“I always balk when people describe it (Saturation Diving) as being dangerous; Danger would infer we are incompetent. We are not. It is high risk, but at the same time we are good risk managers. That is an intrinsic part of the way we work.”

Sam McLeod, Saturation Diver
Risk is Intrinsic to Success

• Risk is an intrinsic part of military operations and modern life
  – We must be excellent risk managers to succeed
  – Management of risk must start knowing that mishap risks can exist even if all standards, specifications, and requirements are met

• The Goal is to ID risks and then eliminate the risk or reduce the probability to as near zero as possible within the bounds of Cost, Schedule and Performance

• Cost, Schedule and Performance Risk Drivers must be recognized by the System Safety Professional

• The System Safety Professional must be able to speak to Program/Project Managers (PM) in terms of they are familiar with
  – It is far easier to learn a language once than teach everyone you meet your language
• Three Mile Island

• Challenger

• USS Forrestal

• USS Thresher

• B-1 Bomber

• HUMVEE Design

• MRAP
ESOH and Programmatic Risk

John Mallino, MS, CSP
Linkedin.com/in/johnmallino
And
James Demacek, MS, CSP
Linkedin.com/in/jamesdemacek
Objectives

• Upon completion, attendees will be able to:
  1. Understand the difference between a risk, an issue and a mishap
  2. Understand the difference between a programmatic risk and a safety risk
  3. Understand how safety risks and programmatic risks complement one another
  4. Understand the benefit of writing safety risk mitigations as programmatic risks
  5. Understand the program office benefit of system safety risks

• Case Studies will allow attendees to:
  1. Write a well-defined Programmatic Risk
  2. Help Program Office understand total risk of trade space decisions.
Risk / Issue / Mishap

Understand the difference between a risk, an issue and a mishap
Programmatic Risk and Issue

• Risk – A measure of future uncertainties in achieving program performance goals within defined cost and schedule constraints.
  – Three components:
    • A future root cause,
    • A likelihood assessed at the present time of that future root cause occurring,
    • The consequence of that future occurrence.

• Issue – A problem or consequence which has occurred due to the realization of a root cause.
  – A current issue was likely a risk in the past that was ignored or not successfully managed

• Risk is classified into Programmatic Risk, ESOH Risk and Operational Risk
Programmatic Risk and Issue

• Once an event is no longer potential, but has happened in the past, or will happen in the future with no way to stop it, then the event isn’t a Risk, it’s an Issue

• Issue management: Cost increased, schedule delayed or performance decreased. Pick one or a combination the three.
  – Once an event is no longer potential, but has happened in the past, or will happen in the future with no way to stop it, then the event isn’t a Risk, it’s an Issue

  VS.

• Risk management: Planning allows for well thought out mitigations to be put in place. Reduces severity/impact if risk is realized. Allows identification and correction of root causes to eliminate the risk or prevent it from becoming an issue.
ESOH: Risk and Mishap

• **Risk:** A combination of the severity of the mishap and the probability that the mishap will occur
  – Three components:
    • Causal Factors
    • Hazards
    • Initiating Events

• **Mishap:** An event or series of events resulting in unintentional death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment
  – A mishap was a risk in the past that was ignored, not identified or identified but not successfully managed
Wave Over Side Risk Ignored
ESOH: Risk and Mishap Continued

- Once a mishap occurs the risk still exists

- **Mishap management:** Cost increased, schedule delayed or performance decreased. Pick one or a combination the three
  - Mishap management is the findings of post mishap investigations
  - Done after loss of equipment, injury or death
  - Reactive: fly, crash; redesign, add procedures, reduce performance, and then repeat: until crashes stop
  - Mishaps cause programmatic risks and issues

  **VS.**

- **Risk management:** Early identification, designed in safety features, well vetted procedures, controlled performance (until proven performance can be expanded)
  - ESOH risk management prevents programmatic risks and issues

- **Issue:** An issue is an event that if immediate corrective action is not taken a mishap will occur
Engine Flameout: Not Yet a Mishap
Programmatic Risk Vs. Safety (ESOH) Risk

Understand the difference between a programmatic risk and a safety risk
The Relationship Between Programmatic and ESOH Risk

- **Programmatic Risk**: Combined expression of the **likelihood** and **consequence** that a future event may negatively impact a program’s performance, schedule, or cost
  - High, Moderate, or Low

- **ESOH Risk**: Combined expression of the **probability** and **severity** that a future mishap will occur
  - High, Serious, Medium, or Low

The difference is seen when the risk becomes realized:
- **Programmatic**: Risk becomes an issue when it is realized and impacts cost, schedule or performance. The risk is no longer tracked in the program risk database. The negative impact of the issue normally drives other programmatic risks to be created or modified
- **ESOH**: Risk is a lifecycle concern that must be managed by the Fleet. When/if the risk is realized and it results in a mishap. However, it is NOT removed from the hazard tracking database. The risk is re-evaluated to determine other mitigations and accepted if required
Case Study One

James Demacek
Walk Through
10 Minute
Road Project
Programmatic Risk Cube &
882E Risk Assessment Matrix

Risk Cube

Risk Assessment Matrix

<table>
<thead>
<tr>
<th>Probability</th>
<th>Severity</th>
<th>Catastrophic (I)</th>
<th>Critical (II)</th>
<th>Marginal (III)</th>
<th>Negligible (IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent (A)</td>
<td>High</td>
<td>High</td>
<td>Serious</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Probable (B)</td>
<td>High</td>
<td>High</td>
<td>Serious</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Occasional (C)</td>
<td>High</td>
<td>Serious</td>
<td>Medium</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Remote (D)</td>
<td>Serious</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Improbable (E)</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Eliminated (F)</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>
What is the difference?

