The Safety Sigma

Mission Readiness through Operational Safety

A PRODUCT OF THE U.S. NAVY SCHOOL OF AVIATION SAFETY

FROM THE DIRECTOR

What is Safety Risk Management?

As Naval Aviation continues to refine and build understanding of the Safety Management System (SMS) construct, I believe it is important to discuss practical application of the concepts outlined in the SMS pillars. In this edition of the School of Aviation Safety (SAS) Safety Sigma, I want to focus on practical application of the Safety Risk Management (SRM) pillar. What do you think about when you think about the Safety & Risk Management? The first concept that comes to mind is probably Operational Risk Management (ORM)…and that is good because it forms the foundation of the SRM pillar. But what else does the Naval Aviation SMS policy (3750.6S) say about the SRM pillar beyond ORM and Time Critical Risk Management (TCRM)? Ch-1, paragraph 110.c states:

Reporting Hazards. Every command and every individual, in naval aviation has an obligation to report hazards. Reporting hazards is one form of administrative control that ***warns similarly equipped and tasked commands of newfound dangers****. Each aviation safety program must encourage and reward hazard reporting.*

So reporting hazards and is a big piece of SRM and most importantly, reporting hazards so that others who operate similar types of aircraft can be warned of the risk and dangers that are out there across the fleet.

Here is what I tell prospective Aviation Safety Officers (ASO) at SAS…..

SRM is not just about doing spot checks, observing FOD walkdown, and making sure you attend the monthly base ASO meeting…that is a part of SRM and Safety Assurance for that matter, but not the most important part in my opinion. Yes you are going to learn a lot by doing those things and you will probably gain insight and information that will help you foster a proactive safety culture, but what about getting direct insight into the next potential mishap? Wouldn't that be fantastic if you could see the holes in the "Swiss Cheese" lining up before they actually resulted in a mishap or near miss? As a squadron ASO, one of the most important day-to-day responsibilities, when it comes to SRM, is to ensure that we don't repeat mistakes/mishaps that someone else in another squadron has learned the hard way and reported as a HAZREP or even a Mishap report. As an ASO, you are the primary conduit of safety information for your squadron. Reading the WESS reports is a great way to gain invaluable insight on mishap prevention…that is why the WESS system exists and why we spend so much time investigating and reporting!

If you don't read all of the safety reports coming out in WESS for your TMS, and ask yourself, "could this happen here", you are missing a big piece of the SRM equation. You have to ask the question… "Do we have the same preconditions and unmitigated risk factors lining up here that lined up in squadron X?"… Thinking in terms of Reason's Swiss cheese model here is appropriate. If you see the same "holes in the cheese" in your squadron, then it's time to do some SRM and come up with a mitigation strategy that fits your unit's needs. If you see those holes and you do nothing, then your squadron will be ill-informed and may in fact be at-risk of having a repeat mishap. Why do we write safety reports? Of course that is rhetorical…We write Safety Investigation Reports (SIR) and Hazard Reports (HAZREP) so that others may learn from the mistakes of the past and to prevent repeat mishaps….why else would we do it?

IN THIS ISSUE:

WINTER 2016

Special points of interest:

* Farewells
* The New ASM Course

FROM THE DIRECTOR (CONT.)

I have numerous examples of repeat mishaps, but I'll share one of my favorite ones to illustrate the point.

When I was in my Department Head (DH) tour in a VP squadron, our Avionics shop was doing some unscheduled maintenance on an aft radar on the ramp at night. During the course of this maintenance evolution, the ATs managed to slide the radome off the tracks and it fell to the deck, destroying the Magnetic Anomaly Detector (MAD) boom and the electronics inside. It was an instant Class C aviation ground mishap. During the course of the investigation, we discovered a few key factors (holes in the Swiss) that lined up and allowed this event to happen. First, the maintainers did not refer to the publications during the evolution. They had the pubs checked out, but they were not open and they were not followed. Secondly, the senior maintainer present (supervisor) had never actually done this evolution. Although he was qualified, he was not experienced enough for the job. Third, the maintenance control brief did not specifically cover the risk, even though the MC Chief knew exactly what happened when the mishap was reported by the maintainers…he knew they had skipped a critical step required when sliding the aft radome….to install the track safety pins!

