Dying to Get There?

Risk reduction for **single-pilot ops**

EXTREME-PHOTOGRAPHER/ISTOCKPHOTO

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LeBron "King" James and his Cleveland Cavalier teammates were engaged in a pitched battle against the Boston Celtics on the evening of Thursday, Dec. 29, 2016. Longtime Cavs fan John Fleming, president of Columbus, Ohio-based Superior Beverage Co., was among the crowd at the Quicken Loans Arena in downtown Cleveland, celebrating his birthday with his family and friends.

Earlier that evening, Fleming flew from Ohio State University Airport (KOSU) in Columbus to Cleveland Burke Lakefront Airport (KBKL) in his newly purchased Cessna Citation CJ4, with his wife Suzanne, sons Jack and Andrew, friend Brian Casey, and his daughter Megan. The game was close, but ultimately the Cavs prevailed over the Celts 124 to 118. Fleming was elated. But he also may have been fatigued as he'd been up since early morning.

The Fleming party left right after the game and drove back to Lakefront to board their aircraft for the 30-min. hop back home to Columbus. They arrived back at the FBO about 10:30 p.m.. While the city lights could be seen along the shoreline, it was inky black over Lake Erie, with low clouds at 1,500 ft. and 2,300 ft. obscuring the crescent moon. Intermittent snow showers created marginal VFR visibility before the flight, but the precipitation stopped before the aircraft departed KBKL.

Fleming had logged more than 370 hr. in a Citation CE510 Mustang in the previous two years, but he had earned his CE525S type rating just three weeks prior to this night flight. His CJ4 training and PIC check had been accomplished in his own airplane rather than at an FAR Part 142 simulator training center. He had logged a scant 8.7 hr. in type as pilot in command, including his check ride. His total flight time in a CJ4 was just over 56 hr.

And in his single-pilot jets, Fleming was consistently taught by his instructor to engage the autopilot after takeoff and use the aircraft's flight guidance system to fly it to near touchdown, according to the NTSB. He was not accustomed to flying the aircraft by hand for prolonged periods.

This created a potentially fatal automation trap. The Garmin G1000 glareshield flight guidance control panel in Fleming's Mustang and the CJ4's Rockwell Collins Pro Line 21 control panel have different layouts. In the Mustang cockpit, the autopilot and yaw damper engage buttons, respectively, are on the left and right, near the bottom of the panel. Aboard the CJ4, the autopilot and yaw damper buttons are on the right and the left, near the top of the panel. Muscle memory from the Mustang could lure a pilot into thinking he'd pressed the autopilot engage button in the CJ4 when he'd only engaged the yaw damper.

Both aircraft, though, have prominent automatic flight guidance system mode annunciators displayed at the top of their PFDs that provide visual confirmation of selected and active modes.

Cleared for takeoff on Lakefront's Runway 24R at 10:55 p.m., Fleming began his takeoff roll a minute later. Tower instructed him to turn right to 330 deg. over the lake and to maintain 2,000 ft. The aircraft soared aloft at better than 6,000 fpm, with the aural altitude alerter cautioning Fleming that he was approaching level-off altitude 21 sec. after liftoff.

The aircraft ballooned through the assigned altitude and a second aural "altitude" alert was triggered 14 sec. later. Fleming pulled back on the thrust levers a few seconds later. But the aircraft started to roll, causing the enhanced GPWS's synthesized voice to warn "Bank Angle, Bank Angle."

By now, tower was quite concerned that it had apparently lost radio contact with Fleming. Ten seconds after the "Bank Angle" warning, the EGPWS warned, "Sink Rate, Sink Rate." Six seconds later, it started to repeatedly warn, "Pull Up, Pull Up" at 1.6-sec. intervals. Then, the overspeed warning was triggered as the aircraft accelerated through its 260 KIAS low-altitude redline.

