



Proactive Top-down Approach to Risk Management at NASA

Supply Chain Conference

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**Dr. Michael Stamatelatos, Director
Safety Assurance Requirements Division
NASA Headquarters**

Definition of Risk



“**Risk**” is operationally defined as a set of triplets*:

- (1) accident **scenarios**;
- (2) associated **probabilities and uncertainties**; and
- (3) associated **adverse consequences and their severities**.

* *Kaplan & Garrick, Risk Analysis, 1981*

Definition of Risk per NPR 8000.4

- **Risk:** The expression of the **potential for performance shortfalls**, which may be realized in the future, with respect to achieving explicitly established and stated performance requirements
- The risk “**portfolio**” may include many types of risk including:
 - **Safety risk**
 - **Technical risk**
 - **Technological risk**
 - **Operational and infrastructure risk**
 - **Schedule risk**
 - **Cost risk**
 - **Other type of risk**

Risk Management Definition

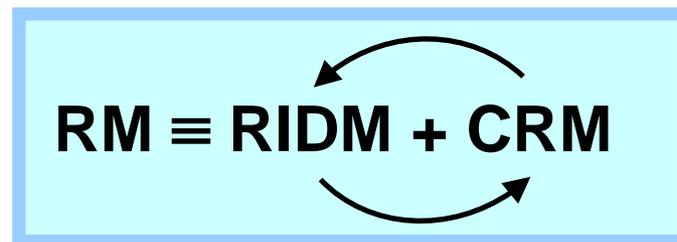
- ***Risk Management (RM) is a systematic approach to set the best course of action under uncertainty by identifying, understanding, assessing, acting on, and communicating risk issues.***
- Risk management is a **proactive, risk-informed approach to enable and enhance the decision makers' effective selection of key decision alternatives with implementation and follow-through**

NASA Risk Management Policy

- ❑ **NASA Policy Directive (NPD) 1000.5 (2009)** states: *“It is NASA policy to incorporate in the overall Agency risk management strategy a risk-informed acquisition process that includes the identification, analysis, and management of programmatic, infrastructure, technical, environmental, safety, cost, schedule, management, industry, and external policy risks that might jeopardize the success with which the Agency executes its acquisition strategies.”*

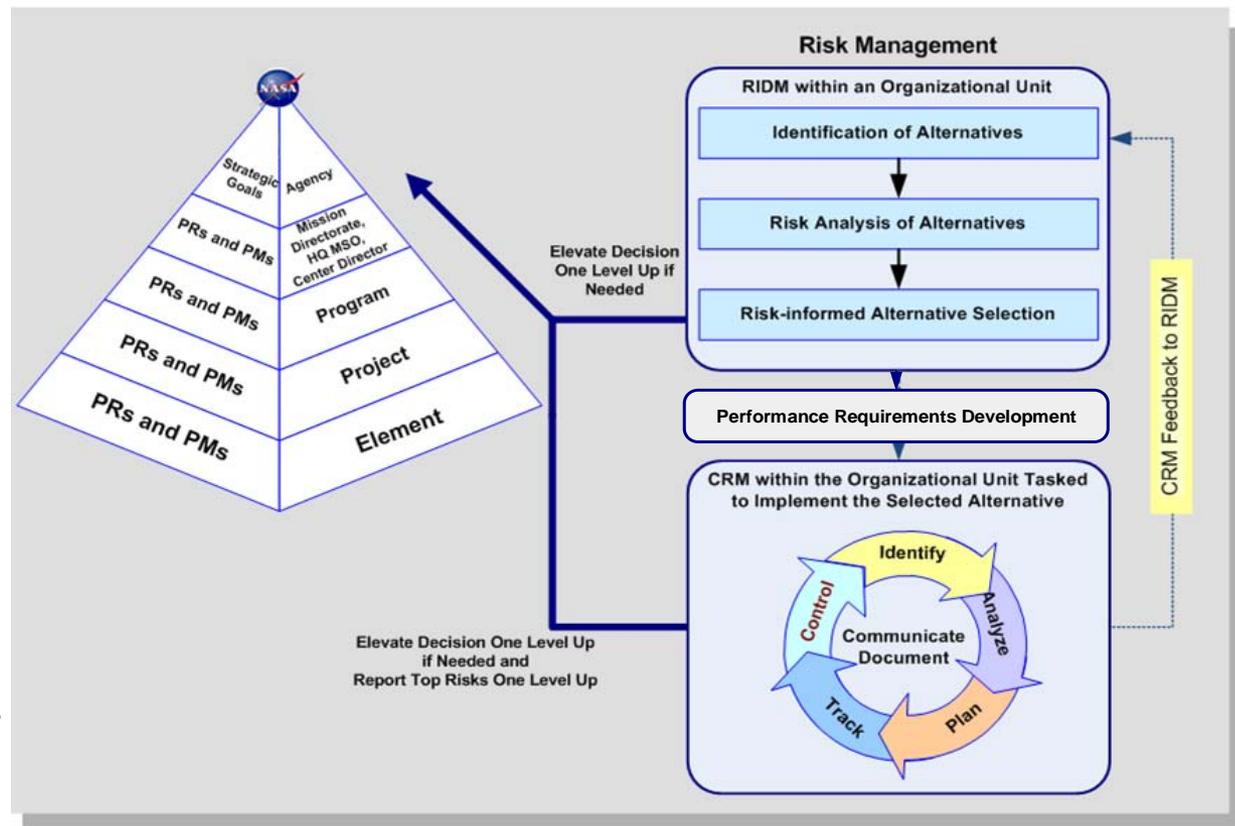
- ❑ **NPR 8000.4 (2009), Agency Risk Management Procedural Requirements**, evolves NASA’s risk management (RM) approach to entail two complementary processes:
 - **Risk-Informed Decision Making (RIDM)**
 - ✓ To risk-inform direction-setting decisions (e.g., space architecture decisions)
 - ✓ To risk-inform the development of credible performance requirements as part of the overall systems engineering process

