Variance Management : : Centerline for Safety

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Peter v. Agur, Jr., President
The VanAllen Group, Inc.

We can no longer afford evolutionary improvements in aviation safety. Bent airplanes will soon litter the countryside-unless we do something revolutionary.

Never mind that the accident rate is at an all-time low. The growth in flight activity is outstripping recent improvements in safety. The forecast for dramatic increases in flight hours, multiplied by a slowly improving accident rate, will equal large numbers of broken aircraft.

Never mind that professionally flown aircraft are the safest travel mode yet devised. Our passengers' perceptions of safety will be pounded into the pavement as they peruse press reports of the human pain and suffering each aircraft accident produces. *Unless we do something revolutionary.*

For its first half-century aviation safety has benefited from two revolutionary improvements to flight operations.

The First Safety Revolution - Mechanical

When my grandfather flew for the RCAF, during the War to End All Wars, he was more apt to be brought down by some failure of his aero machine than hostile fire. Underdeveloped aircraft designs, flaws in structural integrity, and poor engine durability each contributed to large numbers of unscheduled off-aerodrome arrivals.

By the early 1940s, when my father flew off of cruisers, enough improvements in aircraft design and manufacture had occurred that airframe failures were rare. Later, during the 1960s, while flying for United Airlines, Dad enjoyed the fruits of one of the greatest mechanical advances in aviation yet, the turbine-powered engine.

The first revolution in aviation safety has been mechanical. Compared to the aircraft of my grandfather's and father's era, the machines we enjoy today are wonderfully easy to fly and phenomenally reliable. Mechanical malfunctions, including engine failures that lead to accidents, are now extremely rare. In fact, today we have people who go through their entire careers without ever experiencing a significant airframe or power plant problem.

The Second Safety Revolution - Flying Skills

The next revolution in safety focused on piloting or stick and rudder, (or antitorque) and procedural skills. In the late sixties, full-motion simulators with good visual systems became available for airline equipment. At that time, dad was one of United Airline's flight instructors at the Denver training center. He and a few other instructors were tasked with bringing the new DC-10 on line. Their DC-10 full-motion simulator was the first of its kind in their inventory. They flew the hydraulic pistons off that thing preparing for their first aircraft to be delivered.

As that day approached they scheduled their FAA check rides. Dad was first. His ride went well. When he parked the aircraft back on United's ramp the regional inspector asked dad for his logbook to sign him off. After scanning the pages the inspector admitted he couldn't find any DC-10 flights, much less landings, documented. He asked dad why he hadn't kept his logs up to date. Dad had. The landing they had just completed was his first in the airplane. But simulator-only training had not yet been approved. This particular Inspector must have had a sense of humor because he told dad to log two more landings and he'd sign him off.

With the revolutionary advances brought on by current technology simulators, we aviators have lost all our excuses for abusing the aircraft or mishandling unusual circumstances. In fact, most accidents today have less to do with airmanship and emergency procedures than they do with cranial vapors. About 70 percent of today's accidents are crew-sourced.

Why Do We Need a Third Revolution?

Don't misinterpret that 70 percent statistic. The rate of human error as a leading cause of accidents has not grown. In fact, the rate of crew error has diminished over time. But the other causes of accidents have declined so dramatically that the relatively slow rate of improvement in crew performance is striking.

Since the 1970s aviation has made a number of important gains in safety. These advances have been tenaciously pursued and the net gains have truly been impressive. Accident investigators and safety experts have studied accident histories carefully and isolated the most significant causes. They have then pursued the fixes for one cause after another.

Consider the efforts, and improvements we have taken in the arenas of:

1. Teamwork and communications failures with Crew Resource Management (CRM);
2. Midair collisions with the Traffic and Collision Avoidance System (TCAS); and
3. Sudden granite impact with Controlled Flight Into Terrain (CFIT) procedures coupled with an Enhanced Ground Proximity Warning System (EGPWS).

Currently under study are the causes and cures for the highest statistical source of accidents, approach and landings. The Flight Safety Foundation is supporting an international cross-industry effort for Approach and Landing Accident Reduction (ALAR).

Each of these safety achievements has been phenomenally important. Each of them has also taken a great deal of time and, in some cases, investment to make its intended impact. And each of them has, and will, save untold thousands of lives.

But each of these achievements is incremental. They address specific failures and their causes one by one. They have been evolutionary in nature. Future improvements in the current "low" rate are going to come slowly and at even greater costs to our capital budgets.

