list hazards associated with all aspects of the flight: **P**ilot, **A**ircraft, en**V**ironment, and **E**xternal pressures, which makes up the PAVE checklist. *[Figure 2-11]* For each element, ask "what could hurt me, my passengers, or my aircraft?" All four elements combine and interact to create a unique situation for any flight. Pay special attention to the pilot-aircraft combination, and consider whether the combined "pilot-aircraft team" is capable of the mission you want to fly. For example, you may be a very experienced and proficient pilot, but your weather flying ability is still limited if you are flying a 1970s-model aircraft with no weather avoidance gear. On the other hand, you may have a new technically advanced aircraft with moving map GPS, weather datalink, and autopilot—but if you do not have much weather flying experience or practice in using this kind of equipment, you cannot rely on the airplane's capability to compensate for your own lack of experience.

CARE Checklist: Review Hazards and Evaluate Risks

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). The goal is to evaluate their impact on the safety of your flight, and consider "why must I CARE about these circumstances?"

For each hazard that you perceived in step one, process by using the CARE checklist of: **C**onsequences, **A**lternatives, **R**eality, **E**xternal factors. *[Figure 2-12]* For example, let's evaluate a night flight to attend a business meeting:

> **C**onsequences—departing after a full workday creates fatigue and pressure
>
> **A**lternatives—delay until morning; reschedule meeting; drive
>
> **R**eality —dangers and distractions of fatigue could lead to an accident
>
> **E**xternal pressures—business meeting at destination might influence me

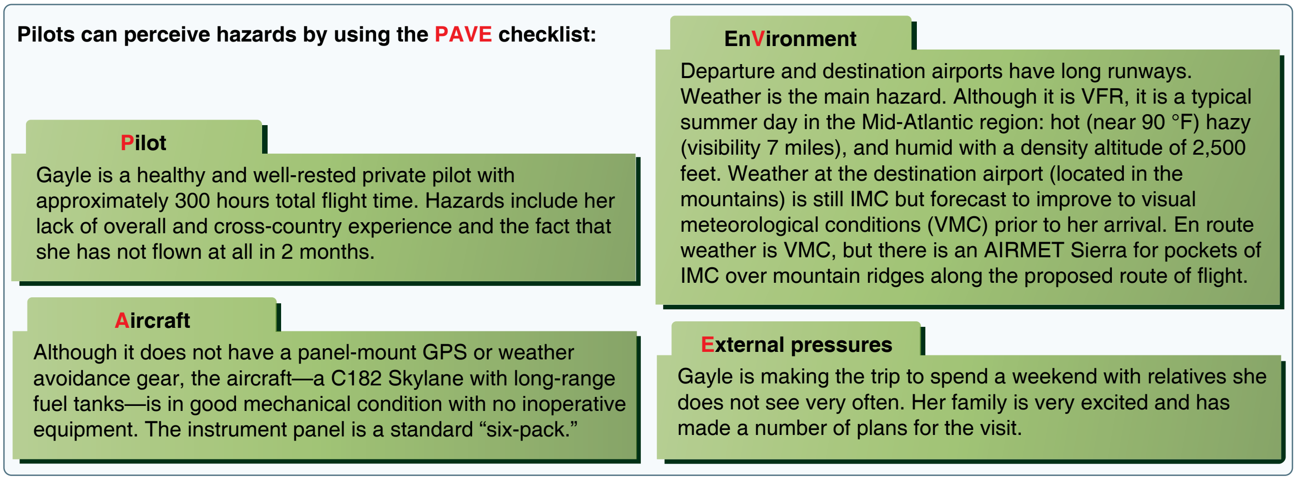
A good rule of thumb for the processing phase: if you find yourself saying that it will "probably" be okay, it is definitely time for a solid reality check. If you are worried about missing a meeting, be realistic about how that pressure will affect not just your initial go/no-go decision, but also your inflight decisions to continue the flight or divert.

TEAM Checklist: Choose and Implement Risk Controls

Once you have perceived a hazard (step one) and processed its impact on flight safety (step two), it is time to move to the third step, perform. Perform risk management by using the TEAM checklist of: **T**ransfer, **E**liminate, **A**ccept, **M**itigate to deal with each factor. *[Figure 2-13]*

> **T**ransfer—Should this risk decision be transferred to someone else (e.g., do you need to consult the chief flight instructor?)
>
> **E**liminate—Is there a way to eliminate the hazard?
>
> **A**ccept—Do the benefits of accepting risk outweigh the costs?
>
> **M**itigate—What can you do to mitigate the risk?

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,



Pilots can perceive hazards by using the PAVE checklist:

Pilot

Gayle is a healthy and well-rested private pilot with approximately 300 hours total flight time. Hazards include her lack of overall and cross-country experience and the fact that she has not flown at all in 2 months.

Aircraft

Although it does not have a panel-mount GPS or weather avoidance gear, the aircraft—a C182 Skylane with long-range fuel tanks—is in good mechanical condition with no inoperative equipment. The instrument panel is a standard "six-pack."

EnVironment

Departure and destination airports have long runways. Weather is the main hazard. Although it is VFR, it is a typical summer day in the Mid-Atlantic region: hot (near 90 °F) hazy (visibility 7 miles), and humid with a density altitude of 2,500 feet. Weather at the destination airport (located in the mountains) is still IMC but forecast to improve to visual meteorological conditions (VMC) prior to her arrival. En route weather is VMC, but there is an AIRMET Sierra for pockets of IMC over mountain ridges along the proposed route of flight.

External pressures

Gayle is making the trip to spend a weekend with relatives she does not see very often. Her family is very excited and has made a number of plans for the visit.

Figure 2-11. *A real-world example of how the 3P model guides decisions on a cross-country trip using the PAVE checklist.*

Pilots can perceive hazards by using the CARE checklist:

Pilot

- Consequences: Gayle's inexperience and lack of recent flight time create some risks for an accident, primarily because she plans to travel over mountains on a hazy day and land at an unfamiliar mountain airport that is still in IMC conditions.
- Alternatives: Gayle might mitigate the pilot-related risk by hiring a CFI to accompany her and provide dual cross-country instruction. An added benefit is the opportunity to broaden her flying experience in safe conditions.
- Reality: Accepting the reality that limited experience can create additional risks is a key part of sound risk management and mitigation.
- External Factors: Like many pilots, Gayle must contend with the emotional pressure associated with acknowledging that her skill and experience levels may be lower than she would like them to be. Pride can be a powerful external factor!

Environment

- Consequences: For a pilot whose experience consists mostly of local flights in good VMC, launching a long cross-country flight over mountainous terrain in hazy conditions could lead to pilot disorientation and increase the risk of an accident.
- Alternatives: Options include postponing the trip until the visibility improves, or modifying the route to avoid extended periods of time over the mountains.
- Reality: Hazy conditions and mountainous terrain clearly create risks for an inexperienced VFR-only pilot.
- External Factors: Few pilots are immune to the pressure of "get-there-itis," which can sometimes induce a decision to launch or continue in less than ideal weather conditions.

Aircraft

- Consequences: This area presents low risk because the aircraft is in excellent mechanical condition and Gayle is familiar with its avionics.
- Alternatives: Had there been a problem with her aircraft, Gayle might have considered renting another plane from her flight school. Bear in mind, however, that alternatives sometimes create new hazards. In this instance, there may be hazards associated with flying an unfamiliar aircraft with different avionics.
- Reality: It is important to recognize the reality of an aircraft's mechanical condition. If you find a maintenance discrepancy and then find yourself saying that it is "probably" okay to fly with it anyway, you need to revisit the consequences part of this checklist.
- External Factors: Pilot decision-making can sometimes be influenced by the external pressure of needing to return the airplane to the FBO by a certain date and time. Because Gayle owns the airplane, there was no such pressure in this case.

