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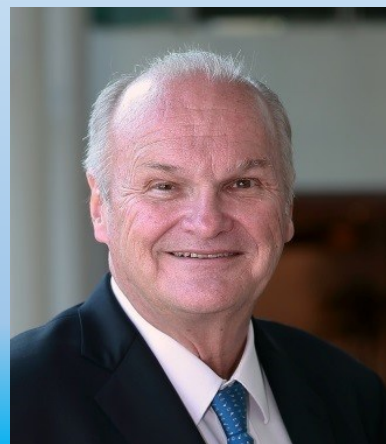
HUMAN FACTORS

QUARTERLY



About the Author

Dr. William Johnson 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.



Addressing Failure to Follow Procedures – Again

Dr. Bill Johnson

Introduction

The FAA human factors research team never stops trying to understand why humans fail to follow procedures (FFP). It is one of the most significant risks in aviation maintenance. Here is a summary of the latest activity and upcoming mitigations. In order to address the FFP challenge, it's critical to consider at least four groups: those who write the procedures; those who use (or fail to use) the procedures; those who manage or supervise; and those who oversee the procedure regulations (aviation authorities) or corporate legal departments ("the lawyers"). I will briefly describe each group, but emphasize that our short-term, planned emphasis is on those who use the procedures and the socio-technical environment (aka, safety culture) in which they work.

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Addressing Failure to Follow Procedures – Again

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Original Equipment Manufacturers (OEMs) strive to develop useable and understandable instructions for those who maintain their products. It is in their best commercial and safety interest to get the technical instructions right. In many cases, OEM engineers who don't have the benefit of testing the procedures in all operational environments are responsible for writing procedures. Therefore, OEMs know that some procedures require customer validation in the real world and; therefore, have systems in place for users to make document improvement suggestions, as necessary. The procedure writers try to act as quickly as possible to revise and validate procedures.

The same is true for operators who convert OEM instructions into company-specific job cards. There is no reason that they would purposely make the instructions difficult to use. This author does not believe that technical instruction complexity and inaccuracy are primary causes of FFP. Of course, it's a very good and often used explanation from users.



Mechanics, those who maintain aircraft, and those who manage or supervise maintenance activities continually strive for quality and safety. All parties benefit from performing every task properly with no requirement for rework; no compromise in operational safety; and without regulatory non-compliance. The very best intentions are often ignored during the "heat of battle." The time rush, management and peer pressure, and other factors often override strict adherence to a written procedure. These are endemic in many aviation maintenance organizations.

Regulators and Corporate Lawyers are often blamed for the complexity and redundancy in written procedures. There is no reason that regulators or lawyers would purposely make instructions difficult to use. Perhaps there is a well-intentioned culture to be thorough and safe vs. being simple with possible room for error. In any case, there are certainly many examples of the complexity of potentially simple instructions because of cautions from overzealous regulators and lawyers. It's critical that users and writers inform regulators and lawyers when their actions are contributing to maintenance safety risk.

Maintenance users must document the challenge of written procedures to raise the likelihood of fast action. Regulators and corporate legal respond best to documented trails of information. A new culture must evolve if the industry can expect change.

FFP is not only one of the largest safety issues in aviation maintenance, but in every aspect of aviation. It leads to errors from the landing checklist of a Piper Cub to the diagnostic procedures of a B-787. Whether it's the OEM, the document users, the regulators, or the lawyers, there are many opportunities for improvement. Everyone in the system must be an active part of the FFP solution. The total industry must undergo a cultural change if we expect significant progress in addressing the FFP challenge.



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Addressing Failure to Follow Procedures – Again (cont.)

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Asking Questions

When trying to address the FFP challenge, some say the solution is based on whom you ask. So FAA researchers asked various industry segments about following procedures. Applied Ergonomics Group (AEG), led by Dr. Colin Drury, conducted the work under an FAA contract. Dr. Drury has been working on the human factors of technical instructions for over 50 years. Using hundreds of event reports from the National Transportation Safety Board, the FAA-NASA Aviation Safety Reporting System, FAA technical reports, and his extensive experience, Dr. Drury created an FFP classification scheme, a listing of best practices, and a structured interview form for interviews with maintenance personnel and management. AEG went to eight diverse organizations that write and use written procedures. They conducted over 150 extended, one-on-one interviews (all extensively documented in an FAA report to be published in 2018). These interviews focused on FFP incidents and on best practices to insure that procedures were followed. The interviews helped insure that our team fully understood the challenges of following written procedure in order to generate excellent examples of best practices.

