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/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, etc.); *probability* (what is the likelihood that the hazard will result in a mishap; unlikely, likely, almost certain); and *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 would be used to further assess the hazard.

Figure 1 shows a typical RAM. 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 (A) "Almost Certain" to (E) "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 (I) "Catastrophic" to (IV) "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, or the Risk Assessment Code (RAC), for 'spilled oil on shop floor' is 1 or Extremely High. The RAC table the bottom of Figure 1 shows the Action Required for each RAC value.

RISK ASSESSMENT MATRIX				PROBABILITY				
				Likelihood of Mishap if Hazard is Present				
				A Almost Certain (Continuously experienced)	B Likely (Will occur frequently)	C Possible (Will occur several times)	D Unlikely (Remotely possible but not probable)	E Rare (Improbable; but has occurred in the past)
SEVERITY	Consequence if Mishap Occurs	Catastrophic (Death, Loss of Asset, Mission Capability or Unit Readiness)	I	1	1	1	2	3
		Critical (Permanent Disabling Injury or Damage, Significantly Degraded Mission Capability or Unit Readiness)	II	1	1	2	3	3
		Moderate (Non-Permanent Disabling Injury or Damage, Degraded Mission Capability or Unit Readiness)	III	2	2	3	4	4
		Negligible (Minimal Injury or Damage, Little or No Impact to Mission Capability or Unit Readiness)	IV	3	3	4	4	4
				Risk Assessment Codes (RAC)				
				1=Extremely High 2=High 3=Medium 4=Low				

Risk Assessment Codes (RAC)

RAC Value	Risk Category	Action Required
1	Extremely High	Stop, Immediate Correction
2	High	Consider Stopping, Urgent Correction
3	Moderate	Corrective Attention Needed
4	Low	Possible Acceptance

Figure 1. Risk Assessment Matrix (RAM).

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. Moreover, 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. Each unit will dictate how to respond to the risk assessment defined by

RAM, including the thresholds at which decisions need to be made up the chain of command.

2. It is difficult to assign a numerical value to human behavior. Numbers may oversimplify real life situations.
3. Numbers often take the place of reasoned judgment. Risk can be unrealistically traded off against benefit by relying solely on numbers.
4. RAM variables can be misrepresented, whether consciously expressed to get a particular outcome, or to reflect unhelpful subjective perspectives such as:

    - Over-optimism - not being totally honest or not looking for root causes
    - Misrepresentation - individual perspective or experience distorts the data
    - Alarmism - "the sky is falling" or "worst case" estimates regardless of their probability
    - Prejudice - subjective or hidden agendas are used instead of actual data
    - Indiscrimination - all information is given equal weight
    - Inaccuracy - inaccurate, incomplete or misunderstood data is used

The Hazards Assessment &Mitigation Worksheet on the next page 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"? For example, consider what can go wrong when conducting a tow using the 47MLB (see example below).

For this example, one possible "what can go wrong" with a tow is that the line can get fouled in the screws. The 'whys' for the line getting fouled include, too much slack in the line, displacement of the MLB, and line parting or snapping. For each 'why', one asks the question, "what is the potential severity (S) if the screws are fouled, and what is the probability (P) that the 'why' will result in fouling the screws? So, using the "slack in line", the Severity (S) is III (Moderate) and the Probability (P) is C (Possible). That is to say, if the "slack in line" results in fouling the screws, the potential severity is damage to asset and degradation of mission (Moderate) and the probability of a "slack in line" fouling screws is Possible, will occur several times. The Risk Assessment Code (RAC) for a hazard with a Severity of III and a Probability of C is 3 (follow row III and column C until they cross in the figure 3). As per the RAC table , bottom of figure 3, a RAC of 3 represents Moderate Risk and Corrective Action is Needed.

Following the risk assessment for "slack in line", the RAM can be used to explore mitigation strategies and the corresponding risk reduction value if the strategy is used. In the current example , some of the potential risk mitigation strategies to reduce/prevent "slack in line" include: monitoring line tension, and maintaining speed and heading. To assess the risk mitigation value, one calculates the S and P associated with each mitigation strategy. For example, if you use "monitoring line tension" would it reduce the Severity of a 'fouled screw' event? In this case, if the line fouls this mitigation would not reduce the Severity of the event. Could "monitoring line tension" reduce the Probability of fouling screws? Yes, this mitigation could reduce the Probability from Possible (C) to Unlikely (D). Repeat the S and P calculations for all potential mitigations. In the case of "monitoring line tension', using this mitigation can reduce the RAC

from 3 (slack line hazard without mitigation) to 4 (with monitoring line tension).

Hazard Assessment and Mitigation Worksheet

Platform	47MLB	Mission	Tow

Task	Towing sailboat
What can go wrong?	Tow line in screws

Why? (Hazard)	S	P	RAC
Too much slack in line	III	C	**3**
Mitigations	**S**	**P**	**RAC**
Monitor line tension	III	D	**4**
Maintain speed and heading	III	D	**4**
Why? (Hazard)	**S**	**P**	**RAC**
Displacement of MLB stern	III	C	3
Mitigations	**S**	**P**	**RAC**
Limit tows to less than XX seas	III	D	3
Monitor line orientation	III	D	3
Why? (Hazard)	**S**	**P**	**RAC**
Line parted or snapped	III	D	4
Mitigations	**S**	**P**	**RAC**
Inspect line for wear	III	D	4