How to Prepare a Systems Engineering Plan (SEP) that Works

Lisa Reuss
Systems and Software Engineering
Office of the Deputy Under Secretary of Defense
for Acquisition and Technology, ODUSD(A&T)

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Outline

- ✓What is a SEP?
- ✓Why do one?
- ✓Who should write it?
- ✓How should it be written?
- ✓When should it be written?

AND, most importantly . . .

- ✓What do I do with it once I have one?

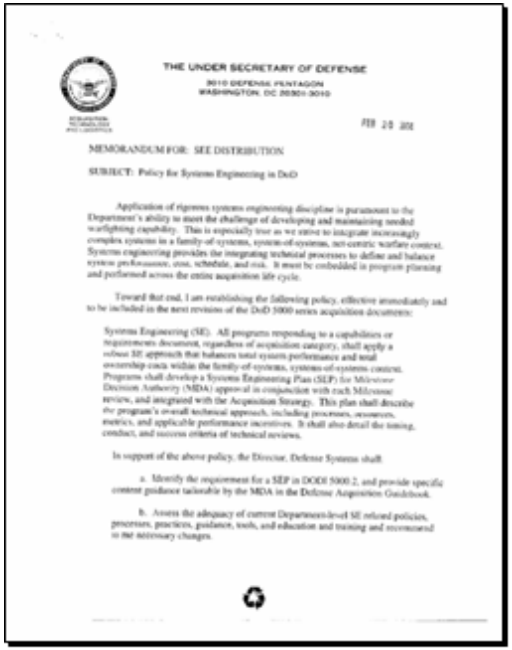
What is a SEP?

A SEP

- Articulates and communicates technical planning and management approach to program team, stakeholders, and contractor teams (including bidders if provided with Request for Proposal (RFP))
- Captures integration of both government and contractor systems engineering (SE) activities, roles, and responsibilities over the acquisition and sustainment life cycle
- Provides expected management interactions and impacts of their respective processes not only by addressing program-tailored processes, but also the "who, when, and to what result(s)”

SE and SEP Policy*

- "Provide a context within which I can make decisions about individual programs."
- "Achieve credibility and effectiveness in the acquisition and logistics support processes."
- "Help drive good *systems engineering* practices back into the way we do business."



THE UNDER SECRETARY OF DEFENSE

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MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Policy for Systems Engineering in DoD

Application of rigorous systems engineering discipline is paramount to the Department's ability to meet the challenge of developing and maintaining needed warfighting capability. This is especially true as we strive to integrate increasingly complex systems in a family-of-systems, system-of-systems, net-centric warfare context. Systems engineering provides the integrating technical processes to define and balance system performance, cost, schedule, and risk. It must be embedded in program planning and performed across the entire acquisition life cycle.

Toward that end, I am establishing the following policy, effective immediately and to be included in the next revision of the DoD 5000 series acquisition documents:

Systems Engineering (SE). All programs responding to a capabilities or requirements document, regardless of acquisition category, shall apply a robust SE approach that balances total system performance and total ownership costs within the family-of-systems, systems-of-systems context. Programs shall develop a Systems Engineering Plan (SEP) for Milestone Decision Authority (MDA) approval in conjunction with each Milestone review, and integrated with the Acquisition Strategy. This plan shall describe the program's overall technical approach, including processes, resources, metrics, and applicable performance incentives. It shall also detail the timing, conduct, and success criteria of technical reviews.

In support of the above policy, the Director, Defense Systems shall:

a. Identify the requirement for a SEP in DODI 5000.2, and provide specific content guidance tailorable by the MDA in the Defense Acquisition Guidebook.

b. Assess the adequacy of current Department-level SE related policies, processes, practices, guidance, tools, and education and training and recommend or take necessary changes.

"PMs shall prepare a SEP for each milestone review, beginning with Milestone A. At Milestone A, the SEP shall support the TDS; at Milestone B or later, the SEP shall support the Acquisition Strategy. The SEP shall describe the program's overall technical approach, including key technical risks, processes, resources, metrics, and applicable performance incentives. It shall also detail the timing, conduct, and success criteria of technical reviews.