 - **Continuous Risk Management (CRM)**
 - ✓ To manage risk associated with the implementation of baseline performance requirements



RM Process Begins with High-Level Objectives

- ❑ Within NASA's **organizational hierarchy**, high-level objectives flow down in the form of increasingly detailed performance requirements, whose satisfaction assures that objectives are met
- ❑ **Risk Informed Decision Making (RIDM)** is designed to maintain focus on strategic goals as decisions are made throughout the hierarchy
- ❑ **Continuous Risk Management (CRM)** is designed to manage “risks” in the context of requirements



Definition of RIDM per NPR 8000.4

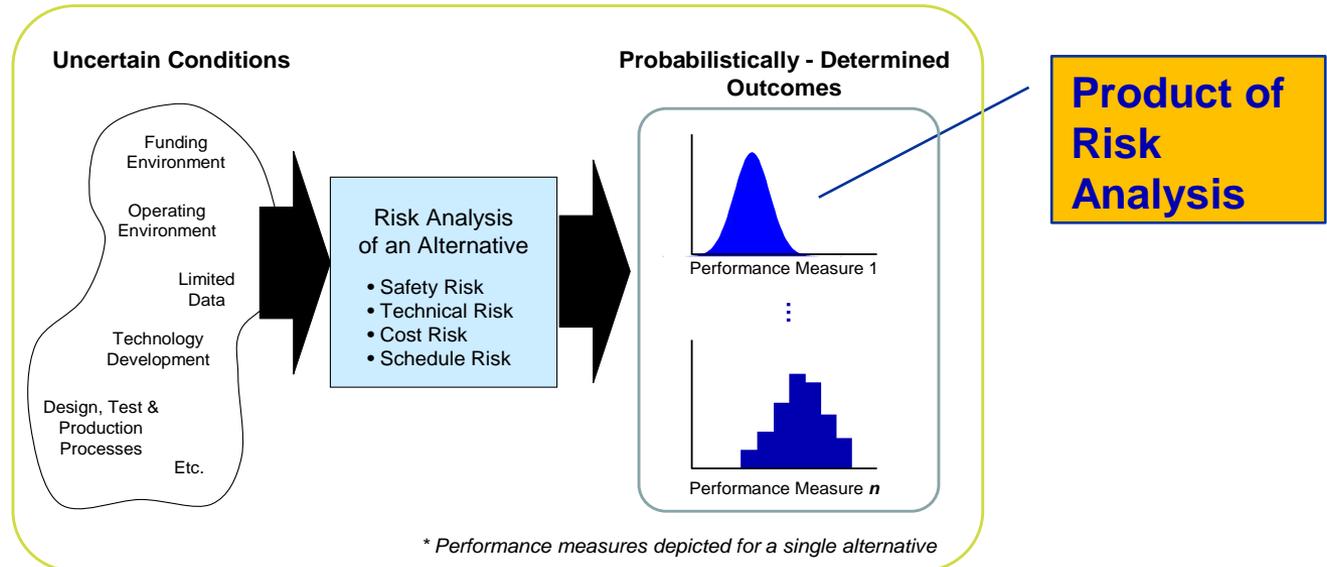
- **RIDM** is a risk-informed decision-making process that uses a diverse set of performance measures along with other considerations within a *deliberative* process to inform decision making
 - decisions are informed by an integrated risk perspective rather than being informed by a set of individual “risk” contributions
 - a decision-making process relying primarily on a narrow set of model-based risk metrics would be considered “risk-based”

