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Accident Reports Offer Hidden Values and Buried Treasures

The careful reader of aviation accident reports can discover useful information lurking beneath the straight facts.

by
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There are hidden values and buried treasures in the aviation accident reports published by the U.S. National Transportation Safety Board (NTSB), as well as the detailed accident reports published by other similar agencies throughout the world. And, as is the case with those who seek buried pirate treasure, it takes initiative and digging to find what has ultimate value, for most real treasures seldom lie exposed to the naked eye.

The primary purpose of NTSB aviation accident investigations is to pinpoint causal factors and publicize them so that accidents of a similar nature may be prevented. NTSB, as an investigative body, cannot issue regulations or directives that would govern the aviation industry and can only propose recommendations or actions that, in its opinion, would benefit aviation safety.

NTSB aviation accident reports generally contain all of the established facts surrounding an accident or incident, but the order in which the facts are presented may vary slightly depending on the nature of the event. A brief summary of the accident and causal factors is usually followed by a chronological review of the flight that ends with the accident. Factors that could have influenced the cause of the accident are examined, evaluated and discussed. Those factors can include the history of the crew, cockpit resource management, human factors, aircraft performance and maintenance, air traffic control procedures, forecasted or existing weather, or other extenuating circumstances. The end result of the NTSB report will be the board's determination of the casual factors.

NTSB reports are sometimes reminiscent of the scenarios written for the original "Dragnet" television series in which Detective Sgt. Joe Friday, as portrayed by Jack Webb, admonished suspects or victims being interviewed to "Just give me the facts, ma'am." What was implied

was that a recitation of the facts would allow the detectives to take that unembellished information, apply their own ingenuity and imagination and develop a course of action that would lead to the solution of the crime.

So it is with NTSB reports. The board does not deal in suppositions, guesses or assumptions, nor does it prepare its documents with an eye toward the dramatic impact they will have. Fundamentally, it is, "Just the facts, ma'am." The NTSB causal factors are explicit, direct and to the point. NTSB's recommendations, based on its determination of what is needed to prevent a similar accident, are equally explicit; the accident analyst who wants to use an NTSB report to bolster safety within a given operating group (airline, commuter, corporate or general aviation operation) has a sound starting point.

However, the accident analyst who chooses to dig for the hidden values and buried treasures has to subject the entire accident report to intensive study. There is much to be discovered from what the board leaves unsaid and that requires reading between the lines. Curiosity and imagination can lead to building scenarios that do not necessarily depart from the facts, but which allow for conjecture, suppositions and assumptions that relate to the given circumstance.

When digging produces a useful result, the next step would be to put that knowledge to work within a given aircraft operation. Airlines and military aviation have structured safety functions with personnel assigned to those chores, so that there is a mechanism for garnering and disseminating safety information. Depending on the size of the department and the number of personnel, corporate aircraft operators may or may not have someone directly responsible for safety, but the need for information is no less important and a proper mechanism can be developed.

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Assuming that a safety officer reviews a specific aviation accident report and finds information to consider, how can that information be put to work? If the data shows malfunction or misuse of aircraft systems, components, instruments or avionics, a review of aircraft in the company's fleet would be in order to determine whether systems are being operated properly, whether there are deficiencies that need to be corrected or if additional equipment would add to safety.

If standard operating procedures or policies contributed to the cause of an accident, a comparison of procedures would be an advisable course of action, to correct, add or explain existing procedures.

If a failure in cockpit resource management played a part in the accident, a hard look at what goes on in the company aircraft cockpit is appropriate because human factors rank close to the top of the list in accident causes.

If there is a particularly significant single factor, or a series of causal factors that warrants discussion and clarification, these should be the subject of a pilot safety meeting where cause, effect and remedy can be aired to determine what the best course of action should be within the company.

A Case in Point Shows How to Find Treasure

Excerpts from a specific NTSB accident report can illustrate how thinking processes can be activated in the search for information beneath the straight facts. Although the accident chosen for this discussion happened some years ago, there are diverse elements that could be considered individually: following procedures that govern the use of airplane deceleration systems; interpretation of wind reports and the affect on airplane airspeed and configuration when landing on a wet runway; pilot technique and decision-making; and crew coordination, to name a few.

