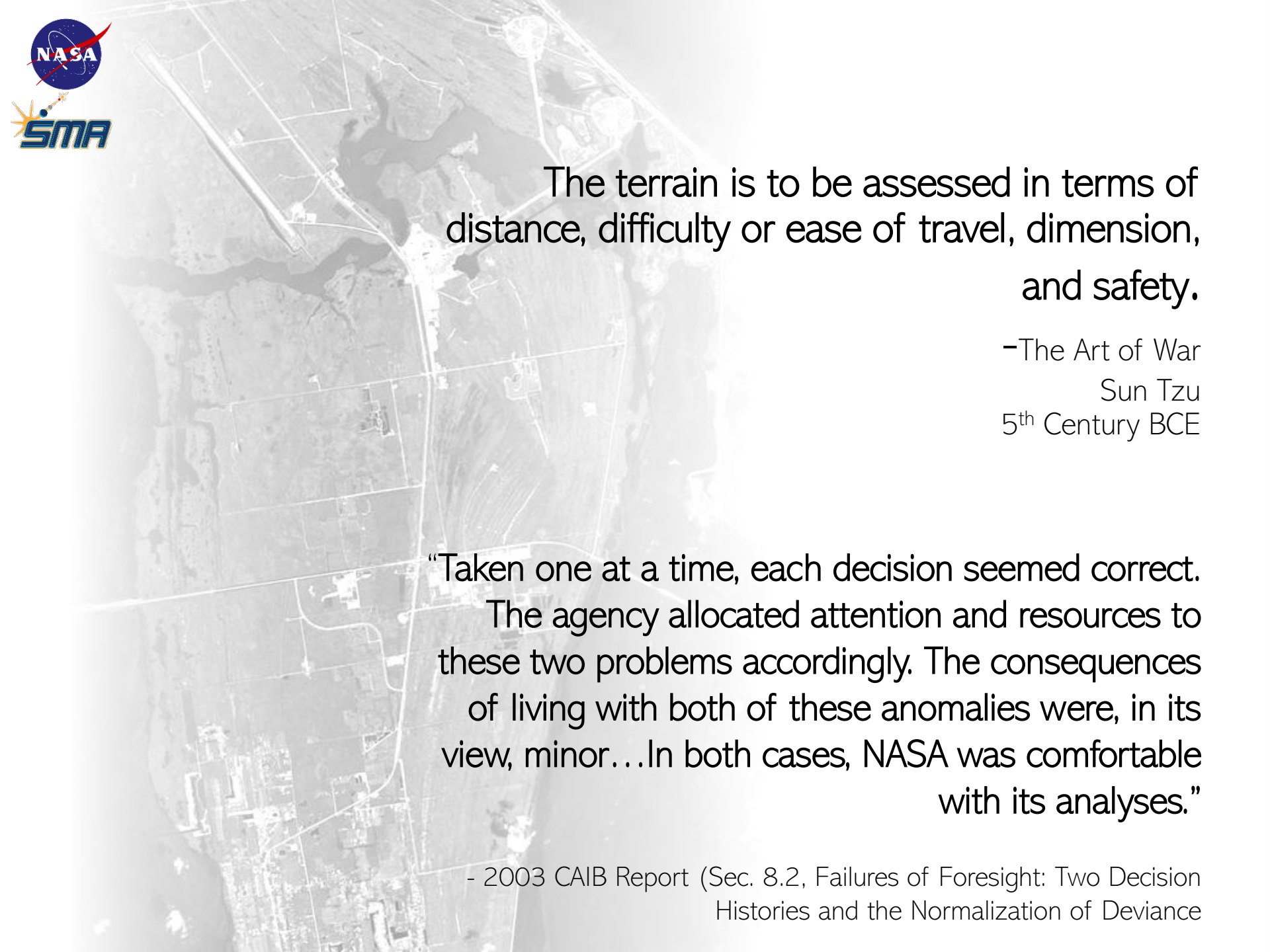
NASA Risk Management: Speaking in the Format of Risk

Taylor Dacko - NASA
Kennedy Space Center Risk Manager
Quality Leadership Forum – May 11th, 2020





The terrain is to be assessed in terms of distance, difficulty or ease of travel, dimension, and safety.

-The Art of War
Sun Tzu
5th Century BCE

"Taken one at a time, each decision seemed correct. The agency allocated attention and resources to these two problems accordingly. The consequences of living with both of these anomalies were, in its view, minor…In both cases, NASA was comfortable with its analyses."

