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NWCG Standards for Aviation Risk Management

PMS 530 May 2021

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The *NWCG Standards for Aviation Risk Management* establishes a common reference for terms, processes, and tools utilized in applying Risk Management to aviation operations. Risk Management is a systems-oriented process for identifying and controlling hazards across the full spectrum of missions, functions, operations, and activities conducted to meet organizational goals. It is a process that assists decision makers in reducing or offsetting risk and making decisions that weigh risks against mission or activity benefits. Risk Management must be fully integrated into planning, preparation, and execution at all levels. Acceptable risk is often related to gain; therefore, decision makers weigh risk against the benefits to be gained from an operation or activity. A decision maker's judgment balances the requirement for mission success with the inherent risks. This system-oriented process was developed to organize and standardize the systems of Risk Management that support decision makers and operators to achieve mission success while meeting key Risk Management goals:

- Create a safety culture where every member is trained to recognize risk by identifying and managing hazards in aviation activities.
- Integrate Risk Management into all facets of mission and activity planning, preparation, and execution ensuring decisions are based upon risk assessments of the mission or activity.
- Enhance mission effectiveness at all levels, while protecting assets, and safeguarding health, and welfare.
- Achieve proficiency in applying Risk Management so that it is an automatic response of the daily decision-making process.

The National Wildfire Coordinating Group (NWCG) provides national leadership to enable interoperable wildland fire operations among federal, state, tribal, territorial, and local partners. NWCG operations standards are interagency by design; they are developed with the intent of universal adoption by the member agencies. However, the decision to adopt and utilize them is made independently by the individual member agencies and communicated through their respective directives systems.

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Introduction

According to National Transportation Safety Board (NTSB) statistics, in the last 20 years, approximately 85 % of aviation accidents have been caused by pilot error. Many of these accidents are the result of the tendency to focus on the physical aspects of flying the aircraft, which is the responsibility of the pilot, and ignoring Risk Management.

Aircraft Accident: An occurrence associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage. (NTSB Definition)

The risks involved with flying are quite different from risk that is experienced while performing daily activities. Managing these risks requires a conscious effort of constant evaluation and decision-making and following established standards and procedures. Personnel who make a habit of using Risk Management tools to identify, assess, and mitigate hazards associated with aviation operations, will find reduced levels of stress and improved success at meeting mission objectives. Aviation personnel are empowered to focus on the task at hand, resulting in a favorable outcome and greater productivity. Being supported at the risk level required to complete the mission can also lead to personnel success.

A key element of risk decision-making is determining if the risk is justified and worth the gain.

What is Risk Management?

Risk Management is a continuous and systematic process for identifying, assessing, and mitigating risk associated with hazards. Aviation operations are inherently complex, dynamic, and by nature dangerous. Risk Management begins with identifying what hazards, conditions that could foreseeably cause or contribute to an aircraft accident, may be encountered during the mission. Innately, aviation operations involve the acceptance of some level of risk. A decision maker's judgment balances the requirement for mission success with the inherent risks, as determined by the presence of hazards associated with conducting the mission. Risk is determined by the probability of a hazard causing a mishap and the severity of the mishap should it occur.

Probability: The chance of an event occurring; likelihood is often used interchangeably. However, probability is most often associated with looking forward towards events that may happen but have not.

Decision makers must weigh the risk against the benefits that will be gained from conducting the mission. Acceptable risk is often related to gain. Risk Management is a process that assists decision makers in reducing or offsetting risk and making Go/No-go decisions that weigh risks against the benefits of mission success. Risk Management is most effective when a systems-oriented process for identifying and mitigating hazards is applied as part of a larger process that informs and evaluates the overall system. Safety Management Systems (SMS) is a best practice that is accepted industry wide and helps to incorporate Risk Management into a larger safety system.

Acceptable Risk: The decision by the appropriate management official to authorize the operation without additional safety risk mitigation. Also referred to as Risk Acceptance.

Some key aspects of Risk Management include:

1. Risk Management assists decision makers by:
    a. Enhancing mission accomplishment.
    b. Supporting risk assessment when analyzing and comparing courses of action.
    c. Enhancing decision-making skills based on a reasoned and repeatable process.
    d. Providing improved confidence in mission success.
    e. Protecting personnel, systems, and support equipment by avoiding unnecessary risk.
    f. Providing adaptive processes for continuous feedback in the planning, preparation, and execution phases of operations.
    g. Identifying feasible and effective control measures where specific standards do not exist.
    h. Reviewing, communicating, and acknowledging the risk associated with the mission to all involved.
2. Risk Management does not:
    a. Replace rational and sound decision-making.
    b. Inhibit the decision maker and leader's flexibility, initiative, or accountability.
    c. Remove risk altogether or support a zero-defect mindset.
    d. Sanction or justify violating any law.
    e. Remove the necessity for training, tactics, techniques, and procedures.
    f. Override or supersede compliance with agency/bureau policy, OSHA standards, or applicable Federal Aviation Regulations.

Exemptions and waivers for policy, standards, and regulations **MUST** be properly vetted through appropriate agency/bureau approval.

What is a Safety Management System (SMS)?

The objective of a SMS is to provide structure and mechanism to mitigate risk and assure quality in operations. A formal system of hazard identification and safety Risk Management is essential in managing risk to acceptable levels. SMS is centered in an organized approach to hazard identification and Risk Management which provides for informed decision-making. SMS provides an organized approach to continually challenge the processes, the culture, and the systems to identify weaknesses that can be mitigated and support the greater purpose of mishap prevention.

The foundation of SMS consists of four components often referred to as Pillars. When fully implemented, SMS provides, and promotes a Positive Safety Culture. The desired positive safety culture is informed, flexible, learning, and a reporting culture that captures the operational knowledge and experience of the employees. One of the many goals of a SMS is to achieve a High Reliability Organization (HRO), an organization that conducts operations with inherent risk while maintaining fewer than their share of mishaps.

The four components of SMS are designed to organize aviation operations using a system that focuses on informing the whole organization while supporting the individual mission. The following make up the four components of SMS:

1. Safety Policy – Every type of management system must define policies, procedures, and organizational structures to accomplish its goals. An SMS must have policies and procedures in place that explicitly describe responsibility, authority, accountability, and expectations.
2. Safety Risk Management – A formal system of hazard identification and management is fundamental to managing risk to acceptable levels. A well-designed Risk Management system describes operational processes across departmental and agency boundaries, identifies key performance indicators and regularly measures them, methodically assesses risk, and exercises controls to mitigate that risk.
3. Safety Assurance – Once policies, processes, measures, assessments, and controls are in place, the organization must incorporate regular management review to assure safety goals are being achieved. Solid change management processes must be in place to assure the system can adapt.

Safety Assurance: Evaluates the continued effectiveness of implemented risk control strategies and supports the identification of new hazards. (FAA Definition)

4. Safety Promotion – The organization must continuously promote safety as a core value with practices that support a sound safety culture. Training, information delivery through alerts and bulletins, and positive reporting culture (i.e., SAFECOM) are all part of the Safety Promotion component of SMS.

One of the most challenging elements of SMS is the creation and nurturing of a positive safety culture, in which every person, from the top of the organization to the new hire, understands his or her role in maintaining a safe operation, and actively participates in controlling and minimizing risk. Creating a safety culture begins at the top of the organization, with the incorporation of policies and procedures that cultivate a reporting culture (where structures are in place that allow safety-related information to flow from all levels of the organization into a system empowered to correct problems) and a just culture (in which individuals are both held accountable for their actions and treated fairly by the organization). Maintaining a safety culture requires constant attention by every layer of management and every department within the organization. A central tenet of SMS is the realization that the safety department does not own safety, rather safety is owned by every employee.

Safety/Safe: The term Safety or Safe is often used to describe a situation free from danger, risk, or injury, or when there is certainty that objectives can be met with positive outcomes. Most work performed in aviation involves some form of risk. Risk Management seeks to reduce risk to manageable levels and recognizes that in most cases there is some residual risk. Therefore, most operations are never Risk Free or totally Safe. Application of Risk Management processes does not guarantee that negative outcomes will never occur, such as injuries, or property damage. As such, it is best not to confuse Risk Management process with subjective concepts such as Safe, (i.e., a mission could be conducted with poor or no Risk Management process in place and due to a successful outcome, the mission be labeled as Safe or Safely Completed).

