Systems Engineering Plans: A Key Systems Engineering Tool

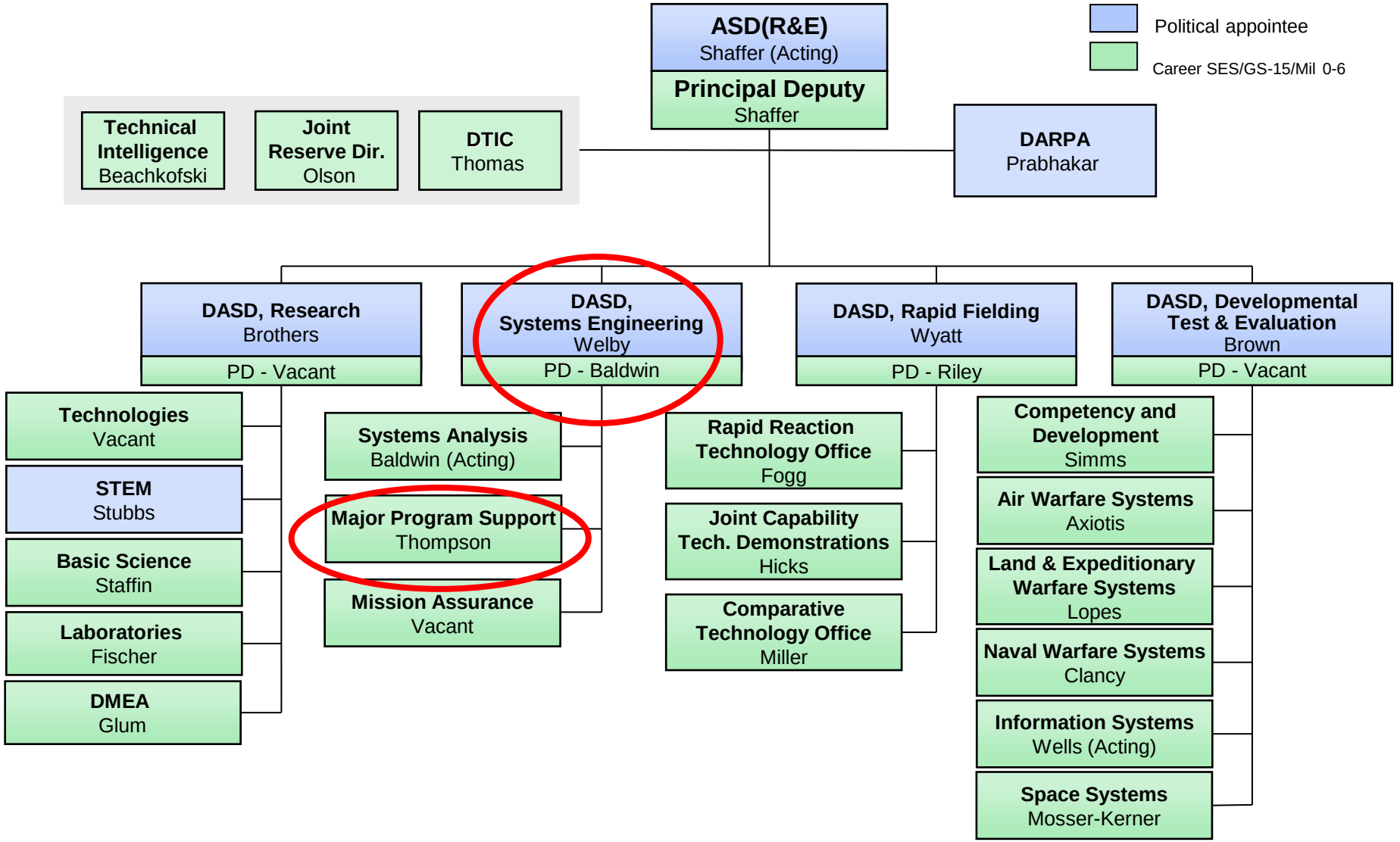
Mr. Scott Menser

Major Program Support

Office of the Deputy Assistant Secretary of Defense for Systems Engineering

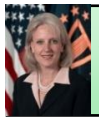
April 29, 2014

ASD(R&E) Organization



DASD, Systems Engineering

DASD, Systems Engineering
Stephen Welby
Principal Deputy Kristen Baldwin



Systems Analysis
Kristen Baldwin (Acting)

Addressing Emerging Challenges on the Frontiers of Systems Engineering

- Analysis of Complex Systems/Systems of Systems
- Program Protection/Acquisition Cyber Security
- University, FFRDC and Industry Engineering and Research
- Modeling and Simulation

Major Program Support
James Thompson

Supporting USD(AT&L) Decisions with Independent Engineering Expertise

- Engineering Assessment / Mentoring of Major Defense Programs
- Program Support Reviews
- OIPT / DAB / ITAB Support
- **Systems Engineering Plans**
- Systemic Root Cause Analysis

Mission Assurance
Vacant

Leading Systems Engineering Practice in DoD and Industry

- Systems Engineering Policy & Guidance
- Development Planning/Early SE
- Specialty Engineering (System Safety, Reliability and Maintainability Engineering, Quality, Manufacturing, Producibility, Human Systems Integration)
- Counterfeit Prevention
- Technical Workforce Development
- Standardization

Providing technical support and systems engineering leadership and oversight to USD(AT&L) in support of planned and ongoing acquisition programs

DASD, Systems Engineering Mission

Systems Engineering focuses on engineering excellence – the creative application of scientific principles:

- To design, develop, construct and operate complex systems
- To forecast their behavior under specific operating conditions
- To deliver their intended function while addressing economic efficiency, environmental stewardship and safety of life and property

DASD(SE) Mission: Develop and grow the Systems Engineering capability of the Department of Defense – through engineering policy, continuous engagement with component Systems Engineering organizations and through substantive technical engagement throughout the acquisition life cycle with major and selected acquisition programs.

- ***US Department of Defense is the World's Largest Engineering Organization***
- ***Over 99,000 Uniformed and Civilian Engineers***
- ***Over 39,000 in the Engineering (ENG) Acquisition Workforce***

A Robust Systems Engineering Capability Across the Department Requires Attention to Policy, People and Practice

Value of System Engineering Plans

- **Provides means to develop, document and approve a program's technical strategy**
  - Basis for cost/schedule baselines at MS reviews
  - Development prior to RFP release ensures precludes program start-up issues
- **The Program's technical planning and management manual**
  - Blueprint for conduct, management, and control of program's technical aspects
  - Reflects both Government & contractor activities, roles, and responsibilities
  - Uses "plain speak" language to communicate what programs are doing
  - Answers the "who, what, why, when, and how" questions associated with technical processes and management activities
- **SEPs should be a "go to" technical planning and management manual**
  - Should be a "living document" and not "shelf-ware"
  - Be consistent with all program documentation
  - Hotlinks to key documents maintains SEP currency and reduce its size

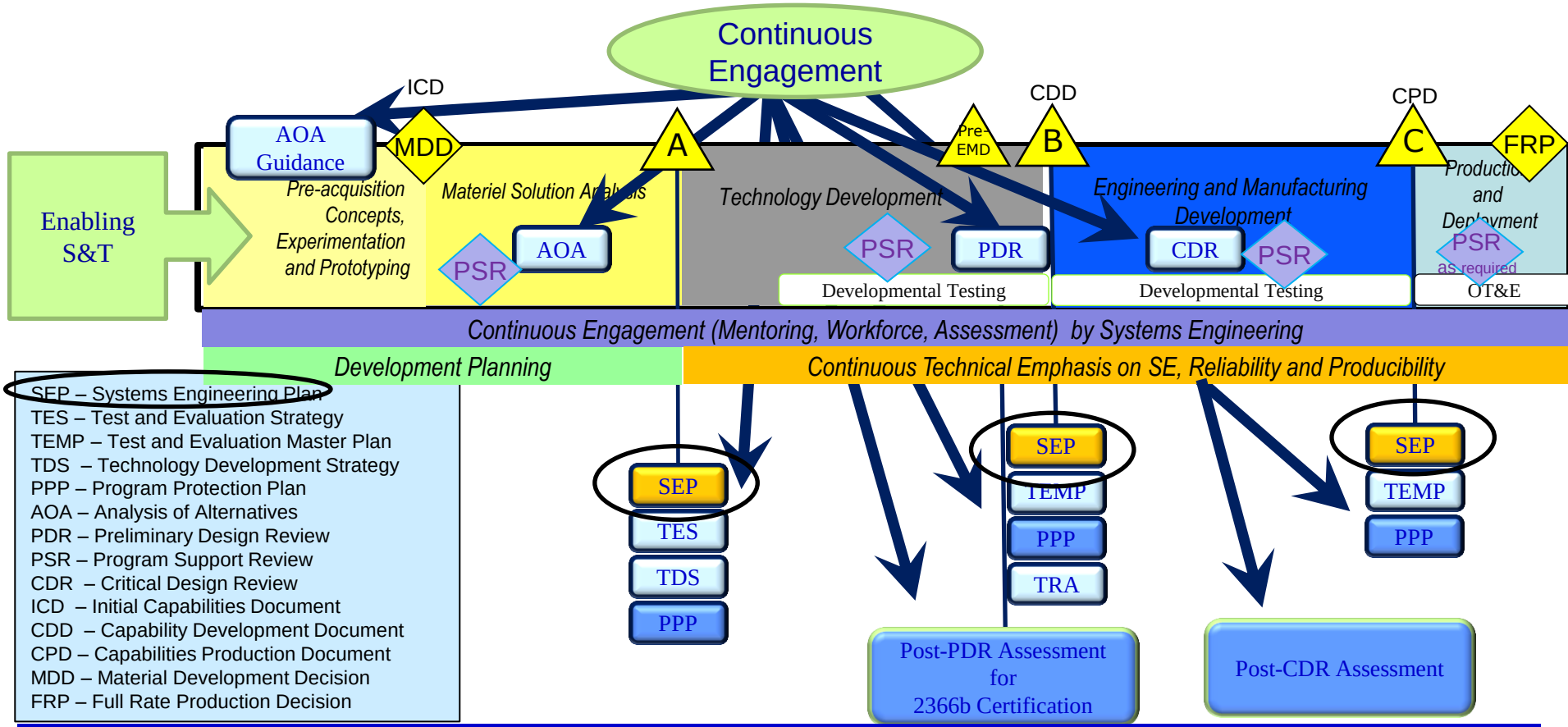
Forcing function to think through what you need to deliver a quality product on time and within budget

New SEP Outline Content and Purpose

Key Sections	Rationale
1. Introduction	• Tracks revision control
2. Program Technical Requirements 2.1. Architectures and Interface Control 2.2. Technical Certifications	• Summarizes the expected architecture products, external interfaces, and links to common architectures • Identifies required system-level certifications
3. Engineering Resources and Management 3.1. Technical Schedule and Schedule Risk Assessment 3.2. Engineering Resources and Cost/Schedule Reporting 3.3. Engineering and Integration and Risk Management 3.4. Technical Organization 3.5. Relationships with External Technical Organizations 3.6. Technical Performance Measures and Metrics	• Documents integrated, event-driven system development schedule including WBS and IMP/IMS • Describes risk management process and organization; identifies system-level technical risks and opportunities • Diagrams technical structure and staffing (e.g., IPTs, Working Groups, etc.) • Identifies management of outside organizational interfaces • Describes program's use of metrics to measure technical progress
4. Technical Activities and Products 4.1. Results of Previous Phase SE Activities 4.2. Planned SE Activities for Next Phase 4.3. Requirements Development and Change Process 4.4. Technical Reviews 4.5. Configuration and Change Management Process 4.6. Design Considerations 4.7. Engineering Tools	• Summarizes completed system-level technical reviews, independent reviews, and trade studies and analogous plans for the next phase • Describes processes for requirements analysis, decomposition, and change management • Summarizes technical review planning details and responsibilities • Lists technical baseline artifacts and describes their management • Identifies relevant design considerations and linkage to contracts • Lists tools and required tool interfaces, if necessary

DASD(SE) Program Engagements

SE has a role in all major acquisition program milestone decisions and oversees and executes critical acquisition risk management processes to reduce program cost, acquisition time and risk.



Cross-Cutting Efforts: Acquisition Workforce Management, Engineering Policy and Guidance, Advocacy for Service Competencies and Initiatives, STEM Initiatives

SEP History

2004
- Wynne Memo Establishes SEP Requirements

SEP guidance evolves
- 1.0 2005
- 1.5 2006
- 2.0 2007

2008
- DoDI 5000.02

2009
- Public Law 111-23 WSARA Establishes DASD(SE)
- DTM 09-027 Implementation memo assigns SEP signature authority to DASD(SE)

2010
- Better Buying Power Memo

2011
- DoDI 5134.16 codifies requirement for MDAP and MAIS SEPs
- Acquisition Streamlining Memo sets new SEP content expectations in outline.
- Improving Milestone Process Effectiveness Memo establishes Pre-EMD review

2012
- Better Buying Power 2.0 Memo

2013
- DAG Chapter 4 Systems Engineering released
- DoDI 5000.02 currently in draft

SE technical planning, documented in the SEP, identified as an indicator of future success.

