6 Aeronautical Decision Making

Aeronautical Decision Making (ADM)—in one form or another—has been around since before the Wright Brothers. Aeronautical Decision Making enhances a pilot's ability to make sound decisions. A sub-set of ADM includes Crew (Single-Pilot) Resource Management CRM (SRM). ADM/CRM has taken on a more serious appreciation as the result of some significant tragedies. In 1978 a United Airlines DC-8 crash initiated one of the first industry wide Crew Resource Management programs.

Case Study

> On December 28, 1978 United Airlines Flight 173 crashed into a wooded area of suburban Portland, Oregon. The airplane had been delayed southeast of the airport at a low altitude for about one hour. The captain was obsessed with trying to solve a possible landing gear problem. Out of fuel, the plane crashed about six miles southeast of the airport. The airplane was destroyed with ten fatalities. The National Transportation Safety Board (NTSB) determined that the captain failed to monitor the airplane's fuel state. Contributing to the accident was the failure of the first and second officers to either fully comprehend the critical nature of the fuel status or successfully communicate their concerns to the captain.

How do we decide if a particular flight is safe—acceptable risk—and will continue to remain within safe margins? We apply the concepts of sound Aeronautical Decision Making: *the ability to obtain all available, relevant information, evaluate alternate courses of action, then analyze and evaluate their risks, and determine the results.* Simple, huh! To begin we'll address impediments to sound Aeronautical Decision Making; look at methods to recognize and correct hazardous behaviors, then examine solutions to minimize and avoid dangerous situations.

Impediments to Sound Aeronautical Decision Making

Obstacles to good Aeronautical Decision Making fall into two general categories: Operational Pitfalls and Hazardous Attitudes. A lack of knowledge and skill or an exaggerated sense of one's abilities exacerbate these dangers.

Note

Human factors most often cited or inferred in National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System (ASRS):

1. Confusion
2. Distraction
3. Communication Breakdown
4. Fatigue
5. Complacency
6. Work Overload
7. Fixation

Operational Pitfalls

Operational pitfalls are behavioral traps. It's normal to try to complete a planned flight, please passengers, meet schedules, and generally demonstrate that we have the "right stuff." A summary of these behavioral traps is outlined in Table 6-1. Pilot behaviors and Case Studies in this section may overlap; often more than one "pitfall" influences our decision making process. Like hazardous attitudes, recognition is the best resolution/prevention.

PEER PRESSURE—an easy trap, especially if the "peer" is a supervisor or manager, or someone we're trying to impress.

Peer pressure results in a decision based on emotional rather than an objective evaluation of the situation. External or internal forces, real or perceived, can often affect a sound decision.

The 1983 movie "The Right Stuff" was the story of the original U.S. Mercury 7 astronauts and their approach to the space program.

Table 6-1. *Operational Pitfalls*	
Peer Pressure	A decision based on an emotional response to others rather than an objective evaluating.
Mind Set	The inability to recognize or cope with changes different from anticipated or planned.
Get-There-Itis	The tendency to fixate on a goal while disregarding alternative courses of action.
Duck-Under Syndrome	The tendency to "sneak a peek" by descending below minimums.
Continuing VFR into IMC	Trying to maintain visual contact while avoiding contact with the ground.
Getting Behind the Aircraft	Allowing events or situations to control your actions.
Loss of Positional or Situational Awareness	Not knowing where you are; inability to recognize deteriorating or misjudging circumstances.
Operating Without Adequate Fuel Reserves	Ignoring minimum fuel reserve.
Flying Outside the Envelope	Unjustified reliance on the aircraft's performance to meet the situation.
Neglect of Flight Planning, Preflight Inspections, Checklists, etc.	Unjustified reliance on memory, flying skills, or repetitive and familiar tasks.

Case Study

Our flight school asked me to take three pilots and ferry a Cessna 182 from Van Nuys, California to Wichita, Kansas. We were to bring four new Cessna 150s back to California. I met with two of the pilots and briefed them on the flight; the other pilot (We'll call him pilot "X.") was difficult to contact, but I did inform him that the "182" was ONLY equipped with a portable communications radio. (The flight school wanted this pilot to build PIC time to sell him a multi-engine rating.)