Principles of Risk Management (RM)

The basic principles that provide a framework for implementing the Risk Management Process include:

Integrate Risk Management into all Phases of Missions and Operations

Integrate Risk Management into planning at all levels and as early as possible. This provides the greatest opportunity to make well informed risk decisions and implement effective risk controls. To effectivity apply Risk Management, personnel must dedicate time and resources to integrate Risk Management principles into planning, operational processes, and day-to-day activities. Risk assessments of operations and activities are most successful when they are accomplished in the normal sequence of events (i.e., pre-panning of a mission or activity) by individuals directly involved in the event, and not as a last minute or add-on process. The earlier the planning process starts, the better the outcomes. Any amount of pre-planning that can be accomplished, even in a time constrained environment, is better than no planning at all.

Accept No Unnecessary Risk

Unnecessary risk comes without a commensurate return in terms of benefits or available opportunities; it will not contribute meaningfully to mission or activity accomplishment and needlessly jeopardizes personnel or other assets. The most logical choices for accomplishing a mission are those that meet all mission requirements while exposing personnel and resources to the lowest acceptable risk; take only those risks that are necessary to accomplish the mission or task. However, we cannot and should not be completely risk averse; even high-risk endeavors may be undertaken when there is a well-founded basis to believe that the sum of the benefits exceeds the sum of the costs. Balancing benefits and costs are a subjective process and tied intimately with the factors affecting the mission or activity; therefore, personnel with prior knowledge and experience of the mission or activity must be engaged whenever possible in making risk decision to ensure a proper balance is achieved.

Accept Necessary Risk When Benefits Outweigh Costs

Compare all identified benefits to all identified costs. The process of weighing risks against opportunities and benefits helps to maximize unit capability. Even high-risk endeavors may be undertaken when decision makers clearly acknowledge the sum of the benefits exceeds the sum of the costs. Balancing costs and benefits may be a subjective process open to interpretation. Ultimately, the appropriate decision authority may have to determine the balance (i.e., is the risk worth the gain).

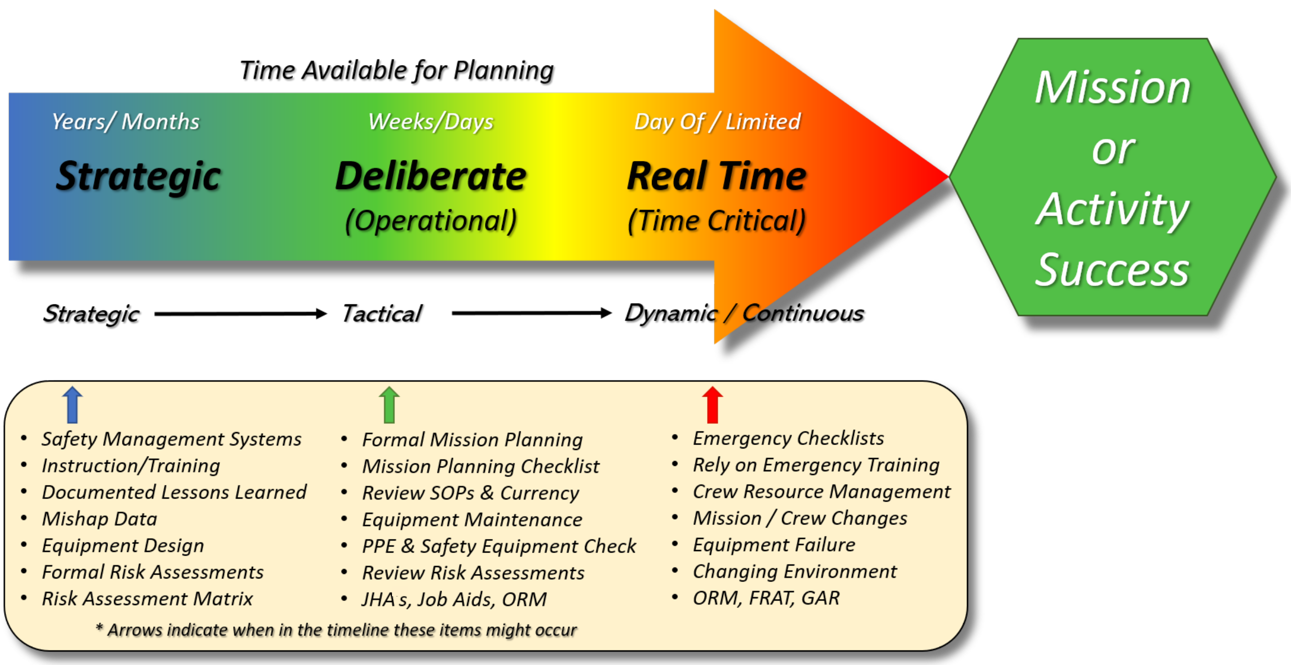
Make Risk Decisions at the Appropriate Level

Anyone can make a risk decision. However, the appropriate level for risk decisions is the person who can make decisions to eliminate or minimize the hazard, implement controls to reduce the risk, or accept the risk. Making risk decisions at the appropriate level establishes clear accountability. Personnel must be aware of how much risk they can accept and when to elevate Risk Management decisions to a higher level. Those accountable for the success or failure of the mission or activity must be fully engaged in the risk decision process. Risk decision policy and processes vary by agency/bureau. Personnel should be familiar with their agency/bureau policy regarding risk decision-making.

Levels of Risk Management

While it is desirable to apply Risk Management in-depth to every mission or task, time, and resources may not always be available. There are three primary levels of Risk Management (Strategic, Deliberate and Real-Time) that dictate the level of effort and scope that should be undertaken when assessing risk(s). Figure 1 depicts the basic relationship of these levels and how they relate across the strategic to tactical spectrums. The controls or resources and issues shown below the Risk Management Levels are examples of resources and impacts that might apply across the planning, preparation, and execution timelines. As the diagram shows, Strategic, Deliberate, and Real-Time Risk Management are interrelated when making Risk Management decisions; they are separated only at the point where the planning phase transitions to the execution phase of the mission or activity. A strong, effective Risk Management Process involves careful and deliberative planning coupled with effective, Real-Time Risk Management. This full spectrum approach ensures comprehensive risk mitigation and the likelihood of mission or activity success. A brief description of the individual Risk Management levels is provided below.

Figure 1: Relationship of Risk Management Levels



Strategic Risk Management

Strategic Risk Management refers to long-term planning for operations, activities, or systems. It follows the 5-Step Risk Management Process (see the Risk Management Process section). It focuses on the first three components of that process (identifying hazards, assessing hazards, and implementing controls). Strategic Risk Management is an in-depth strategic planning process involving hazard identification, detailed data research, diagram, and analysis tools, formal testing and evaluation, and long-term tracking of the risks associated with an operation, activity, or system. This type of Risk Management is typically done at a high level within the organization and applied through policy, Standard Operating Procedures (SOP), and formal guidelines. Components of Strategic Risk Management may be the foundation for Deliberate Risk Management, providing a framework, and reference to guide and direct operational planning. The risk assessments that make up the *NWCG Aviation Risk Management Workbook*, PMS 530-1, https://www.nwcg.gov/publications/530-1, are part of the Strategic Risk Management process. Those risk assessments are informed by in-depth study of previously conducted missions, activities, associated hazards, and successful mitigations that have helped to reduce the associated risks. Strategic Risk Management is a form of Deliberate planning, but the transition to Deliberate Risk Management comes once a mission or activity is scheduled to be implemented.

Deliberate Risk Management

Deliberate Risk Management refers to pre-mission or activity planning and normally involves the full formal application of the complete 5-Step Risk Management Process (outlined in the Risk Management Process Section). This process begins during the planning phase for a specific activity or mission and is typically found in normal day-to-day operations and activity planning. In-depth Risk Management planning is normally implemented well in advance of the target mission, event, or activity. As the situation, operation, or activity becomes less complex, familiar, and/or closer to execution, Deliberate Risk Management focus shifts to ensuring near-term hazards and mitigation strategies are considered. Across the spectrum of Deliberate Risk Management, we must always include the experience, expertise, and knowledge of experienced personnel to identify known hazards/risks and strategies to effectively mitigate risks for the specific mission or activity. Although pre-planning is always desired for any situation, we must also consider how we deal with Risk Management once we begin the execution phase of a mission or activity. This is where Real-Time Risk Management becomes necessary.