DoDI 5000.02, Enclosure 12

*Full policy can be found at http://www.acq.osd.mil/sse/pg/index.html

Top 10 Emerging Systemic Issues*

1. Management	▪ IPT roles, responsibilities, authority, poor communication ▪ Inexperienced staff, lack of technical expertise
2. Requirements	▪ Creep/stability ▪ Tangible, measurable, testable
3. Systems Engineering	▪ Lack of a rigorous approach, technical expertise ▪ Process compliance
4. Staffing	▪ Inadequate Government program office staff
5. Reliability	▪ Ambitious growth curves, unrealistic requirements ▪ Inadequate “test time” for statistical calculations
6. Acquisition Strategy	▪ Competing budget priorities, schedule-driven ▪ Contracting issues, poor technical assumptions
7. Schedule	▪ Realism, compression
8. Test Planning	▪ Breadth, depth, resources
9. Software	▪ Architecture, design/development discipline ▪ Staffing/skill levels, organizational competency (process)
10. Maintainability/Logistics	▪ Sustainment costs not fully considered (short-sighted) ▪ Supportability considerations traded

*From D. Castellano’s brief - NDIA SE Conference – Oct. 2007: *Sharing Lessons Learned Based on Systemic Program Findings (since Mar 04)*

Top Five SE Issues*

- As identified by 2006 NDIA task group, not necessarily in priority order:
  - Key SE practices known to be effective are not consistently applied across all phases of the program life cycle.
  - Insufficient SE is applied early in program life cycle, compromising foundation for initial requirements and architecture development.
  - Requirements are not always well-managed, including effective translation from capabilities statements into executable requirements to achieve successful acquisition programs.
  - Quantity and quality of SE expertise is insufficient to meet demands of government and defense industry.
  - Collaborative environments, including SE tools, are inadequate to effectively execute SE at joint capability, system of systems (SoS), and system levels.

*Full report can be found at http://www.ndia.org

SEP Blooper

“The …staffing *decreases* over the next two years as the …systems engineering effort is completed and the testing effort ramps up.”

SE Working Integrated Product Team (WIPT)

- To be effective, an SE WIPT (like all WIPTs) requires:
  - **Full support of PM and Lead SE**
  - **Charter defining goals, products, membership, and reporting requirements**
- The SE WIPT (similar to a Test and Evaluation (T&E) WIPT) should:
  - **Assist Lead SE in establishing systems engineering planning**
  - **Prepare program's SEP to reflect program office with incorporated contractor's technical planning**
  - **Assist technical authority in assessing:**
    - **Schedule and cost realism**
    - **Readiness to proceed to SE technical reviews**
    - **User's requirement documents (e.g., Initial Capabilities Document (ICD), Capability Development Document (CDD), Capability Production Document (CPD))**
    - **Production and sustainment planning, etc.**
  - **Focus on identifying and resolving issues early by providing continuous assessments and analyses to PM and functional supervisors**
  - **Assess progress to achieving performance requirements and acquisition phase exit criteria to ensure program execution in accordance with the approved SEP**
  - **Review System, Family of Systems (FoS), Systems-of-Systems SoS performance**

SE WIPT Participants

Recommended participants, as applicable:

- PM
- Program's Lead SE/Chief SE
- Program's IPT Leads (e.g., Platform, Propulsion, Communications, T&E, etc.) or SEs, if so staffed
- Contractor Lead SE and IPT Lead counterparts
- Office of the Secretary of Defense (OSD) representatives
  - Systems and Software Engineering
  - Logistics and Materiel Readiness
  - Etc.
- PEO- and Service-level Lead SEs
- Service SE organization representatives (e.g., AF: SAF/AQRE, NAVSEA: SEA05, etc.)

Involve the right people in your SE WIPT

SEP Blooper

“Task analyses conducted by *human and engineers* provide qualitative data to support ….”

SEP Preparation Guide

- Can be found online at http://www.acq.osd.mil/sse/pg/guidance.html
- Currently aligns with policy and guidance
  - DoDI 5000.2
  - Defense Acquisition Guide (DAG) - https://akss.dau.mil/DAG/DoD5000.asp?view=document

