Landing in Extreme Weather: When Getting it on the Ground can Prove Fatal

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The inspiration for this article comes from an experience I had a few years back while flying a Learjet 25. I had onboard a relatively high profile passenger who chartered our flight for a one-way trip from Michigan to Teterboro Airport in New Jersey. The flight was conducted in the early evening and the weather for the route was good VFR with some occasional light turbulence. Upon our arrival into the New York area there was a significant amount of turbulence and windshear due to a strong cold front that had just cleared the area. Surface winds were out of the north/northwest at 15-25 knots with occasional higher gusts and windshear was being reported by all aircraft landing in the New York metro area. The Teterboro ATIS reported that Runway 01 was closed due to construction which meant that we would have to land on Runway 06 with a direct crosswind and windshear. Threat and error management red flags were popping up all over the place. Our arrival into Teterboro unfolded as follows:

It took everything I had to maintain a stabilized approach path. Below 500 feet the windshear was so bad that at times I needed full power to maintain our target Vref speed. I had a decision to make at about 200 feet; do I continue for the sake of getting the passenger to his destination and to satisfy my boss, or do I execute a go-around and then try to sort out options, which included a diversion to Newark? I chose the go-around. At the same time the passenger, who was visibly annoyed, came to the front of the airplane and asked why we didn’t land. I explained and was then chastised because of his tight schedule and because he had someone waiting to pick him up. He said I would hear about it if he had to wind up in Newark. I informed him that I would try one more approach, and if we couldn't get in then we had no choice but to divert to Newark. He walked back to his seat (which he should have been in to begin with…seatbelt securely fastened) and gave me a dirty look. I briefed my first officer that I was going to give it one more try into Teterboro. However, if the picture still looked the same, we would head to Newark without question. We were fortunate on our second approach in that the windshear subsided enough to allow me to make a safe landing. We taxied to the FBO, dropped off our passenger, and went to the hotel for the evening. The outcome was successful and I slept well that night.

The next day I received a call from my charter company asking why I had to conduct a go-around (since go-arounds are a fairly rare event). I gave them the details and in the interest of safety certainly felt that I made the right decision. The response from the charter company was that I wasted quite a bit of fuel on the go-around and that is a cost that the company would have to absorb. Not once was I commended for making a prudent, safe decision, as the captain of their aircraft. On the other hand, I am absolutely sure that if I would have landed and had an accident, this same company would have been the first to ask how I could have made such a terrible decision to land in those conditions (if I were alive to talk about it).

Four Accidents That Involved Flawed Landing Decisions

Unfortunately, in real-world flight operations, the decision to go-around is not always clear-cut. Four major accidents are presented below to illuminate the significance of the problem. All of these accidents have a common theme; they all involved pilots' decisions to land in weather conditions that exceeded either the aircraft limitations, pilot limitations, or a combination of both. Although detailed information about each accident is not included, extracts from the official accident reports as to Probable Cause have been cited.

Air France Flight 358
August 2, 2005

…The crew conducted an approach and landing in the midst of a severe and rapidly changing thunderstorm…When the aircraft was near the threshold, the crew members became committed to the landing and believed their go-around option no longer existed…(Transportation Safety Board, 2007).

Southwest Airlines Flight 1248
December 8, 2005

…Also contributing to the accident was the pilots' failure to divert to another airport given reports that included poor braking action and a tailwind component greater than 5 knots…(National Transportation Safety Board, 2006).

