician careers through its annual Aerospace Maintenance Competition. She also provides regulatory consulting and legal services to air agencies and aviation maintenance technician schools, and is a regular contributor to Aviation Week's Inside MRO. Maguire graduated with a B.A. in management from the University of Tulsa. She received a J.D. from American University, Washington College of Law and is a member of the Virginia and Oklahoma State Bars. She is the recipient of AMT Magazine's Next Gen 40 Under 40 Award, and ARSA's Leo Weston Award for Excellence in Government Service.



Dr. Maggie Ma is an Associate Technical Fellow who specializes in maintenance human factors at the Boeing Company. Maggie has over 15 years of experience in conducting applied human factors research to improve aviation safety through developing various safety programs. She has worked closely with airlines, manufacturers, maintenance organizations, ground service providers, and regulatory agencies around the world.



Training Solutions to Meet the Looming Maintenance Personnel Shortage

Dr. Bill Johnson

Summary

There is a shortage of qualified aviation maintenance technicians. Training programs are not delivering enough Aviation Maintenance Technician (AMTs). Maintenance training regulations are not aligned with current new worker skill and knowledge requirements. Today's young people are not interested in aviation maintenance. You could pick the reason from these statements or add your own! Since there is no single reason, Dr. Bill Johnson offers a few facts that he excerpts from an extended article in the June 2018 edition of *AMT Magazine* (www.aviationpros.com/magazine/amt/issue/2018/jun). Crystal Maguire covers this topic quite well ([see page 6 of this newsletter](#)).

An Example of the Challenge

Let's look at 10 students that enrolled in a Part 147 Aviation Maintenance Technician program (see Figure 1). Schools estimate that as much as 70% of the students graduate the Part 147 program. Now there are 7 students. About 60% of graduates take the certification exam. Leaving 4 AMT certificated graduates. About 25% of these people find employment outside the aviation industry. That leaves only 3 newly certificated AMTs ready to continue training and work in Aviation Maintenance! Complicating this low number of new Aviation Maintainers is the fact that the average age of today's workforce is 51 years old, with 27% being over 64 years old. In other words, attrition is a big cause for the decrease in employment numbers.

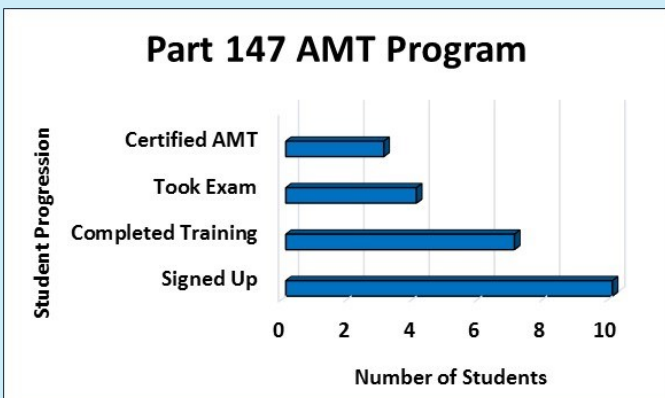
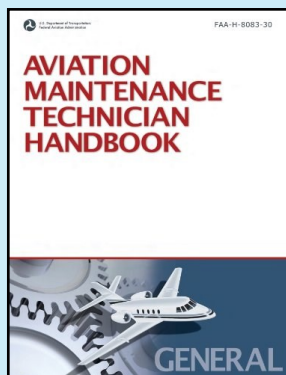


Figure 1. Students enrolled in a Part 147 AMT Program.

Do you want another challenge? Manufacturers estimate that the world fleet of airlines will increase by 40% over the next 10 years. At current graduation rates, it is estimated that the US airlines will have a mechanic shortage of nearly 15,000 by 2027. The world shortage is much greater. Something must be done!

Fix the AMT Training Programs

FAA, with industry, has not substantially modified the required curriculum for many years. Updating the FAA-approved AMT curriculum is often suggested as a best solution to fix the problem. Such change is in the works but may not be moving fast enough. In May 2018, Congress introduced a Bill (SB 2792) to demand an updated curriculum within 180 days after passed. If that happens, schools will have to change dated training



equipment and courses. The result would likely make AMT training more relevant, challenging, and interesting to a broader range of students. For employers, it would reduce the time and logistics associated with new hire training.

