Aviation MX
JUNE 2017
Vol 5, Issue 2
HUMAN FACTORS
QUARTERLY

William B. Johnson

About the Author: "Dr. Bill" Johnson has been associated with the FAA's Maintenance Human Factors Program since its inception in the late 80's. He has held a Pilot certificate for over 50 years and is approaching 50 years since receiving his A&P certificate. He is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems.

A Phase Check of FAA Maintenance Human Factors

Dr. Bill Johnson

Summary

Like aircraft and other heavy equipment research and development programs need regular light and periodic heavy maintenance. In the research environment that is accomplished with quarterly and annual program reviews. Like an aircraft inspection our program reviews check for worn parts (ideas) and often identify new situations that present a hazard to our schedules and budgets. That sounds just like aircraft maintenance. This article will help readers look at some of the components and systems critical for an efficient and effective FAA maintenance human factors research program.

Check the Records/Logbooks

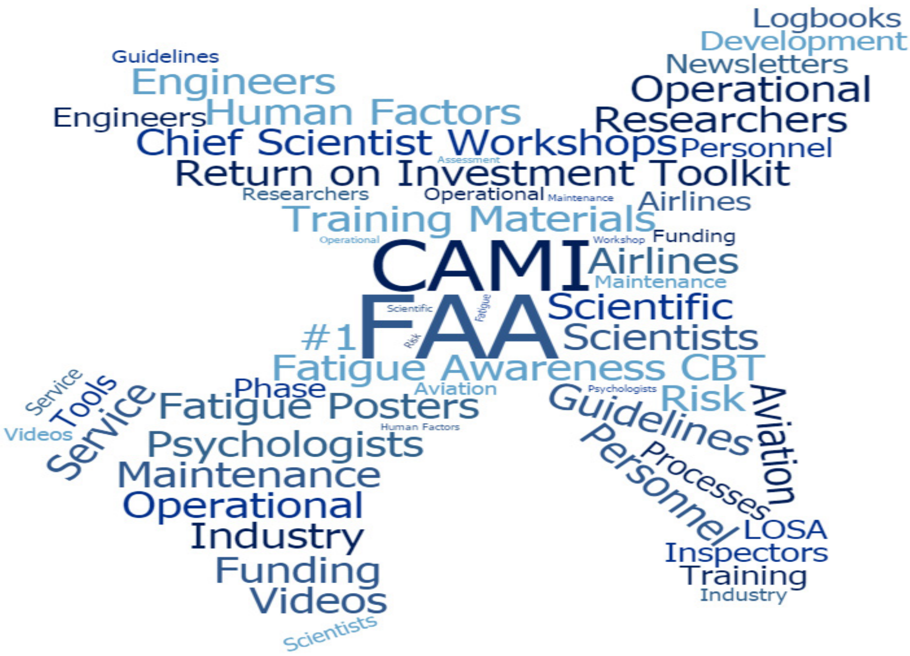
If we look at the age of the FAA Maintenance Human Factors program it would classify as an aging aircraft. It started in 1988, making it just about 30 years old. However, the program is not "ready for the desert!" The FAA Safety Act of 1988 and the robust funding that flowed from Congress coincided with the front-page picture of the convertible Aloha 737. That event drew immediate attention to aging aircraft, aircraft

Inside this issue

Table of Contents

Continued from p. 1

design and maintenance, and the humans that fly and maintain them. The Act explicitly stated, among other things, that the FAA must establish a program that addresses human performance in maintenance. Like an aircraft in design the first response to the Aviation Safety Act was a committee much like an aircraft's Maintenance Steering Group (MSG). I was a member of that committee and helped write the *The FAA National Plan for Aviation Human Factors*, published in 1991.



The National Plan was followed from program inception, when congressional earmarks provided as much as $1.6 Million/per for maintenance research, to the late nineties when the Safety Act funding expired. By the year 2000, Maintenance Human Factors funding had to revert to the normal FAA R&D budget, which was adjusted to about 25% of the resources available throughout the nineties. That change, while significant, demonstrated how commercial maintenance organizations, airlines, and consulting companies have assumed much of the activity formerly done by the FAA. That is a success story!