Risk Informed Decision Management (RIDM) Process

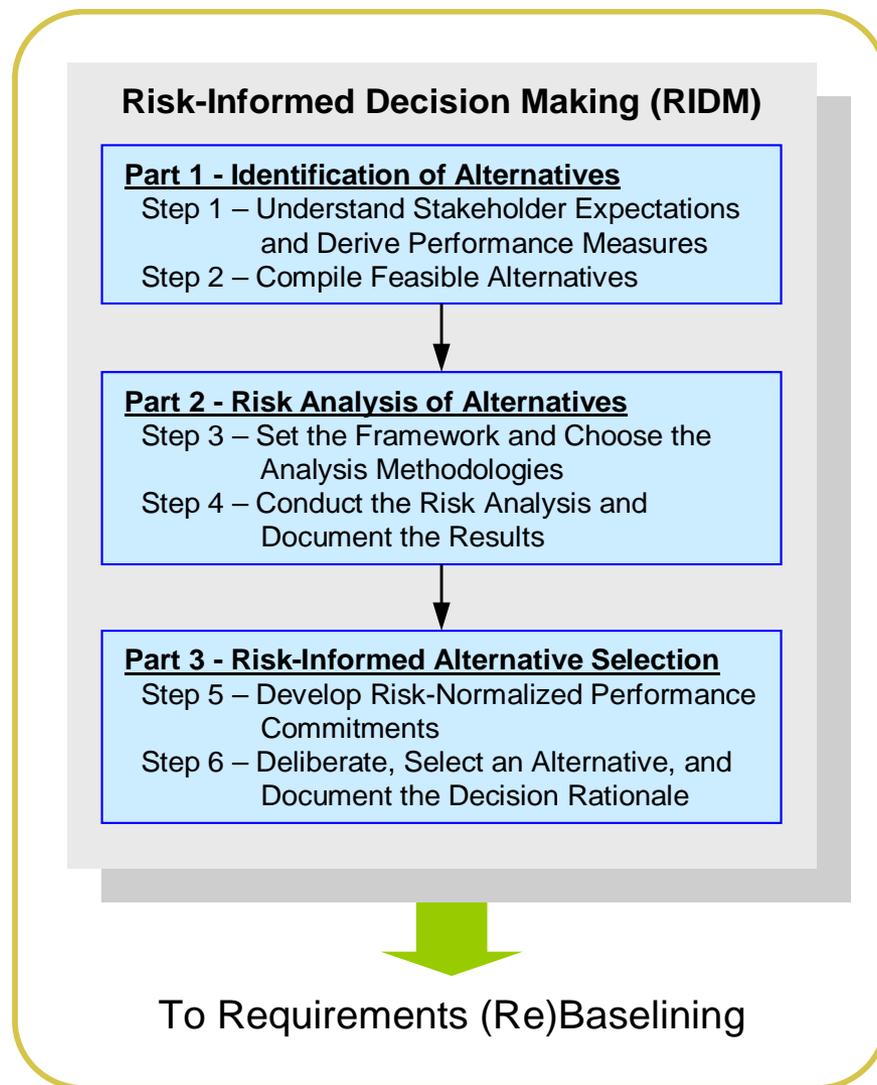