External pressures

- Consequences: Any number of factors can create the risk of emotional pressure from a "get-there" mentality. In Gayle's case, the consequences of her strong desire to visit family, her family's expectations, and personal pride could induce her to accept unnecessary risks.
- Alternatives: Gayle clearly needs to develop a mitigating strategy for each of the external factors associated with this trip.
- Reality: Pilots sometimes tend to discount or ignore the potential impact of these external factors. Gayle's open acknowledgement of these factors (e.g., "I might be pressured into pressing on so my mother won't have to worry about our late arrival.") is a critical element of effective risk management.
- External Factors: (see above)

Figure 2-12. *A real-world examples of how the 3P model guides decisions on a cross-country trip using the CARE checklist.*

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 anew because now 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. With practice and consistent use, running through the 3P cycle can become a habit that is as smooth, continuous, and automatic as a well-honed instrument scan. This basic set of practical risk management tools can be used to improve risk management.

Your mental willingness to follow through on safe decisions, especially those that require delay or diversion is critical. You can bulk up your mental muscles by:

- Using personal minimums checklist to make some decisions in advance of the flight. To develop a good personal minimums checklist, you need to assess your abilities and capabilities in a non-flying environment, when there is no pressure to make a specific trip. Once developed, a personal minimums checklist will give you a clear and concise reference point for making your go/no-go or continue/discontinue decisions.
- In addition to having personal minimums, some pilots also like to use a preflight risk assessment checklist to help with the ADM and risk management processes. This kind of form assigns numbers to certain risks and situations, which can make it easier to see when a particular flight involves a higher level of risk
- Develop a list of good alternatives during your processing phase. In marginal weather, for instance, you might mitigate the risk by identifying a reasonable

Pilots can perform risk management by using the TEAM checklist:

Pilot

To manage the risk associated with her inexperience and lack of recent flight time, Gayle can:

- Transfer the risk entirely by having another pilot act as PIC.
- Eliminate the risk by canceling the trip.
- Accept the risk and fly anyway.
- Mitigate the risk by flying with another pilot.

Gayle chooses to mitigate the major risk by hiring a CFI to accompany her and provide dual cross-country instruction. An added benefit is the opportunity to broaden her flying experience.

Aircraft

To manage risk associated with any doubts about the aircraft's mechanical condition, Gayle can:

- Transfer the risk by using a different airplane.
- Eliminate the risk by canceling the trip.
- Accept the risk.
- Mitigate the remaining (residual) risk through review of aircraft performance and careful preflight inspection.

Since she finds no problems with the aircraft's mechanical condition, Gayle chooses to mitigate any remaining risk through careful preflight inspection of the aircraft.

Environment

To manage the risk associated with hazy conditions and mountainous terrain, Gayle can:

- Transfer the risk of VFR in these conditions by asking an instrument-rated pilot to fly the trip under IFR.
- Eliminate the risk by canceling the trip.
- Accept the risk.
- Mitigate the risk by careful preflight planning, filing a VFR flight plan, requesting VFR flight following, and using resources such as Flight Watch.

Detailed preflight planning must be a vital part of Gayle's weather risk mitigation strategy. The most direct route would put her over mountains for most of the trip. Because of the thick haze and pockets of IMC over mountains, Gayle might mitigate the risk by modifying the route to fly over valleys. This change will add 30 minutes to her estimated time of arrival (ETA), but the extra time is a small price to pay for avoiding possible IMC over mountains. Because her destination airport is IMC at the time of departure, Gayle needs to establish that VFR conditions exist at other airports within easy driving distance of her original destination. In addition, Gayle should review basic information (e.g., traffic pattern altitude, runway layout, frequencies) for these alternate airports. To further mitigate risk and practice good cockpit resource management, Gayle should file a VFR flight plan, use VFR flight following, and call Flight Watch to get weather updates en route. Finally, basic functions on her handheld GPS should also be practiced.

External pressures

To mitigate the risk of emotional pressure from family expectations that can drive a "get-there" mentality, Gayle can:

- Transfer the risk by having her co-pilot act as PIC and make the continue/divert decision.
- Eliminate the risk by canceling the trip.
- Accept the risk.
- Mitigate the risk by managing family expectations and making alternative arrangements in the event of diversion to another airport.

Gayle and her co-pilot choose to address this risk by agreeing that each pilot has a veto on continuing the flight, and that they will divert if either becomes uncomfortable with flight conditions. Because the destination airport is still IMC at the time of departure, Gayle establishes a specific point in the trip—an en route VORTAC located between the destination airport and the two alternates—as the logical place for her "final" continue/divert decision. Rather than give her family a specific ETA that might make Gayle feel pressured to meet the schedule, she manages her family's expectations by advising them that she will call when she arrives.

Figure 2-13. *A real-world example of how the 3P model guides decisions on a cross-country trip using the TEAM checklist.*

alternative airport for every 25–30 nautical mile segment of your route.

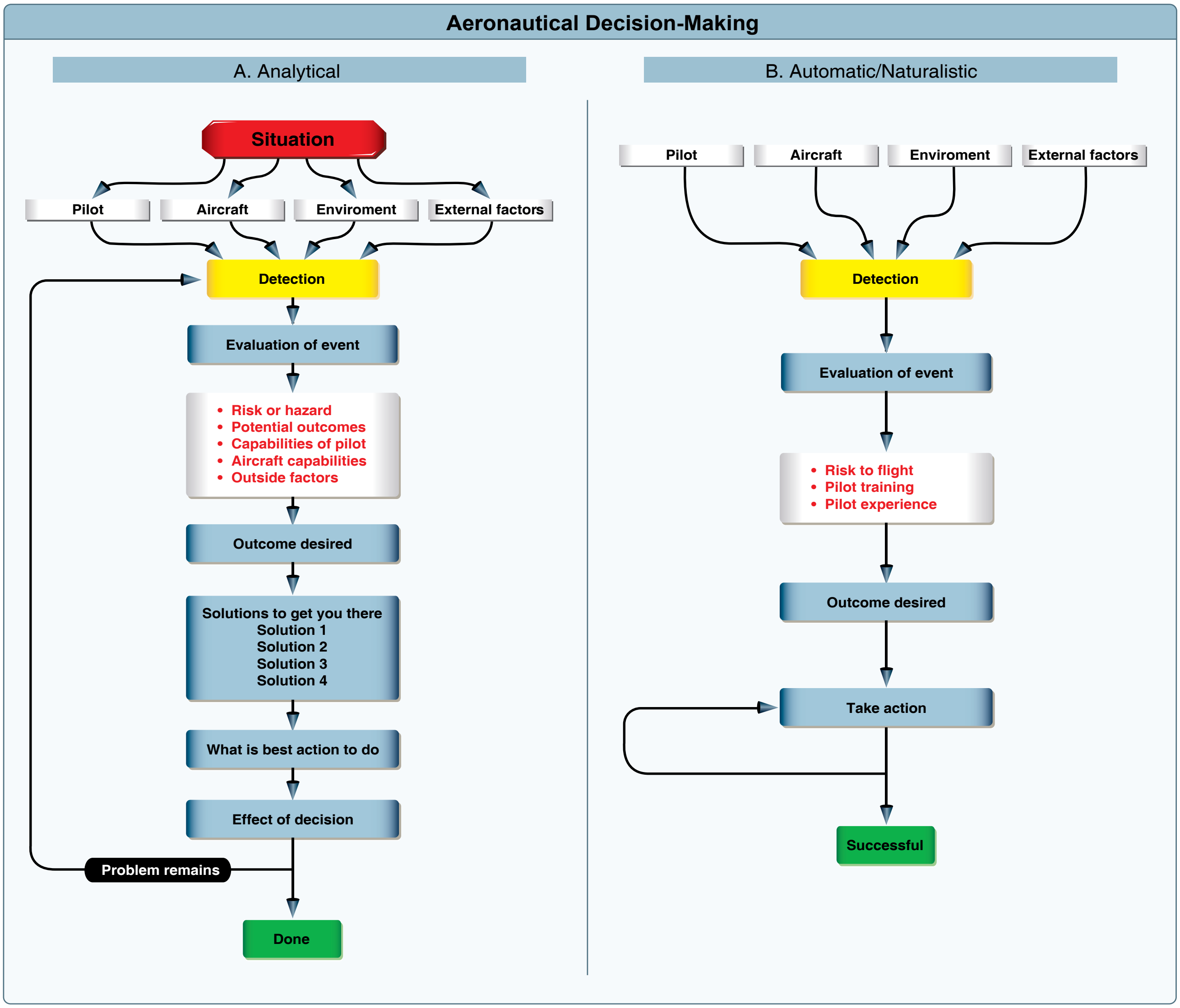
- Preflight your passengers by preparing them for the possibility of delay and diversion, and involve them in your evaluation process.
- Another important tool—overlooked by many pilots—is a good post-flight analysis. When you have safely secured the airplane, take the time to review and analyze the flight as objectively as you can. Mistakes and judgment errors are inevitable; the most important thing is for you to recognize, analyze, and learn from them before your next flight.

