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

Preface

Designed for ground instructors, flight instructors, and aviation maintenance instructors, the Aviation Instructor's Handbook was developed by the Flight Standards Service, Airman Testing Standards Branch, in cooperation with aviation educators and industry to help beginning instructors understand and apply the fundamentals of instruction. This handbook provides aviation instructors with up-to-date information on learning and teaching, and how to relate this information to the task of teaching aeronautical knowledge and skills to learners. Experienced aviation instructors will also find the updated information useful for improving their effectiveness in training activities.

This handbook supersedes FAA-H-8083-9A, Aviation Instructor's Handbook, dated 2008.

This handbook is available for download, in PDF format, from www.faa.gov.

Comments regarding this publication should be emailed to AFS630comments@faa.gov.

The contents of this handbook do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

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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]*

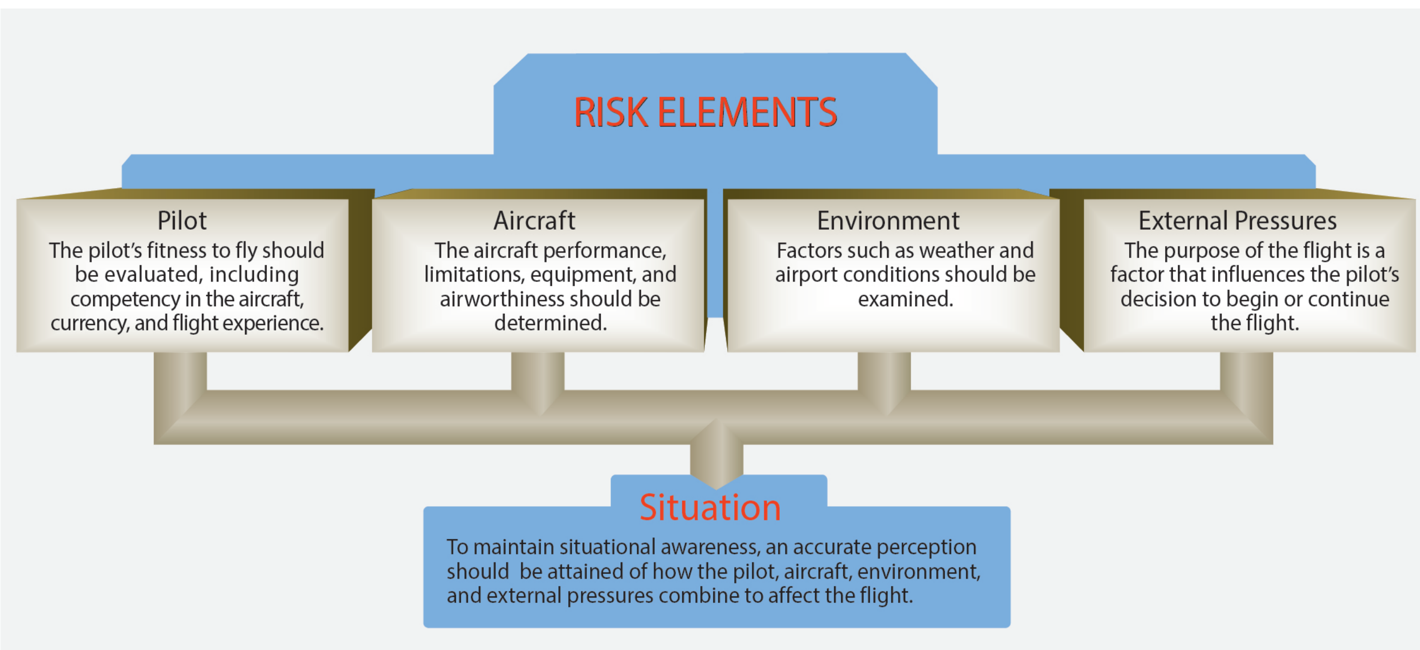

Figure 1-2. *One of the most important decisions that the pilot in command makes is the go/no-go decision. Evaluating each of these risk elements can help the pilot decide whether a flight should be conducted or continued.*

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.

