Integration Risk Assessment

- Assessing Integration Risk Throughout the Lifecycle -

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Integration Risk Overview

Growing consciousness within the Department of Integration risk and mitigation

- Weapon Systems Acquisition Reform Act (PL 111-23) WSARA – Technology Integration Risk
- SE – Integration Readiness Level

- Increased awareness
- Integration Risk Assessment Questions
- Program Notable Efforts
- Department-wide initiatives
- Annual Report topic

- Formal SE guidance
- Integration metrics
- Tracking/Trending
- Dashboard
- Annual Reporting

System / Integration Risk

Background

- **Integration is an aggregation of all of the processes and activities that are applied to assure that a weapon system is designed and developed so that all system elements (hardware, software, people, facilities, procedures, etc.) work together in a way that satisfies the intended purpose of the weapon system (meets the technical, functional and performance requirements)**

- **Systems Engineering is an interdisciplinary approach … Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs. (INCOSE)**

The successful integration of DoD weapons systems relies upon the application of good systems engineering throughout the acquisition life cycle

Integration Issues

45% of Acquisition Programs have Integration Issues

- **Integration issues are an underlying cause of many of the shortfalls to DoD acquisition programs…**

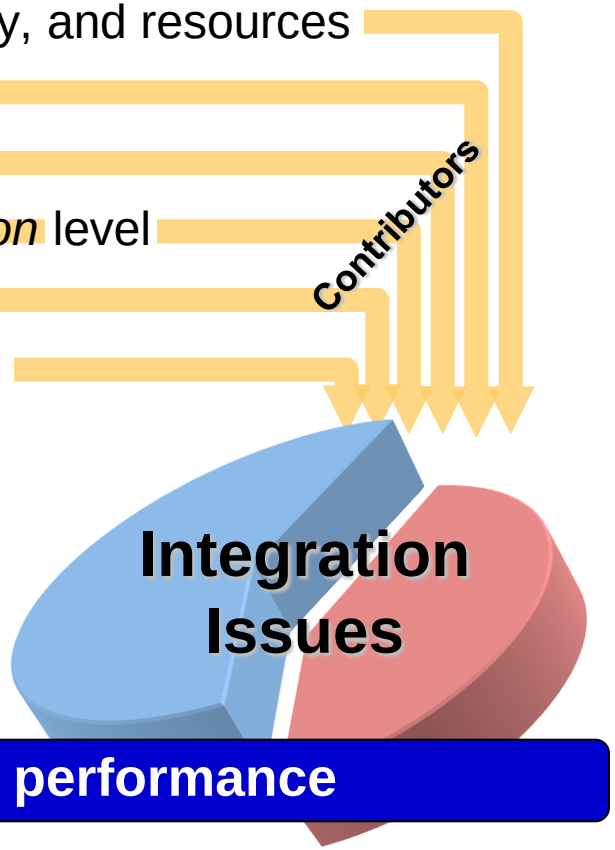
Overall Systemic analysis reveals integration issues in ~45% of Program Support Reviews (PSRs)

but trend is improving…

This past year, of 43 programs examined in depth, only ~25% exhibited integration issues

DoD Systems Engineering Shortfalls*

- **Common failures on acquisition programs include:**
  - Inadequate understanding of requirements
  - Lack of *systems engineering* discipline, authority, and resources
  - Lack of *technical planning* and oversight
  - Stovepipe developments with late *integration*
  - Lack of subject matter expertise at the *integration* level
  - Availability of systems *integration* facilities
  - Incomplete, obsolete, or inflexible architectures
  - Low visibility of software risk
  - Technology maturity over estimated