Operational History

Like an aircraft historical review, it is good to consider service history. An aircraft operating many daily segments requires different maintenance than one that flies one long segment per day. The nearly 30-year service activity of the FAA's maintenance human factors research program has three life phases. In the first phase, from the years 1988 to 2000, the program was directed by the Washington, DC Office of Aviation Medicine, with long-term program continuity and a tenure of FAA personnel and program contractors. The program had extensive senior management support and lots of congressional earmark funding. From the years 1988 to 2000, the FAA, with industry and other national aviation authorities, conducted 21 international conferences on Maintenance Human Factors. The human factors conference size ranged from 70 delegates, in 1988, to nearly 1,000 in the year 2000. At the same time the FAA issued multiple research grants and contracts to universities and commercial engineering companies. The FAA was extremely diligent about publishing all of the conference proceedings, reports, and project tools. The materials were first on paper, then on CD ROMSs and DVDs, and finally transferred to the web to including all legacy and subsequent documents. The website, www.humanfactorsinfo.com, continues to be supported and is absolutely the largest and #1 maintenance human factors information source in the world.

Phase 2 started during the days after 911. The effects of 911 put the human factors program in a bit of "tailspin," in the early to mid-2000s. A radical reduction in personnel and funding slowed research as well as the annual Human Factors conference. Industry ability to travel to conferences stopped. About that time, the international partners each embarked on their own HF efforts. Most significant in the time period was the establishment of the European Aviation Administration Agency, with their new human factors regulations.

Phase 3 started about 2005-2006. At that time, the management of the program changed, FAA leadership interest increased, and FAA began working with the Civil Aerospace Medical Institute and Industry partners to renew the program. A new focus on applied research and on development of tools and processes for industry has led to a prosperous 10-year period. One of the most noteworthy parts of FAA's maintenance human factors program is the past 10 years of human factors training for all Airworthiness Inspectors. All airworthiness inspectors receive a 3-day course in human factors. Many inspectors have repeated the course for recurrent training.

Good research and development must be based on sound scientific principles. Good products must be validated and evaluated in operational environments. That process is critical activity always going on in a quality program. The reports from those "scientific" studies are often more interesting to other scientists, psychologists, engineers, and researchers than to operational maintenance personnel. The reports are all published on the FAA website (www.humanfactorsinfo.com). The tools like videos, training materials, and guidelines are more tangible to the aviation maintenance community and to FAA inspectors. Thus they are the more visible part of the program. It is worthwhile to list some of the example tangible products, see Table 1, that were delivered in the past 10 years of the program.

Continued from p. 2

Table 1: Significant Deliverable in Ten Years
Introduction to FAA Human Factors Video
Maintenance Human Factors Training System
2nd Edition of The Operators Manual for Human Factors in Maintenance
2nd Edition of The Human Factors Guide for Maintenance and Inspection
Return on Investment Tool Kit
Chief Scientist Workshop Reports
Fatigue Awareness CBT
Fatigue Posters
Fatigue Video (Grounded)
Maintenance and Ramp Line Operations Safety Assessment
FAA MxHF Quarterly Newsletters

Current Observations and Projections

Well, we have looked at the logbooks and considered the operational history. The next step is to look at the current condition and determine the results of the phase check. We must also look to the short term expected deliverables and long term strategic direction of the program.

In the past couple of years, we have been in an extensive data collection phase. We have been addressing two of the largest challenges in maintenance. That includes worker fatigue and "failure to follow procedures."

During 2016-17 we collected fatigue data from about 175 workers across the US. Those participants wore Fitbit-like accelerometers, competed diaries of activity, and completed computer-based tests that assessed their alertness levels. We have been actively involved in a variety of operations, large and small, from rotary wing, to large and small airplanes. We structured the data collection so that we could compare current mechanic sleep habits in comparisons to a study competed in 1999-2000. The extensive data analysis is not completed but it appears, initially, that the risk associated with worker sleep habits has improved since that initial study.

In a second study, we spoke to nearly 200 mechanics and managers about the challenges related to using instructions/procedures. We have a renewed understanding of these challenges and are currently working on the final reports. We are seeing that some organizations have found excellent ways to address the documentation challenge. However, there is significant variance among organizations. We are doing our very best to ensure that the final deliverables include clear and actionable procedures that are ready for industry adoption to be delivered later in calendar 2017.

