Chapter 13

Effective Aeronautical Decision-Making

Introduction

The accident rate for helicopters has traditionally been higher than the accident rate of fixed-wing aircraft, probably due to the helicopter's unique capabilities to fly and land in more diverse situations than fixed-wing aircraft and pilot attempts to fly the helicopter beyond the limits of his or her abilities or beyond the capabilities of the helicopter. With no significant improvement in helicopter accident rates for the last 20 years, the Federal Aviation Administration (FAA) has joined with various members of the helicopter community to improve the safety of helicopter operations.

According to National Transportation Safety Board (NTSB) statistics, approximately 80 percent of all aviation accidents are caused by pilot error, the human factor. Many of these accidents are the result of the failure of instructors to incorporate single-pilot resource management (SRM) and risk management into flight training instruction of aeronautical decision-making (ADM).

SRM is defined as the art of managing all the resources (both on board the aircraft and from outside sources) available to a pilot prior to and during flight to ensure a successful flight. When properly applied, SRM is a key component of ADM. Additional discussion includes integral topics such as, the concepts of risk management, workload or task management, situational awareness, controlled flight into terrain (CFIT) awareness, and automation management.

ADM is all about learning how to gather information, analyze it, and make decisions. It helps the pilot accurately assess and manage risk and make accurate and timely decisions. Although the flight is coordinated by a single person, the use of available resources, such as air traffic control (ATC) and flight service stations (FSS)/automated flight service stations (AFSS), replicates the principles of crew resource management (CRM) (see page 14-7).

References on SRM and ADM include:

- FAA-H-8083-2, Risk Management Handbook.
- Aeronautical Information Manual (AIM).
- Advisory Circular (AC) 60-22, Aeronautical Decision Making, which provides background information about ADM training in the general aviation (GA) environment.
- FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge.

Aeronautical Decision-Making (ADM)

Making good choices sounds easy enough. However, there are a multitude of factors that come into play when these choices, and subsequent decisions, are made in the aeronautical world. Many tools are available for pilots to become more self-aware and assess the options available, along with the impact of their decision. Yet, with all the available resources, accident rates are not being reduced. Poor decisions continue to be made, frequently resulting in lives being lost and/or aircraft damaged or destroyed. The Risk Management Handbook discusses ADM and SRM in detail and should be thoroughly read and understood.

While progress is continually being made in the advancement of pilot training methods, aircraft equipment and systems, and services for pilots, accidents still occur. Historically, the term "pilot error" has been used to describe the causes of these accidents. Pilot error means an action or decision made by the pilot was the cause of, or a contributing factor that led 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. *[Figure 13-1]*

The poor judgment chain, sometimes referred to as the "error chain," is a term used to describe this concept of contributing factors in a human factors related accident. Breaking one link in the chain is often the only event necessary to change the outcome of the sequence of events. The following is an example of the type of scenario illustrating the poor judgment chain.

Scenario

A Helicopter Air Ambulance (HAA) pilot is nearing the end of his shift when he receives a request for a patient pickup at a roadside vehicle accident. The pilot has started to feel the onset of a cold; his thoughts are on getting home and getting a good night's sleep. After receiving the request, the pilot checks the accident location and required flightpath to determine if he has time to complete the flight to the scene, then on to the hospital before his shift expires. The pilot checks the weather and determines that, although thunderstorms are approaching, the flight can be completed prior to their arrival.

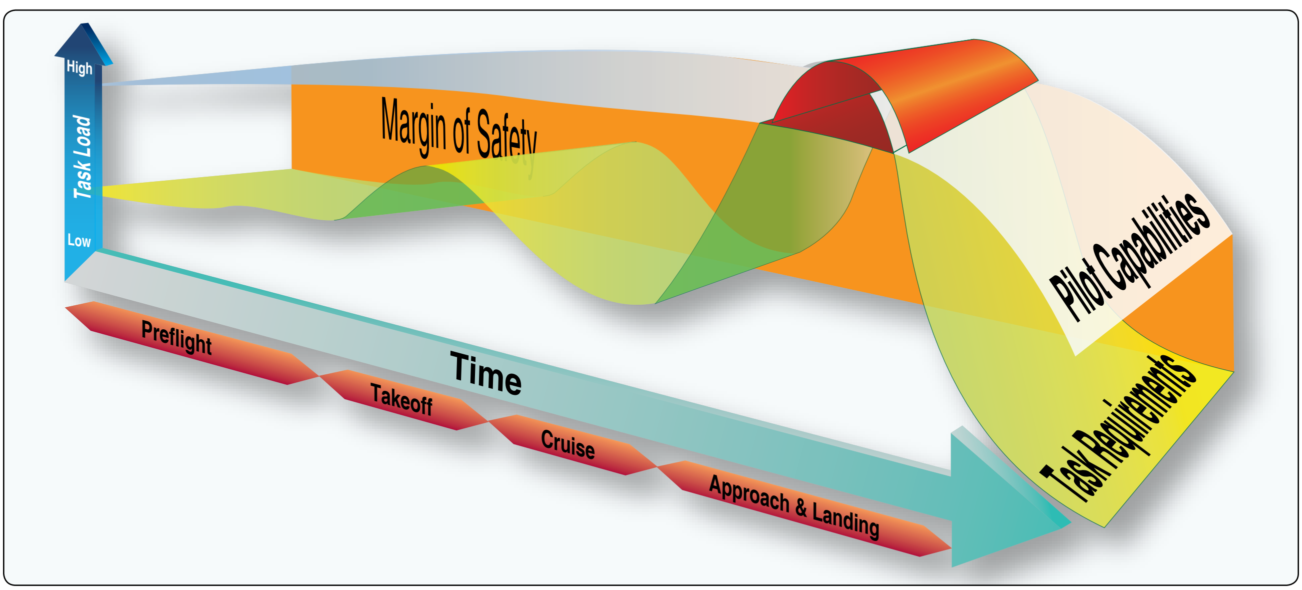

Figure 13-1. *The pilot has a limited capacity of doing work and handling tasks, meaning there is a point at which the tasking exceeds the pilot's capability. When this happens, either tasks are not done properly or some are not done at all.*

The pilot and on-board medical crews depart the home location and arrive overhead, at the scene of the vehicular accident. The pilot is not comfortable with the selected landing area due to tall trees in all quadrants of the confined area. The pilot searches for a secondary landing area. Unable to find one nearby, the pilot then returns to the initial landing area and decides he can make it work.

After successfully landing the aircraft, he is told that there will be a delay before the patient is loaded because more time is needed to extricate the patient from the wreckage. Knowing his shift is nearly over, the pilot begins to feel pressured to "hurry up" or he will require an extension for his duty day.

After 30 minutes, the patient is loaded, and the pilot ensures everyone is secure. He notes that the storm is now nearby and that winds have picked up considerably. The pilot thinks, "No turning back now, the patient is on board and I'm running out of time." The pilot knows he must take off almost vertically to clear the obstacles and chooses his departure path based on the observed wind during landing. Moments later, prior to clearing the obstacles, the aircraft begins an uncontrollable spin and augers back to the ground, seriously injuring all on board and destroying the aircraft.

What could the pilot have done differently to break this error chain? More important—what would you have done differently? By discussing the events that led to this accident, you should develop an understanding of how a series of judgmental errors contributed to the final outcome of this flight.

For example, the pilot's decision to fly the aircraft knowing that the effects of an illness were present was the initial contributing factor. The pilot was aware of his illness, but, was he aware of the impact of the symptoms—fatigue, general uneasy feeling due to a slight fever, perhaps?

Next, knowing the shift was about to end, the pilot based his time required to complete the flight on ideal conditions, and did not take into consideration the possibility of delays. This led to a feeling of being time limited.

Even after determining the landing area was unsuitable, the pilot forced the landing due to time constraints. At any time during this sequence, the pilot could have aborted the flight rather than risk crew lives. Instead, the pilot became blinded by a determination to continue.

