Dodging the Golden BB

There's **good luck and bad,** and neither is a strategy

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Lt. Edwin Wright looking over flak damage to his P-47 Thunderbolt following a mission over Münster, Austria, October 1944.

There is a theory in military aviation that enemy flak, anti-aircraft rounds, or even missiles don't matter because only one is meant for you. And if it was your time to go, the "Golden BB" bearing your name was going to get you no matter what action you try to avoid it. (For our international readers: a "BB" is a pellet fired from a pellet gun.)

My theory is a little different. I do believe there are Golden BBs out there, but they don't bear anyone's name. Rather they adhere to a first come, first served policy. Your job as a professional pilot is to learn how to dodge them. And after you do, it is your duty to teach others the lessons you have learned.

So, all this begs the question, how do you dodge that Golden BB if you can't see it coming? Well, you have to be observant. And you can study cases in which a Golden BB found its mark. Keep in mind that Golden BBs never travel alone. Just because someone else got hit, doesn't mean there isn't another identical round looking for another victim.

The Takeoff Data Golden BB

There have been a few transport category aircraft lost over the years because of improperly computed takeoff data; perhaps the worst example was MK Airlines Flight 1602. On Oct. 14, 2004, this Boeing 747 cargo flight took off from Windsor Locks-Bradley International Airport (KBDL) near Hartford, Connecticut, loaded with lawn tractors. The total gross weight was 240,000 kg (529,109 lb.).

The aircraft landed, refueled and took on an additional cargo of lobsters at Halifax International Airport, Nova Scotia, Canada (CHYZ). The total gross weight then was 353,000 kg (778,231 lb.), but the pilots failed to enter the new weight into their laptop computer, only updating the weather and airport. They ended up using a reduced thrust setting as a result. When the aircraft failed to lift off at the computed rotation speed, the pilot pulled back farther, resulting in the aft fuselage contacting the runway.

The Boeing finally became airborne 670 ft. beyond the paved surface, but the aft fuselage struck an earthen berm and separated on impact. The rest of the aircraft continued in the air for another 1,200 ft. before striking the terrain and bursting into flames. All seven people on board were killed.

MK Airlines, a now-defunct cargo hauler based in Ghana, required its crews to verify the computer-generated numbers. One method would be to verify the numbers using Volume 2 of the Boeing 747 AFM, which would have been time consuming. Another method, which the accident report seems to indicate was an acceptable means of compliance, was to have a second

MK Airlines Boing 747 9G-MKJ, Oct. 10, 2004, four days before its crash.

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crewmember use the laptop to verify the first crewmember's work. A more likely method would be for the pilots to simply look at the numbers and agree that they were "about right."

In the case of the accident airplane, the differences in the numbers should have been apparent. Between 240,000 kg and 353,000 kg, the target thrust setting was very close: 1.33 versus 1.30. But the correct V1, Vr and V2 values were substantially higher: 150 knots and not 123; 161, not 129; and 172, not 137. Fatigue, of course, may have affected each pilot's judgment.

You may argue that the range in speeds for a cargo Boeing 747 are much greater than for a business jet where the largest factor is fuel and is unlikely to render a V-speed off by 30 kt. But if you examine your performance manual, you should find that you, too, can be placed in an unflyable situation because of improperly computed takeoff data.

For aircraft whose variability in speeds and thrust settings are small, "that looks about right" may be a valid verification method. But a better method would be to have an independent source of takeoff data. If you are using computer software developed by the aircraft's manufacturer, it may be prudent to also run data from another source, such as the aircraft's quick reference handbook or performance manual. Even the iPad application method is better than just glancing at the numbers and saying, "that looks about right." You might argue that both sources are derived from the AFM, but this gives you a second chance at data entry and recording and doubles your chances of detecting an error.

The Takeoff Configuration BB

There are all sorts of checklist items that, if missed, can kill. You might argue that flight is a dynamic environment and we can be excused for missing a step here and there while flying. But what about those items you miss while still on the ground? There have been several transport category aircraft lost because the pilots forgot to set their flaps, or mis-set their stabilizer or rudder trim prior to takeoff. It may be necessary to go beyond the checklist to dodge these Golden BBs.