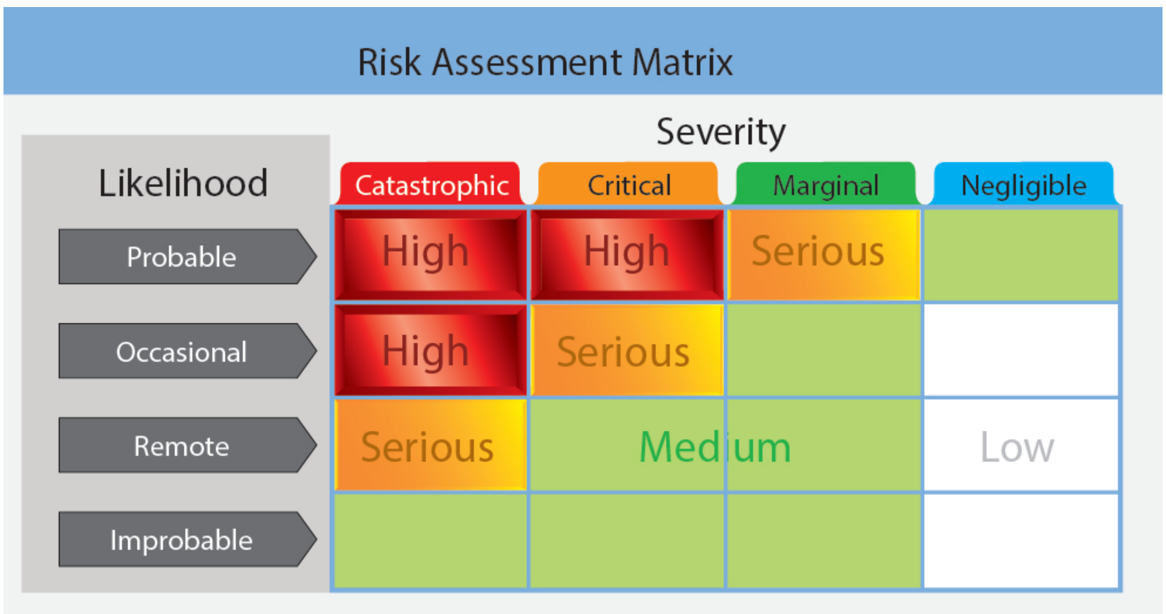

Figure 1-4. *This risk matrix can be used for almost any operation by assigning likelihood and severity. In the case presented, the pilot assigned the likelihood of occasional and the severity as catastrophic falls in the high-risk area.*

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*.

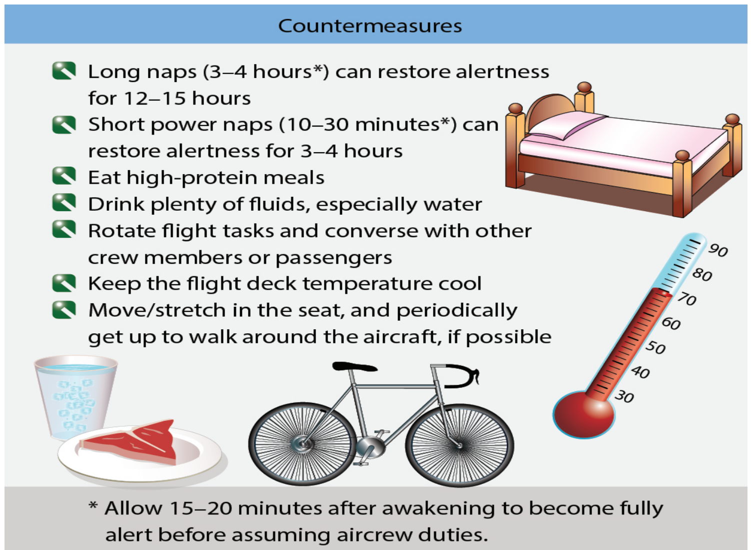

Figure 1-7. *Countermeasures for coping with fatigue.*

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]*