After landing, and waiting 30 minutes longer than planned, the pilot observed the outer effects of the thunderstorm, yet still attempted to depart. The pilot dispelled any available options by thinking the only option was to go forward; however, it would have been safer to discontinue the flight. Using the same departure path selected under different wind conditions, the pilot took off and encountered winds that led to loss of aircraft control. Once again faced with a self-imposed time constraint, the pilot improperly chose to depart the confined area. The end result: instead of one patient to transport by ground (had the pilot aborted the flight at any point), there were four patients to be transported.

On numerous occasions leading to and during the flight, the pilot could have made effective decisions that could have prevented this accident. However, as the chain of events unfolded, each poor decision left him with fewer options. Making sound decisions is the key to preventing accidents. Traditional pilot training emphasizes flying skills, knowledge of the aircraft, and familiarity with regulations. SRM and ADM training focus on the decision-making process and on the factors that affect a pilot's ability to make effective choices.

Trescott Tips

Max Trescott, Master Certificated Flight Instructor (CFI) and Master Ground Instructor and winner of the 2008 CFI of the year, has published numerous safety tips that every pilot should heed. He believes that the word "probably" should be purged from our flying vocabulary. Mr. Trescott contends that "probably" means we've done an informal assessment of the likelihood of an event occurring and have assigned a probability to it. He believes the term implies that we believe things are likely to work out, but there's some reasonable doubt in our mind. He further explains that if you ever think that your course of action will "probably work out," you need to choose a new option that you know will work out.

Another safety tip details the importance of accumulating flight hours in one specific airframe type. He explains that "statistics have shown that accidents are correlated more with the number of hours of experience a pilot has in a particular aircraft model and not with his or her total number of flight hours. Accidents tend to decrease after a pilot accumulates at least 100 hours of experience in the aircraft he or she is flying. Thus, when learning to fly, or when transitioning into a new model, your goal should be to concentrate your flying hours in that model." He suggests waiting until you reach 100 hours of experience in one particular model before attempting a dual rating with another model. In addition, if you only fly a few hours per year, maximize your safety by concentrating those hours in just one aircraft model.

The third safety tip that is well worth mentioning is what Mr. Trescott calls "building experience from the armchair." Armchair flying is simply closing your eyes and mentally practicing exactly what you do in the aircraft. This is an excellent way to practice making radio calls, departures, approaches and even visualizing the parts and pieces of the aircraft. This type of flying does not cost a dime and will make you a better prepared and more proficient pilot.

All three of Max Trescott's safety tips incorporate the ADM process and emphasize the importance of how safety and good decision-making is essential to aviation.

The Decision-Making Process

An understanding of the decision-making process provides a pilot 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. Called automatic decision-making, it is based upon training, experience, and recognition. Traditionally, pilots have been well trained to react to emergencies, but are not as well prepared to make decisions that require a more reflective response when greater analysis is necessary. They often overlook the phase of decision-making that is accomplished on the ground: the preflight, flight planning, performance planning, weather briefing, and weight/center of gravity configurations. Thorough and proper completion of these tasks provides increased awareness and a base of knowledge available to the pilot prior to departure and once airborne. Typically during a flight, a 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.

Defining the Problem

Defining the problem is the first step in the decision-making process and begins with recognizing that a change has occurred or that an expected change did not occur. A problem is perceived first by the senses, then is distinguished through insight (self-awareness) and experience. Insight, experience, and 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.

While going through the following example, keep in mind what errors lead up to the event. What planning could have been completed prior to departing that may have led to avoiding this situation? What instruction could the pilot have had during training that may have better prepared the pilot for this scenario? Could the pilot have assessed potential problems based on what the aircraft "felt like" at a hover? All these factors go into recognizing a change and the timely response.

While doing a hover check after picking up firefighters at the bottom of a canyon, a pilot realized that she was only 20 pounds under maximum gross weight. What she failed to realize was that the firefighters had stowed some of their heaviest gear in the baggage compartment, which shifted the center of gravity (CG) slightly behind the aft limits. Since weight and balance had never created any problems for her in the past, she did not bother to calculate CG and power required. She did try to estimate it by remembering the figures from earlier in the morning at the base camp. At a 5,000-foot density altitude (DA) and maximum gross weight, the performance charts indicated the helicopter had plenty of excess power. Unfortunately, the temperature was 93 °F and the pressure altitude at the pickup point was 6,200 feet (DA = 9,600 feet). Since there was enough power for the hover check, the pilot decided there was sufficient power to takeoff.

Even though the helicopter accelerated slowly during the takeoff, the distance between the helicopter and the ground continued to increase. However, when the pilot attempted to establish the best rate of climb speed, the nose tended to pitch up to a higher-than-normal attitude, and the pilot noticed that the helicopter was not gaining enough altitude in relation to the canyon wall approximately 200 yards ahead.

Choosing a Course of Action

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

The pilot's first thought was to pull up on the collective and pull back on the cyclic. After weighing the consequences of possibly losing rotor revolutions per minute (rpm) and not being able to maintain the climb rate sufficiently to clear the canyon wall, which was then only a hundred yards away, she realized the only course was to try to turn back to the landing zone on the canyon floor.

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, a pilot must continue to evaluate the outcome of the decision to ensure that it is producing the desired result.

As the pilot made the turn to the downwind, the airspeed dropped nearly to zero, and the helicopter became very difficult to control. (At this point, the pilot must increase airspeed in order to maintain translational lift.) Since the CG was aft of limits, she needed to apply more forward cyclic than usual. As she approached the landing zone with a high rate of descent, she realized that she would be in a potential vortex ring state situation if she tried to trade airspeed for altitude and lost effective translational lift (ETL). Therefore, it did not appear that she would be able to terminate the approach in a hover. The pilot decided to make the shallowest approach possible and perform a run-on landing.

Pilots sometimes have trouble not because of deficient basic skills or system knowledge, but because of faulty decision-making skills. Although aeronautical decisions may appear to be simple or routine, each individual decision in aviation often defines the options available for the next decision the pilot must make, and the options (good or bad) it provides.

Therefore, a poor decision early in a flight can compromise the safety of the flight at a later time. It is important to make appropriate and decisive choices because good decision-making early in an emergency provide greater latitude for later options.

Decision-Making Models

The decision-making process normally consists of several steps before a pilot chooses a course of action. A variety of structured frameworks for decision-making provide assistance in organizing the decision process. These models include but are not limited to the 5P (Plan, Plane, Pilot, Passengers, Programming), the OODA Loop (Observation, Orientation, Decision, Action), and the DECIDE (Detect, Estimate, Choose, Identify, Do, and Evaluate) models. *[Figure 13-2]* All these models and their variations are discussed in detail in the Pilot's Handbook of Aeronautical Knowledge section covering aeronautical decision-making.

Whichever model is used, the pilot learns how to define the problem, choose a course of action, implement the decision, and evaluate the outcome. Remember, there is no one right answer in this process: a pilot analyzes the situation in light of experience level, personal minimums, and current physical and mental readiness levels, and then makes a decision.