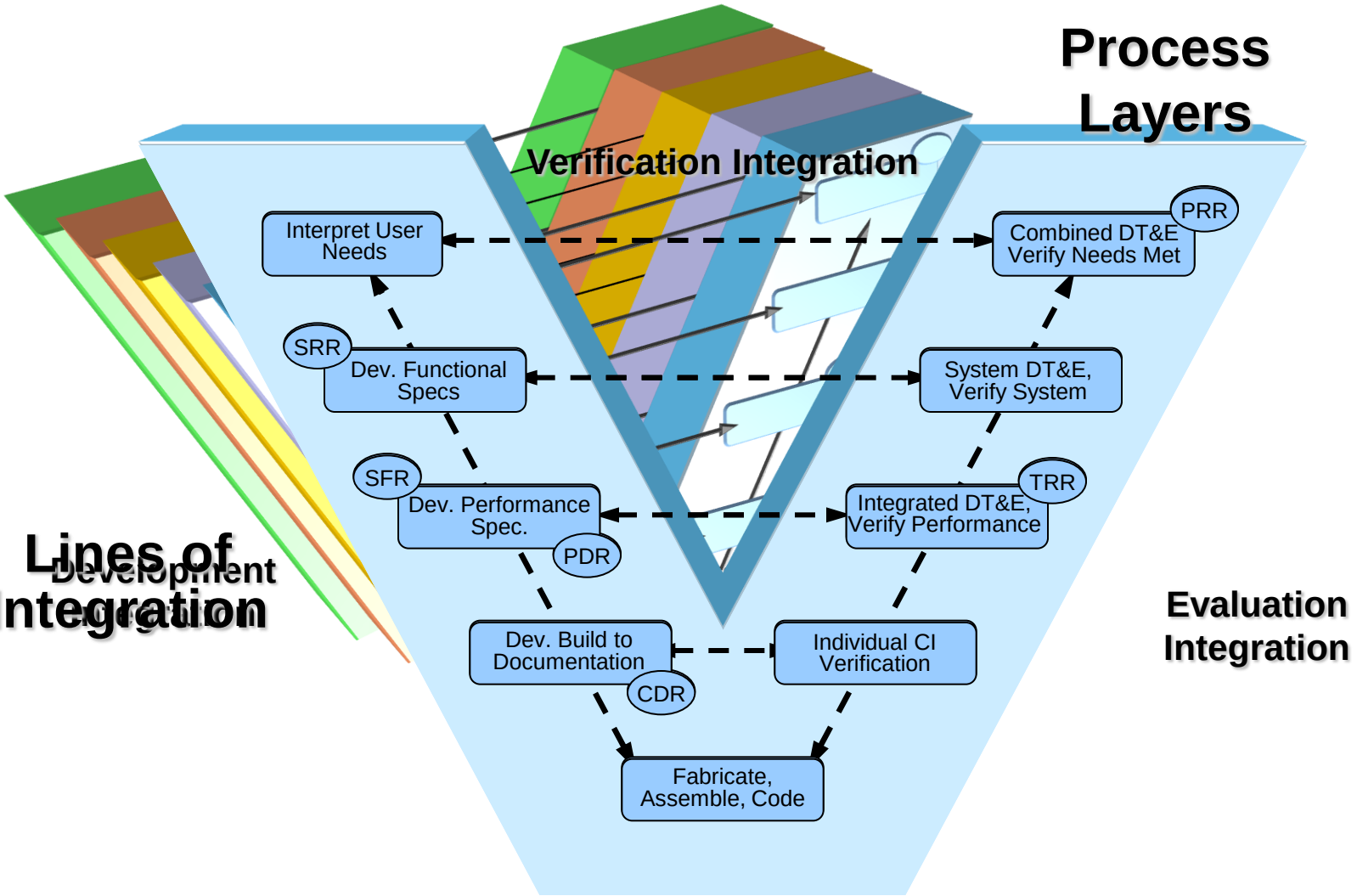


Major contributors to poor program performance stem from integration issues

Major contributors to poor program performance

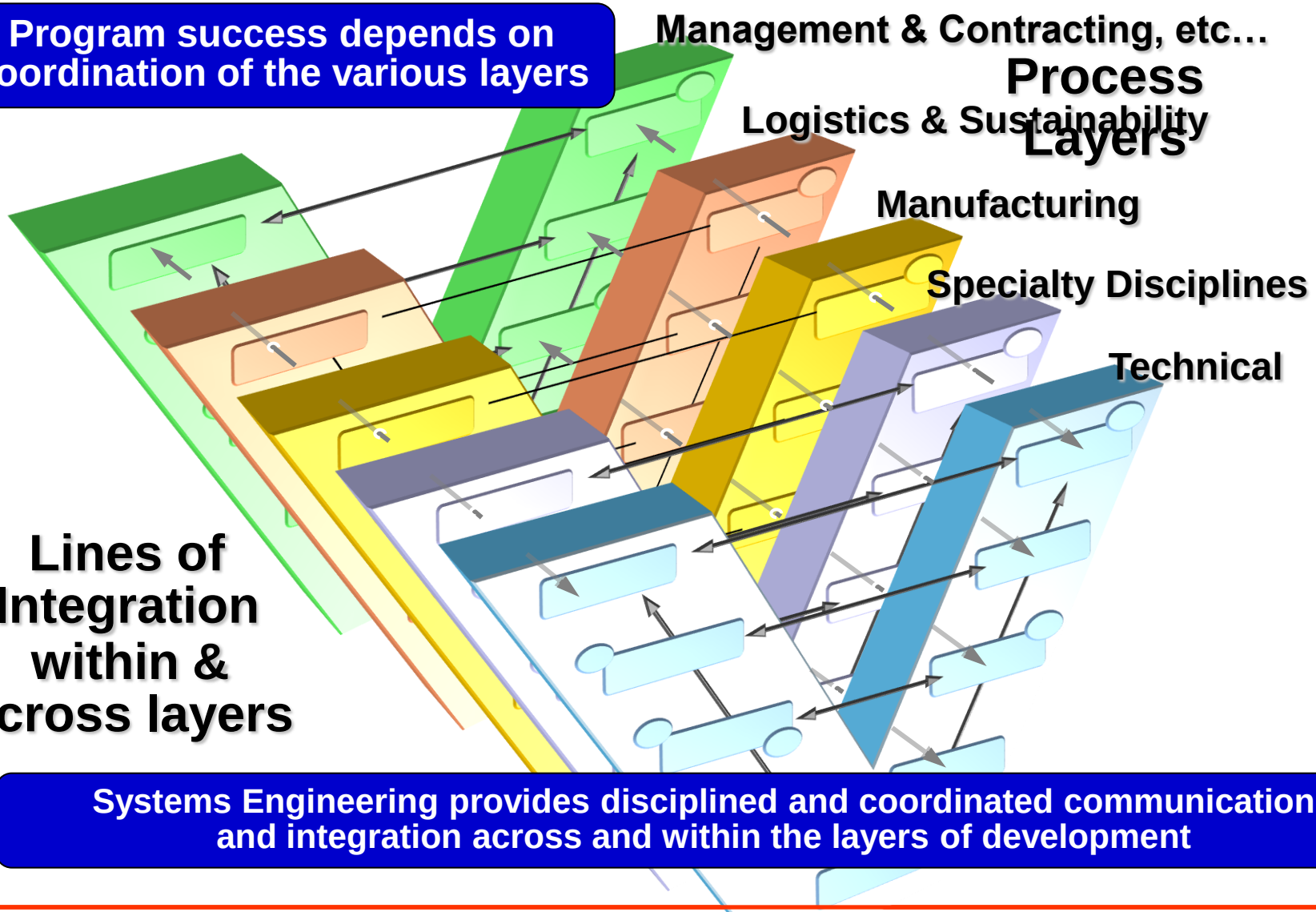
**** Findings from Program Support Reviews and DoD-directed Studies/Reviews 2004-2010***

