Flight Test News

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Spotlight – Flight Test Safety Committee Board of Directors

This week, flight test professionals from all over the world convened in Scottsdale, Arizona for the annual Flight Test Safety Workshop. This workshop is one of many services that the Flight Test Safety Committee has provided to the flight test profession since its inception in 1994, when the Society of Experimental Test Pilots, the SFTE, and the AIAA banded together. The FTSC Board of Directors includes several distinguished SFTE members, like John Hed, an FAA employee in Seattle's certification office. In addition to providing specific input for this edition's focus on flight test safety, John agreed to share some more about himself.

FTN: What have you seen in other newsletters or publications that you think FTN should adopt?
JH: How about a "Lessons Learned" blurb each issue? Someone could contribute a war story (appropriately sanitized) that had some good lessons learned. I want to start feeding these into the FTSDb (http://ftsdb.grc.nasa.gov/). In each issue you could ask the membership for some lesson learned from a specific test and publish it in a subsequent issue.

FTN: If you could give your younger self advice based on what you know right now what would it be?
JH: Work as many different programs as you can. Don't get stuck in a long project forever. The minute you feel comfortable doing your job, move on to another challenge. ***FTN:*** Yes, because "getting comfortable" is also a sign that we may not be taking the flight tests risks as seriously as we should too.

FTN: On a personal note, if money was no object where would you travel?
JH: The moon (if that is acceptable), but if it has to be terrestrial, I'd say Machu Picchu. ***FTN:*** "The moon" is exactly how I answered it the first time, but my wife told me that didn't count. I have to say that I've learned a lot of geography in these interviews, and this looks like a fascinating place too.

FTN: What flight test project would you work on if time, money, and difficulty were not constraints?
JH: A supersonic biz jet turns, if it comes to fruition.

FTN: What critical issues are you currently facing?
JH: First, the desire to do less flight test because of cost and safety and use more simulation versus the need to thoroughly flight test the product. There are still lots of areas that the simulator cannot duplicate very well. Second, with the proliferation of fly-by-wire, the old standard *critical condition* (e.g., aft cg) isn't necessarily the worst anymore!

FTN: What practical approaches to flight test make the most sense that are worth sharing with others?
JH: Plan the flight—fly the plan! Never assume everyone else is doing their job. If you have the bandwidth, back-up other people around you.

Flight Test Safety Committee
http://flighttestsafety.org
Flight Test Safety Database
http://ftsdb.grc.nasa.gov/

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What is the goal of flight test safety?

We were sitting around the office, talking about our mental image of a perfect training environment, sorting through our experiences and perceptions of the world, trying to find an example. In fact, we mentally opened up the box, encouraged ourselves to think outside of it, and even considered non-aerospace organizations: How about the US Navy SEALs? Does Starbucks have an effective corporate training and development program that we can emulate? As we talked about training, the subject of flight safety and test safety came up too. How do you teach safety? And do the goals of a training program align with the goals of a safety program? A couple of ideas percolated to the top of our minds, mission statements, things we'd heard or read, mantras that sounded like, "be the best at…" and "The premier flight test organization…"and even one closer to home, "promoting flight safety…" and so on. There's a problem with this kind of broad and general thinking though: It doesn't give us any idea what we should be doing (and shouldn't be doing) to accomplish the goal of safety. For example, here is a "blurry vision" that confuses rather than directs those that hear it, an example from the book *Made to Stick*, by Chip and Dan Heath.

> "Consider a software start-up whose goal is to build 'the next great search engine.' Within the start-up are two programmers with nearly identical knowledge, working in neighboring cubes. To one 'the next great search engine' means completeness, ensuring that the search engine returns everything on the web that might be relevant, no matter how obscure. To the other it means speed, ensuring pretty good results very fast. Their efforts will not be fully aligned until the goal is made concrete."

The authors spend an entire chapter explaining what they mean by concrete and why its important, but what follows is one of the more helpful examples.

> "When Boeing prepared to launch the design of the 727 passenger plane in the 1960s, its managers set a goal that was deliberately concrete: The 727 must seat 131 passengers, fly nonstop from Miami to New York City, and land on Runway 4-22 at LaGuardia. (The 4-22 runway was chosen for its length–less than a mile, which was much too short for any of the existing passenger jets.) With a goal this concrete, Boeing effectively coordinated the actions of thousands of experts in various aspects of engineering or manufacturing. Imagine how much harder it would have been to build a 727 whose goal was to be 'the best passenger plane in the world.'"