Mandatory Systems Engineering Tables

SEP Update Record

Revision Number	Date	Log of Changes Made and Description of Reason Changes	Approved By
0.7		Addressed Lead Systems Engineer's (LSE's)	

Memoranda of Agreements

REQUIRED MEMORANDA OF AGREEMENT				
Interface	Cooperating Agency	Interface Control Authority	Required By Date	Impact if Not Completed

Certification Requirements

Certification	PMO Team/PoC	Activities to Obtain Certification[1]	Certification Authority	Expected Certification Date
Airworthiness	Airframe IPT			2Q FY2

IPT Team Details

Team Membership (by Function or Organization)	Team Role, Responsibility, and Authority	Products and Metrics
• Program Office • Platform Lead	Role: IPT Purpose	Products: SEP/SEP Updates

Technical Performance Measures

Name	Responsible Position /IPT	KPP or KSA	Performance Spec.	PDR Status Actual	MS B Status Actual	CDR Status Actual	MS C Status Planned	FRP Status Planned
amic Drag	SE IPT		<222	225	223	220	187	187

Technical Review Details

XXX Details Area	XXX Review Details (For this acquisition phase, fill out tailored criteria, etc.)
Chairperson	Identify the Technical Review Chair (Normally the LSE)

Design Considerations

Mapping Key Design Considerations into Contracts					
Name (Reference)	Cognizant PMO Org	Certification	Documentation (hot link)	Contractual Requirements (CDRL #)	Description/Comments
SE Tradeoff Analysis for			(MS B)		Provide the systems engineering trade-off analysis

R&M Activity Planning and Timing

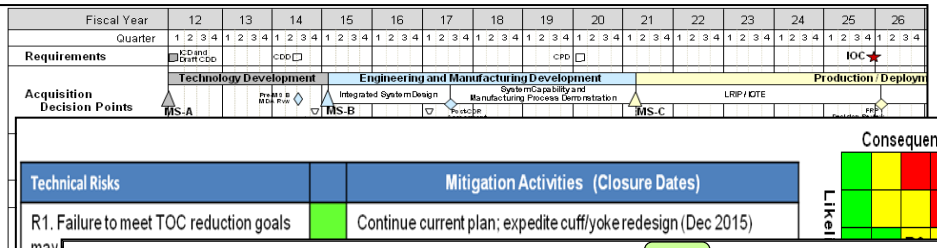
R&M Engineering Activity	Planning and Timing
R&M Allocations	

Engineering Tools

Engineering Tool	Purpose	Position/IPT Responsibility
IMS		
IBM®Rational® DOORS®	Requirements Traceability and Verification Methodology and Completion	SE IPT/Rqmts Manager
Requirements Verification Matrix (RVM)	Requirements Verification	

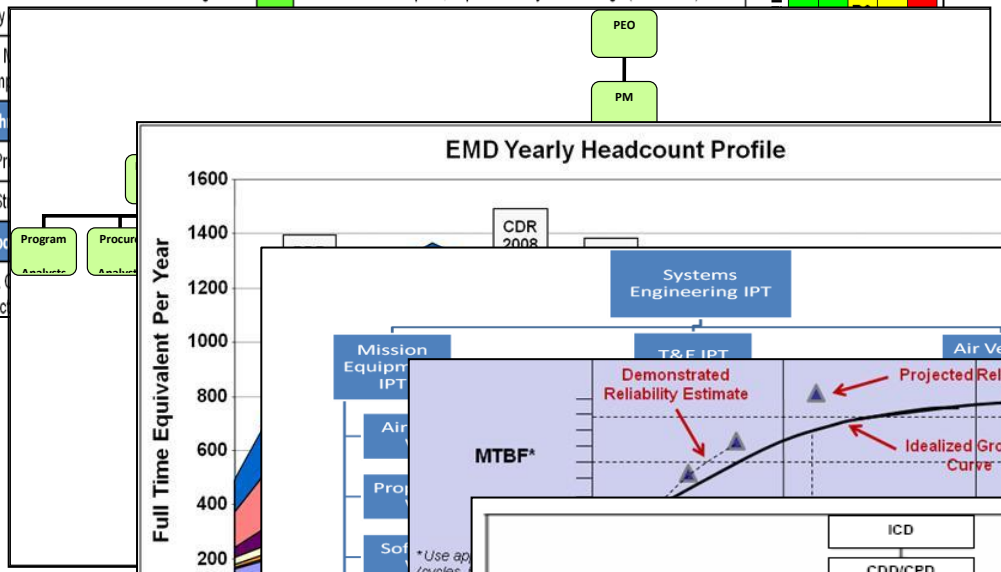
Data-driven SEPs enable assessment of Execution to Plan

Mandatory Systems Engineering Figures



Technical Schedule

Risk Cube



Program Office Organization

Program Technical Staffing

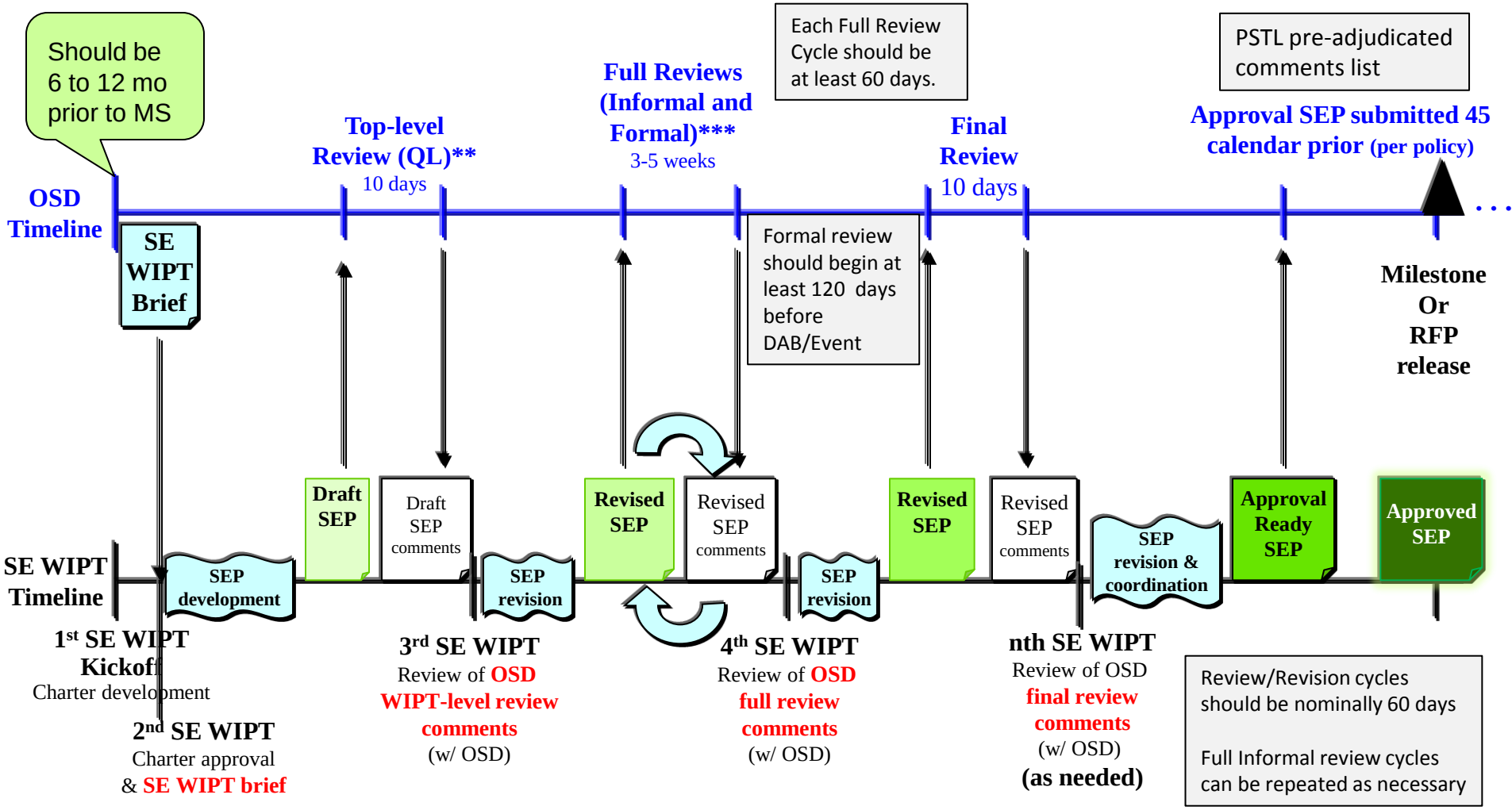
IPT/WG Team Hierarchy

Reliability Growth Curve

Specification Tree

Configuration Management Process

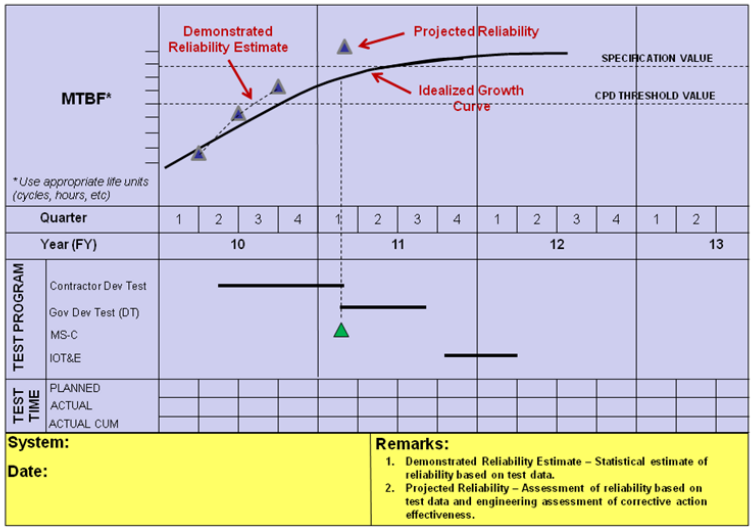
SEP Development Notional Timeline*



*Not to scale **Top-level Review: Week-long showstopper review ***Full Review: 2-3 week detailed review

Consistent Challenges

- **Quantitative Planning**
  - Reliability Growth Curves
    - Sufficient SME knowledge of reliability growth requirements doesn't seem to be resident in program offices.
  - Schedule Risk Assessment
    - We need (and can provide) more instruction on SRA.
- **Data as a Driver**
  - Data-driven is a key aspect of our approach to SEPs and programs.
  - Often missing objective or quantifiable assessments
    - For SE technical reviews entry and exit criteria
    - Job of the IPT and the product
  - TPMs not planned with interim values, may not clearly tie to KPPs
  - Other metrics not identified associated with KSAs or other indicators of program progress towards success



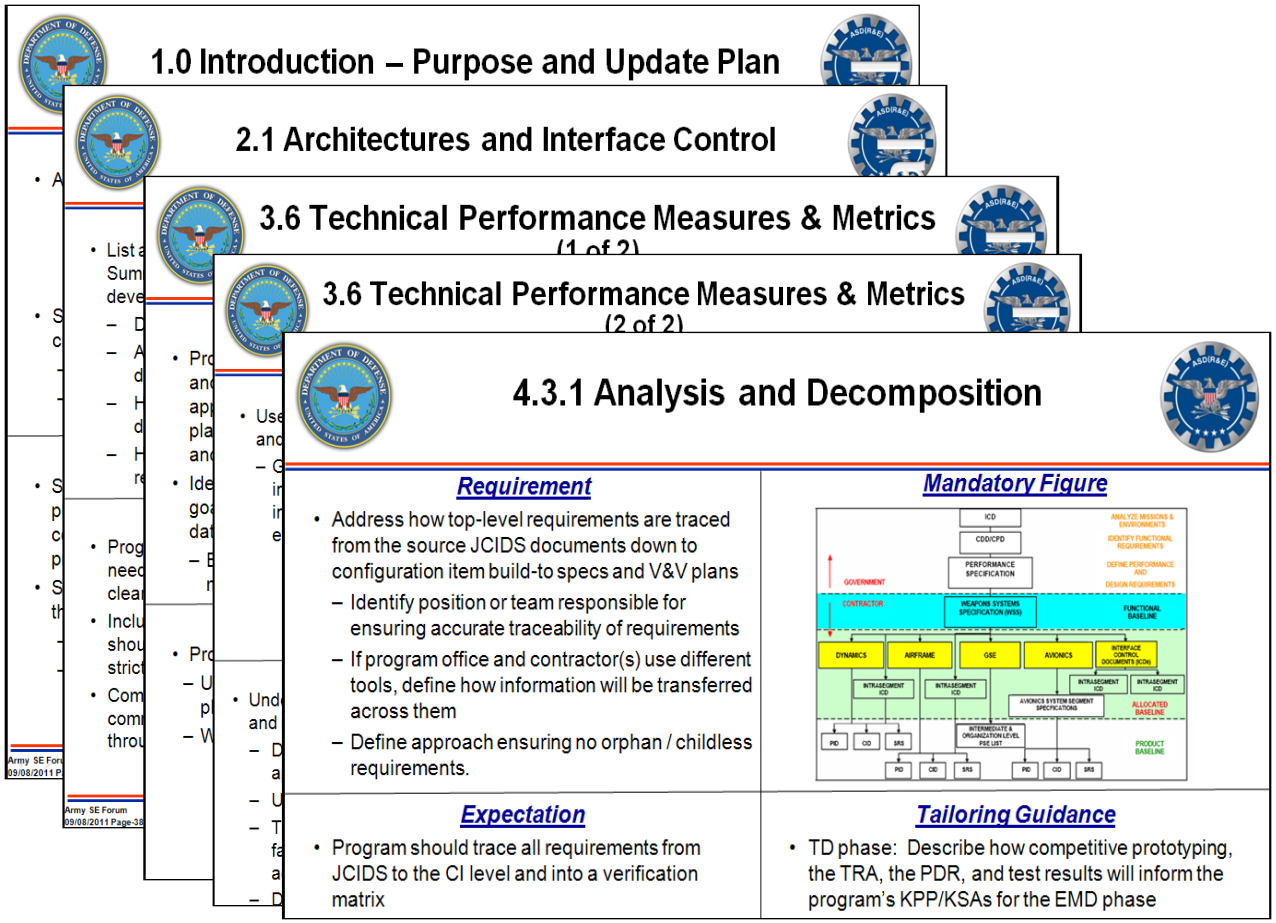
Consistent Challenges - Process

- **Lack of Maturity in Technical Planning**
  - Development of SEPs and related documents are often delayed/postponed – we get many documents incomplete/missing information.
  - Mandated Linked Content (PPP, CPCP, IUID …) is not provided. Check the SEP Outline and DAG 4.1.2 to make sure you know what is needed. Our reviewers expect to see these docs at the appropriate maturity.
  - IMS and IMP (drafts at a minimum) and a WBS are missing.
- **SEP before RFP**
  - A good SEP helps communicate the program's technical approach and demonstrates the sound thinking/planning that supports a quality RFP.
  - Draft DoDI 5000.02 requires Service Component SEP approval for Pre-B DAB.
- **SEP is the responsibility of the Chief Engineer/ Lead SE**
  - Do not delegate development of the SEP and other key documents to the development contractor.
- **Programs don't leverage OSD subject matter experts**
  - Our MA and SA reachback and even DUSD(I&E) and CPO will provide support. It is like free consulting.