Systems Engineering Layers



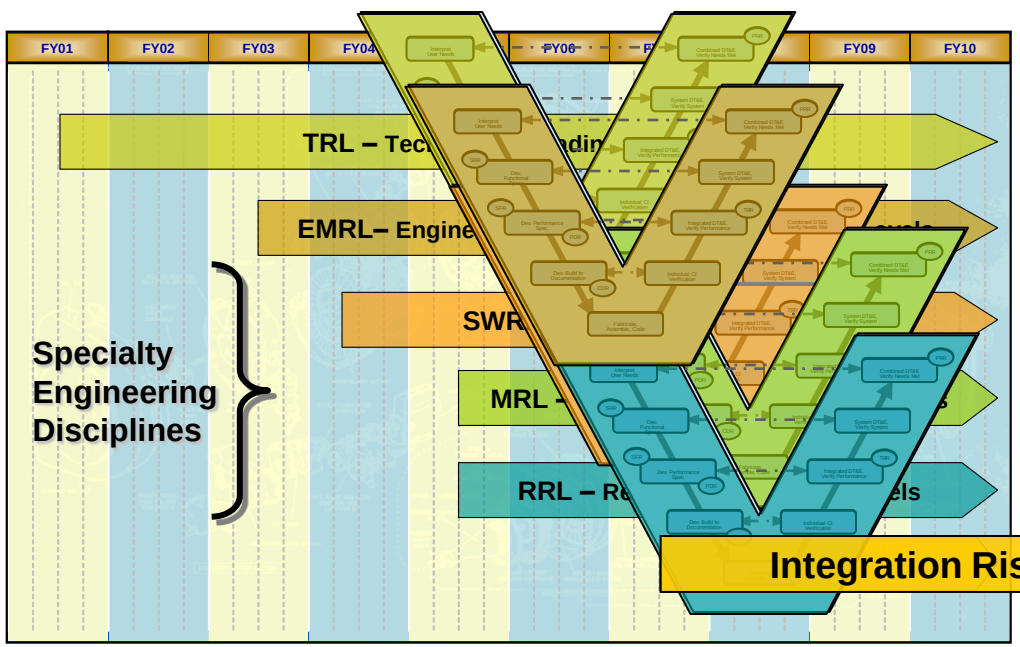
Systems Engineering Layers

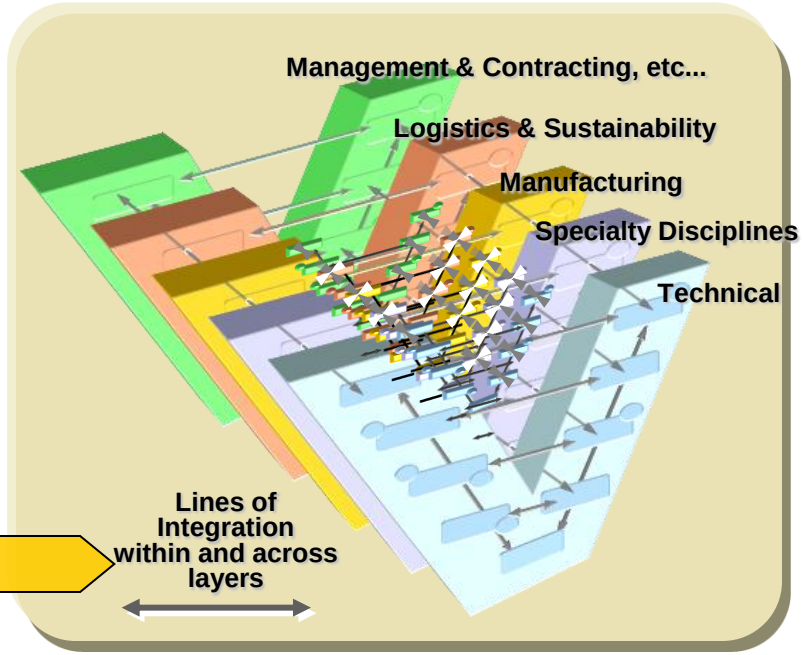
Program success depends on coordination of the various layers



Systems Engineering provides disciplined and coordinated communication and integration across and within the layers of development

Addressing The Problem FY09-10





- Original thinking was to address Integration risk similar to the "Readiness Level" concepts of Manufacturing, Reliability, SW, Technology…
- Integration is the connections between the other specialties – Initial result: a series of questions to the assess "readiness" to couple the "layers"

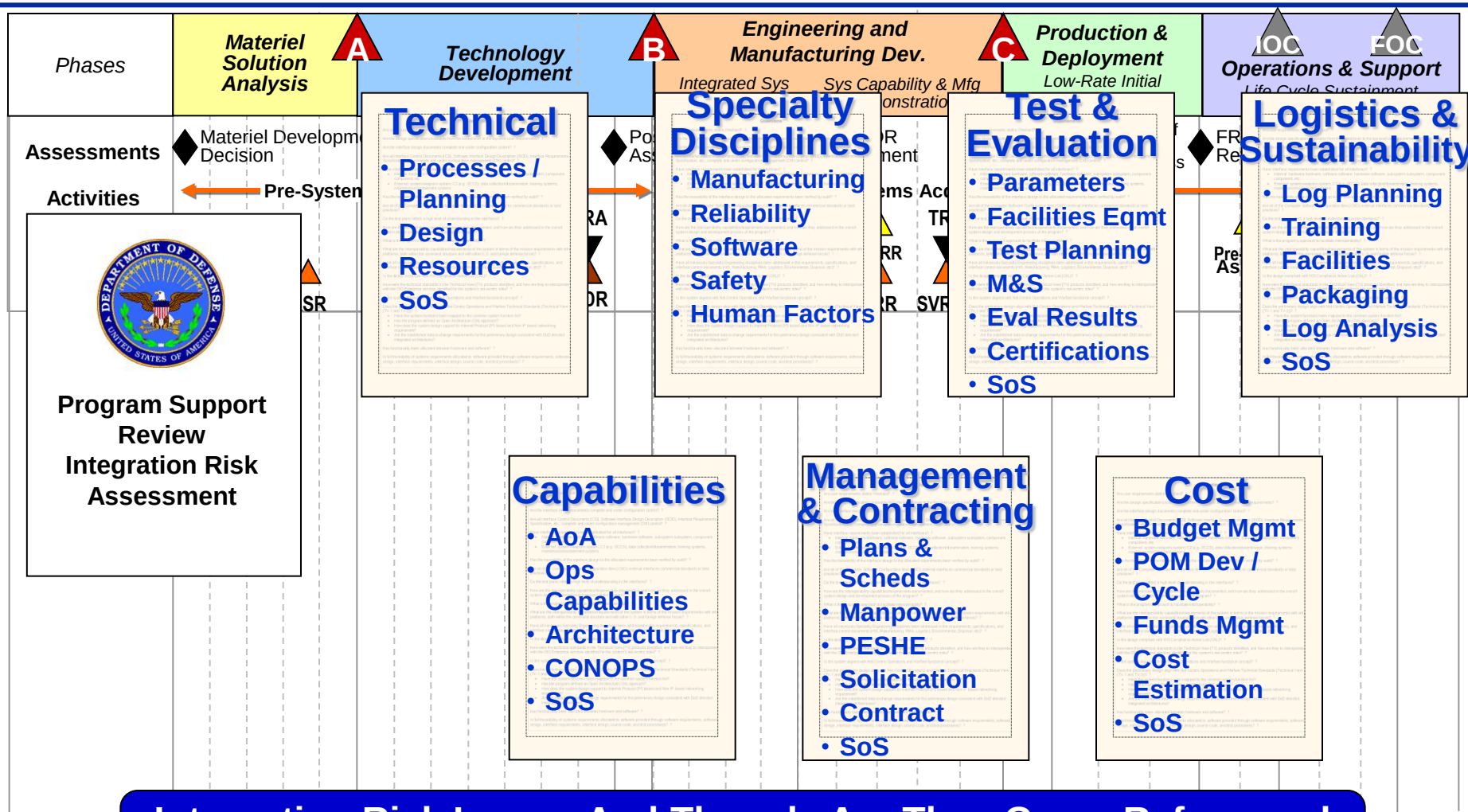
FY09-10 Integration Risk Program Support Review Questions