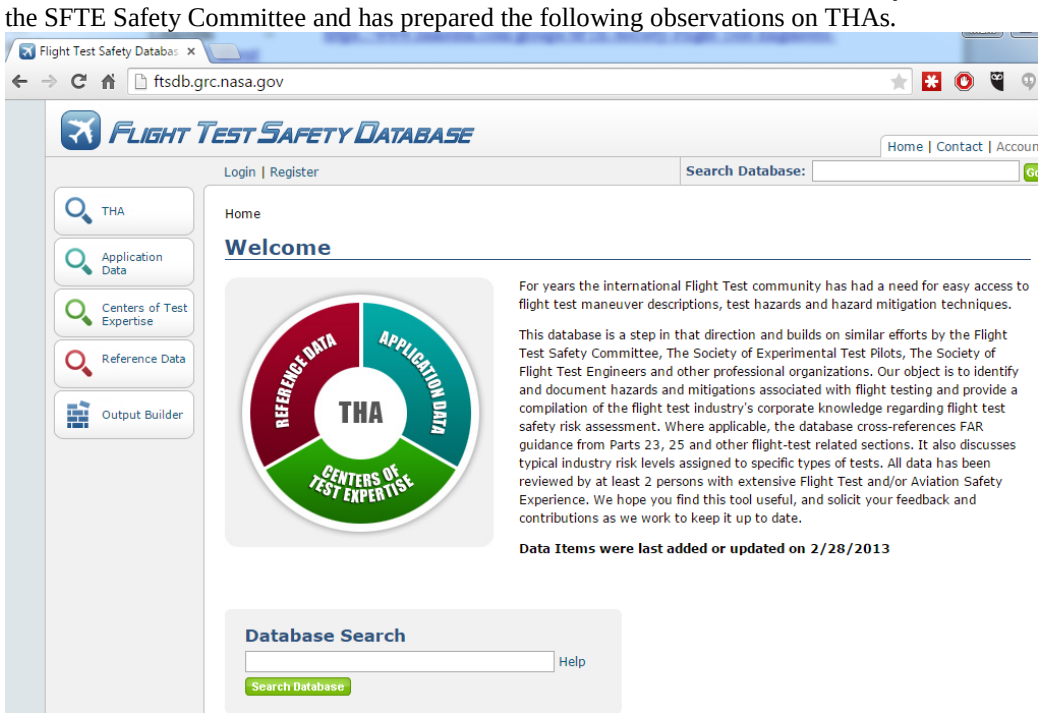
Do these examples help us formulate a useful, meaningful goal for our flight safety efforts and avoid a vague one? Exploring that question is the purpose of this edition of the *Flight Test News*, and we hope it will open up a dialogue about what's right, what's wrong, and what we might accomplish better. I think that in some cases, it's going to be painful, like ripping off a band aid. It might even force some of us to revisit dark places in our memory and experience. But I think it's worth it. Consider these words from USMC General Mattis:

> "The problem with being too busy to read is that you learn by experience, i.e., the hard way. By reading, you learn through others' experiences, generally a better way to do business, especially in our line of work where the consequences of incompetence are so final…"

Mattis comments were intended for the study of military history, but we can directly apply his lesson to the exercise or reading and discussing the accidents of our past. Taking the time to figure out "where we are going" and "why" is important, because the work we do is too dangerous to accept "promoting flight safety" as our goal.

Better THAs

One of the resources available to all members of the aerospace community is the Flight Test Safety Database, as seen below. NASA hosts this website, a project sponsored by the FTSC. The database provides a search function for test hazard analyses (THAs) with a variety of useful filters. The test community would benefit greatly if users "played with" the database, learned its features, and populated it with improvements and new THAs. John Hed and Ralph Mohr are two current members of the FTSC Board of Directors with whom FTN spoke in preparation for this edition, and they could not say enough by way of encouragement to SFTE members, about the database. In addition, SFTE Board of Directors member Bill Jaconetti is currently the chair of the SFTE Safety Committee and has prepared the following observations on THAs.



Flight Test Safety Risk Management and Test Hazard Analysis (THA) by Bill Jaconetti

A critical part in the planning process for any flight test is the Test Hazard Analysis (THA). If you are part of a military program, work at a major aircraft manufacturer, or have just been around flight test for a while, chances are you have a process in place to help guide THA development. This article is not meant to replace procedures your group may have, but to illustrate some best practices and relay the frame of mind I get into when doing a THA.

Hazards and Risks. To best understand how to develop an effective THA, we need to first talk briefly about hazards and risks. A hazard is a present condition that could contribute to an undesired event, such as an accident. Risk is the future impact of a hazard that is not controlled or eliminated. It can be thought of as the future uncertainty created by a hazard. In general, risk can be expressed as follows.

Risk = (Hazard) x (Exposure to the Hazard)

Identifying Hazards. The hazards need to be identified and analyzed to develop a risk profile for an individual test. This step deserves much of our focus and concentration. In the wake of the Apollo 1 disaster, NASA suggested this:

> "What we really learned from the Apollo fire, in the words of [former astronaut] Frank Borman, was the *failure of imagination*," said William H. Gerstenmaier, NASA's associate administrator for space operations. "We couldn't imagine a simple test on the pad being that catastrophic.