Focus Areas

- **Collaborative SEP development with OSD and other Stakeholders**
  - Early and often
- **Complete technical review planning**
  - Criteria and artifacts fully planned out
- **TPM / Metrics planning**
  - Expected event-phased values
- **Effective risk management outputs**
  - Actual technical risks included
- **Use of referenced documents**
  - Suggested but need to provide the documents

SEP Guidance from Outline



- **SE WIPT supports SEP development and program execution to plan**
- **Training material defines:**
  - Requirements
  - Expectation
  - Mandatory tables & figures
  - Provide tailoring guidance

Quad charts of SEP outline training to program offices

Summary

- **SEPs are a tool to document the program's technical planning approach and empower its implementation**
  - PSRs provide constructive insights to shape the development of the technical planning approach
  - SE WIPTs provide forum for documenting "the plan" and for assessing "execution to plan"
- **SEP outline focuses on expectations in order to reduce development, review and approval timelines**
  - Mandatory tables replace extensive narratives
  - Development of metrics to monitor execution of engineering efforts inform risk mitigation efforts and data driven decisions
- **SE WIPTs are a tool to prepare SEPs**
  - Detailed presentation to be provided at SE WIPT kick-off meetings
  - Clarifies the requirements, expectations, lessons learned to avoid, and mandatory tables
  - SEP preparation should be an "open book"

Additional SEP Training Quads

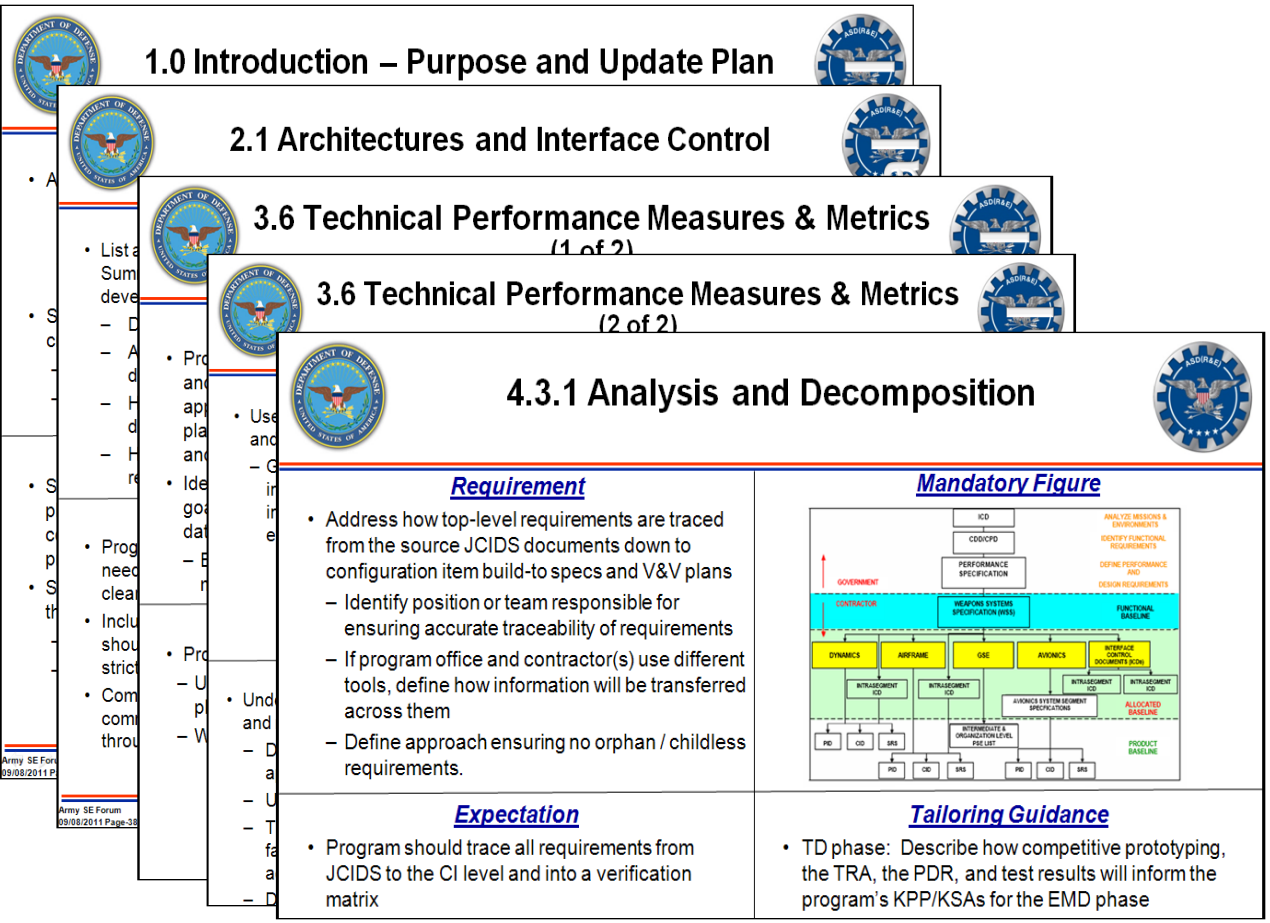
Reference Material

- **Section by Section SEP Guidance**
  - Quad Charts with
    - Requirements
    - Expectations
    - Tailoring Guidance
    - Lessons Learned
    - Some detailed table and figure guidance
  - 1. Introduction
  - 2.1 Architecture and Interface Control
  - 2.2 Technical Certifications
  - 3.1 Technical Schedule and Schedule Risk Assessment
  - 3.2 Engineering Resources and Cost/Schedule Reporting
  - 3.3 Engineering and Integration Risk Management
  - 3.4.1 Government Program Office Organization
  - 3.4.2 Technical Staffing Levels
  - 3.4.3 Contractors Program Office Organization
  - 3.4.4 Engineering Team Organization & Staffing

Backup Material

- **Section by Section SEP Guidance, Continues**
  - 3.5 Relationships with External Technical Organizations
  - 3.6 Technical Performance Measures and Metrics
  - 4.1 Results of Previous Phase SE Activities
  - 4.2 Planned SE Activities for the Next Phase
  - 4.3.1 Requirements Analysis and Decomposition
  - 4.3.2 Requirements Change Management Process
  - 4.4 Technical Reviews
  - 4.5 Configuration and Change Management
  - 4.6 Design Considerations
  - 4.7 Engineering Tools
- **Highlighted SEP Outline**
- **Long form of SEP Content, Rationale & Expectations**
- **Alternate versions of other content**
  - May provide insight into intent for SEP

SEP Guidance from Outline



- **SE WIPT supports SEP development and program execution to plan**
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  - Expectation
  - Mandatory tables & figures
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1.0 Introduction – Purpose and Update Plan

Requirement

- Address:
  - Who will use the Systems Engineering Plan?
  - What is the plan to align Prime Contractor's SEMP with the program office SEP?
- Summarize how the SEP will be updated and the criteria for doing so to include:
  - Timing of SEP updates
  - Updating authority, and approval authorities for different types of updates

Mandatory Table

Revision Number	Date	Log of Changes Made and Description of Reason Changes	Approved By
0.7	April 2008	Addressed Lead Systems Engineer's (LSE's) concerns – see comments in separate file	LSE
0.8	June 2008	Updated Section 1 with draft requirements Added Section 4, Design Verification section	LSE
0.9	October 2008	Addressed SE WIPT (to include Service and OSD) comments – many changes – see Comment Resolution Matrix (CRM)	LSE
Etc.			

Expectation

- SEP should be a "living" "go to" technical planning document and the blueprint for the conduct, management, and control of the programs technical aspects.
- SE planning should be kept current throughout the acquisition lifecycle
  - Consistent with other documentation
  - Defines methods for implementing system requirements having technical content, staffing, and management planning.

Tailoring Guidance

- SEP should be updated after contractor award to reflect winning contractor(s)' technical strategy reflected in SEMP

PSR Lessons Learned

- Incomplete or missing a SEP
- SEP development does not inform the RFP

2.1 Architectures and Interface Control

Requirement

- List architecture products that will be developed. Summarize the approach for architecture development to include:
  - DODAF architecture development efforts
  - A system physical and functional architecture diagram
  - How software architecture priorities will be developed and documented.
  - How architecture products are related to requirements definition

Mandatory Table

REQUIRED MEMORANDA OF AGREEMENT				
Interface	Cooperating Agency	Interface Control Authority	Required By Date	Impact if Not Completed

Required Content

- List external interfaces, fill in all columns.
- External interfaces should be consistent with
- SV-1.

Expectation

- Programs whose system has external interfaces need to have dependencies (i.e., hierarchy) clearly defined
- Include interface control specifications which should be confirmed early on and placed under strict configuration control
- Compatibility with other interfacing systems and common architectures should be maintained throughout the development/design process

Tailoring Guidance

- N/A

PSR Lessons Learned

- Architecture overly complex, does not exist
- Program burdened with system dependencies
- Development relies on several critical complementary systems currently in development
- Schedule is dependent on other external agencies
- Modular Opens Systems Architecture (MOSA) / open systems approach not a high priority for the program

2.2 Technical Certifications

Requirement

- Summarize the system-level technical certifications which must be obtained during program's life-cycle

Mandatory Table

Certification	PMO Team/PoC	Activities to Obtain Certification[1]	Certification Authority	Expected Certification Date
Airworthiness	Airframe IPT			?Q FY?
Clinger Cohen		Confirm compliance	Component CIO (MDAP/MAIS also by DoD CIO)	?Q FY?
Transportability				?Q FY?
Insensitive Munitions	Manufacturing WG	Reference Document: *PEO IM Strategic Plan*		?Q FY?
Etc.				?Q FY?

- Fill in all columns.

Expectation

- Programs understand how the SE activities support the certification requirements
- Programs plan required technical certification activities and timing into the program IMP and IMS.

Tailoring Guidance

- N/A

PSR Lessons Learned

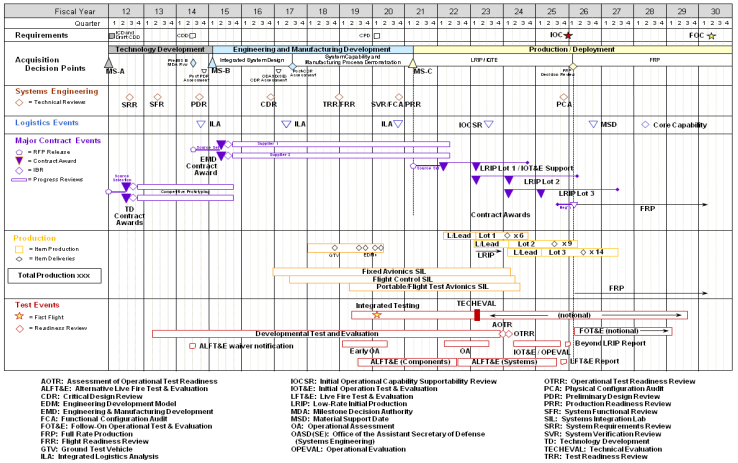
- Program has an inadequate system engineering process
- Key documents are incomplete

3.1 Technical Schedule and Schedule Risk Assessment

Requirement

- **Technical Schedule** - Provide a detailed, integrated, life-cycle system schedule
  - Include planned significant activities (viz., activities which must be performed in order to design/develop/produce the system)
- **Schedule Risk Assessment** - Summarize the schedule risk assessment process/results
- List scheduling/planning assumptions and who is responsible for **t**echnical schedule planning and execution and keeping the schedule up-to-date

Mandatory Figure



AOTR: Assessment of Operational Test Readiness
ALFT&E: Alternative Live Fire Test & Evaluation
CDR: Critical Design Review
EDM: Engineering Development Model
EMD: Engineering & Manufacturing Development
FCA: Functional Configuration Audit
FOT&E: Follow-On Operational Test & Evaluation
FRP: Full Rate Production
FRR: Flight Readiness Review
GTV: Ground Test Vehicle
ILA: Integrated Logistics Analysis

IOCSR: Initial Operational Capability Supportability Review
IOT&E: Initial Operation Test & Evaluation
LFT&E: Live Fire Test & Evaluation
LRIP: Low-Rate Initial Production
MDA: Milestone Decision Authority
MSD: Material Support Date
OA: Operational Assessment
OASD(SE): Office of the Assistant Secretary of Defense (Systems Engineering)
OPEVAL: Operational Evaluation

OTRR: Operational Test Readiness Review
PCA: Physical Configuration Audit
PDR: Preliminary Design Review
PRR: Production Readiness Review
SFR: System Functional Review
SIL: Systems Integration Lab
SRR: System Requirements Review
SVR: System Verification Review
TD: Technology Development
TECHEVAL: Technical Evaluation
TRR: Test Readiness Review

Expectation

- SE activities are planned to be completed in a timely manner to support program progress and key decision points
- Program schedules are event driven; reflect adequate time for SE integration, test, corrective actions and contingencies; and provide a strong basis for making financial commitments
- Programs should use SRAs to inform source selection and milestones, in addition to technical reviews

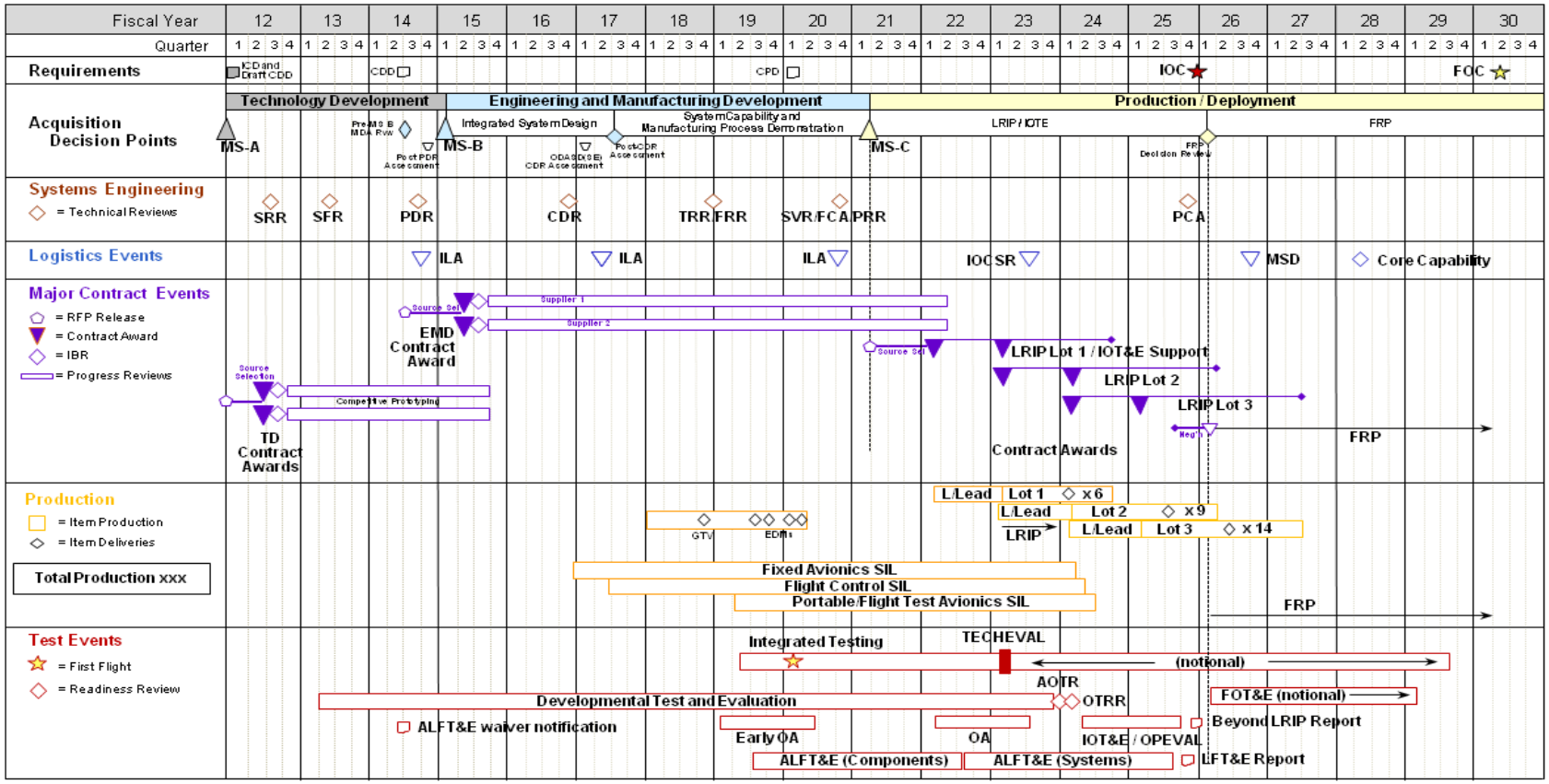
Tailoring Guidance

- N/A

PSR Lessons Learned

- Lack of balance between requirements, schedule and resources
- Programs have success-oriented, aggressive, and often unachievable schedules and don't learn this until the SRA process is complete.
- Failure to demonstrate key functionality prior to decision points
- No "time" to conduct the full suite of SE technical reviews
- Lack of meaningful acquisition phase exit criteria

3.1 Technical Schedule and Schedule Risk Assessment



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More About Schedule

- **Schedule detail**
  - The schedule you provide should include all the events that were described in the previous SEPs with the actual date they occurred, and the events and technical reviews planned for the phase covered by the SEP. It should also have future events for which new versions of the SEP will be expected, and baseline dates. Relates to sections 4.1 and 4.2
- **Schedule Risk Assessment is a special kind of risk analysis.**
  - The outline mentions Monte Carlo analysis. You want to determine the probability of your program completing on schedule. You want to know how likely it is, and how much you could be off. The result is usually presented as an S curve. You add up the distributions of the task schedule possibilities and use the Monte Carlo analysis to consider various combinations of those possibilities and give you the total likely result. If all the individual tasks have a lot of potential variation, then your program completion may not be very certain. You should show you are aware of what the impacts of the variation could be and have risk handling plans.
  - More help is available.