Integration Risk Questions (Multi-Sourced Document)

- DoDI 5000.02, Operation of the Defense Acquisition System Interim Defense Acquisition Guidebook (DAG)
- Defense Acquisition Program Support (DAPS) Methodology
- NAVAIR System Engineering Technical Review (SETR) Resource Kit
- Air Force's Risk RI3 Guidebook

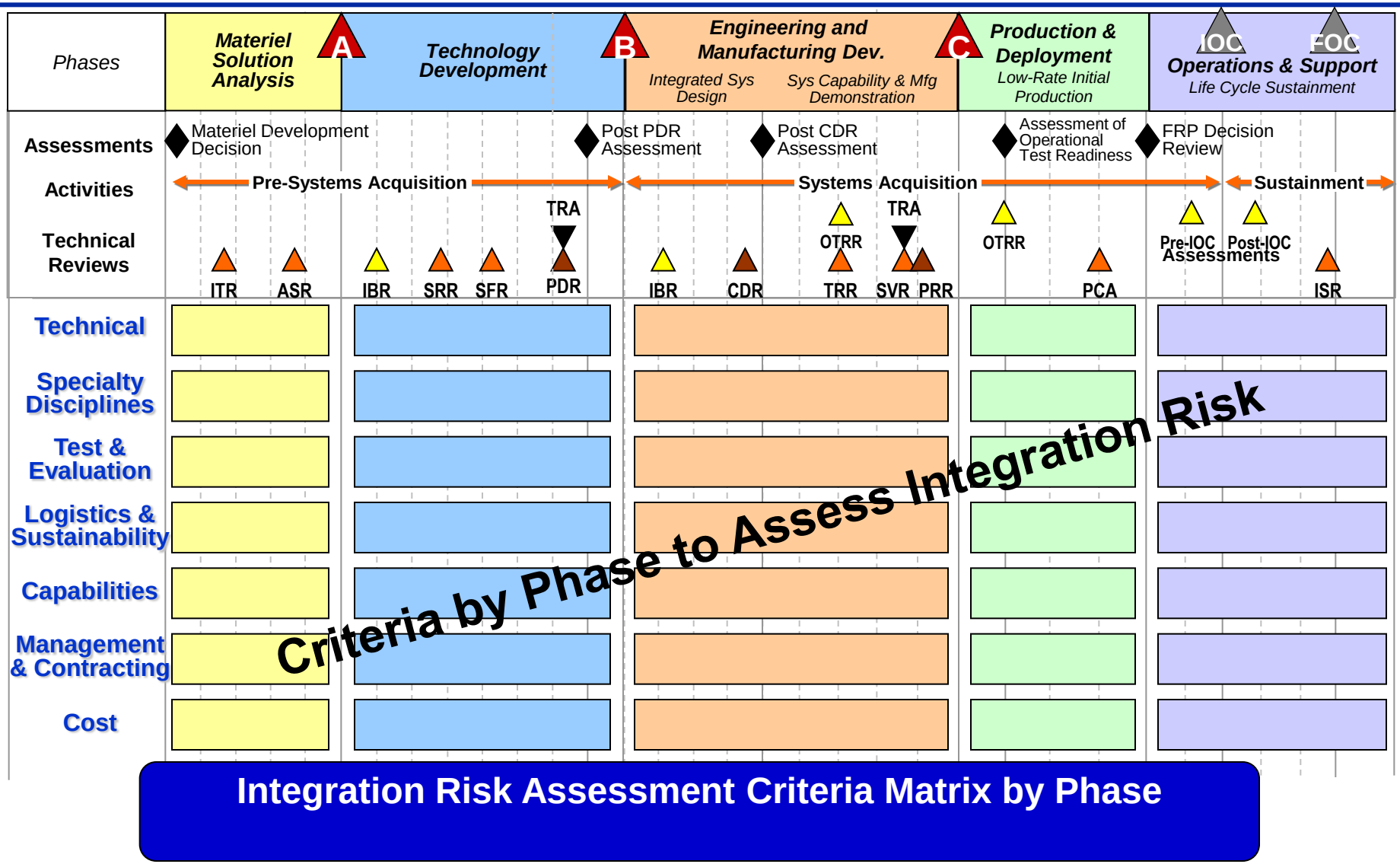
Program Support Review Integration Risk Assessment

Integration Risk Criteria Matrix Spiral 1.0



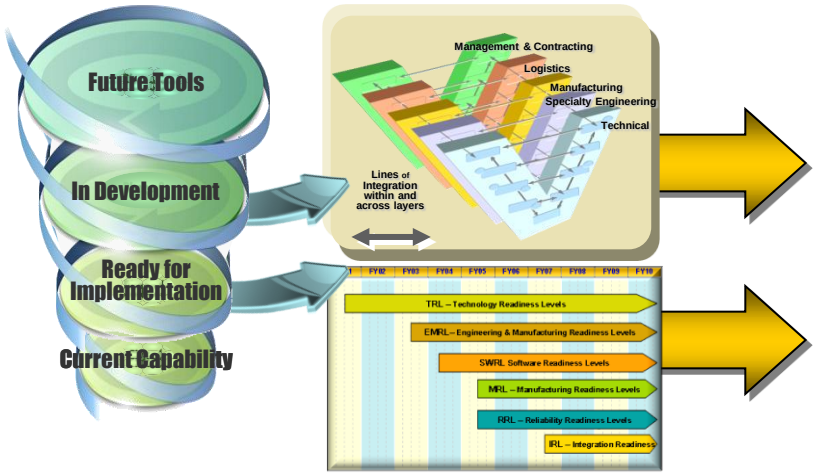
Integration Risk Layers And Threads Are Then Cross Referenced Across The Lifecycle, Establishing Phased Criteria