Discontinued in 2015, World Aeronautical Charts (WAC) were designed for visual navigation by moderate speed aircraft operating at altitudes up to 17,500 ft MSL. Because of their smaller scale (1:1,000,000) they did not show the detail of sectionals or terminal area charts.

"Click" *Norms* to view animation.

On the morning of departure pilot "X" was an hour late. When he did show up, he had WAC charts with a course laid out form VOR to VOR to VOR. By late afternoon we were on the ground in Tucumcari, New Mexico. The wind was blowing out of the northwest at 35 gusting to 45 knots. Amarillo, Texas had similar conditions with blowing dust tops to 9000 ft.

Pilot "X" insisted we continue. I told the others that was fine with me, but the airplane and I were remaining in Tucumcari overnight—I had the keys!

The moral of the story: Don't to let anyone or any situation push you into an ill-conceived action. As a good friend and excellent pilot Gene Cole puts it: "There's never a reason why you have to be there."

Rule

Everyone in the airplane has a "VETO." Unless everyone is comfortable with what we're doing, we DON'T!

Norms—standard practices—are a subset of Peer Pressure. Norms are usually undocumented, adopted by an organization or group; often the result of pilot's initial training—early learning. They may be perpetuated by a flight school or individual instructors. How many times have you heard the statement: "Well, that's the way my instructor taught me to do it." Existing norms don't make it right; just because it has been done, doesn't make it an acceptable practice. The video in the callout shows an example of this behavior.

MIND SET—inability to recognize or cope with changes.

As the saying goes, "Hope springs eternal." In aviation "hope" is not a substitute for knowledge and skill.

Case Study

(ASRS) "I was quickly running out of options."

I received standard weather briefings via DUATS for my route...My interpretation was that it was to be a CAVU (Ceiling and Visibility Unlimited) day along my entire route...I called Approach and obtained VFR flight following...I did not check the weather again before departing. Approaching the mountains...at 8500 ft MSL, I observed what appeared to be poor visibility under the clouds...I informed ATC (Air Traffic Control) that I was climbing to 10,500 ft MSL. When I reached that altitude...I thought after I cleared a 'line of clouds' I would be able to descend. However, it became apparent that the overcast was somewhat widespread, the tops continued to rise, and I soon found myself climbing to 12,500 ft...I was wary of climbing higher, given the oxygen requirements, which I was aware of [and] I was concerned about possible effects of hypoxia...However, the cloud tops continued to rise, and I continued to climb to 14,000 ft...I was approaching the service ceiling of my aircraft and thus quickly running out of options to avoid the clouds....

In retrospect, staying below the clouds would have been a much better option. I allowed incorrect assumptions about the extent of the overcast layer to influence my judgment, and failed to consider turning back when it was still my best option. On the positive side, I did eventually admit my mistake and obtain the assistance I needed, and Flight Watch and ATC were both helpful in resolving the situation without incident.

This pilot's "mind set" was to continue "hoping things would get better." At the first sign of change, update weather and develop a plan that will result in a safe outcome. We'll specifically address this issue later in the chapter and revisit this Case Study. (The more we invest in a flight the more likely we will continue. Beware of a "mission" mindset.)

GET-THERE-ITIS—a pilot's predisposition to push-on no matter what.

A sub-set of get-there-itis is a pilot's psychological tendency to continue with the original plan, regardless of circumstance. At least in part this tendency may be inadvertently instilled in learners during training, as illustrated in the following Case Studies. As a flight school Stage Check pilot, the following incidents took place during the learners' final pre-certification check.

The FAA sponsored a number of entities to provide on-line pilot weather briefing services beginning in 1990. Direct User Access Terminal (DUAT) vendors provided an official source of weather and aeronautical information. DUAT was discontinued in 2018. Leidos Flight Services now provides a similar service.

rote—The ability to repeat something back, but not understanding or being able to apply what has been learned.