Consider the case of Pan American World Airways Flight 799 in 1968. The three-pilot crew of this cargo Boeing 707 was distracted by having to manage a controlled departure time and had poor checklist discipline leading to the flaps being set, then retracted, and then forgotten prior to takeoff. The aircraft's takeoff configuration warning wasn't triggered because the cold temperature during a refueling stop in Anchorage, Alaska, allowed takeoff thrust before reaching the minimum throttle angle needed to activate the warning microswitch. The aircraft stalled after lifting off and crashed, killing all three crewmen on board.

Since this crash there have been at least 22 more crashes of transport category aircraft due to pilots forgetting to set their flaps prior to takeoff. But modern checklists and warning computers have made this a problem of the past, right? The NASA Aviation Safety Reporting System (ASRS) provides evidence to the contrary.

In 2016, an airline captain opted to taxi single-engine because of the substantial taxi distance to the planned departure runway. When the flight was offered a closer runway while taxiing, the first officer was tasked with starting the second engine, making an announcement to the cabin, and completing the checklist. The captain entered the new performance data into the FMS and accepted the takeoff clearance from the tower.

The first officer then asked the captain, "Do you want me to tell him [Tower] we need a little more time?" The captain responded, "No, everything's set, just finish up the taxi and before-takeoff checklists."

In the words of the F/O: "The takeoff appeared to be progressing normally through 80 kt. It was some time after that when I saw the captain move his right hand off the thrust levers and to the flaps selector, changing it from eight to 20. It took me a moment to process what I was seeing and

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Takeoff data verification using Aircraft Performance Group iFlight Genesis tailored for a Gulfstream G450.

then I concluded that he must have realized that, perhaps, the FMS actually did indicate that 20 was required even though he had told me to leave them set at eight. By this time, I believe that we may have been at a very high speed and possibly nearing V_1.

"I had no idea what to say in this case other than, 'Shouldn't we abort?' But, before I could say anything, the captain quickly went to idle thrust and applied hard braking."

A USAir Boeing 737 ended up in Flushing Bay while trying to takeoff from New York's LaGuardia Airport (KLGA) on Sept. 20, 1989. There is circumstantial evidence that a cockpit visitor could have rested his foot on the cockpit center console and pushed the rudder trim knob. The pilots failed to check the trim when they accomplished the "stabilizer and trim" checklist item. The captain and F/O made other mistakes during the takeoff roll and subsequent abort.

No matter the causes, the pilots didn't pay enough attention to the rudder trim prior to takeoff. Two of 57 passengers were killed as a result.

Since that fatal accident, there have been several cases of transport category aircraft failing to rotate when the pitch trim was not correctly set for takeoff. There has been at least

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USAir Flight 5050, September 1989

one case of another transport category aircraft unable to maintain directional control because the rudder trim wasn't correctly set.

A common theme in many of these incidents in which the flaps or trim were not set is that pilots either skipped the checklist item or saw what they expected — that is, that the flaps or trim were set even though they were not. The solution, of course, is greater cockpit discipline when it comes to accomplishing checklists. As for seeing what you want to see, the so-called "expectation bias," I recommend adding tactile and aural senses when it comes to all aircraft configuration changes. Putting your hand on an unset flap handle will improve your odds of realizing the flaps are in the wrong position. (See "Pointing and Calling," *BCA*, July 2017, page 54).

The Single-Engine Taxi BB

In my four-engine past, we routinely shut down our inboard engines in the Boeing 707 after landing to cut down on noise. In the Boeing 747, we sometimes taxied for takeoff with only the outboards to lessen the possibility of ingesting FOD from the lower-hanging inboards. But back then in our U.S. Air Force operations we had a flight engineer who could devote 100% of his attention to the task.

However, I've never delayed engine start prior to takeoff with only two pilots in the cockpit. My rationale is to have both pilots maximize their attention span outside the airplane while it is moving on the ground. The thought that we would actually forget to start the remaining engine(s) before takeoff never entered my mind. But, incredibly, that does happen.

Single-engine taxi (SET) is a common practice for some airlines operating two-engine aircraft. If you multiply the delay times at some airports by the sheer number of daily operations, you end up with significant fuel savings. But the Golden BB waiting for these airlines will evaporate any savings after a single airplane and its passengers are lost.