Dr. Drury repeatedly said, “We see organizations that are having success decreasing FFP incidents. There are best practices that work. People must use them!”

Categorizing Areas of Opportunity for Action

The AEG team, for the purposes of the technical report, used a classification scheme that had five components looking at practices related to the work task, the person(s) doing the work, the written procedures, and then the environment (comprised of the physical and social conditions). The AEG classification was closely aligned with the PEAR concept, widely used in most Human Factors training programs including FAA Inspector training.

As a review, PEAR stands for **People**, **Environment** (Physical and Social-Cultural Environment), **Actions** performed, and **Resources** necessary to complete the job. There is nearly a 100% overlap between the AEG classifications and PEAR. Since the PEAR concept has an extensive legacy of documents and training materials, it will remain the model to use for the continuing development of FFP materials.

Best Practices Examples

Here are some examples of best practices categorized using the PEAR model.

P – People

- Ensure training and qualification for the task
- Be committed to follow the procedures
- Help others follow procedures
- Ensure that you are fit for duty
- Know your individual role in a safety culture

E – Environment

PEAR considers both the physical and social (culture) environment

- Recognize present risk from issues like lighting and temperature extremes
- Reduce/mitigate hazardous environmental conditions, as possible
- Everyone must address time pressure, always
- “Stop and Ask” if the task or procedure is unclear
- Rely on and apply positive safety culture among your peer group



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Addressing Failure to Follow Procedures – Again (cont.)

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A – Actions

- Perform all tasks in the specified order
- Correct problematic procedures at the working level
- Formally recover from any distractions or interruptions in the task
- Be sure to sign off each sub-task
- Have a clear procedure that identifies task completion
- Immediately communicate irregularities in the procedure
- Know that “tribal knowledge” is not necessary in a procedure

R – Resources

- Have the proper procedure available at the task performance site
- Have a system to report issues with the procedure
- Have a way to communicate when FFP contributes to error
- Ensure sufficient root cause analysis to identify all factors causing FFP

Next FAA Actions on FFP

The work related to FFP is endless. That is due to the nature of the aviation maintenance environment and culture. First, FAA will get the technical reports related to this FFP research published.



The writers and editors are keenly aware of at least two unique audiences for this FFP research – the research community and writers and end users of technical procedures. The research community wants to know how the data are collected and analyzed and how the results can be applied to solutions and transferred to other research and development efforts. The FAA Technical reports will satisfy that audience.

The most important audience, however, is the writers and end users of technical procedures. The FAA is aware that mechanics know the regulations and the importance of using the written technical procedures. Maintenance personnel likely know the best practices. They have heard them all before; however, knowledge is not enough! The practical products from the research project must alter daily attitudes and behaviors about explicit use of the procedures. That change must permeate the culture of maintenance from the top executive to the newly hired mechanics. FFP is not a technical issue - it is a cultural issue about attitude and commitment.




Our next deliverable will be two-part. At press time of this article, we are building a web-based training system that focuses on the culture of procedure following. We will supplement the web-based training system with job cards (see figure 1) and workplace signage that will serve as constant reminders for all. The web-based training will be relevant not only to mechanics and aviation maintainers, but to all personnel including managers and supervisors, executives, procedure writers, and corporate legal personnel. Each of those groups has a role in addressing the FFP challenge. It will take all of them to change the corporate culture.



Addressing Failure to Follow Procedures – Again (cont.)

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**Federal Aviation
Administration**
"Procedure Following"

Before the task

Manager/Supervisor Checklist

- Did I assign the task to a person with the correct qualifications, skills and abilities?
- Have I ensured the procedure document is well designed?
- Have I provided the required tools for successful procedure completion?
- Is the time estimate for the procedure realistic?
- Did I enforce a procedure following policy?
- Have I enforced and supported a Stop and Ask policy?
- Did I practice Management By Wandering Around (MBWA)?
- Do I look out for my team members?
- Did I minimize distractions and interruptions?
- Have I done everything in my power to minimize pressure on AMTs?



