Flight Instructor Training Module

For Inclusion in FAA-Approved Flight Instructor Refresher Clinics

Volume 2: System Safety Course Developers' Guide

Flight Standards Service
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Table of Contents

Introduction

Safety is one of the most fundamental considerations in flight training. Every flight instructor can agree that safety is paramount, and everyone wants to be safe. But what does "safety" really mean? How can a flight instructor not only ensure the safety of flight training activities, but also train clients to operate their aircraft safely after they leave the relatively protected flight training environment?

According to one definition, safety is the freedom from those conditions that can cause death, injury, or illness; damage to/loss of equipment or property, or damage to the environment. Regulations are intended to promote safety by eliminating or mitigating conditions that can cause death, injury, or damage. These regulations are comprehensive, but there has been increasing recognition that even the strictest compliance with regulations may not be sufficient to guarantee safety. Rules and regulations are designed to address known or suspected conditions detrimental to safety, but in any system – defined as the combination of people, procedures, equipment, facilities, software, tools, materials that operate in a specific environment to perform a specific task or achieve a specific purpose – there is a high probability that some new combination of circumstances not contemplated by the regulations will arise.

Objective

The recognition of aviation training and flight operations as a system leads to a "system approach" to aviation safety. Since flight instructors are a critical part of the aviation safety system, this module seeks to:

- Introduce the basic concepts of system safety, including risk management; and
- Help flight instructors teach flight training clients to use practical risk management tools in their own flying activities.

System Safety

As noted above, a system is the combination of people, procedures, equipment, facilities, software, tools, materials that operate in a specific environment to perform a specific task or achieve a specific purpose. Flight training and flight operations clearly constitute complex systems with many variables. Pilots have different levels of knowledge, skill, experience, ability, and discipline. Procedures (e.g., instrument approaches) can be very complex. Equipment – both airframes and avionics – is changing rapidly. Facilities (e.g., airports and airspace) vary widely. The flight environment, which includes weather, is also a critical factor in the safety of every flight.

Regulations are intended to address safety considerations and conditions in these areas, and they provide a vital foundation for aviation safety. The problem is that while the regulations offer comprehensive treatment of individual issues, they are simply not designed to cover the nearly infinite number of possible hazards and combinations of hazards that can undermine safety. In this respect, the regulations alone are like bricks without mortar.

The system safety approach provides the mortar needed to bind the individual bricks together and prevent accidents. System safety is the "application of special technical and managerial skills in a systematic, forward-looking manner to identify and control hazards throughout the life cycle of a project, program, or activity." Put another way, system safety is a "compliance-plus" approach that builds on existing regulations and procedures to create a stronger safety structure. To the extent that activities associated with this approach become ingrained as individual and corporate habits, they help create a "safety culture" mentality in which shared values and beliefs about safety become part of an organization's structures and control systems – "how we do business here." An effective safety culture includes a commitment to safety, shared perceptions about safety, and good communication.

Risk Management

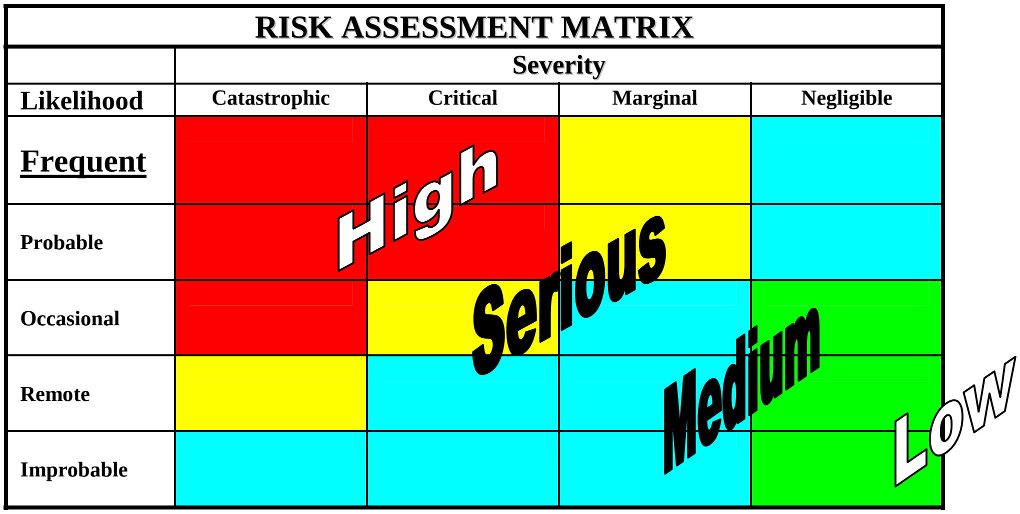
Concepts, Definitions, and Principles

A key part of the system safety approach –one that should be practiced by every pilot before every flight – is risk management (RM). RM is a decision-making process designed to systematically identify hazards, assess the degree of risk, and determine the best course of action. A few key definitions are in order before we continue:

- A hazard is a present condition, event, object, or circumstance that could lead to or contribute to an unplanned or undesired event. For example, a ¼" nick in the propeller represents a hazard.

