Aviation Instructor's Handbook (FAA-H-8083-9)

Chapter 1: Risk Management and Single-Pilot Resource Management

Introduction

"Pull the throttle back!" Lenore, a flight instructor, ordered the learner, Jennifer, as the revolutions per minute (rpm) climbed past past 2,000 on engine start. "I did, I did!"

Both Jennifer and Lenore grabbed the mixture and pulled. The engine went from a deafening roar to silence. They looked at each other. "What happened?" asked Jennifer. "I don't know. Let's check the engine," Lenore said.

Ten minutes later, they had removed the cowling from the airplane. A quick engine check gave them the answer. The throttle rod-end was not connected to the carburetor arm—no bolt, no nut, just air between the rod-end and the arm. Jennifer looked at Lenore. "What if this had happened in flight?"

"What I want to know," Lenore said, "is how this happened at all. The annual inspection was signed off yesterday."

The previous day, the annual inspection had been signed off after a lengthy inspection by a local facility. Several mechanics had been involved in the inspection, including the owner/learner who had installed a headliner. The mechanic with the Inspection Authorization (IA) who signed off the annual was supervising several annuals, so most of the maintenance was performed by other mechanics.

After the inspection, the engine had been run-up according to the usual post-inspection procedures. The learner and instructor had flown the airplane for a half-hour familiarization flight. The next day's engine start resulted in a runaway engine with the apparent cause due to the lack of the throttle rod-end hardware being safetied.

Three deficient areas in this annual inspection were identified by a round-table discussion group of aircraft and powerplant (A&P) mechanics and the learner. These areas were:

- Lack of responsibility
- Checklist misuse
- Complacency

Lack of responsibility—no one took responsibility for the entire inspection. The chances of something being overlooked increase with an increase in the number of mechanics involved in an inspection. The responsible person is removed from the actual procedure. The learner remembers hearing the IA ask one of the engine mechanics about the throttle. However, the question was vague, the answer was vague, and the rod-end was not safetied.

Checklist misuse—Perhaps the throttle rod-end had been disconnected for maintenance after the IA had signed off the control inspection and marked that item as complete on the maintenance checklist. In that case, a discrepancy should have been entered onto the discrepancy sheet stating, "reconnect and safety throttle rod-end."

Complacency—an insidious and hard-to-identify attitude. Each of the mechanics involved in the incident thought someone else had inspected the throttle rod-end. The IA signed off the annual inspection after asking the mechanics about the items on the checklist, making frequent visits to the airplane, inspecting some of the various items, and deciding that was good enough. Complacency crippled the mechanics' quality of work by removing any thoughts of double-checking each other's work.

While a definite answer to the question of what happened remains a matter of speculation, professional mechanics heed warning signs of potential problems. The combination of a lengthy inspection, numerous technicians, an overworked supervisor, a poor checklist, and vague communication raise a red flag of caution.

This scenario underscores the need for safety risk management at all levels of aviation. Safety risk management, a formal system of hazard identification, assessment, and mitigation, is essential in keeping risk at acceptable levels. Part of this process is selecting the appropriate controls to mitigate the risk of the identified hazard. The primary objective of risk management is accident prevention, which is achieved by proactively identifying, assessing, and eliminating or mitigating safety-related hazards to acceptable levels.

This chapter discusses safety risk management in the aviation community, looking at it as preemptive, rather than reactive. The principles of risk management and the tools for teaching risk management in the flight training environment are addressed in Chapter 9, Techniques of Flight Instruction.

Defining Risk Management

Risk is defined as the probability and possible severity of accident or loss from exposure to various hazards, including injury to people and loss of resources. *[Figure 1-1]* All Federal Aviation Administration (FAA) operations in the United States involve risk and benefit from decisions that include risk assessment and risk management. Risk management, a formalized way of thinking about these topics, is the logical process of weighing the potential costs of risks against the possible benefits of allowing those risks to stand uncontrolled.

Types of Risk	
Total Risk	The sum of identified and unidentified risks.
Identified Risk	Risk which has been determined through various analysis techniques. The first task of system safety is to identify, within practical limitations, all possible risks.
Unidentified Risk	Risk not yet identified. Some unidentified risks are subsequently identified when a mishap occurs. Some risk is never known.
Unacceptable Risk	Risk which cannot be tolerated by the managing activity. It is a subset of identified risk that must be eliminated or controlled.
Acceptable Risk	Acceptable risk is the part of identified risk that is allowed to persist without further engineering or management action. Making this decision is a difficult yet necessary responsibility of the managing activity. This decision is made with full knowledge that it is the user who is exposed to this risk.
Residual Risk	Residual risk is the risk left over after system safety efforts have been fully employed. It is not necessarily the same as acceptable risk. Residual risk is the sum of acceptable risk and unidentified risk. This is the total risk passed on to the user.

Figure 1-1. *Types of risk.*

Risk management is a decision-making process designed to identify hazards systematically, assess the degree of risk, and determine the best course of action. Key terms are:

- Hazard—a present condition, event, object, or circumstance that could lead to or contribute to an unplanned or undesired event, such as an accident. It is a source of danger. For example, a nick in the propeller represents a hazard.

- Risk—the future impact of a hazard that is not controlled or eliminated. It is the possibility of loss or injury. The level of risk is measured by the number of people or resources affected (exposure); the extent of possible loss (severity); and likelihood of loss (probability).

- Safety—freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment. Note that absolute safety is not possible because complete freedom from all hazardous conditions is not possible. Therefore, safety is a relative term that implies a level of risk that is both perceived and accepted.

Principles of Risk Management

The goal of risk management is to proactively identify safety-related hazards and mitigate the associated risks. Risk management is an important component of decision-making. When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated. The ability to make good decisions is based upon direct or indirect experience and education. It is important to remember the four fundamental principles of risk management:

Accept No Unnecessary Risk

Unnecessary risk is that which carries no commensurate return in terms of benefits or opportunities. Everything involves risk. The most logical choices for accomplishing a flight are those that meet all requirements with the minimum acceptable risk. The corollary to this axiom is "accept necessary risk" required to complete the flight or task successfully. Flying is impossible without risk, but unnecessary risk comes without a corresponding return. If flying a new airplane for the first time, a flight instructor might determine that the risk of making that flight in low instrument flight rules (IFR) conditions is unnecessary.

Make Risk Decisions at the Appropriate Level

Anyone can make a risk decision. However, risk decisions should be made by the person who can develop and implement risk controls. In a single-pilot situation, the pilot makes the decision to accept certain levels of risk, so why let anyone else—such as ATC or your passengers—make risk decisions for you? In the maintenance facility, an aviation maintenance technician (AMT) may need to elevate decisions to the next level in the chain of management upon determining that those controls available to him or her will not reduce residual risk to an acceptable level.

Accept Risk When Benefits Outweigh the Costs

All identified benefits should be compared against all identified costs. Even high-risk endeavors may be undertaken when there is clear knowledge that the sum of the benefits exceeds the sum of the costs. For example, in any flying activity, it is necessary to accept some degree of risk. A day with good weather, for example, is a much better time to fly an unfamiliar airplane for the first time than a day with low instrument flight rules (IFR) conditions.

Integrate Risk Management into Planning at All Levels

Risks are more easily assessed and managed in the early planning stages of a flight. Changes made later in the process of planning and executing may become more difficult, time consuming, and expensive. However, safety enhancement occurs at any time appropriate and effective risk management take place.

Risk Management Process

Risk management is a simple process which identifies operational hazards and takes reasonable measures to reduce risk to personnel, equipment, and the mission. During each flight, the pilot makes many decisions under hazardous conditions. To fly safely, the pilot needs to identify the risk, assess the degree of risk, and determine the best course of action to mitigate the risk.

Step 1: Identify the Hazard

A hazard is defined as any real or potential condition that can cause degradation, injury, illness, death, or damage to or loss of equipment or property. Experience, common sense, and specific analytical tools help identify risks. Once the pilot determines that a hazard poses a potential risk to the flight, it may be further analyzed.

Step 2: Assess the Risk

Each identified risk may be assessed in terms of its likelihood (probability) and its severity (consequences) that could result from the hazards based upon the exposure of humans or equipment to the hazards. An assessment of overall risk is then possible, typically by using a risk assessment matrix, such an online Flight Risk Awareness Tool (FRAT). This process defines the probability and severity of an accident.

Step 3: Mitigate the Risk

Investigate specific strategies and tools that reduce, mitigate, or eliminate the risk. High risks may be mitigated by taking action to lower likelihood and/or severity to lower levels. For serious risks, such actions may also be taken. Medium and low risks do not normally require mitigation. Effective control measures reduce or eliminate the most critical risks. The analysis may consider the overall costs and benefits of remedial actions, providing alternative choices when possible.

Implementing the Risk Management Process

The following principles allow for maximum benefit from series of steps described above that form a risk mitigation strategy:

- Apply the steps in sequence—each step is a building block for the next and should be completed before proceeding to the next. If a hazard identification step is interrupted to focus on the control of a particular hazard, more important hazards may be overlooked. Until all hazards are identified, the remainder of the process is not effective.

- Maintain a balance in the process—all steps are important. Allocate the time and resources to perform all.

- Apply the process in a cycle—the "supervise and review" step should include a brand-new look at the operation being analyzed to see whether new hazards can be identified.

- Involve people in the process—ensure that risk controls are mission supportive, and the people who do the work see them as positive actions. The people who are exposed to risks usually know best what works and what does not.

Identifying Risk

Hazards and their associated risks can either be obvious or harder to detect. You should methodically identify and classify risks to a proposed or ongoing flight by maintaining constant situational awareness. To assist this process, it is helpful to apply the simple acronym PAVE to your risk management process. The acronym stands for Pilot, Aircraft, Environment, External pressures. Use the following guidelines and questions to identify risk using the PAVE acronym.

The Pave Checklist

By incorporating the PAVE checklist into all stages of flight planning, the pilot divides the risks of flight into four categories: Pilot in command (PIC), Aircraft, enVironment, and External pressures (PAVE), which form part of a pilot's decision-making process.

With the PAVE checklist, pilots have a simple way to remember each category to examine for risk prior to each flight. Once a pilot identifies the risks of a flight, he or she needs to decide whether the risk or combination of risks can be managed safely and successfully. If not, the flight should be cancelled. If the pilot decides to continue with the flight, he or she should develop strategies to mitigate the risks. One way a pilot can control the risks is to set personal minimums for items in each risk category. These are limits unique to that individual pilot's current level of experience and proficiency.

For example, the aircraft may have a maximum crosswind component of 15 knots listed in the aircraft flight manual (AFM), and the pilot has experience with 10 knots of direct crosswind. It could be unsafe to exceed a 10 knot-crosswind component without additional training. Therefore, the 10 knots crosswind experience level should be that pilot's personal limitation until additional training with a flight instructor provides the pilot with additional experience for flying in crosswinds that exceed 10 knots.

One of the most important concepts that safe pilots understand is the difference between what is “legal” in terms of the regulations, and what is “smart” or “safe” in terms of pilot experience and proficiency.

P = Pilot in Command (PIC)

The pilot is one of the risk factors in a flight. When considering that risk, a pilot may ask, “Am I ready for this trip?” in terms of experience, currency, and physical and emotional condition. The IMSAFE checklist (described later in this chapter) combined with proficiency, recency, and currency helps provide the answer.

A = Aircraft

What limitations will the aircraft impose upon the trip? Ask the following questions:

- Is this the right aircraft for the flight?
- Am I familiar with and current in this aircraft? Aircraft performance figures and the AFM are based on a brand-new aircraft flown by a professional test pilot. Keep that in mind while assessing personal and aircraft performance.
- Is this aircraft equipped for the flight? Instruments? Lights? Navigation and communication equipment adequate?
- Can this aircraft use the runways available for the trip with an adequate margin of safety under the conditions to be flown?
- Can this aircraft carry the planned load?
- Can this aircraft operate at the altitudes needed for the trip?
- Does this aircraft have sufficient fuel capacity, with reserves, for trip legs planned?
- Does the fuel quantity delivered match the fuel quantity ordered?