The report, NTSB/AAR-87-08, relates to a Boeing 737-22, operating into Charlotte, North Carolina, U.S., on October 26, 1986. The flight was routine until its arrival in the Charlotte area where instrument meteorological conditions prevailed. The flight was cleared for an instrument landing system approach to runway 36R. The airplane touched down at 2007:19 hours local time and departed the runway 14 seconds later, striking the localizer antenna array located about 300 feet from the departure end of the runway. The airplane struck a concrete culvert 18 feet beyond the localizer, continued through a chain link fence and came to rest at the edge of railroad tracks located 440 feet from the end of the runway. The airplane was destroyed, three passengers sustained serious injuries and three crew members and l28 passengers sustained minor injuries.

The NTSB determined that the probable cause of the accident was the captain's failure to stabilize the approach and his failure to discontinue the approach to a landing that was conducted at an excessive speed beyond

the normal touchdown point on a wet runway. Contributing to the accident were the captain's failure to get the best performance from the airplane's decelerative devices and the lack of effective crew coordination during the approach.

The history of the flight revealed that the final controller at Charlotte directed the aircraft to fly a heading of 195 degrees "for a close-in base leg," and that the transmission was acknowledged. The final controller advised an aircraft ahead of the accident aircraft in the sequence to runway 36R that there was a right-to-left wind of 20 to 25 knots on the final approach course. According to the cockpit voice recorder (CVR), the Boeing 737 also received this information, although neither crew member commented on the winds or discussed possible changes needed to conduct the flight.

The NTSB stated that a combination of operational and runway environmental factors contributed to the accident. These included excessive approach landing speeds for the prevailing conditions, non-adherence to required airspeeds and airplane configurations during the approach, touchdown more than 3,200 feet beyond the approach end of the runway, lack of timely ground spoiler deployment following touchdown and hydroplaning that reduced the airplane's braking capability.

The board stated that each factor, individually, may not have caused the accident. However, in combination, they led to the inability of the flight crew to stop the airplane on the runway.

Therefore, the NTSB focused on the actions of the captain and the first officer to determine how their operation of the flight contributed to the accident. In the board's opinion, the flight crew failed to follow certain required company procedures and did not monitor critical flight parameters. As a result, there was a reduction in the margin of safety.

Before the flight crossed the final approach fix at 2005:31, the captain did not reduce the airspeed to a value appropriate for the approach, nor did he configure the airplane as required, nor did the first officer call this to the attention of the captain. The airline procedures specified that before crossing the outer marker used as the final approach fix, the final landing flap setting should have been selected and the airspeed should have been reduced to a level appropriate for that flap setting.

On this flight, the final flap setting was 30 degrees and the final approach airspeed, or Vref, was 131 knots.

The CVR indicated that the final flap setting was not accomplished until the airplane was on the glideslope, well inside the final approach fix. Further, the first officer did not lower the gear until 2005:39 and the captain did not select the final 30-degree flap setting until 2006:48, when the airplane was less than one mile from the runway threshold and two seconds before the first officer made the callout that the aircraft was 500 feet above the ground. Moreover, the airspeed was not reduced to 131 knots until after landing.

In the board's opinion, the flight crew failed to follow certain required company procedures and did not monitor critical flight parameters.

Because the airplane was not configured for landing until shortly before touchdown, the NTSB said the captain was "behind" the airplane. That is, he was setting flaps, lowering the landing gear and trying to reduce the airspeed after the flight was descending on the glideslope and well inside the final approach fix. Had the captain slowed the airplane and configured it as required before reaching the final approach fix, he could have stabilized the approach and controlled the airspeed with the required precision, the board said. However, the airplane crossed the final approach fix at 194 knots indicated airspeed, crossed the threshold about 165 knots, and touched down about 147 knots, considerably higher than the Vref speed of 131 knots, more than 3,200 feet from the runway threshold and more than 2,000 feet beyond the company's recommended touchdown point.