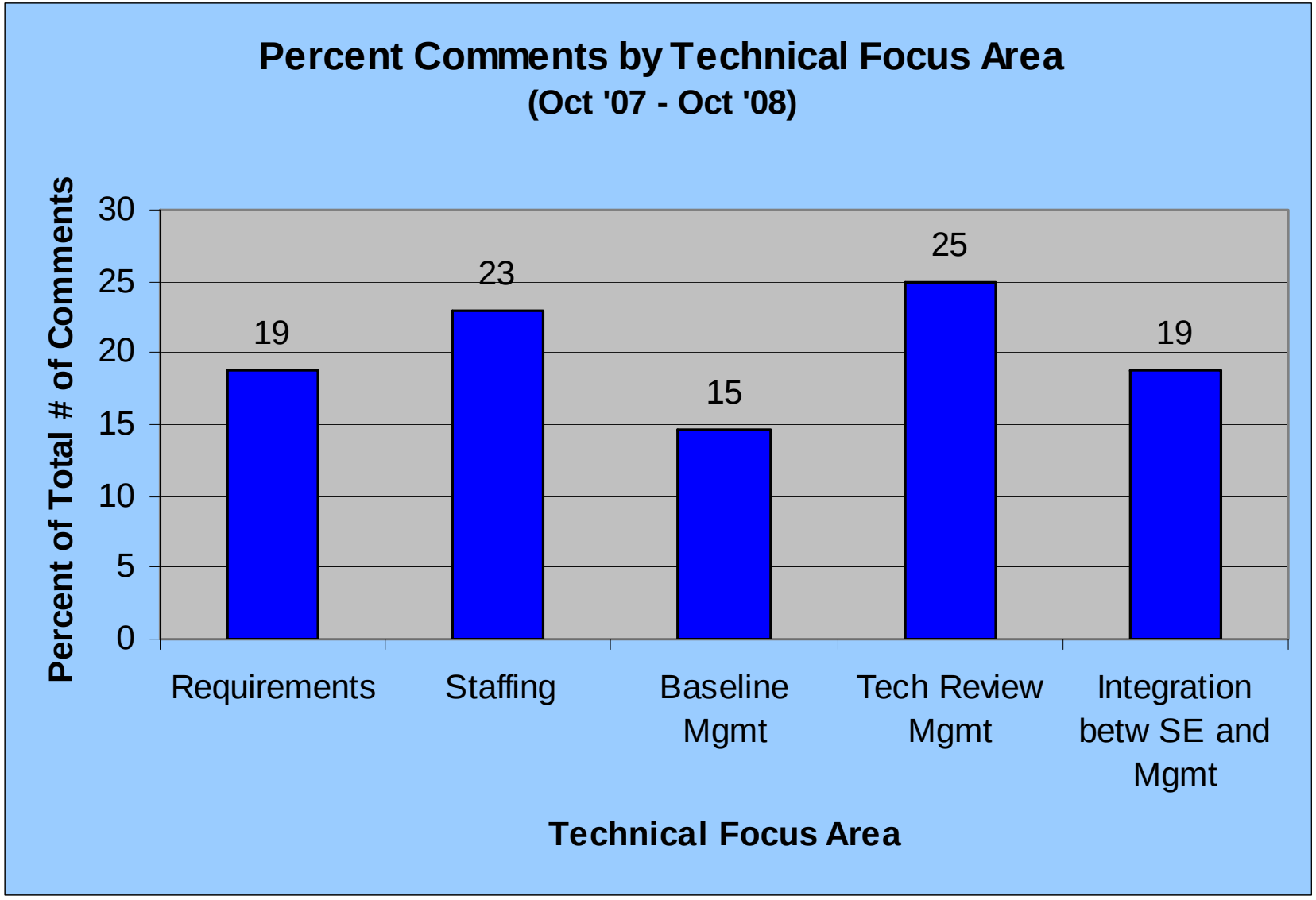
Interim SEP Prep Guide update this year (5000.02 impacts)

SEP Preparation Guide (cont'd)

- **SEP Prep. Guide includes an outline and technical focus areas**
  - **Introduction/Background/Schedule/Program Description**
  - **Requirements**
    - **KPPs**
    - **Statutory**
    - **Regulatory**
    - **Certification**
  - **Technical Staffing organization and details – PMO and IPT**
  - **Technical Baseline Management - traceability and related processes**
    - **Functional**
    - **Allocated**
    - **Product**
  - **Technical Review Management – Tailored details**
  - **Integration of SE Activities with Program Management**

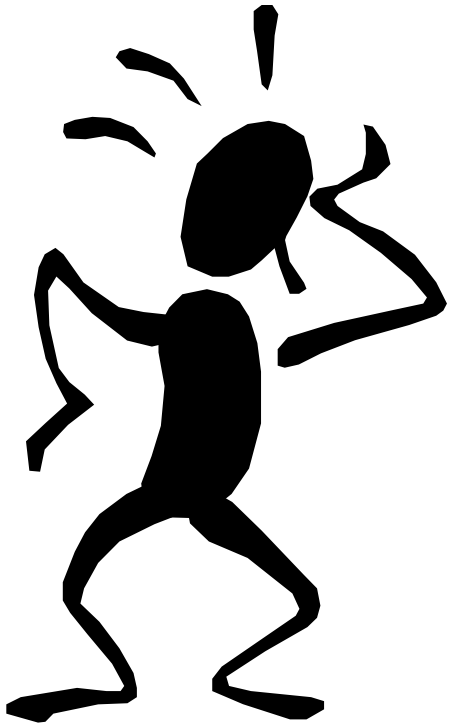
Follow the guidance

Where are SEPs weak?