The DECIDE Model

Using the acronym "DECIDE," the six-step process DECIDE Model is another continuous loop process that provides the pilot with a logical way of making decisions. *[Figure 2-14]* DECIDE means to Detect, Estimate, Choose a course of action, Identify solutions, Do the necessary actions, and Evaluate the effects of the actions.

First, consider a recent accident involving a Piper Apache (PA-23). The aircraft was substantially damaged during impact with terrain at a local airport in Alabama. The certificated airline transport pilot (ATP) received minor injuries and the certificated private pilot was not injured. The private pilot was receiving a checkride from the ATP (who was also a designated examiner) for a commercial pilot certificate with a multi-engine rating. After performing airwork at altitude, they returned to the airport and the private pilot performed a single-engine approach to a full stop landing. He then taxied back for takeoff, performed a short field takeoff, and then joined the traffic pattern to return for another landing. During the approach for the second landing, the ATP simulated a right engine failure by reducing power on the right engine to zero thrust. This caused the aircraft to yaw right.

The procedure to identify the failed engine is a two-step process. First, adjust the power to the maximum controllable level on both engines. Because the left engine is the only engine delivering thrust, the yaw increases to the right, which necessitates application of additional left rudder application.



The DECIDE model

1. **Detect.** The decision maker detects the fact that change has occurred.
2. **Estimate.** The decision maker estimates the need to counter or react to the change.
3. **Choose.** The decision maker chooses a desirable outcome (in terms of success) for the flight.
4 **Identify.** The decision maker identifies actions which could successfully control the change.
5. **Do.** The decision maker takes the necessary action.
6. **Evaluate.** The decision maker evaluates the effect(s) of his/her action countering the change.

Figure 2-14. *The DECIDE model has been recognized worldwide. Its application is illustrated in column A while automatic/naturalistic decision-making is shown in column B.*

The failed engine is the side that requires no rudder pressure, in this case the right engine. Second, having identified the failed right engine, the procedure is to feather the right engine and adjust power to maintain descent angle to a landing.

However, in this case the pilot feathered the left engine because he assumed the engine failure was a left engine failure. During twin-engine training, the left engine out is emphasized more than the right engine because the left engine on most light twins is the critical engine. This is due to multiengine airplanes being subject to P-factor, as are single-engine airplanes. The descending propeller blade of each engine will produce greater thrust than the ascending blade when the airplane is operated under power and at positive angles of attack. The descending propeller blade of the right engine is also a greater distance from the center of gravity, and therefore has a longer moment arm than the descending propeller blade of the left engine. As a result, failure of the left engine will result in the most asymmetrical thrust (adverse yaw) because the right engine will be providing the remaining thrust. Many twins are designed with a counter-rotating right engine. With this design, the degree of asymmetrical thrust is the same with either engine inoperative. Neither engine is more critical than the other.

Since the pilot never executed the first step of identifying which engine failed, he feathered the left engine and set the right engine at zero thrust. This essentially restricted the aircraft to a controlled glide. Upon realizing that he was not going to make the runway, the pilot increased power to both engines causing an enormous yaw to the left (the left propeller was feathered) whereupon the aircraft started to turn left. In desperation, the instructor closed both throttles and the aircraft hit the ground and was substantially damaged.

This case is interesting because it highlights two particular issues. First, taking action without forethought can be just as dangerous as taking no action at all. In this case, the pilot's actions were incorrect; yet, there was sufficient time to take the necessary steps to analyze the simulated emergency. The second and more subtle issue is that decisions made under pressure are sometimes executed based upon limited experience and the actions taken may be incorrect, incomplete, or insufficient to handle the situation.

Detect (the Problem)

Problem detection is the first step in the decision-making process. It begins with recognizing a change occurred or an expected change did not occur. A problem is perceived first by the senses and then it is distinguished through insight and experience. These same abilities, as well as an objective analysis of all available information, are used to determine the nature and severity of the problem. One critical error made during the decision-making process is incorrectly detecting the problem. In the previous example, the change that occurred was a yaw.

Estimate (the Need To React)

In the engine-out example, the aircraft yawed right, the pilot was on final approach, and the problem warranted a prompt solution. In many cases, overreaction and fixation excludes a safe outcome. For example, what if the cabin door of a Mooney suddenly opened in flight while the aircraft climbed through 1,500 feet on a clear sunny day? The sudden opening would be alarming, but the perceived hazard the open door presents is quickly and effectively assessed as minor. In fact, the door's opening would not impact safe flight and can almost be disregarded. Most likely, a pilot would return to the airport to secure the door after landing.

The pilot flying on a clear day faced with this minor problem may rank the open cabin door as a low risk. What about the pilot on an IFR climb out in IMC conditions with light intermittent turbulence in rain who is receiving an amended clearance from ATC? The open cabin door now becomes a higher risk factor. The problem has not changed, but the perception of risk a pilot assigns it changes because of the multitude of ongoing tasks and the environment. Experience, discipline, awareness, and knowledge influences how a pilot ranks a problem.

Choose (a Course of Action)

After the problem has been identified and its impact estimated, the pilot must determine the desirable outcome and choose a course of action. In the case of the multiengine pilot given the simulated failed engine, the desired objective is to safely land the airplane.

Identify (Solutions)

The pilot formulates a plan that will take him or her to the objective. Sometimes, there may be only one course of action available. In the case of the engine failure already at 500 feet or below, the pilot solves the problem by identifying one or more solutions that lead to a successful outcome. It is important for the pilot not to become fixated on the process to the exclusion of making a decision.