Now let's fast forward about 4 years to my XO tour. During a normally scheduled safety standdown, I was assigned to lead a small group discussion with the Avionics Branch. I immediately thought about my DH tour and the mishap we had in the sister squadron and decided that would be perfect material for the discussion. Well to make a long story short, I was extremely surprised to find that not a single AT in the squadron had ever heard about that mishap, a mishaps that happened on the very same ramp just 4 years prior. In-fact, very few even knew about the aft radome track pin and their critical purpose! Now I fast forward another 5 years when I am working as the Director of Aviation Safety Programs at the Naval Safety Center. As I am perusing the latest edition of the RAAF Safety magazine ***Spotlight****, I find and article about the same exact mishap that happened on an Aussie P-3 in 2013! So why do we keep repeating the same events over and over again? Could this have been prevented by a simple HAZREP brief?* I believe it could have. How about some more formal risk controls? Required training for all ATs? A read and initial board? Maybe spot Checks (Safety Assurance) to see if guys are actually using the pubs while doing maintenance?

I truly believe we can do a great deal toward preventing mishaps by ensuring we are investing our efforts in a balanced manner across the SMS pillars. And if you really think about it, simply reviewing Mishap and Hazard reports for you particular airframe, and making sure that you are not at-risk of repeating the same event in your own squadron goes a long way toward not only the SRM pillar, but also the Safety Assurance and Safety Promotions pillars as well.

— CAPT Chris "SanDog" Saindon, USN — Director; Christopher.saindon@navy.mil

MAN
HUMAN FACTORS ANALYSIS AND CLASSIFICATION SYSTEM (HFACS) 7.0

I reported as LCDR Fatolitis' "Dr. Phil" replacement this past July. On board at the schoolhouse for a short 5 months I realize that I still am learning and have much more to learn about aviation and aviation safety. As I have gotten older and grown as a person, a scientist, and a military officer I have come to realize that the more I learn the less I know and this has been and will always be the case when it comes to Human Factors and aviation safety. As we learn more about what causes mishaps we find that new knowledge leads to more questions and that what we may have accepted as truth was in fact wrong. This is how science works and has always worked; we develop theories and models that account for much of what we know but as our knowledge changes so must our theories and models.

Recent advances in the Human Factors Analysis and Classification System (HFACS) to HFACS 7.0 is a great example of how scientists update and change their theories and models as new information becomes available. After examining years of mishap data it became apparent that modification to the existing HFACS model was needed. Several of the nano-codes were not being used and didn't seem to fit well with any of the mishap data and the structure was deemed cumbersome and difficult and needed to be streamlined so that it could be used by people who are not aviators. This led to changes that became HFACS 7.0. Now that HFACS 7.0 is the accepted tool across the Department of Defense being used to classify and catalog the contributions humans are playing in aviation mishaps, the question can rightly be asked now what? We have a great tool to use that will give us information about the human contribution in aviation mishaps but what should we do next? This is an excellent question and requires considerable attention and thought. We need something more than a kneejerk reaction if we ever expect to make head way in further reducing the number of aviation mishaps. Perhaps the single greatest limiting factor in advancing our understanding of Human Factors in aviation mishaps is the quality in terms of the reliability and validity of the data being collected (Figure 1). Unless we can collect data that is both reliable (i.e. tightly grouped) and valid (i.e. hitting the target in the center) every time we use HFACS 7.0 we will never be able to have a meaningful analysis of the data or trends. There is a saying in research about poorly collected data; "garbage in garbage out." Without meaningful data analysis of the Human Factors mishap trends we can never develop substantial programs to close the gaps in our Human Factors safety net.

Over the years we have developed programs to close these gaps such as Safety Management Systems (SMS), Crew Resource Management (CRM), and so forth. The million dollar question is, have these programs worked? And if so, how well have they worked? With reliable and valid data these types of questions are straight forward to answer. But unless we have solid data to work with we will continue to struggle to find the answer to our questions. As Naval Safety Officers you sit at the tip of the spear in this data collection effort. You have to become a mini Human Factors safety expert when investigating mishaps and apply due diligence when it comes to assigning nano-codes. When all else fails there are Human Factors experts at the Naval Safety Center and the Naval School of Aviation Safety that are available for consult. Working together we can make significant progress towards improving our Human Factors data and thereby improving the analysis of the data and the answers we are getting. As I close remember that each new day brings with it another opportunity to improve on our safety culture. Wishing all of you the best as we move forward into this New Year.