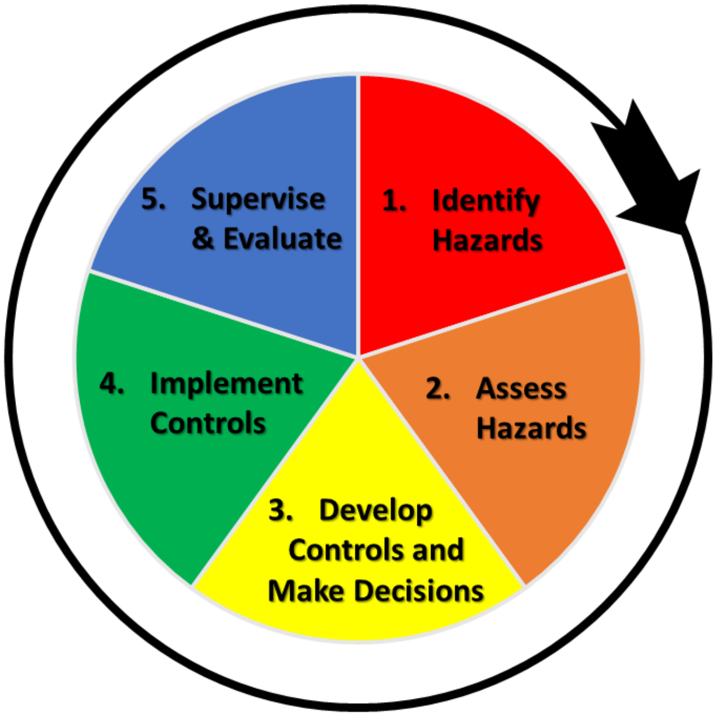
Real-Time Risk Management

This level of Risk Management is always associated with Risk Management decisions made in Real-Time during the execution or tactical phase of training, operations, or emergency or crisis response situations where there is normally little or no time to conduct Deliberate Risk Management. This level of Risk Management can also be used to supplement previously conducted Deliberate Risk Management. Real-time usually entails a cognitive risk assessment that is done on-the-fly using basic Risk Management process steps to identify and mitigate hazards in a new or changing situation. As time is normally constrained or limited in these situations, Deliberate Risk Management is impractical. Real-Time Risk Management may begin using Operational Risk Management (ORM) tools (e.g., GAR, FRAT, checklists) but execution of operations may limit the use of such tools. In Real-Time situations it is imperative that individuals can efficiently and effectively apply Risk Management concepts to mitigate unforeseen or unplanned for risks.

Risk Management Process

The Risk Management process consists of five steps that are applied continuously to make informed decisions regarding risk (Figure 2). These five steps define the formal Risk Management Process primarily associated with Deliberate Risk Management as well as the basis for Real-Time Risk Management considerations. Each step is presented along with a short narrative explaining its purpose. For a more detailed look into this 5-Step Risk Management Process refer to Appendix A.

Figure 2: 5-Step Risk Management Process



Step 1 – Identify the Hazards

This step of the process involves application of appropriate hazard identification techniques to identify hazards associated with the operation or activity. Hazards are defined as any real or potential condition that can cause mission degradation, injury, death to personnel, damage to, or loss of equipment. There are several risk models, widely accepted in aviation, that can assist in looking for potential hazards. Models like the 5Ms (Appendix C) and PEACE (Appendix B) risk models act like a checklist of items to consider when trying to identify potential hazards associated with a mission, activity, or flight profile.

Step 2 – Assess the Hazards

This step involves the application of quantitative and/or qualitative analysis methods to determine the probability and severity of consequences that may result from exposure to hazards and directly affect mission or activity success.

Step 3 – Develop Controls and Make Decision

Step three involves the evaluation of specific strategies and controls that reduce or eliminate hazards. Effective mitigation measures reduce one of the three components (probability, severity, or exposure) of risk. Risk mitigation decisions must be made at the appropriate level for the identified risk. The higher the risk, the higher the decision-level needs to be to ensure that an appropriate analysis of overall costs to benefits has been carefully weighed. It is critical that leadership or decision makers ensure that the levels of decision authority are aligned appropriately for mission requirements and experience levels of the personnel conducting operations or activities under their responsibility. Decision makers must ultimately choose the most mission-supportive risk measures, consistent with Risk Management principles that provide the best solution for the given hazards. Risk decisions should never be delegated to a lower level for convenience or when the situation dictates senior-level involvement; exceptions may be considered in time critical situations where delays might endanger lives, resources, or equipment. The process of developing and applying controls and reassessing risk continues until an acceptable level of risk is achieved or until all risks are reduced to a level where benefits outweigh the potential cost.

Control: A means to reduce or eliminate the effects of hazards. The terms Control, Mitigation, and Safety Risk Control are used synonymously.

Step 4 – Implement Controls

After selecting control measures, develop, and carry out an implementation strategy. The strategy must identify the who, what, when, where, and cost(s) associated with the control measure. For mission-related controls, emphasize accountability across all levels of leadership and personnel associated with the action so that there is clear understanding of the risks and responsibilities. There must always be accountability for acceptance of risk regardless of circumstances.

Step 5 – Supervise and Evaluate

Risk Management is a process that continues throughout the life cycle of the system, mission, or activity. Supervision ensures subordinates understand how, when, and where controls are implemented and determines the effectiveness of risk controls throughout the mission or task. Leaders and supervisors at every level must fulfill their respective roles in ensuring controls are sustained over time. Once controls are in place, the process must be periodically evaluated and reviewed to ensure controls remain effective and mission-supportive over time.

Risk Management Tools

There are many Risk Management tools available to support the Risk Management Process for both Deliberate and Real-Time Risk Management. The tools used by a crew or individual should support the Risk Management Process and achieving mission success. Personnel involved in the planning and execution of a mission or activity should select the right tools to support effective Risk Management. However, agency/bureau management may be prescriptive in which tools are required for personnel. This document does not supersede or give authority to the individual to stray from specific direction, guidance, SOP, or policy that is directed by agency/bureau management.

Risk Assessment Matrix (RAM)

The purpose of assessing hazards is to determine the risk level that the hazards pose so one can determine the need for mitigation and/or whether the mission or activity should continue. While there are numerous approaches to assess hazards, the RAM is arguably the most simplistic and often used approach. To assess risk, one needs to know three characteristics of the hazard:

- *Severity* – if the hazard results in a mishap, what are the potential consequences: for example, injury, property, loss.
- *Probability* – what is the likelihood that the hazard will result in a mishap; Unlikely, Likely, Almost Certain.
- *Exposure* – how often and/or how many people are in contact with the hazard.

The RAM consolidates the *exposure* characteristic into the probability evaluation. In other words, if the number of people exposed to the hazard or the frequency of contact with the hazard increases, the probability of the hazard resulting in a mishap also increases. While not mathematically precise, this consolidation is justified since the intent of the RAM is to provide a gross estimate of risk exposure. If risk exposure is determined to be extreme, more precise tools could be used to further assess the hazard.

Exposure: A term used to assess the amount of time a resource or a value is proximally in-a-position to be harmed by a hazard.

Table 1 shows the widely accepted RAM (this version has been accepted as a standard for NWCG). Columns represent probability information and rows represent severity information. The probability and severity scale levels contain some basic descriptors of the attributes to consider when making your selection. Since not all possible permutations can be represented, the user may need to generalize the category information for the event under analysis. Specifically:

- Columns designate the probability of a mishap associated with a given hazard ranging from Almost Certain to Rare. Probability may be determined through experienced-based estimates or derived from research, analysis, and evaluation of historical data from similar missions and systems. Supporting rationale for assigning a probability should be documented for future reference.
- Rows designate the severity of a possible consequence ranging from Catastrophic to Negligible. The severity of a consequence is expressed in terms of its potential impact on the mission, exposed personnel, and exposed equipment. Severity categories are defined to provide a qualitative measure of the worst credible outcome if a mishap occurs.

For any given hazard, select the appropriate severity level followed by the appropriate probability. For example, if you were evaluating the hazard, spilled oil on a shop floor, the severity might be Critical—if someone slips and hits their head on the concrete floor—and the probability might be Likely—since many people work in the shop and often carry or move objects that obstruct their field of view. To assess the risk level, one would begin at the Critical and Likely cells and move across the row and down the column until the paths cross. In the current example, the risk level, for spilled oil on shop floor is, Extremely High. Table 2, the associated Risk Assessment Code (RAC), indicates that Extremely High is a RAC value of 1, and shows the Action Required for each value, 1 through 4.