With respect to projections, I believe that we are transitioning to a new and fourth Phase of the FAA Maintenance Human Factors Program. This forth phase must remain applied. The products must be understandable and useful for all types of industry users. We must link everything we know about maintenance human factors into evolving Safety Management Systems. We must create tools that will provide explicit step-by-step help with risk based decision making (RBDM). We must provide support to today's workers, new and senior. We believe that we can do that in an environment that is rich with data, reported voluntarily, or collected automatically. We must recognize that there are a variety of new technologies at our finger tips. We must work together in a renewed corporate-regulatory cooperative environment. Human factors challenges and solutions are evolving, not ending. We are convinced that the work related to maintenance human factors shall be an on-going and important way to support continuing safety.

"Human factors challenges and solutions are evolving, not ending."

Comments – Send comments to Dr. Bill Johnson at Bill-dr.johnson@faa.gov.

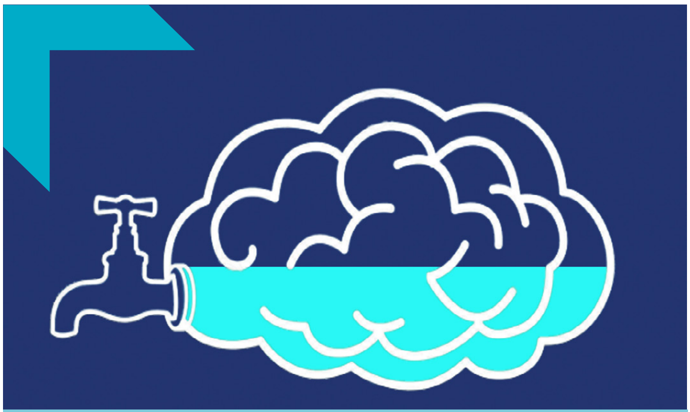


Figure 1. Most of your brain power is needed in a controlled task. A novice will need to use most of their cognitive resources to complete a new task.

How Do Experts Make Mistakes?

By Dr. Michelle Bryant

Research Psychologist for the Civil Aerospace Medical Institute

I had the pleasure of attending two Inspection Authorization (IA) Renewals early this year and had a wonderful time at both. While speaking at each, I noticed there were many interested expressions as I briefly explained the two primary processes by which humans perform tasks; automatic and controlled processes. Briefly, an automatic process is one that has been well practiced, requires little to no attention, and can be done at the same time as other tasks. A controlled process is the opposite. It is a task that requires most of your attention to do well because you have not had extensive practice completing the task.

Why does any of this matter to AMTs?

Understanding which tasks are controlled and which ones are automatic for an AMT is important for two reasons. First, not only do you want to know which tasks are more susceptible to error but you also want to know why. If a change has been made to a protocol you have been following for the last 15 years, as an expert, you are likely to fail to follow the procedure as written and perform it as you have for the last 15 years. However, if you are not familiar with a task, this same protocol change would not likely result in the same kind of error. This is because as a novice, you were likely following the directions more closely, in a step-by-step fashion. Knowing your limitations (which tasks you are an expert on, and which you aren't) help to identify which approach you likely take when performing a task and which kinds of errors to which you may be prone.

The second reason it is important to know which tasks are automatically processed and which are not is that you can increase your awareness of how other factors may negatively impact your performance. Take fatigue from the Dirty Dozen for example.If you are fatigued, you will rely a great deal on your automatic processing to perform a task (experts and novices alike). This is because when you are fatigued, your brain is finding any and every way to preserve its resources. Essentially, you're on autopilot. While autopilot may work well in general, when something occurs that is unexpected, an AMT will need to be able to refocus their attention to adequately perform the task. If the AMT is fatigued, there is a risk that there will not be enough brain power to detect the unexpected event, and/or have enough brain power to adequately problem solve the event. Therefore, fatigue can be especially detrimental for tasks that you have a great deal of experience with or feel most confident about your performance.

To further illustrate the differences between automatic and controlled processes, let's examine a report from the Aviation Safety Reporting System (ASRS).