I've heard of a couple of airlines whose crews made it to the runway and were cleared for takeoff without an engine running. In most cases, the crew figured it out. Here is a recent example reported through the ASRS:

"We pushed off the gate starting engine No, 2. We taxied out with the plan to start the No. 1 engine [later in the taxi] after we saw the lineup. We then switched over to Tower. Just as we were pulling up to stop they cleared us on to the runway, so I ran the before-takeoff checklist just reading through it and the captain answering. I was the flying pilot so I said set thrust and he said thrust set."

"I stated twice that I was using a ton of rudder when he said that we do not have engine No. 1, abort takeoff. We did not travel far, took a breath and did the checklist. We then started engine No. 1, went through all of the checklist from delayed engine start and on, very diligently. We then called Tower and proceeded to taxi back to the runway and took off."

But it gets worse. I've heard from pilots at a major U.S. airline operating MD-80 series aircraft that the carrier had eight incidents in the last few years of pilots forgetting to start the second engine during SET and making it to the runway with takeoff clearance. In one case, the crew ended up aborting doing about 90 kt. And yet this airline continues the practice of single-engine taxi before takeoff. I asked a pilot at another major airline operating the same kind of equipment about this. He said they do not allow single-engine taxi because of the distraction during high workload periods and the chance of forgetting to start the second engine.

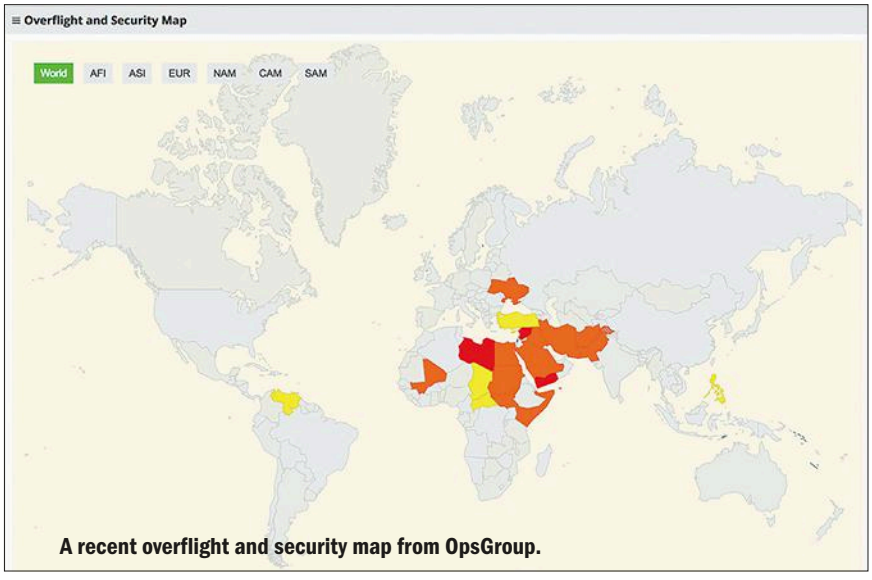
In these examples the aircraft did have some kind of warning system and the crews were provided with electronic messages that something wasn't right. I've read about 20 of these reports in which something distracted the crew before they got to the runway and they accepted their takeoff clearances with something left undone or unstarted. Most of those who were using SET procedures had the option to taxi on two engines but believed they had enough time and a margin of safety to taxi single engine.

The NOTAMs Golden BB

Think back to the last time you flew into Los Angeles, San Francisco, Chicago, Atlanta or New York Kennedy airports. Did you carefully read every NOTAM? What follows are two airport examples and the Golden BBs with each — one hit its mark and the other came within 14 ft. of creating the single largest civil airplane disaster in history.

Let's say you were flying across Europe following a line of other airliners and noticed this NOTAM for a country in the middle of your flight:

A1493/14 NOTAM
Q) UKDV/QARLC/IV/NBO/E /260/320/4820N03716E119
A) UKDV
B) 1407141800 C) 1408142359EST
E) SEGMENTS OF ATS ROUTES CLOSED: T242 NALEM MASOL M996 ABUGA GUKOL G476 MASOL OLGIN W533 TOROS KUBIR L32 NALEM KW P851 LS NESLO A83 LS DIMAB L980 GANRA TAMAK W538 GANRA FASAD W633 LUGAT MAKAK L69 LAMIV GONED W644 DON GETBO



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A recent overflight and security map from OpsGroup.