**Federal Aviation
Administration**
"Procedure Following"

After the task

Manager/Supervisor Checklist

- Did I assign the task to a person with the correct qualifications, skills and abilities?
- Have I ensured the procedure document is well designed?
- Have I provided the required tools for successful procedure completion?
- Is the time estimate for the procedure realistic?
- Did I enforce a procedure following policy?
- Have I enforced and supported a Stop and Ask policy?
- Did I practice Management By Wandering Around (MBWA)?
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- Have I done everything in my power to minimize pressure on AMTs?

Figure 1: Example of FFP Job Cards in Development

We proceed to this next step with full knowledge that changing the culture of FFP will not be easy. However, we are certain that the next important step in our continuing safety efforts centers on an evolved safety culture that is following the procedures. Stay tuned for web-based FFP training, coming to the FAA website in the Fall of 2018!

The author acknowledges all who contributed to this large project including but not limited to the FAA Civil Aeromedical Institute Human Factors Division, Cherokee CRC LLC, the Applied Ergonomics Group, the 160 mechanics and supervisors who participated in research, and their eight companies.



Newsletter Needs You!



We have seen a variety of special interest newsletters. While now digital, perhaps newsletters are a vestige of the past? Before people were tweeting, Facebooking, or blogging, they were writing, or keying, letters. The letters had many of the characteristics that were taught and maybe learned in grade school or in a high school English class. Stories had beginnings, middles, and ends. They could be short or long, but the best ones were kind of like a good story. They gave us something interesting to remember and use in our daily lives.

This quarterly newsletter has been published since 2009 as “The MX Fatigue Focus”, then as the “Aviation MX Human Factors Quarterly” in 2013. You can link to all the newsletters from the front page of the FAA Maintenance Human Factors Website (www.humanfactorsinfo.com). Dr. Bill is a constant contributor. He has not missed a contribution yet and will continue to do so; however, the editors know the best articles and stories come from FAA and industry personnel. Those contributors do not have a primary job responsibility writing articles for government newsletters, but they know what they are talking about when it comes to issues related to aviation maintenance. Most importantly, they tell relevant stories that have wide spread interest and value to readers of this document. We need more contributions!

Our Request and Promise to You

We will give every submission prompt feedback. We have great editors. If you think Dr. Bill can write, then you should see his stuff before our editors get it.

We make him look like he can write. We can do the same for you. With your approval, we will go beyond the Microsoft grammar and spell checker. Before we publish it, we will get your sign-off.

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. Send your submissions to patricia.ctr.davis@faa.gov If you want to talk about your idea before writing, send an E-Mail to Dr. Bill Johnson and he will call with advice (bill-dr.johnson@faa.gov).

If you prefer not to write an article, then you are invited to participate in the Q&A section of this report by submitting those questions to patricia.ctr.davis@faa.gov If you have an interesting maintenance safety picture, please send it along and provide a caption for the photo. We thank you for your input!



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Questions & Answers

Q: I think that strict duty time limits for mechanics is the only way that our company will stop excessive mandatory overtime. When will we see an FAA regulation on duty time limits?

A: The US and domestic trend regarding duty time limitations is to push for Fatigue Risk Management Systems (FRMS). While strict duty time limitations can be preferred over an FRMS, it is likely that the duty time limits may be more restrictive. Evolving regulations for Safety Management Systems (SMS) require that organizations monitor and address safety hazards. That means that current and emerging SMS requirements are, in effect, FRMS requirements. So, you do not yet have an SMS requirement?



That is not a problem. For many companies, the cost control and profit, and the avoidance of blame for an accident, are key factors for decision making. Unquestionably, fatigued workers make mistakes that affect quality, safety, and profit. Based on the amount of fatigue guidance material, like AC 120-115 (Maintenance Fatigue Risk Management), that has been published in the past 15 years, every reasonable aviation maintenance provider should know that fatigue is a safety hazard. What company wants to ignore a known hazard and risk to continuing safety?

Q: When will you see a regulation with explicit duty time limits for maintenance?

A: No time soon.



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:

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