"I [felt] that I safe tied the 3 bolts with a single piece of safety wire. I don't know how and when the safety wire came off. The nuts were found to be not safe tied on the following day. According to aircraft history, there [was] no history between my tire change and the following day. The nuts were found on a [walk-around], by a pilot or FAA [inspector] and corrected by maintenance. This was brought to my attention by my 3rd shift manager on [the day it was discovered]. The only things that could have contributed to me not safe tying the 3 bolts [were]: accomplishing the 'weekly check' by myself and trying to finish in a timely manner, distractions from the fuel control change, and trying to make sure I had my work done before the other guys were done and ready to run-up the engine, poor lighting, and 3rd shift work can be very tiring. None of these are good excuses for missing a safety."

Automatic vs. Controlled Processes

From the details of the narrative highlighted above, the AMT who did not install the safety wire was working routine maintenance on the main gear wheel of an MD-80 aircraft. To complete the task, the procedure requires that the bolts be safe tied together. Tying bolts together via safety wire is required for any tasks where bolts cannot be locked into place. It is a common procedure used on such areas of aircraft as the propeller bolts, control system linkages, areas of movement, engines, or vibration, among others. Therefore, this example is a good one to examine when understanding how automatic and controlled processes work when performing a task.

Let's start at the beginning when the reporter states, "I [felt] that I safe tied the 3 bolts…" It is likely that this AMT has performed many tasks where safe tying the bolts together was the final step of the procedure, and therefore found it difficult to believe that s/he did not complete the step. In fact, if we were to question the reporter today, s/he would likely be able to verbally list the steps for completing the maintenance on the main gear wheel of an MD-80 from memory. The reporter in this example highlights a common experience of experts.

That is, if an expert is asked to recall how they performed a task on a specific date, the expert is likely to only recall the steps of the task, rather than the way they performed in that particular instance. This happens because the expert does not think about each individual step in a task. Rather, they think of the task as a whole with the end product in mind. This perspective will only change if there is an unexpected event, distraction, or other resource-intensive process that occurs while the task is being performed (more on this in the Dirty Dozen section of this article below). When any of these things happen, the step could either be skipped or, if more attention is given to the task, shift from an automatic process to a controlled process.

If you look up how to safe tie bolts on the internet, you will find several how-to videos that outline how to perform this task from a step-by-step, or controlled process, perspective. The step-by-step approach allows for a novice, or someone who has not practiced a task extensively, to successfully complete the task by conducting smaller, incremental steps. The controlled process approach will be used on tasks that have not been practiced long enough for the task to be automatic. When an AMT is just learning any task, s/he will typically follow the steps one by one without thinking too far ahead. This happens because the brain is

Continued from p.4

using up much of its resources (brain power) to perform the steps in the task, and doesn't have much left over to use to think about the task as a whole.

What's highlighted from these points is that it is important to know if the AMT has experience with the task we're asking him or her to perform. Whether s/he does or doesn't will impact the way in which s/he will go about completing the task.

Experts vs. Novices

Though experts and novices work from different processes, skipping a step can routinely occur to both. For example, the expert may not refer back to a manual when interrupted by his or her manager to give a status update. This introduces the risk of skipping a step due to an overreliance on memory to get the job done. If put into the same position, a novice is more likely to have referred back to the task card but his or her inexperience makes it difficult to recognize which steps have already been completed (e.g., if the bolt is torqued appropriately). This introduces risk of missing, or skipping a step due to not recognizing whether a task has been completed. Therefore, awareness of how work cards and procedure manuals can be used to protect both novices and experts from committing errors, especially in a fast-paced hangar, can increase safety and decrease risk of an error.

EDITOR'S NOTE

For questions regarding this article, please contact Dr. Michelle Bryant at michelle.bryant@faa.gov.

How the Dirty Dozen Fits In

Let's revisit the incident report. At the end of the report, the reporter lists some possible causes for why s/he may not have safety tied the bolts: checking their own work, time pressure, distraction from other maintenance tasks going on at the same time, poor lighting, and working night shift. Now that we understand that the AMT is likely completing the task using automatic processing, we can see how the factors s/he identified may individually, or as a complex system, result in skipping the safe tying portion of the task. That is, as mentioned in the introduction, if the AMT was fatigued and relying on his/her expertise to complete the task, s/he was more likely to skip this last step due to a lack of brain power (cognitive resources).

