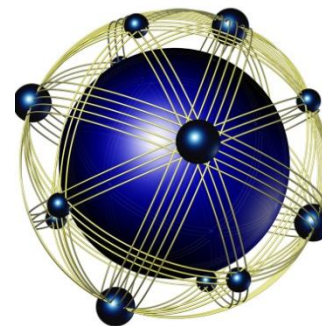




Model Based Systems Engineering (MBSE) Business Case Considerations – An Enabler of Risk Reduction

Prepared for:
National Defense Industrial Association (NDIA)
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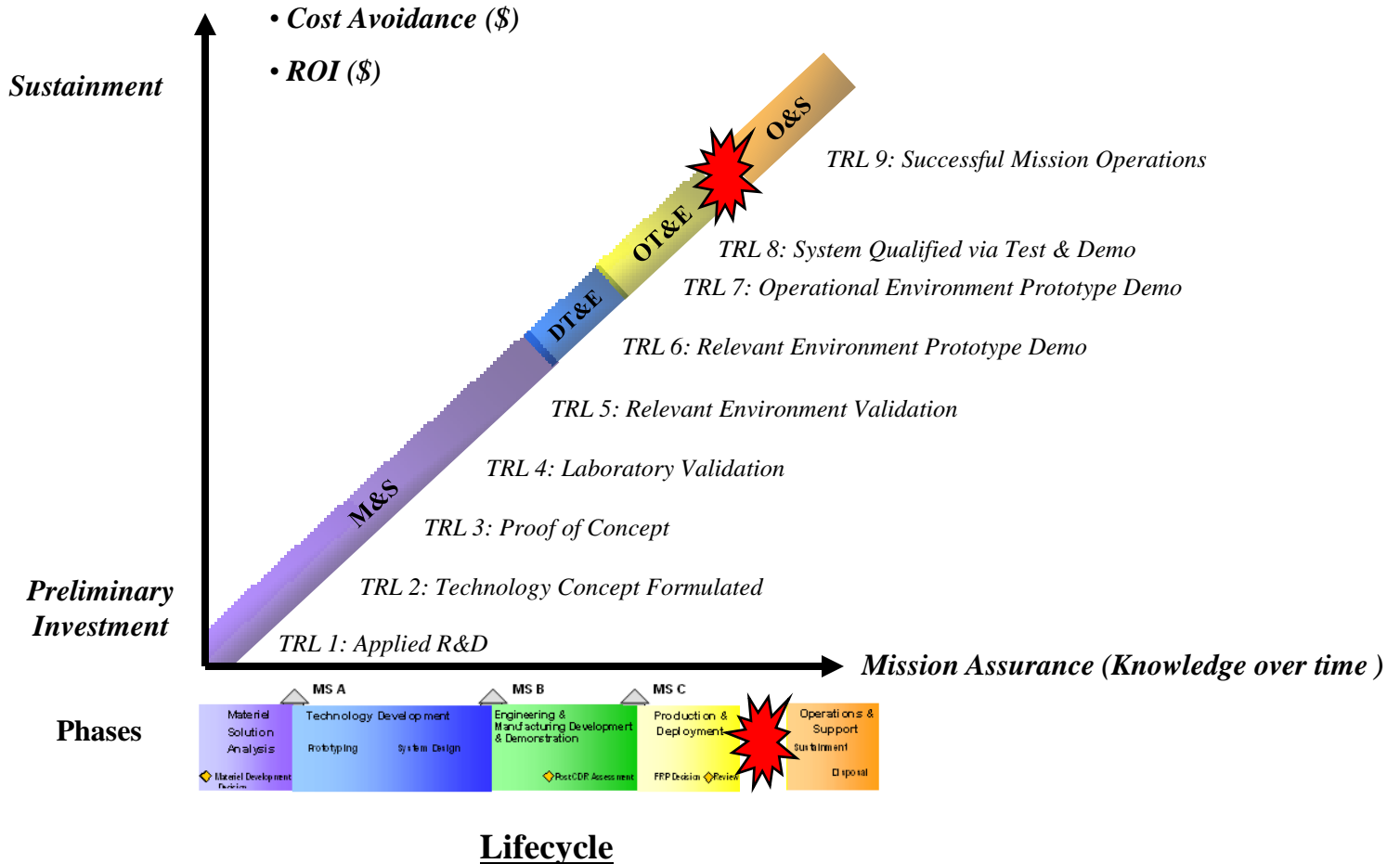


Considerations for Using MBSE As a Risk-Reduction Tool

- Better understand the context of risk
- Know the influences on degree of certainty
- Look at risk holistically
- Enable vigilance
- Use optimum acquisition program risk-reduction window to learn
- Understand details behind previously made decisions
- Integrate risk management with program controls

“MBSE is the formalized application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases”. (INCOSE)

System Delivery ≠ Mission Assurance



Mission Assurance is the assurance that a program knows that it can achieve a warfighter need