Yet, the current growth rate of commercial and corporate aviation will cause today's accident rate to leave bent aluminum and bodies scattered throughout the countryside in just a few short years. We don't have time for major improvements to evolve. We need to do something revolutionary…NOW!

The Next Revolution in Safety - Variance Management

Safety is not an event. Safety is not a deliverable. Safety is a condition of specified performance. We cannot "manage" safety. What we can manage are the flaws or errors that can accumulate and degrade the margins of safety and lead to operational failures.

With that in mind, like most "revolutions", the dust this one is kicking up can be seen all around us. It is a revolution that has already made great improvements in neighboring arenas-in other industries. And like most great ideas, it is deceptively simple in concept. It is Variance Management.

During the late 1970s and early 1980s we were being told that the United States' dominance as a world leader in manufacturing had come to an end. Our productivity and quality were, depending on the ratings, no better than third, fourth and even fifth in the world. We had fallen and were not expected to get up.

Today, we have regained our leadership in productivity and quality even as standards are being set ever higher. How did that happen? The same revolutionary way we can make dramatic improvements in safety. By shifting our sights from preventing failure to that of assuring success. Here is how it worked for the manufacturing industries.

In the 1960s, to get 100 good units delivered to their customers, manufacturers would build 105 units because the expected failure rate was 5 percent. Inspection processes were used to identify the bad units and reroute them for rework or destruction. Even so, faulty units that still got through the system dissatisfied customers.

To address the problem we improved the quality control and inspection processes. Laser measurement systems and computer-aided manufacturing helped. But these steps were designed to compensate for the human element-prevent operator error. The ultimate objective would be to take the operator, his costs and his errors, out of the system. "Fully automated" manufacturing systems continue to evolve but, given current technology and budgets, there are still limits.

The obvious follow-on was to reintroduce the operator back into the system through the concepts of teamwork and high-performance work teams. Machines, including computers, perform repetitive tasks in a stable environment very well. People perceive, collate information, and make decisions very well. People teamed with technology have greatly improved the productivity and accuracy of manufacturing operations in simple or non-dynamic environments.

But in complex or dynamic operations the failure rates continued to be excessive. Automobiles and aircraft, for example, were getting better but not as good as customers expected. Then Dr. Deming and the Japanese introduced us to the answer-process management with continuous improvement.

The latest iteration of process management is ISO 9000. ISO 9000 is the certification of full documentation of a manufacturing process from beginning to end with high emphasis on measurements, identification of variances, and improvement (adjustments or corrections) as integral elements of the process. As a result, the end product is exactly to ISO specification.

ISO works great in an ongoing complex manufacturing environment. What about service businesses like air travel? How can the ISO concept work there? In many ways, very similarly. In fact, service processes can be certified under ISO 9002. A number of high-repetition services functions have already been certified under ISO 9002. The first ISO-certified business aviation organization, UTFlight, achieved this hallmark last year. Others, like the Philip Morris flight department, are actively gathering information about the costs and benefits of ISO 9002 certification. Their efforts are to be applauded!

However, there are risks associated with labeling ISO 9002 as "the answer" for aviation safety.

First, ISO is process focused. This means it is most effective in an environment where the outcomes or deliverables are routine or consistent in their specification. This could lead to some interesting challenges in business aviation because our customers are an "input" to the process, but they also are capable of redefining the deliverables or outputs at any time.

Second, strict adherence to ISO-documented and approved processes can cause flight department members to do the wrong things correctly. For instance, some time ago one of the engine manufacturers asked an associate of ours, Dr.

Roy Autry, for help in reviewing their new production facility for opportunities to improve. Their state-of-the-art operation and organization was designed to create engines of the highest quality while employing the smallest workforces for the plant's size. They were not delivering on that expectation. Roy is a firm believer in finding out what the outcomes need to be before he looks at processes and resources. After all, if you don't know where you are supposed to end up, how can you figure out where you want to start (input or resource definition), much less how you are going to get there (organization and process design)?

After Roy determined the output specifications for the engine manufacturing and assembly processes, he began to walk his way through the production line, from end to beginning. His asked each worker what he or she did. At one station he observed a young man operating a machine that twisted the turbine's compressor blades to the specified angle. Roy asked him how much twist he was adding to the original, or manufactured, blade twist. He responded he consistently increased the pitch of each blade by four degrees. There was no variance from one batch to the next.

As Roy continued his tour he came to the area where the blades were produced. He asked the fellow running that machine for the specification for the blade angles. It matched what was being received at the blade twist point. Roy asked the young man if there was any reason why the blades could not be produced with four degrees of additional twist in them. No, but that was not the production specification. After Roy introduced the two guys to each other, they went to meet with the plant manager. The end result was improved quality, reduced labor and time for production, and one of the guys got moved to another job.