The captain asserted that he added 20 knots to Vref because of his concern for a windshear condition but NTSB said, if the concern was valid, he failed to properly interpret and apply guidance provided on the subject in the company operations manual. From that guidance, with surface wind reports, the lack of significant convective activity and his knowledge of the tailwind on the approach, the captain should have known that any existing windshear involved that of a tailwind shearing to a light crosswind or no wind. Under those conditions, significant speed additions were not needed and would have compounded airplane controllability problems because this type of windshear tends to increase indicated airspeed during descent through reducing tail-windshear. Finally, the company operations manual stated that "if the airplane is below 500 feet above ground level and the approach becomes unstable, a go-around should be initiated immediately."

Moreover, said the NTSB, the evidence indicates that the captain and first officer were aware that the approach was unstable, yet they continued the approach. The captain knew that the turn given to him to final approach

course was going to be close to the final approach fix and he accepted it. He was aware that the likelihood of encountering a tailwind on final approach was high. Further, he received several indications that the approach was not procedurally correct. At 2005:02, he told the first officer, "It's going to be tight," presumably in reference to configuring the airplane properly and capturing the glideslope and localizer.

At 2006:22, when the captain told the first officer that "George didn't do me any favors there," he recognized that the autopilot was not capturing the glideslope. This was most likely caused by the excessive descent rate which exceeded the autopilot's capabilities to maintain the glideslope path, due to the high airspeed and substantial tailwind.

At 2006:37, the first officer informed the captain that the speed brake lever was in manual, or down, detent, contrary to the airline's requirement that the speed brake lever be armed before landing. The captain's response to that call is unclear on the cockpit voice recorder. Thus, the NTSB could not determine whether he armed the speed brake lever; but the failure of the ground spoilers to deploy immediately after landing suggested that they were not armed.

The ground proximity warning system (GPWS) sounded twice thereafter, further indicating that the approach was unstable and not in accordance with company procedures. Since the runway was in sight when the first GPWS alert sounded, and since the first officer called "minimums" when the second alert sounded, the captain probably recognized that terrain clearance was adequate and, as a result, he believed that he could safely ignore the alert. However, the NTSB indicated that the GPWS was being triggered because of an excessive descent rate close to the ground and not because of inadequate terrain clearance. The board contended that the captain should have recognized that the approach was not stabilized at the appropriate airspeed, descent rate and power setting and, consequently, that the margin of safety for landing on a wet runway had been reduced to an unacceptably low level.

The NTSB pointed out that the airline's flight crew publication had discussed the role of proper airspeed management and proper touchdown point to avoid a runway overrun just five months before the accident. It noted that the captain and the first officer should have been acutely attentative to proper airspeed management. Rather, the evidence indicated to the board that proper airspeed management was not present and that the airspeed throughout the approach was excessive for the existing runway conditions. As a result, the captain's failure to stabilize the approach compromised his ability to stop the airplane on the runway. The NTSB concluded that this was the major factor in establishing the conditions for the accident.

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Despite the unstabilized nature of the approach, and the touchdown that occurred at a point considerably beyond the recommended touchdown point on a runway that contained areas of standing water, NTSB's evidence indicated that the airplane could have been stopped on the remaining runway had the captain made optimal use of the airplane's decelerative devices: the spoilers, thrust reversers, brakes and antiskid system. However, the evidence suggested to the NTSB that, despite repeated guidance in the airline operations manual on the need to arm spoilers and, if not armed, deploy them upon touchdown before the other decelerative devices, the spoilers on the accident aircraft were neither armed nor deployed. The NTSB granted that this could be accounted for by the rushed nature with which the approach was conducted and the extent to which required procedures were not followed.

Crew Coordination Is a Two-way Street

While the decision to continue the approach belonged to the captain only, the NTSB said that the first officer participated in the decision-making process in the information he provided to the captain. The first officer recited the landing checklist and stated that the speed brakes were in the manual mode of operation. He also called out the approach lights when they became visible.

The first officer's statement about the speed brake lever being in the manual mode contained the clear implication that it was not armed as required. To the NTSB, this was a subtle reminder to the captain that the required approach and landing procedures were not being adhered to. At the same time, the first officer did not point out to the captain that the airplane was still not configured for landing even though it was well inside the final approach fix, and he did not call out to the captain that the airspeed was excessive throughout the approach. The NTSB concluded that the first officer's lack of assertiveness in providing the captain with needed information and the captain's failure to respond to the "subtle" callout of the

speed brakes in manual were indicative of deficient crew coordination, also known as cockpit resource management, and that this deficiency contributed to the accident.