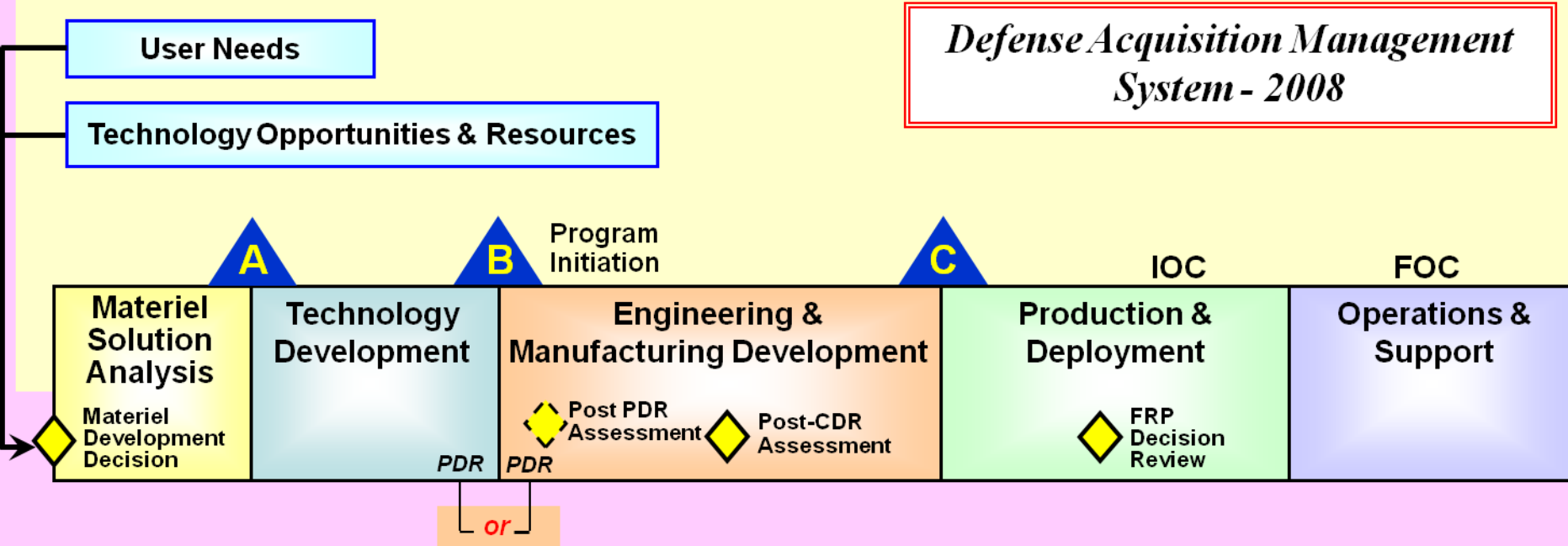
State-of-Play in MDAPs

- **Unmatched resources and requirements**
 - Insufficient technology maturity before start of systems development
- **Unstable product design**
 - Design does not meet customer requirements
 - Cost, schedule, and reliability targets not met
- **Immature manufacturing processes**
 - Inability of developer to demonstrate that system can be manufactured within cost, schedule, and quality targets

Most programs still proceed with far less technology, design, and manufacturing knowledge than best practices suggest and face a higher risk of cost increases and schedule delays

Critical Role of Risk Management in DoD 5000 Series

Defense Acquisition Management System - 2008



The importance of risk management in DoD 5000 Series is evident throughout

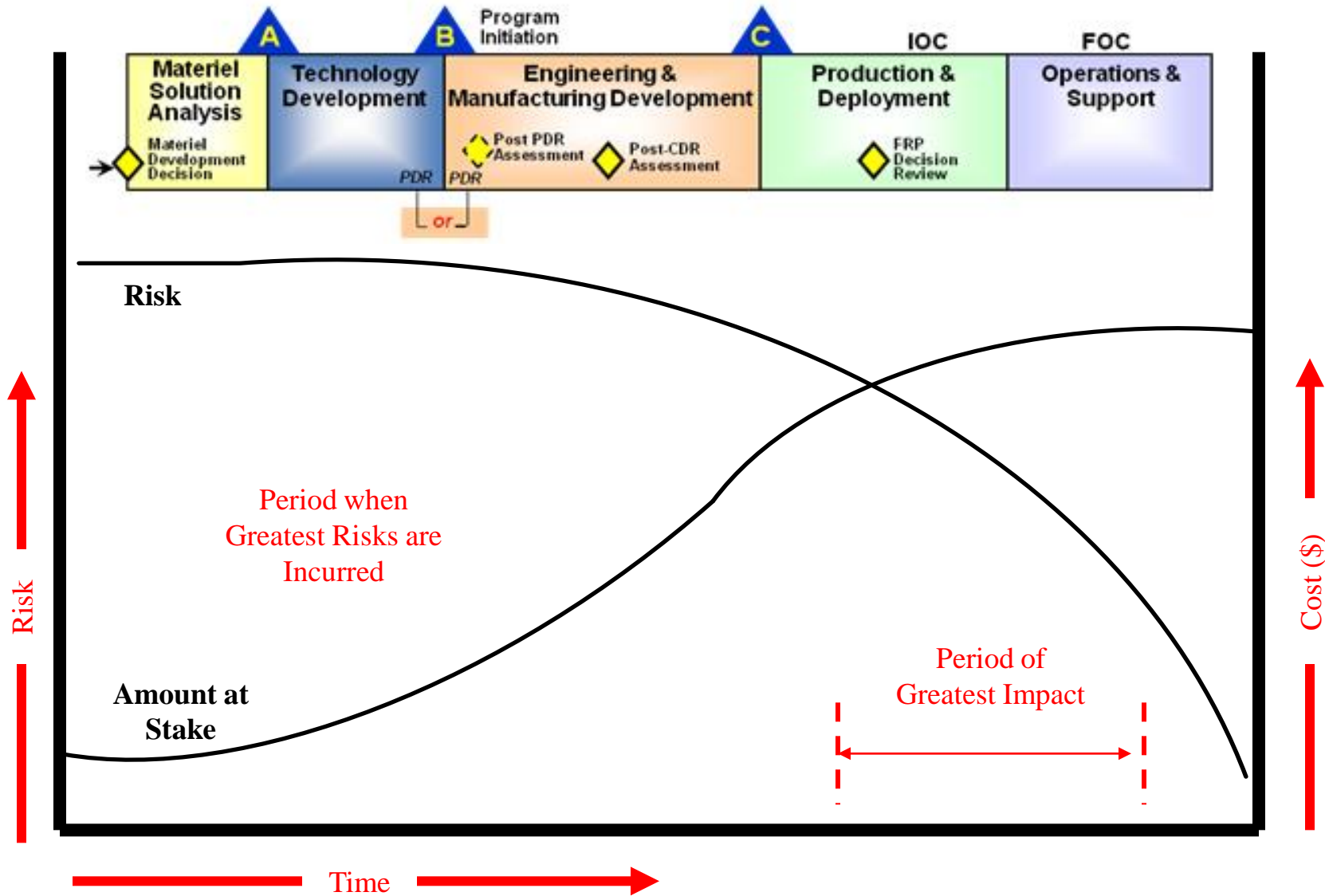
Risk Management Objectives

- Increase visibility
- Enhance communication
- Add realism
- Improve the likelihood of success