Summary

The most important point to take away from this article is that both expert and novice AMTs are susceptible to error for different reasons. Additional contributing factors identified best as the Dirty Dozen can increase the risk of those errors. However, since the reason behind the error is completely different for experts and novices these increased risks must also be approached differently. One such way to do this may be to identify the experts and novices in your organization. For experts, this may mean starting with mitigation strategies that bring them out of their automatic processes, and into more controlled processes. Doing so will inherently slow down some of your expert performers. This is risky in the maintenance world where money and time require speed and efficiency. Therefore, a balance will need to be struck between slowing experts down just enough to mitigate errors and still get the job done quickly. For novices, the approach is different. Begin with mitigation strategies that do not interrupt their controlled processes. For example, insulate your novices from frequent interruptions and distractions. If this isn't possible, then limit those interruptions to the best of your ability. This can, in some ways, increase productivity of your lesser experienced AMTs by keeping them "in the zone".

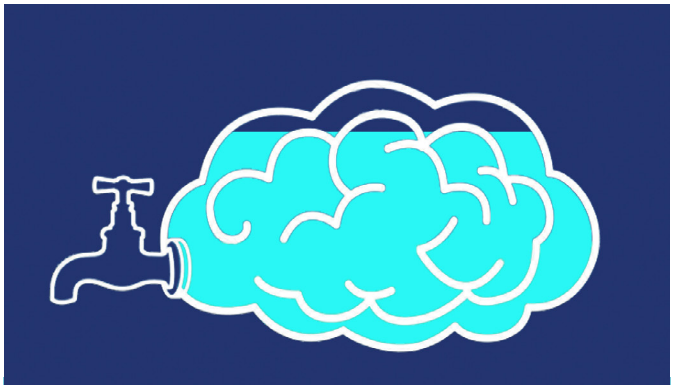


Figure 2. When performing a well-practiced task, you will often run on autopilot, leaving a lot of brain power left to do other tasks. An expert will be able to complete a familiar task, while performing other activities fairly easily.

These kinds of solutions are by no means a one-size-fits-all. However, by starting here, you begin the process of considering and addressing expert/novice performance risk in your organization. Additionally, using your SMS to consider these human factors can be a gateway for determining relevant countermeasures for your organization while creating a resilient workforce within your company.

Maintenance Line Operations Safety Assessment (MLOSA) at Air France: A Three-Year Journey

By Christine Zylawski, Flight Safety Delegate, Air France Industries
Maggie Ma, Ph.D., Associate Technical Fellow, Boeing Commercial Airplanes

Air France Industries (AFI) launched its Maintenance Line Operations Safety Assessment (MLOSA) program with Boeing's assistance in November 2014, using a strategically phased campaign approach (Ma & Zylawski, 2016; Zylawski & Ma, 2016).

In the past three years, the program has come a long way evolving through four phases:

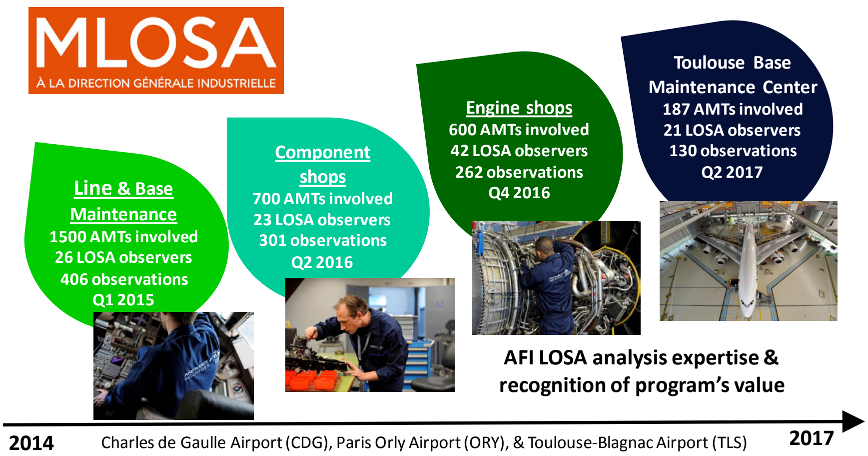


Figure 1. Phases 1-4 of MLOSA Campaign at AFI

A fifth phase (planned in 2018) will focus on Nacelle and Thrust Reverser Repair shops. MLOSA campaign has become a part of annual AFI Corporate Safety Action Plan, which is associated with a compliance target. After the fifth phase of MLOSA, AFI will not resume active observations in a given business unit that has already participated in MLOSA, until the relevant action plan from previous observations has been implemented and accomplished.