At that time, the NTSB was aware of the difficulty that first officers faced in attempting to provide captains with needed information at critical points in a flight, when such attempts could be distracting. More important, said the board, is the difficulty they may face when attempting to influence the pilot-in-command to reconsider and possibly alter a decision. Thus, it would have been very difficult, once inside the final approach fix, for the first officer to suggest to the captain that the approach was not stabilized and, as a result, that they should go around. Such a suggestion, if presented inappropriately, could distract the captain and could potentially endanger the safety of flight, said the NTSB.

Brainstorming the Facts Can Lead to Insights

What have been stated above are "Just [some of] the facts, ma'am" as taken from the NTSB accident report. From this point on, a reader can indulge in an uninhibited brainstorming exercise. For example, consider the following points.

The airline operations manual appears to be rather specific as to what it requires and when. What happened to break down the normal sequence?

The flight received instructions for a tight turn to the final approach fix which appeared to have effectively reduced the time available to perform cockpit functions in a timely and orderly manner. The NTSB makes reference to the crew being "rushed." Given the necessity for maintaining a landing sequence at a busy hub airport, keeping up to the scheduled flight times and avoiding the ignominy of making a go-around, what options are open to the pilot-in-command and which have company backing? Air traffic controllers may not fully understand the cockpit workload and, in their anxiety to keep the traffic moving, may cut a corner or two and rely on the flight crew to compensate accordingly.

In this instance, the airline policy is, "If the airplane is below 500 feet above ground level and the approach becomes unstable, a go-around *should* (emphasis added) be initiated immediately." The word "should" implies that the pilot-in-command has the option of going around or continuing with the approach. Would the policy have more teeth if the word were "shall," a more mandatory term that takes the option away from the pilot-in-command? How does this compare with your company policy and how would pilots interpret the words "shall" and "should?"

How does a pilot cope with being behind the airplane? The Boeing 737 captain was setting flaps, lowering the landing gear and trying to reduce the airspeed after the flight was descending on the glideslope and well inside the final approach fix. An over simplified answer would be that the pilot stays ahead so that he can not fall behind. This suggests that preparation for the approach, including all the possible variables, should begin as far in advance as is reasonable in order to organize the cockpit and aircraft configuration so that both pilots understand what is going to happen. And, would it be a good idea in simulator training to rush the pilot in an attempt to get him behind the airplane to see how the pilot can cope with such a situation.

The position of the speed brake lever could lead to an assumption that the required and proper checklist callout and response was overlooked in the scramble of cockpit activity. Improper checklist use has been pinpointed as a primary causal factor in several major accidents. This suggests that how the checklist is used and what responses are mandatory should be a matter of review by company management and pilots, regardless of the boredom, monotony and time consumption involved.

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How and when should first officers assert themselves when the safety of the flight and their own hides are in jeopardy? Since this accident happened in 1986, much has been accomplished by cockpit resource management (CRM) training and line oriented flight training (LOFT). Nevertheless, lack of assertiveness remains a problem. Take the matter of declaring an abort on takeoff. Most airlines restrict the declaration of a rejected takeoff to the captain. To a casual observer, this might indicate that only half of the cockpit resources are being used. To others, the captain's prerogative in this instance is inviolate even though it may be the first officer who is in the best position to determine that the airplane cannot make a successful takeoff. And the first officer, regardless of whether he is right or not, may believe that he cannot really assert himself during those two or three seconds when a decision has to be made.

In the accident sequence discussed earlier, the first officer

kept his silence because he did not want to "distract the captain and potentially endanger the flight." The fact of the matter is that the silence did endanger the flight, for if the first officer had asserted himself, he may have shown his support for a decision by the captain to go-around. The question for the reader is, "What are company procedures and are they in the best interests of safety?"

The Bottom Line: Read Between the Lines

Granted that this discussion may only scratch the surface of the process of digging for hidden information. The basic intent is to stimulate thought processes that will allow readers of accident reports to not only accept the facts and conclusions as reported, but to question what else can be learned and put to good use. ♦

About the Author

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