- 2003 CAIB Report (Sec. 8.2, Failures of Foresight: Two Decision Histories and the Normalization of Deviance

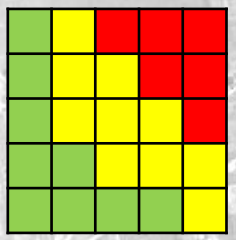
Today's Topics



Overview of Risk Management Principles

NASA's Risk Management Program





Risk Analysis and Communication

Why Risk Management?

NASA defines a risk as:

"the potential for performance shortfall… with respect to achieving explicitly established and stated goals, objectives, and performance requirements"



Probability of performance shortfall that is acceptable to decision makers is the risk tolerance

NASA Model

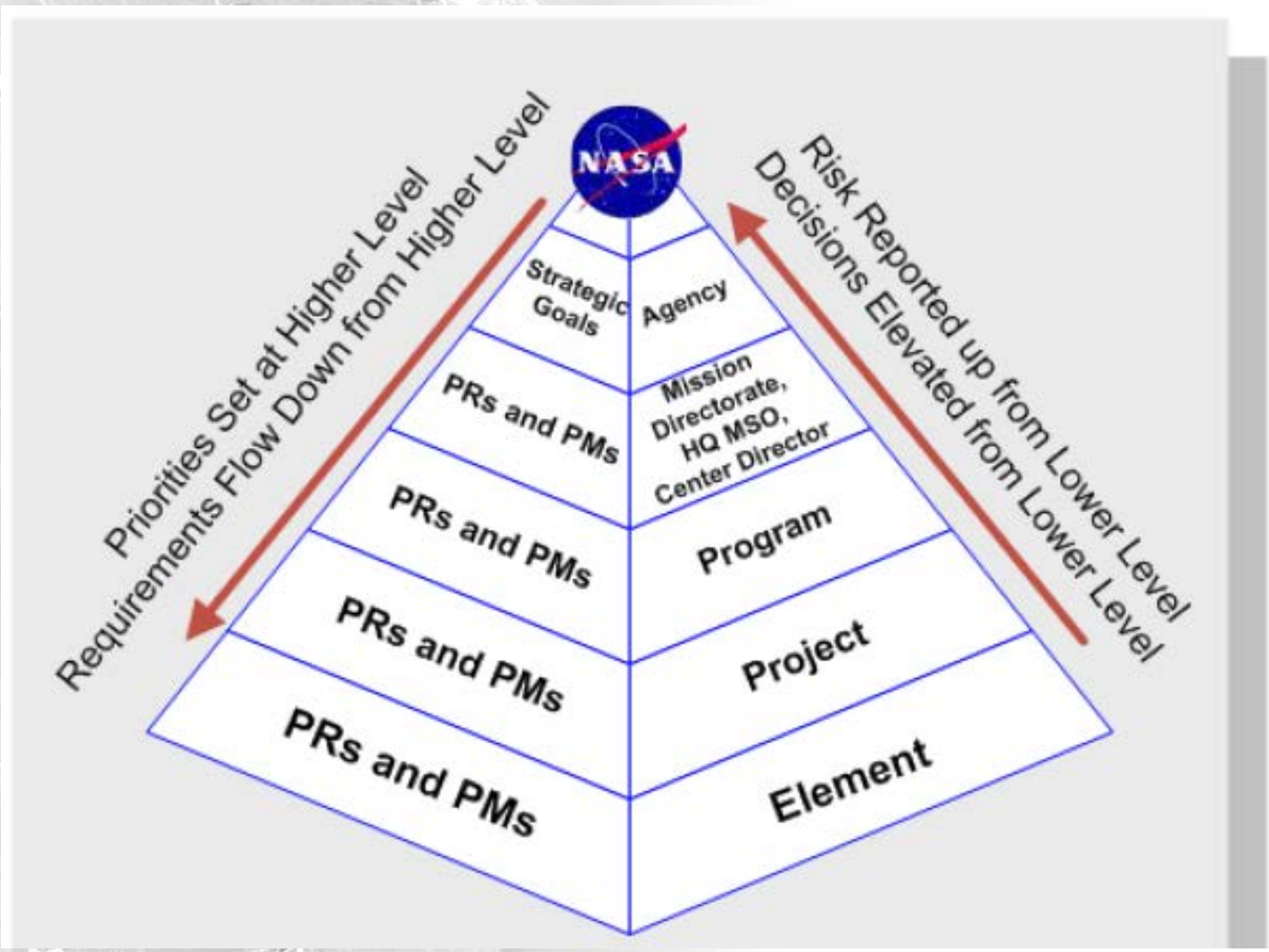


Establish Performance Requirements

- Identification, Analysis, and Selection of Alternatives

Achieving Performance Requirements

- Continually Identify, Analyze, Plan, Track, and Control Risks

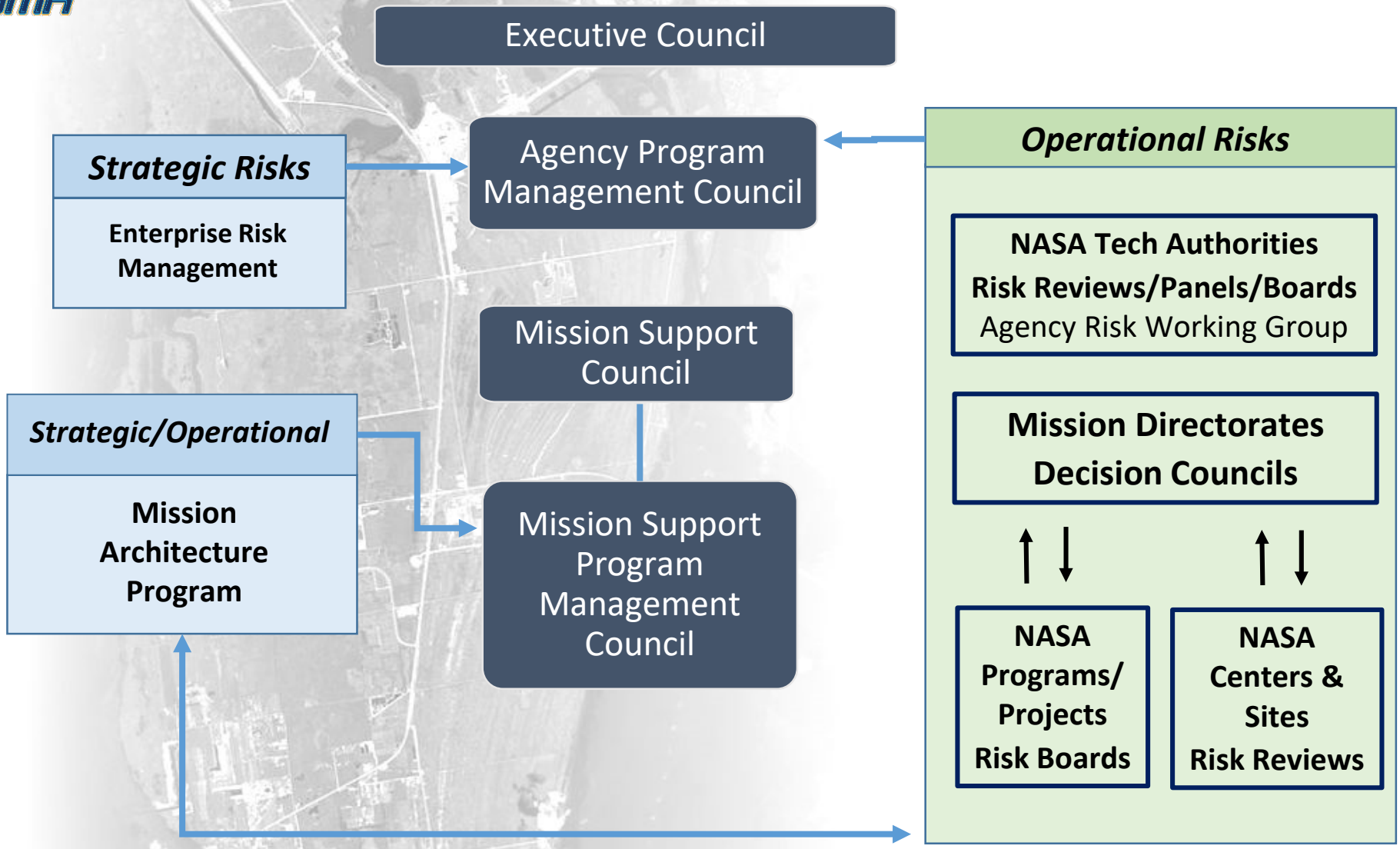


PRs and PMs = Performance Requirement and Measures

Quality and risk play at all decision-making levels.