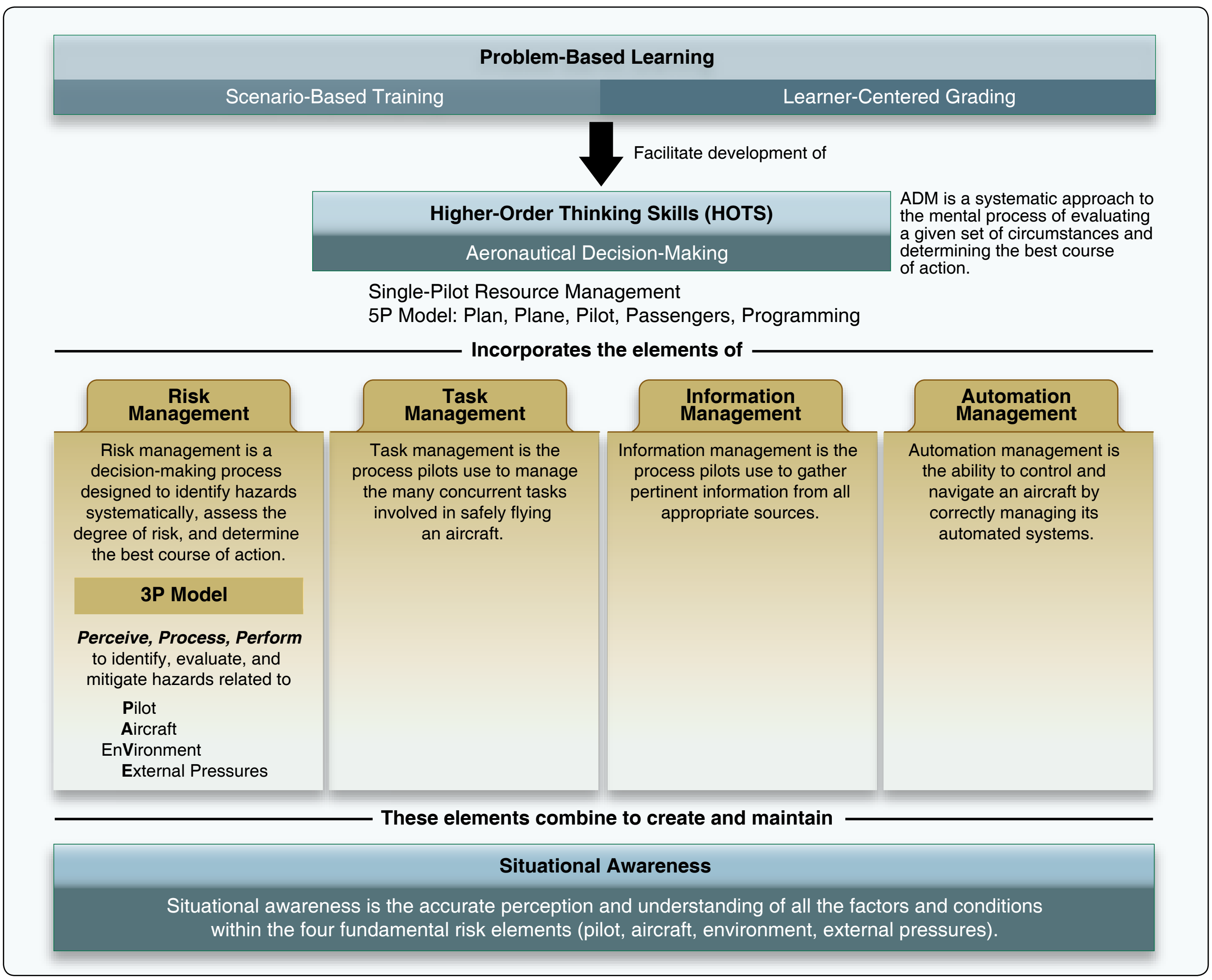

Figure 13-2. *Various models of decision-making are used in problem solving.*

Pilot Self-Assessment

The pilot in command (PIC) of an aircraft is directly responsible for and is the final authority for the operation of that aircraft. The list of PIC responsibilities is long, and nothing should be overlooked. To exercise those responsibilities effectively and make effective decisions regarding the outcome of a flight, a pilot must have an understanding of personal limitations. Pilot performance from planning the flight to execution of the flight is affected by many factors, such as health, experience, knowledge, skill level, and attitude.

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. Specifying when refresher training should be accomplished and designating weather minimums, which may be higher than those listed in Title 14 of the Code of Federal Regulations (14 CFR) part 91, are elements that may be included on a personal checklist. Over confidence can kill just as fast as inexperience. In addition to a review of personal limitations, a pilot should use the I'M SAFE checklist to further evaluate fitness for flight. *[Figure 13-3]*

Curiosity: Healthy or Harmful?

The roots of aviation are firmly based on curiosity. Where would we be today had it not been for the dreams of Leonardo da Vinci, the Wright Brothers, and Igor Sikorsky? They all were infatuated with flight, a curiosity that led to the origins of aviation. The tale of aviation is full of firsts: first flight, first helicopter, first trans-Atlantic flight, and so on. But, along the way there were many setbacks, fatalities, and lessons learned.

Figure 13-3. *I'M SAFE checklist.*

Today, we continue to learn and investigate the limits of aviation. We've been to the moon, and soon beyond. Our curiosity will continue to drive us to search for the next challenge.

However, curiosity can also have catastrophic consequences. Despite over 100 years of aviation practice, we still see accidents that are caused by impaired judgment formed from curious behavior. Pilots commonly seek to determine the limits of their ability as well as the limits of the aircraft. Unfortunately, too often this leads to mishaps with deadly results. Inquisitive behavior must be harnessed and displayed within personal and material limits.

Deadly curiosity may not seem as obvious to some as it is to others. Simple thoughts such as, "Is visibility really as bad as what the ATIS is reporting?" or "Will the 20-minute fuel light really indicate only 20 minutes worth of fuel?" can lead to poor decisions and disastrous outcomes.

Some aviators blatantly violate rules and aircraft limitations without thinking through the consequences. "What indications and change in flight characteristics will I see if I fly this helicopter above its maximum gross weight?" or "I've heard this helicopter can do aerobatic flight. Why is it prohibited?" are examples of extremely harmful curiosity. Even more astounding is their ignoring to the fact that the damage potentially done to the aircraft will probably manifest later in the aircraft's life, affecting other crews. Spontaneous excursions in aviation can be deadly.

Curiosity is natural and promotes learning. Airmen should abide by established procedures until proper and complete hazard assessment and risk management can be completed.

The PAVE Checklist

As found in the Pilot's Handbook of Aeronautical Knowledge, the FAA has designed a personal minimums checklist. To help pilots with self-assessment, which in turn helps mitigate risk, the acronym PAVE divides the risks of flight into four categories. For each category, think of the applicability specific to helicopter operations:

- Pilot (pilot in command)
  - Physical, emotional readiness.
  - Flight experience, recency, currency, total time in type.
- Aircraft
  - Is the helicopter capable of performing the task?
  - Can it carry the necessary fuel?

- Does it provide adequate power margins for the task to be accomplished?
- Can it carry the weight and remain within CG?
- Will there be external loads?

- Environment
  - Helicopters are susceptible to the impact of changing weather conditions.
  - How will the change in moderating temperatures and DA affect performance?
  - Will controllability be jeopardized by winds, terrain, and turbulence?
- External pressures
  - Do not let the notion to accomplish "the mission" override good judgment and safety.
  - Many jobs include time lines. How often do we hear "time is money" or "time is wasting"? Don't sacrifice safety for an implied or actual need to meet the deadline!
  - Do not allow yourself to feel pressured by coworkers, family events, or friends.

Incorporated into preflight planning, the PAVE checklist provides the pilot with a simple way to remember each category to examine for risk prior to each flight. Once the 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. Remember, the PIC is responsible for deciding about canceling the flight. If the pilot decides to continue with the flight, he or she should develop strategies to mitigate the risks.

One way to control risk is by setting personal minimums for items in each risk category. Remember, these are limits unique to an individual pilot's current level of experience and proficiency. They should be reevaluated periodically based upon experience and proficiency.

Single-Pilot Resource Management

Many of the concepts utilized in CRM have been successfully applied to single-pilot operations which led to the development of SRM. Defined as the art and science of managing all the resources (both on board the aircraft and from outside resources) available to a single pilot (prior to and during flight), SRM helps to ensure the successful outcome of the flight. As mentioned earlier, this includes risk management, situational awareness (SA), and CFIT awareness.

SRM training helps the pilot maintain SA by managing automation, associated control, and navigation tasks. This enables the pilot to accurately assess hazards, manage resulting risk potential, and make good decisions.

To make informed decisions during flight operations, a pilot must be aware of the resources found both inside and outside the cockpit. Since useful tools and sources of information may not always be readily apparent, learning to recognize these resources is an essential part of SRM training. The pilot must not only identify the available resources, but he or she must also assess whether sufficient time is available to use a particular one, and the impact its use will have upon the safety of the flight.

If a pilot is flying alone into a confined area with no wind sock or access to a current wind report, should that pilot pick an approach path based on the direction of wind information received from an earlier weather brief? Making an approach into a confined area with a tailwind is a bad decision and can be avoided. Prior to landing, the pilot should use outside resources such a smoke, trees, and water on a pond to help him or her accurately determine which direction the winds are coming from. Pilots should never leave flying up to chance and hope for the best. Many accidents could and should be avoided by simply using the resources, internal and external that are available.