This is what risk management should do for MDAPs

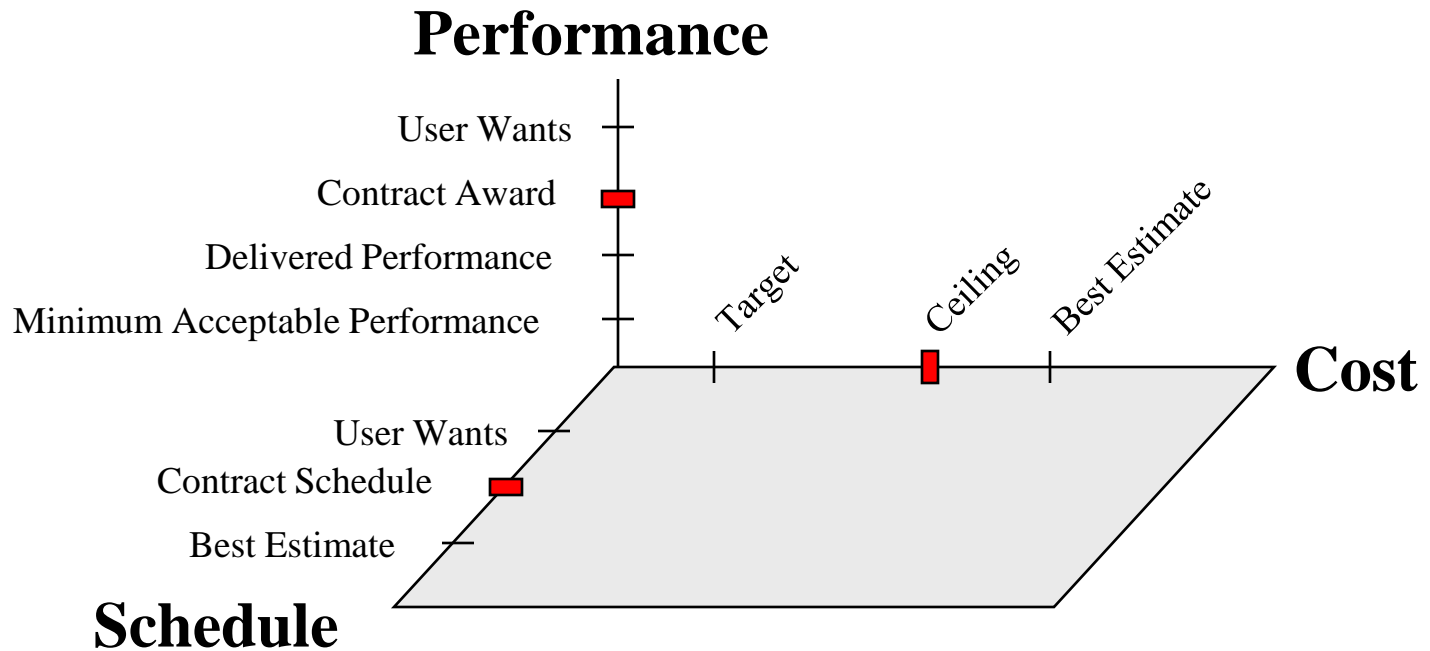


Characteristics of Acquisition Risk





Why We Find Risk on MDAPs

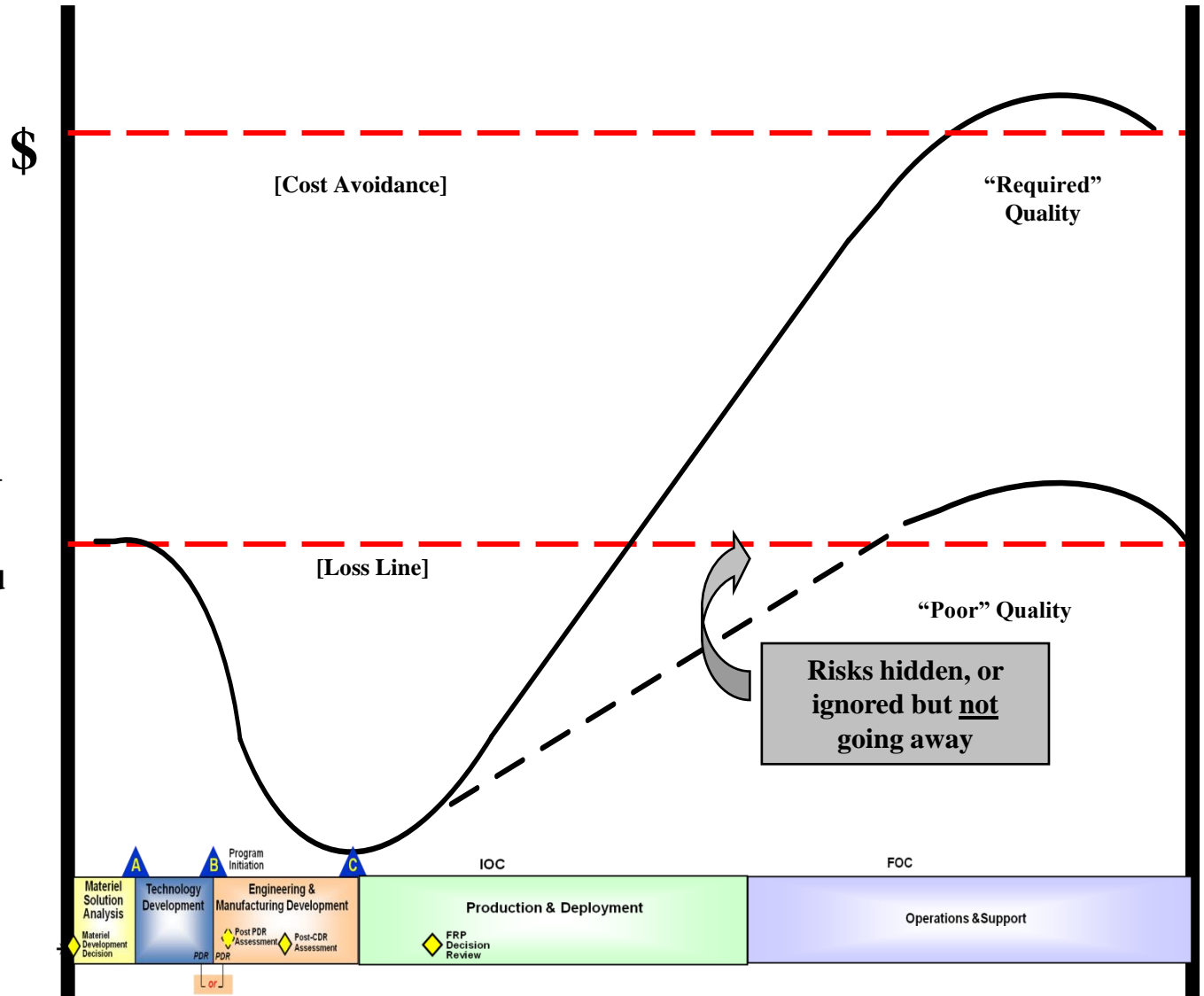