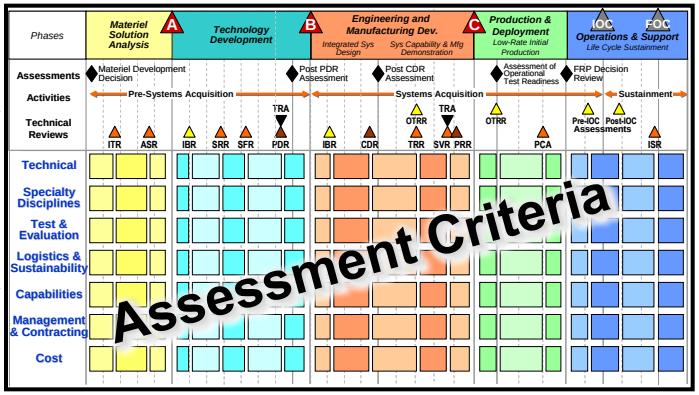
Integration Risk Criteria Matrix Spiral 1.0



Integration Risk Assessment Criteria Matrix by Phase

Awareness and Lessons Learned





Lessons Learned

- Readiness Level approach aggregates issues losing insight
- Multi-dimensional approach good, but "layer" categories not crisp
- Technology integration (WSARA focus) is not THE driver of integration issues

DoD-wide Awareness

- Increased focus throughout the Department on Integration risk
- Assessment Criteria serve better as "Good Practice" type guidance adopted by programs (Notable examples)

FY09-10 development provided valuable insight for next spiral

FY10 Notable Efforts

Notable Program Efforts

- Air and Missile Defense Radar (AMDR) – Open Architecture with Integration IPR prior to MS-B
- Ground Combat Vehicle (GCV) –Subsystem prototypes integrated on surrogate vehicles
- Ohio Replacement Program (ORP) – Mature integration processes & integration facilities
- Cooperative Engagement Capability (CEC) - Navy Open Architecture Computing Environment (OACE) compliant
- JLENS – Dedicated System Integration Cross Product Team (CPT) working integration
- AIAMD –Working Group coordinating Interface Control Documents across team
- P-8A –Integration Readiness Reviews; >20,000 SIL Hours, 6,000 test problem reports
- JMS (JSPOC) – Conducting technical interchanges and integration risk reduction activities.
- SDBII –Joint Interface Control Working Group to facilitate weapon system integration
- >20 Programs implementing SOAs

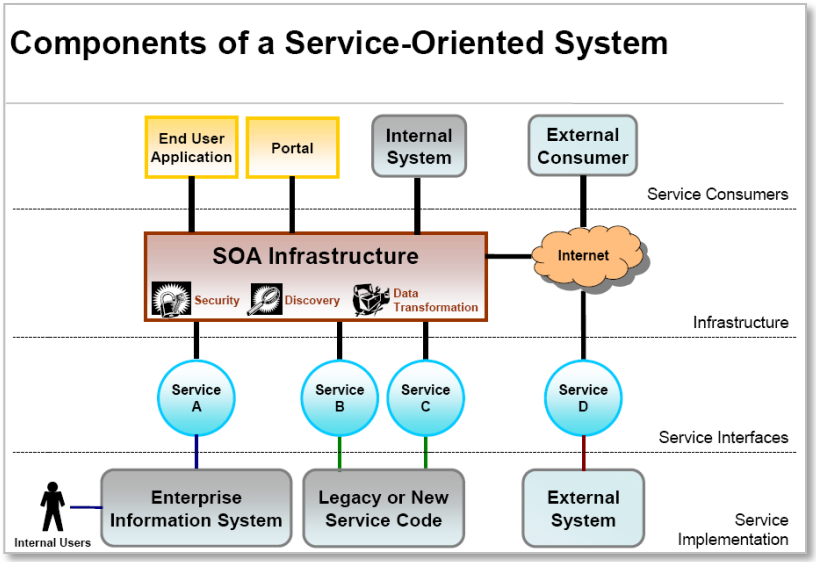
Integration Challanges

- Pgm A – Disconnect between Mission and Functional decomposition
- Pgm B – Performance across all connectivity paths not adequately planned or executed.
- Pgm C – Sensors and Platform developed separately without schedule/funding/and contractual linkages
- Pgm D – Lack Architectural views of system
- Pgm E – Methodical build up of integrated system not accomplished
- Pgm F – Integration across system nodes not adequately planned
- Pgm G – DoD programs not available in time frame needed to integrate with system

Integration Awareness Increasing… Performed 43 Integration Evaluations: 20 Positive, 12 Negative, and 11 Neutral

Open System Architecture Initiatives

- **Programs implementing Service Oriented Architectures (SOA)**
  - ISPAN
  - AOC WS
  - CANES
  - BCTM
  - NCES
  - AOC-WS
  - BTA program
  - KMI
  - PKI
  - MCSC M&JIC
  - SSWG
  - GV-ES
  - TEDS JCTD
  - JITC-G
  - GCSS-AF
  - ECSS
  - EHR
  - NGEN