Case Study

> It was a hot spring morning, and I was conducting a flight in a Piper Warrior. We were climbing on course. It was evident that the airplane would not out climb the mountains, but the learner kept "trucking on." I finally had to suggest we select an alternate course to avoid terrain.

The second incident involved a learner that had the regulations down "pat." At least by rote.

Case Study

> As we approached a cloud layer, I had to intervene to avoid the learner taking us through the clouds!

Both incidents emphasize the point that as instructors we must train learners to recognize abnormal situations and take appropriate action that will result in a safe outcome—Aeronautical Decision Making.

DUCK-UNDER SYNDROME—the tendency to "sneak a peek."

This usually results in descending below minimums during an approach or minimum altitudes enroute.

Case Study

> The pilot's first destination did not have an instrument approach. It was snowing and the pilot reported "whiteout" conditions—an atmospheric optical phenomenon in which the pilot appears to be engulfed in a uniformly white glow, neither shadow, horizon, or clouds are discernible; sense of depth and orientation is lost. Blowing snow may be an additional cause. The pilot diverted to an airport with an instrument approach.
>
> Reported weather: visibility one-half variable between one-quarter and one mile in snow, indefinite ceiling 600 ft. Radio contact was lost after the second

missed approach. The wreckage was located an hour later.

The following is strictly speculation. Because the crash occurred after the declaration to miss the approach, it appears the pilot decided to miss after the missed approach point. The transition between instrument and visual flight under these conditions is extremely difficult, especially for single pilot operations. The pilot may have acquired ground contact straight down, but slant range and apparent whiteout conditions precluded visual contact with the approach environment and airport.

CONTINUING VFR INTO IMC—trying to maintain visual contact while avoiding contact with the ground, including "scud running."

We've already provided a "Case Study" and discussed this pitfall. It's often associated with GET-THERE-ITIS. Because of its significance we'll continue to revisit this issue.

GETTING BEHIND THE AIRCRAFT—allowing events or situations to control our actions rather than the other way around.

It's happened to all of us. With today's high performance aircraft and exotic avionics there is an even greater potential for pilots to let things "get out of hand." Like Continued VFR... we'll revisit this pitfall.

LOSS OF POSITIONAL OR SITUATIONAL AWARENESS—an inability to recognize deteriorating conditions or a misjudgment of the rate of deterioration.

This condition is amplified by distractions. There are an unlimited number of possible events/conditions that interrupt our ability to focus on a specific task. This includes failure to see a condition, understand what it is, and predict the possible results.

Case Study

> We were flying at night, in marginal weather at Van Nuys, California. I was a relatively new Private Pilot without the benefit of an instrument rating. I turned around 180° and was heading for the hills—literally. Fortunately, my fellow pilot caught the error and got us back on track.

"Confusion now hath made his masterpiece."

William Shakespeare (Macbeth)

OPERATING WITHOUT ADEQUATE FUEL RESERVES—ignoring minimum fuel.

Case Study

> A Grumman Tiger pilot—instructor with learner—on a flight from Salt Lake City to Tonopah, Nevada crashed short of the airport, out of fuel. The instructor couldn't understand why, after calculating the airplane had 2:45 minutes of fuel, the engine quit after only 2:31 minutes.

FLYING OUTSIDE THE ENVELOPE—an unjustified reliance on the aircraft's performance.

As we'll see in chapter 19, Aircraft Performance, all too often, an incident or accident results from a pilot's attempt to fly the aircraft beyond its design capabilities. This pitfall is often reinforced by NORMs—It's OK to fly above certified takeoff weight; a little ice won't affect flight characteristics that much. A negative—but predictable—consequence of the pitfall is the tendency to push the limits a little further on each flight.

Case Study

> Four of us were planning to fly to the Reno Air Races. With full fuel we were 100 pounds over gross weight. I was criticized by some (supposedly) more experienced pilots for de-fueling the airplane to bring it within maximum certificated weight.

NEGLECT OF FLIGHT PLANNING, PREFLIGHT INSPECTIONS, CHECKLISTS, ETC.—unjustified reliance on the pilot's memory, skills, or repetitive and familiar chores, or routes.