- Risk is the future impact of a hazard that is not controlled or eliminated.

As shown in the matrix below, the level of risk posed by a given hazard is measured in terms of severity (extent of possible loss), and probability (likelihood that a hazard will cause a loss). (*Note: Although not shown directly on the matrix, exposure (number of people or resources affected) can also be considered in risk assessment*.) The hazard described above – a ¼" nick in the propeller – poses a risk only if the airplane is flown. If the damaged prop is exposed to the constant vibration of normal engine operation, there is a high risk is that it could fracture and cause catastrophic damage to the engine and/or airframe (not to mention the occupants of the aircraft). As illustrated on the chart below, the level of risk can be assessed as "low," "medium," or "high."



The four fundamental principles of operational risk management (RM) recognize that all human activities – especially those involving technical devices or complex processes -- entail some element of risk.

Accept no unnecessary risk.

Flight training is not possible without risk, but unnecessary risk comes without a corresponding return. With a brand-new instrument student, for example, you may determine that the risk of conducting the training in instrument meteorological conditions (IMC) outweighs the potential benefit that s/he might gain from the experience.

Make risk decisions at the appropriate level.

Risk decisions should be made by the person who can develop and implement risk controls. Since you are training students to act as pilot-in-command, you should give them the opportunity to learn and practice risk management on every flight by asking them to identify hazards, assess risks, and implement risk controls.

Accept risk when benefits outweigh dangers (costs).

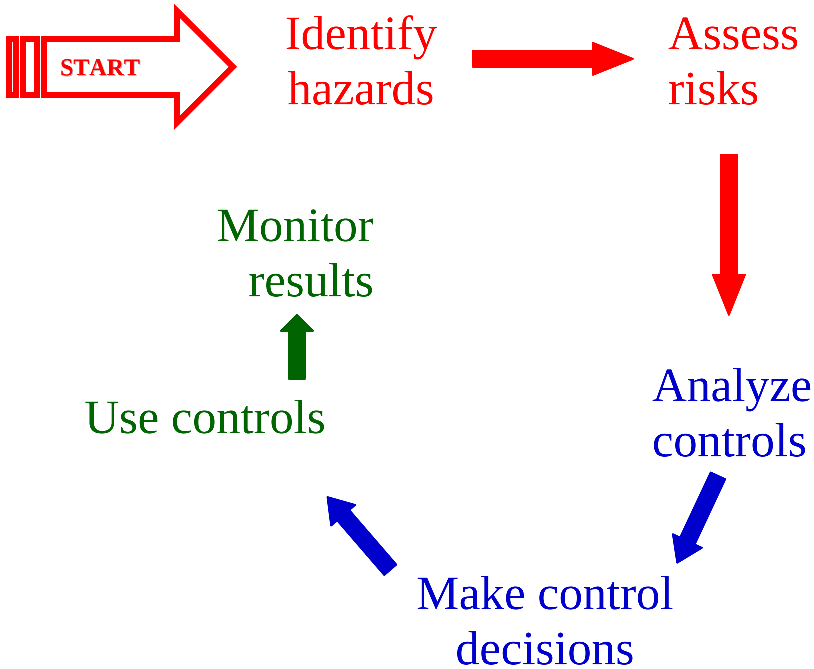
In any flight training program, it will be necessary to accept some degree of risk. With an advanced instrument student, for example, you may determine that the benefits of training in IMC outweigh the potential dangers (costs) – a determination you should make only after careful assessment of the risk and implementation of appropriate risk controls.

Integrate risk management into planning at all levels.

Because risk is an unavoidable part of every flight, safety requires the use of appropriate and effective risk management before every flight.

Risk Management Process

So how do you practice risk management? The goal of RM is to proactively identify safety-related hazards and mitigate the associated risks. The formal RM decision-making process involves six steps:



Depending upon the nature of the activity and the time available, risk management processing can take place in any of three timeframes.