3.2 Engineering Resources and Cost/Schedule Reporting

Requirement

- List and summarize the program oversight and management systems that will integrate cost, schedule, and technical performance goals, metrics, and resources
- Specifically address:
  - Work Breakdown Structure (WBS)
  - Integrated Master Plan (IMP) / Integrated Master Schedule (IMS)

Mandatory Figure

- No mandatory figure included in SEP Outline. program office has option to include explanatory figure/table, as appropriate.
- Reviewers will expect to find links to document(s) containing these items. They aren't part of the SEP, but they are still expected

Expectation

- IMP and IMS clearly communicates program expectations and provides traceability to the management / execution of the program by IPTs
- Program events, accomplishments, and criteria defined in the government's IMP/program schedule should define top-level structure of IMS
- In RFP, offerors should be directed to:
  - ~~Include cross linkage to the IMP in the offeror's IMS, WBS/BOE, and risk mitigation steps~~

Tailoring Guidance

- N/A

PSR Lessons Learned

- Lack of IMP or current IMS
- Management metrics are not collected, or are not collected frequently enough, or used to monitor program health
- Lack of meaningful acquisition phase exit criteria
- EVMS does not provide insight and does not reflect work being done

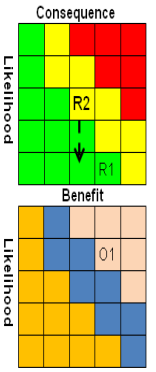
3.3 Engineering and Integration Risk Management

Requirement

- Risk Management process diagram showing how the program plans to manage engineering and integration risk and how these processes will be integrated with the contractor(s)
- Identify roles, responsibilities, and authorities within the risk management process
- Provide a risk cube with a listing of the current system-level technical risks including as-of date, risk rating, description, driver, and mitigation status

Mandatory Figure

Technical Risks		Mitigation Activities (Closure Dates)
R1. Failure to meet TOC reduction goals may cause budget exceedance		Continue current plan; expedite cuff/yoke redesign (Dec 2015)
R2. Main rotor cuff/yoke redesign not complete in time for test		Certification milestone plan developed and monitored by PM. (Jun 2011)
Technical Issues		
1. Production parts; spares		Continue focus on contractor's SCM and make parts (ongoing)
2. Structural Repair Manual late to need		Expedite approval of DL&T's (ongoing with NAVAIR)
Opportunities		
O1. Capture lessons learned; best practices; store in command library		Low investment; great benefit for program and NAVAIR



Note: Figures showing risk burn-down plans optional.

Expectation

- Programs commonly use hierarchal boards to address risks and have integrated risk systems with their contractors, and their approach to identify risks is both top-down and bottoms-up
- Risks related to technology maturation, integration, and design considerations should be considered in risk identification process

Tailoring Guidance

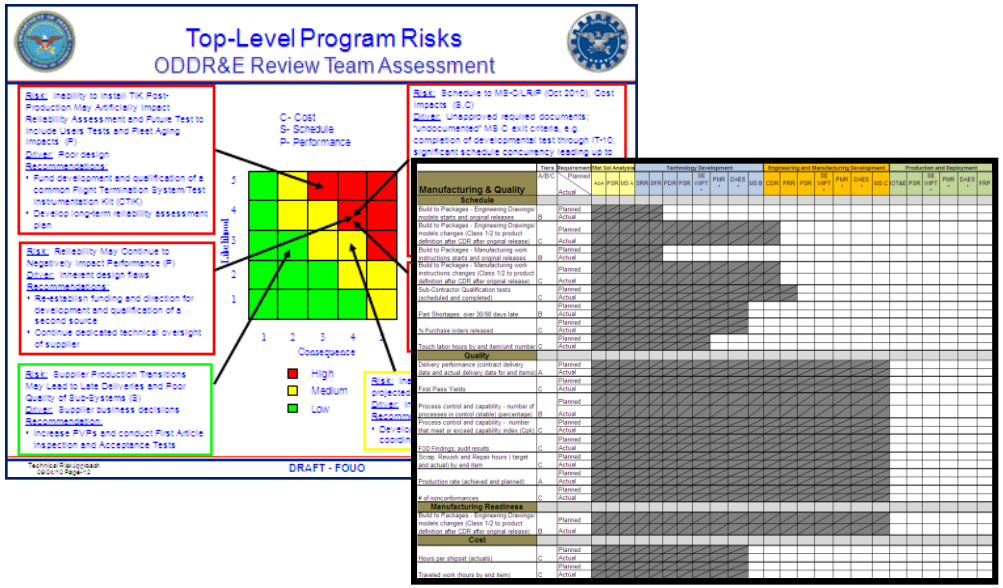
- N/A

PSR Lessons Learned

- Programs lack a mature risk management program
- Lack of properly documented risks
- Programs have inadequate risk mitigation plans
- Risk mitigation activities not reflected in program IMS
- Not performing integration risk analysis
  - Results in integration schedule growth adversely impacting system verification testing

Risk Management

- **Technology Risk**
  - Maturity of critical technologies (HW/SW)
- **Engineering Risk**
  - Technical and management risk of a system throughout the lifecycle
- **Integration Risk**
  - Technology, component, platform, SoS integration



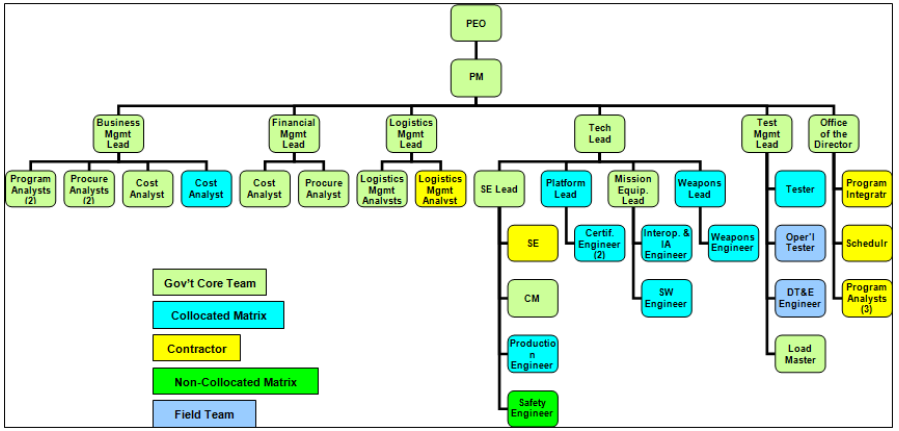
- **Risk Assessment**
  - Identification
  - Recommendations
  - Mitigation/ risk burndown
  - Root Cause Analysis
- **Program Support Reviews**
  - Approved methodology
  - Rigorous/phased-based criteria
- **Metrics**
  - **Manufacturing**
  - Software
  - Reliability
  - Integration
  - Technical Management
- **PDR/CDR Assessments**

3.4.1 Government Program Office Organization

Requirement

- Provide planned program office organization structure with an as-of date and include the following elements:
  - Legend, as applicable, Organization to which the program office reports, Program Manager (PM), Lead/Chief Systems Engineer (LSE/CSE), Functional Leads, Core, matrix, and contractor support personnel, Field or additional Service representatives

Mandatory Figure



Expectation

- Programs has all appropriate functions represented in the program office structure to include key technical positions
- Programs will have SE in such a program office position as to enable strong communication and integration
- Organizational structure support successful program execution

Tailoring Guidance

- N/A

PSR Lessons Learned

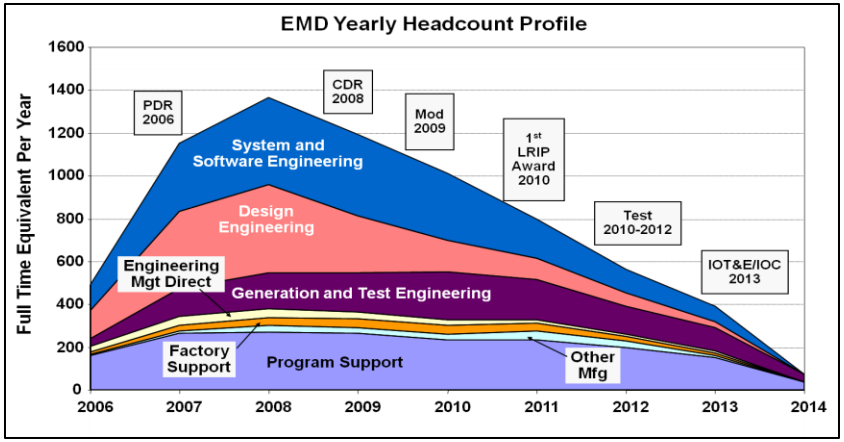
- Marginal program office staffing
- Difficult to retain high quality personnel
- Unclear roles, responsibilities, lines of authority
- Poor communication across program lines / IPTs
- Missing acquisition or specialized expertise
  - Needed functions/personnel skill sets are not available at program start

3.4.2 Technical Staffing Levels

Requirement

- Summarize the program's technical staffing plan
  - Process and tools program will use to determine required technical staffing
  - Risks and increased demands on existing resources if staffing requirements not met
  - A figure to show the number of required full-time equivalent (FTE) positions by key program events

Mandatory Figure



Expectation

- Programs should use a workload analysis tool to determine staffing level, skill mix, and required amount of experience to properly staff, manage, and execute successfully

Tailoring Guidance

- N/A

PSR Lessons Learned

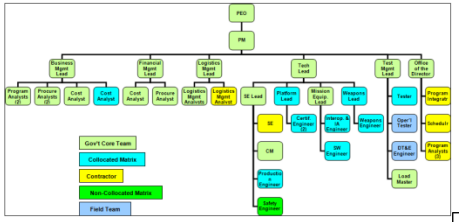
- Challenge to find the right size team
  - Too few: Lose the benefit of multi-disciplines, cross functional expertise
  - Too many: Overwhelms Program Office, viewed as burdensome
- Difficult to hire government employees with required multidisciplinary skills (SE, T&E, MFG, LOG, etc.)

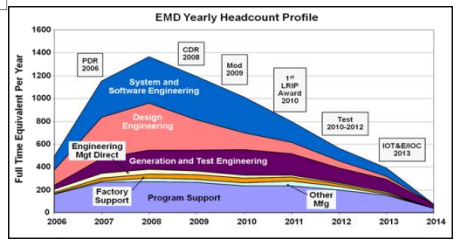
3.4.3 Contractors Program Office Organization

Requirement

- When available, provide diagrams of the contractor(s) program office organization and staffing plans in figures analogous to Government program office organizational and staffing figures

Mandatory Figure





Expectation

- Contractor has all appropriate functions represented in their program office structure to include key technical positions
- Contractor used a workload analysis tool and lessons learned from similar programs to determine staffing level, skill mix, and required amount of experience to properly staff, manage, and execute successfully

Tailoring Guidance

- N/A

PSR Lessons Learned

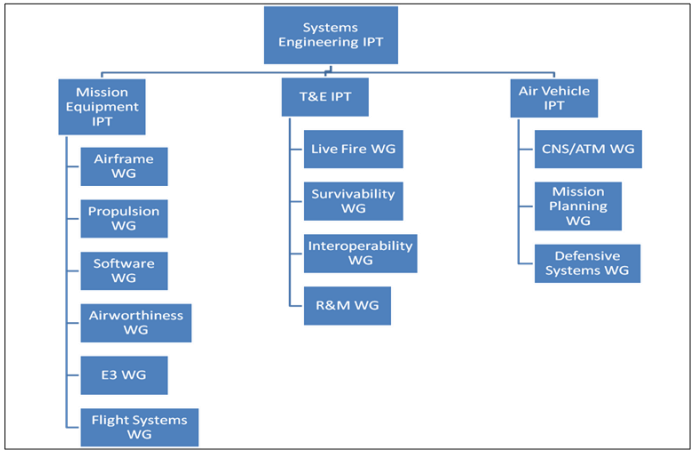
- Contractor has not demonstrated significant control of subcontractors/key suppliers
  - Lacks insight into subcontractor's status
- Needed functions/personnel skill sets not available at program start
- Instability in key positions

3.4.4 Engineering Team Organization & Staffing (1 of 2)

Requirement

- Integrated Product Team (IPT) Organization
  - Provide diagrams that show all Government and contractor IPTs and their associated Working IPTs and Working Groups, interrelated vertically and horizontally
  - Illustrate the hierarchy and relationship among them
  - Identify the Government and contractor(s)' leadership for all teams

Mandatory Figure



Expectation

- Program personnel should integrate SE activities with all appropriate functional and stakeholder organizations
- IPTs should include personnel responsible for each design consideration areas
- Programs should shift IPT focus depending on the acquisition phase

Tailoring Guidance

- P&D Phase: Describe how the organizational structure evolves after MS C. If the program doesn't have a Production IPT during EMD Phase, one should be established in the P&D Phase

PSR Lessons Learned

- Unclear roles, responsibilities, and lines of authority
- Needed skill sets are not available at program start
- Instability in key positions
- IPTs are neither chartered nor implemented

3.4.4 Engineering Team Organization & Staffing (2 of 2)

Requirement

- For all Government and contractor(s) IPTs and other key teams, include details either by attaching approved charters or as a table:
  - IPT name; Chairperson position and name; Functional team membership; IPT roles, responsibilities, and authorities; IPT processes; products; and specific metrics.
  - Summarize how the Government and contractor(s)teams relate to/interact if they are not the same teams.