— LCDR Greg "Debbie" Gibson, MSC, USN — Human Factors Instructor; gregory.gibson2@navy.mil

MEDIUM — *SYSTEM SAFETY WORKING GROUP*

Aviation Safety Officers (ASOs) are trained at the squadron level on techniques to identify and mitigate risk in an effort to bolster their command's Safety Management System (SMS). Commanders are tasked with communicating their guidance and policy for acceptable levels of risk management to subordinates. At the NAVAIR level, System Safety personnel have the task of ensuring hazards associated with each system, subsystem, and component is identified, analyzed, prioritized and either eliminated or controlled to an acceptable level of risk. This information is utilized by the Program Manager for applying engineering and management principles, criteria, and techniques in order to achieve acceptable risk within the constraints of operational effectiveness, time, and cost. The aviation community, as a whole, has an underutilized tool at its disposal to bolster aircraft systems risk management – the System Safety Working Group (SSWG). The SSWG is an informal working group, representing organizations initiated during the system acquisition program, organized to assist the Type/Model/Series (TMS) Program Manager (PM) in achieving the system safety objectives of the customer – you, the fleet maintainers and operators.

Once a year (sometimes more depending on platform), NAVAIR engineers, prime contractors, System Safety representatives, Foreign Military Sales, your T/M/S class desk, and Naval Safety Center analysts get together with you, the fleet operators and maintainers, to discuss safety issues you are experiencing in your aircraft. The intent of the SSWG is to raise awareness to certain safety critical issues in your aircraft in hopes of funding research and development toward a mitigating solution. This process cannot fulfill its mission without input from fleet operators and maintenance personnel. These inputs come in several flavors – hazard reports, safety investigation reports, hazardous material reports, engineering investigations, and your "top 10" safety concerns. The formal fleet input process typically starts 90 days prior to the SSWG, but can always be communicated directly to the T/M/S System Safety representative at any time. A Naval message is sent out requesting "top 10" safety concerns from individual fleet squadrons. ASOs from the Wing and Marine Air Group gather responses and submit these individual squadron responses to the SSWG. The responses are then tabulated in order to create a master "top 10" list for your T/M/S.

During the SSWG, fleet operators get to make valuable contact with the Program Manager Chief Engineer, NAVAIR engineers, and the prime contractors (among many others) who design and test their aircraft systems and become educated on the progress made to mitigate the risks in our system. Maintenance personnel and aviators close the loop in the process by providing their feedback of daily operations and amplifying hazard report information to their System Safety representatives tasked with ensuring the safety and reliability of their aircraft.

The SSWG process does not effect change overnight, but it is an important first step to improve the safety of our aircraft. Talk to your Safety Center Analysts and TYCOM safety officers and find the date of the next SSWG conference. Query your squadron for inputs and plan on attending the conference with a maintenance representative to voice your squadron's and community's concerns.

— LCDR Julio "K.G." Ledesma, USN —
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MACHINE — *STALL AND STALL RECOVERY*

Stall recognition and stall recovery is a basic flight skill. It is taught in military primary flight training, it's required on a private pilot check-ride, and yet it is something that experienced pilots can and do get wrong, occasionally with catastrophic results. Pilot decisions during aircraft stall can be influenced by many factors including autopilot modes, fly-by-wire control laws, and other use and misuse of automated system. Aerodynamically speaking, stall occurs when an airfoil exceeds critical angle of attack (AOA). It isn't nearly so straightforward in practice, however. Aircraft without AOA indicators rely on stall speeds for prediction and planning, but those V-speeds correspond to critical AOA only under a certain set of conditions (1-G flight and a specified configuration). Even aircraft with direct AOA display still have a variety of factors that can cause an aircraft to stall at lower AOA than expected. Ice accumulation, leading edge damage, flight control degradations, and high altitude effects are examples. Asymmetric power conditions and sideslip also affect the stall characteristics of your aircraft as does maneuvering flight and g-loading.