"The failure of imagination." What a powerful phrase! What it means is that the complexity of aircraft design, the proliferation of software based systems, etc.—all of these things create hazards that we haven't even begun to imagine.

There are three main steps I use when identifying the list of hazards that go into a THA:

1. The bottoms up review of the test plan
    a. Focus on the plan, the system under test, the environment, and other unique factors that may present hazards in the test.
    b. Some hazards are the result of aircraft (im)maturity, and some are the result of exposure, i.e., danger inherent in a maneuver. (The former hazards may not present as much risk as the latter after development testing is complete).
2. Other Resources
    a. Your experience
    b. The experience of your teammates and/or organization (similar tests on other projects/programs)
    c. Industry Guidance (FAA Order 4040.26, US Navy/US Air Force Equivalent)
    d. Other industry specialists
    e. THA databases (NASA/Flight Test Safety)
3. Brainstorming
    a. Step back and think: what else can happen that is unique to this test?

All three of the steps are important in developing a comprehensive list of hazards. Using only what was done in the past, just like ignoring past plans can leave you with an incomplete list. Finally, a hazard should have a consequence associated with it. The consequence is what will happen to the system under test and/or crew if the hazard occurs.

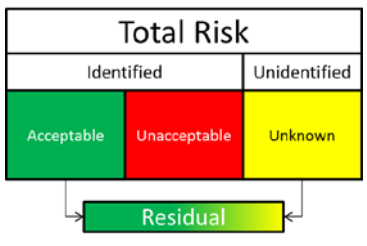
Turning Hazards into Risks

Once hazards are identified and analyzed, the next step is to generate the risk level for the hazard. Per the definition above, to establish the risk level, the exposure to the hazard has to be quantified. For example, your exposure to a loss of control hazard may be significantly lower for a test that integrates a new display than it would be if your plan contains stall testing. Further, THAs should not include hazards that are part of normal flying. All THAs should be specific to the testing involved. For example, even though bird strike can always be a problem, a function and reliability test might not need a risk for bird strike. However, if you are doing low altitude flight testing for a Ground Proximity Warning System it may be appropriate to have a hazard for bird strike since the test drove specific exposure to the a hazard that was above and beyond normal flying.

The combination of the likelihood and the consequence can help you to assign a risk level. There are many published examples of likelihood vs. consequence tables that are available for translating hazards into risks, but most have high/high resulting in High Risk, and low/low at Low Risk with a standard distribution in between.

Mitigating Risks

When the risk levels are understood and assigned, it is time to mitigate each risk. In some cases the risk from a hazard may still be high, but the key is that it was brought to an acceptable level of risk. You can think about total risk as being a combination of the Identified and Unidentified risks (see graphic below). Of those identified, there are acceptable and unacceptable risks. We don't test with unacceptable risks. The combination of the acceptable risks and the unknown risks, defined as the residual risk, is what we accept when we go test. All of the steps listed above can help to drive that area of unknown/unidentified risks to be as small as possible.



The mitigation steps for each risk can come from many places. Mitigation may be based on analysis or reports from other engineering disciplines, ground testing, specific training or a multitude of other risk management processes. Be as specific as possible to your application and avoid the temptation to just re-write the standard mitigation you may have used before. Also, the mitigation steps will likely be read many, many times throughout your program, so be as succinct as possible. This is not the time to be wordy!

Organizing the THA

Regardless of whether your THA is resident in your test plan or in some separate document or database, it is critical to tie a THA to a specific type of test. Additionally, each organization should maintain a master list of THAs to ensure consistency between test plans with similar hazards. There may be some hazards that are general to the program, and those will be tied to any flight, but most will be test specific. By creating a coherent link between a THA and a type of testing you can ensure that when planning an individual test, you capture all the THAs needed and none of the ones that are not applicable.

As a final thought it is easy to get caught up in the THA and risk management process, but we always have to remember that our job in the end is to test these systems. There will be risk, but in the balance between test efficiency and safety, it is the test team that identifies and manages risk most effectively that will ultimately be the most successful.

The annual Flight Test Safety Workshop just wrapped up a week of presentations in Arizona. During that time, the FTSC presented the annual Tony Levier Flight Test Safety Award. While the timeline for the event and the presentation of the award did not coincide ideally with the publication of the FTN, the Committee members did encourage us to publicize the annual conference and award. It's not too soon to start thinking about next years Workshop—often the approval process at many OEMs will require a year of lead time.

The website announcement for both the workshop and the award is flightestsafety.org.

Bill Jaconetti, who chairs the Safety Committee for the SFTE Board of Directors, was present at the conference. Contact Bill via email: director2@sfte.org.