*Based on actual ACAT 1D and 1AM program full SEP reviews

SEP Blooper



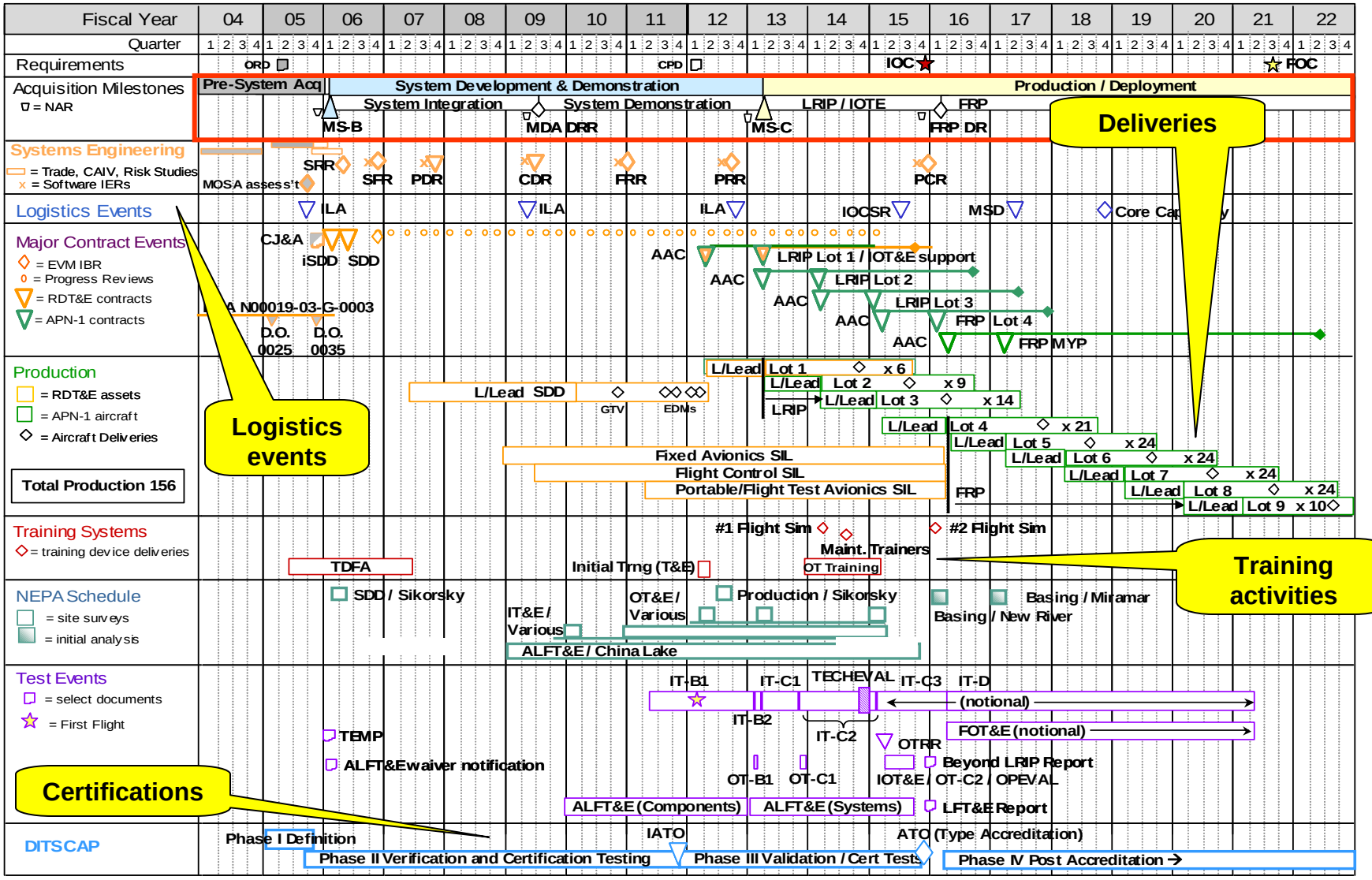
“Fifteen (15) trade studies are planned during the SDD phase. These trade studies are undefined at this time.”