Risk is introduced when expectations in any of these dimensions push what is technically or economically feasible

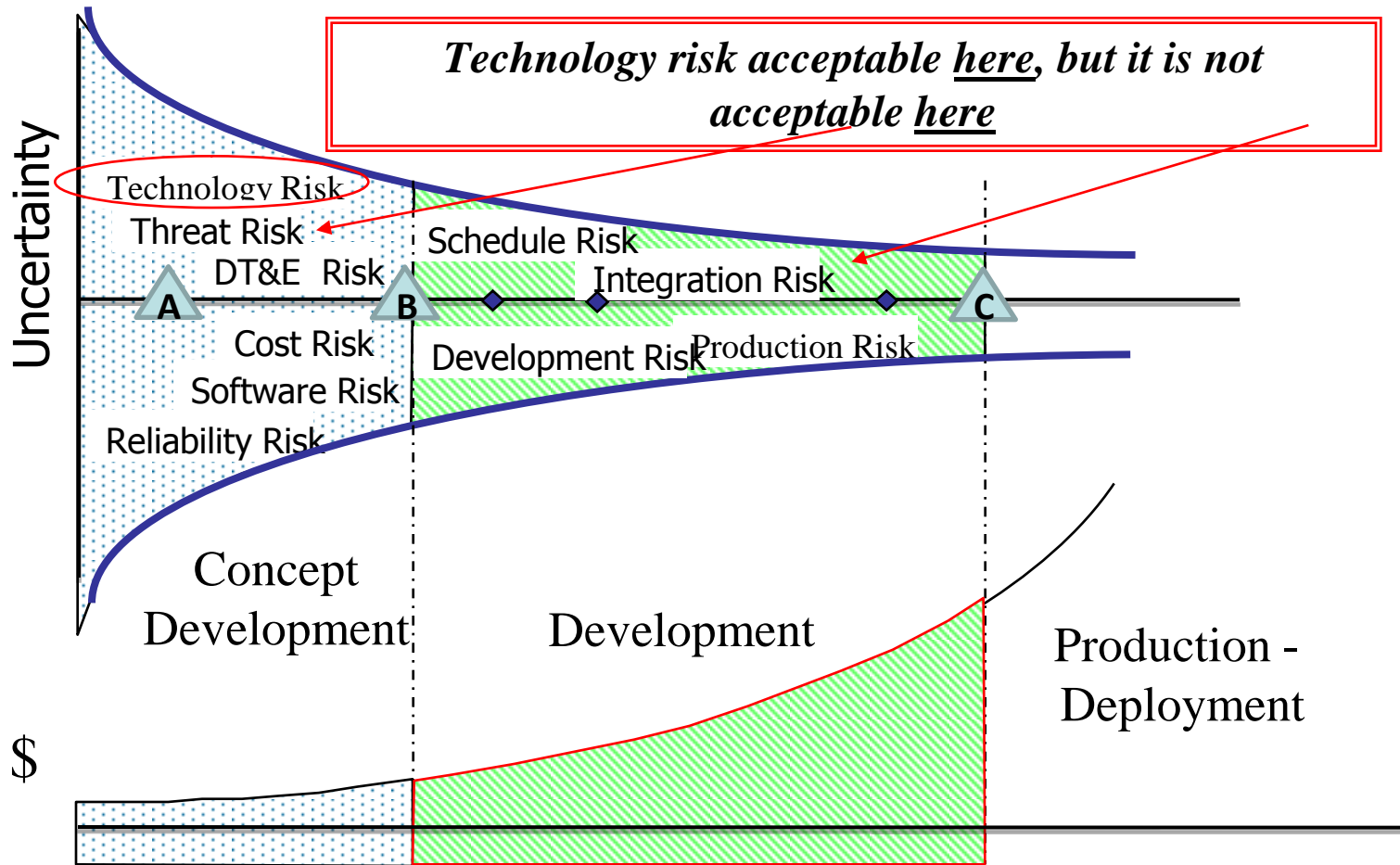


System Lifecycle Quality Risk

Program Cost +
Cost Avoidance
(in Dollars that
are Accumulated
and Discounted)