American Airlines Flight 1420
June 1, 1999

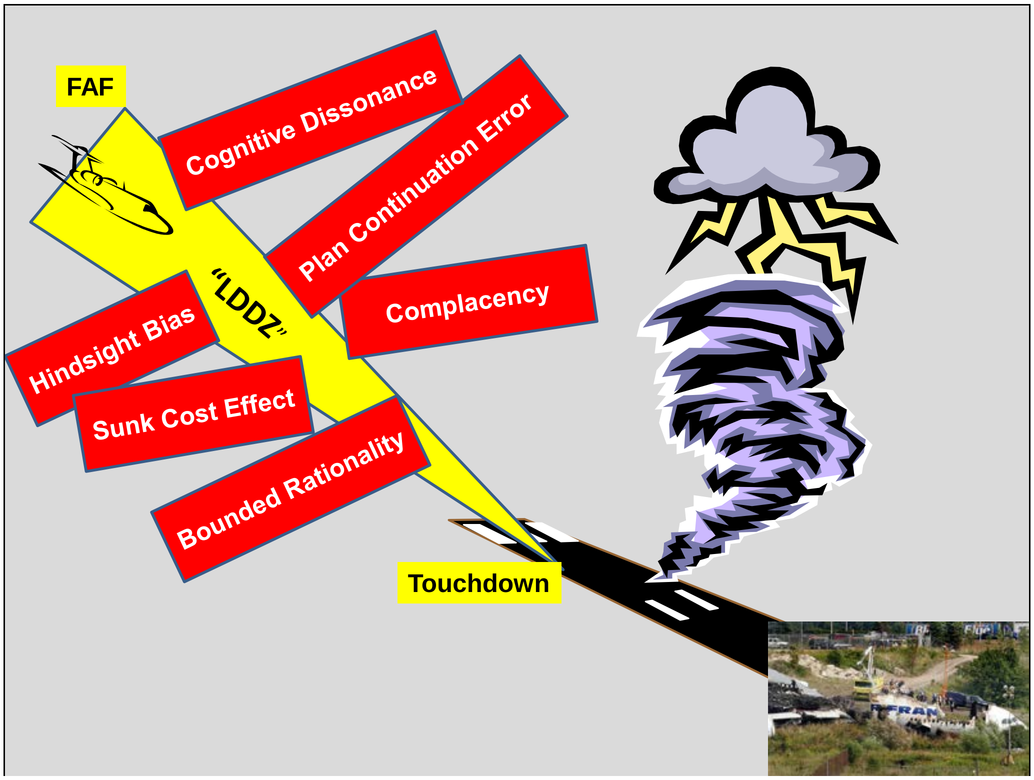
…The flight crew’s failure to discontinue the approach when severe thunderstorms and their associated hazards to flight operations had moved into the airport area…Contributing to the accident were the flight crew’s impaired performance resulting from fatigue and the situational stress associated with the intent to land under the circumstances…Continuation of the approach to a landing when the company’s maximum crosswind component was exceeded…(National Transportation Safety Board, 2001).

One-Two-Go Airlines Flight 269
September 16, 2007

…The weather condition changed suddenly over the airport vicinity…The flight crew had accumulated stress, insufficient rest, and fatigue…The transfer of aircraft control took place at a critical moment, during the go-around (Ministry of Transport, n.d.).

Factors Affecting Landing Decisions

There can be a great amount of stress placed on flightcrews towards the end of a flight. Stress factors include on-time performance, company pressure, personal pride, peer pressure, complex arrival procedures, and weather. These stress factors are typically combined, and can be further exacerbated by fatigue. Pressure to land can be so intense that an otherwise rational pilot may make irrational decisions and fall into a “must get there” mindset at the expense of safety. This was elucidated in the above examples where, in each case, the pilots elected to continue an approach and land in weather conditions that were outside of the aircraft and/or pilots’ limitations, and each resulted in a runway excursion. And even when there is no actual pressure to land, and fatigue does not play a role, there are still occasions where pilots may succumb to factors such as perceived pressure, or just want to test their luck. That may have been the case where a Learjet 55, on a five minute repositioning flight from Fort Lauderdale Hollywood International Airport to Fort Lauderdale Executive Airport, ran off the end of the runway in a severe thunderstorm. The National Transportation Safety Board issued the Probable Cause as, “The flight crew's decision to continue the approach into a known area of potentially severe weather [Thunderstorm], which resulted in the flight encountering a 30-knot cross wind, heavy rain, low-level wind shear, and hydroplaning on a ungrooved contaminated runway” (National Transportation Safety Board, 2005). So the question remains as to why such highly qualified and experienced pilots could commit such egregious decision errors. Shown below are some common factors that may influence the landing decision process.



The "Landing Decision Danger Zone." Copyright 2009 by Robert Baron, Ph.D

Decision Factors

Plan Continuation Error

Pilots may choose a course of action and stay with it regardless of the consequences or rule violations simply because they have "made a plan and they are going to stick to it." Plan Continuation Error (PCE) is a term developed by Burian, Orasanu, and Hitt (2000) who found that a large number of general aviation accidents that involved flight from VFR into IMC involved a plan continuation error. While the crux of their study focused on general aviation and enroute weather situations, PCE can be easily applied to landing decisions in commercial air transport operations. There is a tremendous amount of pressure for a pilot to complete a trip as planned, and because of this there may be a degradation of rational decision making towards the end of a flight.

Sunk Cost Effect

Similar to PCE, O'Hare and Smitheram (1995) suggest that decision frames may be induced by the proximity of the pilots' goals, such as the destination airport. As goal achievement gets closer, the "sunk cost" effect might be more likely. The sunk-cost effect specifies that if more has been invested in a certain course of action, the less likely this course of action will be abandoned than if less were invested (Kahneman & Tversky, 1982, as cited in Wiegmann, Goh, & O'Hare, 2001).