V = EnVironment

Weather is a major environmental consideration. Earlier it was suggested pilots set their own personal minimums, especially when it comes to weather. As pilots evaluate the weather for a particular flight, they should consider the following:

- What are the current ceiling and visibility? In mountainous terrain, consider having higher minimums for ceiling and visibility, particularly if the terrain is unfamiliar.
- Consider the possibility that the weather may be different than forecast. Have alternative plans and be ready and willing to divert should an unexpected change occur.
- Consider the winds at the airports being used and the strength of the crosswind component.
- If flying in mountainous terrain, consider whether there are strong winds aloft. Strong winds in mountainous terrain can cause severe turbulence and downdrafts and can be very hazardous for aircraft even when there is no other significant weather.
- Are there any thunderstorms present or forecast?
- If there are clouds, is there any icing, current or forecast? What is the temperature-dew point spread and the current temperature at altitude? Can descent be made safely all along the route?
- If icing conditions are encountered, is the pilot experienced at operating the aircraft’s deicing or anti-icing equipment? Is this equipment in good condition and functional? For what icing conditions is the aircraft rated, if any?

Evaluation of terrain is another important component of analyzing the flight environment. To avoid terrain and obstacles, especially at night or in low visibility, determine safe altitudes in advance by using the altitudes shown on VFR and IFR charts during preflight planning. Use maximum elevation figures (MEFs) and other easily obtainable data to minimize chances of an inflight collision with terrain or obstacles.

Airport considerations include:

- What lights are available at the destination and alternate airports? VASI/PAPI or ILS glideslope guidance? Is the terminal airport equipped with them? Are they working? Will the pilot need to use the radio to activate the airport lights?
- Check the Notices to Airmen (NOTAMs) for closed runways or airports. Look for runway or beacon lights out, nearby towers, etc.
- Choose the flight route wisely. An engine failure gives the nearby airports (and terrain) supreme importance.
- Are there shorter or obstructed fields at the destination and/or alternate airports?

Airspace considerations include:

- If the trip is over remote areas, are appropriate clothing, water, and survival gear onboard?
- If the trip includes flying over water or unpopulated areas might there be a loss of visual references?
- Will there be any airspace or temporary flight restrictions (TFRs) along the route of flight?

Night flying requires special consideration:

- Will the trip include flying over water or unpopulated areas?
- Will the flight conditions allow a safe emergency landing at night?
- Are the aircraft lights found to be operational during preflight and is a flashlight available that is appropriate for intended use before and during flight?

E = External Pressures

External pressures are influences external to the flight that create a sense of pressure to complete a flight—often at the expense of safety. Factors that can be external pressures include the following:

- Someone waiting at the airport for the flight's arrival.
- A passenger the pilot does not want to disappoint.
- The desire to demonstrate pilot qualifications.
- The desire to impress someone. (Probably the two most dangerous words in aviation are "Watch this!")
- The desire to satisfy a specific personal goal ("get-home-itis," "get-there-itis," and "let's-go-itis").
- The pilot's general goal-completion orientation.
- Emotional pressure associated with acknowledging that skill and experience levels may be lower than a pilot would like them to be. Pride can be a powerful external factor!

Management of external pressure is the single most important key to risk management because it is the one risk factor category that can cause a pilot to ignore all the other risk factors. External pressures put time-related pressure on the pilot and figure into a majority of accidents.

The use of personal standard operating procedures (SOPs) is one way to manage external pressures. The goal is to supply a release for the external pressures of a flight. These procedures include but are not limited to:

- Allow time on a trip for an extra fuel stop or to make an unexpected landing because of weather.
- Have alternate plans for a late arrival or make backup airline reservations for must-be-there trips.
- For important trips, plan to leave early enough so that there would still be time to drive to the destination.
- Advise those who are waiting at the destination that the arrival may be delayed. Know how to notify them when delays are encountered.
- Manage passengers' expectations. Make sure passengers know that they might not arrive on a firm schedule, but if they need to arrive by a certain time, they may make alternative plans.
- Eliminate pressure to return home, even on a casual day flight, by carrying a small overnight kit containing prescriptions, contact lens solutions, toiletries, or other necessities on every flight.

The key to managing external pressure is to be ready for and accept delays. Remember that people get delayed when traveling on airlines, driving a car, or taking a bus. The pilot's goal is to manage risk, not create hazards.

During each flight, decisions should be made regarding events involving interactions between the four risk elements—PIC, aircraft, environment, and external pressures. The decision-making process involves an evaluation of each of these risk elements to achieve an accurate perception of the flight situation. *[Figure 1-2]*

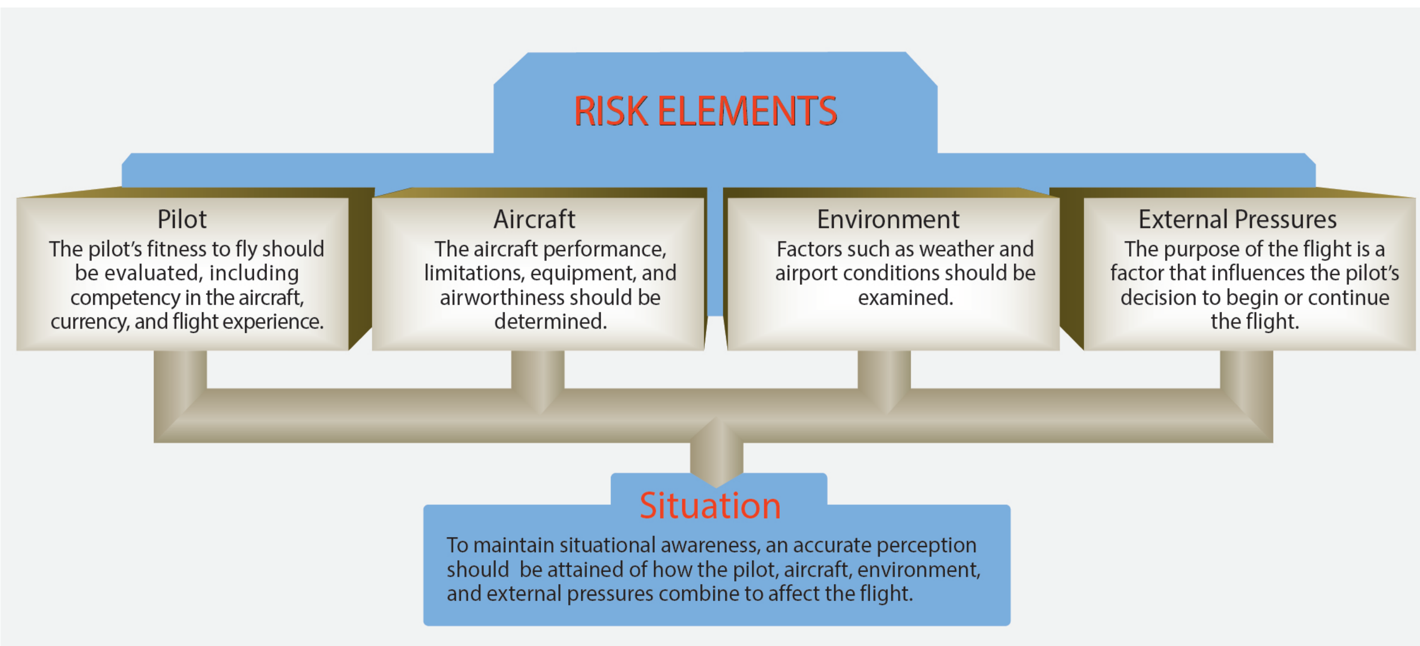

Figure 1-2. *One of the most important decisions that the pilot in command makes is the go/no-go decision. Evaluating each of these risk elements can help the pilot decide whether a flight should be conducted or continued.*

IMSAFE Checklist

As mentioned earlier, one of the best ways that single pilots can identify risk associated with physical and mental readiness for flying is to use the IMSAFE checklist acronym. *[Figure 1-3]*

Figure 1-3. *Prior to flight, pilots may use a checklist to assess their fitness, just as they evaluate the aircraft's airworthiness.*

1. **I**llness—Am I sick? Illness is an obvious pilot risk.

2. **M**edication—Am I taking any medicines that might affect my judgment or make me drowsy?

3. **S**tress—Am I under psychological pressure from the job? Do I have money, health, or family problems? Stress causes concentration and performance problems. While the regulations list medical conditions that require grounding, stress is not among them. A thorough evaluation of risk accounts for the effects of stress on performance.

4. **A**lcohol—Have I been drinking within 8 hours? Within 24 hours? A small amount of alcohol can impair flying skills. Alcohol also renders a pilot more susceptible to disorientation and hypoxia.

5. **F**atigue—Am I tired and not adequately rested? Fatigue continues to be one of the most insidious hazards to flight safety, as it may not be apparent to a pilot until serious errors are made.

6. **E**motion—Am I emotionally upset? The emotions of anger, depression, and anxiety from such events as a serious argument; death in the family; separation or divorce; loss of employment; and/or financial problems not only decrease alertness, but may also lead to taking risks that border on self-destruction. A pilot who experiences an emotionally upsetting event may choose to refrain from flying until the pilot has satisfactorily recovered.

Assessing Risk

Assessment of risk is an important part of good risk management. For example, the hazard of a nick in the propeller poses a risk only if the airplane is flown. If the damaged prop is exposed to the constant vibration of normal engine operation, there is a high risk is that it could fracture and cause catastrophic damage to the engine and/or airframe and the passengers.

Every flight has hazards and some level of risk associated with it. It is critical that pilots and especially learners can differentiate in advance between a low-risk flight and a high-risk flight, and then establish a review process and develop risk mitigation strategies to address flights throughout that range.

For the single pilot, assessing risk is not as simple as it sounds. For example, the pilot acts as his or her own quality control in making decisions. If a fatigued pilot who has flown 16 hours is asked if he or she is too tired to continue flying, the answer may be no. Most pilots are goal oriented and, when asked to accept a flight, there is a tendency to deny personal limitations while adding weight to issues not germane to the mission. For example, pilots of helicopter emergency services (EMS) have been known to make flight decisions that add significant weight to the patient's welfare. These pilots add weight to intangible factors (the patient in this case) and fail to appropriately quantify actual hazards such as fatigue or weather when making flight decisions. The single pilot deals with the intangible factors that may draw one into a hazardous position. Therefore, he or she has a greater vulnerability than a full crew.

Examining National Transportation Safety Board (NTSB) reports and other accident research can help a pilot learn to assess risk more effectively. For example, the accident rate during night VFR decreases by nearly 50 percent once a pilot obtains 100 hours and continues to decrease until the 1,000- hour level. The data suggest that for the first 500 hours, pilots flying VFR at night might want to establish higher personal limitations than are required by the regulations and, if applicable, apply instrument flying skills in this environment.

Several risk assessment models are available to assist in the process of assessing risk. The models, all taking slightly different approaches, seek a common goal of assessing risk in an objective manner.

The most basic tool is the risk matrix. *[Figure 1-4]* It assesses two items: the likelihood of an event occurring and the consequence of that event.