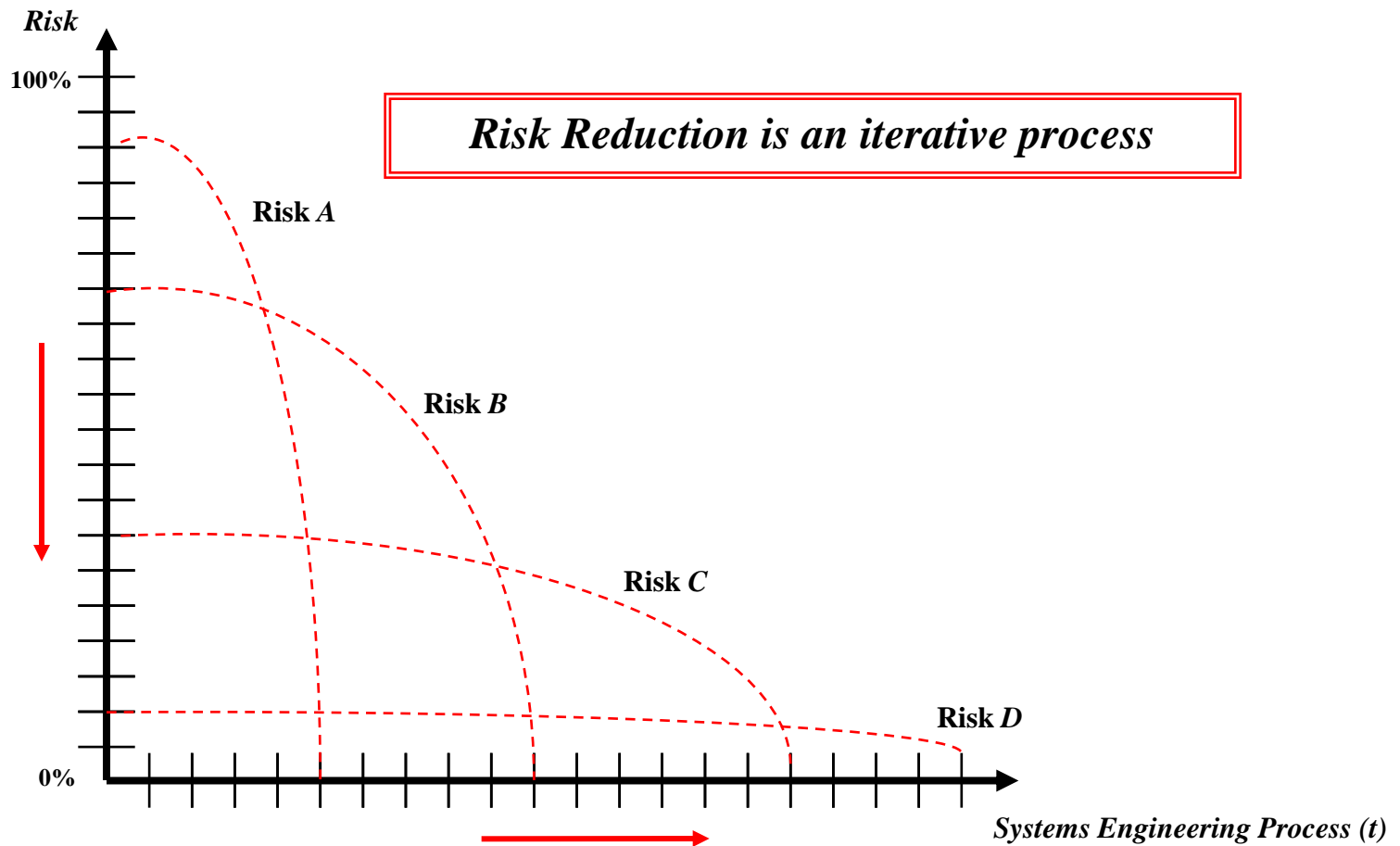
Risk Is Inherent In All Knowledge Domains



We will always have risk in the knowledge domains; however, certain risks in certain knowledge domains become less acceptable as time goes on



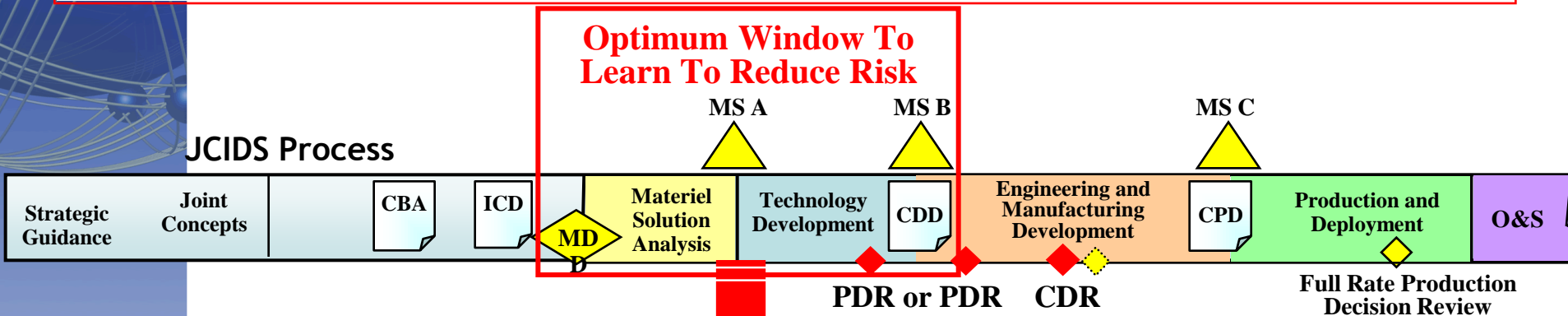
Risk Profile



Always expect a risk profile to exist on a program. Some risks are mitigated quickly (Risk A); others take a little longer (Risks B,C, and D)

Optimum Window To Learn In Order To Reduce Risk on MDAPs

Risk ~ ΣK_i^d where K=Knowledge; d=Deployable knowledge; and i=Knowledge from different systems