Mandatory Table

Team Name	Chairperson	Team Membership (by Function or Organization)	Team Role, Responsibility, and Authority	Products and Metrics
SE IPT	Lead SE	• Program Office o Platform Lead o Mission Equipment Lead o Weapons Lead o Test Manager o Logistics Manager o SW Lead o Production/Quality Manager o Safety Lead o Interoperability Rep. o R&M Lead • PEO and PM • Service Representative • OSD SE • Key Subcontractor or Suppliers	Role: IPT Purpose Responsibilities: Integrate all technical efforts • Team Member Responsibilities • Cost, Performance, Schedule Goals • Scope, Boundaries of IPT Responsibilities Schedule and frequency of meetings Date of signed IPT charter and signatory	Products: SEP/SEP Updates IMP/IMS Input Specifications Metrics: -Cost -Performance -Schedule
XXX IPT	XXX Lead	• Program Office o Lead SE o Mission Equipment Lead o Weapons Lead o Test Manager o Logistics Manager o SW Lead o R&M Lead o Production/Quality Manager o Safety Lead o Interoperability Rep. Key Subcontractor or Suppliers	Role: IPT Purpose Responsibilities: Integrate all technical efforts • Team Member Responsibilities • Cost, Performance, Schedule Goals • Scope, Boundaries of IPT Responsibilities Schedule and frequency of meetings Date of signed IPT charter and signatory	Products: Specification input SEP input TES/TEMP input AS input Metrics: Technical Performance Measure (TPM) 1 TPM 2

Expectation

- Program personnel should integrate SE activities with all appropriate functional and stakeholder organizations
- IPTs should include personnel responsible for each design consideration areas
- Programs should shift IPT focus depending on the acquisition phase

Tailoring Guidance

- P&D Phase: Describe how the organizational structure evolves after MS C. If the program doesn't have a Production IPT during EMD Phase, one should be established in the P&D Phase

PSR Lessons Learned

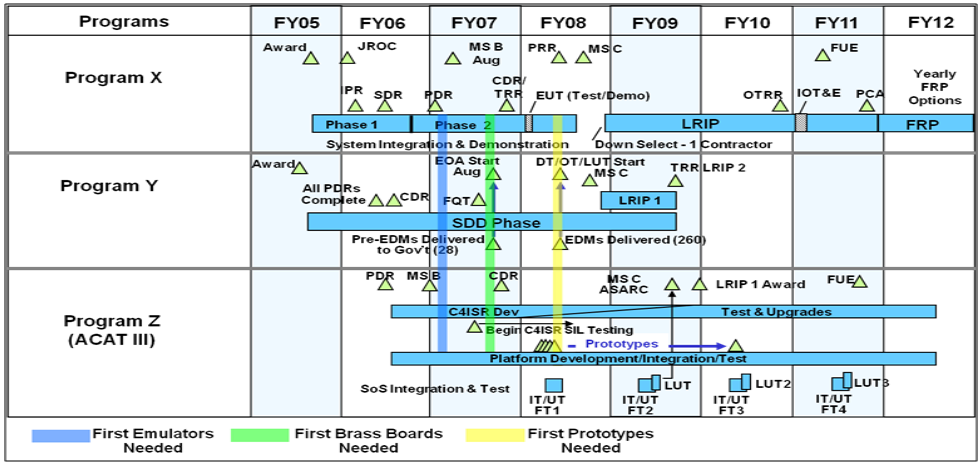
- Unclear roles, responsibilities, and lines of authority
- Needed skill sets are not available at program start
- Instability in key positions
- Missing specialized expertise

3.5 Relationships with External Technical Organizations

Requirement

- Define processes or methods used to document, facilitate, and manage interaction among SE team(s), external-to-program government organizations on technical tasks, activities, and responsibilities down to and including subcontractors
  - Identify the organization responsible for coordinating SE and integration efforts associated with the FoS/SoS and its authority to reallocate resources; Summarize how FoS/SoS interfaces will be managed

Mandatory Figure



Expectation

- Recognize importance of managing both internal program schedule and maintaining synchronization with external program schedules
- Develop MOAs with interfacing organizations that includes tripwires addressing significant cost, schedule, or performance variance and fast-track issue identification and resolution process
- Inform Component and OSD staffs so they better understand synchronizing funding and aligning priorities with external programs

Tailoring Guidance

- N/A

PSR Lessons Learned

- Program burdened with system dependencies
- Development relies on several critical complementary systems currently in development
- Schedule is dependent on other external agencies
- Lack of formal MOA including
  - Triggers to inform parties of significant variances
  - Established issue resolution process

3.6 Technical Performance Measures & Metrics (1 of 2)

Requirement

- Provide an overview of measurement planning and metrics selection process, including approach to monitor execution to established plan, and identification of roles, responsibilities, and authorities for this process
- Identify a minimum set of TPMs and intermediate goals and the plan to achieve them with as-of dates
  - Examples include TPMs for software, reliability, manufacturing, and integration

Mandatory Table

Name	Responsible Position /IPT	KPP or KSA	Performance Spec.	PDR Status Actual	MS B Status Actual	CDR Status Actual	MS C Status Planned	FRP Status Planne
Aerodynamic Drag (count)	SE IPT		<222	225	223	220	187	187
Thermal Utilization (kW)	SE IPT		<60	56	59	55	51	50
Electrical Power Usage (kW)	SE IPT		<201	150	185	123	123	123
Operating Weight (lb)	SE IPT		<99,000	97,001	101,001	97,001	85,540	85,650
Range (nm)	SE IPT		>1,000	1,111	1,101	1,111	1,122	1,130
Average Flyaway Unit Cost (number)	SE IPT		<1.5	1.3	1.58	1.37	1.35	1.32

Expectation

- Programs use metrics to measure progress
  - Understand how to measure performance-to-plan
  - What to measure with how much margin

Tailoring Guidance

- Use TPMs and metrics appropriate for predicting success with the current phase of the program.

PSR Lessons Learned

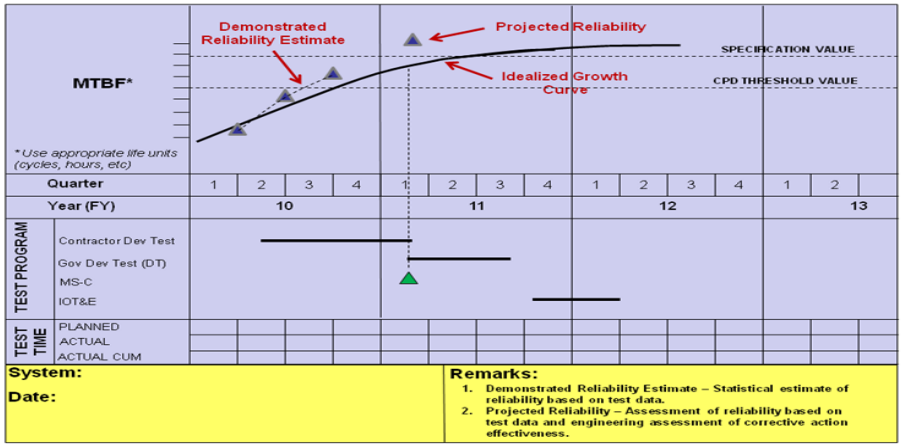
- Management metrics are not collected, or are not collected frequently enough, or used to monitor program health
- EVMS does not provide insight and does not reflect work being done
- Lack of software metrics prevent accurate awareness of software activities

3.6 Technical Performance Measures & Metrics (2 of 2)

Requirement

- Use a reliability growth curve to plan, illustrate, and report progress
  - Growth curves will be stated in a series of intermediate goals and tracked through fully integrated, system-level test and evaluation events

Mandatory Figure



Expectation

- Understand the amount of testing, test schedule and resources available
  - Develop the growth curve as a function of appropriate life units (hours, cycles, etc.,)
  - Understand how starting point was determined
  - Tie rate of growth to realistic metrics of initial failure rate to be addressed by corrective actions and corrective action fix effectiveness
  - Describe growth tracking & projection methodology

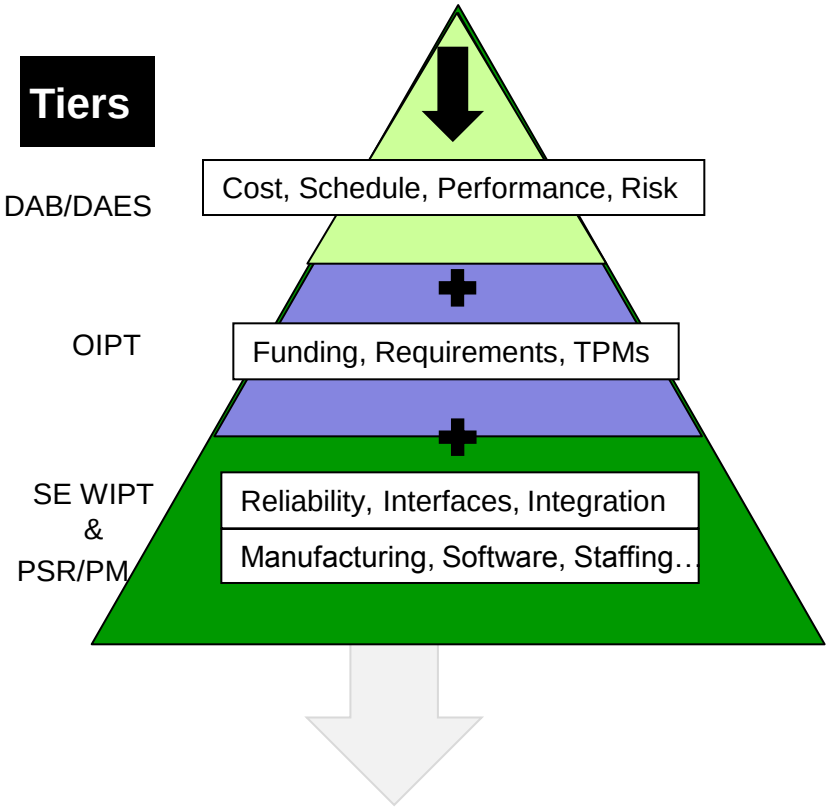
Tailoring Guidance

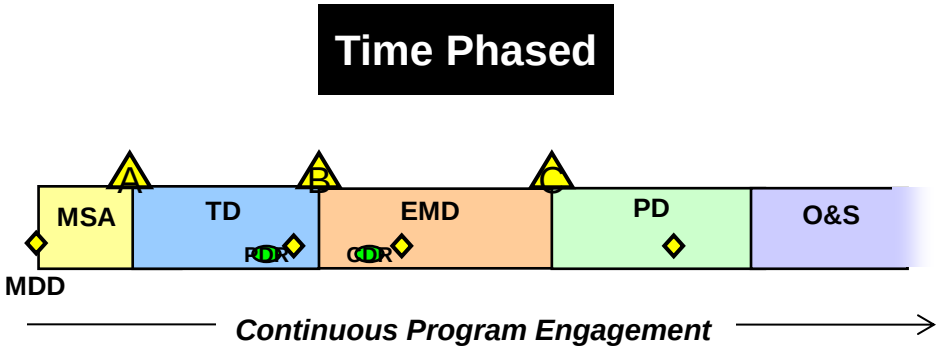
- N/A

PSR Lessons Learned

- Optimistic software productivity, reuse and growth estimates
- Insufficient efforts to design-in reliability and maintainability, including diagnostics
- Highly concurrent, success oriented test schedules
- Aggressive schedule lacks adequate time for corrective actions

Tiered and Time-Phased Measures





Information needs vary by Tier

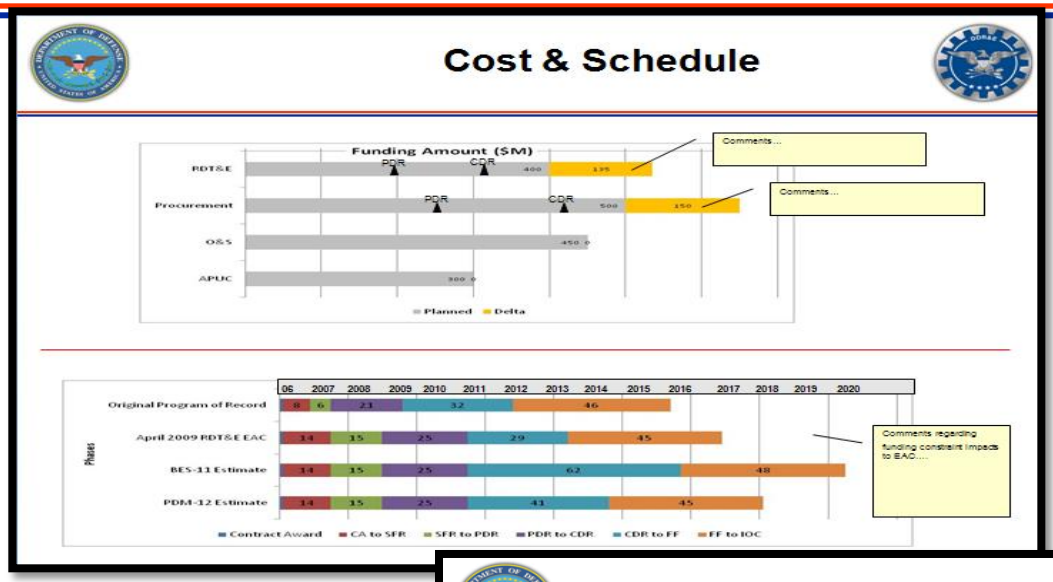
- Summary and roll-up information at highest tier
- Greater engineering detail and number of metrics provided at lowest tier

Metric relevancy based on lifecycle phase and events

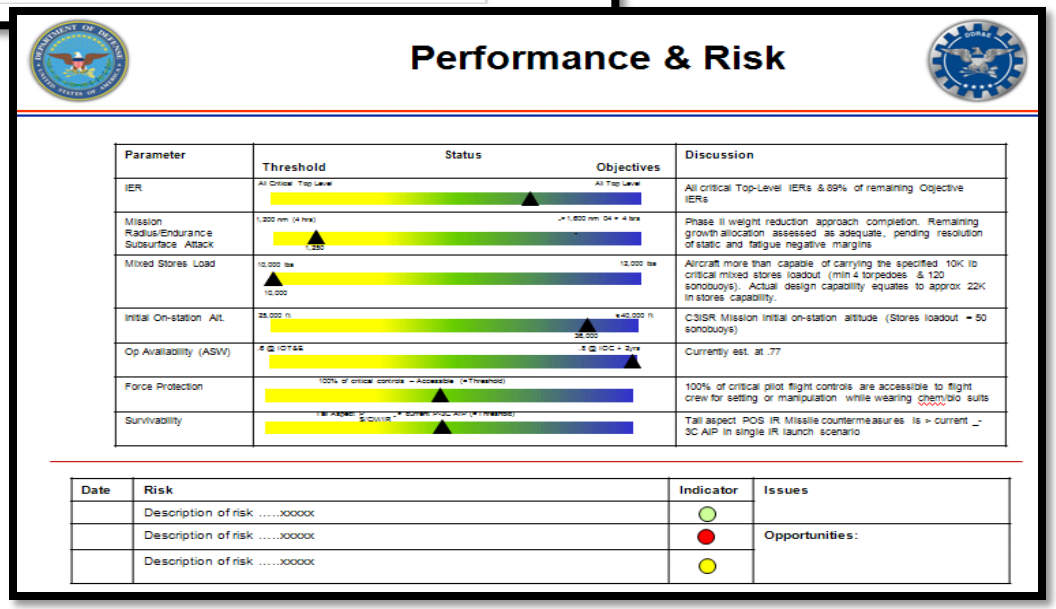
- E.g. T&E metrics prevalent later
- Decisions based on time cycles (e.g. DAES every 3 months)