	Strategic	*Deliberate*	*Time-Critical*
Purpose	Used in a complex operation (e.g., introduction of new equipment); involves research, use of analysis tools, formal testing, or long term tracking of risks.	Uses experience and brainstorming to identify hazards, assess risks, and develop controls for planning operations, review of standard operating or training procedures, etc.	"On the fly" mental or verbal review using the basic risk management process during the execution phase of an activity.

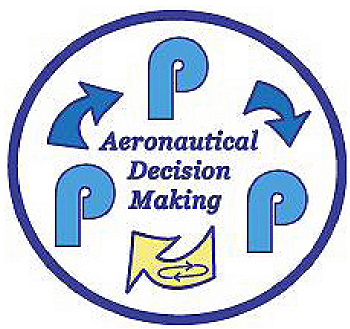
Practical Risk Management Tools

Now that you have a basic understanding of risk management, we can turn to a set of practical risk management tools that you can use and teach. 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.

Time-Critical Risk Management

Most flight training activities take place in the "time-critical" timeframe for risk management. The following model combines the six formal steps of RM into an easy-to-remember and easy-to-use "3P" model for practical risk management: **P**erceive, **P**rocess, **P**erform.

1. ***PERCEIVE*** hazards (what factors and conditions might create risk?) by using the ***PAVE*** checklist.



3. ***PERFORM*** by implementing controls and monitoring results with ***CARE***.

2. ***PROCESS*** hazards to assess the level of risk involved and use the ***TEAM*** list to determine risk controls

PAVE Checklist (to identify hazards and personal minimums)

Pilot	experience, recency, currency, physical and emotional condition
Aircraft	fuel reserves, experience in type, aircraft performance, aircraft equipment (e.g., avionics)
en***V***ironment	airport conditions, weather (VFR & IFR requirements), runways, lighting, terrain
External pressures	allowance for delays and diversions; alternative plans, personal equipment

TEAM Checklist (to choose and implement risk controls)

Transfer	Should this risk decision be transferred to someone else (e.g., do you need to consult the chief flight instructor?)
Eliminate	Is there a way to eliminate the hazard?
Accept	Do the benefits of accepting risk outweigh the costs?
***M*itigate**	What can you do to mitigate the risk?

CARE Checklist (to review hazards and risks while en route)

Consequences	Continuously evaluate the consequences (risks) of hazards that arise while en route
Alternatives	Continuously evaluate all available options and alternatives
Reality	Acknowledge and address the reality of your situation (weather, aircraft, etc), and avoid wishful thinking
External pressures	Be mindful of external pressures, especially tendencies toward "get-home-itus."

Deliberate Risk Management

Although most of your risk management activities are likely to fall into the "time-critical" sphere, you should also encourage your flight training clients to practice deliberate risk management. As noted above, deliberate RM uses brainstorming to identify hazards and assess risks. In addition to helping identify hazards for the 3P practice of time-critical RM, the PAVE Checklist can be used for such deliberate risk management tasks as:

- Helping pilots identify hazards, assess risks, and establish individual risk controls in the form of tailored personal minimums for various operations.
- Brainstorming "what-if" scenarios for events such as an extended cross-country or journey to an unfamiliar location.
- Transitioning to a new aircraft and/or new avionics, including portable GPS devices.

<u>Example - Real World Risk Management</u>

Let's look at a real-world example of how you might actually use the 3P model to guide decisions on a cross-country trip.

Step 1 – Perceive hazards.

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

<u>Aircraft</u>: 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.”

<u>enVironment</u>: 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 VMC prior to her arrival. Enroute weather is VMC, but there is an AIRMET Sierra for pockets of IMC over mountain ridges along the proposed route of flight.

<u>External Pressures</u>: Gayle is making the trip to spend a weekend with relatives she doesn’t see very often. Her family is very excited and has made a number of plans for the visit.

Step 2 – Process to determine risk and decide risk controls.

<u>Pilot</u>: Gayle’s inexperience and lack of recent flight time create medium risk of an accident, primarily because she plans to travel over mountains on a hazy day and land at an unfamiliar mountain airport that is still IMC. Risk control options:

- **<u>TRANSFER</u>** the risk entirely by having another pilot act as PIC.
- **<u>ELIMINATE</u>** the risk by canceling the trip.
- **<u>ACCEPT</u>** the risk and fly anyway.
- **<u>MITIGATE</u>** the risk by flying with another pilot.

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

<u>Aircraft</u>: This area presented low risk: the aircraft is in excellent mechanical condition, and Gayle is familiar with its avionics. Risk control options:

- **<u>TRANSFER</u>** Had there been a problem with this aircraft, Gayle might have transferred risk by using a different airplane.
- **<u>ELIMINATE</u>** the risk by canceling the trip.
- **<u>ACCEPT</u>** the risk.