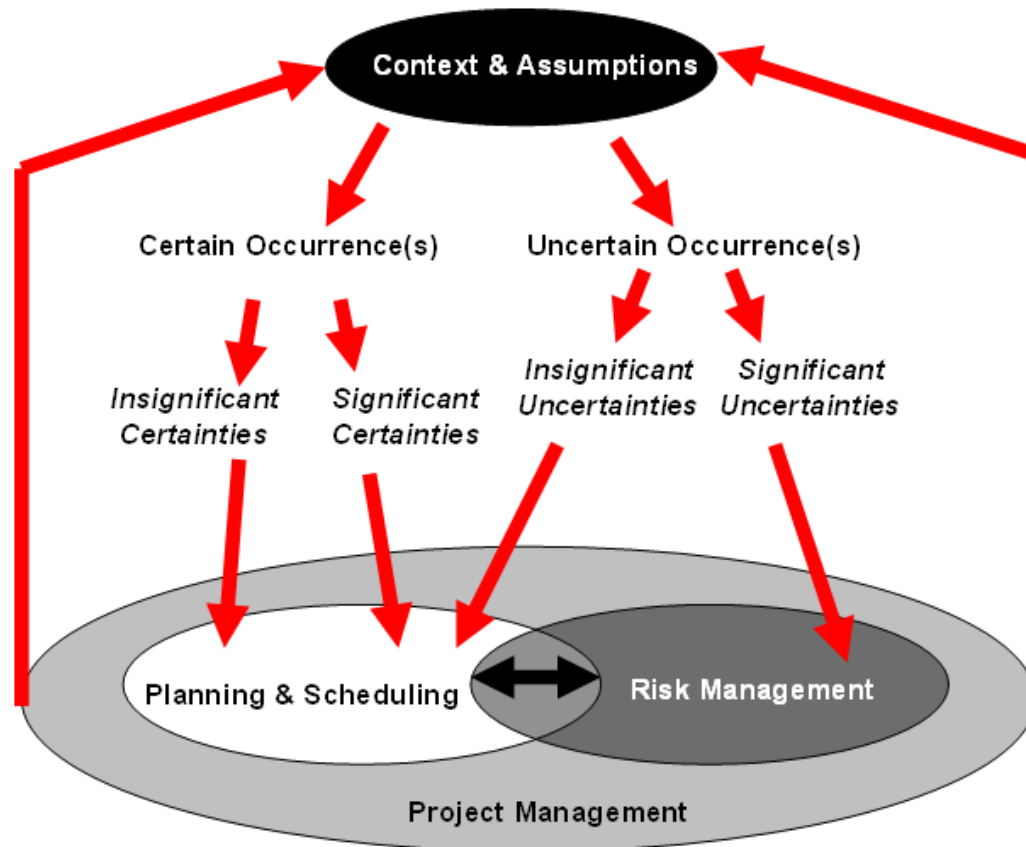
- Mature technologies and modular open architecture
- Reliability and maintainability designed-in
- Early focus on production planning
- Realistic software size, productivity, and reuse estimates
- Adequate staffing with qualified personnel
- Adequate management reserve
- Good communication between Government Integrated Product Teams (IPTs) and with Contractor
- Management of external interfaces with complementary programs
- Event-driven schedules
- Etc.

Increase knowledge in time to decrease uncertainty, increase control, and reduce risk uncertainty – Establish a “Learning Program” Pre-MS B

Risk Is Inherently A Natural Part of Change

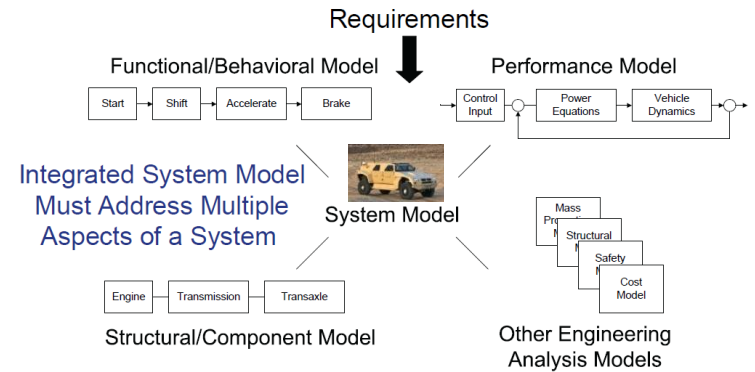
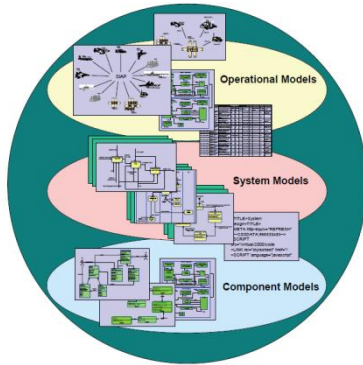
- Change is constant with all programs
- Change results from known things “as planned”
 - e.g., conducting a technical review
- Change results from eventual unknowns “as unplanned”
 - e.g., having funding cut

The Influence of the Degree of Certainty



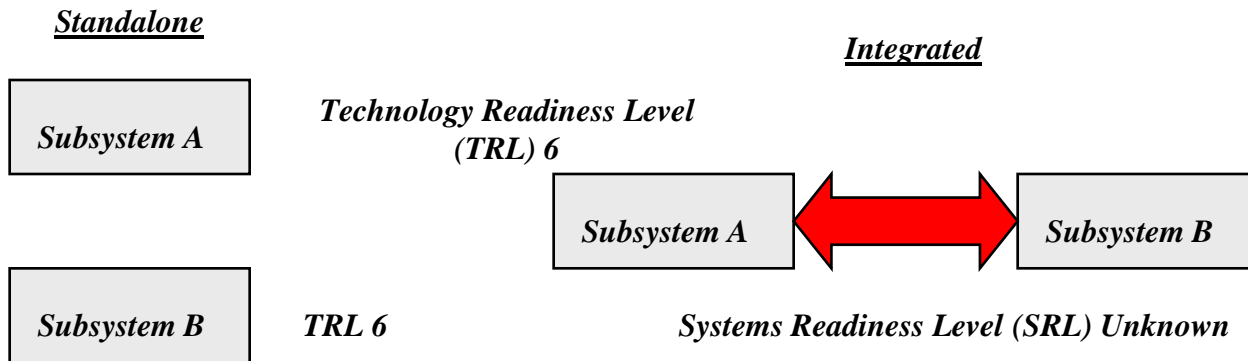
The notion of explicitly establishing the context in which you analyze and manage risk is vitally important to ensure that you make appropriate choices about how you manage your risks

Understand Context of Risk



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For Example: The impact of integration on readiness levels