NASA Risk Management Governance

(NPR 8000.4B, Agency RM Procedural Requirements)



Sources: *MAP, ERM Team, MSD, EPP, ARMWG*

December 7, 2018

Low Risk Tolerance

(High Aversion to These Risks)

- Human lives
- Critical institutional capabilities
  - Infrastructure
  - Workforce
- High-value assets
  - Unique capabilities
  - High replacement cost
  - Low downtime tolerance
- Strategic objectives achievement



High Risk Tolerance

(Lower Aversion to These Risks)

- Technology development
- Research activities
- Collaborations
  - Commercialization of services
  - Cooperative efforts
- Capability enhancement
- (Individually) lower-value assets
- Redundant capability

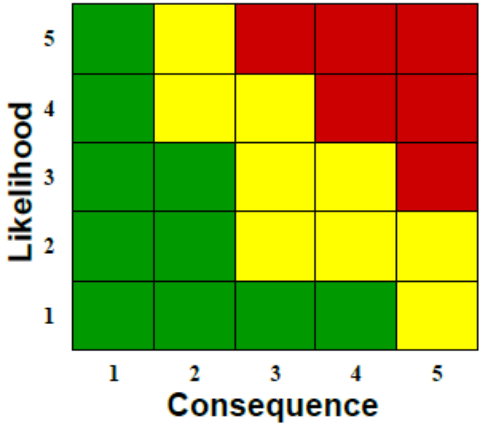
Similar to Industry, NASA operational and business risk scenarios must consider and then communicate a range of possible impacts with often complex variables.

Risk Scoring = Communication

Benefits	Drawbacks
• Visual communication & ranking tool • Tailorable heat map • Useful where quantitative precision is unavailable • Bounds uncertainties • Definitions for Likelihood or Probability and Severity of Consequence	• Not a substitute for actual analysis • Lack of commonality (range of heat maps) • Range compression or ambiguity • Potential to "game" the system (rank higher than credible likelihood or consequence)

KSC Risk Management Scorecard

Likelihood Risk Attribute Definitions				
Level	Probability	Qualitative Criteria	Quantitative Criteria	
			Safety	Other Impacts
5	Very High	Highly likely. Existing controls have little or no effect and cannot prevent this risk scenario; no alternative controls are available.	$P > 10^{-1}$	P > 90%
4	High	Likely. Existing controls have significant limitations and/or uncertainties and will likely not prevent this risk scenario; additional actions will be required.	$10^{-2} < P \leq 10^{-1}$	67% < P ≤ 90%
3	Moderate	Could happen. Existing controls have some limitations and/or uncertainties and may prevent this risk scenario; additional actions may be required.	$10^{-3} < P \leq 10^{-2}$	33% < P ≤ 67%
2	Low	Unlikely. Existing controls have minor limitations and/or uncertainties and usually are sufficient to prevent this risk scenario; some additional actions may be required.	$10^{-6} < P \leq 10^{-3}$	10% < P ≤ 33%
1	Very Low	Highly unlikely. Existing controls are strong and are expected to prevent this risk scenario.	$P \leq 10^{-6}$	P ≤ 10%



Mitigation Timeframe Definitions	
Near-Term	0-3 Months
Mid-Term	3-9 Months
Far-Term	> 9 Months