Table 1: Risk Assessment Matrix

RISK ASSESSMENT MATRIX			PROBABILITY				
			Likelihood of Mishap if Hazard is Present				
			Almost Certain (Continuously experienced)	**Likely** (Will occur frequently)	**Possible** (Will occur several times)	**Unlikely** (Improbable; but has occurred in the past)	**Rare** (Remotely possible; but highly improbable)
SEVERITY	Consequence if Mishap Occurs	**Catastrophic** (Death, Loss of Asset, or Mission Capability, or Unit Readiness)	Extremely High	Extremely High	Extremely High	High	Medium
		Critical (Permanent Disabling Injury or Damage, Significantly Degraded Mission Capability or Unit Readiness)	Extremely High	Extremely High	High	Medium	Medium
		Moderate (Non-Permanent Disabling Injury or Damage, Degraded Mission Capability, or Unit Readiness)	High	High	Medium	Low	Low
		Negligible (Minimal Injury or Damage, Little, or No Impact to Mission Capability or Unit Readiness)	Medium	Medium	Low	Low	Low
			Risk Assessment Codes (RAC)				
			Extremely High=1, High=2, Medium=3, Low=4				

Table 2: Risk Assessment Code

RAC Value	Risk Category	Action Required
1	Extremely High	Stop, Mitigation Required
2	High	Mitigation Needed, Consider Stopping
3	Medium	Mitigation Recommended
4	Low	Possible Acceptance, Mitigation Optional

The RAC quantifies the risk level associated with the hazard's probability and severity ratings. Risk can fall into one of four levels. Each of the four levels requires specific actions to mitigate. The RAC helps to prioritize hazards such that those that pose the greatest risk can be addressed first. Additionally, quantifying risk enables personnel to reconsider the impact of their mitigation efforts as they develop controls.

The following are some guidelines and cautions related to attempting to quantify risk.

1. A crew or individual may decide to dictate how to respond to the risk assessment defined by the RAM, including the thresholds at which decisions need to be made up the chain-of-command. To help ensure this doesn't happen, make sure that personnel are well informed of their decision-making authority.

2. It is difficult to assign a numerical value to human behavior. Numbers may oversimplify real life situations.
3. Numbers may take the place of reasoned judgment. Risk can be unrealistically traded off against benefit by relying solely on numbers. Numerical averages do not clearly define the stages of risk the mission may progress through. If during the mission you enter a High level of risk, which cannot be mitigated any lower using the Risk Management process, than the overall risk would remain High for the given mission.
4. RAM variables can be misrepresented, whether consciously expressed to get a particular outcome, or to reflect unhelpful subjective perspectives such as:
    a. Over-optimism – not being totally hones or not looking for root causes.
    b. Misrepresentation – individual perspective or experience distorts the data.
    c. Alarmism – the sky is falling, or worst-case estimates regardless of their probability.
    d. Indiscrimination – all information is given equal weight.
    e. Inaccuracy – inaccurate, incomplete, or misunderstood data is used.

The Risk Assessment Worksheet in the *NWCG Aviation Risk Management Workbook*, PMS 530-1, https://www.nwcg.gov/publications/530-1, can be used to organize and capture RAM assessment results. For any given mission and/or platform, ask yourself what can go wrong and why? Refer to Appendix A for more considerations when assessing risk.

General Assessment of Risk (GAR)

The GAR, often referred to as *Green-Amber-Red* due to the associated outcomes, can be used for both Deliberate and Real-Time Risk Management. Keep in mind the distinction between Deliberate and Real-Time is timing of the Risk Management not the tools or techniques that are used. Deliberate Risk Management is conducted with sufficient time to perform thorough analysis, while Real-Time Risk Management is conducted just prior to or during the mission or activity. GAR will support both Deliberate and Real-Time Risk Management. Keep in mind that GAR is simply a tool to evaluate hazards and assess risk. As you go through the Risk Management steps, GAR is used to standardize and document the analysis process. GAR is an important component of the Risk Management process but is not a wholistic replacement for Risk Management.

Several versions of the GAR model exist. Table 3 shows a version of the latest United States Coast Guard (USCG) GAR 2.0. The GAR and GAR 2.0 were both originally developed by the USCG and have been widely accepted as a standard. The GAR 2.0 is a convenient tool to capture the deliberations of the PEACE Risk Model (refer to Appendix B), and integration of Gain information to make warranted risk decisions. GAR 2.0 introduces the idea of Risk vs Gain when making the decision to accept residual risk when completing a mission or activity. GAR 2.0 uses the PEACE Risk Model, which is a memory aid for elements considered essential in the safe and effective execution of any mission. Core elements (e.g., PEACE, 5Ms) should be standardized to add consistency when completing a GAR. However, space should be included to add additional elements that can support specific mission functions.

Table 3: GAR 2.0

General Assessment of Risk – Version 2.0

Mission		**Date**		
Step 1: Identify, Assess, & Mitigate Risk Elements				
Instructions: To determine the level of risk for each element below, estimate the risk level based on the Low/Medium/High scale. If your perceived rating is Medium or High, explore mitigations. Draw a line through the risk zone that corresponds to the mitigated risk level and document the perceived risk(s) and mitigation(s) in the space provided.	**Rate Risk Zone**			
Planning – Enough time and information to conduct thorough pre-mission planning. Consider: response, completeness of mission info and on scene details. NOTES/MITIGATIONS:	**Complete** *L*	**Partial** *M*	**None** *H*	
Event – Refers to mission complexity. Consider: non-standard mission profile, coordinating multi-agency, not performed often. NOTES/MITIGATIONS:	**Low** *L*	**Moderate** *M*	**Extreme** *H*	
Asset – Pilot(s) – Proper number and skillset for mission. Consider: time w/ crew, familiarity w/ op area, fatigue. NOTES/MITIGATIONS	**Excellent** *L*	**Marginal** *M*	**Poor** *H*	
Asset – Crew – Proper number and skillset for mission. Consider: time w/ crew, familiarity w/ op area, fatigue, adequate supervision. NOTES/MITIGATIONS	**Ideal** *L*	**Marginal** *M*	**Limited** *H*	
Asset – Aircraft/Resource – Proper number and operational capabilities for mission. Consider: operational limitations, status of equipment. NOTES/MITIGATIONS	**Excellent** *L*	**Partial** *M*	**Poor** *H*	
***C**ommunications/Supervision* – Ability to maintain comms throughout mission. Consider: availability/quality of internal and external comms with command and adjoining units. NOTES/MITIGATIONS	**Ideal** *L*	**Marginal** *M*	**Poor** *H*	
***E**nvironment* – External conditions surrounding mission. Consider: weather, visibility, terrain, vegetation. NOTES/MITIGATIONS	**Ideal** *L*	**Marginal** *M*	**Poor** *H*	
*Other (unit specific element) –	________ *L*	________ *M*	________ *H*	
Step 2: Determine Overall Risk Level				
Consider: 1) the rating for each element above, 2) the importance of the element for mission execution, 3) how elements may interact. Rate the perceived **Overall Risk Level** when considering this information. Circle the final risk level:				
Low	***Medium***	***High***		

Step 3: Determine Risk vs. Gain: Do gains warrant the risk?

Step 3a. Enter the **Overall Risk Level** (Step 2 on prior page) in the **RISK** box below *(Low, Medium, or High)*.
Step 3b. Review definitions for Gain below and enter the level in the **GAIN** box below *(Low, Medium, or High)*.

Level of Gain

- Low – Situation with unclear benefits or a low probability for providing concrete results.
  Examples: non-essential passenger transport, non-critical logistics mission, public affairs flight.
- Medium – Situation that provides immediate and real benefits.
  Examples: saving property, protecting the environment, supporting critical ground operations.
- High – Situation that provides immediate and real benefits that if ignored could result in loss of life.
  Examples: Search and Rescue (SAR) and MEDEVACs, Extraction of personnel in compromised position.

______	VS	______
RISK (Low, Med, High)		**GAIN** (Low, Med, High)

Step 3c. Use the Risk vs Gain values from above and follow the column and row until they cross. The intersecting point is the recommended action.