Do (the Necessary Actions)

Once pathways to resolution are identified, the pilot selects the most suitable one for the situation. The multiengine pilot given the simulated failed engine must now safely land the aircraft.

Evaluate (the Effect of the Action)

Finally, after implementing a solution, evaluate the decision to see if it was correct. If the action taken does not provide the desired results, the process may have to be repeated.

Decision-Making in a Dynamic Environment

A solid approach to decision-making is through the use of analytical models, such as the 5 Ps, 3P, and DECIDE. Good decisions result when pilots gather all available information, review it, analyze the options, rate the options, select a course of action, and evaluate that course of action for correctness.

In some situations, there is not always time to make decisions based on analytical decision-making skills. A good example is a quarterback whose actions are based upon a highly fluid and changing situation. He intends to execute a plan, but new circumstances dictate decision-making on the fly. This type of decision-making is called automatic decision-making or naturalized decision-making. *[Figure 2-14B]*

Automatic Decision-Making

In an emergency situation, a pilot might not survive if he or she rigorously applies analytical models to every decision made as there is not enough time to go through all the options. Under these circumstances he or she should attempt to find the best possible solution to every problem.

For the past several decades, research into how people actually make decisions has revealed that when pressed for time, experts faced with a task loaded with uncertainty first assess whether the situation strikes them as familiar. Rather than comparing the pros and cons of different approaches, they quickly imagine how one or a few possible courses of action in such situations will play out. Experts take the first workable option they can find. While it may not be the best of all possible choices, it often yields remarkably good results.

The terms "naturalistic" and "automatic decision-making" have been coined to describe this type of decision-making. The ability to make automatic decisions holds true for a range of experts from firefighters to chess players. It appears the expert's ability hinges on the recognition of patterns and consistencies that clarify options in complex situations. Experts appear to make provisional sense of a situation, without actually reaching a decision, by launching experience-based actions that in turn trigger creative revisions.

This is a reflexive type of decision-making anchored in training and experience and is most often used in times of emergencies when there is no time to practice analytical decision-making. Naturalistic or automatic decision-making improves with training and experience, and a pilot will find himself or herself using a combination of decision-making tools that correlate with individual experience and training.

Operational Pitfalls

Although more experienced pilots are likely to make more automatic decisions, there are tendencies or operational pitfalls that come with the development of pilot experience. These are classic behavioral traps into which pilots have been known to fall. More experienced pilots, as a rule, try to complete a flight as planned, please passengers, and meet schedules. The desire to meet these goals can have an adverse effect on safety and contribute to an unrealistic assessment of piloting skills. All experienced pilots have fallen prey to, or have been tempted by, one or more of these tendencies in their flying careers. These dangerous tendencies or behavior patterns, which must be identified and eliminated, include the operational pitfalls shown in *Figure 2-15.*

Stress Management

Everyone is stressed to some degree almost all of the time. A certain amount of stress is good since it keeps a person alert and prevents complacency. Effects of stress are cumulative and, if the pilot does not cope with them in an appropriate way, they can eventually add up to an intolerable burden. Performance generally increases with the onset of stress, peaks, and then begins to fall off rapidly as stress levels exceed a person's ability to cope. The ability to make effective decisions during flight can be impaired by stress. There are two categories of stress—acute and chronic. These are both explained in Chapter 17, "Aeromedical Factors."

Factors referred to as stressors can increase a pilot's risk of error in the flight deck. *[Figure 2-16]* Remember the cabin door that suddenly opened in flight on the Mooney climbing through 1,500 feet on a clear sunny day? It may startle the pilot, but the stress would wane when it became apparent the situation was not a serious hazard. Yet, if the cabin door opened in IMC conditions, the stress level makes significant impact on the pilot's ability to cope with simple tasks. The key to stress management is to stop, think, and analyze before jumping to a conclusion. There is usually time to think before drawing unnecessary conclusions.

There are several techniques to help manage the accumulation of life stresses and prevent stress overload. For example, to help reduce stress levels, set aside time for relaxation each day or maintain a program of physical fitness. To prevent stress overload, learn to manage time more effectively to avoid pressures imposed by getting behind schedule and not meeting deadlines.

Use of Resources

To make informed decisions during flight operations, a pilot must also become aware of the resources found inside and outside the flight deck. Since useful tools and sources of information may not always be readily apparent, learning to recognize these resources is an essential part of ADM training. Resources must not only be identified, but a pilot must also develop the skills to evaluate whether there is

Operational Pitfalls

Peer pressure
Poor decision-making may be based upon an emotional response to peers, rather than evaluating a situation objectively.

Mindset
A pilot displays mind set through an inability to recognize and cope with changes in a given situation.

Get-there-itis
This disposition impairs pilot judgment through a fixation on the original goal or destination, combined with a disregard for any alternative course of action.

Duck-under syndrome
A pilot may be tempted to make it into an airport by descending below minimums during an approach. There may be a belief that there is a built-in margin of error in every approach procedure, or a pilot may want to admit that the landing cannot be completed and a missed approach must be initiated.

Scud running
This occurs when a pilot tries to maintain visual contact with the terrain at low altitudes while instrument conditions exist.

Continuing visual flight rules (VFR) into instrument conditions
Spatial disorientation or collision with ground/obstacles may occur when a pilot continues VFR into instrument conditions. This can be even more dangerous if the pilot is not instrument rated or current.

Getting behind the aircraft
This pitfall can be caused by allowing events or the situation to control pilot actions. A constant state of surprise at what happens next may be exhibited when the pilot is getting behind the aircraft.

Loss of positional or situational awareness
In extreme cases, when a pilot gets behind the aircraft, a loss of positional or situational awareness may result. The pilot may not know the aircraft's geographical location or may be unable to recognize deteriorating circumstances.

Operating without adequate fuel reserves
Ignoring minimum fuel reserve requirements is generally the result of overconfidence, lack of flight planning, or disregarding applicable regulations.

Descent below the minimum en route altitude
The duck-under syndrome, as mentioned above, can also occur during the en route portion of an IFR flight.

Flying outside the envelope
The assumed high performance capability of a particular aircraft may cause a mistaken belief that it can meet the demands imposed by a pilot's overestimated flying skills.

Neglect of flight planning, preflight inspections, and checklists
A pilot may rely on short- and long-term memory, regular flying skills, and familiar routes instead of established procedures and published checklists. This can be particularly true of experienced pilots.

Figure 2-15. *Typical operational pitfalls requiring pilot awareness.*

Stressors

Environmental
Conditions associated with the environment, such as temperature and humidity extremes, noise, vibration, and lack of oxygen.

Physiological stress
Physical conditions, such as fatigue, lack of physical fitness, sleep loss, missed meals (leading to low blood sugar levels), and illness.

Psychological stress
Social or emotional factors, such as a death in the family, a divorce, a sick child, or a demotion at work. This type of stress may also be related to mental workload, such as analyzing a problem, navigating an aircraft, or making decisions.

Figure 2-16. *System stressors. Environmental, physiological, and psychological stress are factors that affect decision-making skills. These stressors have a profound impact especially during periods of high workload.*

time to use a particular resource and the impact its use will have upon the safety of flight. For example, the assistance of ATC may be very useful if a pilot becomes lost, but in an emergency situation, there may be no time available to contact ATC.