Internal resources are found in the cockpit during flight. Since some of the most valuable internal resources are ingenuity, knowledge, and skill, a pilot can expand cockpit resources immensely by improving these capabilities. This can be accomplished by frequently reviewing flight information publications, such as 14 CFR and the AIM, as well as by pursuing additional training.

No other internal resource is more important than the pilot's own ability to control the situation, thereby controlling the aircraft. Helicopter pilots quickly learn that it is not possible to hover, single pilot, and pick up the checklist, a chart, or publication without endangering themselves, the aircraft, or those nearby.

Checklists are essential cockpit resources used to verify the aircraft instruments and systems are checked, set, and operating properly. They also ensure proper procedures are performed if there is a system malfunction or inflight emergency. Pilots at all levels of experience refer to checklists. The more advanced the aircraft is, the more crucial checklists are.

Therefore, have a plan on how to use the checklist (and other necessary publications) before you begin the flight. Always control the helicopter first. When hovering in an airport environment, the pilot can always land the aircraft to access the checklist or a publication, or have a passenger assist with holding items. There is nothing more unsettling than being in flight and not having a well thought-out plan for managing the necessary documents and data. This lack of planning often leads to confusion, distractions and aircraft mishaps.

Another way to avoid a potentially complex and confusing situation is to remove yourself from the situation. The following is an example of how proper resource management and removal from a situation are vital to safe flight.

A single pilot is conducting a helicopter cross-country flight. He frequently goes to and is familiar with the final destination airport. Weather is briefed to be well above the minimum weather needed, but with isolated thunderstorms possible. For the pilot, this is a routine run-of-the-mill flight. He has done this many times before and has memorized the route, checkpoints, frequencies, fuel required and knows exactly what to expect.

However, once within 30 miles of the destination airport the pilot observes that weather is deteriorating, and a thunderstorm is nearby. The pilot assesses the situation and determines the best course of action is to reroute to another airport. The closest airport is an airport within Class C airspace. At this point, the pilot realizes the publications with the required alternate airport information are in the back of the helicopter out of reach. Now what?

The pilot continues toward the alternate airport while using the onboard equipment to access the information. He struggles to obtain the information because he or she is not thoroughly familiar with its operation. Finally, the information is acquired and the pilot dials in the appropriate alternate airfield information. Upon initial contact ARTCC (Air Route Traffic Control Center) notifies the pilot that he has entered the airspace without the required clearance; in effect the pilot has violated airspace regulations.

Things have gone from bad to worse for him. When did the trouble begin for this pilot and what options were available? Without a doubt, problems began during the planning phase, as the necessary resources were placed in the back of the aircraft, unavailable to the pilot during flight. Additional training with the available automated systems installed on the helicopter would have expedited access to the necessary information. What if they hadn't been installed or were inoperative?

Next, a poor decision to continue towards the Class C airspace was made. The pilot could have turned away from the Class C airspace, removing himself from the situation until the frequencies were entered and contact established. Remember, when possible, choose an option that gives more time to determine a course of action. Proper resource management could have negated this airspace violation.

The example also demonstrates the need to have a thorough understanding of all the equipment and systems in the aircraft. As is often the case, the technology available today is seldom used to its maximum capability. It is necessary to become as familiar as possible with this equipment to utilize all resources fully. For example, advanced navigation and autopilot systems are valuable resources. However, if pilots do not fully understand how to use this equipment, or they rely on it so much they become complacent, the equipment can become a detriment to safe flight.

Another internal resource is the Rotorcraft Flight Manual (RFM). *[Figure 13-4]* The RFM:

- Must be on board the aircraft.
- Is indispensable for accurate flight planning.
- Plays a vital role in the resolution of inflight equipment malfunctions.

Other valuable flight deck resources include current aeronautical charts and publications, such as the Airport/Facility Directory (A/FD).

As stated previously, 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. Crew briefs to passengers should always include some basic helicopter terminology. For example, explain that in the event you ask them if you are clear to hover to the right, their response should be either "yes, you are clear to hover to the right" or "no you are not clear." A simple yes or no answer can be ambiguous. A strange smell or sound may alert a passenger to a potential problem. As PIC, a pilot should brief passengers before the flight to make sure that they are comfortable voicing any concerns.

Figure 13-4. *Rotorcraft Flying Manual (RFM).*

Instruction that integrates Single-Pilot Resource Management into flight training teaches aspiring pilots how to be more aware of potential risks in flying, how to identify those risks clearly, and how to manage them successfully. The importance of integrating available resources and learning effective SRM skills cannot be overemphasized. Ignoring safety issues can have fatal results.

Risk Management

Risk management is a formalized way of dealing with hazards. It is the logical process of weighing the potential cost of risks from hazards against the possible benefits of allowing those risks from hazards to stand unmitigated. It is a decision-making process designed to identify hazards systematically, assess the degree of risk, and determine the best course of action. Once risks are identified, they must be assessed. The risk assessment determines the degree of risk (negligible, low, medium, or high) and whether the degree of risk is worth the outcome of the planned activity. If the degree of risk is "acceptable," the planned activity may then be undertaken. Once the planned activity is started, consideration must then be given whether to continue. Pilots must have preplanned, viable alternatives available in the event the original flight cannot be accomplished as planned.

Two defining elements of risk management are hazard and risk.

- A hazard is 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, binding in the antitorque pedals represents a hazard.
- Risk is 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 the likelihood of loss (probability).

A hazard can be a real or perceived condition, event, or circumstance that a pilot encounters. Learning how to identify hazards, assess the degree of risk they pose, and determine the best course of action is an important element of a safe flight.

Four Risk Elements

During each flight, decisions must be made regarding events that involve interactions between the four risk elements—the PIC, the aircraft, the environment, and the operation. The decision-making process involves an evaluation of each of these risk elements to achieve an accurate perception of the flight situation. *[Figure 13-5]*

One of the most important decisions that a PIC must make is the go/no-go decision. Evaluating each of these risk elements can help a pilot decide whether a flight should be conducted or continued. In the following situations, the four risk elements and how they affect decision-making are evaluated.

Pilot—A pilot must continually make decisions about personal competency, condition of health, mental and emotional state, level of fatigue, and many other variables. A situation to consider: a pilot is called early in the morning to make a long flight. With only a few hours of sleep and congestion that indicates the possible onset of a cold, is that pilot safe to fly?