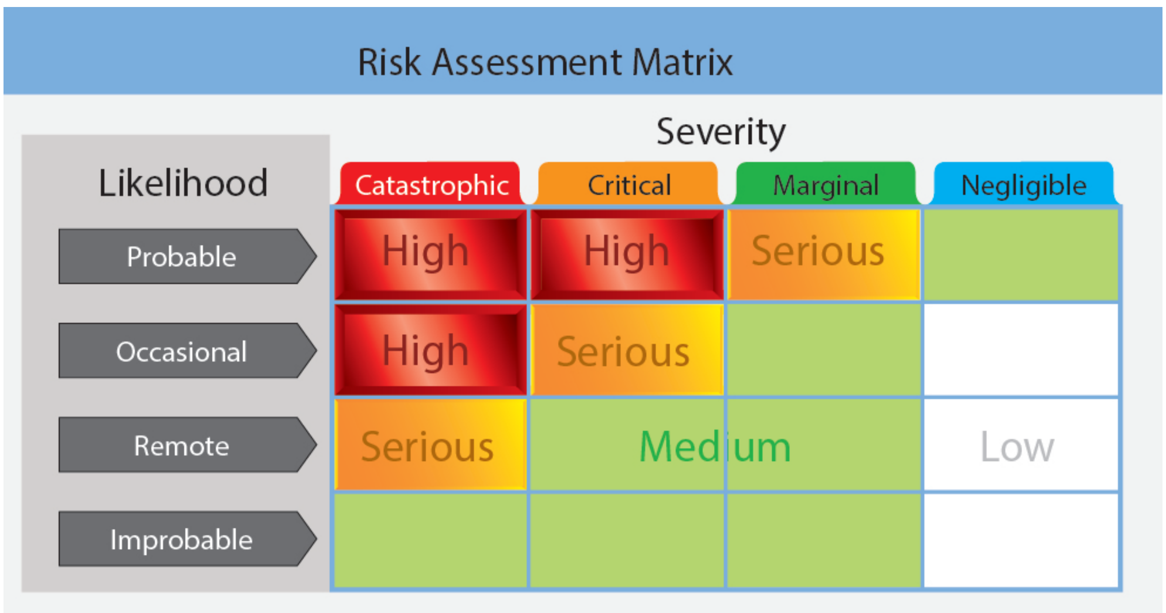

Figure 1-4. *This risk matrix can be used for almost any operation by assigning likelihood and severity. In the case presented, the pilot assigned the likelihood of occasional and the severity as catastrophic falls in the high-risk area.*

Likelihood of an Event

Likelihood is nothing more than taking a situation and determining the probability of its occurrence. It is rated as probable, occasional, remote, or improbable. For example, a pilot is flying from point A to point B (50 miles) in marginal visual flight rules (MVFR) conditions. The likelihood of encountering potential instrument meteorological conditions (IMC) is the first question the pilot needs to answer. The experiences of other pilots, coupled with the forecast, might cause the pilot to assign "occasional" to determine the probability of encountering IMC.

The following are guidelines for making assignments.

- Probable—an event will occur several times.
- Occasional—an event will probably occur sometime.
- Remote—an event is unlikely to occur but is possible.
- Improbable—an event is highly unlikely to occur.

Severity of an Event

The next element is the severity or consequence of a pilot's action(s). It can relate to injury and/or damage. If the individual in the example above is not an instrument flight rules (IFR) pilot, what are the consequences of encountering inadvertent IMC? In this case, because the pilot is not IFR rated, the consequences could be fatal. The following are guidelines for this assignment.

- Catastrophic—results in fatalities, total loss
- Critical—severe injury, major damage
- Marginal—minor injury, minor damage
- Negligible—less than minor injury, less than minor system damage

Assessing risk may be the most difficult part of risk management and applying the terms described above to specific risks takes some practice. Once you have assessed risk likelihood and severity for all identified risks, you can readily classify the overall risk level for that hazard. For example, simply connecting the two factors as shown in *Figure 1-4* indicates the risk is high and the pilot may consider whether to not fly or fly only after finding ways to mitigate, eliminate, or control the risk.

Risk

The final step in risk management is mitigation, which is the payoff for accomplishing the entire risk management process and will often allow for mission accomplishment (the reason most pilots fly). By effectively mitigating known risks to acceptable levels, pilots can complete their planned flights safely or ensure that alternate options are selected for those rare occasions when the planned or ongoing flight cannot be completed.

There are almost an infinite number of actions you can take, depending on the nature of the hazard or risk. For example, the pilot flying from point A to point B (50 miles) in MVFR conditions has several ways to reduce risk:

- Drive.
- Wait for the weather to improve to good visual flight rules (VFR) conditions.
- Take a pilot who is rated as an IFR pilot.
- Delay the flight.
- Cancel the flight.

Risk mitigation often begins days, sometimes weeks, before a planned flight. For example, a pilot flying a single-engine piston aircraft without ice protection lives in the Pacific Northwest and is planning a trip in January for a scheduled speech. While keeping the long-range weather forecast in mind, planning in advance gives the pilot several options to mitigate risk:

- Book commercial flight/transfer the risk to the airlines.
- Change the date of the event to accommodate weather.
- Cancel flight altogether.
- Depart a day early from the Pacific Northwest to avoid an incoming low-pressure area that will bring low IFR and certain icing conditions.

After all mitigating steps have been completed, you may confront the possibility that a flight cannot be made or continued for a variety of reasons not only for yourself but also for your passengers. Remember that many pilots have ignored or failed to mitigate serious and high-risk hazards, and a tragic fatal accident is all too often the result.

Flight Risk Assessment Tools

Because every flight has some level of risk, it is critical that pilots can differentiate, in advance, between a low risk flight and a high-risk flight, establish a review process, and develop risk mitigation strategies. A Flight Risk Analysis Tool (FRAT) enables proactive hazard identification, is easy to use, and can visually depict risk. It is a tool many pilots use to make better go/no-go decisions.

Why Should I Use a FRAT?

"In the thick" is no time to try to mitigate a potentially hazardous outcome. When preparing for a flight or maintenance task, pilots and maintenance technicians may set aside time to stop and think about the hazards involved.

Just thinking about this task may not consider the actual risk exposure. We may allow our personal desires to manipulate our risk assessment in order to meet personal goals. A formal process using pen and paper gives a perspective on the entire risk picture and is a good way to make a thorough analysis.

A risk assessment tool allows pilots to see the risk profile of a flight in its planning stages. Each pilot determines an acceptable level of risk for flight based on the type of operation, environment, aircraft used, training, and overall flight experience. When the risk for a flight exceeds the acceptable level, the hazards associated with that risk may be further evaluated and the risk reduced. A higher risk flight might not be operated if the hazards cannot be mitigated to an acceptable level.

What Do I Do with My Score?

When using a FRAT, the pilot creates numerical thresholds that trigger additional levels of scrutiny prior to a go/no-go decision for the flight. These thresholds help ensure that the safety standards of each individual flight are maintained. However, it is important that the pilot create realistic thresholds. If every flight is within the acceptable range under any condition, it is likely that the thresholds have not been set correctly.

An effective FRAT has at least three possible score ranges. These are often grouped into green, yellow and red sections.

- RED (HIGH): Risk likelihood and/or severity is normally reduced to lower levels before departure. Unless the risks involved in the flight can be mitigated (different crew/adding a copilot, better equipment, delayed launch time…) flight cancellation occurs.

- YELLOW (SERIOUS): Risk likelihood and/or severity needs reduction to lower levels before departure. Begin by mitigating some of the higher scoring items, and consider consulting with a flight instructor or mechanic if the score remains in the yellow.

- GREEN (MEDIUM): Flight can depart or continue, but risk severity and/or likelihood may be reduced.

No FRAT can anticipate all the hazards that may impact a particular flight but there are some common hazards that GA pilots encounter regularly. The National Business Aviation Association (NBAA) has developed a free online Flight Risk Awareness Tool (FRAT) to help flightcrews quickly assess threats to safety for a particular flight. Developed as part of a study, the FRAT presents operators with an easy-to-understand summary of the risks associated with each mission. No identifying data is collected to produce a risk analysis and pilots can try the tool before putting it to use on a live flight. This downloadable tool presents pilots with an easy-to-understand summary of the risks associated with each flight and can be found at https://nbaa.org/wp-content/uploads/2018/06/flight-risk-assessment-tool.pdf

Three-P Model for Pilots

As we have just learned with the Identify, Assess, & Mitigate model, risk management is a decision-making process designed to identify or perceive hazards systematically, assess the degree of risk associated with a hazard, and determine the best course of action to mitigate the risk. For example, the Perceive, Process, Perform (3P) model for aeronautical decision-making (ADM) offers a simple, practical, and structured way for pilots to manage risk. *[Figure 1-5]*

Figure 1-5. *3P Model (Perceive, Process, and Perform).*

To help understand the 3P model, it may be easier to relate this concept to the three steps of the Risk Management Process discussed earlier in this chapter. Recall that these three steps include identifying the risk, assessing the risk, and finally mitigating the risk. Imagine the 3P model in parallel to those three steps by perceiving (identifying the risk), processing (assessing the risk), and performing (mitigating the risk).

To use the 3P model, the pilot:

- Perceives the given set of circumstances for a flight.
- Processes by evaluating the impact of those circumstances on flight safety.
- Performs by implementing the best course of action.

In the first step, the goal is to develop situational awareness by perceiving hazards, which are present events, objects, or circumstances that could contribute to an undesired future event. In this step, the pilot systematically identifies and lists hazards associated with all aspects of the flight: pilot, aircraft, environment, and external pressures. It is important to consider how individual hazards might combine. Consider, for example, the hazard that arises when a new instrument pilot with no experience in actual instrument conditions wants to make a cross-country flight to an airport with low ceilings in order to attend an important business meeting.

In the second step, the goal is to process this information to determine whether the identified hazards constitute risk, which is defined as the future impact of a hazard that is not controlled or eliminated. The degree of risk posed by a given hazard can be measured in terms of exposure (number of people or resources affected), severity (extent of possible loss), and probability (the likelihood that a hazard will cause a loss). If the hazard is low ceilings, for example, the level of risk depends on a number of other factors, such as pilot training and experience, aircraft equipment, and fuel capacity.

In the third step, the goal is to perform by taking action to eliminate hazards or mitigate risk, and then continuously evaluate the outcome of this action. With the example of low ceilings at destination, for instance, the pilot can perform good ADM by selecting a suitable alternate, knowing where to find good weather, and carrying sufficient fuel to reach it. This course of action would mitigate the risk. The pilot also has the option to eliminate it entirely by waiting for better weather.

Once the pilot has completed the 3P decision process and selected a course of action, the process begins again because the set of circumstances brought about by the course of action requires analysis. The decision-making process is a continuous loop of perceiving, processing, and performing.

It is never too early to start teaching risk management. Using the 3P model gives flight instructors a tool to teach them a structured, efficient, and systematic way to identify hazards, assess risk, and implement effective risk controls. Practicing risk management needs to be as automatic in general aviation (GA) flying as basic aircraft control. Consider making the 3P discussion a standard feature of the preflight discussion. As is true for other flying skills, risk management habits are best developed through repetition and consistent adherence to specific procedures.

Hazard List for Aviation Technicians

AMTs should learn about risk management early in training. Instructors tasked with integrating risk management into instruction can turn to hazard assessments that identify the safety risks associated with the facility being used, the tools used in the procedure, and/or the job being performed.

The process for identifying hazards can be accomplished through the use of checklists, lessons learned, compliance inspections/audits, accidents/near misses, regulatory developments, and brainstorming sessions. For example, aviation accident reports from the National Transportation Safety Board (NTSB) can be used to generate discussions pertaining to faulty maintenance that led to aircraft accidents. All available sources should be used for identifying, characterizing, and controlling safety risks.

The 3P model can also be adapted for use in a nonflight environment, such as a maintenance facility. For example, the AMT perceives a hazard, processes its impact on shop or personnel safety, and then performs by implementing the best course of action to mitigate the perceived risk.