Congress has also introduced two additional bills, in 2018, that would fund development of new instructional approaches and equipment for AMT programs. The same bills could create programs to attract student populations who, traditionally, have not enrolled in AMT programs. The bills would also offer opportunities to personnel whose careers have changed due to changing work environments and technology. These are excellent ways to add to the potential aviation maintenance workforce.

FAA welcomes opportunities to improve the maintenance curriculum and to ensure an adequate number of safe qualified maintenance workers. Expect to hear more on this topic. In the meantime, please see the June *AMT Magazine* (www.aviationpros.com/magazine/amt/issue/2018/jun).

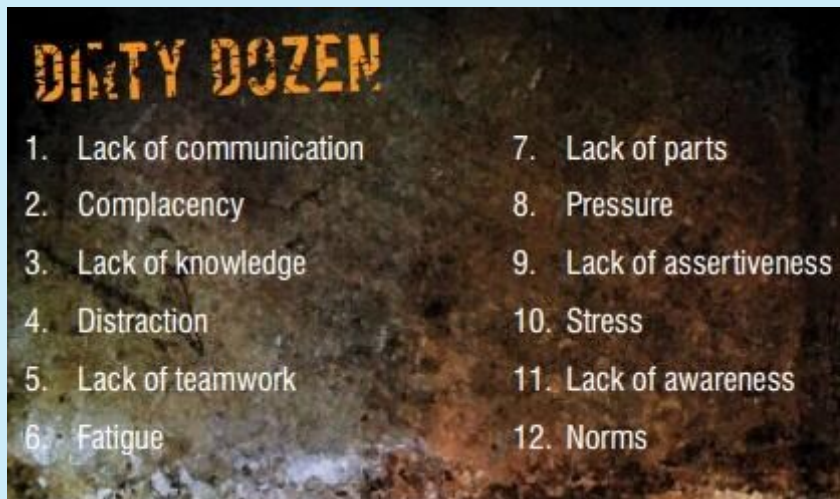
Human Factors and SMS Implementation

Doug Neufeldt

14 CFR, Part 5, the Safety Management Systems (SMS) rule, has fundamentally, and some would argue dramatically, changed how airlines have to analyze and assess hazards in their operational environment. What about Human Factors (HF) and SMS? How do they relate? At its core, Human Factors affects SMS, but how and at what level? Let's take a look at how the implementation of SMS interacts with some of the HF that affect all airline operations.

If you look at the classical "Dirty Dozen" of HF there are clearly some that are affected more by the SMS rule than others, but as a whole all HF certainly has SMS implications. It has implications from several sides actually; there is the front line Aircraft Maintenance Technician, Management, and even the Regulator. Let's

updating Part 65, and he told us we already have a new rule that will help us with fatigue in maintainers, Part 5. He also told us that he firmly believes that if we had Part 5 in place at the time of the Colgan accident that part 117 would not have been written, and crew fatigue would have been managed via the SMS process. So how do we manage Human Factors using SMS? Well, as anyone with an SMS background can tell you, SMS is all about data. We use data to identify hazards, then we mitigate the hazard(s), and ensure it stays mitigated by following up. One of the ways, and something we have already started looking at here at United, is looking at maintainer fatigue through our data, more specifically using our time clock system for maintainers.



We can look at how many days and hours a technician has worked in the last days and week(s) and assess the potential fatigue risk that technician will have for their next shift. Doing that with all of the technicians coming in for a particular shift at a particular station, we can then give the station leadership a "snapshot" of where their fatigue risk is for any particular day and shift to better manage that potential risk.

take a look at a few of these Human Factors, looking at a couple of different perspectives as some roles are the same, such as reporting hazards, the role of one group in SMS is not always the role of another.

One of the biggest HF issues that has a very direct link to SMS is fatigue. There has been a lot of work done with FAR 117 in dealing with fatigue from a Flight Operations and crew management perspective, but what about part 65 and Maintainers? That part hasn't been updated in decades. I was recently at an industry meeting and we asked John Duncan, head of Flight Standards, about

The tool can be automated so that the station management can pull a report before every shift, using up to the minute data. This is just one way of addressing the HF of fatigue.



Human Factors and SMS Implementation - Continued...



Lower maintainer fatigue definitely leads to lower amounts of risk, and being able to proactively identify potential risk is a great start. Remember, fatigue affects everyone, front line, manager, and regulator alike. The best defense against fatigue will always be the responsibility of the individual to be rested for their shift.