Aircraft—A pilot frequently bases decisions to fly on

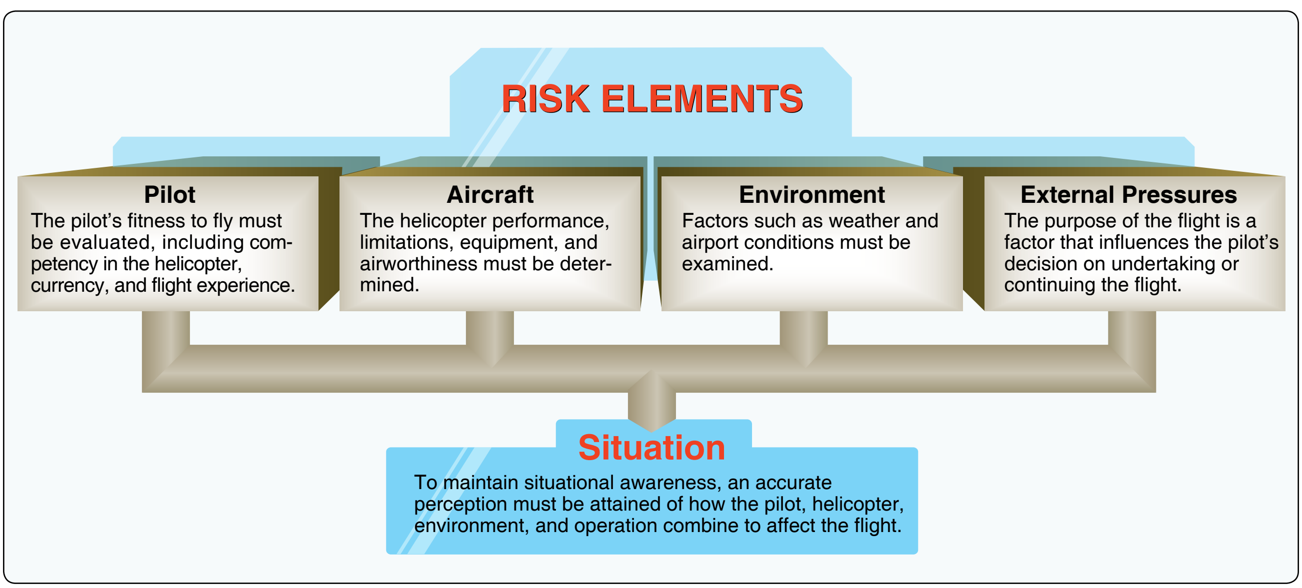

Figure 13-5. *Risk elements to evaluate in decision-making.*

personal evaluations of the aircraft, such as its powerplant, performance, equipment, fuel state, or airworthiness. A situation to consider: en route to an oil rig an hour's flight from shore, having just passed the shoreline, the pilot notices the oil temperature at the high end of the caution range. Should the pilot continue out to sea or return to the nearest suitable heliport/airport?

Environment—This encompasses many elements unrelated to the pilot or aircraft. It can include such factors as weather, ATC, navigational aids (NAVAID), terrain, takeoff and landing areas, and surrounding obstacles. Weather is one element that can change drastically over time and distance. A situation to consider: a pilot is ferrying a helicopter cross-country and encounters unexpected low clouds and rain in an area of rising terrain. Does the pilot try to stay under them and scud run, or turn around, stay in the clear, and obtain current weather information?

External Pressures—The interaction between the pilot, the aircraft, and the environment is greatly influenced by the purpose of each flight operation. A pilot must evaluate the three previous areas to decide on the desirability of undertaking or continuing the flight as planned. It is worth asking why the flight is being made, how critical it is to maintain the schedule, and if the trip is worth the risks. A situation to consider: a pilot is tasked to take some technicians into rugged mountains for a routine survey in marginal weather. Would it be preferable to wait for better conditions to ensure a safe flight? How would the priorities change if a pilot were tasked to search for cross-country skiers who had become lost in deep snow and radioed for help?

Assessing Risk

It is important for a pilot to learn how to assess risk. Before a pilot can begin to assess risk, he or she must first perceive the hazard and attendant risk(s). In aviation, experience, training, and education help a pilot learn how to spot hazards quickly and accurately. During flight training, the instructor should point out the hazards and attendant risks to help the student pilot learn to recognize them.

Once a hazard is identified, determining the probability and severity of an accident (level of risk associated with it) becomes the next step. For example, the hazard of binding in the antitorque pedals poses a risk only if the helicopter is flown. If the binding leads to a loss of directional control, the risk is high that it could cause catastrophic damage to the helicopter and the passengers. The pilot learns to identify hazards and how to deal with them when they are incorporated into the training program.

Every flight has hazards and some level of risk associated with it. It is critical that pilots be able to:

- Differentiate, in advance, between a low-risk flight and a high-risk flight.
- Establish a review process and develop risk mitigation strategies to address flights throughout that range.

Examining NTSB reports and other accident research can help a pilot to assess risk more effectively. For example, the accident rate 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 visual flight rules (VFR) at night should establish higher personal limitations than are required by the regulations and, if applicable, apply instrument flying skills in this environment.

Individuals training to be helicopter pilots should remember that the helicopter accident rate is 30 percent higher than the accident rate for fixed-wing aircraft. While many factors contribute to this, students must recognize the small margin of error that exists for helicopter pilots in making critical decisions. In helicopters, certain emergency actions require immediate action by the pilot. In the event of an engine malfunction, failure to immediately lower the collective results in rotor decay and failed autorotation. Fixed wing pilots may have slightly more time to react and establish a controllable descent. According to the General Aviation (GA) Joint Steering Committee, the leading causes of accidents in GA are CFIT (see p.14-15), weather, runway incursions, pilot decision-making, and loss of control. These causes are referred to as pilot-error, or human factors related, accidents. CFIT, runway incursions, and loss of control type accidents typically occur when the pilot makes a series of bad judgments, which leads to these events. For example, when the pilot has not adequately planned the flight and the pilot subsequently fails to maintain adequate situational awareness to avoid the terrain, a CFIT accident occurs.

While the reasons for individual helicopter incidents vary, it can be argued that it is the helicopter's flight mode and operational complexity that directly contributes to each incident. By nature of its purpose, a helicopter usually flies closer to terrain than does a fixed-wing aircraft. Subsequently, minimal time exists to avoid CFIT, weather related, or loss of control type incidents that require quick and accurate assessments. Fixed-wing aircraft normally fly at higher altitudes and are flown from prepared surface to prepared surface. Helicopters are often operated in smaller, confined area-type environments and require continuous pilot control. Helicopter pilots must be aware of what rotor wash can do when landing to a dusty area or prior to starting where loose debris may come in contact with the rotor blades.

Often, the loss of control occurs when the pilot exceeds design or established operating standards, and the resulting situation exceeds pilot capability to handle it successfully. The FAA generally characterizes these occurrences as resulting from poor judgment. Likewise, most weather-related accidents are not a result of the weather per se, but of a failure of the pilot to avoid a weather phenomenon for which the aircraft is not equipped, or the pilot is not trained to handle. That is, the pilot decides to fly or to continues into conditions beyond pilot capability, an action commonly considered to be demonstrating bad judgment.

It cannot be emphasized enough that the helicopter's unique capabilities come with increased risk. Since most helicopter operations are conducted by a single pilot, the workload is increased greatly. Low-level maneuvering flight (a catch-all category for different types of flying close to terrain or obstacles, such as power line patrol, wildlife control, crop dusting, air taxiing, and maneuvering for landing after an instrument approach), is one of the largest single categories of fatal accidents.

Fatal accidents that occur during approach often happen at night or in instrument flight rules (IFR) conditions. Takeoff/initial climb accidents are frequently due to the pilot's lack of awareness of the effects of density altitude on aircraft performance or other improper takeoff planning that results in loss of control during or shortly after takeoff. One of the most lethal types of GA flying is attempting VFR flight into instrument meteorological conditions (IMC). Accidents involving poor weather decision-making account for about 4 percent of the total accidents but 14 percent of the fatal mishaps. While weather forecast information has been gradually improving, weather should remain a high priority for every pilot assessing risk.

Using the 3P Model to Form Good Safety Habits

As discussed in the Pilot's Handbook of Aeronautical Knowledge, the Perceive, Process, Perform (3P) model helps a pilot assess and manage risk effectively in the real world. *[Figure 13-6]*

To use this model, the pilot will:

- Perceive hazards
- Process level of risk
- Perform risk management

Let's put this to use through a common scenario, involving a common task, such as a confined area approach. As is often the case, the continuous loop consists of several elements; each element must be addressed through the 3P process.

Figure 13-6. *3P Model.*

A utility helicopter pilot receives the task of flying four passengers into a remote area for a hunting expedition. The passengers have picked the location where they would like to be dropped off based on the likelihood of wildlife being in the area. The area has steep, rugged terrain in a series of valleys and canyons leading up to large mountains.

Upon arrival at the location, the pilot locates a somewhat large confined area near the base of one of the mountains. The pilot begins the 3P process by quickly noting (or perceiving) the hazards that affect the approach, landing, and takeoff. Through thorough assessment the pilot takes into consideration:

- *Current aircraft weight/power available,*
- *Required approach angle to clear the trees for landing in the confined area,*
- *Wind direction and velocity,*
- *Limited approach and departure paths (due to constricting terrain),*
- *Escape routes should the approach need to be terminated prior to landing,*
- *Possible hazards, such as wires or structures either around the landing site or inside of the confined area, and*
- *The condition of the terrain at the landing site. Mud, dust, and snow can be extreme hazards if the pilot is not properly trained to land in those particular conditions.*

The pilot reviews the 3P process for each hazard. The pilot has perceived the risk associated for each of the bullets listed above. Now, the pilot assesses the risk level of each and what to do to manage or mitigate the risk.