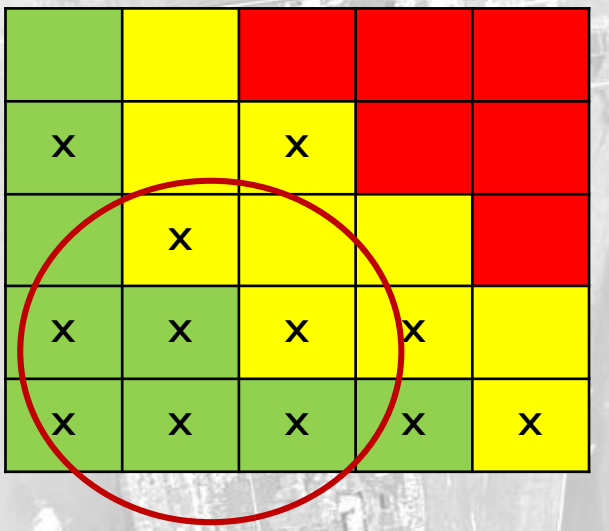
Consequence Risk Attribute Definitions						
Level		1	2	3	4	5
Consequence Categories		Very Low	Low	Moderate	High	Very High
Safety, Health, and Environmental	Personnel Safety	A condition that could cause the need for minor first aid	A condition that may cause short-term, minor injury, impairment, or incapacitation	A condition that may cause long-term, severe injury, impairment, or incapacitation	A condition that may cause permanent, severe injury, impairment, or incapacitation	A condition that may cause loss of life
	Facilities/Equipment	A condition that subjects facilities, equipment, or flight hardware to more than normal wear and tear	A condition that may cause minor property damage to facilities, systems, equipment, or flight hardware	A condition that may cause moderate property damage to facilities, systems, equipment, or flight hardware	A condition that may cause major property damage to facilities, systems, equipment, or flight hardware	A condition that may cause destruction of critical facilities on the ground, major systems, or vehicle during ground operations
	Environmental	Insignificant release to the environment; negligible or non-reportable EPA violation	Minor release to the environment; warning letter or self-reportable EPA violation without penalty	Significant release to the environment; possible formal EPA enforcement action with possible penalty	Major release to the environment; formal EPA violation with minor penalty	Catastrophic release to the environment; formal EPA enforcement action with major penalty and/or criminal investigation
Technical	Meeting performance requirements or goals and objectives	Negligible impact to program/ project/institutional services performance requirements and/or goals and objectives	Minor impact to program/ project/institutional services performance requirements and/or goals and objectives	Moderate impact to program/ project/institutional services performance requirements and/or goals and objectives	Major impact to program/ project/institutional services performance requirements and/or goals and objectives	Failure to meet program/project/ institutional services performance requirements and/or goals and objectives
Center Capabilities	Workforce	Negligible impact to workforce	Minor impact to workforce	Moderate impact to workforce (reduced capability in one or more skill sets)	Major impact to workforce (loss of skill set)	Loss of a workforce core competency
	Infrastructure/Facilities	Negligible impact to infrastructure/facilities	Minor impact to infrastructure/ facilities (reduced effectiveness)	Moderate impact to infrastructure/facilities (reduced operational support)	Major impact to infrastructure/ facilities (delays in Center operations)	Extended loss of an infrastructure/facility critical capability
Cost	Program/Project or Organizational impacts	Negligible cost impact < 2% budget impact or <$1M CMO threat	Minor cost impact 2-5% budget impact or $1M-5M CMO threat	Moderate cost impact 5-10% budget impact or $5M-10M CMO threat	Major cost impact 10-15% budget impact or $10M-35M CMO threat	Catastrophic cost impact > 15% budget impact (potential cancellation) or >$35M CMO threat
Schedule	Ability to support activity milestones	Negligible schedule impact	Minor overall schedule impact (Accommodate with reserve, no impact to critical path)	< 1 month impact to critical path/milestones	1-6 month impact to critical path/milestones	> 6 month impact to critical path/milestones or possible program/activity cancellation

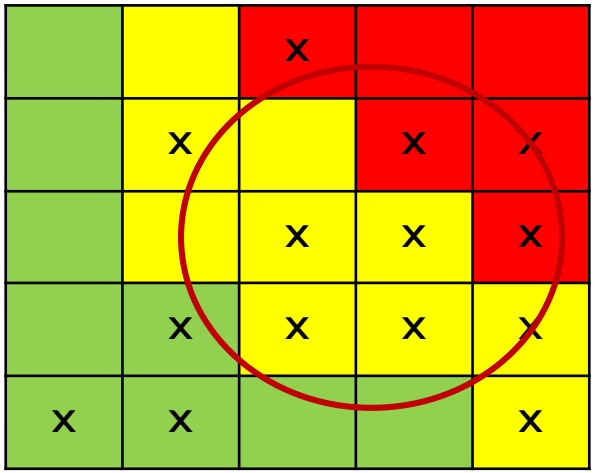
RELEASED - Printed documents may be obsolete; validate prior to use.

Exercise: Assigning Risk

- Laboratory Audit
- 100 Items on Surveillance Plan
- 53 Identified Nonconformances

Thinking about risk tolerance, how do we communicate risk?



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Collaborate!