Internal Resources

One of the most underutilized resources may be the person in the right seat, even if the passenger has no flying experience. When appropriate, the PIC can ask passengers to assist with certain tasks, such as watching for traffic or reading checklist items. The following are some other ways a passenger can assist:

- Provide information in an irregular situation, especially if familiar with flying. A strange smell or sound may alert a passenger to a potential problem.
- Confirm after the pilot that the landing gear is down.
- Learn to look at the altimeter for a given altitude in a descent.
- Listen to logic or lack of logic.

Also, the process of a verbal briefing (which can happen whether or not passengers are aboard) can help the PIC in the decision-making process. For example, assume a pilot provides a lone passenger a briefing of the forecast landing weather before departure. When the Automatic Terminal Information Service (ATIS) is picked up, the weather has significantly changed. The discussion of this forecast change can lead the pilot to reexamine his or her activities and decision-making. *[Figure 2-17]* Other valuable internal resources include ingenuity, aviation knowledge, and flying skill. Pilots can increase flight deck resources by improving these characteristics.

When flying alone, another internal resource is verbal communication. It has been established that verbal communication reinforces an activity; touching an object while communicating further enhances the probability an activity has been accomplished. For this reason, many solo pilots read the checklist out loud; when they reach critical items, they touch the switch or control. For example, to ascertain the landing gear is down, the pilot can read the checklist. But, if he or she touches the gear handle during the process, a safe extension of the landing gear is confirmed.

It is necessary for a pilot to have a thorough understanding of all the equipment and systems in the aircraft being flown. Lack of knowledge, such as knowing if the oil pressure gauge is direct reading or uses a sensor, is the difference between making a wise decision or poor one that leads to a tragic error.

Figure 2-17. *When possible, have a passenger reconfirm that critical tasks are completed.*

Checklists are essential flight deck internal resources. They are used to verify the aircraft instruments and systems are checked, set, and operating properly, as well as ensuring the proper procedures are performed if there is a system malfunction or in-flight emergency. Students reluctant to use checklists can be reminded that pilots at all levels of experience refer to checklists, and that the more advanced the aircraft is, the more crucial checklists become. In addition, the pilot's operating handbook (POH) is required to be carried on board the aircraft and is essential for accurate flight planning and resolving in-flight equipment malfunctions. However, the most valuable resource a pilot has is the ability to manage workload whether alone or with others.

External Resources

ATC and flight service specialists are the best external resources during flight. In order to promote the safe, orderly flow of air traffic around airports and, along flight routes, the ATC provides pilots with traffic advisories, radar vectors, and assistance in emergency situations. Although it is the PIC's responsibility to make the flight as safe as possible, a pilot with a problem can request assistance from ATC. *[Figure 2-18]* For example, if a pilot needs to level off, be

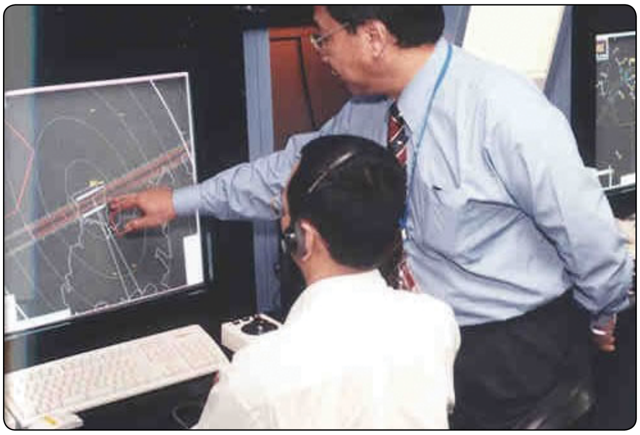


Figure 2-18. *Controllers work to make flights as safe as possible.*

given a vector, or decrease speed, ATC assists and becomes integrated as part of the crew. The services provided by ATC can not only decrease pilot workload, but also help pilots make informed in-flight decisions.

The Flight Service Stations (FSSs) are air traffic facilities that provide pilot briefing, en route communications, VFR search and rescue services, assist lost aircraft and aircraft in emergency situations, relay ATC clearances, originate Notices to Airmen (NOTAM), broadcast aviation weather and National Airspace System (NAS) information, receive and process IFR flight plans, and monitor navigational aids (NAVAIDs). In addition, at selected locations, FSSs provide En Route Flight Advisory Service (Flight Watch), issue airport advisories, and advise Customs and Immigration of transborder flights. Selected FSSs in Alaska also provide TWEB recordings and take weather observations.

Situational Awareness

Situational awareness is the accurate perception and understanding of all the factors and conditions within the five fundamental risk elements (flight, pilot, aircraft, environment, and type of operation that comprise any given aviation situation) that affect safety before, during, and after the flight. Monitoring radio communications for traffic, weather discussion, and ATC communication can enhance situational awareness by helping the pilot develop a mental picture of what is happening.

Maintaining situational awareness requires an understanding of the relative significance of all flight related factors and their future impact on the flight. When a pilot understands what is going on and has an overview of the total operation, he or she is not fixated on one perceived significant factor. Not only is it important for a pilot to know the aircraft's geographical location, it is also important he or she understand what is happening. For instance, while flying above Richmond, Virginia, toward Dulles Airport or Leesburg, the pilot should know why he or she is being vectored and be able to anticipate spatial location. A pilot who is simply making turns without understanding why has added an additional burden to his or her management in the event of an emergency. To maintain situational awareness, all of the skills involved in ADM are used.

Obstacles to Maintaining Situational Awareness

Fatigue, stress, and work overload can cause a pilot to fixate on a single perceived important item and reduce an overall situational awareness of the flight. A contributing factor in many accidents is a distraction that 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 proper control of the aircraft.

Workload Management

Effective workload management ensures essential operations are accomplished by planning, prioritizing, and sequencing tasks to avoid work overload. *[Figure 2-19]* As experience is gained, a pilot 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 when they are needed helps reduce workload as the flight nears the airport. In addition, a pilot should listen to 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.

Recognizing a work overload situation is also an important component of managing workload. The first effect of high workload is that the pilot may be working harder but accomplishing less. As workload increases, attention cannot be devoted to several tasks at one time, and the pilot may begin to focus on one item. When a pilot becomes task saturated, there is no awareness of input from various sources, so decisions may be made on incomplete information and the possibility of error increases. *[Figure 2-20]*

When a work overload situation exists, a pilot needs to stop, think, slow down, and prioritize. It is important to understand how to decrease workload. For example, in the case of the cabin door that opened in VFR flight, the impact on workload should be insignificant. If the cabin door opens under IFR different conditions, its impact on workload changes. Therefore, placing a situation in the proper perspective,

Figure 2-19. *Balancing workloads can be a difficult task.*

remaining calm, and thinking rationally are key elements in reducing stress and increasing the capacity to fly safely. This ability depends upon experience, discipline, and training.

Managing Risks

The ability to manage risks begins with preparation. Here are some things a pilot can do to manage risks:

- Assess the flight's risk based upon experience. Use some form of risk assessment. For example, if the weather is marginal and the pilot has little IMC training, it is probably a good idea to cancel the flight.
- Brief passengers using the SAFETY list:

S	Seat belts fastened for taxi, takeoff, landing
	Shoulder harness fastened for takeoff, landing
	Seat position adjusted and locked in place
A	Air vents (location and operation)
	All environmental controls (discussed)
	Action in case of any passenger discomfort
F	Fire extinguisher (location and operation)
E	Exit doors (how to secure; how to open)
	Emergency evacuation plan
	Emergency/survival kit (location and contents)
T	Traffic (scanning, spotting, notifying pilot)
	Talking, ("sterile flight deck" expectations)
Y	Your questions? (Speak up!)