An Assessment of Overall Effectiveness

MLOSA has brought specific enhancement to maintenance operations in the following areas:

(1) Technical solutions (a majority of them were employees initiated)
(2) Work process improvements
(3) Training innovation

In Phases 1 and 2 of the MLOSA implementation, frontline Aircraft Maintenance Technicians (AMTs) helped to improve "Change of oxygen bottle/cylinder" task for multiple airplane models and design a safer "HALON gas sample tool." AFI has adopted key management and access control cabinets in the tooling rooms, which significantly enhanced the efficiency and traceability of checking-out and returning process of tools. A major project is in progress to further improve the efficiency of tooling processes, i.e., Radio-frequency Identification (RFID) is under evaluation.

MLOSA has been found to empower frontline AMTs, which in some cases directly led to technical solutions. For example, Hydraulic Pumps Test Cell workshop is known for its high temperature and dangerous Skydrol vapor. Hydraulic pumps allow hydraulic fluid to circulate from the reservoir into the circuits, which powers flight controls, landing gear brakes or landing gear systems maneuvers. During testing, Skydrol is injected to the hydraulic pumps at a heated temperature of 60 Celsius (140 Fahrenheit) to test the performance of the hydraulic pumps (e.g., pressure, flow, leakage). MLOSA observers discovered that the lighting in the Test Cell was inadequate, and AMTs tended to pause their operations very often to get away from the high temperature and Skydrol vapor for a few minutes at a time. The work environment presented health threats. Stepping out frequently (AMTs' current mitigation of safety threats) interrupted the task, which may lead to errors. Observational data drove a more effective solution – installing an extractor ventilation fan. The entire team that works in the Test Cell was mobilized to assist a subcontractor, and installed the fan above the test bench. Consequently, the fan ventilates the room by eliminating the Skydrol vapor and helps to keep the room temperature down. Lighting of the test cell was also improved.

Based on MLOSA findings, AFI has launched a project to digitalize maintenance documentation. A future tool will help to harmonize and align the information system between Air France and KLM Engineering & Maintenance, while streamlining the process of managing the technical documentation within the AFI group (i.e., from documentation update to

1. Maintenance records
2. End of shift good practices
3. Risk management techniques
4. Workstation & housekeeping management
5. Documentation best practices
6. Self audits
7. Ingredients utilization best practices
8. Parts traceability best practices
9. Parts protection and identification
10. Training
11. Tooling management

Figure 2. 11-Item Maintenance Best Practice Reminders

Continued from p.6

distribution through a new intranet/output Portal).
MLOSA team created a set of 11-item Maintenance Best Practice Reminders (see Figure 2). Each reminder includes basic rules and tips to promote frontline employees' best practices, which traditionally rely on coaching and constant monitoring by the frontline management.

In addition to revamping maintenance human factors training, delivering training tutorials on Ground Support Equipment using TechPad (iPads for AMTs at AFI), AFI introduced a new generation of iPads with enhanced connectivity performance, as well as strengthened the technical English training for AMTs.

An Effective Tool for Risk Management

Over the last two decades, traditional System Safety approach using Safety Assessment tools has evolved into a more holistic "Safety Management System (SMS)" approach. Regulations and guidance now exist in most safety-related industries. One of the major components of an SMS is Risk Management. Risk Management requires that safety of flight hazards be identified and assessed for risk, and that unacceptable risk be mitigated to acceptable levels. Analysis of the risks can provide feedback to management as to the success or failure of policy decisions, design decisions, and so on. Airline operators carefully manage their maintenance activities, which are critical to the success of overall business, safety management, and customer experience. MLOSA is a tool in the SMS toolset using a predictive approach in hazard identification and risk management, which aims to meet the highest standards demanded by regulators and customers.

MLOSA is powerful in safety diagnosis utilizing field observations, consequently allows an organization to measure, quantify, and understand un/safe performance as well as superior vs. poor performance. MLOSA observations also shine light on group norms and shortcuts. Recommendations are derived from a scientific and standardized analysis of field observations. At AFI, MLOSA findings and recommendations have been well accepted because they do not point fingers at an individual, a team or a business unit. AFI executive management made it very clear that embracing MLOSA results and implementing recommendations are the responsibility of the whole organization.