Overconfidence—complacency—from repeated experience on a specific activity. In God we trust, everything else we check!

Case Study

> The pilot departed a Southern California airport during the evening for a

flight to Monterey, California. Arriving in the Monterey area about midnight the pilot found the airport overcast. Out of options—and fuel—the pilot made an emergency landing on a highway south of the Reid Hillview airport near San Jose.

There was no record of the pilot checking enroute for a weather update, which would have revealed the onset of coastal stratus! There is no rational reason for this accident. The pilot landed safely and was applauded by some. Unfortunately for aviation, opponents of the Reid-Hillview airport sighted this incident as another reason to close the airport.

When I began my Commercial Pilot training with a major flight school at the Van Nuys, California airport my instructor "poo-pooed" my use of a checklist for the Cessna 150. (As a U.S. Air Force Nuclear Weapons Specialist, they would put you in jail—literally—for not using the checklist.) NORMs again!

A subset of GET-THERE-ITIS and MIND SET is denial. Humans have an uncanny psychological unwillingness to accept that something's not right, especially if there is strong motivation to complete the mission.

Case Study

> I was flying a Piper Warrior from Fresno, California to Sacramento. It was typical winter fog in California's Central Valley. On top the skies were clear, visibility unlimited. About 40 minutes into the flight the "Low Vacuum" enunciator light illuminated. My reaction: No, this can't be happening! I glanced at the suction gage. It read ZERO. Again: No, this can't be happening! In a few minutes the Attitude Indicator went "belly up"—literally. My reaction: No, this can't be happening! Well, it did.

Many Operational Pitfalls result from a pilot's inappropriate level of optimism. This is no better illustrated than by the fact that most low ceiling and visibility accidents involve pilots with over 1000 hours and that more than one-quarter held an instrument rating. This can be countered by developing and adhering to Personal Minimums discussed in chapter 7.

"The alleviation of human error, whether design or intrinsically human, continues to be the most important problem facing aerospace safety."

Jerome Lederer
Slipping the Surly Bonds

Hazardous Attitudes

Attitude (ours, not the airplane) management is the ability to recognize hazardous attitudes in oneself and the willingness to modify our behavior as necessary through the application of an appropriate antidote. ADM addresses the hazardous attitudes shown in Table 6-2.

Table 6-2. *Hazardous Attitudes*

Macho	I can do it!
Anti-Authority	No one tells me what to do!
Invulnerability	It won't happen to me.
Impulsiveness	Do something quickly, anything.
Resignation	What's the use.

Each hazardous attitude can adversely affect our ability to make sound decisions. Macho describes an attitude where an individual thinks they must continually demonstrate that they're better than others. This often results in unsafe actions. Although typically associated with men, women are just as susceptible.

Anti-authority is closely associated with macho. These individuals believe the rules don't apply to them. This attitude often manifests itself as the rules don't apply to me.

As our capability grows through training and experience, we gain an appreciation for aviation and the nature of flight. Hopefully, we develop a positive mental attitude. Be careful not to slip into an invulnerability behavior. Some people feel that bad things only happen to others. I hope we can see how a combination of macho, anti-authority, and invulnerability can lead to disaster!

Impulsive individuals feel they must do something, anything, immediately! Aa example is the failure of an engine on a multiengine airplane. Pilots can become so impulsive that they shut down the good engine or stall the airplane. It has happened to air carriers, as well as General Aviation. They don't take the time to evaluate the situation or consider options and risks before acting.

Resignation describes the behavior of individuals who just give up. It's their fate or bad luck. While attending the FAA Academy in Oklahoma City they played a tape of an

airplane accident. The pilot, while flying in IFR conditions, lost the attitude and heading indicators and advised ATC, "I've lost the gyros and we're going in...." The hair stood up on the back of my neck! The pilot made no attempt to control the airplane. Good thing the astronauts and Mission Control on Apollo 13 weren't afflicted by this attitude!