The mishap report for Indonesia AirAsia Flight 8501 was released by the Indonesian National Transportation Safety Committee on Dec 7, 2015. Similarities to Air France 447 in 2009 are not subtle. Aircraft stall recovery procedures were not executed correctly by the pilot resulting in a deep stall, high rate of descent, and catastrophic impact. Not surprisingly, there were multiple compounding factors that added to the workload of the aircrew, in this case, trouble shooting a rudder limiter fail indication. That troubleshooting led to resetting two circuit breakers, an action which disconnected the autopilot and auto-throttles, as well as disabling some of the flight envelope protection features of the fly-by-wire control system.

The Commercial Aviation Safety Team formed a working group to study aviation mishaps and safety reports from around the world and released a report in 2013 entitled Operational Use of Flight Management Systems. The research focused squarely on use, design, regulation, and training with regards to automated flight systems. The recommendations for the training piece included maintaining hands-on flying skills and using Flight Mission Computers effectively but without over reliance or complacency. Misuse and overreliance on automated systems is a significant contributor to Loss of Control inflight incidents, a major cause of commercial mishaps. The Federal Aviation Administration has put specific training requirements in place with deadlines of 2019, as some of the mandates require updated simulator modelling in order to implement (not something that can be done cheaply or quickly). Several airlines have taken the initiative and already increased requirements for upset recovery training in their programs.

The military is generally much more proactive than commercial airlines with regards to stall and upset recovery training; of course with such a wide range of missions and aircraft in the inventory, this varies greatly by community. Modern military aircrews are trained to take full advantage of their flight related systems (autopilots, auto-throttles, flight directors, etc.) in order to load shed appropriately and prioritize whatever complex mission you have at hand. Many modern aircraft are purported to be stall resistant, or to have flight envelope protection, and the automated systems have become very capable in recent times. These factors can have a tendency to lead to an overreliance on automated systems. Fleet Safety Officers and FRS Instructors in particular are in position to identify these risks and propose community specific mitigations when appropriate.

Flight control laws on modern aircraft can be programmed to enhance safe operation, but as with any system they have limits and failure modes that must be considered. In just the past few months, HAZREPs from across Naval aviation have reported stuck flaps, slats failing to retract, runaway rudder trim, propeller damage due to rain, uncommanded roll, Flight Control Computer failure, 2-engine landing (on a 4 engine aircraft), abnormal rudder operation, short circuited trim switch, and starboard AOA probe and pitot tube damaged during aerial refueling. Sometimes relatively minor degradations can significantly affect flight control computers and systems, and can change the stall characteristics of your aircraft. It is important to continue reporting these incidents and sharing those lessons learned across the fleet. A proactive example from the C-37 community is a 2013 HAZREP recommendation for developing scenario based stall recovery training in the simulator; experiencing an unexpected stall warning is different than setting up in the normal stall initiation and recovery profile.

Stalls and departures have happened even in the most modern advanced aircraft; it is worth a little simulator time and wardroom discussion to refresh and maintain awareness of this very real hazard.

— CDR Jason "Casper" Bragg — FW Aerodynamics Instructor and Associate Director; jason.bragg@navy.mil

MISHAPS — *FROM THE NEW INVESTIGATIONS INSTRUCTOR*

I have had the pleasure of recently taking over the job as the Mishap Investigations Instructor here at the School of Aviation Safety. In the six months I've spent teaching future ASO's and Commanders the art and science of conducting investigations, I try to emphasize the basics. As I take ASO classes through the crash lab to study mishap aircraft, the majority of the students focus in on a drive shaft that has buckled or a piece of fuselage that shows evidence of fire. They spend the entire lab session focused on a specific part and miss the big picture. This translates to the real world when people arrive at mishap sites and get focused on one element- it could be something that they learned about in the structures course, or the search for a flight data recorder.

As an investigator you have to account for all of the major components of the aircraft; find the things that make your aircraft fly (i.e. engines, wings, rotor blades, and propellers). As overwhelmed as you may feel, take a breath and start by looking at the big picture and figure out the 5 W's. For all categories of mishaps, the investigative process remains the same:

Gather evidence in the form of records, pictures, videos, and witness statements.
Complete the 72 hour history of all crew members involved in the mishap.
Conduct an analysis of all the information using EI's, expert consultation, prior SIR's and HAZREPS, and AMB discussions.
Write and submit an SIR or HAZREP.