Traditionally AFI SMS had been focusing on reactive event investigations and analyzing voluntary reporting of maintenance occurrences. Starting in January 2016, AFI adopted Systemic Safety Analysis using Bowtie analysis tool to identify and analyze latent conditions deep in the organization that set the context for maintenance events (see Figure 3). Systemic Safety Analysis approach allows the organization to identify the extent of its contribution to the causes of different types of safety occurrences, and generate a comprehensive plan of corrective actions to address latent organizational deficiencies. Specifically, a bowtie record is created for each maintenance event. On a regular basis, all bowtie records will be analyzed and compared to LOSA reports, which will inform organization's recommendations of corrective actions. LOSA data and analysis complete the picture of risk management by identifying threats, unmanaged errors/ undesirable state, and weak barriers.

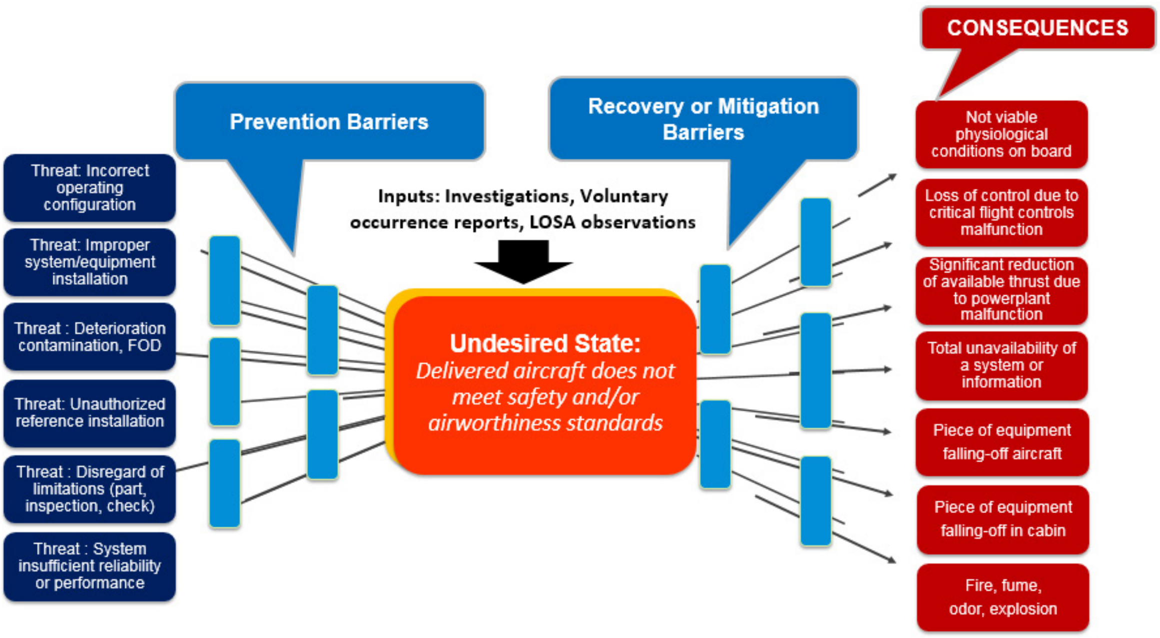


Figure 3. MLOSA Data Feed into AFI Systemic Safety Analysis

Return on Investment

AFI is convinced that MLOSA findings and implemented recommendations have helped the organization to avoid costs related to aircraft damage, delays, aircraft downtime due to maintenance errors, reworks and interruptions, employee injuries and so on. Because individual threats are identified and addressed through MLOSA, AFI is able to reduce probability and severity of associated risks.

MLOSA has proven to be very effective in empowering frontline employees and promote a positive safety culture. Multi-phased MLOSA campaign has mobilized a significant number of frontline professionals (e.g., observers, observees), which not only improved the risk management practices at the frontline level, but also transformed those frontline professionals into the best safety spokespersons and allies. AFI realized that (1) it is critical to seize the "safety momentum" by implementing recommendations as soon as possible, and (2) keep the entire workforce informed that improvements and changes have become possible and taken effects due to their participation.