Case Study

> On a flight from Phillipsburg, Pennsylvania to Huntington, West Virginia we were forced to fly below a 1500 ft overcast. Due to poor planning on my part (pitfall), we only had a World Aeronautical Chart. I misidentified the Kanawha River as the Ohio. To verify the position I checked the highways, railroads, and power lines adjacent to the river. Nothing matched! My wife was looking for golf courses. A precautionary landing with over an hour and a half of fuel would certainly have been impulsive under these circumstances.
>
> After a few moments of confusion and resignation, I checked the time from our last known position and determined we could not have made it all the way to the Ohio River. Based on this estimate, I reevaluated our position as over the Kanawha—everything matched! On the WAC Chart the Kanawha was represented by a thin blue line, the Ohio by a wide blue line. From the air both appeared identical.

The solution to avoiding hazardous attitudes is recognition through realistic self-evaluation. If you don't know you have a problem, it's virtually impossible to correct. Table 6-3 provides antidotes to hazardous attitudes.

Table 6-3. *Antidotes to Hazardous Attitudes*

Macho	Taking chances is foolish.
Antiauthority	Follow the rules.
Invulnerability	It CAN happen to me!
Impulsiveness	Not so fast; think first.
Resignation	I'm not helpless; I can make a difference.

Wishful thinking is a sub-set of Pitfalls and Hazardous Attitudes. Hoping a relatively minor problem will not affect the flight or clear up soon can have catastrophic results. The following Case Study illustrates this point.

Case Study

I had remained overnight in Amarillo, Texas due to a line of thunderstorms. The Cessna 150 was parked into the wind as torrential rains moved through the area. The next morning was clear, with abundant surface moisture—nearly 100% relative humidity.

My first clue was the increased throttle required to obtain idle RPM. Engine runup also took more throttle than usual. I suspected a water saturated air filter and carburetor ice. Amarillo has a 13,000 ft runway.

Full throttle only gave me about 2200 RPM. The increased ground run to rotation—about 7000 ft—was another clue. I was off the ground with no runway remaining and 200 ft of altitude when the engine began losing power. I applied carburetor heat; the engine was running rough at about 1700 RPM.

At this point there was a tremendous psychological urge to reduce carb heat and get back the RPM. I was preparing to crash straight ahead—that's what training teaches—but the engine was still producing power. I decided to make a shallow 180° turn and landed on the parallel taxiway. I then informed a rather surprised tower controller what happened. A pilot's first job is to fly the airplane—aviate!

After running the engine for 20 minutes, and an aborted takeoff later, I launched. The engine performed normally above the shallow, moist surface layer. This is a perfect example of having all the clues and ignoring them!

Alternatives I had available: Wait for the moisture to evaporate; run the engine enough to purge the water. I wanted to get home—where have we heard this before? This incident involved a series of poor behaviors. However, as the incident unfolded there were a couple of good decisions. My initial decision to leave the carb heat on and not to try to turn back to the airport was correct; after reevaluating alternatives I had enough power and altitude to return to the airport, I mitigated circumstances by landing on the taxiway and not trying to maneuver to the runway. However, the entire incident was of my own making!

"It is not in the stars to hold our destiny but in ourselves."

William Shakespeare

We'll tie operational pitfalls and hazardous attitudes into "Case Studies" and the decision making process throughout the remainder of the material.

Sound Aeronautical Decision Making

As well as recognizing operational pitfalls and hazardous attitudes, the application of sound resource management and decision making enhances safety.

Resource Management—in its various incarnations—has been around for decades. Whether it's called Crew Resource Management or Single-Pilot Resource Management it refers to the same process. The application of personal and team management concepts to enhance the safe operation of aircraft, both on the ground and in the air. Resource Management not only includes the pilot, but the crew, ground personnel, and all others who work together to ensure a safe outcome. It's about the gathering of information, analysis, and decision making.

Elements in Resource Management include:

- Pilot Not Flying
- Aircraft Equipment (radios, Global Positioning System, data link)
- Passengers
- Air Traffic Control (including Flight Service)
- Fixed Base Operators – Flight Schools

The presence of a second pilot simplifies matters. Typically, the pilot "not flying" handles communications, selects radio frequencies, briefs procedures, and reads checklists. What about single pilot operations? A passenger in the right seat can be a significant resource. With limited training the person can hold charts and help scan for other aircraft. But they must have some rudimentary training. How to scan? What to report? If it's not clear, they may become more of a distraction—one of NASA's "most often sited" human factors issues—rather than an asset.