In the near future, I will continue to update and refine The Investigations Course. As I attend investigations courses from other branches of the military and civilian organizations, I will pass on lessons learned via my course and The Safety Sigma Newsletter. Please feel free to contact me with any questions or suggestions.

—Maj Maj Viet "Mahu" Tran, USMC — Mishap Investigations Instructor; viet.b.tran@navy.mil

CRM — *FUTURE CONSIDERATIONS TO NAVAL AVIATION CRM*

The Crew Resource Management (CRM) Schoolhouse is constantly seeking ways to improve CRM throughout the fleet. Through the Assist Visit process, we have discovered that the fleet has a solid understanding of the 7 skills and that aviators are continually becoming more effective in utilizing the precepts of CRM. Fleet CRM instructors' focus has been on adoption and implementation of these principals in order to reduce the rates of human factor related mishaps. As we review current mishap reports, it is evident that CRM breakdowns are often touted as causal factors. Because of the causality assigned to human factors, we must ask, "What can we do to invigorate the CRM program in order to protect the warfighter?"

Understanding how commercial aviation continually and successfully prepares their crews to deal with complex environments and systems is a proven model that we can emulate. The commercial sector is operating on sixth generation CRM (Figure 1), known as Threat and Error Management (TEM), Navy and Marine Corps CRM Fleet programs remain focused on fourth generation CRM (Figure 1). The sixth generation's concepts of TEM have been instrumental in helping lower mishap rates in commercial aviation, Navy leadership believes it can achieve the same reduction in mishap rates in Naval Aviation. The CRM Schoolhouse has been teaching the basic concepts of TEM for eight years; the Navy and Marine Corps are now beginning the process of fully integrating TEM as part of the vernacular of Naval Aviation.

The updated CRM instruction, *CNAF 1542.7B,* is currently awaiting stakeholder review and CNAF signature before release and includes Threat and Error Management as well as removal of the flight under evaluation for CRM Instructors, inclusion of Simulator Based Training commands, as well as updates for NAVAIR Enclosure (2), and the inclusion of an O-2 CRM Instructor waiver process. Incorporations of all these changes will help further improve CRM implementation in the fleet.

Change in policy is the first step of the process, leadership support and operational implementation is essential for the program to be successful. CRM is a behavioral modification program and should be adopted with the same priority as NATOPS, ORM and Tactics, an effective CRM program requires support from, and is reliant on, squadron leadership at all levels. In order to reduce mishaps, CRM has to become second nature, not an afterthought.

Every seasoned aviator would agree that successful missions rely on groups of teams working together. From maintenance, to the flight deck, from the controlling agencies, to the prepared aviator, each team must accomplish their individual missions to ensure the successful completion of the missions of other teams. Prioritizing and integrating crucial programs is critical to aviator development. By leveraging the TEM Triad (Figure 2) to develop a robust capability of squadron interoperability, efficiencies can be gained while increasing overall squadron readiness as well as a superior level of cooperation and dependability within the ranks. The triad concept is supported by the squadron Weapons and Tactics Instructor, Aviation Safety Officer, and CRM Instructor. The teams mutually support each other through the combination of resources in order to combat both the blue and red threats. By working together, they identify trends and find ways to mitigate human error.

True implementation of CRM in Naval Aviation is a daunting task; leaders that are proactive and passionate about these programs are the ones that truly form commitment from their sailors and Marines. Daily implementation and accountability are the tools of success. An environment that focuses on CRM, tactics and safety builds a culture of confidence and professionalism.