- In addition to the SAFETY list, discuss with passengers whether or not smoking is permitted, flight route altitudes, time en route, destination, weather during flight, expected weather at the destination, controls and what they do, and the general capabilities and limitations of the aircraft.
- Use a sterile flight deck (one that is completely silent with no pilot communication with passengers or by passengers) from the time of departure to the first intermediate altitude and clearance from the local airspace.
- Use a sterile flight deck during arrival from the first radar vector for approach or descent for the approach.
- Keep the passengers informed during times when the workload is low.
- Consider using the passenger in the right seat for simple tasks, such as holding the chart. This relieves the pilot of a task.

Automation

In the GA community, an automated aircraft is generally comprised of an integrated advanced avionics system consisting of a primary flight display (PFD), a multifunction flight display (MFD) including an instrument-certified global positioning system (GPS) with traffic and terrain graphics, and a fully integrated autopilot. This type of aircraft is commonly known as a technically advanced aircraft (TAA). In a TAA aircraft, there are typically two display (computer) screens: PFD (left display screen) and MFD.

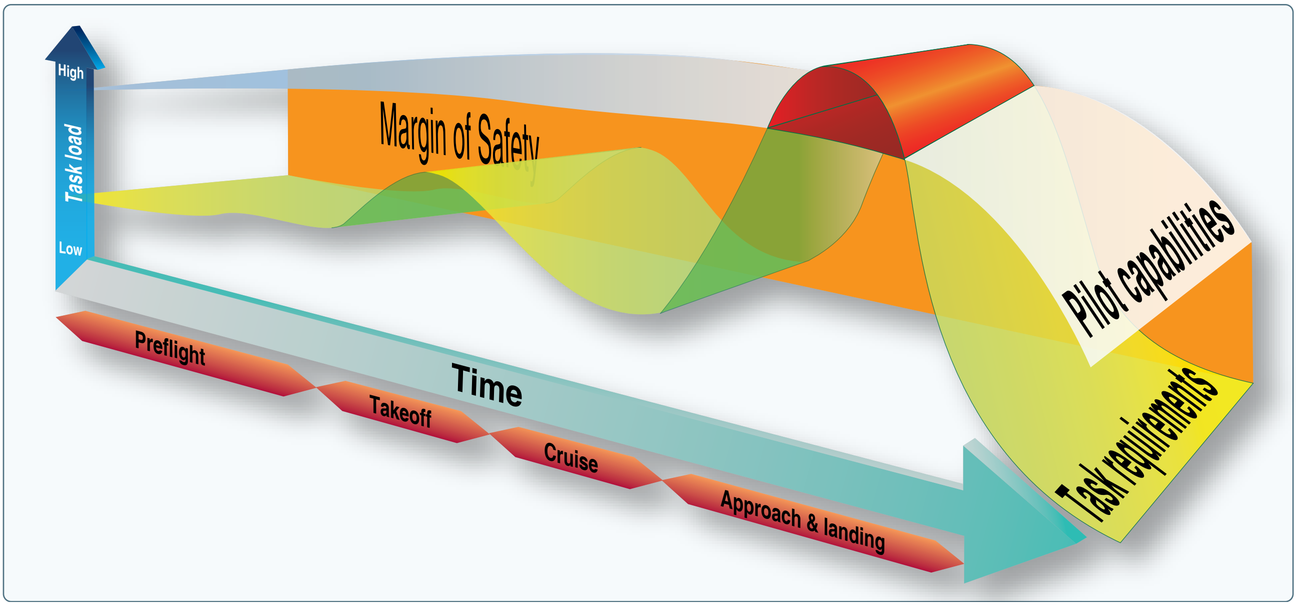


Figure 2-20. *The pilot has a certain capacity of doing work and handling tasks. However, there is a point where the tasking exceeds the pilot's capability. When this happens, tasks are either not performed properly or some are not performed at all.*

Automation is the single most important advance in aviation technologies. Electronic flight displays (EFDs) have made vast improvements in how information is displayed and what information is available to the pilot. Pilots can access electronic databases that contain all of the information traditionally contained in multiple handbooks, reducing clutter in the flight deck. *[Figure 2-21]*

MFDs are capable of displaying moving maps that mirror sectional charts. These detailed displays depict all airspace, including Temporary Flight Restrictions (TFRs). MFDs are so descriptive that many pilots fall into the trap of relying solely on the moving maps for navigation. Pilots also draw upon the database to familiarize themselves with departure and destination airport information.

More pilots now rely on electronic databases for flight planning and use automated flight planning tools rather than planning the flight by the traditional methods of laying out charts, drawing the course, identifying navigation points (assuming a VFR flight), and using the POH to figure out the weight and balance and performance charts. Whichever method a pilot chooses to plan a flight, it is important to remember to check and confirm calculations. Always remember that it is up to the pilot to maintain basic airmanship skills and use those skills often to maintain proficiency in all tasks.

Figure 2-21. *Electronic flight instrumentation comes in many systems and provides a myriad of information to the pilot.*

Although automation has made flying safer, automated systems can make some errors more evident and sometimes hide other errors or make them less evident. There are concerns about the effect of automation on pilots. In a study published in 1995, the British Airline Pilots Association officially voiced its concern that "Airline pilots increasingly lack 'basic flying skills' as a result of reliance on automation."

This reliance on automation translates into a lack of basic flying skills that may affect the pilot's ability to cope with an in-flight emergency, such as sudden mechanical failure. The worry that pilots are becoming too reliant on automated systems and are not being encouraged or trained to fly manually has grown with the increase in the number of MFD flight decks.

As automated flight decks began entering everyday line operations, instructors and check airmen grew concerned about some of the unanticipated side effects. Despite the promise of reducing human mistakes, the flight managers reported the automation actually created much larger errors at times. In the terminal environment, the workload in an automated flight deck actually seemed higher than in the older analog flight decks. At other times, the automation seemed to lull the flight crews into complacency. Over time, concern surfaced that the manual flying skills of the automated flight crews deteriorated due to over-reliance on computers. The flight crew managers said they worried that pilots would have less "stick-and-rudder" proficiency when those skills were needed to manually resume direct control of the aircraft.

A major study was conducted to evaluate the performance of two groups of pilots. The control group was composed of pilots who flew an older version of a common twin-jet airliner equipped with analog instrumentation and the experimental group was composed of pilots who flew the same aircraft, but newer models equipped with an electronic flight instrument system (EFIS) and a flight management system (FMS). The pilots were evaluated in maintaining aircraft parameters, such as heading, altitude, airspeed, glideslope, and localizer deviations, as well as pilot control inputs. These were recorded during a variety of normal, abnormal, and emergency maneuvers during 4 hours of simulator sessions.

Results of the Study

When pilots who had flown EFIS for several years were required to fly various maneuvers manually, the aircraft parameters and flight control inputs clearly showed some erosion of flying skills. During normal maneuvers, such as turns to headings without a flight director, the EFIS group exhibited somewhat greater deviations than the analog group. Most of the time, the deviations were within the practical test standards (PTS), but the pilots definitely did not keep on the localizer and glideslope as smoothly as the analog group.