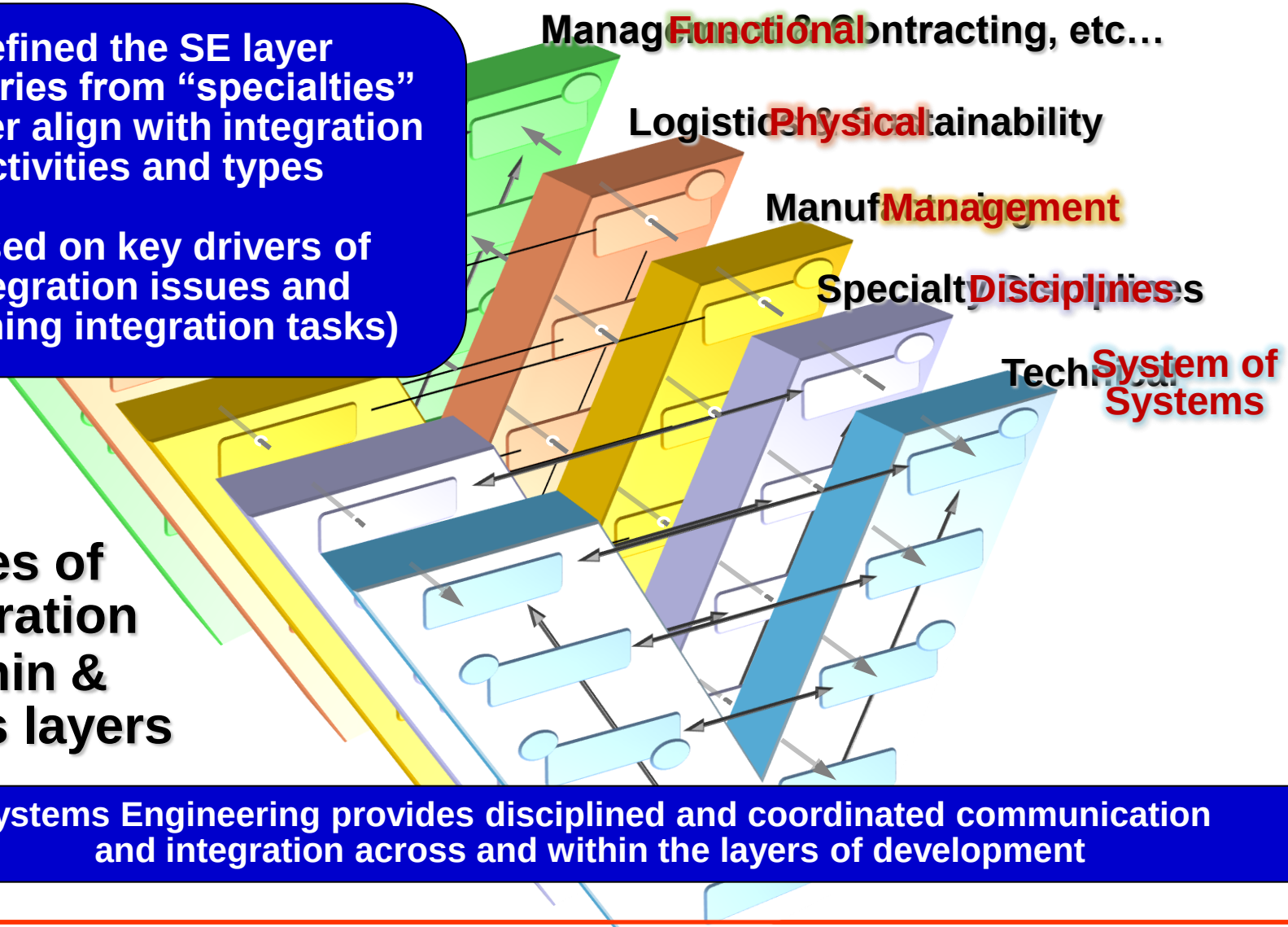
Software Engineering Institute, Carnegie Mellon

- **Overall SOA Integration benefits**
  - Reusable functionality and interfaces
  - Loosely-coupled functions that are not required to be installed onto platforms
  - Standards-based design – greater degree of rigor to interface specifications
  - Multi-Service SOA Consortium – DoD programs implementing SOA environments meet and share experiences and best-practices

Refined / Aligned Multi-Dimensional Layer Definitions

Refined the SE layer categories from "specialties" to better align with integration activities and types

(Based on key drivers of integration issues and matching integration tasks)



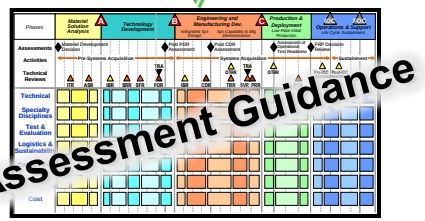
Lines of Integration within & across layers

Systems Engineering provides disciplined and coordinated communication and integration across and within the layers of development

Metrics Development Evolution

Top down

DAP | GAO Repo | USI SET | AF RI3 | 5000.2



Bottoms Up

Systemic integration issues from PSR Database

- Lessons Learned
- Notable Practices
- Integration Focus

Vision:

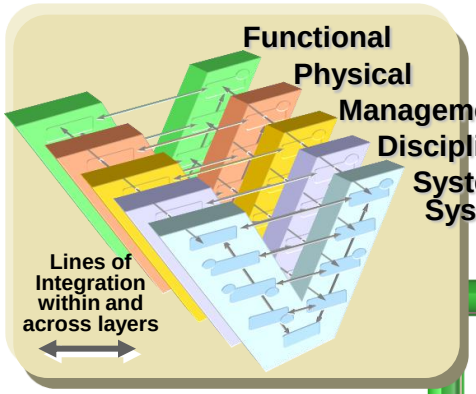
- Measures that change over time
- Streamline multi-dimensional layers
- Focus on documented integration issues