Bank angle increased to 62 deg. and the aircraft slowly pitched over to 15-deg. nose down. While Fleming reduced bank angle to 25 deg., he did not arrest the acceleration or descent. Speed now topped 300 KIAS and the aircraft plunged down at 6,000 fpm. Less than 90 sec. after the aircraft began its takeoff roll, it crashed into Lake Erie, killing all on board.

The NTSB concluded that Fleming "likely experienced some level of spatial disorientation" and that he also perhaps thought the autopilot was engaged when it wasn't. It was easy to mistakenly press the yaw damper button on the Pro Line 21 flight guidance panel instead of the autopilot button because of the differences in cockpit layout between the CJ4 and the Mustang. Contributing factors were found to be pilot fatigue that "hindered his ability to manage the high workload environment," his failure to maintain an adequate instrument scan and his failure to respond with "prompt and accurate" control inputs to the warnings he was receiving from the avionics system, according to the NTSB.

The Startle Factor in IMC — Quickly Reverting to Standby Instruments

Don Baker, a successful commercial real estate developer and community philanthropist in Tucson, Arizona, and his wife, Dawn Hunter, were returning home in January 2016 from a general aviation safety conference in the Utah mountains. Rated as an airline transport pilot, Baker had logged more than 3,300 hr. total, of which almost 1,600 hr. were in his CE525 CitationJet.

The 1999 aircraft was originally equipped with Bendix/King CNI 5000 Silver Crown panel-mount avionics, but it had been upgraded with a pair of Garmin touchscreen GTN750 GPS/COM/NAV/MFD units and two Garmin GTX-33 Mode S transponders in October 2014. It also had the standard-fit SPZ-5000 integrated flight guidance system featuring left-side EADI and EHSI and standby attitude indicator. The flight guidance system and autopilot require two vertical gyro sources and a single directional gyro to function properly. It also has an analog air data system. The aircraft had been upgraded with dual Honeywell Ametek AM-250 digital air data altimeters for RVSM operations, units that also were linked to the Garmin GTX-33 transponders for Mode C altitude reporting. The left side AM-250 also supplied air data to the flight guidance system. Other mods included a Shadin ADC-200 fuel flow system and Garmin XM satellite radio weather receiver.

Baker completed semi-annual recurrent training at a Part 142 simulator training facility in August 2015. But the training facility didn't have a CitationJet simulator equipped with the non-standard Garmin avionics or the other instrument panel mods. Rather, it had the original SPZ 5000/CNI 5000 package. And the sim training center didn't provide any specific Garmin avionics training during ground school.

Baker and his wife departed Salt Lake City for Tucson on an IFR flight plan at about 09:50 a.m. on Jan. 18, 2016. Ten minutes later, he and his wife were killed in the CJ, as detailed in *BCA*'s January 2018 *Cause and Circumstance* report (page 26).

The weather conditions for the initial part of the mission would have been challenging. There were cloud layers at 3,000 ft., 3,500 ft. and 4,000 ft., with solid IMC between 9,000 ft. and FL 250. Icing conditions were forecast for the climb through FL 210 and areas of super-cooled large droplets and ice crystals were likely encountered, according to the NTSB's forensic meteorology assessment. AIRMETs had been issued for icing and mountain obscuration.

PAVE – Risk Assessment Matrix

- PILOT
- AIRCRAFT
- ENVIRONMENT
- EXTERNAL PRESSURES

PILOT

SLEEP - <=12 HOURS / 48 HOURS	4
SLEEP - < 8 HOURS / 24 HOURS	2
SLEEP - >=8 HOURS / 24 HOURS	0
HEALTH – COLD / FLU / ILL	4
HEALTH – OKAY, BUT OFF A BIT	2
HEALTH – GREAT – NEVER BETTER	0
TRAINING – MINS TO BE LEGAL	4
TRAINING – 180 DAY PROFICIENCY	2
TRAINING – 60 TO 90 DAY - EXTRAS	0