- **MITIGATE** the risk through review of aircraft performance and careful preflight inspection.

enVironment: Hazy conditions and mountainous terrain clearly created medium risk for an inexperienced VFR-only pilot. Risk control options:

- **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 has to 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 ETE, 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 enroute. Finally, Gayle should review and practice basic functions on her hand-held GPS.

External Pressures: Family expectations can create risk of a pressure from a "get-there" mentality. Risk control options:

- **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 might 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, she should also establish a specific point in the trip – for example, an enroute 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 can manage her family's expectations by advising them that she will call when she arrives.

Step 3– Perform by flying with CARE

Consequences: Throughout the flight, Gayle should review the status of each PAVE element. She must pay close attention to weather, using Flight Watch monitoring ATIS and AWOS frequencies along the route.

Alternatives: Gayle did her preflight homework on alternatives to the planned destination, and performs risk management enroute by using Flight Watch to ensure that these airports were still available to her.

Reality: When she reaches the VORTAC that she had previously established as the continue/divert decision point, Gayle recognizes that destination weather is not improving as forecast. On the contrary, she encounters a combination of thickening haze and building clouds. Rather than hope for better conditions and continue toward rising terrain, Gayle accepts the reality, turns toward the alternate, and advises Flight Service of the change to her VFR flight plan.

External Pressures: Gayle knew in advance that rental cars were available at the alternate airport, so she is not influenced by fear of being stranded. Since she has managed her family's expectations by declining to provide an estimated arrival time, she avoids the pressure of rushing herself in order to keep them from waiting at the airport and worrying about her late arrival.

Forming Good Safety Habits

As you may have noticed, the 3P model is not all that different from what you may have been doing all along. So why use it at all? Here are two reasons. First, the 3P model gives your students a structured, efficient, and systematic way to identify hazards, assess risk, and implement effective risk controls. Second, practicing risk management needs to be as automatic in general aviation flying as basic airplane control. As is true for other flying skills, risk management thinking habits are best developed through repetition and consistent adherence to specific procedures. In the increasingly complex aviation system, we owe it to the pilots we train to equip them with tools to practice this vital skill.

Glossary of System Safety & Risk Management Terms

Exposure: the number of personnel or resources affected by a given event or, over time, by repeated events. [back]

Hazard: a real or potential condition, event, or circumstance that could lead to or contribute to an unplanned or undesired event. A hazard exists in the present. [back]

Mishap: an unplanned event, or series of events, that results in death, injury, occupational illness, or damage or loss of equipment or property.

Probability: the estimate of the likelihood that a hazard will cause a loss (frequent, likely, occasional, seldom, unlikely). [back]

Process: a set of tasks, workflows, and information flows that produce a desired result. A process defines how work is done, how results are achieved, and how value is provided. [back]

Risk: an expression of the impact of an undesired event in terms of event severity and event likelihood. A risk exists only in the future. [back]

Risk analysis: involves developing a preliminary hazards list; creating a risk statement, determining the extent of hazard, estimating likelihood and severity.

Risk assessment: process of identifying hazards and quantifying or qualifying the degree of risk they pose for exposed individuals, populations, or resources. This process involves sorting, combining, prioritizing risks and documenting priorities/risk information.

Risk control measures. Specific strategies that reduce, mitigate, or eliminate one or more of the three risk components (probability of occurrence, severity of hazard, exposure of people and equipment).

Risk management: iterative activity ensuring that risk is identified and eliminated or controlled within established program risk parameters. The four basic principles of risk management are: (a) accept no unnecessary risk; (b) make risk decisions at the appropriate level; (c) accept risks when benefits outweigh costs; and (d) integrate risk management into planning at all levels. Levels of risk management include time critical, deliberate, and strategic. [back]

Safety: the freedom from those conditions that can cause death, injury, or illness; damage to/loss of equipment or property, or damage to the environment. [back]

Safety Decision Process: involves five steps: (a) accurately identify hazards; (b) assess risk involved; (c) determine if risk is acceptable; (d) determine if risk can be eliminated; and (e) look for ways to reduce risk. [back]

Severity: the estimate of the extent of loss that is likely (catastrophic, critical, marginal, or negligible). [back]

System: the combination of people, procedures, equipment, facilities, software, tools, materials that operate in a specific environment to perform a specific task or achieve a specific purpose. [back]

System Safety: the application of special technical and managerial skills in a systematic, forward-looking manner to identify and control hazards throughout the life cycle of a project, program, or activity. [back]

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