MLOSA has made a significant impact on enhancing safety culture in three areas (see Figure 4): (1) helping frontline employees maintain risk consciousness, (2) raising employee awareness of AFI safety philosophy/policies/reporting procedures, and (3) raising management awareness in its role in shaping a positive safety culture and disseminating safety information. This is a major step forward. After four phases of MLOSA campaign, AFI now has over 100 trained MLOSA observers, who have become the ambassadors of safety by displaying different perspective on safety and projecting a positive influence on their coworkers. AMTs no longer wait for things to happen, instead they initiate the change. MLOSA campaign has increased self-reporting and people are more willing to bring things up because the frontline workers understand and trust that AFI management takes reports seriously and works hard to solve the reported issues. Once action plans are proposed, MLOSA team goes back to the observers for validation of those solutions, which tremendously enhance the buy-in of the frontline workers. At Phase 4 closing ceremony, sponsoring Vice President of Engine Services, M. José-Marie Louis said "I can count on you and you can count on me." MLOSA offers an opportunity to renew the link between top management and frontline workers.

Over the last three years, targeting at "Generative" level, AFI has transitioned from "Reactive" to "Calculative" safety culture, (referring to the pathological-reactive-calculative-proactive-generative safety culture maturity model). MLOSA is a precious tool that boosts this culture evolution and has offered a better perception of individual responsibility towards safety promotion and good work practices.

EDITOR'S NOTE

For questions regarding this article, please contact Dr. Maggie Ma at maggie.j.ma@boeing.com or Christine Zylawski at chzylawski@airfrance.fr

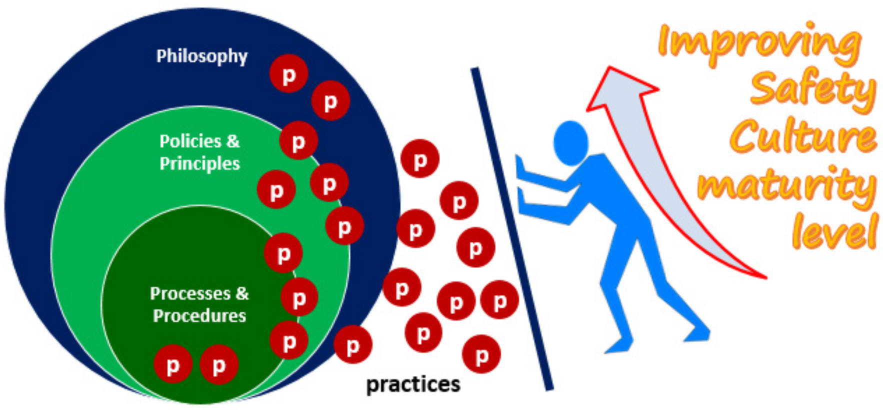


Figure 4. MLOSA Uses a Grassroots Approach to Improve Safety Culture

References:

1. Ma, M.J. & Zylawski, C. (2016). Frontline Volunteers. AeroSafety World Magazine by Flight Safety Foundation. The cover story in Oct., 2016 Issue (p.19-23). https://flightsafety.org/aerosafety-world/aerosafety-world-magazine/

2. Zylawski, C. & Ma, M. (2016). Air France Embraces Maintenance Line Operations Safety Assessment (MLOSA). FAA Maintenance HF Newsletter. Sept., 2016 Issue (p. 4-6). https://www.faa.gov/about/initiatives/maintenance_hf/fatigue/publications/media/september_2016_Newsletter_508_Compliant.pdf

CAMI IS LOOKING FOR YOU

The Civil Aerospace Medical Institute is always looking for industry partners that are willing to assist with data collection, vetting of materials, and other partnerships to ensure the research that is conducted is operationally relevant. If you have an interest or need in any of the topics discussed in the newsletter, please reach out to MichelleBryant@faa.gov. CAMI greatly appreciates your input and involvement in the research behind the resources.

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:

crystal.rowley@faa.gov

MAINTENANCE HUMAN FACTORS RECENT AND UPCOMING EVENTS

A4A Maintenance Safety Committee Meeting Dr. Michelle Bryant	June 26-28, 2017 New York, NY
Chief Scientist/Transport Safety Institute Workshop to Train Human Factors Trainers Dr. Bill Johnson	June 26-29, 2017 Oklahoma City, OK
Transport Safety Institute Maintenance Human Factors Workshop for Aviation Safety Inspectors Mr. D Smith	August 8-10, 2017 Oklahoma City, OK