The aircraft weight/power risk is assessed as low. While performing power checks, the pilot verified adequate out of ground effect (OGE) power exists. The pilot is also aware that, in this scenario, the departure DA (6,500 feet) is greater than the arrival location DA (6,000 feet) and that several hundred pounds of fuel have been burned off en route. Furthermore, once the passengers have disembarked, more power will be available for departure.

The pilot estimates that the highest obstacles along the approach path are 70–80 feet in height. With the size of the confined area, a normal approach angle can be maintained to clear these obstacles, giving this a low risk level. To further mitigate this risk the pilot has selected mental checkpoints along the approach path that will serve as go/no-go points should the pilot feel any assessed parameter is being exceeded.

Wind direction and velocity are assessed as a medium risk because (for this scenario) the direction of the wind is slightly offset from the chosen approach path, creating a 15–20° crosswind with a steady 10-knot wind. The pilot also takes into consideration that, due to the terrain, the wind direction and velocity may change during the approach. The pilot's experience and awareness of the complexity of mountain flow wind provide a management tool for risk reduction.

From an approach and departure standpoint, the risk is assessed to be medium. There is only one viable approach and departure path. Given the size of the confined area and the wind direction, the approach and departure path is deemed acceptable.

The pilot assigns a medium risk level to the selection of an escape route. The pilot is aware of the constricting terrain on either side. Although adequate area exists for maneuvering, the pilot realizes there are physical boundaries and that they can affect the options available should the pilot need to conduct a go-around or abort the approach. Again, the pilot uses mental checkpoints to ensure an early decision is made to conduct a go-around, if needed. The selected go-around or escape route will be in line with the selected approach/departure path and generally into the wind.

As you may have noticed, one identified hazard and its correlating risk management action may have subsequent impact on other factors. This demonstrates the need for continuous assessment and evaluation of the impact of chosen courses of action.

The 3P model offers three good reasons for its use. First, it is fairly simple to remember. Second, it offers a structured, efficient, and systematic way to identify hazards, assess risk, and implement effective risk controls. Third, practicing risk management needs to be as automatic as basic aircraft control. As is true for other flying skills, risk management thinking habits are best developed through repetition and consistent adherence to specific procedures.

Once the pilot completes the 3P decision process and selects a course of action, the process begins anew as the set of circumstances brought about by the selected course of action requires new analysis. Thus, the decision-making process is a continuous loop of perceiving, processing, and performing.

Workload or Task Management

One component of SRM is workload or task management. Research shows that humans have a limited capacity for information. Once information flow exceeds the person's ability to mentally process the information, any additional information becomes unattended or displaces other tasks and information already being processed. Once this situation occurs, only two alternatives exist: shed the unimportant tasks or perform all tasks at a less than optimal level. Like an overloaded electrical circuit, either the consumption must be reduced or a circuit failure is experienced.

Effective workload management ensures essential operations are accomplished by planning and then placing them in a sequence that avoids work overload. As a pilot gains experience, he or she learns to recognize future workload requirements and can prepare for high workload periods during times of low workload.

Reviewing the appropriate chart and setting radio frequencies well in advance of need help reduce workload as a flight nears the airport. In addition, a pilot should listen to Automatic Terminal Information Service (ATIS), Automated Surface Observing System (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. For example, during any situation, and especially in an emergency, a pilot should remember the phrase "aviate, navigate, and communicate." This means that the first thing a pilot should do is make sure the helicopter is under control, then begin flying to an acceptable landing area. Only after the first two items are assured should a pilot try to communicate with anyone.

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

A very good example of this is inadvertent IMC. Once entering into bad weather, work overload can occur immediately. Mentally, the pilot must transition from flying outside of the aircraft to flying inside the aircraft. Losing all visual references can cause sensory overload and the ability to think rationally can be lost. Instead of trusting the aircraft's instruments, pilots may try to hang onto the few visual references that they have, and forget all about all other factors surrounding them. Instead of slowing the helicopter down they increase airspeed. This can be caused by an oculogravic illusion. This type of illusion occurs when an aircraft accelerates and decelerates. Inertia from linear accelerations and decelerations cause the otolith organ to sense a nose-high or nose-low attitude. Pilots falsely perceive that the aircraft is in a nose-high attitude. Therefore, pilots increase airspeed. Pilots can also be looking down for visual references and forget about the hazards in front of them. Finally, since the pilots are not looking at the flight instruments, the aircraft is not level. All of this can be avoided by proper training and proper planning. If going inadvertent IMC is your only course of action, pilots must commit to it and fly the helicopter using only the flight instruments and not trying to follow the few visual references they have.

When a work overload situation exists, a pilot needs to:

- Stop,
- Think,
- Slow down, and then
- Prioritize.

It is important for a pilot to understand how to decrease workload by:

- Placing a situation in the proper perspective,
- Remaining calm, and
- Thinking rationally.

These key elements reduce stress and increase the pilot's ability to fly safely. They depend upon the experience, discipline, and training that each safe flight earns. It is important to understand options available to decrease workload. For example, setting a radio frequency may be delegated to another pilot or to a passenger, freeing the pilot to perform higher-priority tasks.

Situational Awareness

In addition to learning to make good aeronautical decisions, and learning to manage risk and flight workload, SA is an important element of ADM. SA is the accurate perception and understanding of all the factors and conditions within the four fundamental risk elements (PAVE) that affect safety before, during, and after the flight. SA involves being aware of what is happening around you, in order to understand how information, events, and your own actions will impact your goals and objectives, both now and in the near future. Lacking SA or having inadequate SA has been identified as one of the primary factors in accidents attributed to human error.

SA in a helicopter can be quickly lost. Understanding the significance and impact of each risk factor independently and cumulatively aid in safe flight operations. It is possible, and all too likely, that we forget flying while at work. Our occupation, or work, may be conducting long line operations, maneuvering around city obstacles to allow a film crew access to news events, spraying crops, ferrying passengers or picking up a patient to be flown to a hospital. In each case we are flying a helicopter. The moment we fail to account for the aircraft systems, the environment, other aircraft, hazards, and ourselves, we lose SA.

To maintain SA, all of the skills involved in SRM are used. For example, an accurate perception of pilot 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, while establishing a productive relationship with ATC can be accomplished by effective resource use.

Obstacles to Maintaining Situational Awareness

What distractions interfere with our focus or train of thought? There are many. A few examples pertinent to aviation, and helicopters specifically, follow.

Fatigue, frequently associated with pilot error, is a threat to aviation safety because it impairs alertness and performance. *[Figure 13-7]* The term is used to describe a range of experiences from sleepy or tired to exhausted. Two major physiological phenomena create fatigue: circadian rhythm disruption and sleep loss.

Many helicopter jobs require scheduling flexibility, frequently affecting the body's circadian rhythm. You

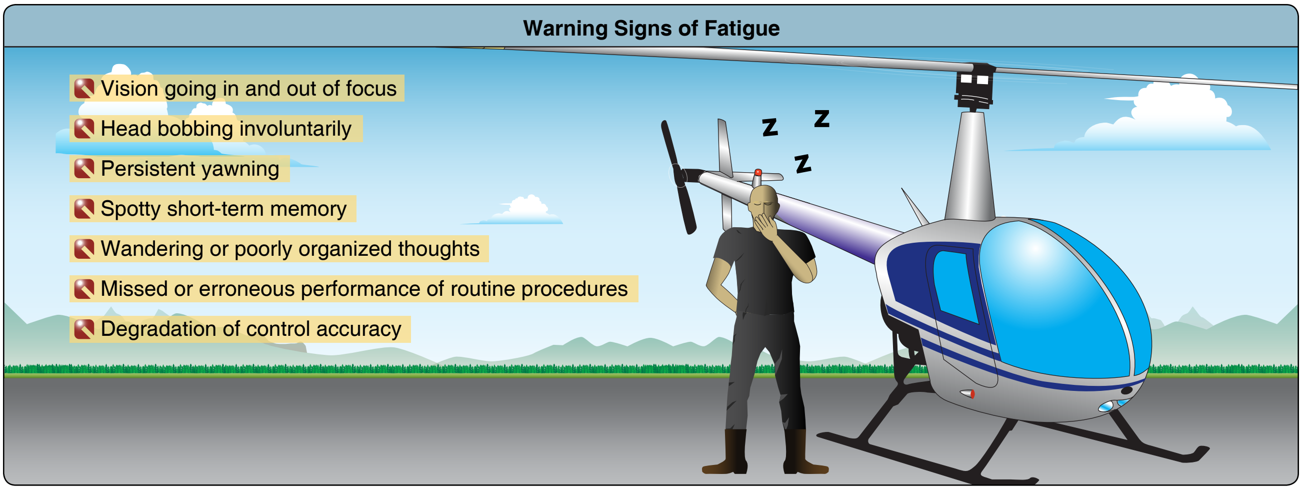

Figure 13-7. Warning signs of *fatigue* according to the FAA Civil Aerospace Medical Institute (CAMI).