AIRCRAFT

AIRWORTHINESS – MAJOR DEFERRED	4
AIRWORTHINESS – MINOR DEFERRED	2
AIRWORTHINESS – ALL SYSTEMS GO	0
PERF + W&B – MINIMUM REQUIRED	4
PERF + W&B – OKAY FOR MISSION	2
PERF + W&B – WIDE MARGINS	0
RANGE/ FUEL – MINIMUM REQUIRED	4
RANGE / FUEL – OKAY FOR MISSION	2
RANGE / FUEL – WIDE MARGINS	0

ENVIRONMENT

ORIGIN – NIGHT / LOW IMC / TURB / ICE	4
ORIGIN - M VFR / IMC	2
ORIGIN – DAY / CAVU OKAY	0
ENR – NIGHT / LOW IMC / TURB / ICE	4
ENR - M VFR / IMC	2
ENR – DAY / CAVU OKAY	0
DEST'N – NIGHT / LOW IMC / TURB / ICE	4
DEST'N - M VFR / IMC	2
DEST'N – DAY / CAVU OKAY	0

EXTERNAL

MISSION – URGENT / CRITICAL	4
MISSION – IMPORTANT / ESSENTIAL	2
MISSION – OKAY TO SAY "NO"	0
PAX – URGENT / CRITICAL	4
PAX – IMPORTANT / ESSENTIAL	2
PAX – BRING YOUR TOOTHBRUSH	0
HOME – SICKNESS / STRESS / TENSION	4
HOME – MINOR / ANNOYING CONCERNS	2
HOME – HAPPY / HEALTHY / WHOLESOME	0

Shortly after departing Salt Lake, ATC directed Baker to climb to and maintain 14,000 ft. Three minutes later, the pilot notified ATC that his FMS had failed and he requested a climb to VMC conditions. ATC, in response, made available several headings and altitudes to help him maneuver to an area with better weather conditions. Baker transmitted that he was "losing his instruments" and having to hand-fly the aircraft, most likely because the autopilot was inoperative. He was urgently trying to "get clear of the weather." ATC controllers could almost feel the angst in his voice. Precious seconds elapsed with no corrective action being taken to regain situational awareness.

It appeared as though Baker was experiencing "spatial disorientation." An FAA Advisory Circular states that it can take up to 35 sec. to take complete control of an aircraft by reference to instruments after going from VMC to IMC. By inference, it can take several seconds to make the transition between primary flight instruments and standby or backup instruments in IMC, if there is little or no warning of the former malfunctioning.

Radar tracking backed up Baker's tension and apparent spatial disorientation. The aircraft climbed, turned right and crested 21,000 ft. Then, it entered a progressive downward spiral. It rolled partially inverted and its descent rate increased to 36,000 fpm.

Radar contact was lost as the aircraft nosedived through 16,000 ft. Already the aircraft was starting to break up due to structural overload. Witnesses heard a loud boom near the impact zone near Cedar Fort, Utah. The CitationJet's remains smacked into the ground just 30 mi. south of Salt Lake.

In its accident report, the NTSB noted that the CitationJet's emergency/abnormal checklist says that if the pilot's EADI or EHSI become inoperative and cannot be reset, then the pilot should "continue the flight by referring to the standby gyro and the pilot's air data and NAV instruments, and cross referencing the copilot's attitude and heading. The autopilot will be inoperative."

Probable causes of the accident? The pilot's loss of control due to spatial disorientation in IMC when the primary flight instruments failed. He needed to make a quick transition to scanning the standby and right-side backup instruments. A possible secondary cause was the malfunctioning of the primary flight instruments. This fatal inflight loss of control might have been prevented had the pilot been proficient in flying the aircraft after loss of the pilot's-side primary flight instruments.

Task Over-Saturation — Prevention Through Prior Planning

The Fleming and Baker accidents accentuate the consequences of startle factor, loss of situational awareness and spatial disorientation that can lead to loss of control in flight. The NBAA's "Alone in the Cockpit" Safety Committee video vividly portrays the type of high workload environment that can quickly lead to task saturation, mental overload and breakdown of SA.

