A Common Risk Language

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Collaboration Effort – Need for Consistent Communication

- Two different cultures, two set of terms used
  - NASA
  - DOD
- Even within the same culture, individual programs may define terms differently due to the different backgrounds of the project personnel

*Having a common language is a key factor to implementing a successful risk management process*
Current Situation

- **Some terms are used consistently**
  - The same terms have similar definitions, so the potential for misuse is low

- **Some terms are not consistently used**
  - The same term has different or contradictory meanings
  - Multiple terms have similar meanings
  - Vaguely defined terms
  - Terms where the meaning is dependent upon the context (organizational, technical, or experiential context)
Consistently Used Terms

- A risk is usually described as:
  - The event causing the failure to achieve a set objective
  - The likelihood/probability of this event occurring
  - The consequences/impact of failing to achieve the objective

- Risk management
  - Is the act or practice of dealing with risk
Inconsistently Used Terms

• Risk type (group, category, etc.)
  – Examples include technical risks, cost risks, schedule risk, programmatic risks, mission risks, implementation risk
  – Unclear what benefits these groupings brings to the process

Is Risk Type a Useful Attribute of a Risk?
Inconsistently Used Terms (cont.)

- Mitigation, prevention, control, handling
  - Often used interchangeably to mean the same thing
  - Sometimes used to mean different things
  - Mitigation and prevention actions sometimes are broken down under handling
  - These words are also used also outside the context of risk management
  - Potential for misuse is high
  - Can be used either:
    - As an action to reduce the probability of occurrence of the risk causing event, OR
    - As an action to reduce the impact of the event

Are there any consequences to misusing these terms?
Inconsistently Used Terms (cont.)

- **Problems/Issues/Concerns**
  - Often poorly defined in terms of what action should be taken
  - These words are also used outside the context of risk management
  - The relationships among these terms – e.g. does a concern become an issue at some point, and then become a risk or a problem?

Is there any clarification and/or specificity to these terms that is helpful?
Inconsistently Used Terms (cont.)

• Severity
  – Often used in describing only the consequence if a risk is realized
  – Sometimes used in describing the rating of a risk as a function of (the probability of occurrence) x (the consequence of the risk)

Any other usages? Can we eliminate the use of this word from the risk management context?
Current Status

• Compiled some definitions within NASA and DOD programs
  - Terms that have a common usage require no change
  - Terms that cause confusion should be explicitly defined or eliminated from the vocabulary
  - Terms that cannot be changed should be clearly defined and the limits of the associated context (e.g. for the purposes of risk management)
Future Plans

- Sample additional NASA and DOD programs for term definitions
- Create a compilation of terms that can be used to standardize usage and/or translate risk terms

Your risk management terms, their definitions and associated context are solicited.
Backup Data Collected
Risk Definitions in different contexts

- DOD
- NASA
  - TeamX
  - Mars Science Laboratory
  - SMO
  - Mission Assurance Office
Common Definitions in the DoD world

- Risk is a measure of the potential inability to achieve overall program objectives within defined cost, schedule, and technical constraints and has two components:
  - (1) the *probability/likelihood* of failing to achieve a particular outcome, and
  - (2) the *consequences/impacts* of failing to achieve that outcome.
Common Definitions in the DoD world

• Risk events, i.e., things that could go wrong for a program or system,
  - are elements of an acquisition program that should be assessed to determine the level of risk.
  - The events should be defined to a level that an individual can comprehend the potential impact and its causes.
• For example, a potential risk event for a turbine engine could be turbine blade vibration. There could be a series of potential risk events that should be selected, examined, and assessed by subject matter experts.
Common Definitions in the DoD world

- Risk management is the act or practice of dealing with risk. It includes planning for risk, assessing (identifying and analyzing) risk areas, developing risk-handling options, monitoring risks to determine how risks have changed, and documenting the overall risk management program.
Common Definitions in the DoD world

- TECHNICAL RISK This is the risk associated with the evolution of the design, production, and supportability of the system affecting the level of performance necessary to meet the operational requirements. The contractor and subcontractors' design, test, and production processes (process risk) influence the technical risk and the nature of the product as depicted in the various levels of the Work Breakdown Structure (product risk). Process risks are assessed in terms of process variance from known best practices and potential consequences/impacts of the variance. Product risks are assessed in terms of technical performance measures and observed variances from established profiles.
Common Definitions in the DoD world

- **COST RISK** The risk associated with the ability of the program to achieve its life-cycle cost objectives. Two risk areas bearing on cost are (1) the risk that the cost estimates and objectives are accurate and reasonable and (2) the risk that program execution will not meet the cost objectives as a result of a failure to mitigate technical risks.