Risk vs. Gain	High Gain	Medium Gain	Low Gain
Low Risk	**Accept the Mission** Monitor Risk Factors and re-evaluate if conditions or mission/activities change.	**Accept the Mission** Monitor Risk Factors and re-evaluate if conditions or mission/activities change.	**Accept the Mission** Monitor Risk Factors and re-evaluate if conditions or mission/activities change.
Medium Risk	**Accept the Mission** Monitor Risk Factors and re-employ Controls when available. Re-evaluate if conditions or mission change.	**Accept the Mission** Monitor Risk Factors and re-employ Controls when available. Re-evaluate if conditions or mission change.	**Accept the Mission Only with Approval from appropriate level** Communicate Risk vs. Gain to Chain-of-Command. Implement Controls and continuously evaluate conditions and mission for change.
High Risk	**Accept the Mission Only with Approval from appropriate level** Communicate Risk vs. Gain to Chain-of-Command. Implement Controls and continuously evaluate conditions and mission for change.	**Accept the Mission Only with Approval from appropriate level** Communicate Risk vs. Gain to Chain-of-Command. Implement Controls and continuously evaluate conditions and mission for change.	**DO NOT Accept the Mission** Communicate to Chain-of-Command. Wait until Risk Factors change, or Controls are available to warrant Risk exposure.

NOTES:

Using the GAR

There are two primary ways in which the GAR may be utilized. The choice of which method to employ is directly related to its utilization in Deliberative Risk Management vs Real-Time Risk Management. For Deliberative use the document is a method to work through the Risk Management process and record the overall risk of a planned project or operation. When using the GAR for Real-Time use there are several ways to employ the document. The following describes a beneficial method of using the GAR (widely accepted as best practice).

ORM, which is conducted just prior to and during the execution of the mission or activity, utilizes the GAR as a check of unit readiness. A selection of key members to the mission, to include the pilot, work through the questions of the GAR individually. The leader of the operation then conducts a conversation in which each component of the GAR is discussed, those who participated without influence of other mission members now share their rating. If the rating is similar across the group, then the leader moves on to the next component. If there are discrepancies, the leader will facilitate a conversation to address the differences. This is repeated for each component of the GAR. The benefit of conducting this type of GAR utilization is the various perceptions of the individual mission members are brought forward in a non-confrontational way. It allows for discussion regarding areas where mission members have concern and provides the opportunity to address those concerns before conducting the mission or activity.

> Example: Prior to conducting a Short-Haul rescue of an injured hiker, the team members conduct a GAR exercise. Following a thorough briefing of the mission on site, the pilot, spotter, short hauler, and crew member all complete the GAR individually. The spotter (Crew Lead) then conducts a discussion on each individual component of the GAR by starting with the first element, Planning. After reading the element context, the spotter shares his rating for this element and then goes around the group to each member (pilot, short hauler, crew member) for their rating of this element. When the group gets to the element, Asset – Crew, there is a discrepancy between ratings. The short hauler rates this element as High-Risk due to his own fatigue level. The group then discusses ways to mitigate the risk as perceived by the individual with the concern.

Flight Risk Assessment Tool (FRAT)

When implementing a SMS, one of the most critical components to develop is a FRAT. Because every flight has some level of risk, it is critical that pilots can differentiate, in advance, between a low-risk flight and a high-risk flight, and then establish a review process and develop risk mitigation strategies. A FRAT enables proactive hazard identification, is easy to use, and can visually depict risk. It is an invaluable tool in helping pilots make better Go/No-go decisions and should be made part of every flight operation whenever able.

Although designs can vary, FRATs generally ask a series of questions that help identify and quantify risk for a flight. A GAR utilized for Real-Time Risk Management is an example of a FRAT. There are additional examples available. Figure 3 provides another example of what a FRAT might look like.

Figure 3: Example FRAT

RISK ASSESSMENT

Pilot's Name ______ **Flight From** ______ **To** ______

SLEEP		
1. Did not sleep well or less than 8 hours	◯	2
2. Slept well	◯	0

HOW DO YOU FEEL?		
1. Have a cold or ill	◯	4
2. Feel great	◯	0
3. Feel a bit off	◯	2

WEATHER AT TERMINATION		
1. Greater than 5 miles visibility and 3,000 feet ceilings	◯	1
2. At least 3 miles visibility and 1,000 feet ceilings, but less than 3,000 feet ceilings and 5 miles visibility	◯	3
3. IMC conditions	◯	4

Column total ◯

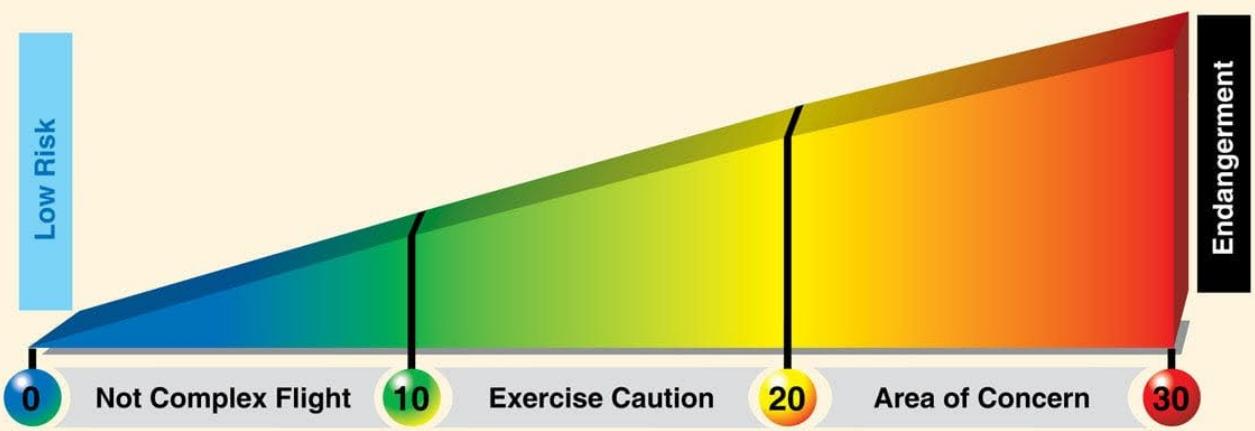
HOW IS THE DAY GOING?		
1. Seems like one thing after another (late, making errors, out of step)	◯	3
2. Great day	◯	0

IS THE FLIGHT		
1. Day?	◯	1
2. Night?	◯	3

PLANNING			
1. Rush to get off ground		◯	3
2. No hurry		◯	1
3. Used charts and computer to assist		◯	0
4. Used computer program for all planning	Yes	◯	3
	No	◯	0
5. Did you verify weight and balance?	Yes	◯	0
	No	◯	3
6. Did you evaluate performance?	Yes	◯	0
	No	◯	3
7. Do you brief your passangers on the ground and in flight?	Yes	◯	0
	No	◯	2