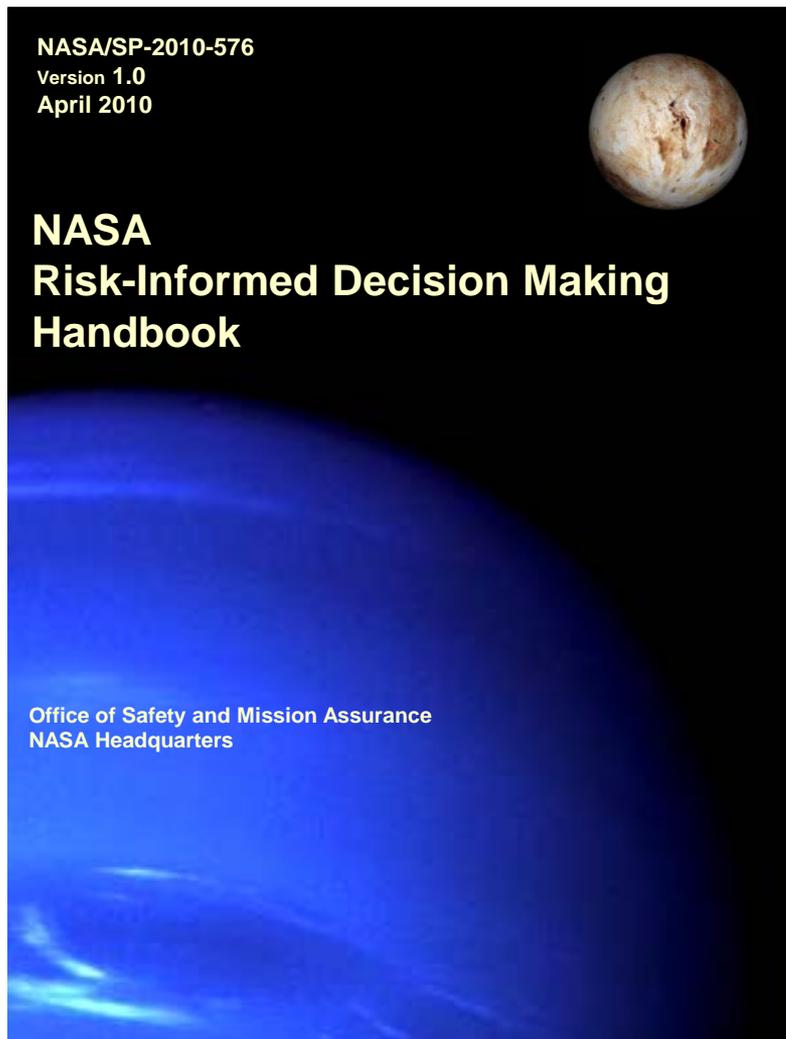
Risk Analysis of Alternatives