M70 BULIG TAMAK B493 PODOL FASAD L984 BULIG FASAD W531 KOVIL PW M136 MEBAM DON M995 OLGIN PENAK L140 KOVIL FASAD. FM FL260 UP TO FL320

First question: Do you understand what it is telling you? It is basically saying the airspace bounded along those routes is closed between FL 260 and FL 320.

Second question: If you are flight planned to fly over this airspace at FL 330 (above the NOTAMed airspace), would you consider flying around it regardless, even if it meant adding 30 min. or so to your flight? Thirty-one operators (including Emirates, KLM, Lufthansa, Malaysian and Singapore Airlines) overflew the airspace. Eight operators (including British Airways, Air France and Qantas) flew around it.

Third question: If I told you that three days prior to your flight a large aircraft was shot down at high altitude and the day prior a second one was downed, would that change your answer to question two?

If you fly internationally, I recommend you subscribe to the OpsGroup for their Overflight and Security Map, available at https://ops.group/dashboard/airspace/ so you aren't at the mercy of the International NOTAM system for figuring out what airspace is hostile and what airspace is not. But even if you don't fly internationally, there are threats domestically that you need to be wary of.

On July 7, 2017, about 2356 Pacific Daylight Time, Air Canada Flight 759, an Airbus A320, Canadian registration C-FKCK, was cleared to land on Runway 28R at San Francisco International Airport (KSFO) but instead lined up on parallel Taxiway C, where four air carrier airplanes were awaiting takeoff clearance. The Air Canada flight descended below 100 ft. AGL before the crew realized their error and initiated a go around. (See "A Near Catastrophe," *Cause & Circumstance, BCA,* December 2018, page 28.)

These pilots screwed up, no doubt about it. They lined up on the taxiway thinking it was Runway 28R. Their error resulted from their unawareness that Runway 28L was closed for major construction. Why didn't they know? It was right there in the NOTAMs — that is, the 52nd NOTAM behind 18 mentions of cranes, five out-of-service lights, three closed aprons and an internet reference to a Letter to Airmen warning against wrong surface landings.

I've been saying for a long time that the single purpose of NOTAMs is to protect everyone except the pilot. If someone misses a turn because of an out-of-service light, the bureaucrat in charge of lights will be off the hook. Contemplating the carnage that could have occurred in San Francisco, NTSB Chairman Robert Sumwalt, a former airline captain, said the NOTAMs were, "Just a pile of garbage."

You can help yourself avoid a wrong surface landing by always backing up a visual approach with lateral and vertical guidance. (See "Oops, Wrong Airport," BCA, January 2018, page 40). Until the NOTAM system is fixed, you can also avail yourself of the many commercial applications that color code and categorize the important NOTAMs to help them stand out.

Game Plan for Dodging Golden BBs

When the Golden BB finds its mark, lives can be lost, aircraft destroyed and reputations tarnished. Then come the recriminations, investigations and corrective actions. If

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Air Canada 759 about to overfly three airliners on a San Francisco taxiway.

The 117 NOTAMs during a typical KLAX to KSFO flight.

you manage to dodge that BB, none of that happens. But perhaps we should take advantage of having dodged the Golden BB and do the investigation and take the corrective action as if it had hit its mark. That could inoculate you from the next one headed your way.

Consider the case of Air Florida and a hypothetical twist to its fate in 1982. The company started 10 years earlier using two Boeing 707s from Pan Am and grew to the point where it had a fleet of 58 aircraft and a substantial presence on the East Coast of the U.S. All of that came to an end with the crash of Air Florida Flight 90 during takeoff from Washington, D.C.'s National Airport (KDCA) in January 1982.

The crew of this Boeing 737 made a number of foolish decisions in what seemed like an effort to avoid a second deice application and a misunderstanding of the causes and effects of airframe and engine icing. The airline's lack of experience in dealing with long ground delays during icing conditions as well as the crew's inexperience with winter operations contributed to the loss of the airplane and the deaths of 74 of the 79 crew and passengers on board.

The Air Florida brand did not survive the crash. All of this is true. But for our hypothetical, let's say the pilots had the presence of mind to firewall the throttles as soon as the stick shaker went off. They could have just barely cleared all obstacles and would have survived had they done so. Would that have been enough for Air Florida to make the changes to their company procedures and crew training to prevent future Golden BBs from finding their targets?