The differences in hand-flying skills between the two groups became more significant during abnormal maneuvers, such as accelerated descent profiles known as "slam-dunks." When given close crossing restrictions, the analog crews were more adept at the mental math and usually maneuvered the aircraft in a smoother manner to make the restriction. On the other hand, the EFIS crews tended to go "heads down" and tried to solve the crossing restriction on the FMS. *[Figure 2-22]*

Another situation used in the simulator experiment reflected real world changes in approach that are common and can be assigned on short notice. Once again, the analog crews transitioned more easily to the parallel runway's localizer, whereas the EFIS crews had a much more difficult time with the pilot going head down for a significant amount of time trying to program the new approach into the FMS.

While a pilot's lack of familiarity with the EFIS is often an issue, the approach would have been made easier by disengaging the automated system and manually flying the approach. At the time of this study, the general guidelines in the industry were to let the automated system do as much of the flying as possible. That view has since changed and it is recommended that pilots use their best judgment when choosing which level of automation will most efficiently do the task considering the workload and situational awareness.

Emergency maneuvers clearly broadened the difference in manual flying skills between the two groups. In general, the analog pilots tended to fly raw data, so when they were given an emergency, such as an engine failure, and were instructed to fly the maneuver without a flight director, they performed it expertly. By contrast, SOP for EFIS operations at the time was to use the flight director. When EFIS crews had their flight directors disabled, their eye scan again began a more erratic searching pattern and their manual flying subsequently suffered.

Those who reviewed the data saw that the EFIS pilots who better managed the automation also had better flying skills. While the data did not reveal whether those skills preceded or followed automation, it did indicate that automation management needed to be improved. Recommended "best practices" and procedures have remedied some of the earlier problems with automation.

Pilots must maintain their flight skills and ability to maneuver aircraft manually within the standards set forth in the PTS. It is recommended that pilots of automated aircraft occasionally disengage the automation and manually fly the aircraft to maintain stick-and-rudder proficiency. It is imperative that the pilots understand that the EFD adds to the overall quality of the flight experience, but it can also lead to catastrophe if not utilized properly. At no time is the moving map meant to substitute for a VFR sectional or low altitude en route chart.

Equipment Use

Autopilot Systems

In a single-pilot environment, an autopilot system can greatly reduce workload. *[Figure 2-23]* As a result, the pilot is free to focus his or her attention on other flight deck duties. This can improve situational awareness and reduce the possibility of a CFIT accident. While the addition of an autopilot may certainly be considered a risk control measure, the real challenge comes in determining the impact of an inoperative unit. If the autopilot is known to be inoperative prior to departure, this may factor into the evaluation of other risks.

For example, the pilot may be planning for a VHF omnidirectional range (VOR) approach down to minimums on a dark night into an unfamiliar airport. In such a case, the pilot may have been relying heavily on a functioning autopilot capable of flying a coupled approach. This would free the pilot to monitor aircraft performance. A malfunctioning autopilot could be the single factor that takes this from a medium to a serious risk. At this point, an alternative needs to be considered. On the other hand, if the autopilot were to fail at a critical (high workload) portion of this same flight, the pilot must be prepared to take action. Instead of simply being an inconvenience, this could quickly turn into an emergency if not properly handled. The best way to ensure a pilot is prepared for such an event is to carefully study the issue prior to departure and determine well in advance how an autopilot failure is to be handled.

Familiarity

As previously discussed, pilot familiarity with all equipment is critical in optimizing both safety and efficiency. If a pilot is unfamiliar with any aircraft systems, this will add to workload and may contribute to a loss of situational awareness. This level of proficiency is critical and should be looked upon as a requirement, not unlike carrying an adequate supply of fuel. As a result, pilots should not look upon unfamiliarity with the aircraft and its systems as a risk control measure, but instead as a hazard with high risk potential. Discipline is key to success.

Figure 2-22. *Two similar flight decks equipped with the same information two different ways, analog and digital. What are they indicating? Chances are that the analog pilot will review the top display before the bottom display. Conversely, the digitally trained pilot will review the instrument panel on the bottom first.*

Figure 2-23. *An example of an autopilot system.*

Respect for Onboard Systems

Automation can assist the pilot in many ways, but a thorough understanding of the system(s) in use is essential to gaining the benefits it can offer. Understanding leads to respect, which is achieved through discipline and the mastery of the onboard systems. It is important to fly the aircraft using minimal information from the primary flight display (PFD). This includes turns, climbs, descents, and being able to fly approaches.

Reinforcement of Onboard Suites

The use of an EFD may not seem intuitive, but competency becomes better with understanding and practice. Computer-based software and incremental training help the pilot become comfortable with the onboard suites. Then the pilot needs to practice what was learned in order to gain experience. Reinforcement not only yields dividends in the use of automation, it also reduces workload significantly.

Getting Beyond Rote Workmanship

The key to working effectively with automation is getting beyond the sequential process of executing an action. If a pilot has to analyze what key to push next, or always uses the same sequence of keystrokes when others are available, he or she may be trapped in a rote process. This mechanical process indicates a shallow understanding of the system. Again, the desire is to become competent and know what to do without having to think about, "what keystroke is next." Operating the system with competency and comprehension benefits a pilot when situations become more diverse and tasks increase.

Understand the Platform

Contrary to popular belief, flight in aircraft equipped with different electronic management suites requires the same attention as aircraft equipped with analog instrumentation and a conventional suite of avionics. The pilot should review and understand the different ways in which EFD are used in a particular aircraft. *[Figure 2-24]*

The following are two simple rules for use of an EFD:

- Be able to fly the aircraft to the standards in the PTS. Although this may seem insignificant, knowing how to fly the aircraft to a standard makes a pilot's airmanship smoother and allows him or her more time to attend to the system instead of managing multiple tasks.
- Read and understand the installed electronic flight systems manuals to include the use of the autopilot and the other onboard electronic management tools.

Managing Aircraft Automation

Before any pilot can master aircraft automation, he or she must first know how to fly the aircraft. Maneuvers training remains an important component of flight training because almost 40 percent of all GA accidents take place in the

Figure 2-24. *Examples of different platforms. Top to bottom are the Beechcraft Baron G58, Cirrus SR22, and Cirrus Entega.*

landing phase, one realm of flight that still does not involve programming a computer to execute. Another 15 percent of all GA accidents occurs during takeoff and initial climb.

An advanced avionics safety issue identified by the FAA concerns pilots who apparently develop an unwarranted over-reliance in their avionics and the aircraft, believing that the equipment will compensate for pilot shortcomings. Related to the over-reliance is the role of ADM, which is probably the most significant factor in the GA accident record of high performance aircraft used for cross-country flight. The FAA advanced avionics aircraft safety study found that poor decision-making seems to afflict new advanced avionics pilots at a rate higher than that of GA as a whole. The review of advanced avionics accidents cited in this study shows the majority are not caused by something directly related to the aircraft, but by the pilot's lack of experience and a chain of poor decisions. One consistent theme in many of the fatal accidents is continued VFR flight into IMC.

Thus, pilot skills for normal and emergency operations hinge not only on mechanical manipulation of the stick and rudder, but also include the mental mastery of the EFD. Three key flight management skills are needed to fly the advanced avionics safely: information, automation, and risk.

Information Management

For the newly transitioning pilot, the PFD, MFD, and GPS/VHF navigator screens seem to offer too much information presented in colorful menus and submenus. In fact, the pilot may be drowning in information but unable to find a specific piece of information. It might be helpful to remember these systems are similar to computers that store some folders on a desktop and some within a hierarchy.