Pilot Self-Assessment

Setting personal minimums is an important step in mitigating risk, and safe pilots know how to properly self-assess. For example, in the opening scenario, the aircraft Mary plans to fly may have a maximum crosswind component of 15 knots listed in the aircraft flight manual (AFM), but she only has experience with 10 knots of direct crosswind. It could be unsafe to exceed a 10 knot-crosswind component without additional training. Therefore, the 10 knot-crosswind experience level should be Mary’s personal limitation until additional training with Daniel provides her with additional experience for flying in crosswinds that exceed 10 knots.

Pilots in training should be taught that exercising good judgment begins prior to taking the controls of an aircraft. Often, pilots thoroughly check their aircraft to determine airworthiness, yet do not evaluate their own fitness for flight. Just as a checklist is used when preflighting an aircraft, a personal checklist based on such factors as experience, currency, and comfort level can help determine if a pilot is prepared for a particular flight. The FAA's "Personal Minimums Checklist" located in Appendix D is an excellent tool for pilots to use in self-assessment. This checklist reflects the PAVE approach to risk mitigation discussed in the previous paragraphs.

Worksheets for a more in-depth risk assessment are located in the "FAA/Industry Training Standards Personal and Weather Risk Assessment Guide" located online at www.faa.gov. This guide is designed to assist pilots in developing personal standardized procedures for accomplishing PIC responsibilities and in making better preflight and inflight weather decisions. Flight instructors should stress that frequent review of the personal guide keeps the information fresh and increases a pilot's ability to recognize the conditions in which a new risk assessment should be made, a key element in the decision-making process.

Situational Awareness

Situational awareness is the accurate perception and understanding of all the factors and conditions within the four fundamental risk elements that affect safety before, during, and after the flight. Maintaining situational awareness requires an understanding of the relative significance of these factors and their future impact on the flight. When situationally aware, the pilot has an overview of the total operation and is not fixated on one perceived significant factor. Some of the elements inside the aircraft to be considered are the status of aircraft systems, pilot, and passengers. In addition, an awareness of the environmental conditions of the flight, such as spatial orientation of the aircraft and its relationship to terrain, traffic, weather, and airspace should be maintained.

To maintain situational awareness, all of the skills involved in ADM are used. For example, an accurate perception of the pilot's fitness can be achieved through self-assessment and recognition of hazardous attitudes. A clear assessment of the status of navigation equipment can be obtained through workload management and establishing a productive relationship with ATC can be accomplished by effective resource use.

Obstacles to Maintaining Situational Awareness

Many obstacles exist that can interfere with a pilot's ability to maintain situational awareness. For example, fatigue, stress, or work overload can cause the pilot to fixate on a single perceived important item rather than maintaining an overall awareness of the flight situation. A contributing factor in many accidents is a distraction, which diverts the pilot's attention from monitoring the instruments or scanning outside the aircraft. Many flight deck distractions begin as a minor problem, such as a gauge that is not reading correctly, but result in accidents as the pilot diverts attention to the perceived problem and neglects to properly control the aircraft.

Fatigue, discussed as an obstacle to learning, is also an obstacle to maintaining situational awareness. It is a threat to aviation safety because it impairs alertness and performance. *[Figure 1-6]* The term is used to describe a range of experiences from sleepy, or tired, to exhausted. Two major physiological phenomena create fatigue: sleep loss and circadian rhythm disruption.

Figure 1-6. *Fatigue is a threat to aviation safety because it impairs alertness and performance.*

Fatigue is a normal response to many conditions common to flight operations because characteristics of the flight deck environment, such as low barometric pressure, humidity, noise, and vibration, make pilots susceptible to fatigue. The only effective treatment for fatigue is adequate sleep. As fatigue progresses, it is responsible for increased errors of omission, followed by errors of commission, and microsleeps, or involuntary sleep lapses lasting from a few seconds to a few minutes. For obvious reasons, errors caused by these short absences can have significant hazardous consequences in the aviation environment.

Sleep-deprived pilots may not notice sleepiness or other fatigue symptoms during preflight and departure flight operations. Once underway and established on altitude and heading, sleepiness and other fatigue symptoms tend to manifest themselves. Extreme fatigue can cause uncontrolled and involuntary shutdown of the brain. Regardless of motivation, professionalism, or training, an individual who is extremely sleepy can lapse into sleep at any time, despite the potential consequences of inattention. There are a number of countermeasures for coping with fatigue, as shown in *Figure 1-7*.

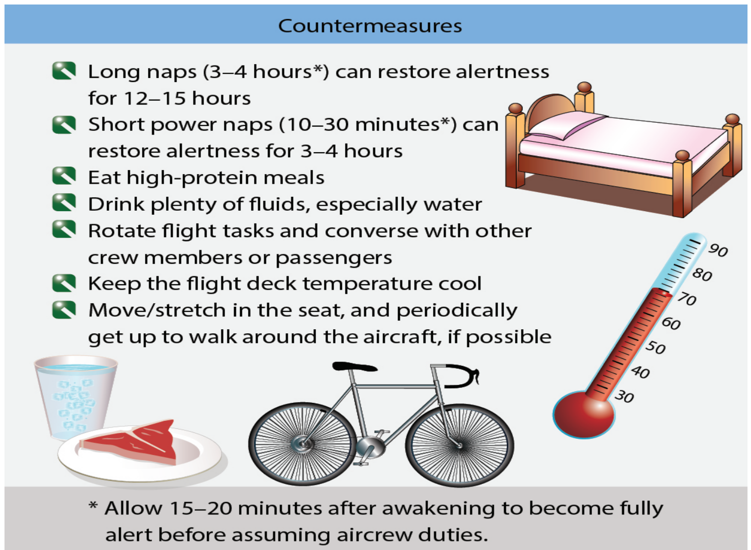

Figure 1-7. *Countermeasures for coping with fatigue.*

Complacency presents another obstacle to maintaining situational awareness. Defined as overconfidence from repeated experience on a specific activity, complacency has been implicated as a contributing factor in numerous aviation accidents and incidents. Like fatigue, complacency reduces the pilot's effectiveness in the flight deck. However, complacency is harder to recognize than fatigue, since everything is perceived to be progressing smoothly. Highly reliable automation has been shown to induce overconfidence and complacency. This can result in a pilot following the instructions of the automation even when common sense suggests otherwise. If the pilot assumes the autopilot is doing its job, he or she does not crosscheck the instruments or the aircraft's position frequently. If the autopilot fails, the pilot may not be mentally prepared to fly the aircraft manually. Instructors should be especially alert to complacency in learners with significant flight experience. For example, a pilot receiving a flight review in a familiar aircraft may be prone to complacency.

Advanced avionics have created a high degree of redundancy and dependability in modern aircraft systems, which can promote complacency and inattention. During flight training, the flight instructor should emphasize that routine flight operations may lead to a sense of complacency, which can threaten flight safety by reducing situational awareness.

By asking about positions of other aircraft in the traffic pattern, engine instrument indications, and the aircraft's location in relation to references on a chart, the flight instructor can determine if the learner is maintaining situational awareness. The flight instructor can also attempt to focus the learner's attention on an imaginary problem with the communication or navigation equipment. The flight instructor should point out that situational awareness is not being maintained if the learner diverts too much attention away from other tasks, such as controlling the aircraft or scanning for traffic. These are simple exercises that can be done throughout flight training, which help emphasize the importance of maintaining situational awareness.

Operational Pitfalls

There are numerous classic behavioral traps that can ensnare the unwary pilot. Pilots, particularly those with considerable experience, try to complete a flight as planned, please passengers, and meet schedules. This basic drive to demonstrate achievements can have an adverse effect on safety and can impose an unrealistic assessment of piloting skills under stressful conditions. These tendencies ultimately may bring about practices that are dangerous and sometimes illegal and may lead to a mishap. Learners develop awareness and learn to avoid many of these operational pitfalls through effective ADM training. The scenarios and examples provided by instructors during ADM instruction should involve these pitfalls. *[Figure 1-8]*

Single-Pilot Resource Management (SRM)

Single pilot resource management (SRM) is defined as the art and science of managing all the resources (both onboard the aircraft and from outside sources) available to a single pilot (prior to and during flight) to ensure the successful outcome of the flight. SRM includes the concepts of Aeronautical Decision-Making (ADM), Risk Management (RM), Task Management (TM), Automation Management (AM), Controlled Flight Into Terrain (CFIT) Awareness, and Situational Awareness (SA). SRM training helps the pilot maintain situational awareness by managing the automation and associated aircraft control and navigation tasks. This enables the pilot to accurately identify, assess, and manage risk and make accurate and timely decisions.

SRM is all about helping pilots learn how to gather information, analyze it, and make decisions. Although the flight is coordinated by a single person and not an onboard flightcrew, the use of available resources such as air traffic control (ATC) and Flight Service replicates the principles of CRM.

Operational Pitfalls
Peer Pressure Poor decision-making may be based upon an emotional response to peers, rather than evaluating a situation objectively.
Mind Set A pilot displays mind set through an inability to recognize and cope with changes in a given situation.
Get-There-Itis This disposition impairs pilot judgment through a fixation on the original goal or destination, combined with a disregard for any alternative course of action.
Duck-Under Syndrome A pilot may be tempted to make it into an airport by descending below minimums during an approach. There may be a belief that there is a built-in margin of error in every approach procedure, or a pilot may want to admit that the landing cannot be completed and a missed approach must be initiated.
Scud Running This occurs when a pilot tries to maintain visual contact with the terrain at low altitudes while instrument conditions exist.
Continuing Visual Flight Rules (VFR) into Instrument Conditions Spatial disorientation or collision with ground/obstacles may occur when a pilot continues VFR into instrument conditions. This can be even more dangerous if the pilot is not instrument rated or current.
Getting Behind the Aircraft This pitfall can be caused by allowing events or the situation to control pilot actions. A constant state of surprise at what happens next may be exhibited when the pilot is getting behind the aircraft.
Loss of Positional or Situational Awareness In extreme cases, when a pilot gets behind the aircraft, a loss of positional or situational awareness may result. The pilot may not know the aircraft's geographical location or may be unable to recognize deteriorating circumstances.
Operating Without Adequate Fuel Reserves Ignoring minimum fuel reserve requirements is generally the result of overconfidence, lack of flight planning, or disregarding applicable regulations.
Descent Below the Minimum En Route Altitude The duck-under syndrome, as mentioned above, can also occur during the en route portion of an IFR flight.
Flying Outside the Envelope The assumed high-performance capability of a particular aircraft may cause a mistaken belief that it can meet the demands imposed by a pilot's overestimated flying skills.
Neglect of Flight Planning, Preflight Inspections, and Checklists A pilot may rely on short- and long-term memory, regular flying skills, and familiar routes instead of established procedures and published checklists. This can be particularly true of experienced pilots.

Figure 1-8. *All experienced pilots have fallen prey to, or have been tempted by, one or more of these tendencies in their flying careers.*

SRM and the 5P Check

SRM is about gathering information, analyzing it, and making decisions. Learning how to identify problems, analyze the information, and make informed and timely decisions is not as straightforward as the training involved in learning specific maneuvers. Learning how to judge a situation and "how to think" in the endless variety of situations encountered while flying out in the "real world" is more difficult. There is no one right answer in ADM; rather, each pilot is expected to analyze each situation in light of experience level, personal minimums, and current physical and mental readiness level, and make his or her own decision.

SRM sounds good on paper, but it requires a way for pilots to understand and use it in their daily flights. One practical application is called the "Five Ps" (5 Ps). *[Figure 1-9]* The 5 Ps consist of "the Plan, the Plane, the Pilot, the Passengers, and the Programming." Each of these areas consists of a set of challenges and opportunities that face a single pilot. And each can substantially increase or decrease the risk of successfully completing the flight based on the pilot's ability to make informed and timely decisions. The 5 Ps are used to evaluate the pilot's current situation at key decision points during the flight, or when an emergency arises. These decision points include preflight, pretakeoff, hourly or at the midpoint of the flight, predescent, and just prior to the final approach fix or for visual flight rules (VFR) operations, just prior to entering the traffic pattern.