□ Goal is to

- **Establish a transparent framework that:**
 - ✓ Operates on a common set of **performance parameters** for each alternative
 - ✓ Consistently addresses uncertainties across mission execution domains and across alternatives
 - ✓ Preserves correlations between performance measures
- **Develop a **risk analysis framework** that integrates domain-specific performance assessments and quantifies the performance measures**



RIDM Process and NASA Document - NASA/SP-2010-576

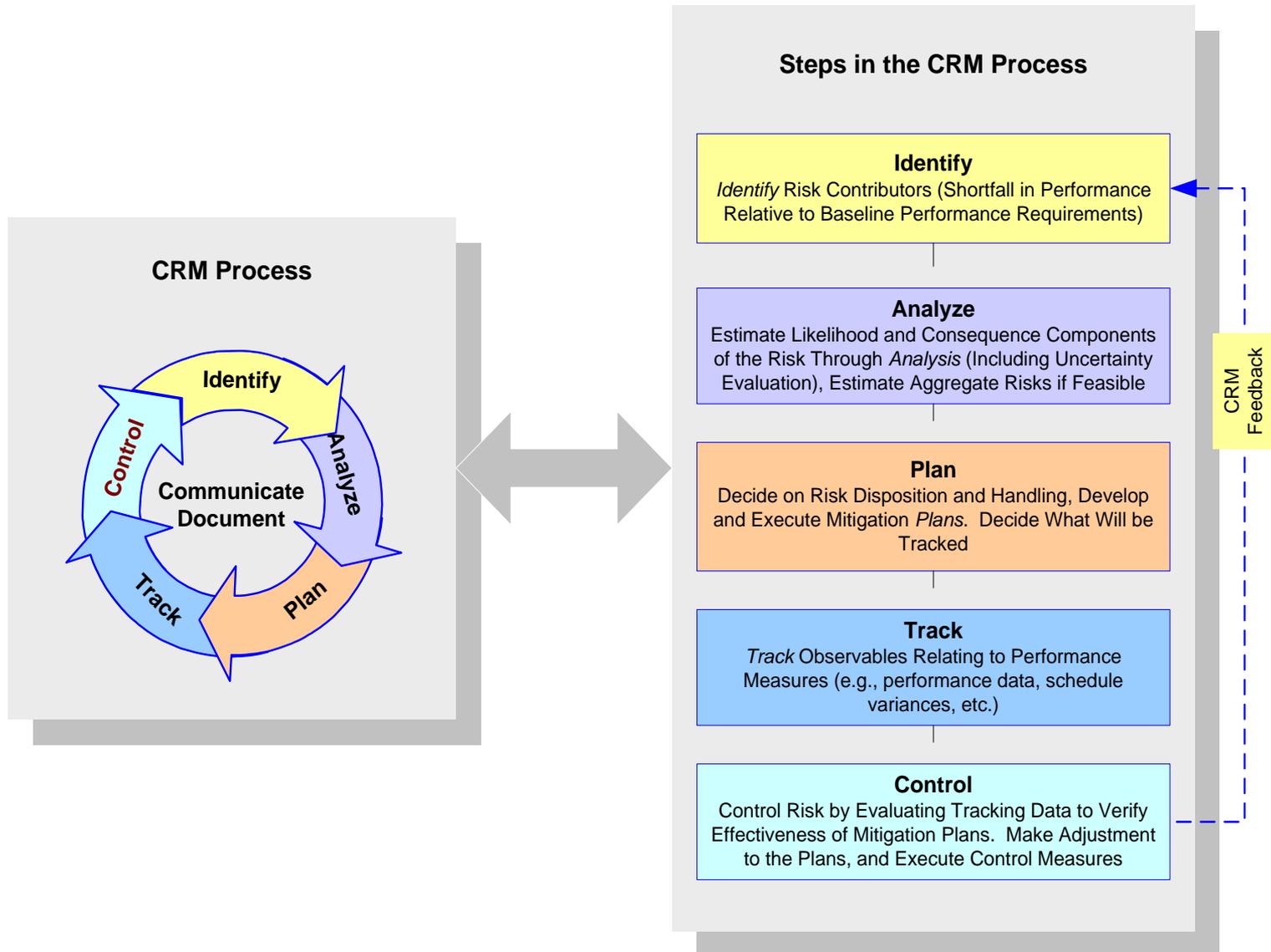


RIDM Process

Performance Measures and Performance Requirements

- ❑ **A Performance Measure (PM)** is a metric used to quantify the extent to which a Performance Objective is fulfilled. Examples:
 - **Safety** (e.g., avoidance of injury, fatality, or destruction of key assets)
 - ✓ **Maintain Astronaut Safety** → **Probability of Loss of Crew (P(LOC))**
 - **Technical** (e.g., increase thrust or output, maximize amount of observational data acquired)
 - ✓ **Maximize Payload Capability** → **Payload Capability (kg)**
 - **Cost** (e.g., execution within minimum cost)
 - ✓ **Minimize Cost** → **Cost (\$)**
 - **Schedule** (e.g., meeting milestones)
 - ✓ **Minimize completion time** → **Schedule (days/months)**
- ❑ **The PM values imputed to the selected alternative are Performance Requirements**
 - They essentially define “success”
 - Significant shortfalls in performance are “failures”

The Continuous Risk Management (CRM) Process



Summary

- ❑ **Our goal is to manage risk in an integrated and coherent fashion across the Agency**
 - **The RIDM process is intended to risk-inform direction-setting decisions**
 - **The CRM process is intended to manage risk associated with the implementation of baseline performance requirements**
- ❑ **Currently, we are working on**
 - **Better integration of the RIDM and CRM processes**
 - **Better integration of institutional risk considerations into RM framework**