Now let's apply this hypothetical rewriting of history to current, everyday operations at your airport. We often hear about line technicians fired from their jobs because they towed an airplane into a hangar door or another aircraft. In many of these cases the line person was at the nose of the aircraft, driving the tug, looking at wingtips from a distance or guessing at tail positions. In the end, the tech loses his or her job and the operator hires a replacement.

At that point, there are two possible outcomes. In some cases, the news of the firing is considered enough to warn everyone to be more careful next time. This usually works, for a while at least. But in other cases, the operator realizes the action that damaged the $50,000 winglet could easily have been damage to a $5 million engine or might have resulted in serious injury to a person.

Wise operators will realize it will be cheaper in dollars and better for their reputation to hire additional people to ensure they have wing walkers when towing aircraft. They recognize that the first dodged Golden BB required a bit of luck and that dodging them in the future will require thought and skill. There is a method to dodging Golden BBs.

(1) Go public.
They say confession is good for the soul. It will certainly help the individuals involved in a near incident to take the lessons to heart. But it will do more than that. It will help others to realize that this could happen to even the best people and it isn't something to be dismissed as a rare event that will only bite the inexperienced. Furthermore, it will get others involved when it comes to finding solutions.

(2) Consider what could have happened.
Once you've identified the dodged Golden BB, it will be tempting to think all you need to do is promise yourself to be more careful next time. But what if the circumstances leading to the problem in the first place are systemic — that is, they are part of your normal processes and are bound to happen again? What is to prevent you from falling for these circumstances again, or to others who are unaware of the problem in the first place? The only way to address the problem with the seriousness it deserves is to consider just how bad it could have been. You can easily imagine the obvious: injuries to people, fatalities, damage to the aircraft or loss of the aircraft. But it can be far worse if the aircraft ends up in a populated area.

(3) Take corrective actions as if the Golden BB had not been dodged.
Armed with the knowledge that things could have been much worse, you will be prepared to expend time, effort and money to ensure the dodged BB in question will never reach its target. An aircraft accident will have to be reported to the NTSB, as a start. The company will come under intense public scrutiny. The company may suffer loss of the aircraft and the people on board. If the company survives, things will have to change. So, why not make those changes before anything of this magnitude happens in the first place?

(4) Implement your safety management system and consider a threat error management (TEM) program.
Your first reaction to a close call may be, "Whew!" Your next

reaction should be, "Why didn't we catch this sooner?" That is precisely why you need a TEM program. You should come up with ways to trap the errors that led to your close call. But once you've done that, you aren't actually done. Every "Plan B" needs to be watched closely for future modifications. The threat is evolving. Your Plan B needs to evolve too.

(5) Understand that you don't know what you don't know.
Has the airplane ever surprised you? Did it react contrary to what your best systems knowledge and procedural expertise would have predicted? Me, too. Some operators shut down an engine after landing thinking it will save wear and tear on the brakes. But carbon-carbon brakes wear very little after landing.

(6) Stack the odds in your favor where you can.
The best checklists are short and have the most important items up front. Old-school checklists were designed for cockpits with a crew of three or more, where one crewmember's total focus is on the checklist. Expecting a two-pilot crew to run a very long taxi checklist while negotiating with ground control and all the other moving obstacles on the tarmac is asking too much. You can fix that. A G150 operator tells me they moved 17 items from the taxi checklist (when they are moving) to the after-start checklist (when the parking brake is set). That's a great way to dodge a Golden BB!

(7) Give the bean counters something big to count.
I get the impression that many of the pilots bitten by the need to operate SET are enthusiastic supporters of the practice. The airline's management figured the amount of time spent with two engines at idle waiting for takeoff was much costlier than just one, and that's a big debit on the balance sheet. Nobody in the accounting department can think of something for the other side of the ledger. I can suggest one for you: the cost of the airplane and the lawsuits sure to follow if you find yourself at 90 kt. wondering why you need so much rudder. Other pilots have dodged that Golden BB successfully. But let's add to your woes a contaminated runway and a crosswind. Now you might not be so lucky.

So, do you believe there is a Golden BB out there with your name on it? Regardless of your answer, doesn't it make sense to do everything you can to dodge it and the one coming right after it? Assuming you agree, then you need to take the corrective action that would have become necessary had the Golden BB found its target. **BCA**

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