Cognitive Dissonance

Pairs of cognitions can be relevant or irrelevant to one another (Festinger, 1957). If two cognitions are relevant to one another, they are either consonant or dissonant. The existence of dissonance, being psychologically uncomfortable, motivates the person to reduce the dissonance and leads to avoidance of information likely to increase the dissonance.

Conflicting cognitions may be apparent when making the decision, for instance, to land in a thunderstorm with windshear. The dissonance manifests as a conflict between *arriving successfully at the destination airport* and the *possibility of having to go missed approach (*the least preferred choice). In an attempt to lessen the dissonance between these two cognitions, the pilot may use the rationale that the landing will ultimately be successful and the chance of a missed approach is comparatively small. This type of thinking can create tunnel vision and can significantly affect good decision making at critical times.

Complacency

Complacency is a feeling of well-being, contentment, and invulnerability, and can be associated with performing the same task over and over again with the same predictable outcome. Pilots conduct landings thousands of times in their careers under varying levels of complexity and weather conditions. Once the pilot has hundreds or thousands of landings under his or her belt there may be a certain level of complacency that develops. The mindset that develops is that all landings will be successful, which may also lead to pushing more limits and personal thresholds. It must be kept in mind that every landing is somewhat different and a pilot should never let his or her guard down during the landing process. The option to go-around remains viable during the approach and up to a certain point during touchdown.

Hindsight Bias

Most people have heard of the adage "hindsight is 20/20." This implies that what we see in the past is always clearer than what can be seen now or in the future. This can create what is known as hindsight bias, and this can have a profound effect on decision making. According to Plous (1993), "Hindsight bias is the tendency to view what has already happened as relatively inevitable and obvious—without realizing that retrospective knowledge of the outcome is influencing one's judgments."

Hindsight bias breeds complacency and may result in losing focus of the big picture. The pilot must understand that although he or she has landed successfully in “similar” adverse weather situations in the past, that does not guarantee that this particular landing will yield the same outcome.

Bounded Rationality

In the decision making process, people tend to be only partly rational, and are in fact emotional or irrational in the remaining part of their actions. Aviation is a skilled domain and pilots are considered experts when they apply their knowledge to decision situations (Orasanu & Martin, 1998). Humans are simply not capable of processing large amounts of information at once, so this becomes known as bounded rationality. People may try to rationalize decisions by *Satisficing,* which is a behavior that attempts to achieve at least some minimum level of a particular variable, but which does not strive to achieve its maximum possible value (Simon, 1957).

The implications of bounded rationality in aviation decision making can be clearly articulated when pilots are confronted with, for example, landing in extreme weather conditions. In these cases, the pilot might make a decision—albeit not the best decision, based strictly on an on-time arrival and personal pride. All of the conflicting information for a safe landing tends to be minimized or excluded from the decision process.

Conclusion

Making that last minute decision to land in extreme weather conditions can be one of the most challenging moments for a pilot. Even with standard operating procedures (SOPs) in place, the pressure to land can be so intense that pilots are willing to take the risk with the assumption that the outcome will be successful. Four air transport accidents were cited in this paper that showed how flawed landing decisions can lead to an accident. Each involved a runway excursion due to landing in conditions that were beyond the aircraft and pilot limitations. In each case, the aircraft were perfectly airworthy and the pilots were experienced and highly qualified. In each case, a go-around would have prevented the accident from occurring.

The pressure to land in these types of conditions comes from many sources. Some of the sources mentioned in this article included sunk cost effect, plan continuation error, hindsight bias, cognitive dissonance, complacency, and bounded rationality. There are other additive components in the mix as well; these include company pressure, flight schedules, and personal pride. And all of this is typically exacerbated by fatigue. Fatigue can be detrimental to the decision making process in that it can make a person do things they normally would not do.

Preventing these types of accidents from happening again will require some rethinking by both the airlines and pilots. Airlines should have a non-jeopardy policy for go-arounds. If a pilot chooses to go around because of a safety issue, there should be no repercussions from the company. If the company does not stand by the pilot and views go-arounds as “poor piloting skills,” or “an added fuel expense we don’t need,” then there is going to be a big problem. Pilots will then believe that it will be better to risk an unsafe landing than be questioned, or perhaps punished, for going around.

Pilots should pay careful attention to risk management when landing in extreme weather conditions. Understand all the factors that might be influencing your decision making process at the very end of the flight. If in doubt, it will be safer to go-around and either hold until conditions improve or fly to the alternate.

Hopefully, this paper has shed some light on a topic that seems to get little attention but can have major consequences. Follow your SOPs, abide by your aircraft’s and your own limitations, and most of all, don’t be pressured to land when you are outside the limits. It could be the landing that you will not walk away from.

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