Figure 1-9. *The 5P checklist.*

The 5 Ps are based on the idea that the pilot has essentially five variables that impact his or her environment and that can cause the pilot to make a single critical decision, or several less critical decisions, that when added together can create a critical outcome. This concept stems from the belief that current decision-making models tend to be reactionary in nature. A change must occur and be detected to drive a risk management decision by the pilot. For instance, many pilots use risk management sheets that are filled out by the pilot prior to takeoff. These form a catalog of risks that may be encountered that day and turn them into numerical values. If the total exceeds a certain level, the flight is altered or canceled. Informal research shows that while these are useful documents for teaching risk factors, they are almost never used outside of formal training programs. The 5P concept is an attempt to take the information contained in those sheets and in the other available models and use it.

The 5P concept relies on the pilot to adopt a scheduled review of the critical variables at points in the flight where decisions are most likely to be effective. For instance, the easiest point to cancel a flight due to bad weather is before the pilot and passengers walk out the door to load the aircraft. So, the first decision point is preflight in the flight planning room, where all the information is readily available to make a sound decision, and where communication and Fixed Base Operator (FBO) services are readily available to make alternate travel plans.

The second easiest point in the flight to make a critical safety decision is just prior to takeoff. Few pilots have ever had to make an emergency takeoff. While the point of the 5P check is to help the pilot fly, the correct application of the 5P before takeoff is to assist in making a reasoned go/no-go decision based on all the information available. These two points in the process of flying are critical go/no-go points on each and every flight.

The third place to review the 5 Ps is at the midpoint of the flight. Often, pilots may wait until the Automated Terminal information Service (ATIS) is in range to check weather, yet at this point in the flight many good options have already passed behind the aircraft and pilot. Additionally, fatigue and low-altitude hypoxia serve to rob the pilot of much of his or her energy by the end of a long and tiring flight day. This leads to a transition from a decision-making mode to an acceptance mode on the part of the pilot. If the flight is longer than 2 hours, the 5P check should be conducted hourly.

The last two decision points are just prior to decent into the terminal area and just prior to the final approach fix, or if VFR just prior to entering the traffic pattern, as preparations for landing commence. Some pilots execute approaches with the expectation that they will land out of the approach every time. When using a risk management thought process, the pilot realizes that changing conditions (the 5 Ps again) may cause the pilot to divert or execute the missed approach on each approach. Let's look at a detailed discussion of each of the Five Ps.

The Plan

The plan can also be called the mission or the task. It contains the basic elements of cross-country planning, weather, route, fuel, publications currency, etc. The plan should be reviewed and updated several times during the course of the flight. A delayed takeoff due to maintenance, fast moving weather, and a short notice temporary flight restriction (TFR) may all radically alter the plan. The plan is not only about the flight plan, but also all the events that surround the flight and allow the pilot to accomplish the mission. The plan is always being updated and modified and is especially responsive to changes in the other four remaining Ps. If for no other reason, the 5P check reminds the pilot that the day's flight plan is real life and subject to change at any time.

Obviously, weather is a huge part of any plan. The addition of real time data link weather information gives the pilot a real advantage in inclement weather, but only if the pilot is trained to retrieve, and evaluate the weather in real time without sacrificing situational awareness. And of course, weather information should drive a decision, even if that decision is to continue on the current plan. Pilots of aircraft without data link weather should get updated weather in flight through Flight Service.

The Plane

Both the plan and the plane are fairly familiar to most pilots. The plane consists of the usual array of mechanical and cosmetic issues that every aircraft pilot, owner, or operator can identify. With the advent of advanced avionics, the plane has expanded to include database currency, automation status, and emergency backup systems that were unknown a few years ago. Much has been written about single-pilot IFR flight both with and without an autopilot. While this is a personal decision, it is just that—a decision. Low IFR in a non-autopilot equipped aircraft may depend on several of the other Ps to be discussed. Pilot proficiency, currency, and fatigue are among them.

The Pilot

Flying, especially when used for business transportation, can expose the pilot to high altitude flying, long distance and endurance, and more challenging weather.

The combination of late night, pilot fatigue, and the effects of sustained flight above 5,000 feet may cause pilots to become less discerning, less critical of information, less decisive, and more compliant and accepting. Just as the most critical portion of the flight approaches (for instance, a night instrument approach in the weather after a 4-hour flight), the pilot's guard is down the most. The 5P process helps a pilot recognize the physiological situation at the end of the flight before takeoff and continues to update personal conditions as the flight progresses. Once risks are identified, the pilot is in a better position to make alternate plans that lessen the effect of these factors and provide a safer solution.

The Passengers

One of the key differences between CRM and SRM may include the way passengers interact with the pilot. The pilot of a single-pilot aircraft may often interact with the passengers. In fact, the pilot and passengers may sit within arm's reach.

The desire of the passengers to make airline connections or important business meetings enters easily into this pilot's decision-making loop. Done in a healthy and open way, this can be a positive factor. Consider a flight to Dulles Airport and the passengers, both close friends and business partners, need to get to Washington, D.C., for an important meeting. The weather is VFR all the way to southern Virginia, then turns to low IFR as the pilot approaches Dulles. A pilot employing the 5P approach might consider reserving a rental car at an airport in northern North Carolina or southern Virginia to coincide with a refueling stop. Thus, the passengers have a way to get to Washington, and the pilot has an out to avoid being pressured into continuing the flight if the conditions do not improve.

Passengers can also be pilots. If no one is designated as pilot in command (PIC) and unplanned circumstances arise, the decision-making styles of several self-confident pilots may conflict.

Pilots also need to understand that non-pilots may not understand the level of risk involved in the flight. There is an element of risk in every flight. That is why SRM calls it risk management, not risk elimination. While a pilot may feel comfortable with the risk present in a night IFR flight, the passengers may not. A pilot employing SRM should ensure the passengers are involved in the decision-making and given tasks and duties to keep them busy and involved. If, upon a factual description of the risks present, the passengers decide to buy an airline ticket or rent a car, then a good decision has generally been made. This discussion also allows the pilot to move past what he or she *thinks* the passengers want to do and find out what they actually *want* to do. This removes self-induced pressure from the pilot.

The Programming

The electronic instrument displays, GPS, and autopilot reduce pilot workload and increase pilot situational awareness. While programming and operation of these devices are fairly simple and straightforward, unlike the analog instruments they replace, they tend to capture the pilot's attention and hold it for long periods of time. To avoid this phenomenon, the pilot should plan in advance when and where the programming for approaches, route changes, and airport information gathering should be accomplished as well as times it should not. Pilot familiarity with the equipment, the route, the local air traffic control environment, and personal capabilities vis-à-vis the automation should drive when, where, and how the automation is programmed and used.

The pilot should also consider what his or her capabilities are in response to last-minute changes of the approach (and the reprogramming required) and ability to make large-scale changes (a reroute for instance) while hand flying the aircraft. Since formats are not standardized, simply moving from one manufacturer's equipment to another should give the pilot pause and may require more conservative planning and decisions.

The SRM process is simple. At least five times before and during the flight, the pilot should review and consider the "Plan, the Plane, the Pilot, the Passengers, and the Programming" and make the appropriate decision required by the current situation. It is often said that failure to make a decision is a decision. Under SRM and the 5 Ps, even the decision to make no changes to the current plan is made through careful consideration of all the risk factors present.

Information Management

The volume of information presented in aviation training is enormous, but part of the process of good SRM is a continuous flow of information in and actions out. How a learner manages the flow of information definitely has an effect on the relative success or failure of each and every flight because proper information contributes to valid decisions. Scenario-based training (SBT) plays an important part in teaching the learner how to gather pertinent information from all available sources, make appropriate decisions, and assess the actions taken.

Some pilots who transition to an unfamiliar sophisticated aircraft, may be overwhelmed and unable to find a specific piece of information. The first critical information management skill includes understanding the systems and displays at a conceptual level. Remembering how the system is organized helps the pilot manage the available information. Simulation software and manuals on the specific system used are of great value in furthering understanding for both the flight instructor and the learner.

A good strategy for accessing and managing the available information from PFD to navigational charts is to stop, look, and analyze. The goal is for the learner to understand how to monitor, manage, and prioritize the information flow to accomplish specific tasks.

Task Management

Task management (TM), a significant factor in flight safety, is the process by which pilots manage the many, concurrent tasks that should be performed to safely and efficiently fly a modern aircraft. A task is a function performed by a human, as opposed to one performed by a machine (e.g., setting the target heading in the autopilot).

The flight deck is an environment in which important tasks compete for pilot attention at any given time. TM determines which tasks the pilot(s) should attend to. TM entails initiation of new tasks; monitoring of ongoing tasks to determine their status; prioritization of tasks based on their importance, status, urgency, and other factors; allocation of human and machine resources to high-priority tasks; interruption and subsequent resumption of lower priority tasks; and termination of tasks that are completed or no longer relevant.

When information flow exceeds a person's ability to mentally process the information, any additional information becomes unattended or displaces other tasks and information already being processed. Once the information flow reaches its limit, two alternatives exist: shed the unimportant tasks or perform all tasks at a less than optimal level. Like an electrical circuit being overloaded, either the consumption must be reduced, or a circuit failure is experienced. Once again, SBT helps the learner understand how to effectively manage tasks and properly prioritize them.

Automation Management

Automation management is the demonstrated ability to control and navigate an aircraft by means of the automated systems installed in the aircraft. One of the most important concepts of automation management is knowing when to use it and when not to use it. Ideally, the goal of the flight instructor is to train the learner until he or she understands how to operate the aircraft, using all the available automation. However, the flight instructor should ensure the learner also knows how and when to operate the aircraft without the benefit of the automation.

No one level of automation is appropriate for all flight situations, and the learner should know how to set the level of automation. It is important for a learner to know how to operate the particular automated system being used. This ensures the learner knows what to expect, how to monitor for proper operation, and promptly take appropriate action if the system does not perform as expected.

At the most basic level, managing the autopilot means knowing at all times which modes are engaged and which modes are armed to engage. The learner needs to verify that armed functions (e.g., navigation tracking or altitude capture) engage at the appropriate time. Automation management is a good place to practice the callout technique, especially after arming the system to make a change in course or altitude.

Aeronautical Decision-Making

Aviation training and flight operations are now seen as a system rather than individual concepts. The goal of system safety is for pilots to utilize all four concepts (ADM, risk management, situational awareness, and SRM) so that risk can be reduced to the lowest possible level.

ADM is a systematic approach to the mental process used by aircraft pilots to consistently determine the best course of action in response to a given set of circumstances. Risk management is a decision-making process designed to systematically identify hazards, assess the degree of risk, and determine the best course of action associated with each flight. Situational awareness is the accurate perception and understanding of all the factors and conditions within the four fundamental risk elements that affect safety before, during, and after the flight. SRM is the art and science of managing all resources (both onboard the aircraft and from outside sources) available to a single pilot (prior and during flight) to ensure the successful outcome of the flight.

These key principles are often collectively called ADM. The importance of teaching learners effective ADM skills cannot be overemphasized. While progress is continually being made in the advancement of pilot training methods, aircraft equipment and systems, and services for pilots, accidents still occur. Despite all the changes in technology to improve flight safety, one factor remains the same—the human factor. It is estimated that approximately 80 percent of all aviation accidents are human factors related.

By taking a system approach to aviation safety, flight instructors interweave aeronautical knowledge, aircraft control skills, ADM, risk management, situational awareness, and SRM into the training process.

Historically, the term “pilot error” has been used to describe the causes of these accidents. Pilot error means that an action or decision made by the pilot was the cause of, or contributing factor to, the accident. This definition also includes the pilot’s failure to make a decision or take action. From a broader perspective, the phrase “human factors related” more aptly describes these accidents since it is usually not a single decision that leads to an accident, but a chain of events triggered by a number of factors.