Top Tier: Senior Leadership Level

Sample Metrics

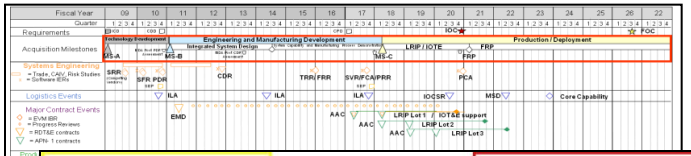


1. **Top level understanding of program status**
2. **Execution to plan**
3. **Key risks**
4. **Adequacy of path forward to resolve risks/issues**

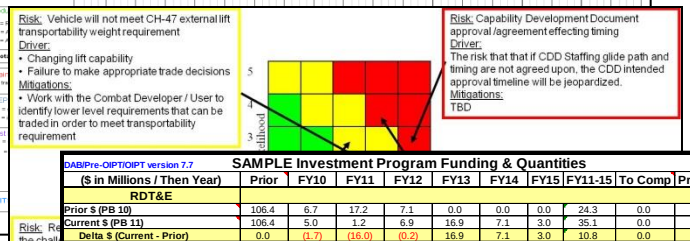


Mid Tier: Principal Managers

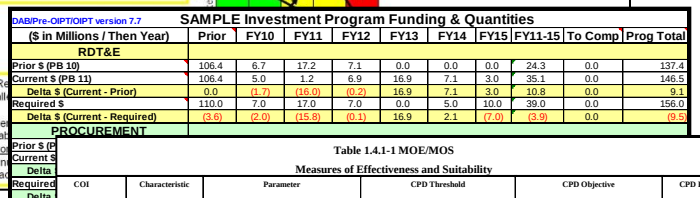
Sample Metrics



Schedule



Risks



SAMPLE Investment Program Funding & Quantities

DAB/Pre-OIPT/OIPT version 7.7

($ in Millions / Then Year)	Prior	FY10	FY11	FY12	FY13	FY14	FY15	FY11-15	To Comp	Prog Total
RDT&E										
Prior $ (PB 10)	106.4	6.7	17.2	7.1	0.0	0.0	0.0	24.3	0.0	137.4
Current $ (PB 11)	106.4	5.0	1.2	6.9	16.9	7.1	3.0	35.1	0.0	146.5
Delta $ (Current - Prior)	0.0	(1.7)	(16.0)	(0.2)	16.9	7.1	3.0	10.8	0.0	9.1
Required $	110.0	7.0	17.0	7.0	0.0	5.0	10.0	39.0	0.0	156.0
Delta $ (Current - Required)	(3.6)	(2.0)	(15.8)	(0.1)	16.9	2.1	(7.0)	(3.9)	0.0	(9.5)
PROCUREMENT										

Cost

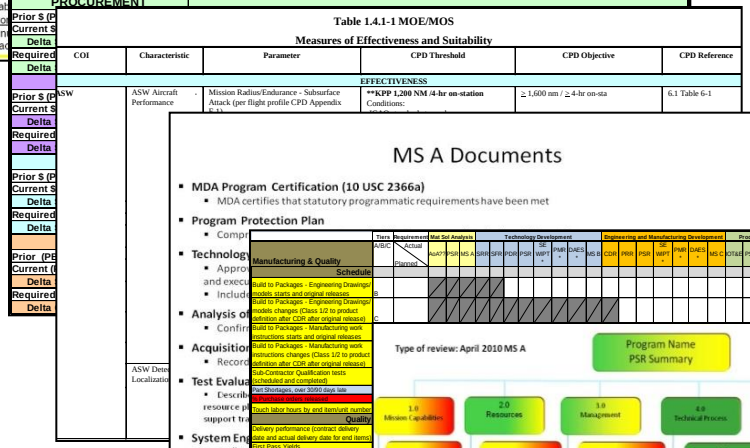


Table 1.4.1-1 MOE/MOS

Measures of Effectiveness and Suitability

COI	Characteristic	Parameter	CPD Threshold	CPD Objective	CPD Reference
			EFFECTIVENESS		
ASW	ASW Aircraft Performance	Mission Radius/Endurance - Subsurface Attack (per flight profile CPD Appendix	**KPP 1,200 NM /4-hr on-station Conditions:	≥ 1,600 nm / ≥ 4-hr on-sta	6.1 Table 6-1

T&E

Documentation Status

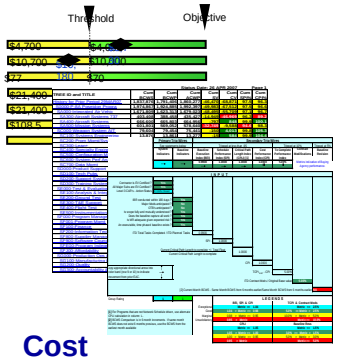
Manufacturing

PSR Scorecard

- Top level findings and recommendations
- Metric summaries across wider breadth of engineering and management areas
- Insights on PM incorporation of recommendations
- Positive observations

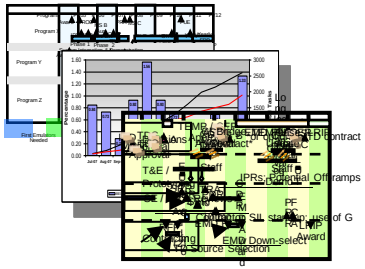
Lower Tier: Working Level

Sample Metrics



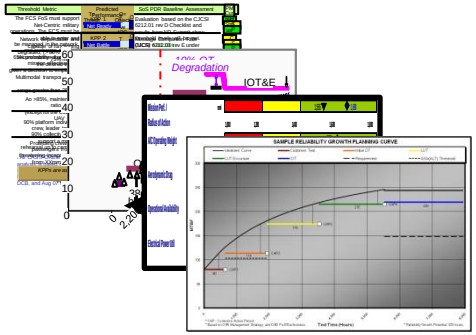
Cost

- EVMS Dashboard
- CPI-SPI
- Variances
- Burn rate
- Management Reserve



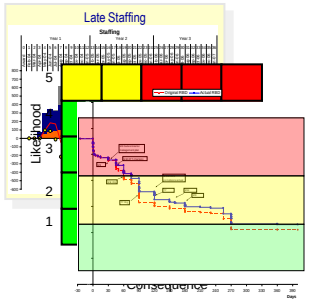
Schedule

- Tier 1
- Critical path
- Schedule risk assessment
- Late starts/finishes
- FoS/SoS schedules



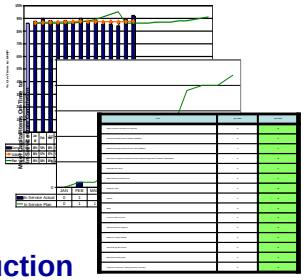
Performance

- KPP/KSA progress
- TPMs
- Reliability growth curve
- TRLs



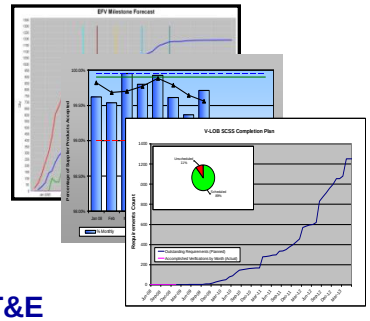
Management

- Staffing
- Risk cube and Burn-down curve
- Exit criteria



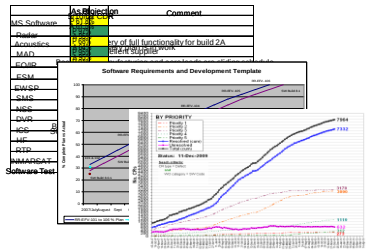
Production

- Build-to-Package completions
- Traveled work
- Supplier/Subcontractor Quality tests
- Scrap, Rework and Repair hours
- First pass yields
- Touch labor hours
- Etc.



T&E

- Schedules
- CTPs
- MOE/S
- Retest
- Verification status



Software

- SLOC
- Productivity
- Reuse
- Defects

SE Metrics Goals
"What we are trying to achieve"

- Emphasize quantitative understanding consistent with Industry practice of system engineering
- Make visible relationships between system/equipment design objectives and performance
- Harness and use existing information for timely and better decisions at the appropriate levels

"To measure is to know."
"If you can not measure it, you can not improve it."
Lord William Kelvin (1824-1907)

4.1 Results of Previous Phase SE Activities

Requirement

- Summarize (consider a tabular format) system-level technical reviews, trade studies, and independent reviews conducted to date; date(s) conducted; and key results or impact(s) to design and any related recommendations and status of actions taken
- For MDAPs, these reviews shall include an assessment of manufacturing risk and readiness

Mandatory Figure

- Program office may choose to use a table that summarizing previous acquisition phase SE activities and results.

Expectation

- Technical reviews and other SE activities provide insight of system maturation process

Tailoring Guidance

- N/A

PSR Lessons Learned

- Software reuse was significantly less than planned
- Requirements cannot be met
- Lack of software metrics prevent accurate awareness of software activities
- Reliability is not progressing as planned
- Key documents are incomplete

4.2 Planned SE Activities for the Next Phase

Requirement

- Summarize key planned system engineering, integration, and verification processes and activities established or modified since the previous acquisition phase, including updated risk reduction and mitigation strategies and technical and manufacturing maturity.

Mandatory Figure

- No mandatory figure or table included in SEP Outline

Expectation

- Technical reviews and other SE activities provide insight of system maturation process

Tailoring Guidance

- N/A

PSR Lessons Learned

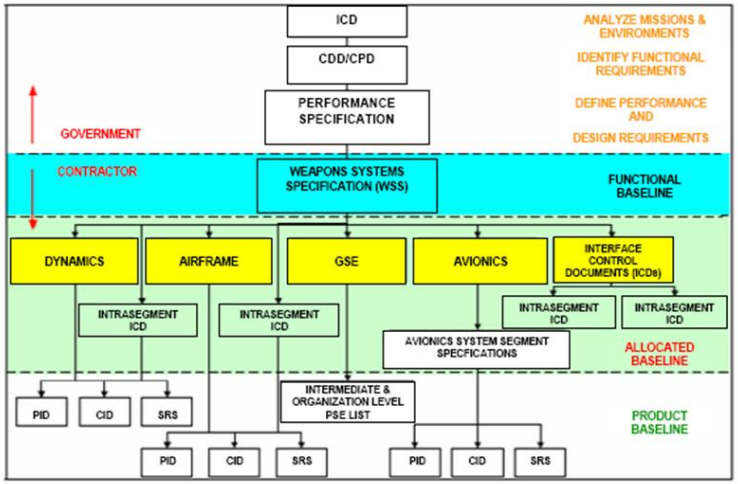
- Testing and verification approach are inadequate
- Developmental testing not complete prior to IOT&E
- Challenging production ramp rates for contractors/suppliers
- Optimistic software productivity, reuse and growth estimates
- Projected technical maturity unlikely to be achieved

4.3.1 Analysis and Decomposition

Requirement

- Address how top-level requirements are traced from the source JCIDS documents down to configuration item build-to specs and V&V plans
  - Identify position or team responsible for ensuring accurate traceability of requirements
  - If program office and contractor(s) use different tools, define how information will be transferred across them
  - Define approach ensuring no orphan / childless requirements.

Mandatory Figure



Expectation

- Program should trace all requirements from JCIDS to the CI level and into a verification matrix

Tailoring Guidance

- TD phase: Describe how competitive prototyping, the TRA, the PDR, and test results will inform the program's KPP/KSAs for the EMD phase

PSR Lessons Learned

- Requirements vague, poorly stated, incomplete, unreasonable, untestable, or not defined
- Process to flow down requirements not established
- Inability to meet system requirements within defined constraints, lack of growth margins/trade-space
- Lingering requirements issues increase costs/risks

4.3.2 Requirements Management and Change Process

Requirement

- Describe how requirements will be managed and how changes will be made and tracked
- Summarize the mechanism by which the program will involve its Configuration Steering Board
- Identify which program office position or team will be responsible for continuously ensuring the accurate management of requirements and requirement changes

Mandatory Figure

- No mandatory figure or table included in SEP Outline

Expectation

- Programs understand that changes to requirements need to go through same rigor as initial requirements and are integral to change control
- Programs ensure requirements traceability from the lowest level component all the way back to the user's capability document

Tailoring Guidance

- Consider requirements stability or volatility as a metric, with planned and actual, and apply it to help manage requirements change.

PSR Lessons Learned

- Requirements creep leads to a constantly evolving baseline
- Unstable requirements – large number of JROC approved changes to performance baseline
- Lack of JROC validated requirements document for follow-on program increments

4.4 Technical Reviews

Requirement

- Summarize plans for conducting each technical review with emphasis on the next acquisition phase -- include a marker on program schedule
- Identify which program office position is responsible for overall conduct of system-level and/or key subsystem-level technical reviews
- Identify who or what team has responsibility, authority, and accountability for determining that: entry criteria have been met, action item tasking and closure, and that exit criteria are met

Mandatory Table

XXX Details Area	**XXX Review Details** (For this acquisition phase, fill out tailored criteria, etc.)
Chairperson	Identify the Technical Review Chair (Normally the LSE)
PMO Participants	Identify Positions/functions/IPTs within the program offices which are anticipated to participate. (Engineering Leads; Risk, Logistics, and Configuration Managers, Defense Contracting Management Agency (DCMA) Rep., and Contracting Officer, etc.)
Anticipated Stakeholder Participant Organizations	Representatives (stakeholders) from Service SE and Test, OSD SE and Developmental Test and Evaluation (DT&E), FoS/SoS, and the User
Anticipated Peer and Program-Independent SME Participant Orgs.	Identify Organizations which can provide a peer perspective and participants who will provide an independent assessment of how well the program is progressing but which have no stake in the program's success.
Purpose (of the review)	Describe the main purpose of the review and any specific SE goals
Entrance Criteria	Identify tailored Entrance Criteria
Exit Criteria	Identify tailored Exit Criteria
Products/Artifacts (from the review)	List expected products from the technical Review (for example) • Established system allocated baseline • Updated risk assessment for EMD • Updated Cost Analysis Requirements Document (CARD) or CARD-like document based on system allocated baseline • Updated program schedule including system and SW critical path drivers • Approved LCSP updating program sustainment development efforts and schedules • Draft Post-PDR Report (MDAPS)

Expectation

- Technical reviews are event-driven
- Programs should use a standard process for conducting technical reviews

Tailoring Guidance

- TD Phase: Provide SRR, SFR, and PDRs details
- EMD Phase: Provide delta PDR (if planned), CDR, SVR/ FCA /PRR details
- P&D Phase: Provide SVR/FCA/PRR (if hot held in EMD), PCA and ISR details

PSR Lessons Learned

- No "time" to conduct the full suite of SE technical reviews
- Entrance & exit criteria not established
- Inadequate baseline management