may be flying a day flight Monday and then at night on Tuesday. Your awareness of how your body and mind react to this variation in schedule is vital to safety. This disruptive pattern may result in degradation of attention and concentration, impaired coordination, and decreased ability to communicate.

Physical fatigue results from sleep loss, exercise, or physical work. Factors such as stress and prolonged performance of cognitive work result in mental fatigue. Consecutive days of flying the maximum allowable flight time can fatigue a pilot, mentally and physically. It is important to take breaks within the workday, as well as days off when possible. When you find yourself in this situation, take an objective, honest assessment of your state of mind. If necessary, use rest periods to allow rejuvenation of the mind and body. *[Figure 13-8]*

Fatigue also occurs under circumstances in which there is anticipation of flight followed by inactivity. For instance, a pilot is given a task requiring a specific takeoff time. In anticipation of the flight, the pilot's adrenaline kicks in and SA is elevated. After a delay (weather, maintenance, or any other unforeseen delay), the pilot feels a letdown, in effect, becoming fatigued. Then, upon resuming the flight, the pilot does not have that same level of attention.

Complacency presents another obstacle to maintaining SA. Defined as overconfidence from repeated experience with a specific activity, complacency has been implicated as a contributing factor in numerous aviation accidents and incidents. When activities become routine, a pilot may have a tendency to relax and not put as much effort into performance. Like fatigue, complacency reduces a pilot's effectiveness on the flight deck. However, complacency is more difficult to recognize than fatigue, since everything seems to be progressing smoothly.

Since complacency seems to creep into our routine without notice, ask what has changed. The minor changes that go unnoticed can be associated with the four fundamental risks we previously discussed: pilot, aircraft, environment, and external pressures.

As a pilot, am I still using checklists or have I become reliant on memory to complete my checks? Do I check (Notices to Airmen) NOTAMs before every flight or only when I think it is necessary? And the aircraft: did I feel that vibration before or is it new? Was there a log book entry for it? If so,

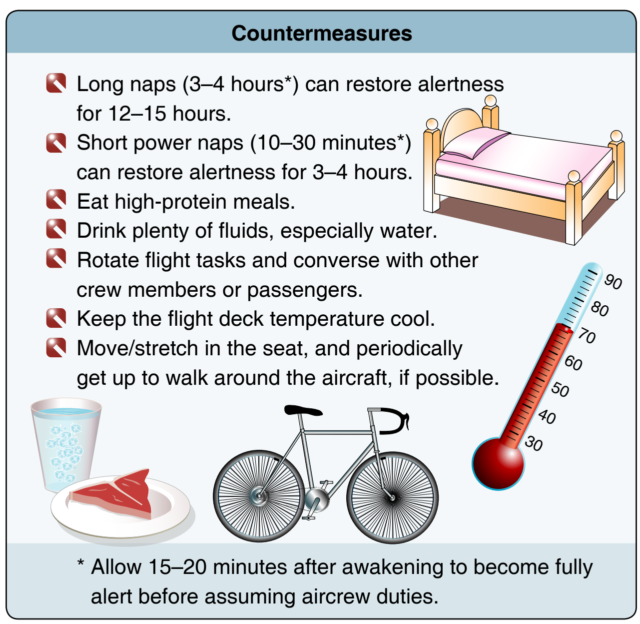

Figure 13-8. Countermeasures to fatigue according to the FAA Civil Aerospace Medical Institute (CAMI).

has it been checked?

Complacent acceptance of common weather patterns can have huge impacts on safety. The forecast was for clearing after the rain shower, but what was the dew-point spread? The winds are greater than forecast. Will this create reduced visibility in dusty, snowy areas or exceed wind limitations?

While conducting crop spraying, a new agent is used. Does that change the weight? Does that change the flight profile and, if so, what new hazards might be encountered? When things are going smoothly, it is time to heighten your awareness and become more attentive to your flight activities.

Advanced avionics have created a high degree of redundancy and dependability in modern aircraft systems, which can promote complacency and inattention. Routine flight operations may lead to a sense of complacency, which can threaten flight safety by reducing SA.

Loss of SA can be caused by a minor distraction that diverts the pilot's attention from monitoring the instruments or scanning outside the aircraft. For example, a gauge that is not reading correctly is a minor problem, but it can cause an accident if the pilot diverts attention to the perceived problem and neglects to control the aircraft properly.

Operational Pitfalls

There are numerous common 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 achieve 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. Pilots develop awareness and learn to avoid many of these operational pitfalls through effective SRM training. *[Figure 13-9]*

Controlled Flight Into Terrain (CFIT) Awareness

An emergency medical services (EMS) helicopter departed for a night flight to transport an 11-day-old infant patient from one hospital to another. No record was found indicating the pilot obtained a weather briefing before departure. The pilot had a choice of taking either a direct route that crossed a remote area of rugged mountainous terrain with maximum ground elevations of about 9,000 feet or a route that was about 10 minutes longer and followed an interstate highway with maximum ground elevations of about 6,000 feet. Radar data, which show about 4 minutes of the helicopter's flight before coverage was lost due to mountainous terrain, are consistent with the flight following the direct route.

A search was initiated about 4 hours after the helicopter did not arrive at the destination hospital, and the wreckage was located the following morning. Physical evidence observed at the accident site indicated that the helicopter was in level flight at impact and was consistent with CFIT. [Figure 13-10]

CFIT is a type of accident that continues to be a major safety concern, while at the same time difficult to explain because it involves a pilot controlling an airworthy aircraft that is flown into terrain (water or obstacles) with inadequate pilot awareness of the impending disaster.

One constant in CFIT accidents is that outside visibility is limited, or the accident occurs at night and the terrain is not seen easily until just prior to impact. Another commonality among CFIT accidents is lack of SA. This includes not only horizontal awareness, and knowing where the helicopter is over the ground, but also vertical awareness.

Training, planning, and preparation are a pilot's best defenses for avoiding CFIT accidents. For example, take some time before takeoff to become familiar with the proposed flight and the terrain. Avoidance of CFIT begins before the helicopter departs the home location. Proper planning, including applied risk mitigation must occur before the aircraft is even started. Thorough assessment of terrain, visibility, pilot experience and available contingencies must be conducted. If necessary, delay or postpone the flight while on the ground. The decision to abort the flight is much easier to make in the planning room than in the air. In case conditions deteriorate once in flight. Have contingency options available.

While many CFIT accidents and incidents occur during nonprecision approaches and landings, great measures have been taken to improve instrument training, equipment and procedures. For the qualified pilot, instrument flight should not be avoided, but rather, trained as a viable option for safely recovering the aircraft. Like any other training, frequent instrument training builds confidence and reassurance.

Good instrument procedures include studying approach charts before leaving cruise altitude. Key fixes and airport elevation must be noted and associated with terrain and obstacles along the approach path. Pilots should have a good understanding of both approach and departure design criteria to understand fully the obstacle clearance margins built into them. Some pilots have the false belief that ATC provides obstacle clearance while en route off airways. The pilot is ultimately responsible for obstacle clearance.