The poor judgment chain, or the error chain, describes this concept of contributing factors in a human factors-related accident. Breaking one link in the chain is all that is usually necessary to change the outcome of the sequence of events. The best way to illustrate this concept to learners is to discuss specific situations that lead to aircraft accidents or incidents. The following is an example of the type of scenario that can be presented to illustrate the poor judgment chain.

A private pilot with 100 hours of flight time made a precautionary landing on a narrow dirt runway at a private airport. The pilot lost directional control during landing and swerved off the runway into the grass. A witness recalled later that the aircraft appeared to be too high and fast on final approach, and speculated the pilot was having difficulty controlling the aircraft in high winds. The weather at the time of the incident was reported as marginal VFR due to rain showers and thunderstorms. When the aircraft was fueled the following morning, 60 gallons of fuel were required to fill the 62-gallon capacity tanks.

By discussing the events that led to this incident, instructors can help learners understand how a series of judgmental errors contributed to the final outcome of this flight.

- Weather decision—on the morning of the flight, the pilot was running late and, having acquired a computer printout of the forecast the night before, he did not self-brief or obtain a briefing from Flight Service before his departure.

- Flight planning decision/performance chart—the pilot calculated total fuel requirements for the trip based on a rule-of-thumb figure he had used previously for another airplane. He did not use the fuel tables printed in the pilot's operating handbook (POH) for the aircraft he was flying on this trip. After reaching his destination, the pilot did not request refueling. Based on his original calculations, he believed sufficient fuel remained for the flight home.

- Fatigue/failure to recognize personal limitations—in the presence of deteriorating weather, the pilot departed for the flight home at 5:00 p.m. He did not consider how fatigue and lack of extensive night flying experience could affect the flight.

- Fuel exhaustion—with the aircraft fuel supply almost exhausted, the pilot no longer had the option of diverting to avoid rapidly developing thunderstorms. He was forced to land at the nearest airfield available.

On numerous occasions during the flight, the pilot could have made decisions which may have prevented this incident. However, as the chain of events unfolded, each poor decision left him with fewer and fewer options. On the positive side, the pilot made a precautionary landing at a time and place of his choosing. VFR into IMC accidents often lead to fatalities. In this case, the pilot landed his aircraft without loss of life.

Teaching pilots to make sound decisions is the key to preventing accidents. Traditional pilot instruction has emphasized flying skills, knowledge of the aircraft, and familiarity with regulations. ADM training focuses on the decision-making process and the factors that affect a pilot's ability to make effective choices.

Timely decision-making is an important tool for any pilot. The learner who hesitates when prompt action is required, or who makes the decision to not decide, has made a wrong decision. Emergencies require the pilot to think—assess the situation, choose and execute the actions that assure safety.

It is important for flight instructors to teach learners that declaring an emergency when one occurs is an appropriate reaction. Once an emergency is declared, air traffic control (ATC) gives the pilot priority handling. 14 CFR Section 91.3, Responsibility and Authority of the Pilot in Command, states that "In an inflight emergency requiring immediate action, the pilot in command may deviate from any rule of this part to the extent required to meet that emergency."

Flight instructors should incorporate ADM, risk management, situational awareness, and SRM throughout the entire training course for all levels of learners. AC 60-22, Aeronautical Decision Making, provides background references, definitions, and other pertinent information about ADM training in the general aviation (GA) environment. *[Figure 1-10]*

The Decision-Making Process

An understanding of the decision-making process provides learners with a foundation for developing ADM skills. Some situations, such as engine failures, require a pilot to respond immediately using established procedures with little time for detailed analysis. Traditionally, pilots have been well trained to react to emergencies but are not as well prepared to make decisions, which require a more reflective response. Typically during a flight, the pilot has time to examine any changes that occur, gather information, and assess risk before reaching a decision. The steps leading to this conclusion constitute the decision-making process. When the decision-making process is presented to learners it is essential to discuss how the process applies to an actual flight situation. To explain the decision-making process, the instructor can introduce the following steps with the accompanying scenario that places the learners in the position of making a decision about a typical flight situation.

Defining the Problem

The first step in the decision-making process is to define the problem. This begins with recognizing that a change has occurred or that an expected change did not occur. A problem is perceived first by the senses, and then is distinguished through insight and experience. These same abilities, as well as an objective analysis of all available information, are used to determine the exact nature and severity of the problem.

One critical error that can be made during the decision-making process is incorrectly defining the problem. For example, failure of a landing-gear-extended light to illuminate could indicate that the gear is not down and locked into place or it could mean the bulb is burned out. The actions to be taken in each of these circumstances would be significantly different. Fixating on a problem that does not exist can divert the pilot's attention from important tasks. The pilot's failure to maintain an awareness of the circumstances regarding the flight now becomes the problem. This is why once an initial assumption is made regarding the problem, other sources should be used to verify that the pilot's conclusion is correct.

While on a cross-country flight, Brenda discovers her time en route between two checkpoints is significantly longer than the time she originally calculated. By noticing this discrepancy, she has recognized a change. Based on insight, cross-country flying experience, and knowledge of weather systems, she considers the possibility that she has an increased headwind. She verifies that the original calculations are correct and considers factors that may have lengthened the time between checkpoints, such as a climb or deviation off course. To determine if there is a change in the winds aloft forecast and to check recent pilot reports, she contacts Flight Service. After weighing each information source, she concludes that the headwind has increased. To determine the severity of the problem, she calculates a new groundspeed and reassesses fuel requirements.

Definitions
Aeronautical Decision-Making (ADM) is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances.
Attitude is a personal motivational predisposition to respond to persons, situations, or events in a given manner that can, nevertheless, be changed or modified through training as sort of a mental shortcut to decision-making.
Attitude Management is the ability to recognize hazardous attitudes in oneself and the willingness to modify them as necessary through the application of an appropriate antidote thought.
Crew Resource Management (CRM) is the application of team management concepts in the flight deck environment. It was initially known as cockpit resource management, but as CRM programs evolved to include cabin crews, maintenance personnel, and others, the phrase crew resource management was adopted. This includes single pilots, as in most general aviation aircraft. Pilots of small aircraft, as well as crews of larger aircraft, must make effective use of all available resources: human resources, hardware, and information. A current definition includes all groups routinely working with the cockpit crew who are involved in decisions required to operate a flight safely. These groups include, but are not limited to: pilots, dispatchers, cabin crewmembers, maintenance personnel, and air traffic controllers. CRM is one way of addressing the challenge of optimizing the human/machine interface and accompanying interpersonal activities.
Headwork is required to accomplish a conscious, rational thought process when making decisions. Good decision-making involves risk identification and assessment, information processing, and problem solving.
Judgment is the mental process of recognizing and analyzing all pertinent information in a particular situation, a rational evaluation of alternative actions in response to it, and a timely decision on which action to take.
Personality is the embodiment of personal traits and characteristics of an individual that are set at a very early age and extremely resistant to change.
Poor Judgment Chain is a series of mistakes that may lead to an accident or incident. Two basic principles generally associated with the creation of a poor judgment chain are: (1) One bad decision often leads to another; and (2) as a string of bad decisions grows, it reduces the number of subsequent alternatives for continued safe flight. ADM is intended to break the poor judgment chain before it can cause an accident or incident.
Risk Elements in ADM take into consideration the four fundamental risk elements: the pilot, the aircraft, the environment, and the type of operation that comprise any given aviation situation.
Risk Management is the part of the decision-making process which relies on situational awareness, problem recognition, and good judgment to reduce risks associated with each flight.
Situational Awareness is the accurate perception and understanding of all the factors and conditions within the four fundamental risk elements that affect safety before, during, and after the flight.
Skills and Procedures are the procedural, psychomotor, and perceptual skills used to control a specific aircraft or its systems. They are the airmanship abilities that are gained through conventional training, are perfected, and become almost automatic through experience.
Stress Management is the personal analysis of the kinds of stress experienced while flying, the application of appropriate stress assessment tools, and other coping mechanisms.

Figure 1-10. *Terms used in AC 60-22 to explain concepts used in ADM training.*

Choosing a Course of Action

After the problem has been identified, the pilot evaluates the need to react to it and determines the actions that may be taken to resolve the situation in the time available. The expected outcome of each possible action should be considered, and the risks assessed before the pilot decides on a response to the situation.

Brenda determines the fuel burn if she continues to her destination and considers other options: turning around and landing at a nearby airport, diverting off course, or landing prior to her destination at an airport en route. She considers the expected outcome of each possible action and assesses the risks involved. After studying the chart, she concludes an airport with fueling services is within a reasonable distance along her route. She can refuel there and continue to her destination without a significant loss of time.

Implementing the Decision and Evaluating the Outcome

Although a decision may be reached and a course of action implemented, the decision-making process is not complete. It is important to think ahead and determine how the decision could affect other phases of the flight. As the flight progresses, the pilot should continue to evaluate the outcome of the decision to ensure that it is producing the desired result.

To implement her decision, Brenda plots the course changes and calculates a new estimated time of arrival. She also amends her flight plan and checks weather conditions at the new destination. As she proceeds to the airport, she continues to monitor groundspeed, aircraft performance, and weather conditions to ensure no additional steps need to be taken to guarantee the safety of the flight.

Factors Affecting Decision-Making

It is important to stress to a learner that being familiar with the decision-making process does not ensure he or she has the good judgment to be a safe pilot. The ability to make effective decisions as PIC depends on a number of factors. Some circumstances, such as the time available to make a decision, may be beyond the pilot's control. However, a pilot can learn to recognize those factors that can be managed, and learn skills to improve decision-making ability and judgment.

Recognizing Hazardous Attitudes

While the ADM process does not eliminate errors, it helps the pilot recognize errors, and in turn enables the pilot to manage any errors to minimize their effects. In addition, two steps to improve flight safety are identifying personal attitudes hazardous to safe flight and learning behavior modification techniques.

Flight instructors should be able to spot hazardous attitudes in a learner because recognition of hazardous thoughts is the first step toward neutralizing them. Flight instructors should keep in mind that being fit to fly depends on more than just a pilot's physical condition and recency of experience. Hazardous attitudes contribute to poor pilot judgment and affect the quality of decisions.

Attitude can be defined as a personal motivational predisposition to respond to persons, situations, or events in a given manner. Studies have identified five hazardous attitudes that can affect a pilot's ability to make sound decisions and exercise authority properly. *[Figure 1-11]*

The Five Hazardous Attitudes
Anti-authority: "Don't tell me." This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, "No one can tell me what to do." They may be resentful of having someone tell them what to do, or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always pilot prerogative to question authority if it seems to be in error.
Impulsivity: "Do it quickly." This is the attitude of people who frequently feel the need to do something—anything—immediately. They do not stop to think about what they are about to do; they do not select the best alternative, and they do the first thing that comes to mind.
Invulnerability: "It won't happen to me." Many people believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. They never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.
Macho: "I can do it." Pilots who are always trying to prove that they are better than anyone else are thinking, "I can do it, I'll show them." Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.
Resignation: "What's the use?" Pilots who think, "What's the use?" do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that "someone is out to get me," or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a "nice guy."

Figure 1-11. *Pilots should examine their decisions carefully to ensure that their choices have not been influenced by a hazardous attitude*

In order for a learner to self-examine behaviors during flight, the learner should be taught the potential risks caused from hazardous attitudes and, more importantly, the antidote for each. *[Figure 1-12]* For example, if a learner has an easy time with flight training and seems to understand things very quickly, there may be a potential for that learner to develop a hazardous attitude regarding their ability. A successful flight instructor points out the potential for the behavior and teaches the learner the antidote for that attitude. Hazardous attitudes need to be noticed immediately and corrected with the proper antidote to minimize the potential for any flight hazard.