Column total ◯

LEFT COLUMN TOTAL ◯ **+ RIGHT COLUMN TOTAL** ◯ **= TOTAL SCORE** ______

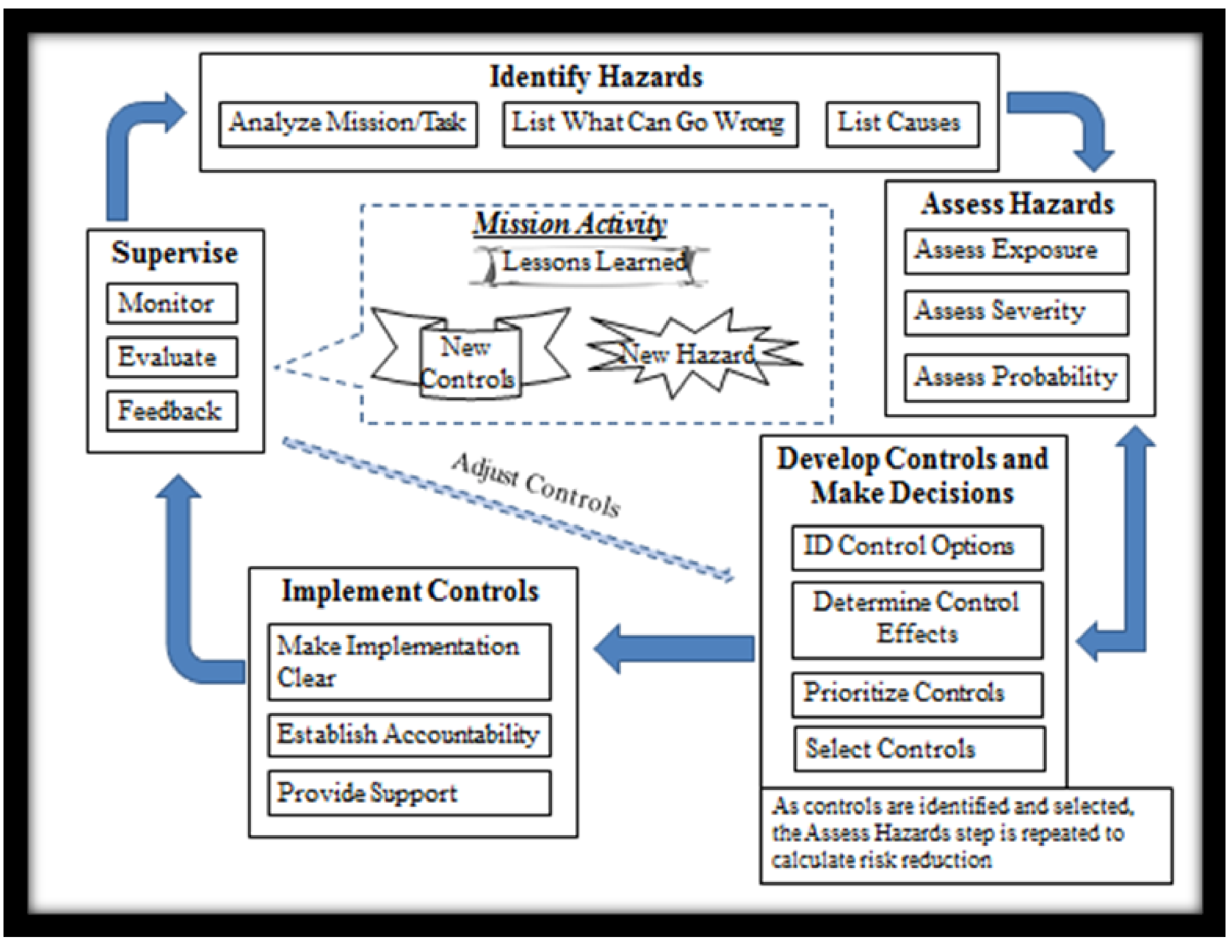


Appendix A – Risk Management Process and Operational Considerations

Background

Risk Management is a continuous and systematic process. Figure 4 depicts the 5-step process as a continuous cycle with feedback loops to reflect system adjustments to ineffective risk controls and unrecognized hazards. For example, evaluations during the Supervise step may determine that the controls selected are not producing the necessary effects to maintain safety or mission performance. Using this information, members can return to the Develop Controls and Make Decisions to explore other solutions for implementation. Additionally, mission activity may reveal lessons learned, New Controls, and/or New Hazards that can be used to refine the risk assessment and Risk Management process. The Risk Management process is very dynamic and flexible. However, a critical dependency of the Risk Management process is the need to have subject-matter experts and accomplished performers, individuals with extensive experience planning, performing, or supervising the mission or activity, contribute to the preliminary hazard identification, assessment, and control analysis. Without this contribution to the preliminary analysis from experienced personnel, members must rely on recognizing hazards during the conduct of the mission or activity and make the appropriate controls on-the-fly. This appendix discusses each step of the Risk Management process with an emphasis on techniques and tools to accomplish each step.

Figure 4: Risk Management Process Cycle



Step 1 – Identify Hazards

A hazard is a condition with the potential to cause injury, illness, or death of personnel; damage to or loss of equipment or property; or mission degradation. Hazard identification is the foundation of the entire Risk Management process; if a hazard is not identified it cannot be controlled. The effort expended in identifying hazards will have a multiplier effect on the impact of the total Risk Management process. There are three primary actions necessary to identify hazards: mission or task analysis; what can go wrong analysis; and list causes.

Action 1 – Mission or Task Analysis

This can be accomplished by:

1. Reviewing plans and documents describing the mission or activity.
2. Constructing a list or chart depicting the major phases of the operation or activity normally in time sequence.
3. Decomposing the operation or activity down into bite-size chunks.
4. Identifying specified & implied tasks.
5. Prioritizing significant events or activities.

Action 2 – What Can Go Wrong Analysis

For each of the task or mission elements identified in Action 1, ask, what can go wrong? For example, a what can go wrong, associated with the task climbing stairs, is that one can slip, trip, and/or fall. This analysis will reveal system deficits that can result in negative or undesirable consequences. The intent of this action is to identify potential undesirable consequences so that causes can be identified and corrected. Hazards are identified based on the mission or activity vulnerabilities. However, you must go beyond just identifying what can go wrong, it is necessary to understand what the primary causation is.

Action 3 – List Causes (Why Analysis)

For each of the consequences identified in Action 2, ask, “why did that consequence occur?” Continue to ask why until the root cause chain for the consequence is exhausted. For example, a negative consequence of the task, climbing stairs, mentioned above was slipping. A why for the slip might be a wet surface. However, the cause, wet surface, may be too general to offer specific controls so ask an additional why question. Why is the surface wet? Will offer more resolution for hazard control. The additional why question may reveal that the standing water was due to sloppy maintenance so effective hazard control must focus on improving maintenance procedures. Make a list of the causes, and why responses associated with each consequence identified in Action 2.

If time is limited and a thorough task analysis cannot be performed, use the PEACE Model (Planning, Event complexity, Asset selection, Communications, and Environmental conditions) to focus the analysis on critical mission or activity elements that can compromise safety and mission or activity success. As with the more Deliberate Risk Management approach above, ask what can go wrong for each of the elements in the PEACE Model (refer to Appendix B) to identify hazards in each of the following three categories:

Equipment

Is the equipment functioning properly and will it do so throughout the planned evolution? Has the equipment been tested and certified for the intended purpose? Are the users familiar and understand the capabilities of the equipment to be used? Is there a process in place to track equipment uses and age?

Environment

How will weather, geographic influences, physical barriers, workplace climate, reduced visibility, and available light affect the event?

Personnel

Are personnel properly trained and capable of handling the mission's demands? Are they fatigued, complacent, or suffering from physical or mental stress? Are they working in a team environment or in a vacuum when making critical decisions? Are the most experienced employees involved with the final decision?

Step 2 – Assess Hazards

Hazard assessment is the process which associates Hazards with Risk. Risk is the expression of possible loss due to the presence of hazards. Typically, risk assessments express the probability or likelihood that a hazard(s) will result in a mishap and the severity or consequence of the mishap.

Action 1 – Assess Hazard Severity

If the hazard leads to a mishap, what are the potential consequence(s) in terms of mission execution, personnel casualties, and equipment loss? Hazard assessment tools provide categories of severity that represent various degrees of consequence if a mishap were to occur.

Action 2 – Assess Hazard Probability

Use the RAM to combine the severity and probability estimates and compute risk exposure. While the RAM can provide a framework for computing risk exposure, the process relies heavily on prior experience to provide estimates of severity and probability. Most susceptible to inaccuracies is the probability estimate where long-term data do not exist for dynamic operation environments common to the operations. Due to the reliance on qualitative data, the RAM approach is susceptible to many pitfalls.

Risk Assessment Pitfalls

Try to avoid the following pitfalls during the assessment:

a. Over-optimism: "It can't happen to us. We're already doing it." This pitfall results from not being totally honest and not looking for root causes of the hazards.

b. Misrepresentation: Individual perspectives may distort data. This can be deliberate or unconscious.

c. Alarmism: The sky is falling approach, or worst-case estimates are used regardless of their possibility.

d. Indiscrimination: All data is given equal weight.

e. Prejudice: Subjectivity and/or hidden agendas are used instead of facts.

f. Inaccuracy: Bad or misunderstood data nullify accurate risk assessment.

g. Enumeration: It is difficult to assign a numerical value to human behavior.

(1) Numbers may oversimplify real life situations.

(2) It may be difficult to get enough applicable data; this could force inaccurate estimates.

(3) Numbers often take the place of reasoned judgment.

(4) Risk can be unrealistically traded off against benefit by relying solely on numbers.

Step 3 – Develop Controls and Make Risk Decisions

For each hazard identified, develop one, or more control options to mitigate the risk. The actions below describe the systematic process to Develop Controls and Make Decisions.

Action 1 – Develop Controls

For each hazard identified, develop one or more control options that either eliminate or reduce hazard risk to a level that is justified by mission or activity benefits. When exploring options to reduce risk, it is helpful to consider the three aspects of risk (probability, severity, and exposure). Reducing risk can be achieved through lowering the likelihood of the hazard causing a mishap, the severity of the consequence if a mishap occurs, or the percent of time or people exposed to the hazard.