Operational Pitfalls

Peer Pressure
It would be foolish and unsafe for a new pilot to attempt to compete with an older, more experienced pilot. The only safe competition should be completing the most safe flights with no one endangered or hurt and the aircraft returned to service. Efficiency comes with experience and on-the-job training.

Mindset
A pilot should be taught to approach every day as something new.

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 arrive at 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 the pilot may not want to admit that the landing cannot be completed and a missed approach must be initiated.

Scud Running
It is difficult for a pilot to estimate the distance from indistinct forms, such as clouds or fog formation.

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 of a pilot getting 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
Pilots should use the last of the known fuel to make a safe landing. Bringing fuel to an aircraft is much less inconvenient than picking up the pieces of a crashed helicopter! Pilots should land prior to whenever their watch, fuel gauge, low-fuel warning system, or flight planning indicates fuel burnout. They should always be thinking of unforecast winds, richer-than-planned mixtures, unknown leaks, mis-servicing, and errors in planning. Newer pilots need to be wary of fuselage attitudes in low-fuel situations. Some helicopters can port air into the fuel system in low-fuel states, causing the engines to quit or surge.

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 pilot must understand how to check the charts, understand the results, and fly accordingly.

Neglect of Flight Planning, Preflight Inspections, and Checklists
All pilots and operators must understand the complexity of the helicopter, the amazing number of parts, and why there are service times associated with certain parts. Pilots should understand material fatigue and maintenance requirements. Helicopters are unforgiving of disregarded maintenance requirements. Inspections and maintenance are in place for safety: something functioning improperly can be the first link in the error chain to an accident. In some cases, proper maintenance is a necessary condition for insurance converage.

Figure 13-9. *Operational pitfalls.*

Altitude error is another common cause of CFIT. Cases of altitude error involve disorientation with respect to the NAVAID, improper transition on approach, selecting the wrong NAVAID, or just plain lack of horizontal SA. Today's modern aircraft have sophisticated flight directors, autopilots, autothrottles, and flight management systems. These devices make significant contributions to the overall safety of flight, but they are only machines that follow instructions. They do whatever is asked of them, even if it is wrong. When commanded, they unerringly follow instructions—sometimes straight into the ground. The pilot must ensure that both vertical and horizontal modes are correct and engaged. Cross-check autopilots constantly.

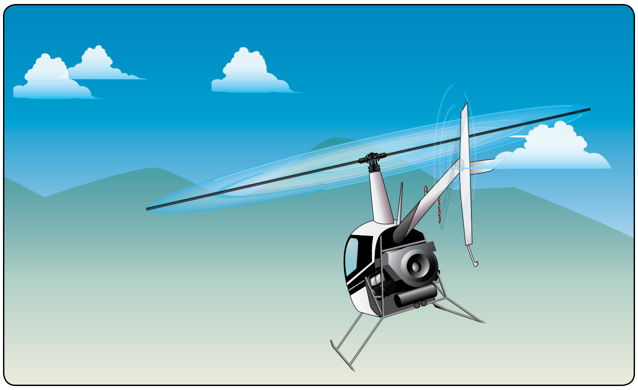

Figure 13-10. *Helicopter heading straight for mountain.*

When automated flight equipment is not available, great care must be taken to prepare properly for a night flight. SRM becomes more challenging under the cover of darkness, and caution should be exercised when determining what artificial light source to use inside the aircraft. A light source that is too bright will blind the pilot from seeing outside obstacles or rising terrain. Certain colored lenses bleach out symbols and markings on a map. Conduct this planning on the ground, in a dark room if necessary, before the actual flight.

Pilots must be even more conservative with their decision-making and planning when flying at night. Flying becomes more difficult due to the degradation of our sensory perception and the lack of outside references. Beginning with preflight, looking over the helicopter with a flashlight can cause pilots to miss even the smallest discrepancy that they would easily see during the day. For example, failing to remove one or all of the tie downs and attempting to take off would probably result in a dynamic rollover accident. Whenever possible, preflight inspection should always be conducted during the day or in a lighted hangar. Depth perception is less acute; therefore, hover height should be increased to avoid contact with obstacles and hover speed should be reduced. Weather conditions can be very deceptive and difficult to detect in flight under night conditions. On a low-illumination night, it is easy to fly into clouds without realizing it before it is too late to correct.

Due to the number of recent CFIT night accidents, the NTSB issued a safety alert in 2008 about avoiding night CFIT accidents. That alert included the following information:

- Terrain familiarization is critical to safe visual operations at night. Use sectional charts or other topographic references to ensure the helicopter will safely clear terrain and obstructions all along the route.
- When planning a nighttime VFR flight, follow IFR practices, such as climbing on a known safe course until well above surrounding terrain. Choose a cruising altitude that provides terrain separation similar to IFR flights (2,000 feet above ground level in mountainous areas and 1,000 feet above the ground in other areas). Using this technique, known obstacles, such as towers, will be avoided.
- When receiving radar services, do not depend on ATC to warn of terrain hazards. Although controllers try to warn pilots if they notice a hazardous situation, they may not always recognize that a particular VFR aircraft is dangerously close to terrain.
- When ATC issues a heading with an instruction to “maintain VFR,” be aware that the heading may not provide adequate terrain clearance. If any doubt exists about your ability to avoid terrain and obstacles visually, advise ATC immediately and take action to reach a safe altitude.
- For improved night vision, the FAA recommends the use of supplemental oxygen for flights above 5,000 feet.
- Obtain as much information about areas in which you will be flying, and the routes to them, by utilizing hazard maps and satellite imagery.
- Before flying at night to unfamiliar remote areas or areas with hazardous terrain, try to arrange a day flight for familiarization.
- If a pilot flies at night, especially in remote or unlit areas, consider whether a global positioning system (GPS)-based terrain awareness unit would improve the safety of the flight.

Of particular note in the 2008 safety alert is a comment regarding oxygen use above 5,000 feet. Most helicopters are neither required nor equipped for supplemental oxygen use at this altitude. Due to the physiological effect on night vision of reduced available oxygen at higher elevations, care should be taken to exercise light discipline. Interior lighting should be lowered to the lowest possible levels but must allow adequate illumination of necessary systems and instruments. This, in turn, allows greater recognition of outside obstacles and terrain features.

Limited outside visibility is one constant in CFIT accidents. In the accident cited at the beginning of this section, it appears the pilot failed to obtain a weather briefing. If the pilot had obtained one, he would probably have learned of the cloud cover and light precipitation present along his planned route of flight. The limited outside visibility probably caused the CFIT accident, since no evidence was found of any pre-impact mechanical discrepancies with the helicopter’s airframe or systems that would have prevented normal operation.

Automation Management

Automation management is the control and navigation of an aircraft by means of the automated systems installed in the aircraft. One of the most important concepts of automation management is simply knowing when to use it and when not to.

Ideally, a pilot first learns to perform practical test standard (PTS) maneuvers and procedures in the aircraft manually, or hand flying. After successfully demonstrating proficiency in the basic maneuvers, the pilot is then introduced to the available automation and/or the autopilot. Obviously, in some aircraft, not all automated systems may be disengaged for basic flight. The purpose of basic flight without automation is to ensure the pilot can hand fly the maneuver when necessary.

Advanced avionics offer multiple levels of automation, from strictly manual flight to highly automated flight. No one level of automation is appropriate for all flight situations, but to avoid potentially dangerous distractions when flying with advanced avionics, the pilot must know how to manage the course indicator, the navigation source, and the autopilot. It is important for a pilot to know the peculiarities of the particular automated system in use. This ensures the pilot 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 pilot 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. Callouts are verbalizations of particular flight guidance automation mode changes. In an attempt to reduce the risk for mode confusion some operators have required flight crews to callout all flight guidance automation mode changes as a means of forcing pilots to monitor the Flight Mode Annunciator (FMA).

Chapter Summary

This chapter focused on aeronautical decision-making, which includes SRM training, risk management, workload or task management, SA, CFIT awareness, and automation management. Factors affecting a helicopter pilot's ability to make safe aeronautical decisions were also discussed. The importance of learning how to be aware of potential risks in flying, how to clearly identify those risks, and how to manage them successfully were also explored.