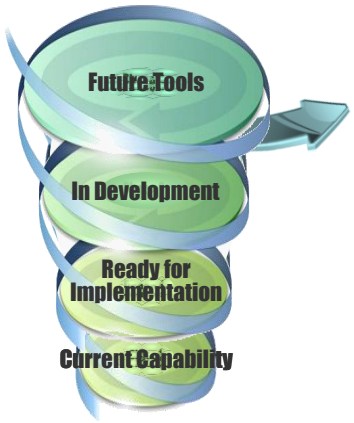
Realignment

- Functional
- Physical
- Management
- Disciplines
- SoS

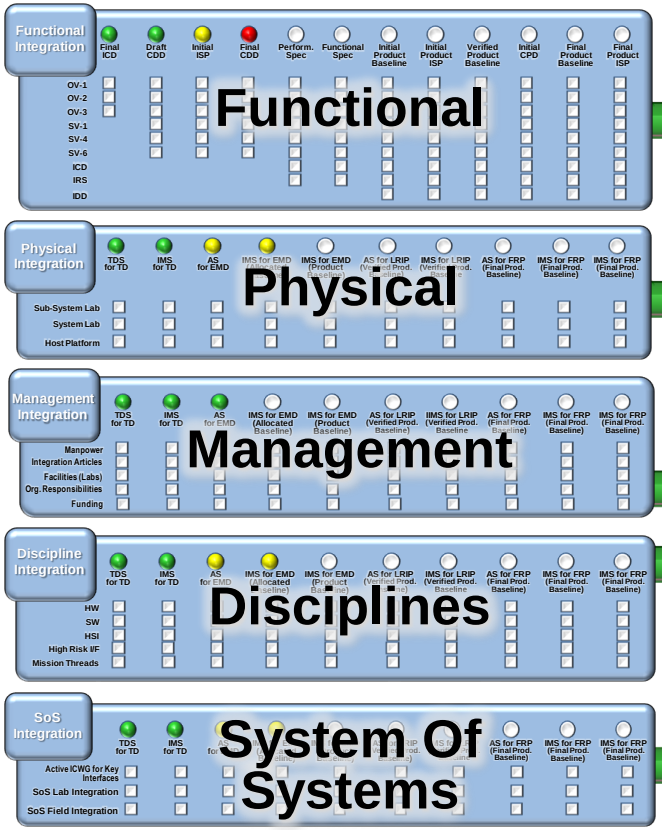
Consolidated Integration Risk Metrics

Qualitative and Quantitative Metrics Development





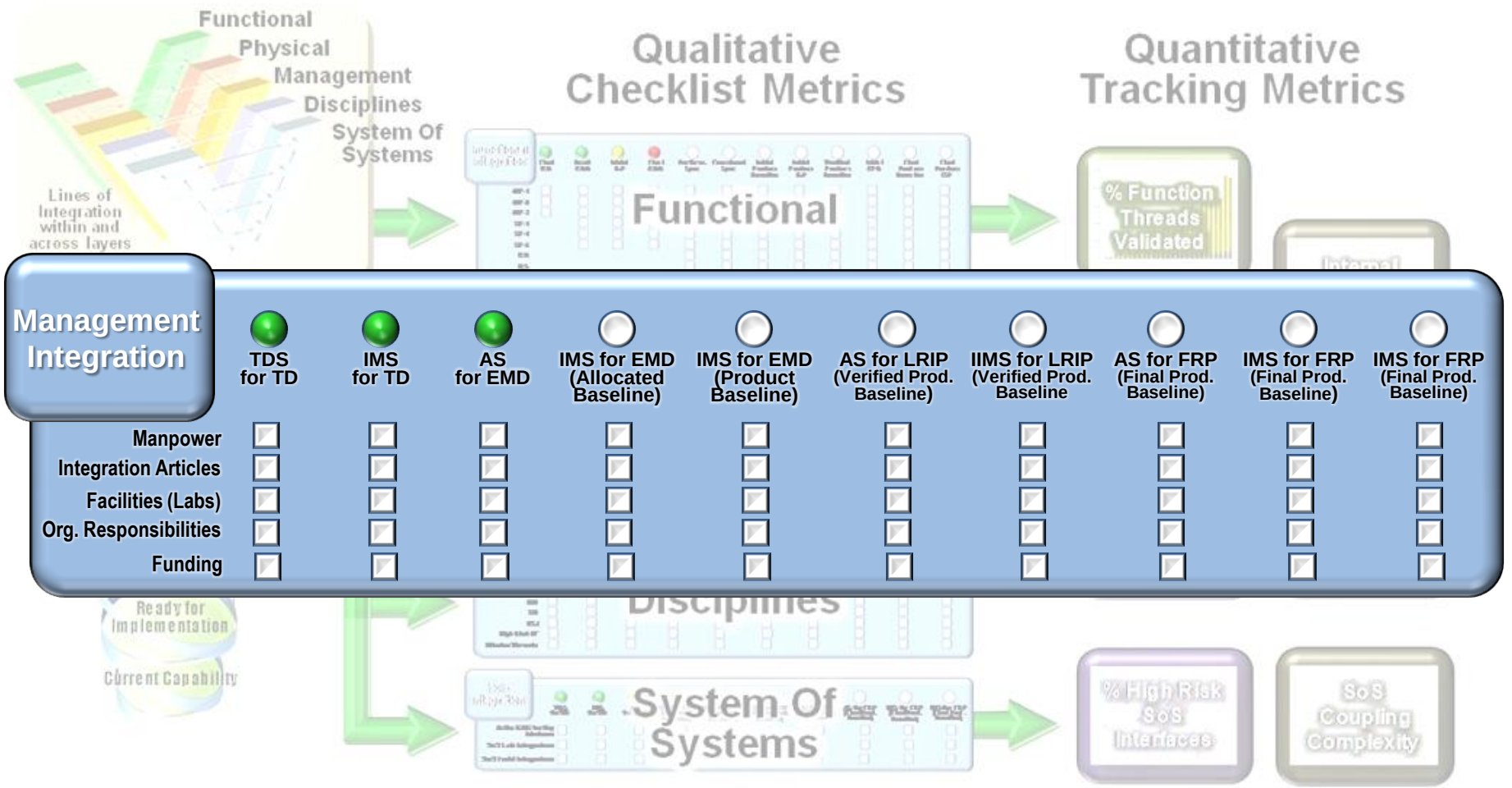
Qualitative Checklist Metrics



Quantitative Tracking Metrics

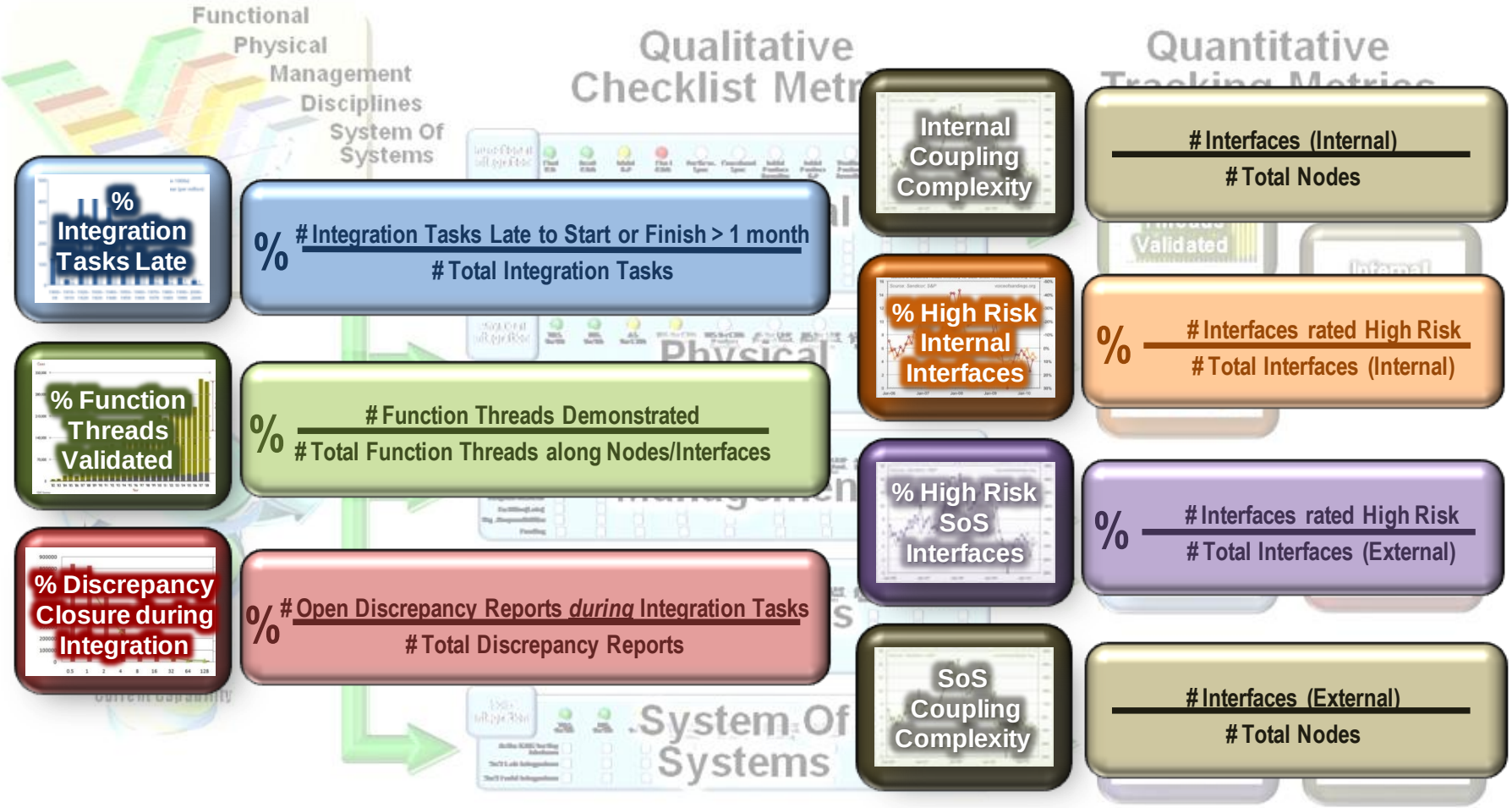
Qualitative and Quantitative Integration Metrics