This is a classic example of doing things right but not doing the right things. Similarly, blind adherence to ISO doctrine could lead a flight department down a rigid path to customer dissatisfaction. An ISO risk is that it can be applied with an inward focus to the processes to the exclusion of the customer's changing needs. That kind of myopia could lead to fatal service errors for a corporate flight department, a charter company or an airline.

Third and most important, there are more than 6,000 corporate flight departments operating turbine equipment in the U.S. alone. Of that number, about 60 percent are single-aircraft operators. The vast majority of those smaller departments do not have the resources needed to achieve ISO certification. In fact, I doubt that even one percent of turbine aircraft operators in the U.S. will achieve ISO certification during the next few years. Therefore, ISO's substantial benefits, including improvements in safety, will be lost to most companies and their flight departments.

As an example, aviation has a large set of sources for variances such as weather, ATC, our aircraft, its subsystems, the customers, and even the service delivery team (flight crews, maintenance technicians and schedulers). The documentation of the processes necessary to handle the expected variances is an admittedly Herculean task. Just ask the folks at UTFlight. The shear burden of the ISO process is a barrier for most flight departments. Its benefits will be limited to only the largest and most well-endowed departments. That isn't good enough.

Variance Management Made Easier

Rather than give up in the face of the massive administrative burden of achieving ISO certification, we can make use of what ISO has to offer. The entire ISO process has one objective: to eliminate variances. And, isn't that what the "error chain" is, a series of variances? For decades aviation safety gurus have preached the gospel of breaking the error chain. The members of the choir have responded time and again with one grand solo effort after another (TCAS, ESPWS, et al). Variance management invokes the entire choir.

If we can systematically identify and correct variances as they happen, we will routinely disrupt the error chain at its earliest links. In doing so, we will achieve the next great improvement in safe performance.

Variance Management processes for flight departments large and small uses the concepts of ISO 9002 and applies them in a focused fashion. It starts with the customer and assumes the customer defines the outcomes (deliverables). The systems and processes are applied to create those outcomes in the most effective manners.

Many of the benefits of ISO 9002, including improvements in safety, are available through Variance Management without the extreme efforts required for ISO certification. The process for establishing Variance Management is straightforward:

1. Clearly identify, in measurable terms, the parameters for a successful outcome. These elements include, but are not limited to,
2. Effective gathering of all necessary customer information, arrangement or assurance of ancillary services such as ground transportation, etc. (scheduling elements),
3. Proper preparation of the aircraft-fuel load, maintenance status, etc. (maintenance elements),
4. Delivery of the services-expeditious departure and timely arrival, smooth flight, etc. (flight crew elements), and
5. Trip administration-accurate and timely billing, management reports, etc. (leadership and administration elements).
6. Map the ideal process flow for each of the trip elements. This defines the centerline of your trip process "runway". Most companies have gone through process improvement efforts and internal process mapping gurus in-house. Seek yours out.
7. Locate on the process map the critical event points (where a variance is apt to be most disruptive) and the points where variances are most likely to occur, like the handoff point from one process team to another, i.e., maintenance to flight crew. Note that variances can be induced by internal or external inputs. Critical event points are where you may have a sudden divergence from your process "centerline". Knowing where they are allows your team to anticipate and respond quickly and appropriately.
8. Reinforce these critical event points with improved or enhanced processes AND back them up to assure the results you need. This will minimize divergence from process centerlines, and support the return to centerline when a variance begins to take effect.
9. Define the point beyond which a variance can cause you to alter the definition of the initially intended outcome. There can be times when a variance is so great that the original objective is no longer achievable or desirable. At that point it may be necessary to redefine the objective and its centerline process. For instance, a crew approaching an airport covered by a thunderstorm may need to redefine its destination or its arrival time in order to be successful. Going to an alternate is not a failure; it is an adjustment of the trip's objectives based on variances (severe weather) beyond the control of the crew.

10. Create measurements for each of your processes: scheduling, maintenance, flight and administration. This will allow you to understand when and how variances are occurring, and give you the opportunity to continue to improve your processes and resources as you work to stay on centerline.

This five-step process for establishing Variance Management is not revolutionary. Its application in an aviation service environment is.

You and your company have probably already invested the time and money in the technology of warning systems like TCAS and GPWS. But trying to prevent every form of failure is not enough-it is time to assure your flight service's success. It is time to make the modest, and possibly even more effective, time and effort investment in Variance Management.