In it, "Pilot John" (*Flying* magazine editor and NBAA Safety Committee member Rob Mark) is flying his single-pilot light jet home to Miami from the Caribbean. The weather conditions at Miami are changing rapidly, with numerous thunderstorms in the vicinity and shifting winds. There is plenty of arriving and departing commercial traffic at the busy international airport, requiring ATC to change altitude assignments, vectors and even landing runways in a rapid-fire sequence.

This is when task saturation sets in. The video shows a growing, palpable angst as Pilot John starts to miss radio calls while responding to altitude and heading assignments in increasingly rough weather conditions. Adding to the tension, Miami Approach directs him to hold at a FOWEE intersection, some 71 mi. southeast of the airport, as arrivals change from west to east flow in response to a change in wind direction.

"Sheez. When's the last time I held?" Pilot John asks himself about entering a holding pattern.

Now, he realizes that his fuel reserves are becoming tight. This distraction makes him forget his max endurance speed and approximate power setting. But presently Approach is vectoring him westbound to align him for landing on Runway 9. He then realizes he should have planned the flight for a nearby airport with much less traffic, such as Tamiami or Fort Lauderdale.

Thunderstorm cells are now rapidly building west of the airport, creating the potential for heavy turbulence, wind shear and microbursts. It also creates the potential for more arrival delays as air traffic control vectors him on a prolonged downwind leg.

Pilot John tells ATC he's low on fuel and he gets expedited handling for landing. But in all the confusion, he fails to program in the ILS Runway 8R into the FMS. At the same time, the ceiling and visibility deteriorate to 0.5 mi. and 200 ft. in heavy rain. The ever-tightening fuel state adds to his tension and disorientation.

He's confused when the ILS won't arm or engage and the autopilot won't engage. It's because he doesn't have the ILS procedure programmed into the FMS or proper frequency dialed into the NAV radio. He finds his programming error and makes the needed corrections. But by then he's now down to 30 min. of fuel and he can't see anything ahead of the aircraft in full IMC.

Just when he's settled down, he flies through wind shear and almost loses control of the aircraft, but he reverts to his training and regains control. He executes a missed approach and gets vectors to Fort Lauderdale Executive, where he makes a no-stress VFR landing and taxies to the ramp, grateful to be alive and safely on the ground.

Lessons learned? Thinking back on the flight, he recognizes that his failure to assess and anticipate all the risks he might potentially encounter cranked up his workload and tension to the point where he started making several errors. He didn't expect the weather to deteriorate so rapidly and he didn't use his onboard weather radar to detect and avoid thunderstorms.

The IMC caused heavy traffic saturation at the airport. As the winds shifted, there were late stage changes to the approach paths. He arrived in the terminal area with inadequate fuel reserves for weather, traffic and ATC delays, including an unexpected holding pattern assignment. And he wasn't current on holding procedures.

His tension made him forget to reprogram the FMS for the new ILS procedure. And he never activated the approach until later in the flight. Perhaps if he had used a comprehensive risk assessment matrix, he could have anticipated and avoided many of the challenges encountered.

Lessons Engraved on Tombstones

Fear of dying is a powerful motivator for pilots. At this year's NBAA Single-Pilot Safety Standdown, Dan Ramirez, XOJet's director of safety, launched into an eight-year analysis of 7,457 business aircraft accidents broken down into turbofan, turboprop and piston airplane categories. Runway excursions accounted for 28% of the events, but a large number of these accidents were non-fatal.

This leaves four big culprits, the ones that command attention if you strive to avoid potentially lethal pitfalls. Inflight loss of control, such as the fatal accident involving John Fleming's CJ4, is the second leading cause, making up nearly 23% of fatal accidents. Controlled flight into terrain (CFIT) (13%), mechanical failure (12%) and undershoot/overshoot (6%) are the next highest causes.

Isolating single-pilot accidents that account for 27% of all the accidents in Ramirez' study, runway excursions, inflight loss of control, undershoot/overshoot and controlled flight into terrain are the top four accident causes.