4.5 Configuration and Change Management

Requirement

- For each baseline established at a technical review, list and describe the planned artifact
- Provide a process diagram of how the program will maintain configuration control of its baselines
- Identify when in the acquisition lifecycle the program will assume initial and full configuration control of its baselines
- Summarize the roles, responsibilities, and authorities within the CM process

Mandatory Figure

- *See next page*

Expectation

- Programs should understand which artifacts make up each technical baseline and manage changes appropriately
- Programs will control their baselines

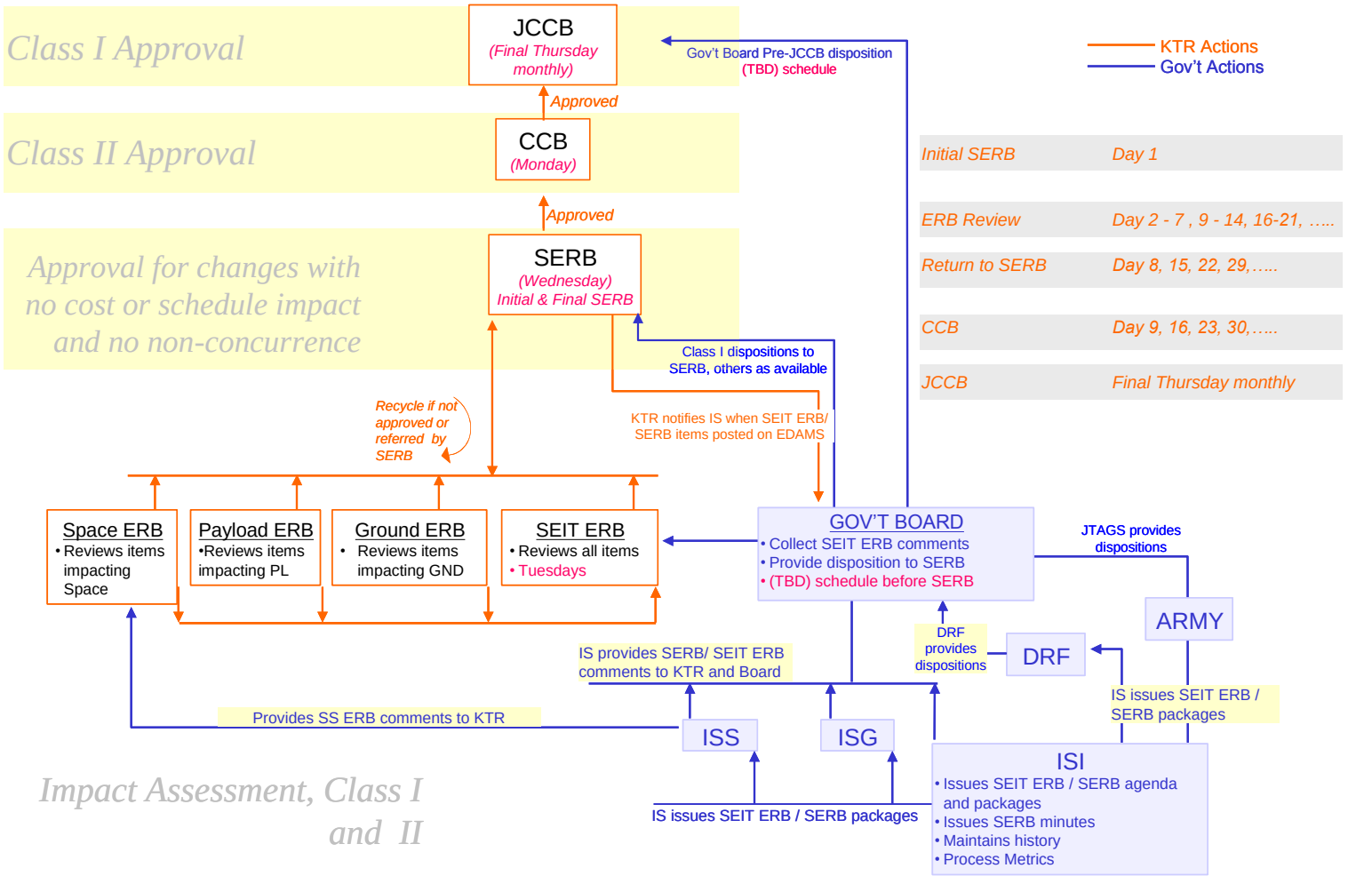
Tailoring Guidance

- N/A

PSR Lessons Learned

- Roles, responsibilities, and lines of authority for configuration management not clear
- Inadequate baseline management
- Definition of Class I & II ECPs not in contract
  - Unclear who has approval authority for Class II changes

Change Management Process Example



4.6 Design Considerations (1 of 2)

Requirement

- Examine for relevancy the list of design considerations in DAG Section 4.4
- Identify design considerations that are critical to the achievement of the program's technical requirements
- The entries in the table are mandated by policy for inclusion as are their reference documents, which must be embedded in the SEP or hot linked

Mandatory Table

Mapping Key Design Considerations into Contracts

Name (Reference)	Cognizant PMO Org	Certification	Documentation (hot link)	Contractual Requirements (CDRL #)	Description/Comments
SE Tradeoff Analysis for Affordability			(MS B)		Provide the systems engineering trade-off analysis showing how cost varies as the major design parameters and time to complete are traded off against one another. The analysis will reflect attention to capability upgrades. The analysis will support DAE approval of an Affordability Requirement to be treated as a Key Performance Parameter (KPP) in the Acquisition Decision Memorandum. The analytical summary will include a graphic illustrating cost tradeoff curves or trade space around major affordability drivers (including KPPs when they are major cost drivers) to show how the program has established a cost-effective design point for those affordability drivers.
Corrosion Prevention and Control (ACAT I only)			CPCP (MS B & C)		Describe how design will minimize impact of corrosion and material deterioration on system throughout system life cycle.
Environmental Safety and Occupational Health (ESOH)			PESHE NEPA Compliance Schedule (MS B & C)		Describe how design will minimize ESOH by summarizing how program will integrate ESOH considerations into SE processes to include method for tracking hazards and ESOH risks and mitigation plans throughout the life cycle of system.
Human Systems Integration (HSI)					Summarize how HSI will be integrated within the SE processes, specifically addressing the human operator and maintainer requirement allocation approach that accounts for total system performance.

See SEP Outline for complete table and legend

Expectation

- SEP demonstrates that the mandated design considerations are an integral part of the design decision process including trade study criteria

Tailoring Guidance

- N/A

PSR Lessons Learned

- Insufficient trade space (management reserve) to accommodate contingencies
- Programs lack a mature risk management program
- Program lacks a formal or current Corrosion Prevention & Control (CPC) Program
- Modular Opens Systems Architecture (MOSA) / open systems approach were not a high priority for the program

More About Design Considerations

- **An early lesson learned on the Design Considerations table is that programs are not including links in the column headed Documentation hotlink, or are not providing access to the linked documents. Ensure the OSD reviewers can access the documents and confirm that they include the needed info.**
- **Part of the DoD streamlining was to get the content into separate documents so it could be managed more easily – not to eliminate the content.**

4.6 Design Considerations (2 of 2)

Requirement

- Identify R&M Activity Planning and Timing
  - Allocations / Block Diagram / Predictions
  - Failure Definition and Scoring Criteria
  - FMECA
  - Maintainability and Built-In Test
  - Reliability Growth Testing at the System and Subsystem Level
  - FRACAS

Mandatory Table

R&M Engineering Activity	Planning and Timing
R&M Allocations	
R&M Block Diagrams	
R&M Predictions	
Failure Definitions and Scoring Criteria	
Failure Mode, Effects, and Criticality Analysis (FMECA)	
Maintainability and Built-in Test Demonstrations	
Reliability Growth Testing at the System and Subsystem Level	
Failure Reporting , Analysis, and Corrective Action System (FRACAS)	

Expectation

- Programs should understand that the content of the R&M artifacts need to be consistent with the level of design knowledge that makes up each technical baseline
- The table is Planning and Timing
  - Timing is required.

Tailoring Guidance

- N/A

PSR Lessons Learned

- Insufficient efforts to design-in reliability and maintainability, including diagnostics
- Weak emphasis on suitability contributes to IOT&E issues
- R&M activities not completed in time to inform the design and development process

4.7 Engineering Tools

Requirement

- Identify the engineering tools the program plans to use

Mandatory Table

Engineering Tool	Purpose	Position/IPT Responsibility
IMS		
IBM®Rational® DOORS®	Requirements Traceability and Verification Methodology and Completion	SE IPT/Rqmts Manager
Requirements Verification Matrix (RVM)	Requirements Verification	
Computer-Aided Three-Dimensional Interactive Application (CATIA)	Design	SE IPT
Risk Mgmt Information System (RMIS)	RM	SE IPT/Risk Manager
SW Integration Lab (SIL)	M&S	SW WG
SW Engineering	Design	SW WG
SW cost estimating (e.g., COCOMO)		SW WG
Producibility/Throughput Analysis Tool		Manufacturing WG
Line of Balance	Production planning	Manufacturing WG
Reliability Growth (e.g., RGA®, PM2, RGTM, AMPM)	Reliability growth planning and tracking	SE IPT/R&M Lead
Etc.		

Expectation

- Program should ensure design solutions are documented based upon sound SE practices using engineering tools to augment the technical approach
- Programs should define tool interfaces when the government and contractor(s) plan to use different tools for the same purpose

Tailoring Guidance

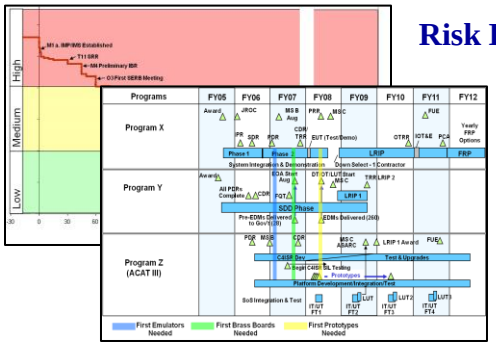
- N/A

PSR Lessons Learned

- Incomplete or missing a SEP
- Lack of IMP or current IMS
- Underestimation of integration efforts and COTS modifications
- Software Development Plans do not exist, lack needed information, or are outdated
- EVMS does not provide insight and does not reflect work being done
- No reliability growth planning

Non-Mandatory SEP Content

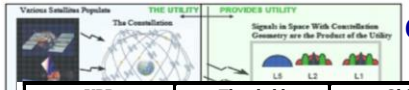
- In the SEP Outline, but not mandatory:



Risk Burn Down Plan

System-of-Systems Schedule

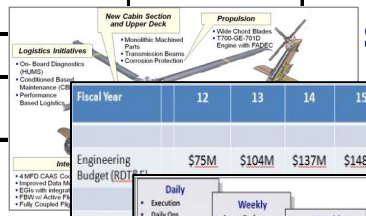
- The following items were removed from the SEP due to their inclusion in other program documents



CONOPS

KPP	Threshold	Objective
Net-Ready (Mandatory)		
Force Protection (Mandatory)		
Survivability (Mandatory)		
Sustainment/Materiel Availability (Mandatory)		

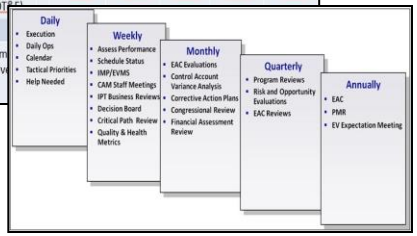
KPPs/KSAs



System Description

Fiscal Year	12	13	14	15	16
Engineering Budget (RDT&E)	$75M	$104M	$137M	$148M	$89M

Engineering Budget



Technical Meetings and Issue Resolution

- **Acquisition Strategy**
- **Design Verification**

- Services can include additional content in the SEP, as desired

Concept of Operations

Requirement

- Identify Summarize the CONOPS to include:
  - Problem being addressed and/or current mission gap(s)
  - User's expectation of system on its use (e.g., while deployed, employed, operated (Operational View (OV-1))
  - How system complements integrated joint warfighting force
  - How CONOPs was used to influence requirements and system architectures.

Extra Credit Table

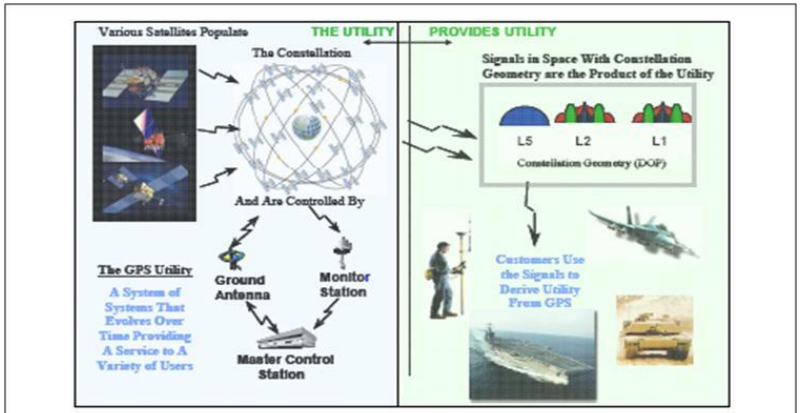


Figure 2-2 Operational Mission Utility View of Integrated GPS/NDS System Operations

Expectation

- Programs understand that the system CONOPS is a driver for the system solution and risks and that it is foundational to understanding the requirements generation process and the Analysis of Alternatives (AoA) required by Clinger-Cohen Act, JCIDS Manual, and Department of Defense Instruction (DoDI)5000.02. Also, programs will use standardized architectural products and conventions, data formats, and open interface standards and protocols to enable interoperability

Tailoring Guidance

- N/A

PSR Lessons Learned

- N/A

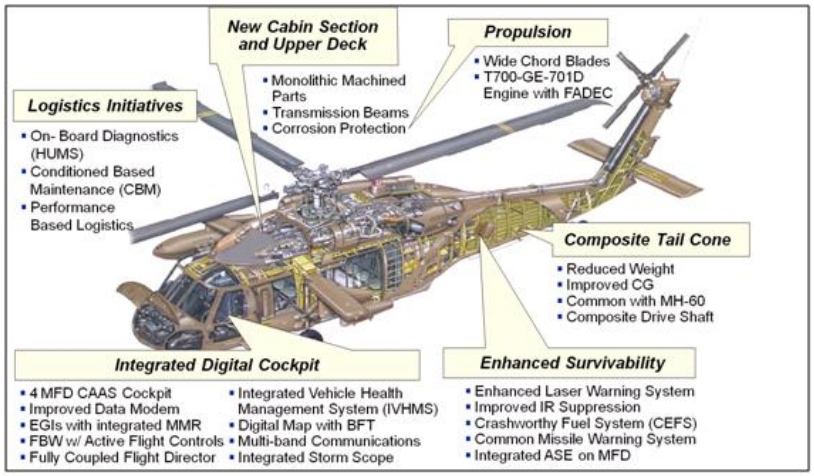
Extra Credit

System Description

Requirement

- Describe system to be developed to include:
  - Major components/sub-systems to include planned COTS/GOTS/NDI systems
  - Functions of major components/sub-systems and planned COTS/GOTS/NDI systems
  - Other systems within FoS/SoS
  - Annotated diagram making sure to highlight as applicable, any critical technology element (CTE) areas or competitive prototyping areas.