Notional Example of Qualitative Checklist Metrics Development



Qualitative Integration Metrics

Notional Example of Quantitative Tracking Metrics Development



Quantitative Integration Metrics

Key Characteristics of Addressing Integration Risk

- Sensitive to phases of acquisition Life-Cycle development
- Measures and Threshold expectations on a:
  - DAES (3 mo cycle)
  - Annual Report cycle
  - Milestone cycle
- Planning and execution of integration tasks
- Multi-Dimensional contribution of functions, disciplines, etc.
- Provides Governance
- Indicates rate of change
- Coupling complexity (not all integration is equal)

Time-sensitive Qualitative and Quantitative Integration Metrics

Path Forward

- **Implementing Systems Engineering guidance:**
  - **Socialize "Good" practices to prevent integration issues**
  - **Update Defense Acquisition Program Support (DAPS) methodology**
  - **Emphasize Integration processes and tasks**
- **Implementing Risk Assessment and Metrics:**
  - **Pilot Program**
  - **Full Scale**
  - **Engage with industry and academia**
- **Implementing AT&L Affordability Initiatives:**
  - **Early SE**
  - **Execution via Touch points**
  - **Integration as part of RFP's and Contracts**

Institutionalizing Integration Risk Assessment

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For Additional Information

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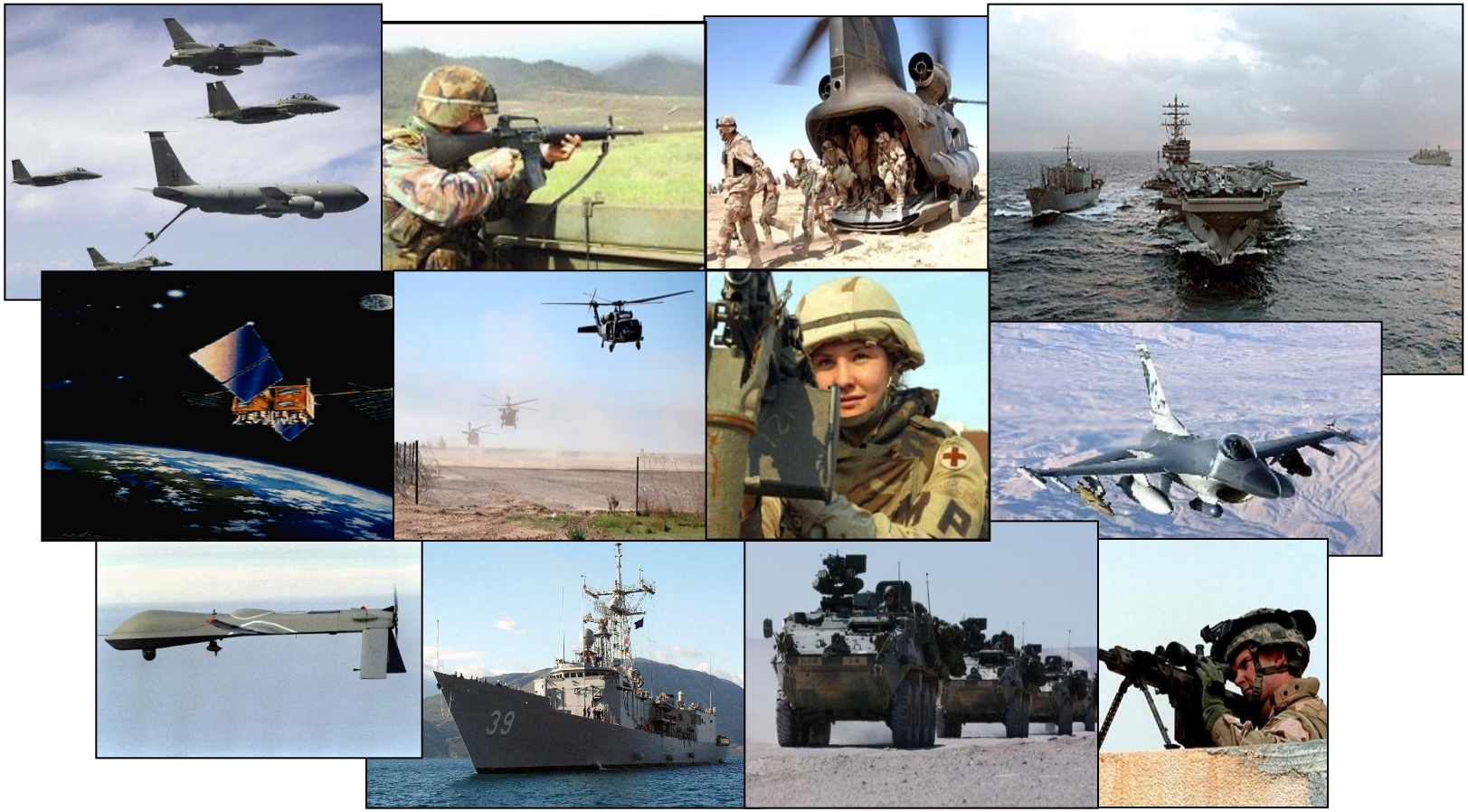
Systems Engineering: Critical to Program Success



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