—Capt Justin Hall, USMC — CRM Instructor; justin.a.hall@navy.mil

Commercial Aviation CRM Generations

- 1st Generation – Cockpit Resource Management
  - Formal program to focus on human factors in aviation
- 2nd Generation – Crew Resource Management
  - Focus on more on specific aviation concepts and teamwork
- 3rd Generation – Broadening the Scope
  - Focus on specific skills and behaviors
- 4th Generation – Integration and Proceduralization
  - FAA mandated program
  - Integration of all flight crew
- 5th Generation – Error Management
  - Utilization of CRM to Identify/Manage/Reduce Error
- 6th Generation – Threat and Error Management
  - Includes Threat identification/management

Navy/Marine Corps CRM Generations

- 1st Generation – Research and Development
  - Intro to Naval Aviation
  - "One size fits all" concept
- 2nd Generation – Aircrew Coordination Training
  - First fleet integration
  - "Sell it to the fleet"
- 3rd Generation – Crew Resource Management
  - Full integration of 7 skills
  - CRM flight evaluations
- 4th Generation – T/M/S Specific
  - Focus on proper skill utilization
  - Start to incorporate Threat and Error Management into Naval Aviation

Figure 1 – Generations of CRM

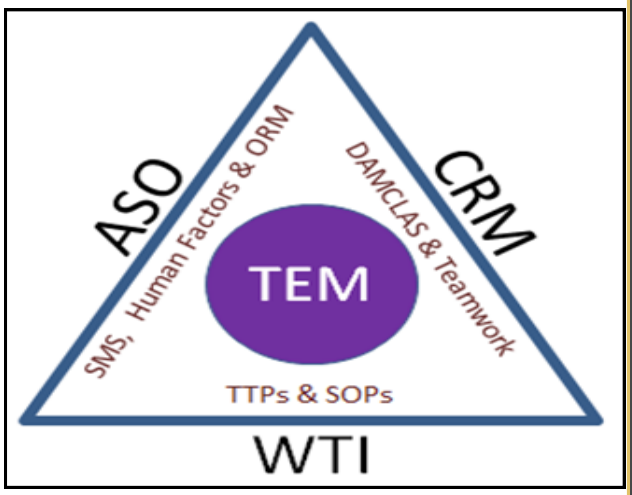

Figure 2: TEM Triad - The mutual support of people and programs within TEM framework. Resources combine in the aviation unit to combat both the Blue and Red Threat.

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"Doc" Bank Memorial Award

The *Milt "Doc" Bank Memorial Distinction*, recognizes the student or students in each graduating ASO class who best exemplify the characteristics of the late, great Milt "Doc" Bank, PhD: motivation, intelligence, imagination and aptitude to be a potential future ASO Instructor. The recipient of this award for ASO Class 16-1, the winner was ***LT Levi Lundell***, USN; for ASO Class 16-2 the winner was ***LCDR Jason Rogge***, USN.

If you would like to be removed from future emails, please email LCDR Winstead (info above) with name and approximate

The Safety Sigma is published quarterly by the Naval School of Aviation Safety located at NAS Pensacola, Florida. If you have a question for the staff, or are interested in attending Aviation Safety Officer, Aviation Safety Command, or Crew Resource Management Instructor training, please visit our website at http://www.public.navy.mil/navsafecen/Pages/aviation/SAS/index.aspx or call (850) 452-3181. **If you would like to submit** a short article for publication, please contact LCDR Richard "O.B." Winstead at richard.winstead@navy.mil.

SPECIAL POINTS OF INTEREST

HAILS AND BAILS

The SAS said farewell to two long-time instructors this winter:

CDR Gerald "Pee Wee" Hermann USN
LT Mark "Milk" Demann, USN

Thanks to all for your outstanding support of SAS and our fleet safety cultures at large!

NEW ASM COURSE

After completion of the initial pilot course, the SAS successfully conducted the first Aviation Safety Manager (ASM) course November 16-20 2016.

The Aviation Safety Manager Course is designed to prepare mid-grade officers as ASOs in the policy, implementation, and management of an effective Base, Staff, MAG, or Wing Aviation Safety Management System.

If you are interested in attending the ASM course, please contact Dr. Robert Hahn via email at: sas_programs@navy.mil

SAS FACEBOOK PAGE

The Official SAS Facebook Page can now be accessed at

www.facebook.com/navysafetyschool

Be sure to "Like" us in order to immediately receive important information and articles relative to your job, your community, and the School of Aviation Safety. Your level of involvement can make this a truly worthwhile online community of aviation safety professionals. This is soon to become the primary way of announcing new issues of the Safety Sigma, so please join our Page.