Two of the other barriers, I feel, that are very much an issue in regards to HF and SMS implementation are lack of knowledge and lack of communication. We have an 8 hour SMS training program that we developed to give our Management staff, and designed it to give them the tools and knowledge they would need to comply with Part 5. We used real world examples to communicate the meaning behind the different parts of the rule so they could better understand the concepts, exercises to strengthen that understanding, and paper handouts to help with retention. That training concluded some time ago, and I still find myself explaining aspects of the four “triggers” of Safety Risk Management, and other parts of the rule. Is this due to a lack of knowledge or comprehension due to how it was communicated? I would imagine that it is a bit of both.

While we can do all the things to try and teach the subject matter comprehensively, only time and repetition will really ingrain the concepts into day to day practice.

That’s why ongoing communication and using different methods of keeping the information fresh is so vital. SMS is not something you can have a single class on, and expect that everyone is going to just start doing it and be proficient. and the front line side.

One of the methods we use to ensure that level of communication is actively engaging within our organization through computer-based refresher courses, as well as briefing points and articles in internal publications like our Tech Ops Human Factors Newsletter. These are things that happen on both the management and the front line side.

To summarize, these are just a couple of the Human Factors and their interactions with SMS. The key takeaway’s, I think, is to look at your SMS program, in your operation, and determine where and how you can use SMS to help mitigate your Human Factor issues in your operation. Like with all new regulations, take the time to understand them fully; and communicate, communicate, communicate with all of your company’s stakeholders, which in the case of SMS (and Human Factors) is everyone! Stay safe out there!



Mechanic Training Changes are Coming, Focus on Human Factors Anticipated

Crystal Maguire

The FAA is expected to issue a supplement to its 2015, part 147 notice of proposed rulemaking this summer. The regulation governs the curriculum and operational requirements for certificated aviation maintenance technician schools but has not been significantly updated in more than 50 years.

While industry is not privy to the details until it is published, we expect the second proposal to allow for competency-based aviation maintenance programs, in agreement with the agency's emphasis on a more "performance-based" or "risk-based" approach. Whatever the change, the removal of static curriculum requirements from the regulation will provide welcome relief to educational institutions aiming to better prepare their students for careers in aviation maintenance.

a mechanic applicant needs to know, consider, and do to earn an airman certificate, it will also be periodically reviewed and revised (in partnership with industry) to ensure testing is in line with airman knowledge and skill requirements.



To develop the testing standard, the AMT ACS working group took advantage of the good work of a 2007 Aviation Rulemaking Advisory Committee working group, tasked with recommending part 147 revisions. Those suggestions included particular focus on human factors principles; something that has been tested for years but never systematically incorporated into FAA guidance material and school curriculum.

The AMT ACS will also introduce risk management elements that mechanics must consider in association with requisite knowledge and skill. The idea is to enhance safety by translating abstract terms into specific safety behaviors relevant to each task and to test the knowledge of those behaviors in context, during the practical portions of the test.

Meanwhile, an industry-agency working group is developing new Aviation Maintenance Technician (AMT) Airman Certification Standards (ACS) and is expected to be published in 2020.

The new document—which will replace current practical test standards (PTS)—will provide a single set of standards for the AMT airman knowledge, oral, and practical tests. Not only will it better communicate what

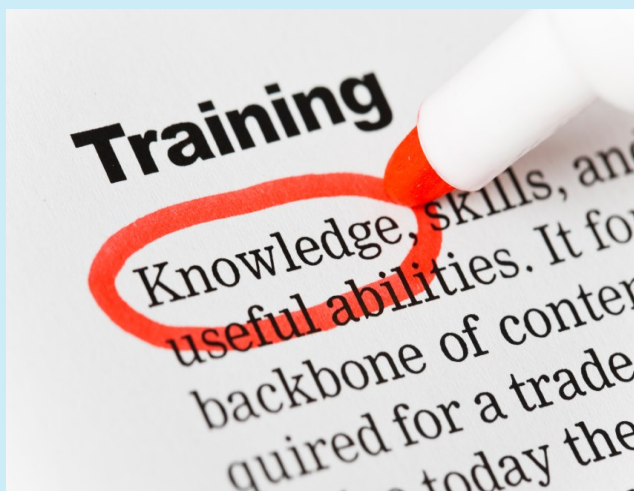


Mechanic Training Changes are Coming, Larger Focus on Human Factors Anticipated - Continued...