Not surprisingly, nearly 70% of fatal accidents occur during approach and landing, according to the study, data that correlates closely with statistics compiled by the Flight Safety Foundation.

Delving deeper into the data, three-quarters of the runway excursion accidents involve poor speed management on approach. Two-thirds of the loss-of-control accidents occur in the terminal area environment, with only one in seven being experienced during high-altitude flight. More than half of the undershoot/overshoot accidents involve not touching down at the appropriate point on the runway. And more than half of the CFIT accidents were related to unknown causes, including the possibility that the pilots were unfamiliar with the terrain in the accident area.

"This is data telling us what we need to do," says Ramirez.

With those statistics in mind, Bob Wright of Wright Aviation Solutions convened four breakout groups at the Standdown to discuss top accident causes: inflight loss of control, led by APS's Paul "BJ" Randsburg; CFIT, headed up by Avsafe's W. Jeff Edwards; runway excursions, guided by Pfizer's Ben Kohler; and overshoot/undershoot events, coached by Capt. J. R. Russell of ProActive Safety Systems. Wright believes that pilots learn most effectively when they actively participate in such sessions.

Russell says the same lessons learned from each of the four groups apply to all. "It's all about evidence-based or scenario-based training, preflight preparation and proactive thinking." He says ground training ought to include recaps of accidents or incidents, such as the ones already described. The major U.S. airline for which Russell works as a Boeing 787 captain not only wraps accident or incident scenarios into its simulator training syllabi, it also requires pilots to fly line-oriented flight training (LOFT) missions with multiple emergencies and abnormalities, including having to fly all the way to landing with inoperative primary flight instruments, engine and autopilot failures and degraded systems.

After successfully completing recurrent simulator training at his airline, Russell says there are few, if any, surprises he's seen while flying the line. His carrier also uses briefing cards to review, rehearse and prepare for every phase of the mission, paying attention to mitigating potential weather, winds, airport and traffic risks.

FAA

RISK ASSESSMENT GUIDE

LIKELIHOOD ↑ / SEVERITY →	CATASTROPHIC	CRITICAL	MARGINAL	NEGLIGIBLE
PROBABLE	HIGH	HIGH	SERIOUS	MEDIUM
OCCASIONAL	HIGH	SERIOUS	MEDIUM	LOW
REMOTE	SERIOUS	MEDIUM	MEDIUM	LOW
IMPROBABLE	MEDIUM	MEDIUM	MEDIUM	LOW

Quantifying Risk

Recognizing, assessing and mitigating risks can be quantified by using a Risk Assessment Matrix, as illustrated on page 49. The FAA's *Risk Management Handbook*, FAA-H-8083-2, breaks this down into a four-part process called "PAVE" — Pilot, Aircraft, enVironment and External pressures. Within each category, several risk factors can be identified, assessed and scored. As with golf, lower total PAVE scores are better. Higher total PAVE scores should merit special attention. Higher scores may even require postponing or canceling the mission and rescheduling for a time when identified risks can be mitigated.

Using a Risk Assessment Guide, similar to the one shown above*, can be useful when determining a specific score to be assigned to a risk item. If, for instance, the weather at the destination airport is forecast to be daylight with ceiling and visibility unlimited (CAVU) and those conditions are not likely to change, then the relative severity is full right and probability of risk is full down, resulting in a zero point score.

In contrast, if severe thunderstorms, capable of causing catastrophic damage, are probably going to be encountered, then the relative severity is full left and the relative probability is full high. This would result in a high score — at least four points in the "V" quadrant of the PAVE matrix.

Having one or more high item scores doesn't necessarily require canceling or postponing the mission. Each item, however, requires an effective mitigation strategy. As the late Robert A. "Bob" Hoover was fond of asking, "What's your Plan B?"