Extra Credit Figure



Expectation

- Programs understand hardware and SW components of the system and can provide a single picture for illustration purposes.

Tailoring Guidance

- N/A

PSR Lessons Learned

- N/A

Extra Credit

Key Performance Parameters/ Key System Attributes

Requirement

- Provide table of emerging or actual KPPs and KSAs with threshold and objective values.
- Describe process for how SE will provide or has already provided input to KPPs and KSAs and their values.

Extra Credit

Extra Credit Table

KPP	Threshold	Objective
Net-Ready (Mandatory)	Classified, see CDD dated 13 July 2010	Classified, see CDD dated 13 July 2010
Force Protection (Mandatory)	Value	Value
Survivability (Mandatory)	Value	Value
Sustainment/Materiel Availability (Mandatory)	Value	Value
System Training (Selectively Applied)	Value	Value
Energy Efficiency (Selectively Applied)	Range	Range
Etc.		

Table 2.4-1: Sample KPPs

KSA	Threshold	Objective
Materiel Reliability	Value	Value
Ownership Cost	Value	Value
Etc.		

Table 2.4-2: Sample KSAs

Expectation

- Per the JCIDS manual, programs ensure the number of KSAs is “kept to a minimum to maintain program flexibility…” and that they are complete and reasonable in the context of system operational requirements and compliance with the net- centric operational environment.

Tailoring Guidance

- TD Phase: Describe how competitive prototyping trade studies, and the Preliminary Design Review (PDR) informs program KPP/KSAs.
- P&D Phase: Summarize any changes between CDD and CPD requirements including the rationale for the changes. Describe the use of Configuration Steering Boards (CSBs) to approve requirements trades

PSR Lessons Learned

- N/A

Engineering Budget

Requirement

- Describe how the program's SE budget was or will be built to include:
  - Engineering team's role in building the program's cost estimate
  - Engineering cost estimation/budget assumptions to include the use of integration tools such as Systems or Software Integration Lab (SIL)
  - Analogous systems used as the basis for cost estimating
  - Program budget constraints/limitations which might impact SE/technical planning

Extra Credit Table

Fiscal Year	12	13	14	15	16
Engineering Budget (RDT&E)	$75M	$104M	$137M	$148M	$89M
Key Program & Technical Events	△ MSA, △ SRR	△ SFR	△ MSB, △ PDR	△ CDR	△ PRR

Expectation

- Program's budget is sufficient to support each acquisition phase; program funding is stable; and program has adequate management reserve to deal with technical issues/contingencies.

Extra Credit

Tailoring Guidance

- N/A

PSR Lessons Learned

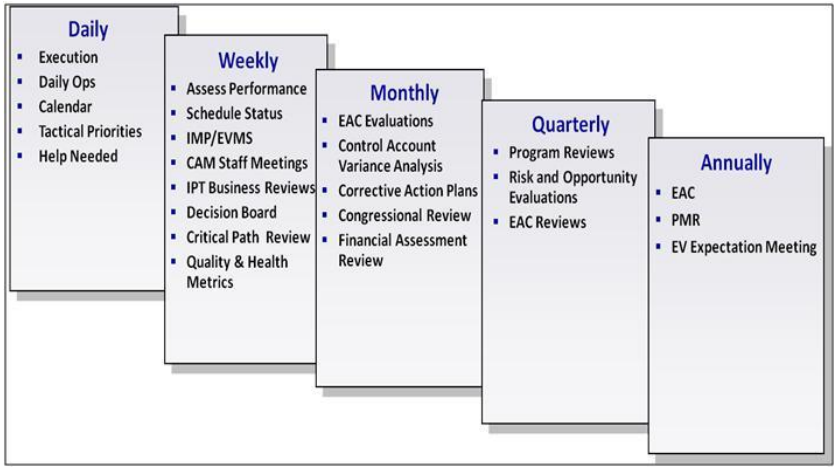
- Budget is insufficient; not funded to Cost Assessment and Program Evaluation (CAPE) estimates/low confidence estimates
- Budget improperly phased to support planned developmental (SE, T&E, production, etc.) efforts
- Current unit cost factors indicate significant/critical Acquisition Program Baseline (APB) breach
- Insufficient trade space (management reserve) to accommodate contingencies

Technical Meetings and Issue Resolution

Requirement

- Describe how often program personnel /IPTs will meet to integrate and coordinate SE and management activities within and across program on a day to day basis. (Many programs refer to this as their "Battle Rhythm.") If there are multiple contractors competing, describe how day-to-day interaction may differ from just one contractor.

Extra Credit Table



Expectation

- Programs have a battle rhythm and strong communication /transparency with stakeholders. Risk/issues are addressed proactively.

Tailoring Guidance

- N/A

PSR Lessons Learned

- N/A

Extra Credit

Design Verification

Requirement

- Describe how the requirements verification processes will be planned for and implemented across the lifecycle of the program. Indicate which tools, such as M&S, the program plans to use during testing and V&V of requirements. Make sure to include tools in Table 4.9-1. Also, describe how Contractual requirements (Specification Section 3) are verified with test events outlined in Section 4 of a Specification (Section 3 is meaningless unless requirements can be verified in accordance with Section 4).

Extra Credit Table

- N/A

Extra Credit

Expectation

- All requirements have plans to be verified and tracked during the design verification process.

Tailoring Guidance

- N/A

PSR Lessons Learned

- Test schedules are aggressive/ success-oriented/ and highly concurrent
- Testing is incomplete or inadequate and system-level testing conducted without all equipment installed
- Scope of testing is not defined.
- TES/TEMP is immature or is late.
- Lack of a realistic test environment

SEP Content, Rationale & Expectations

Content	Rationale
1. **Introduction**	Describes the purpose of the SEP as well as who will use the SEP, the plan to align Prime Contractor's SEMP with SEP, and the approach for updating/maintaining the SEP throughout the life of the program. Expectation: SE planning is kept current throughout acquisition lifecycle and that programs understand the criteria and approval level for between-cycle updates.
2. **Program Technical Requirements** 2.1 Architectures and Interface Control	Illustrates program understanding of the system's relationship with other systems from the technical perspective. Describes: 1) Relationship, dependencies, and the desired interfaces envisioned between this system and other existing or planned systems; 2) How architecture products are related to requirements definition and the functional and physical architectures, and 3) Process for distributing DODAF architectures to the vendors Expectation: Programs which include a system with external interfaces will have the dependencies (i.e., hierarchy) clearly defined. This definition will include interface control specifications, which will be confirmed early on and placed under strict configuration control.
2.2 Technical Certifications	Illustrates program understanding of required certifications throughout the lifecycle of the system, their required timing and program office responsibility. Expectation: Programs will plan required certification activities and timing into the program IMP and IMS.

SEP Content, Rationale & Expectations

Content	Rationale
3.Engineering Resources and Management	
3.1 Technical Schedule and Schedule Risk Assessment	1) Ensures detailed planning for technical activities. Programs often have success-oriented, aggressive, and unachievable schedules. 2) SRAs provide mechanism for assessing viability of technical and acquisition key decision points. Expectation: 1) Programs properly phase activities, key events (e.g., competitive prototyping, CDRs, etc.) to ensure a strong basis for making long lead financial commitments. Program schedules are event driven and reflect adequate time for SE , integration, test, corrective actions and contingencies. 2) Programs use SRAs to inform source selection, milestones, in additional to technical reviews.
3.2 Engineering Resources and Cost/Schedule Reporting	Ensures stronger linkage between SE planning, costing, and tracking (i.e., IMP, IMS, WBS, and EVM). Programs often gloss over this topic and rarely provide strong evidence during PSRs Expectation: The IMP and IMS will clearly communicate the expectations of the program team. IMP/IMS will be traceable to the WBS, the program's Contract Work Break-down Structure (CWBS), the SOW, SE, risk management, and the EVMS, which together define the products and key processes associated with program success and are the basis of Team-generated cost estimates and cost reporting.

SEP Content, Rationale & Expectations

Content	Rationale
3.Engineering Resources and Management	
3.3 Engineering and Integration Risk Management	Illustrates program understanding for how to handle risks from identification/capture to mitigation. PSR findings have shown that failure to address integration risks. Expectation: Programs will use levels of boards to address risks often. Program offices and contractors will have an integrated risk management system. The approach to identify risks will address both a top down and bottoms up approach.
3.4 Technical Organization	Illustrates program understanding of the appropriate staffing/functions required within a program office, especially the importance of the key technical positions such as for the Lead Systems Engineer. Expectation: Programs will have all necessary appropriate functions represented in the program office structure. Programs will have the SE function in such a position in the program office as to enable strong communication and integration.

SEP Content, Rationale & Expectations

Content	Rationale
3.Engineering Resources and Management	
3.5 Relationship with External Technical Organizations	Programs have critical dependencies on external programs which often impact their cost and schedule. Including this in the SEP illustrates the entire program is working with external organizations, not just SE. Expectation: Program will: 1) Recognize the importance of maintaining synchronization with external programs schedules. 2) Develop MOAs with interfacing organizations that includes: 3) Develop a synchronized program schedule with interfacing programs schedules to provide insight into the potential impact of interfacing program schedule changes
3.6 TPMs and Metrics	Illustrates program understanding for how to measure performance-to-plan and what to measure with how much margin. Expectation: Programs will use metrics to measure progress.

SEP Content, Rationale & Expectations

Content	Rationale
4. **Technical Activities and Products**	
4.1 Previous Phase SE Results	Summarize results from technical and independent reviews conducted to date • Dates conducted, results or impact(s) to design, risks/issues addressed, technical baseline established
4.2 Planned Next Phase SE Activities	Illustrates program understanding of the activities it must accomplish throughout the phase Expectation: • For EMD Phase: Describe the results of the PDR, plans for any delta-PDRs, the CDR, Production Readiness Review (PRR), and Functional Configuration Audit/System Verification Review (SVR). • For P&D Phase: Describe plans for verification, PCAs, and PRRs.
4.3 Requirements Development and Change Process	Illustrates program has established a clear linkage from top-level requirements to the CI level and the verification methodology. Expectation: Describes how the program plans to trace top-level requirements (i.e. from draft or final AoA, KPPs, KSAs, statutory, regulatory, certification, safety, SW and hardware, etc.) from the source JCIDS requirements document down to CI build-to specifications and Verification and Validation (V&V) plans

SEP Content, Rationale & Expectations

Content	Rationale
4. **Technical Activities and Products**	
4.4 Technical Reviews	Purpose of the SEP is to ensure good technical planning. Including tailored entry criteria illustrates event-driven technical reviews which are key to strong technical planning. Illustrates program understanding that technical reviews are important check points which ensure results and designs are technically sound. Expectation: Program will use a standard process for conducting technical reviews. Program will have event-driven technical reviews.
4.5 Configuration / Change Management	Illustrates program understanding that changes to requirements go through the same rigor as initial requirements and are an integral part of the basic change control process. Expectation: Programs ensure requirements traceability from the lowest level component all the way back to the user capability document.

SEP Content, Rationale & Expectations

Content	Rationale
4. T**echnical Activities and Products**	
4.6 Mapping Key Design Considerations into Contracts (e.g. RAM Strategy, etc.)	Illustrates program understanding of all the areas to consider when designing a system. Design considerations include those attributes that must be factored into the design solution. Expectation :The program will think through each design consideration during design in order to create a design that provides the required capabilities, is easily operated and maintained, and is affordable. In addition, the program will ensure there is sufficient time to obtain the certification prior to the need date; consider the administrative lead times.
4.7 Engineering Tools	Illustrates program understanding of tools available to apply to the SE process to efficiently and effectively meet system requirements. Expectation: Program will ensure design solutions are documented based upon sound SE practices using engineering tools to augment the technical approach.

Questions?

SE and SEP Law

- **Public Law 111-23 (WSARA) recognizes the importance of SE to weapon systems acquisition**
- **Heavy focus on starting MDAPs and MAIS programs right:**
  - Development and tracking of measurable performance criteria as part of SEPs and TESs / TEMPs
  - Requiring completion of competitive prototypes for all Major Defense Acquisition Programs
  - Requiring completion and MDA assessment of a system-level Preliminary Design Review before MS B
  - Codifying a role for SE in development planning, lifecycle management and sustainability
- **Yearly OSD assessment to Congress**
  - which shall set forth, at a minimum, the following:
  - "(1) A discussion of the extent to which the major defense acquisition programs are fulfilling the objectives of their systems engineering master plans and developmental test and evaluation plans." PL 111-23 (page 11 of embedded file)

WSARA PL 111-23

Implementing Directive-Type Memorandum 09-027 signed Dec. 4, 2009

Key Elements of SEP Content

- **SEP content informed by PSR and SEP review lessons learned and Service comments**
- **Key SEP elements which guide technical planning and execution:**
  - **Risk, Issue (and Opportunity) Management (DAG 4.3.6)**
    - PSR Systemic issue: 18% of programs lack sufficient risk management tools and methodology
  - **Technical Performance Measures (DAG 4.3.4.1)**
    - Facilitates assessment and communication of “Execution to Plan”
    - Key design software/ manufacturing/reliability
  - **Reliability (DAG 4.3.18.19)**
    - PSR Systemic Issue: 34% of programs have reliability program that aren't progressing as planned
  - **Technical Reviews (DAG 4.2.9 – 4.2.17)**
    - Entry and Exit Criteria
  - **Requirements Management (DAG 4.3.5)**
    - Trade studies
    - PSR Systemic Issue: 54% of program have problems will well defined and stable requirements
  - **Schedule and Schedule Risk Assessment (DAG 4.3.2.2)**
    - Adequate completeness and phasing of planned technical efforts to support acquisition decisions
    - Assesses risks of achieving upcoming technical reviews and milestones to inform mitigation activities
    - PSR Systemic Issue: 44% of programs do not have an IMS or does not have a current IMS
  - **Management of Interfaces (DAG 4.3.9)**
    - System level performance

References

- **DoD Issuances (Directives, Instructions, Publications, Forms) - http://www.dtic.mil/whs/directives/**
  - Interim DoDI 5000.02 Operation of the Defense Acquisition System
  - DoDI 5134.16 Deputy Assistant Secretary of Defense for Systems Engineering
- **DASD(SE) Policy & Guidance Website - http://www.acq.osd.mil/se/pg/guidance.html**
  - SEP Outline
- **Defense Acquisition Portal https://dap.dau.mil/**
  - Defense Acquisition Guidebook (DAG) Chapter 4 Systems Engineering - https://acc.dau.mil/dag4
  - Integrated Life Cycle Chart - https://ilc.dau.mil/
  - Acquisition Community Connection (ACC) Systems Engineering Community of Practice - https://acc.dau.mil/se
- **JCS publications - http://www.dtic.mil/cjcs_directives/index.htm**
  - JCIDS Manual - https://www.intelink.gov/wiki/JCIDS_Manual