The working group made a concerted effort to get industry feedback on the standard during its development. ATEC did its part by publishing every iteration since the project began in 2016. Last month, the agency published a [draft version of the AMT ACS](#), and solicited public commentary.

Within the last year, industry working group leaders have taken the project one step further by asking the agency to consider utilizing the AMT ACS as the basis for part 147 curriculum requirements once the new rule is published. The group maintains that utilization of the AMT ACS for both testing and training will ensure correlation between the two, something the aviation maintenance education community has yet to experience. (ATEC has a long history of helping schools reconcile curriculum requirements found in part 147, with differing testing standards found in the PTS.)

While subsequent agency communications suggest a separate standard for training curriculum is in the works (in conjunction with part 147 rulemaking), ATEC will continue to push for a streamlined and simplified process. Imminent workforce challenges demand that we get this seemingly simple issue resolved so that schools can better teach knowledge and skills that are relevant to both the FAA airman test and today's AMT professional.



A [bill introduced last month](#) by U.S. Senators Orrin Hatch (R-UT), Maria Cantwell (D-WA), James Inhofe (R-

OK), and Richard Blumenthal (D-CT) would expedite the part 147 rulemaking process, and require the FAA to consider the AMT ACS as the basis for testing and training. While aggressive, ATEC hopes it will get the attention of those in charge of agency prioritization.



The AMT ACS working group meets quarterly to continue development of the new testing standards—expected to publish in 2020. A final part 147, unless expedited by statute, is anticipated by 2021.

In other news, a very heartfelt thank you to Dr. Bill Johnson who has volunteered to host an Aug. 7 ATEC webinar on Human Factors and Failure to Follow Procedures. The event is free for government employees. For more information and to register, visit <https://www.atec-amt.org/webinars>.



COMING SOON TO A COMPUTER NEAR YOU!

Dr. Bill Johnson

Summary of this News Story

Our team at the Civil Aerospace Medical Institute is especially excited about one of our newest applied research products. It is a web-based training (WBT) course, scheduled for September delivery! The topic is "Failure to Follow Procedures (FFP)." Of course, all aviation maintenance personnel know the importance of procedures, as well as how to use them. So, what's to train? Why the big excitement? What's in it for you? Let me explain herein.

The Continuing #1 Challenge

Some things never change. FFP may be the very best example of an unchangeable safety hazard in aircraft maintenance. It always ranks as the number 1 cause of enforcement action on certificated aviation maintenance technicians and their maintenance organizations. It is the leading cause of events/accidents, injuries, rework, and daily chaos at work. In our studies, in 2010 and 2014, it was at the top of the list of human factors challenges, grouped with safety culture and worker fatigue. It remains a high threat today.

In 2016-17, our team conducted an extensive series of interviews with mechanics, supervisors, and those who write technical procedures. Hundreds of hours and interviews later, we reinforced what we knew at the start. That is, FFP is not about knowledge. It is about maintenance work challenges, time pressure, culture, attitude, commitment, teamwork, and more.

It is obvious that we cannot eliminate the daily schedule-driven maintenance workplace. Our best hope and intention is to address the maintenance culture. That culture is challenged by the requirement to follow procedures 100% of the time.

If a procedure is unnecessary, unavailable, and difficult to find and understand, then we want a culture that is determined to fix the problem quickly, 100% of the time. Workers must remind one another and their

supervisors that procedures must be followed 100% of the time. I am surmising that you are getting the non-negotiable "100% of the time" message.

Dr. Colin Drury, with the Applied Ergonomics Group, participated in all of the interviews and authored some of the reports. He commented that we have seen the challenges, listened to many stories, and understand potential FFP solutions. He said, "There are maintenance organizations that are committed to always following procedures. They are doing that. It works. It is not causing them to lose revenue or go out of business..." It is clear that procedure following requires a cultural commitment. Everyone, from the accountable executive to the new maintenance worker, must be "on board." Everyone must understand that the "Buck Stops Here." Thus the title of the WBT, FFP: The Buck Stops with Me.

What does it Look Like?

The WBT product is simple to access and use from any web browser. It has an interface matched to the expectations and attention span of modern users. The total training will take less than 30 minutes, enough time to do it twice (see Figure 1 for a sample screen).