While there are many types of controls that can be applied to hazards, they generally fall into five categories:

1. Engineering controls – These controls use engineering methods to reduce risks, such as developing new technologies or design features, selecting better materials, identifying suitable substitute materials or equipment, or adapting new technologies to existing systems.
2. Physical controls – These controls may take the form of barriers and guards or signs to warn individuals and units that a hazard exists. Use of personal protective equipment, fences around areas of hazards, and special controller or oversight personnel (i.e., marshaller, Helibase manager) responsible for locating specific hazards fall into this category.
3. Administrative controls – These controls involve administrative actions, such as establishing written policies, programs, instructions, and SOP, or limiting the exposure to a hazard either by reducing the number of personnel or length of time they are exposed to the hazard.
4. Educational controls – These controls are based on the knowledge and skills of the crews and individuals. Effective control is implemented through individual and collective training that ensures performance to standard.
5. Operational controls – These controls involve operation actions such as tempo of operations, trigger points, airspace control measures.

The standard order of precedence for controls is to first use design and engineering solutions to achieve minimum risk. Less desirable control options are to add safety devices, warning devices, or change procedures, and training. This order of preference makes perfect sense while the system is still being procured, contracted, or designed, but once the system is acquired this approach is frequently not cost effective. Redesigning to eliminate a hazard or add safety or warning devices can be both expensive and time consuming, and, until the retrofit is complete, the hazard remains unabated.

STAAR to Identify Control Options

When considering control options, there are various strategies that can be used to eliminate or reduce the risk from hazard. The Spread out, Transfer, Avoid, Accept, and Reduce (STAAR) mnemonic provides a simple and convenient aid to identify some approaches to eliminate or reduce risk.

The STAAR approach includes:

1. Spread out – Refers to the movement of crews, equipment, or tasks to other areas, in-order-to avoid risk to the entire mission.
2. Transfer – Risk may be reduced by transferring all or some portion of that mission or task, to another individual, crew, or platform that is better positioned, more capable, or does not have the same associated hazards. Transfer does not necessarily decrease the probability or severity of the risk. For example, the decision to fly an Unmanned Aerial System (UAS) instead of risking a manned aircraft is risk transfer. The risk still exists but the exposure to personnel is limited.
3. Avoid – It may be possible to avoid specific risk by going around them or doing the mission or task in a different way. For example, risks associated with weather may be avoided by planning for mission flexibility that would allow for better weather before executing the mission.
4. Accept – Accept risk when the benefits clearly outweigh the costs, but only as much as necessary to accomplish the mission or task.
5. Reduce – Reducing the number of individuals, equipment, or resources exposed to a hazard is a very simple way of mitigating overall risk. Although this strategy may reduce risk, it must be weighed carefully against potential rewards. Just as adding resources allows for probability of success, reduction can sometimes have the negative consequence of not having back-up options available when you need them or enough personnel or resources to accomplish the mission effectively and successfully.

Action 2 – Determine Control and Mitigation Effects

After identifying and selecting controls for hazards, assess the risk mitigation benefits of each control using the RAM introduced in Step 2. For each control, determine if, and/or how severity and probability levels are impacted if the control is used. The risk that remains after controls are implemented for the hazard is referred to as the Residual Risk.

Action 3 – Prioritize Risk Controls

For each hazard, prioritize those controls that will reduce the risk to an acceptable level. The ideal control option is to design-out a solution to permanently eliminate or reduce the severity or probability of the hazard. Less desirable is the use of safety or warning devices, procedure changes, or training that is dependent on personnel to apply the control reliably and consistently. Generally, revising operational, or support procedures may be the lowest cost control alternative. While this approach does not eliminate the hazard, it may significantly reduce the likelihood of a mishap or the severity of a mishap, and the change can usually be implemented quickly.

Action 4 – Select Risk Controls

For each identified hazard, select those risk controls that will reduce the risk to an acceptable level. The best controls will be consistent with mission or activity objectives and optimum use of available resources (manpower, material, equipment, funding, and time). Recording implementation decisions in some standardized format for future reference can assist in consistently applying controls to similar future missions or activities (refer to the *NWCG Aviation Risk Management Workbook*, PMS 530-1, https://www.nwcg.gov/publications/530-1).

Action 5 – Make Risk Decision

Analyze the level of risk for the operation with the proposed controls in place. Determine if the benefits of the mission or activity now exceed the level of risk the mission or activity presents. Be sure to consider the cumulative risk of all the identified hazards and the long-term consequences of the decision. After deciding to assume risk, record the factors (cost versus benefit information) involved in this decision. Documentation is important to provide future leaders and managers the steps necessary to mitigate or accept the hazard associated with the risk. This is critical to the success of Step 5 (Supervise, Evaluate, and Review) in the overall Risk Management process.

1. If the cost of the risk(s) outweighs the benefits, re-examine the control options to see if any new or modified controls are available. If no additional controls are identified, inform the next level in the chain-of-command that, based on the evaluation, the risk of the mission exceeds the benefits and should be modified.
2. If the benefits of the mission or activity outweigh the risk, with controls in place, determine if the controls can all be implemented at your level in the chain-of-command or if the decision should be elevated to a higher authority (as applicable). Remember that policy and not personal choice might dictate the decision to elevate the risk control decision; ensure you are aware of the policies and rules you are working under. If you cannot implement the decision at your level due to circumstances or policy, notify the chain-of-command, or others that can assist in the decision as appropriate for the situation.

Step 4 – Implement Controls

Once the risk control decision is made, personnel must be made available to implement the specific controls. Part of implementing controls is informing the personnel involved in the mission or activity of the Risk Management process results and subsequent decisions. Careful documentation of each step in the Risk Management process facilitates risk communication and the rational processes behind Risk Management decisions. This is where the use of the Risk Assessment Worksheet (RAW) can assist you in capturing the hazards, risk assessment, controls (or mitigations), and appropriate level of approval based on level of residual risk. Refer to the *NWCG Aviation Risk Management Workbook*, PMS 530-1, https://www.nwcg.gov/publications/530-1.

Action 1 – Make Implementation Clear

To make the implementation directive clear, consider using examples, providing pictures or charts, including job aids, etc. Provide a roadmap for implementation, a vision of the end state, and description of successful implementation. Present the control so it will be received positively by the intended personnel. This may require more than just recording the control and associated mitigated risk level.

Action 2 – Establish Accountability

Accountability is important to effective Risk Management. The accountable person is the one who makes the final decision (approves the control measures); therefore, the right person (appropriate level) must make the final decision. Clear assignment of responsibility for implementation of the risk control (mitigation) is required.

Action 3 – Provide Support

To be successful, the proper authority must support the risk controls. This support requires:

1. Providing the personnel and resources necessary to implement the control measures.
2. Designing in sustainability from the beginning.
3. Employing the control with a feedback mechanism that will provide information on whether the control (mitigation) is achieving the intended purpose.

Step 5 – Supervise and Evaluate

Supervision involves determining the effectiveness of risk controls throughout the operation. There are three aspects: monitoring the effectiveness of risk controls; evaluation to determine need for further assessment of all, or a portion of, the operation due to an unanticipated change; and feedback to capture lessons learned, both positive, and negative.

Action 1 – Monitor

Monitor the operation to ensure:

1. Controls are implemented correctly, effective, and remain in place.
2. Changes requiring further Risk Management are identified.
3. Action is taken to correct ineffective hazard controls and reinitiate the Risk Management process in response to new hazards.
4. Hazards and controls are reevaluated any time the personnel, equipment, or mission tasks change, or new operations are anticipated in an environment not covered in the initial Risk Management analysis.

Action 2 – Evaluate

The evaluation should consider whether the hazard controls used performed in line with expectations and what effect the control had on mission performance. It is difficult to evaluate or review the risk control by itself; therefore, the focus should be on the aspect of the mission performance the controls were designed to improve. For example, mission planning identified high temperature and low humidity operational conditions that could expose employees to heat stress-related illness. Propose ensuring that employees had access to coolers of chilled water. The evaluation activity should answer the following question: did the coolers of chilled water mitigate heat stress-related illness or discomfort, or did packing the coolers to the jobsite burden the employees and raise heat stress risk? After Action Reviews (AAR) or post mission debriefs should include a discussion of hazard mitigation strategies and an assessment of the efficacy of the controls (mitigations) used.

Action 3 – Feedback

An evaluation or review by itself is not enough; a mission feedback system must be established to ensure that the corrective or preventative action taken was effective and that any newly discovered hazards identified during the mission are analyzed and corrective action taken. Feedback informs all involved as to how the implementation process is working, and whether the controls were effective. The overall effectiveness of these implemented controls must also be shared with other organizations that might have similar risks to ensure the greatest possible number of people benefit. Feedback can be in the form of briefings, lessons learned, SAFECOMs (or SAFENETs), or recommended changes to the *NWCG Aviation Risk Management Workbook*, PMS 530-1, https://www.nwcg.gov/publications/530-1. Without this feedback loop, we lack the benefit of knowing if the previous forecasts were accurate, contained minor errors, or were completely incorrect.