Combine several risk factors such as pilot fatigue, relatively low time in the aircraft type, pitch dark, murky sky conditions and possible flight guidance mode confusion, for instance. All of these can increase the probability of reduced situational awareness and possible loss of control in flight, with catastrophic results. What if pilot Fleming had recognized and assessed these risk factors? He might have decided to cancel the flight home from Cleveland to Columbus, get a full night's sleep and return the following morning in daylight conditions.

Another example. You're flying an aircraft fitted with an aftermarket avionics package for which no simulator training is available. While you've frequently completed recurrent training in a sim that has the factory-standard avionics kit, you've never had the opportunity to fly the same configuration in a sim and then train to proficiency with single or multiple failures. Having to revert suddenly to standby instruments when your primary EFIS fails in hard IMC and severe to extreme icing conditions can be quite disorienting. And prolonged instrument flying using standby instruments is not part of most FAR Part 142 simulation recurrent training syllabi. The risk assessment score associated with potentially losing primary instruments during actual instrument flying in a real airplane might be quite high. Are you ready to hand-fly the aircraft by reference to standby instruments for a prolonged period?

Then, take the case of Pilot John. He was facing a possible encounter with severe thunderstorms, certainly resulting in a high-risk assessment score. To mitigate the risk, he might have planned to get frequent storm track updates by means of XM satellite radio or ADS-B weather graphics while en route, assured he was proficient using a full-function onboard weather radar and anticipated arrival delays by loading the tanks with plenty of extra fuel for possible prolonged holding at the destination landing facility or a divert to a suitable alternate airport. As he also noted, it's essential to be up to snuff on holding pattern entry and procedures, including receiving and acknowledging your expected further clearance time. And being mentally prepared for executing a missed approach in case of bad weather or a disabled aircraft on the runway is essential when planning for such challenging conditions.

Pilots may not have the time to fill out a risk assessment matrix before each flight, says Russell. But they can use it as guide to identify areas of risk and get prepared to mitigate them.

Single-Pilot Tightrope

Tom Huff, the former skipper of the U.S. Navy's VF/A-87 squadron and then Commander U.S. Naval Test Wing, Patuxent River, Maryland, is now Gulfstream's aviation safety officer and the NBAA Safety Committee chairman. He says that single-pilot operators face the challenge of being their own "chief pilot, safety officer, director of maintenance, dispatcher and copilot, all rolled up into one." There are few, if any, backup mechanisms or people to trap errors that single pilots inadvertently miss. In essence, they're walking on aviation tightropes without a safety net.

"There's oversight built into large corporate flight departments and other organizations," he says, but "threat and error management systems are missing from single-pilot operations."

He also believes that many aircraft approved for single-pilot operations lack the human-centered cockpit design of military aircraft, such as the F/A-18 Hornets and Rhinos he flew. "They're designed with hands-on stick and throttle controls for single-pilot operations."

Most general aviation aircraft also lack flight operations quality assurance (FOQA) systems, such as quick access recorders (QARs) and video recorders. "They're safety assurance tools," he said. These postflight feedback mechanisms can help pilots spot errors they miss while they're fully focused on cockpit tasks. Huff believes that QARs would be a boon to improving single-pilot performance under pressure. Video recorders also can help capture images that provide better maintenance troubleshooting data, such as discrepancies between cockpit attitude indicators and actual aircraft attitude and sorting out CAS messages.

Yet, Huff is aware of the Big Brother inferences, but "Culturally, we have to get over video monitoring."

Yet preflight training, not postflight feedback, is even more critical. "So many of us dread recurrent training. Then, we feel better after completing it," he said. Still, "There is so much stuff on the FAR Part 61.58 [pilot-in-command proficiency check] dance card," he noted. And this also applies to the myriad requirements in the Part 61.56 biennial flight review and Part 61.57 recent flight experience — pilot in command.

General aviation pilots, as a whole, do not train to the same level of proficiency as airline pilots, says Russell. There just isn't enough sim time available. This would require several scenario-based simulator sessions involving multiple abnormalities and/or emergencies that have to be handled in challenging and changing weather and traffic conditions. Russell says, for instance, he's had to fly a Boeing on standby instruments with one engine inoperative down to ILS minimums in gusting, crosswind conditions during sim training at his airline.