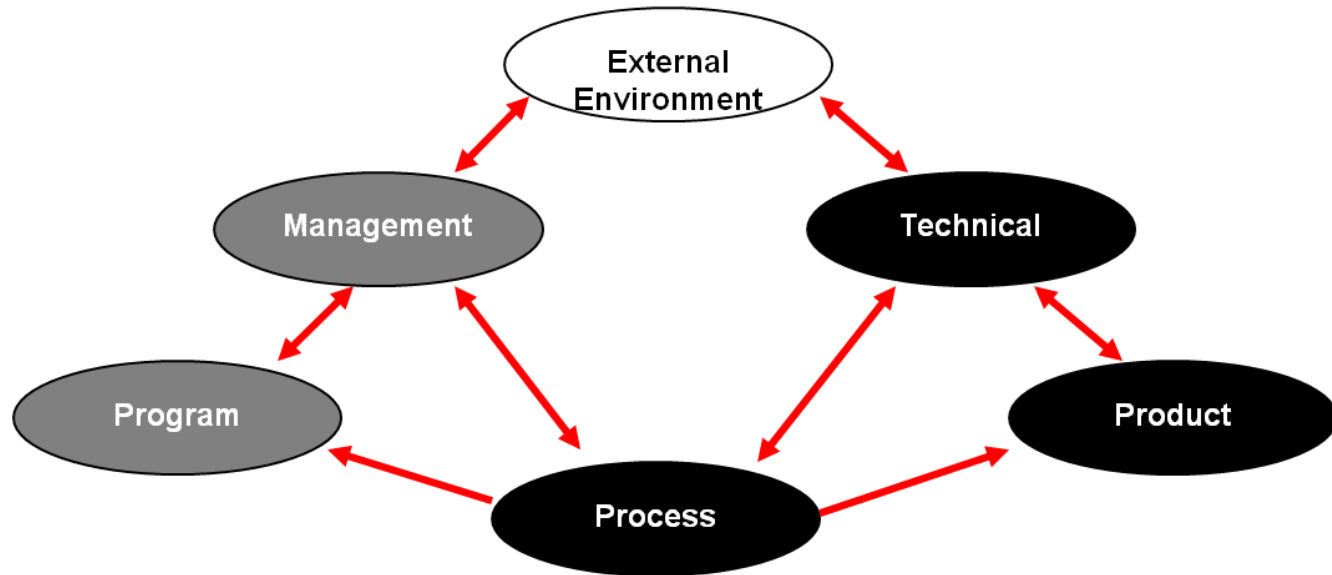


Risk can only be understood in context; In this example, acceptable TRLs do not necessarily determine the SRL



Look At Risk Holistically

Risk ~ Function Σ (TRL + Degree of Integrability + Dependencies + Utility + Insertability + Design Agility)



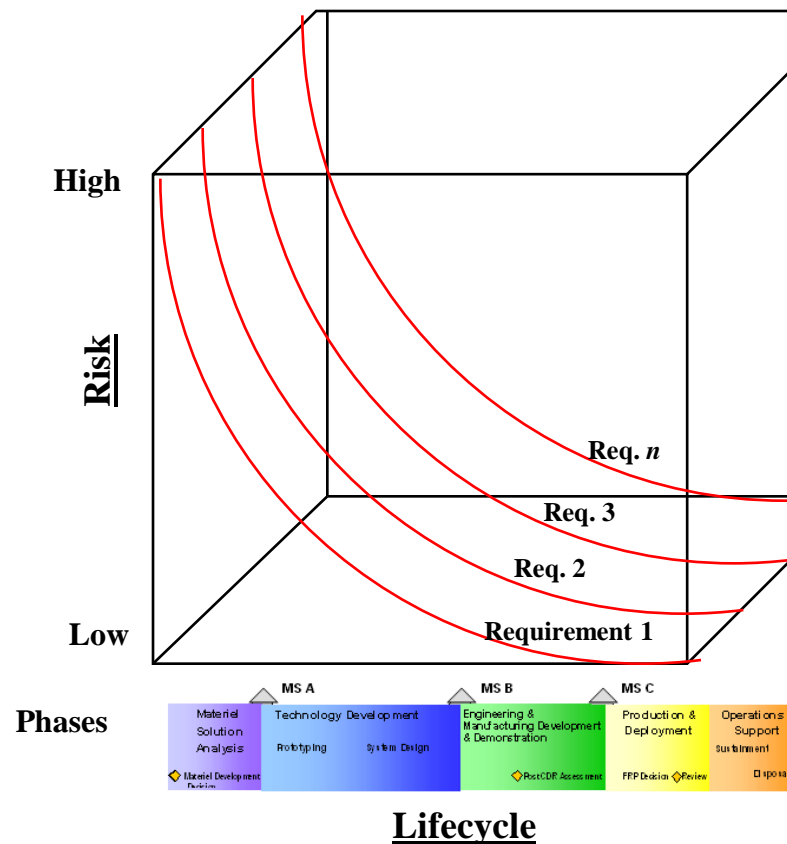
Technical risk is a function of many variables, and risk areas can often influence one another

Accepting Risk Makes Progress Possible

- Essential to enhancing performance that achieves organizational objectives and realizing improvement
 - Lack of thorough planning and departure from sound risk management practices are not considered prudent
- Risk must be objectively assessed and appropriately mitigated and consciously accepted on a case-by-case basis by stakeholders
 - Management and stakeholders must be part of risk acceptance process
 - Risk acceptance process is same regardless of what organization/program activity is being done although degree of acceptable risk will vary greatly depending on unique considerations (i.e., one size does not fit all)
- A risk profile and balance of scope and resources must be continuously evaluated (adequate reserves and margins must accommodate risk)