- Goal of Programmatic Risk Management is to push the risk to the origin of X/Y Axis
- Goal of System Safety is to eliminate the risk through design or lower the probability
- Once a Programmatic risk is mitigated to a non-factor or becomes an issue, then the risk is retired
- System Safety risk only goes away if it is eliminated or item retired
Same Risk Managed Different

Understand how safety risks and programmatic risks complement one another
Programmatic and ESOH Risks

• The same risk may be tracked as both a programmatic risk and an ESOH risk
  – Same risk different prospective
  – Programmatic risk is looking for impacts to cost, schedule or performance
  – Safety risk is looking for potential equipment damage, injury, death or environmental damage

• Example: Blue on Blue engagement of smart munition
  – Programmatic
    • Performance requirement to “Not fall short” or “Impact within 30 meters”
    • If Glide Ratio is not 1 to 5, then munition will not meet its maximum standoff firing distance requirement
  – ESOH
    • Safety requirement to ensure protection of forces on the ground
    • If Glide Ratio is not 1 to 5, then munition may fall short on friendly forces
Program and ESOH Risk Cube Plotting

Program Risk Cube

Safety Risk Cube

Glide Ratio

Noise

GPS

Maintenance & Sustainment
Waterfall Charts / Risk Burn Down

High
Serious
Medium
Low
Eliminate

TIME

Mitigation
Change / Mishap
Acceptance

ISSUE
EVENT
EVENT
EVENT
Case Study 2

James Demacek
Small Group
10 Minute
Engineer As Safe As Possible Within the bounds of Cost, Schedule and Performance.

- Mower Cost - $299.99
- On Sale by March
- Must Cut Grass

System Safety designs in safety features.
Layers on administrative controls when:
Cost, Schedule or Performance require safety risk to be present in final design.
Safety Is Not Free

Understand the benefit of writing safety risk mitigations as programmatic risks
ESOH Risk Mitigations May Be Programmatic Risks

• ESOH Risk Mitigations typically require resources, time and limit performance
  – When an ESOH risk is identified the first step is to attempt to eliminate the risk
    • Elimination of risk, generally, requires a design change
  – Use of MOGAS (gasoline) may result in out of control shipboard fire
    • If MOGAS is used, then host ship must be modified to allow MOGAS storage.
      » Cost — to meet shipboard stowage of MOGAS program must fund SHIPALT — $500,000 per ship
      » Schedule — SHIPALT process is 3 year lead time event
  – When an ESOH risk cannot be eliminated mitigations should be proposed
    • Mitigations may impact Cost, Schedule or Performance
  – GB-AB processor failure will cause munition to fall short, may impact friendly/non-hostile personnel, resulting in injury or death
    • If G-AB processor fails, then munition will fall in ballistic trajectory not meeting its maximum standoff distance requirement
      – Performance — will not meet 1 to 5 glide slope required to obtain maximum standoff distance
      – Performance — Legacy G-AA processor proven reliability
      – Performance — Legacy G-AA processor weighs 11 ounces more than G-AB processor
      – Cost — Adding redundant processor will cost $30K per munition
      – Cost — Using Legacy G-AA processor will save 20K per munition
      – Schedule — Redundant processor = five month delay
      – Schedule — Legacy processor = 3 month delay
Get to Yes

Understand the program office benefit of system safety risks
Programmatic Risk Statements

• PMs and Program Offices personnel speak in terms of Risk
  – Cost: Cost is an independent variable, Cost is locked
  – Schedule: Pushed to the right, Pulled to the left
  – Performance: Objective and Goals, Requirements

• Good Risk Statement is phrased in “IF”, “THEN” statements
  – If “THIS”, Then “That”: Impacts...
  – If new engine requires MOGAS, then host ships will require redesign
    • Cost: SHIPALTs are estimated to be $500K per ship
    • Schedule: SHIPALTs require three year lead time
    • Performance: Fuel quantities for deployments will be limited

• ESOH Risks may also be written in “IF”, “Then” statements
  – If engine requires MOGAS, then fire or explosion may occur
  – If engine requires MOGAS, then personnel may be exposed to toxic chemical
PMs Must Make Trade-Space Decisions

• When Programmatic risks become realized PM must decide which area of their trade-space must be modified
  – Engineers and Subject Matter Experts will all attempt to defend their reserve trade-space
  – Change to design will be proposed
  – Cost increase will be proposed
  – Performance change will be proposed
  – Schedule change will be proposed

• ESOH risk(s) must reviewed or generated for impact due to proposed changes

• ESOH risk(s) must be presented to PM in THE SAME package/brief as proposed change to manage programmatic issue

• Allows PM to understand the impact to safety caused by their trade-space decisions
Outcome of Trade-Space Decisions
Case Study 3

James Demacek
Small Group
10 Minute
Takata Airbag Recall

Determine the Programmatic Risks of Airbag Recall
Automotive airbags produced by Takata have been found to contain
dangerous defects contributing to multiple fatalities.

• What are the safety risks of the defective airbags?
• When did the programmatic risks become Issues?
• Identify programmatic risks that now result.
Review and Questions