Appendix B – PEACE Model

PEACE is a memory aid for elements considered essential in the safe and effective execution of any mission. Deficits or inefficiencies in these elements increases mission risk exposure. The objective of the Risk Management process is to identify, assess, and mitigate deficits in the PEACE elements to maintain mission risk level within safe limits.

The PEACE Model is an effective tool to conduct risk assessments and ensures that all critical mission elements are considered in the analysis. Each PEACE element is described below. For any mission, review tasks and activities to determine if and/or how each of the PEACE elements increase risk exposure. The GAR 2.0 uses the PEACE elements as a foundation for the risk assessment. The PEACE Model can be used as a mental model for any Deliberative or Real-Time Risk Management process used in preparation for or during the execution of a mission or activity.

Planning

Mission plans have a shelf-life and can be out-of-date shortly after getting underway for any number of reasons. Always anticipate possible deviations, especially if you suspect your information is incomplete. Questions about planning prompt you to consider problems that may come up as to the quality of the mission context-related information (mission and conditions). Consider what could go wrong with equipment, personnel, the environment, or mission if: (1) the team has incorrect or insufficient information, (2) the team has not clarified methods of performing key tasks, such as communication frequencies, and (3) roles are left unclear or unassigned.

Consider the following questions:

What could go wrong with equipment, personnel, the environment, or mission if:

1. You have incorrect or insufficient information?
2. Next steps are unclear or undefined?
3. Roles are unclear or not assigned?

Event Complexity

Event complexity depends on the amount of data, number of participants, and number of steps that must be performed with little margin for error. Each unit defines their own level of comfort with an evolution, typically based on their capabilities and recent experience. A break down in ability to process data or execute a series of activities correctly at the right time can lead to mishaps. Consider what could go wrong with equipment, personnel, or the environment if: (1) Coordination with other agencies, assets, or units breaks down, (2) The crew performs a series of finely tuned activities incorrectly, and (3) The crew is unable to continually monitor multiple dynamic data streams.

Consider the following questions

What could go wrong with equipment, personnel, or the environment if:

1. Coordination with other agencies, assets, or crews breaks down?
2. The crew performs a series of finely tuned activities incorrectly?
3. The crew is unable to continually monitor multiple dynamic data streams?

Assets

Specific assets may be associated with specific hazards for a given evolution. Assets include equipment, event platform performance tolerance thresholds, and personnel details such as experience and confidence.

Considering assets provides individuals the opportunity to apply their own subjective assessment. Are they stressed? Are they alert, confident? Consider what could go wrong with equipment of personnel if: (1) A platform is used in its current condition for the evolution, (2) The operational experience, fitness, and confidence of the crew is inadequate, and (3) The fitness level (e.g., rest, hydration, nutrition) of the crew is not satisfactory.

Consider what could go wrong with equipment, personnel, or the environment if:

1. A platform is used in its current condition for the evolution.
2. The operational experience, fitness, and confidence of the crew is inadequate?
3. The fitness level (e.g., rest, hydration, nutrition) the crew is not satisfactory?

Communication and Supervision

Poor communication and supervision can impair the crew's ability to maintain situational awareness and receive feedback and decisions (including making risk decisions at the appropriate level). Consider what could go wrong with equipment, personnel, the environment, or mission if: (1) The crew cannot communicate with the command center, and (2) There are communications problems amongst the crew.

Consider the following questions

What could go wrong with equipment, personnel, or the environment if:

1. The crew cannot communicate with Dispatch or Command Staff?
2. There are communications problems between the crew?
3. The crew is lacking cohesive and effective Crew Resource Management (CRM)?

Environment

Environment: How will weather, geographic influences, physical barriers, workplace climate, and available light affect the event? Consider what could go wrong with equipment, personnel, the environment, or mission given the: (1) Weather, (2) Visibility, (3) Airspace conflicts, (4) Terrain and Vegetation, and (5) Time of day.

Consider the following questions

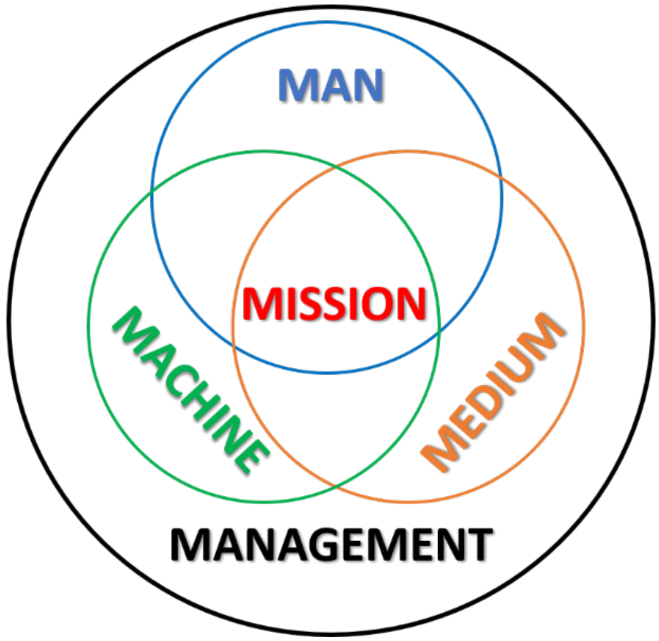
What could go wrong if there are changes in the:

1. Weather,
2. Visibility,
3. Airspace,
4. Terrain or Vegetation?

Appendix C – 5M Model

The 5M Model is a Risk Management model used in aviation safety. It is based on T.P. Wright's original work conducted at Cornell University, Man-Machine-Environment triad, which incorporates a diagram of three interlocking circles and one all-encompassing circle. The smaller circles are labeled *Man*, *Machine*, and *Medium*; the intersecting space in the middle, where they all meet, is labeled *Mission*, while the larger circle is labeled *Management* (see figure 5).

Figure 5: 5M Model Diagram



This model is useful when analyzing a project or system. The 5M Model enables a person to visualize the system and how the various parts come together during a mission or activity. Each of the elements interact in various ways during operations. The 5Ms are:

Man

The human element of the system or mission. This includes all personnel involved in direct support of the aviation operation being conducted. From dispatchers to on site managers, ramp personnel, aircrew, and pilots. Each area in which a person interacts with the flight operation is part of the Man.

Machine

Any hardware or software that is used to conduct the mission. This is not limited to just the aircraft. It could include equipment and hardware used to support the mission. It would also include any software (e.g., radio, GPS, flight tracking) used to support the aircraft or mission. This includes the design, manufacture, maintenance, reliability, and performance of any equipment and/or aircraft.

Medium

This refers to the environment that the system is operating in. It includes weather, terrain, obstructions, lighting conditions, and any other environmental factor that could affect the system during the mission.

Management

This component of the 5M Model involves setting policy, rules, regulations, and providing resources for the operation and maintenance of a system. These are the variable factors that are established by management which may affect the way a system operates or can operate. This also considers the financial component of the 5M Model. These are not specifically present during the operation but may heavily influence the way in which a mission is conducted.

Mission

The mission is the central purpose behind *Man*, *Machine*, and *Medium* coming together. Considerations like the activity or operation being conducted and the planning of that operation are a part of *Mission*. This is where the end result is considered, and success is defined.

When using 5M as a model for conducting risk analysis, it is best to look for potential hazards in each of the five areas that might prohibit the mission's success. There are many options for recording the hazards identified using this mental model. The intent is to provide an organized look at all aspects which affect the outcome of a specific operation or activity. The diagram shows how each of the 5Ms (*Man, Machine, Medium, Management, and Mission*) interact with one another and change the potential for hazards to be present which would affect the successful outcome of the operation or activity.

More information about the 5M Model can be found in these resources:

Commercial Aviation Safety (2012) Stephen Cusick, Alexander Wells, Clarence Rodrigues

Safety Management Systems in Aviation (2016) Alan J. Stolzer, John J. Goglia

The *NWCG Standards for Aviation Risk Management* is developed and maintained by the Aviation Risk Management Subcommittee (ARMS), under the direction of the National Interagency Aviation Committee (NIAC), an entity of the National Wildfire Coordinating Group (NWCG).

Previous editions: first.

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