The first critical information management skill for flying with advanced avionics is to understand the system at a conceptual level. Remembering how the system is organized helps the pilot manage the available information. It is important to understanding that learning knob-and-dial procedures is not enough. Learning more about how advanced avionics systems work leads to better memory for procedures and allows pilots to solve problems they have not seen before.

There are also limits to understanding. It is generally impossible to understand all of the behaviors of a complex avionics system. Knowing to expect surprises and to continually learn new things is more effective than attempting to memorize mechanical manipulation of the knobs. Simulation software and books on the specific system used are of great value.

The second critical information management skill is stop, look, and read. Pilots new to advanced avionics often become fixated on the knobs and try to memorize each and every sequence of button pushes, pulls, and turns. A far better strategy for accessing and managing the information available in advanced avionics computers is to stop, look, and read. Reading before pushing, pulling, or twisting can often save a pilot some trouble.

Once behind the display screens on an advanced avionics aircraft, the pilot's goal is to meter, manage, and prioritize the information flow to accomplish specific tasks. Certificated flight instructors (CFIs), as well as pilots transitioning to advanced avionics, will find it helpful to corral the information flow. This is possible through such tactics as configuring the aspects of the PFD and MFD screens according to personal preferences. For example, most systems offer map orientation options that include "north up," "track up," "DTK" (desired track up), and "heading up." Another tactic is to decide, when possible, how much (or how little) information to display. Pilots can also tailor the information displayed to suit the needs of a specific flight.

Information flow can also be managed for a specific operation. The pilot has the ability to prioritize information for a timely display of exactly the information needed for any given flight operation. Examples of managing information display for a specific operation include:

- Program map scale settings for en route versus terminal area operation.
- Utilize the terrain awareness page on the MFD for a night or IMC flight in or near the mountains.
- Use the nearest airports inset on the PFD at night or over inhospitable terrain.
- Program the weather datalink set to show echoes and METAR status flags.

Enhanced Situational Awareness

An advanced avionics aircraft offers increased safety with enhanced situational awareness. Although aircraft flight manuals (AFM) explicitly prohibit using the moving map, topography, terrain awareness, traffic, and weather datalink displays as the primary data source, these tools nonetheless give the pilot unprecedented information for enhanced situational awareness. Without a well-planned information management strategy, these tools also make it easy for an unwary pilot to slide into the complacent role of passenger in command.

Consider the pilot whose navigational information management strategy consists solely of following the magenta line on the moving map. He or she can easily fly into geographic or regulatory disaster, if the straight-line GPS course goes through high terrain or prohibited airspace, or if the moving map display fails.

A good strategy for maintaining situational awareness information management should include practices that help ensure that awareness is enhanced, not diminished, by the use of automation. Two basic procedures are to always double-check the system and verbal callouts. At a minimum, ensure the presentation makes sense. Was the correct destination fed into the navigation system? Callouts—even for single-pilot operations—are an excellent way to maintain situational awareness, as well as manage information.

Other ways to maintain situational awareness include:

- Perform verification check of all programming. Before departure, check all information programmed while on the ground.
- Check the flight routing. Before departure, ensure all routing matches the planned flight route. Enter the planned route and legs, to include headings and leg length, on a paper log. Use this log to evaluate what has been programmed. If the two do not match, do not assume the computer data is correct, double check the computer entry.
- Verify waypoints.
- Make use of all onboard navigation equipment. For example, use VOR to back up GPS and vice versa.
- Match the use of the automated system with pilot proficiency. Stay within personal limitations.
- Plan a realistic flight route to maintain situational awareness. For example, although the onboard equipment allows a direct flight from Denver, Colorado, to Destin, Florida, the likelihood of rerouting around Eglin Air Force Base's airspace is high.
- Be ready to verify computer data entries. For example, incorrect keystrokes could lead to loss of situational awareness because the pilot may not recognize errors made during a high workload period.

Automation Management

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 in order to avoid potentially dangerous distractions when flying with advanced avionics, the pilot must know how to manage the course deviation indicator (CDI), the navigation source, and the autopilot. It is important for a pilot to know the peculiarities of the particular automated system being used. 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.

For example, 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 another good place to practice the callout technique, especially after arming the system to make a change in course or altitude.

In advanced avionics aircraft, proper automation management also requires a thorough understanding of how the autopilot interacts with the other systems. For example, with some autopilots, changing the navigation source on the e-HSI from GPS to LOC or VOR while the autopilot is engaged in NAV (course tracking mode) causes the autopilot's NAV mode to disengage. The autopilot's lateral control will default to ROL (wing level) until the pilot takes action to reengage the NAV mode to track the desired navigation source.

Risk Management

Risk management is the last of the three flight management skills needed for mastery of the glass flight deck aircraft. The enhanced situational awareness and automation capabilities offered by a glass flight deck airplane vastly expand its safety and utility, especially for personal transportation use. At the same time, there is some risk that lighter workloads could lead to complacency.

Humans are characteristically poor monitors of automated systems. When asked to passively monitor an automated system for faults, abnormalities, or other infrequent events, humans perform poorly. The more reliable the system, the poorer the human performance. For example, the pilot only monitors a backup alert system, rather than the situation that the alert system is designed to safeguard. It is a paradox of automation that technically advanced avionics can both increase and decrease pilot awareness.

It is important to remember that EFDs do not replace basic flight knowledge and skills. They are a tool for improving flight safety. Risk increases when the pilot believes the gadgets compensate for lack of skill and knowledge. It is especially important to recognize there are limits to what the electronic systems in any light GA aircraft can do. Being PIC requires sound ADM, which sometimes means saying "no" to a flight.

Risk is also increased when the pilot fails to monitor the systems. By failing to monitor the systems and failing to check the results of the processes, the pilot becomes detached from the aircraft operation and slides into the complacent role of passenger in command. Complacency led to tragedy in a 1999 aircraft accident.

In Colombia, a multi-engine aircraft crewed with two pilots struck the face of the Andes Mountains. Examination of their FMS revealed they entered a waypoint into the FMS incorrectly by one degree resulting in a flight path taking them to a point 60 NM off their intended course. The pilots were equipped with the proper charts, their route was posted on the charts, and they had a paper navigation log indicating the direction of each leg. They had all the tools to manage and monitor their flight, but instead allowed the automation to fly and manage itself. The system did exactly what it was programmed to do; it flew on a programmed course into a mountain resulting in multiple deaths. The pilots simply failed to manage the system and inherently created their own hazard. Although this hazard was self-induced, what is notable is the risk the pilots created through their own inattention. By failing to evaluate each turn made at the direction of automation, the pilots maximized risk instead of minimizing it. In this case, a totally avoidable accident become a tragedy through simple pilot error and complacency.

For the GA pilot transitioning to automated systems, it is helpful to note that all human activity involving technical devices entails some element of risk. Knowledge, experience, and mission requirements tilt the odds in favor of safe and successful flights. The advanced avionics aircraft offers many new capabilities and simplifies the basic flying tasks, but only if the pilot is properly trained and all the equipment is working as advertised.

Chapter Summary

This chapter focused on helping the pilot improve his or her ADM skills with the goal of mitigating the risk factors associated with flight in both classic and automated aircraft. In the end, the discussion is not so much about aircraft, but about the people who fly them.