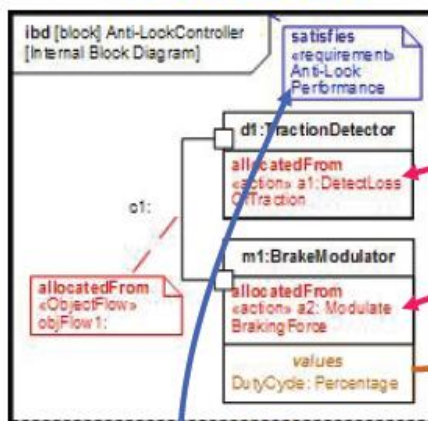
Risk Reduction Should Be Dispositive



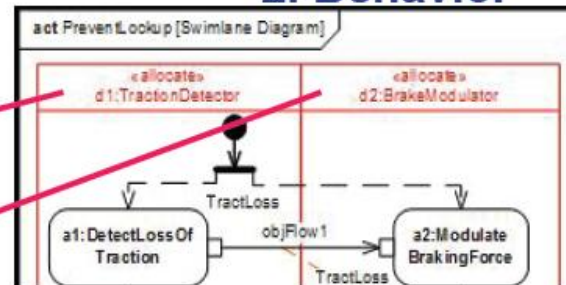
Risk is not something to be feared. Instead, we should embrace it as something to guide us in our engineering of systems; it should enable our decision-making

Enabling Vigilance and Integrating Risk Management

1. Structure



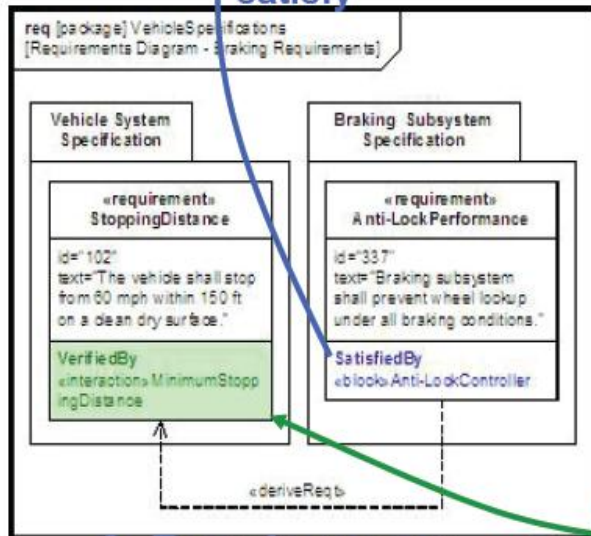
2. Behavior



allocate

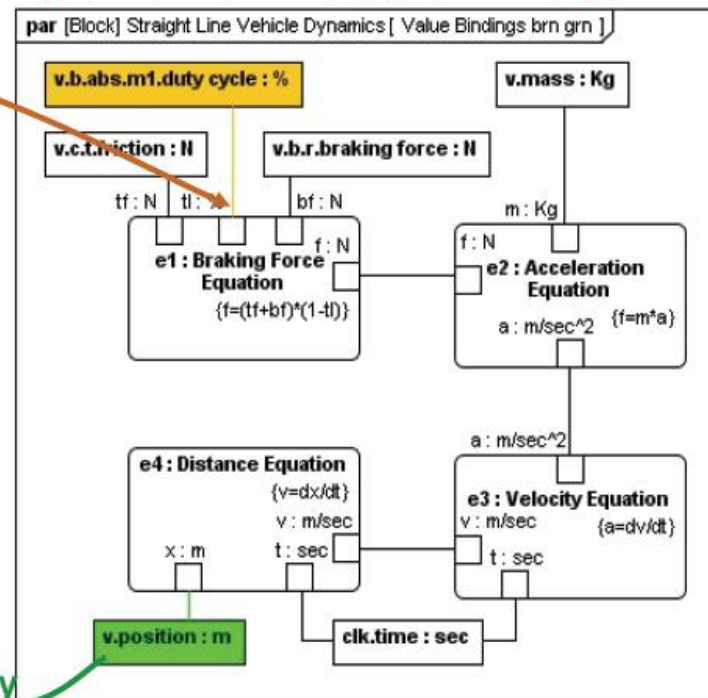
value binding

satisfy



3. Requirements

(via interaction)



4. Parametrics

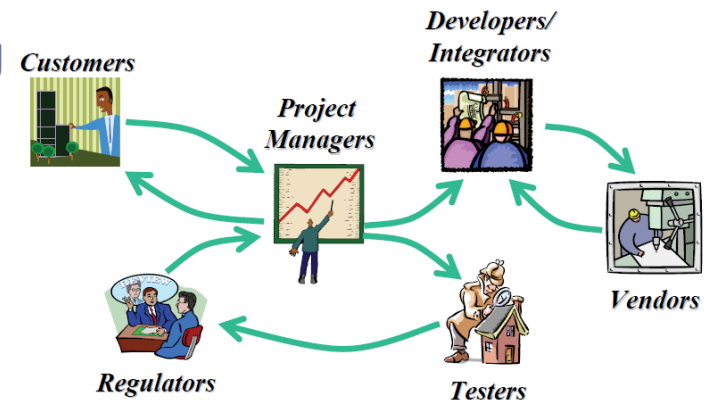
Prevent Organizational Knowledge from Being Lost

- Systematically secure knowledge gained from outcomes of risk mitigation
 - “Certain knowledge and useful experiences otherwise gained could be lost to the detriment of future technical planning and improving risk reduction on the program, as well as the portfolio of programs within the organization”
- Have PM continually seek out and capture lessons learned, particularly as root cause analysis is performed throughout the program... Enables Knowledge-based Risk Management
- Use “knowledge gained over time” to improve processes, as well as entry and exit criteria of program/technical readiness reviews
- Lessons Learned:
 - 1) Repeatable 2) Traceable 3) Assignable 4) Measurable and 5) Provides Benefit”

Knowledge increases Certainty which increases Control which decreases Risk

MBSE contributes to risk reduction on MDAPS by:

- Increasing visibility and improving communication between all stakeholders involved in acquisition process
- Increasing ability to manage a program's complexity by viewing its models from many different perspectives
- Identifying early requirements risk that could cause serious issues later on in acquisition process
- Increasing requirements traceability accuracy
- Showing impacts of proposed requirements changes
- Allowing early and on-going system validation and verification
- Allowing reuse of early program specifications, which results into better program quality



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Questions?

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