Hazardous Attitude	Antidotes
Macho Steve often brags to his friends about his skills as a pilot and how close to the ground he flies. During a local pleasure flight in his single-engine airplane, he decides to buzz some friends barbecuing at a nearby park.	Taking chances is foolish.
Anti-authority Although he knows that flying so low to the ground is prohibited by the regulations, he feels that the regulations are too restrictive in some circumstances.	Follow the rules. They are usually right.
Invulnerability Steve is not worried about an accident since he has flown this low many times before and he has not had any problems.	It could happen to me.
Impulsivity As he is buzzing the park, the airplane does not climb as well as Steve had anticipated and, without thinking, he pulls back hard on the yoke. The airspeed drops and the airplane is close to stalling as the wing brushes a power line.	Not so fast. Think first.
Resignation Although Steve manages to recover, the wing sustains minor damage. Steve thinks to himself, "It doesn't really matter how much effort I put in—the end result is the same whether I really try or not."	I'm not helpless. I can make a difference.

Figure 1-12. *Learners in training can be asked to identify hazardous attitudes and the corresponding antidotes when presented with flight scenarios.*

Stress Management

Learning how to recognize and cope with stress is another effective ADM tool. Stress is the body's response to demands placed upon it. These demands can be either pleasant or unpleasant in nature. The causes of stress for a pilot can range from unexpected weather or mechanical problems while in flight to personal issues unrelated to flying. Stress is an inevitable and necessary part of life; it adds motivation and heightens an individual's response to meet any challenge.

Everyone is stressed to some degree all the time. A certain amount of stress is good since it keeps a person alert and prevents complacency. However, the effects of stress are cumulative and, if not coped with adequately, they eventually add up to an intolerable burden. Performance generally increases with the onset of stress, peaks, and then begins to fall off rapidly as stress levels exceed a person's ability to cope. The ability to make effective decisions during flight can be impaired by stress. Factors, referred to as stressors, can increase a pilot's risk of error in the flight deck. *[Figure 1-13]*

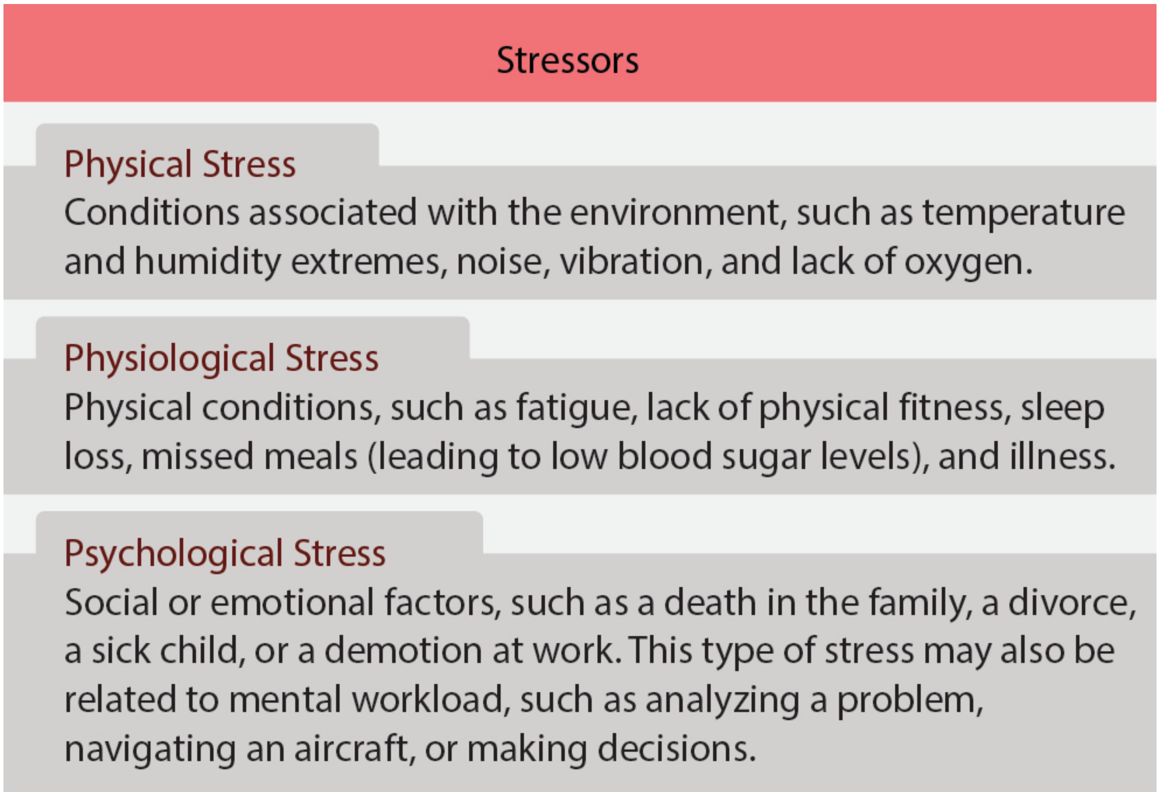

Figure 1-13. *Three types of stressors that can affect pilot performance.*

One way of exploring the subject of stress with a learner is to recognize when stress is affecting performance. If a learner seems distracted, or has a particularly difficult time accomplishing the tasks of the lesson, the instructor can query the learner. Was the learner uncomfortable or tired during the flight? Is there some stress in another aspect of the learner's life that may be causing a distraction? This may prompt the learner to evaluate how these factors affect performance and judgment. The instructor should also try to determine if there are aspects of pilot training that are causing excessive amounts of stress for the learner. For example, if the learner consistently makes a decision not to fly, even though weather briefings indicate favorable conditions, it may be due to apprehension regarding the lesson content. Stalls, landings, or an impending solo flight may cause concern. By explaining a specific maneuver in greater detail or offering some additional encouragement, the instructor may be able to alleviate some of the learner's stress.

To help learners manage the accumulation of life stresses and prevent stress overload, instructors can recommend several techniques. For example, including relaxation time in a busy schedule and maintaining a program of physical fitness can help reduce stress levels. Learning to manage time more effectively can help pilots avoid heavy pressures imposed by getting behind schedule and not meeting deadlines. While these pressures may exist in the workplace, learners may also experience the same type of stress regarding their flight training schedule. Instructors can advise learners to self-assess to determine their capabilities and limitations and then set realistic goals. In addition, avoiding stressful situations and encounters can help pilots cope with stress.

Use of Resources

To make informed decisions during flight operations, learners should be familiar with the resources found both inside and outside the flight deck. Since useful tools and sources of information may not always be readily apparent, learning to recognize these resources is an essential part of ADM training. Resources should not only be identified, but learners should also develop the skills to evaluate whether they have the time to use a particular resource and the impact that its use would have upon the safety of flight. For example, the assistance of ATC may be very useful if a pilot is lost. However, in an emergency situation when action needs be taken quickly, time may not be available to contact ATC immediately. During training, flight instructors can routinely point out resources to learners.

Internal Resources

Internal resources are found in the flight deck during flight. However, some of the most valuable internal resources include ingenuity, knowledge, and skill. Pilots can enhance flight deck resources by improving their own capabilities. This can be accomplished by pursuing additional training and by frequently reviewing flight information publications including the Aeronautical Information Manual (AIM), instruction manuals for on board equipment, and safety journals.

With the advent of advanced avionics with glass displays, GPS, and autopilot, flying has become more complex. Avionics and automation systems are valuable resources, and flight instructors should teach learners how to use this equipment properly. If learners do not fully understand how to use the equipment, or if they rely on it so much that they become complacent, it can become a detriment to safe flight.

Checklists are essential flight deck resources for verifying that the aircraft instruments and systems are checked, set, and operating properly, as well as ensuring that the proper procedures are performed if there is a system malfunction or inflight emergency. Learners reluctant to use checklists can be reminded that pilots at all levels of experience refer to checklists, and that the more advanced the aircraft is, the more crucial checklists become. With the advent of electronic checklists, it has become easier to develop and maintain personal checklists from the manufacturer's checklist with additions for specific aircraft and operations.

In addition, the AFM/POH, which is required to be carried onboard the aircraft, is essential for accurate flight planning and for resolving inflight equipment malfunctions. Other valuable flight deck resources include current aeronautical charts and publications, such as the Chart Supplement (CS).

It should be pointed out to learners that passengers can also be a valuable resource. Passengers can help watch for traffic and may be able to provide information in an irregular situation, especially if they are familiar with flying. A strange smell or sound may alert a passenger to a potential problem. The PIC should brief passengers before the flight to make sure that they are comfortable voicing any concerns.

External Resources

Possibly the greatest external resources during flight are air traffic controllers. ATC can help decrease pilot workload by providing traffic advisories, radar vectors, and assistance in emergency situations. When learners use ATC during training, they develop the confidence to ask controllers to clarify instructions and to use ATC as a resource for assistance in unusual circumstances or emergencies. Fight Service specialists can provide updates on weather, answer questions about airport conditions, and may offer direction-finding assistance on frequencies used for flight plan communications. These services can be invaluable in enabling pilots to make informed inflight decisions.

Throughout training, learners can be asked to identify internal and external resources, which can be used in a variety of flight situations. For example, if a discrepancy is found during preflight, what resources can be used to determine its significance? In this case, the learner's knowledge of the aircraft, the POH, an instructor or other experienced pilot, or an AMT can be a resource which may help define the problem. During cross-country training, learners may be asked to consider the following situation. On a cross-country flight, you become disoriented. Although you are familiar with the area, you do not recognize any landmarks, and fuel is running low. What resources do you have to assist you? Learners should be able to identify their own skills and knowledge, aeronautical charts, ATC, Flight Service, and navigation equipment as some of the resources that can be used in this situation.

Workload Management

Effective workload management ensures that essential operations are accomplished by planning, prioritizing, and sequencing tasks to avoid work overload. As experience is gained, a pilot learns to recognize future workload requirements and can prepare for high workload periods during times of low workload. Instructors can teach this skill by prompting their learners to prepare for a high workload. For example, when en route, the learner can be asked to explain the actions that need to be taken during the approach to the airport. The learner should be able to describe the procedures for traffic pattern entry and landing preparation. Reviewing the appropriate chart and setting radio frequencies well in advance of need helps reduce workload as the flight nears the airport. In addition, the learner should listen to the Automatic Terminal Information Service (ATIS), Automated Surface Observing Systems (ASOS), or Automated Weather Observing System (AWOS), if available, and then monitor the tower frequency or Common Traffic Advisory Frequency (CTAF) to get a good idea of what traffic conditions to expect. Checklists should be performed well in advance so there is time to focus on traffic and ATC instructions. These procedures are especially important prior to entering a high-density traffic area, such as Class B airspace.

To manage workload, items should be prioritized. This concept should be emphasized to learners and reinforced when training procedures are performed. For example, during a go-around, adding power, gaining airspeed, and properly configuring the aircraft are priorities. Informing the tower of the balked landing should be accomplished only after these tasks are completed. learners should understand that priorities change as the situation changes. If fuel quantity is lower than expected on a cross-country flight, the priority can shift from making a scheduled arrival time at the destination, to locating a nearby airport to refuel. In an emergency situation, the first priority is to fly the aircraft and maintain a safe airspeed.

Another important part of managing workload is recognizing a work overload situation. The first effect of high workload is that the pilot begins to work faster. As workload increases, attention cannot be devoted to several tasks at one time, and the pilot may begin to focus on one item. When the pilot becomes task saturated, there is no awareness of inputs from various sources; decisions may be made on incomplete information, and the possibility of error increases. *[Figure 1-14]*

During a lesson, workload can be gradually increased as the instructor monitors the learner's management of tasks. The instructor should ensure that the learner has the ability to recognize a work overload situation. When becoming overloaded, the learner should stop, think, slow down, and prioritize. It is important that the learner understand options that may be available to decrease workload. For example, locating an item on a chart or setting a radio frequency may be delegated to another pilot or passenger, an autopilot (if available) may be used, or ATC may be enlisted to provide assistance.