Russell also says his airline sim training specifically includes situations or equipment malfunctions that are experienced by line pilots in everyday operations. Lessons learned from incidents, accidents and just inadvertent lapses in cockpit disciplines are fed back into the training process to reduce the probability of their happening in the future.

Type Clubs Lead

Former NASA chief astronaut Charles Precourt flies his own Citation CJ1+ and he's head of the Citation Jet Pilots (CJP) Association's safety committee. He's been instrumental in raising standards for pilot training and proficiency, using positive incentives to motivate members to participate in advanced programs.

CJP's Gold Standard Safety Award, for instance, is given to pilots who log 100 hr. of PIC turbine time in 12 months, who complete two Part 61.58 PIC proficiency checks, including at least one at a Part 142 simulator training center, and who participate in additional training courses.

The association now publishes best standard operating practices lists for various Citation Jet models, including different ones for those with Garmin and Collins avionics packages.

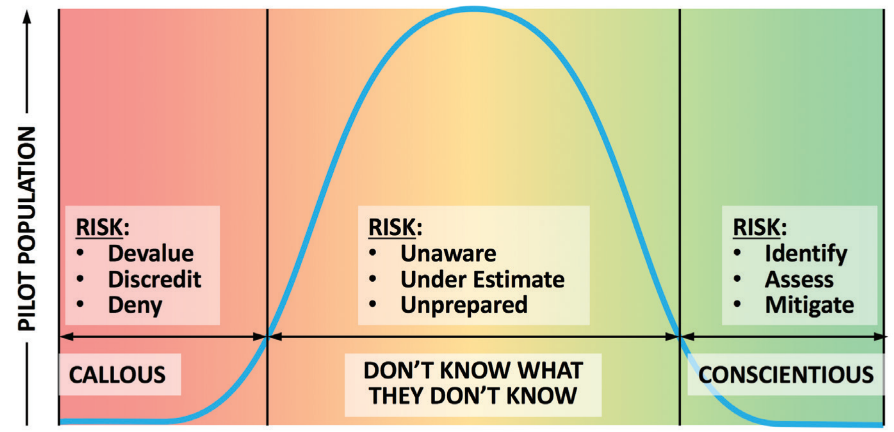
In line with Russell and Huff, Precourt believes that general aviation pilots need much more scenario-based training. He's actively working with major Part 142 simulator training service providers to upgrade their syllabi with actual evidenced-based situations.

Runway overrun prevention nears the top of Precourt's sim training priorities. He cites the case of a CJ2 crew that attempted to land an aircraft on a 4,100-ft., snow-covered runway. The reduction in traction due to surface contamination actually required more than 7,000 ft. of pavement.

"They were virtually dead on downwind," says Precourt. Fortunately, both pilots survived with minor injuries. However, the aircraft was totally destroyed after careening off the end of the runway, plowing through an Armco fence bordering a perimeter road and coming to rest 300 yd. from the end of the runway.

"So many pilots just don't know what they don't know. It's not their fault," he said. "They haven't grown up in a disciplined aviation environment."

RISK MITIGATION BELL CURVE



ROBERT WRIGHT/WRIGHT AVIATION SOLUTIONS

While Precourt calls mandating FOQA and QARs in general aviation aircraft "a step too far," he highly recommends installation of such systems. He believes they could be set up to provide postflight feedback directly to the pilot. He's also working with ForeFlight and Garmin Pilot to develop tracking or tracing software that would enable pilots to review approach and landing performance in private. This would include course and glidepath deviation, actual threshold crossing height and speed, touchdown point and touchdown speed. The timely and personalized review would help pilots hone their skills by using objective data.