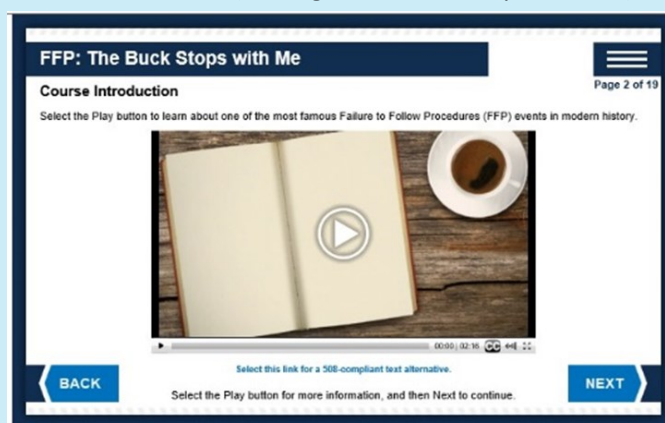


Figure 1. FFP: The Buck Stops with Me.

Much of the training is scenario-based, where the learner, watches a dialog and then determines the best solutions and the best way to exhibit the skills of an FFP Safety Champion (see Figure 2).

Coming Soon to a Computer Near You! - Continued...



Figure 2. Safety Champion Skills.

That theme promotes thinking about culture and about how to address FFP Challenges as they occur. The WBT also contains a few knowledge check questions along the way. The training culminates with a Safety Champion Pledge that asks the learners to demonstrate their commitment to reduce FFP events and be a Safety Champion at their organization (see Figure 3).



Figure 3. Safety Champion Pledge.

The training has a listing of printable resources about FFP. Perhaps the highest value printable take-a-ways are the before and after checklists for AMTs, Managers/Supervisors, and Procedure Writers (see Figure 4). If all parties commit to the training, we believe that it will

reduce FFP and ensure continuing worker and flight safety.

BEFORE the task
PROCEDURE FOLLOWING

AMT's Commitment Checklist:

- ☐ I am current, qualified, and fit for duty.
- ☐ I am committed to follow all current procedures.
- ☐ I have current procedures available at the task site.
- ☐ I will follow procedures in the proper order.
- ☐ I will report missing or unclear procedures.
- ☐ I will check part effectivity and serviceability.
- ☐ I will set a good example on procedural adherence.
- ☐ I will manage my time and work pressures.

AFTER the task
PROCEDURE FOLLOWING

AMT's Commitment Checklist:

- ☐ I set a good example on procedural adherence.
- ☐ I followed all maintenance procedures, in order.
- ☐ I reported missing or unclear procedures.
- ☐ I signed off each task as required.
- ☐ I recovered from interruptions.
- ☐ I did not use "norms" – undocumented procedures.
- ☐ I mitigated personal and environmental risks.
- ☐ I managed job pressure.

Figure 4. AMT Before and After Checklists.

Thirty-Minutes of WBT, a Pledge, and Checklists

We do not have "visions of grandeur." We know that a short WBT and a few safety print outs will not change a culture. Everyone is in favor of regulatory compliance and the associated safety benefits of following the procedures. But, demonstrated actions speak louder than positive words. Therefore, everyone must commit to being a part of the solution. Stay tuned for the WBT Launch in Fall 2018! In the meantime, please see the promotional video at www.followprocedures.com.

A Primer: Two Upcoming Human Factors Guidance Documents

Dr. Maggie Ma

ATA Spec 116: Integrating AMT Fatigue Management into SMSs

The Airlines for America (A4A) formed a Maintenance Safety Committee (MSC) in 2012. The purpose of the MSC is to promote, enhance, and support comprehensive and proactive maintenance safety programs and to assist member airlines in identifying and resolving new and emerging safety issues and concerns. Currently the A4A MSC is authoring a new specification – ATA Spec 116: Integrating Aircraft Maintenance Technician (AMT) Fatigue Management into Safety Management Systems.



Fatigue has been identified as a critical issue in aviation maintenance by the National Transportation Safety Board (NTSB) since 1996. Since 2000, the Federal Aviation Administration (FAA) has conducted research that finds fatigue continues to be a primary concern for aviation, and especially for aviation maintenance. Aviation maintenance operation is particularly susceptible to fatigue and negative impact of fatigue due to the following factors: lack of fact-based knowledge on fatigue recognition and effects, back-of-the-clock operations, condensed scheduling, frequent overtime/shift swapping, and a lack of regulatory requirements associated with reducing fatigue risk in the AMT population.