Many commercial operators have a *Sterile Flight Deck* requirement below 10,000 ft—no unnecessary conversation. We may wish to adopt this procedure, especially on the ground and in the terminal environment.

Case Study

> My son, who was 16 at the time, and I were on our way to Oshkosh. Landing at Sioux Falls, South Dakota I was instructed to land and hold short; a Boeing 727 was landing on a crossing runway. My son cautioned me about the other airplane. As I was beginning to admonish him for violating our "sterile flight deck" rule, I realized he was doing exactly what I had told him—pointing out a potential hazard.

The cabin of our Mooney isn't much bigger than a "bread box." My wife, who has no interest in learning to fly, never-the-less handles charts, looks for checkpoints, and scans for other traffic—and verifies the gear is "down and locked!"

Aircraft equipment is another resource—assuming we know how to use it. Electronic flight displays, Global Positioning System (GPS) and Automatic Dependent Surveillance—Broadcast (ADS-B) can be a "God sent." But their proper use—especially in actual instrument conditions—requires complete familiarity. If we must think "which switch, do I use to get that function" it's most likely too late!

Air Traffic Control can be a significant resource. But we must ask—or maybe confess. Recall the MIND SET "Case Study" in the Operational Pitfalls section. This pilot's "mind set" was to continue "hoping things would get better." At the first sign of change, update weather and develop a plan that will result in a safe outcome.

Warning

> Over reliance on Air Traffic Control. ATC's primary responsibility is the separation of known aircraft and the expeditious flow of traffic. Unfortunately, some pilots expect controllers to assume pilot-in-command responsibility—sometimes with tragic results. ATC is a resource, not a substitute for lack of flight planning. We'll continue to explore this issue in subsequent chapters.

Fixed Base Operators (FBOs), flight schools, and even UNICOM may be a resource. The quality and usefulness of their assistance depends on the ground personnel's training and experience.

Calling UNICOM the pilot asked, "What's your ceiling." The operator replied, "I think it's oak."

Case Study

Working Oakland Flight Watch I received a call from a Bonanza pilot in California's Central Valley. He was having landing gear problems. I directed the pilot to the Beechcraft UNICOM at Fresno Air Terminal. They were able to assist the pilot with his difficulty.

Since the beginning days of aviation pilots have been cautioned to "get their heads outside the aircraft." This behavior has been exacerbated by electronic flight displays, GPS, ADS-B displays, and data link. With flight deck weather and traffic presentations, there is a tendency for pilots to keep their "heads inside." This equipment is a resource, not an end in itself! The aircraft that's going to hit you isn't inside your airplane!

A change may be initiated by pilot action or inaction. The following Case Study illustrates this scenario.

Case Study

On an IFR flight from Van Nuys, California to San Francisco in a Cessna 172 we encountered trace to light icing after an ATC instruction to climb. I periodically applied carburetor heat. Something odd occurred. With carburetor heat ON, the engine ran fine. OFF, the engine faltered. On the ramp at San Francisco we parked next to a Navion that had also flown up from the Los Angeles area, but at a higher altitude. In the Navion's air filter was a large chunk of ice! I realized, then, that the carburetor heat in the 172 was functioning as an alternate air source. I'm sure this seems ridiculously obvious; it didn't at the time, which illustrates the hazards of *learning by experience*—where the test comes before the lesson.

Superior pilots employ their superior knowledge to avoid the need to employ their superior skills.

UNICOM—A nongovernment communication facility which may provide airport information at certain airports. Locations and frequencies are shown on aeronautical charts and publications.

Ice in the airplane's air filter.

An experienced commercial pilot was ferrying this airplane from the mid-west to California during the warm season. The pilot lost control at 8500 ft MSL west of Rock Springs, Wyoming. Density Altitude was calculated to be over 12,000 feet!