- **SCHEDULE RISK** These risks are those associated with the adequacy of the time estimated and allocated for the development, production, and fielding of the system. Two risk areas bearing on schedule risk are (1) the risk that the schedule estimates and objectives are realistic and reasonable and (2) the risk that program execution will fall short of the schedule objectives as a result of failure to handle cost, schedule, or performance risks.
Common Definitions in the DoD world

• RISK RATINGS
  – Low Risk: Has little or no potential for increase in cost, disruption of schedule, or degradation of performance. Actions within the scope of the planned program and normal management attention should result in controlling acceptable risk.
  – Moderate Risk: May cause some increase in cost, disruption of schedule, or degradation of performance. Special action and management attention may be required to handle risk.
  – High Risk: Likely to cause significant increase in cost, disruption of schedule, or degradation of performance. Significant additional action and high priority management attention will be required to handle risk.
What is risk? What is an issue or concern?

- Risk is defined as a triplet:
  - What can go wrong?
  - What is the likelihood?
  - What is the consequence (or impact)?
- It is anything that can prevent some requirement (or objective) from being satisfied.
- An Issue is an item under discussion or in dispute
- A Concern is an uneasy state of blended interest, uncertainty or apprehension.
- Issues and Concerns may turn into Risks, but aren’t necessarily so from the beginning.
What are the different types of risk?

- **Programmatic Risks:** Their consequence or impact can be:
  - Mission Cancellation.
  - Launch Slide.
  - Proposal not being considered further.
  - Budget Overrun

- **Technical Risk:** Engineering, Design, or Integration Issues that could result in:
  - Mission Failure
  - Degraded mission value
    - Degraded Science return
    - Degraded Technology demonstration.

- There is a likelihood and impact associated with each type of risk.

- The severity of the consequence depends on the phase in which the risk occurs.
Examples:

- MDS has never been used before – a concern.
- Using MDS can cause unpredictable software behavior.
- Unpredictable SW behavior can cause:
  - miscalculation of costs and schedule – a risk – it can prevent the cost and schedule requirements from being met.
  - Operating system to be less deterministic – therefore the Ground Systems will be unable to verify the paths that rover has taken – this could result in degraded science return and hence not meeting the science requirements – a risk!
Examples:

- Excessive cooling of propulsion system during descent – this is a concern
- This excessive cooling could cause the regulator to fail – a risk
  - If regulator fails, we could overpressure the tanks, causing a mission failure.
- Unclear whether there will be sufficient control if an engine goes out – a concern
  - If there isn’t sufficient control, this may result in uncontrolled landing – a risk – we’re not meeting the soft landing requirement.
More definitions

- Anomaly/Problem: A risk with a likelihood of 1; when we KNOW there is a problem for sure! (we know for sure that the battery during EDL is a single point of failure, and that is a problem, but we get waivers for it!)
- Prevention: The reduction of the likelihood of a risk. (We test the battery extensively to prevent it from failing.)
- Mitigation: The reduction of the impact of a risk. (We come up with fallback positions for some risk to reduce it’s impact if it happens.)
Risk Assessment Criteria

**Likelihood (summary definition)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Level Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (Very High)</td>
<td>&gt;70%, almost certain</td>
</tr>
<tr>
<td>4 (High)</td>
<td>&gt;50%, More likely than not</td>
</tr>
<tr>
<td>3 (Moderate)</td>
<td>&gt;30%, Significant Likelihood</td>
</tr>
<tr>
<td>2 (Low)</td>
<td>&gt;1%, Unlikely</td>
</tr>
<tr>
<td>1 (Very Low)</td>
<td>&lt;1%, Very unlikely</td>
</tr>
</tbody>
</table>

**Consequence (summary definition)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Mission</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Mission failure</td>
<td>Overrun reserves</td>
</tr>
<tr>
<td>4</td>
<td>Significant reduction</td>
<td>Consume all reserves</td>
</tr>
<tr>
<td>3</td>
<td>Moderate reduction</td>
<td>Sig. reduction in reserves</td>
</tr>
<tr>
<td>2</td>
<td>Small reduction</td>
<td>Small red. In reserves</td>
</tr>
<tr>
<td>1</td>
<td>Minimal (or no) impact</td>
<td>Min. reduction in reserves</td>
</tr>
</tbody>
</table>

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Risk Rating Criteria

- Risks are rated on a 5X5 matrix, using the previous definitions.