Precourt says NASA's GII space shuttle simulator aircraft had a similar quick access tracking and playback system on board. Shuttle pilots flying simulated approach and landing patterns in it could review their performance immediately after completing the maneuver, while the aircraft was climbing back to altitude for the next simulated approach and landing sequence. The near-real-time feedback enabled him and others to refine their approach and landing technique to near perfection. To fly copilot aboard the shuttle, pilots had to log 500 approaches and landings in the aircraft. To qualify as PIC, they needed 1,000 landings.

Precourt also believes pilots need to learn from the mistakes of others, such as the ones reported in NASA's Aviation Safety Reporting System (ASRS) *Callback* monthly safety newsletters. NTSB accident reports are another excellent resource.

Not all mishaps make the news, though. At this year's CJP single-pilot safety standdown, owner-pilot David Miller talked about lessons that he's learned, especially those associated with mistakes that he and others have survived. Miller discussed many pitfalls that can trap single pilots when they're rushed, including missing simple preflight items such as baggage door latches, pitot-static covers and engine duct covers.

Miller cited mistakes he has made and what he's learned from those missteps.

Good Enough . . . Isn't

The takeaway from this year's NBAA and CJP single-pilot safety standdowns is that minimum FAA requirements for recurrent training and pilot proficiency aren't good enough to assure general aviation pilots have the skills, knowledge and judgment to handle challenges at the same level as aviators at major airlines and military organizations.

It's not that airline and military pilots are born with the "right stuff" and general aviation pilots are not. Rather, the former undergo more rigorous training and have to pass tougher initial and recurrent training tests than most of the latter.

Precourt, Wright and others believe that aircraft manufacturers, insurance companies, training service providers and type clubs, such as CJP, all have to work together to raise standards for general aviation single-pilot training. Online, computer-based training plays a key role in the plan as it enables pilots to bone up on systems, performance, regulations and weather from homes, hotels and offices. Textron's Tru Simulation division, for instance, automatically emails multiple choice quizzes to recurrent training clients as part of its virtual, continuous ground school.

But there are conspicuous holes in Part 142 training programs. Simulator companies assume that clients are current on instrument flying regulations, airspace limitations and lost communications procedures. Companies, such as King Schools, can help fill in knowledge gaps with airspace review, airport signage and IFR refresher courses that help general aviation pilots get the most out of their sim training sessions.

Some GA pilots seize every opportunity to improve their knowledge and skills. For example, Brad Pierce, president of Restaurant Equipment World in Orlando, Florida, flies his Cirrus SR22T more than 800 hr. per year on business all over the continental U.S.

"I've always taken a proactive, progressive approach to my business flying," he said. "Even after getting my instrument rating, I eased into things. I avoided getting rushed or stressed. I started by flying to the business destination the day before the appointment. Then, the following day I'd meet with the client. I'd depart the day after the appointment. I wouldn't fly unless the ceiling was at least 2,000 ft." He now flies to three or four appointments in a single day, but he eased into that pace over several months.

"I also train at least six times per year with an experienced instrument instructor who has me fly into challenging airports in the Rockies," Pierce notes. "The Cirrus has automation that's fantastic, but it's also infatuating. You have to remember the fundamentals and be able to hand-fly the aircraft in all weather conditions."

He continued, "I have no customer out there worth dying for. I use predefined criteria. I adhere to specific SOPs. I won't use airports with less than 3,000 ft. of runway, even though the aircraft only needs 1,200 ft. most of the time. I use floating personal [weather] minimums. Day 1 of flying after a long layoff, I use higher [weather] minimums than on Day 32."

But sometimes missions have to be scrubbed for safety's sake. "Above all, I've learned to say 'No,'" Pierce says.

He also says he's insistent on having the best maintenance for his aircraft. He doesn't defer squawks until the next scheduled shop visit. As he's flying a single-engine piston aircraft, he cares meticulously for the powerplant.

Pierce is looking forward to upgrading to turbine power someday. It's safe to assume he'll upgrade the intensity of his training to match the higher performance of that aircraft. He's setting an example for other single-pilot operators to follow. BCA