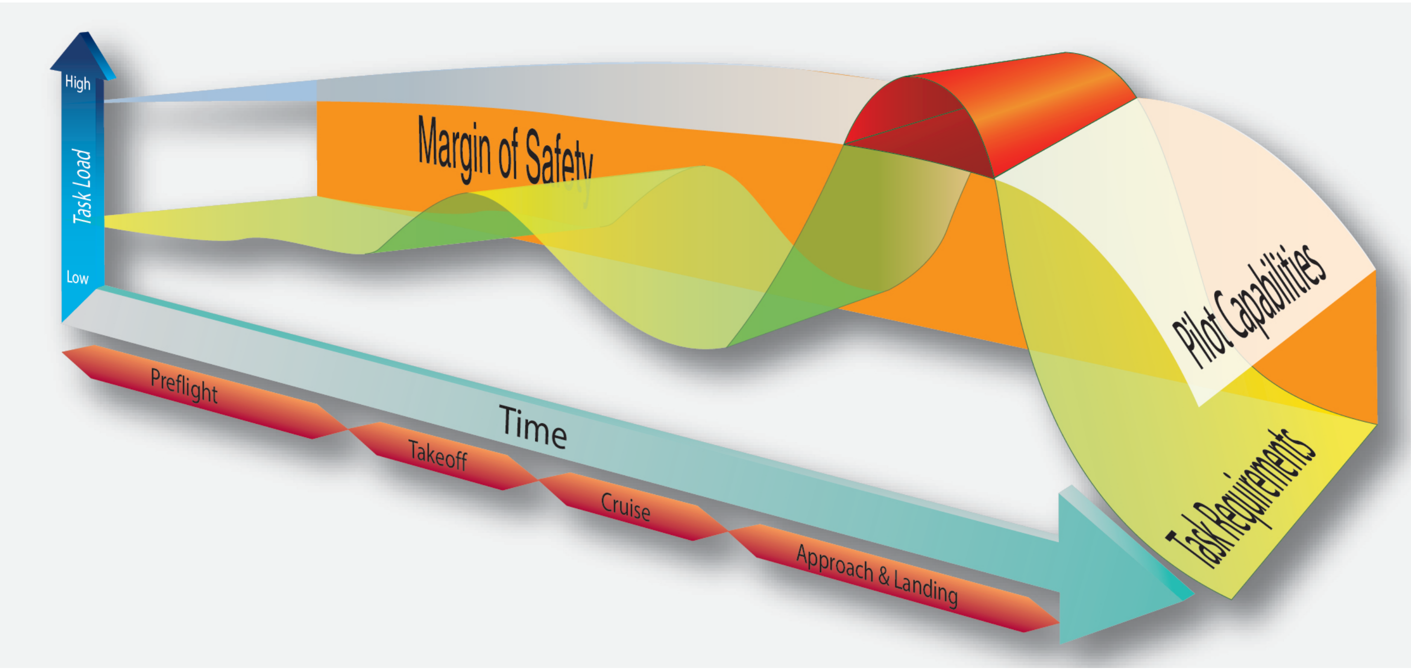

Figure 1-14. *Accidents often occur when flying task requirements exceed pilot capabilities. The difference between these two factors is called the margin of safety. Note that in this idealized example, the margin of safety is minimal during the approach and landing. At this point, an emergency or distraction could overtax pilot capabilities, causing an accident.*

Teaching Decision-Making Skills

When instructor pilots discuss system safety, they generally worry about the loss of traditional stick-and-rudder skills. The fear is that emphasis on items such as risk management, ADM, SRM, and situational awareness detracts from the training necessary in developing safe pilots.

It is important to understand that system safety flight training occurs in three phases. First, there are the traditional stick and rudder maneuvers. In order to apply the critical thinking skills that are to follow, pilots should develop a high degree of confidence in their ability to fly the aircraft. Next, the tenets of system safety are introduced into the training environment as learners begin to understand how best to identify hazards, manage risk, and use all available resources to make each flight as safe as possible. This can be accomplished through scenarios that emphasize the skill sets being taught. Finally, the learner may be introduced to more complex scenarios that focus on several safety-of-flight issues. Thus, scenarios should start out rather simply, then progress in complexity and intensity as the learner becomes able to handle the increased workload.

A traditional stick-and-rudder maneuver such as short field landings can be used to illustrate how ADM and risk management can be incorporated into instruction. In phase l the initial focus is on developing the stick-and-rudder skills required to execute this operation safely. These include power and airspeed management, aircraft configuration, placement in the pattern, wind correction, determining the proper aim point and sight picture, etc. By emphasizing these points through repetition and practice, a learner eventually acquires the skills needed to execute a short field landing.

Phase II introduces the many factors that come into play when performing a short field landing, which include runway conditions, no-flap landings, airport obstructions, and rejected landings. The introduction of such items need not increase training times. In fact, all of the hazards or considerations referenced in the short field landing lesson plan may be discussed in detail during the ground portion of the instructional program. For example, if training has been conducted at an airport that enjoys an obstruction-free 6,000-foot runway, consider the implications of operating the same aircraft out of a 1,800-foot strip with an obstruction off the departure end. Add to that additional considerations, such as operating the aircraft at close to its maximum gross weight under conditions of high density altitude, and now a single training scenario has several layers of complexity. The ensuing discussion proves a valuable training exercise, and it comes with little additional ground and no added flight training.

Finally, phase III takes the previously discussed hazards, risks, and considerations, and incorporates them into a complex scenario. This forces a learner to consider not only a specific lesson item (in this case, short-field landings), but also requires that it be viewed in the greater context of the overall flight. For example, on a cross-country flight, the learner is presented with a realistic distraction, perhaps the illness of a passenger. This forces a diversion to an alternate for which the learner has not planned. The new destination airport has two runways, the longest of which is closed due to construction. The remaining runway is short, but while less than ideal, should prove suitable for landing. However, upon entering the pattern, the learner finds the electrically driven flaps do not extend. The learner should now consider whether to press on and attempt the landing or proceed to a secondary alternate.

If he or she decides to go forward and attempt the landing, this proves an excellent time to test the requisite stick and rudder skills. If the learner decides to proceed to a second alternate, this opens new training opportunities. Proceeding further tests cross-country skills, such as navigation, communication, management of a passenger in distress, as well as the other tasks associated with simply flying the aircraft. The outlined methodology simply takes a series of seemingly unrelated tasks and scripts them into a training exercise requiring both mechanical and cognitive skills to complete it successfully.

Scenario-based training (SBT) helps the flight instructor effectively teach ADM and risk management. The what, why, and how of SBT will be discussed extensively throughout this handbook. In teaching ADM, it is important to remember the learning objective is for the learner to exercise sound judgment and make good decisions. Thus, the flight instructor should be ready to turn the responsibility for planning and execution of the flight over to the learner as soon as possible. Although the flight instructor continues to demonstrate and instruct skill maneuvers, when the learner begins to make decisions, the flight instructor should revert to the role of mentor and/or learning facilitator.

The flight instructor is an integral part of the systems approach to training and is crucial to the implementation of an SBT program, which underlies the teaching of ADM. Remember, for SBT instruction to be effective, it is vital the flight instructor and learner establish the following information:

- Scenario destination(s)
- Desired learning outcome(s)
- Desired level of learner performance
- Possible inflight scenario changes

It is also important for the flight instructor to remember that a good scenario:

- Is not a test.
- Will not have a single correct answer.
- Does not offer an obvious answer.
- Engages all three learning domains.
- Is interactive.
- Should not promote errors.
- Should promote situational awareness and opportunities for decision-making.
- Requires time-pressured decisions.

The flight instructor should make the situation as realistic as possible. This means the learner knows where he or she is going and what transpires on the flight. While the actual flight may deviate from the original plan, it allows the learner to be placed in a realistic scenario. The learner should plan the flight to include:

- Route
- Destination(s)
- Weather
- NOTAMS
- Possible emergency procedures

Since the scenarios may have several good outcomes and a few poor ones, the flight instructor should understand in advance which outcomes are positive and/or negative and give the learner the freedom to make both good and poor decisions. This does not mean that the learner should be allowed to make an unsafe decision or commit an unsafe act. However, it does allow the learners to make decisions that fit their experience level and result in positive outcomes.

Teaching decision-making skills has become an integral part of flight training. The word "decision" is used several times in each ACS and applicants are judged on their ability to make a decision as well as their ability to perform a task. Thus, it is important for flight instructors to remember that decision-making is a component of the ACS.

Assessing SRM Skills

A learner's performance is often assessed only on a technical level. The instructor determines whether maneuvers are technically accurate and that procedures are performed in the right order. In SRM assessment, instructors should learn to assess on a different level. How did the learner arrive at a particular decision? What resources were used? Was risk assessed accurately when a go/no-go decision was made? Did the learner maintain situational awareness in the traffic pattern? Was workload managed effectively during a cross-country flight? How does the learner handle stress and fatigue?

Instructors should continually evaluate learner decision-making ability and offer suggestions for improvement. It is not always necessary to present complex situations, which require detailed analysis. By allowing learners to make decisions about typical issues that arise throughout the course of training, such as their fitness to fly, weather conditions, and equipment problems, instructors can address effective decision-making and allow learners to develop judgment skills. For example, when a discrepancy is found during preflight inspection, the learner should be allowed to initially determine the action to be taken. Then the effectiveness of the learner's choice and other options that may be available can be discussed.

Opportunities for improving decision-making abilities occur often during training. If the tower offers the learner a runway that requires landing with a tailwind in order to expedite traffic, the learner can be directed to assess the risks involved and asked to present alternative actions to be taken. Perhaps the most frequent choice that has to be made during flight training is the go/no-go decision based on weather. While the final choice to fly lies with the instructor, learners can be asked to assess the weather prior to each flight and make a go/no-go determination.

In addition, instructors should utilize SBT to create lessons that are specifically designed to test whether learners are applying SRM skills. Planning a flight lesson in which the learner is presented with simulated emergencies, a heavy workload, or other operational problems can be valuable in assessing the learner's judgment and decision-making skills. During the flight, learner performance can be evaluated for workload and/or stress management.

SRM grades are based on these four components:

- Explain—the learner can verbally identify, describe, and understand the risks inherent in the flight scenario. The learner needs to be prompted to identify risks and make decisions.

- Practice—the learner is able to identify, understand, and apply SRM principles to the actual flight situation. Coaching, instruction, and/or assistance from the flight instructor quickly corrects minor deviations and errors identified by the flight instructor. The learner is an active decision maker.

- Manage/Decide—the learner can correctly gather the most important data available both within and outside the flight deck, identify possible courses of action, evaluate the risk inherent in each course of action, and make the appropriate decision. Instructor intervention is not required for the safe completion of the flight.

- Not Observed—any event not accomplished or required.

Postflight, collaborative assessment or learner centered grading (LCG) also discussed in Chapter 6, Assessment, is a vital component of assessing a learner's SRM skills. As a reminder, collaborative assessment includes two parts: learner self-assessment and a detailed assessment by the flight instructor. The purpose of the self-assessment is to stimulate growth in the learner's thought processes and, in turn, behaviors. The self-assessment is followed by an in-depth discussion between the flight instructor and the learner, which compares the flight instructor's assessment to the learner's self-assessment.

An important element of SRM skills assessment is that the flight instructor provides a clear picture of the progress the learner is making during the training. Grading should also be progressive. During each flight, the learner should achieve a new level of learning. For flight one, the automation management area might be a "describe" item. By flight three, it would be a "practice" item, and by flight five, a "manage-decide" item.

Chapter Summary

This chapter introduced aviation instructors to the underlying concepts of safety risk management, which the FAA is integrating into all levels of the aviation community.