Aircraft maintenance personnel play a critical safety role ensuring the airworthiness of aircraft and safety of flight to meet an aviation organization's primary goals and business needs (e.g., effective and efficient aviation



operations). Maintenance/inspection failures can directly result in an aircraft accident/incident or contribute to the event chain of an accident/incident. Under 14 CFR Part 5, Safety Management Systems (SMS), operators are responsible for applying SMS principles to address all identified safety-of-flight hazards. Therefore, understanding how to detect, identify, assess, and mitigate fatigue risk within an aviation maintenance operation's current SMS is a necessary priority.

The MSC uses the FAA/Industry Aviation Safety InfoShare series as a platform to discuss and address real world safety issues. In March 2014, technician fatigue was first covered as one of the MSC InfoShare topics focusing on scientific evidence of the negative impacts of sleep deficit. Since then, AMT fatigue has been an expanding concern that requires collaboration of operators and labor groups to effectively address.

This upcoming ATA Spec 116 will offer guidance to A4A member airlines and other maintenance organization as well as all AMTs in general. This specification complements the FAA Advisory Circular 120-115: Maintainer Fatigue Risk Management. A final draft is expected to be available for member review by the end of third quarter of 2018.

A Primer: Two Upcoming Human Factors Guidance Documents - Continued...

ICAO Human Performance Manual

In February 2017 the International Civil Aviation Organization (ICAO) formed a Human Performance (HP) Task Force, which is composed of 16 recognized HP experts from a variety of sections of the aviation industry worldwide. The task force is currently developing an HP Manual. The effort is to update ICAO guidance materials related to human factors to ensure alignment with revisions of the Procedures for Air Navigation Services (PANS) – Training, the Safety Management Manual (Doc 9859) and other relevant publications. Together, these documents will replace the existing Human Factors Training Manual (Doc 9683), which is referenced in numerous ICAO provisions.



Target Audience and Goal

The primary target audience of the ICAO HP Manual is those personnel who contribute to the development and the implementation of ICAO provisions at international, national, and local levels. The goal is to support states in incorporating HP considerations with an understanding of why and how to incorporate HP considerations when they develop regulations and provide oversight. It therefore aims to provide assistance as to how future ICAO provisions, national regulations, and oversight approaches are developed so that they can better support the contribution of the

human to the performance of the aviation system as a whole.

The secondary audience of the manual includes all other aviation organizations and professionals, for example, service providers and accidents investigators. The HP manual hopes to provide a recognizable insight on regulatory thinking for those who are directly responsible for implementing those provisions. Others within and beyond the aviation industry may also benefit from the manual.

The upcoming ICAO HP manual is not intended to be a human factors encyclopedia or a standalone HP toolkit. Reading the manual will not make somebody an instant human factors expert.

Expected Date of Delivery

The HP manual is expected to go through two rounds of reviews by the end of 2018. Its usefulness, clarity, and potential impact will be assessed. The task force has also made a priority to ensure the HP manual is easily accessible.



So...



*you want to be
a writer*

We would like to extend our gratitude to the readers and authors for their continued support of this newsletter. We enjoy your reviews and look forward to future article submissions, keep up the good work!

Our best articles and resources come from FAA employees and industry personnel. Our contributors are not primarily responsible for writing articles for this newsletter, however, the vast majority are experts in their fields when it comes to issues related to aviation maintenance.



Most importantly, we value their input and reviews that bring interest and value to readers of this quarterly forum.

Our Request and Promise to You

Every submission will receive prompt feedback from our great editors! With your approval, we will go beyond the Microsoft grammar and spellcheck, followed by an author sign-off prior to the publish date.

Newsletters come out every 3 months, yes quarterly, starting at the end of March. If you get something to us by the middle of the quarter, then we can usually make the deadline.

If you want to talk about your idea prior to the writing phase, please E-Mail Dr. Bill Johnson at bill-dr.johnson@faa.gov for guidance or recommendations. Send your submissions to Janine King at janine.ctr.king@faa.gov. If you have any interesting maintenance safety images, please include in your submission with an image caption. We appreciate your input!

See something missing?

Are you a regular reader of our Mx HF Newsletter? Do you see something we're missing? As always, please let us know! If you have ideas for future articles or would like to contribute, please contact our newsletter staff at: janine.ctr.king@faa.gov