Schedule

Schedules within SEPs should include:

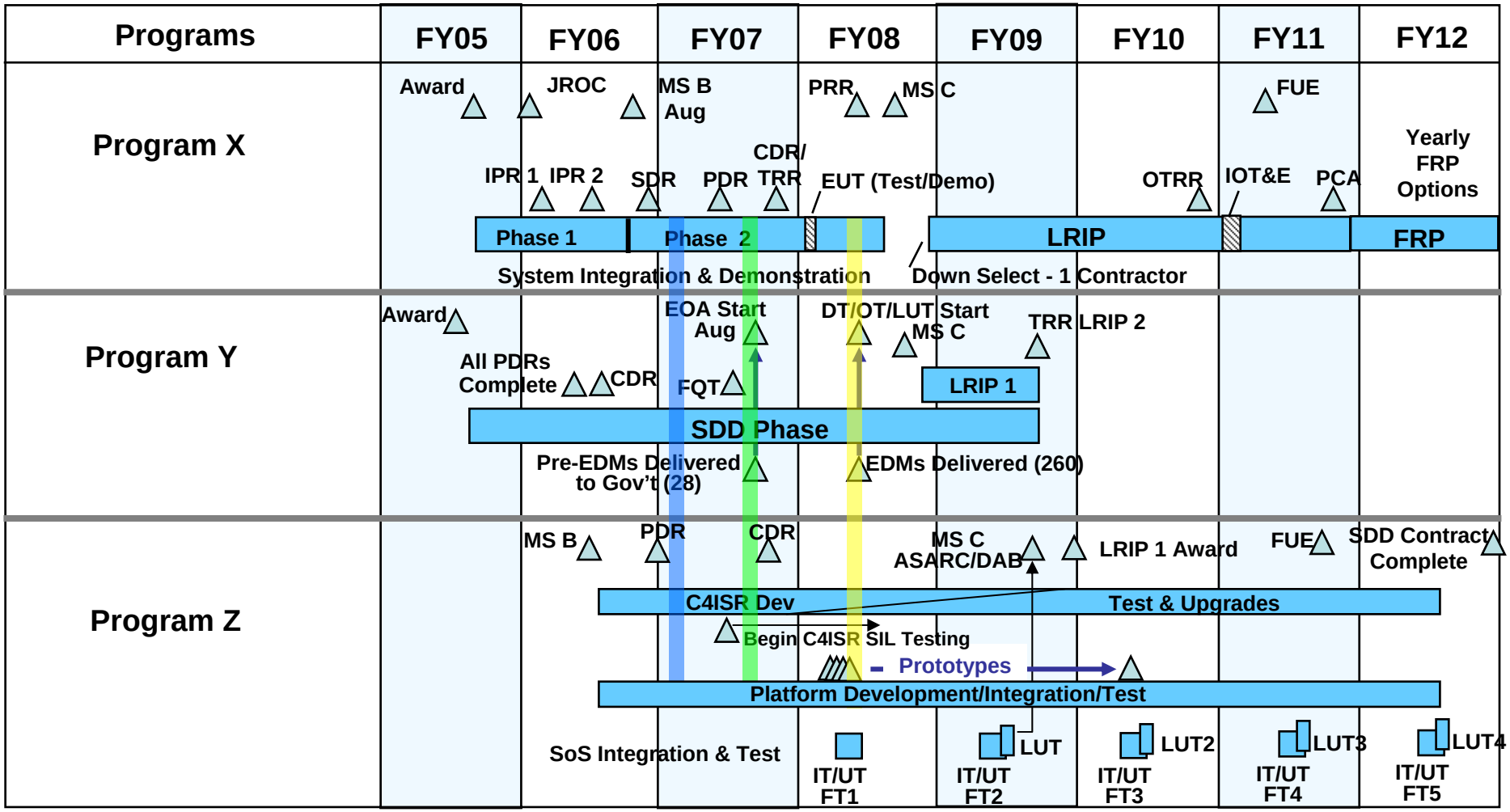
- Major program milestones (A, B, C), Post-CDR Assessment, Low Rate Initial Production (LRIP), and Full-Rate Production (FRP), etc.)
- SE technical reviews (System Requirements Reviews (SRR), PDR, CDR, Test Readiness Review (TRR), Production Readiness Review (PRR)/ Functional Configuration Audit (FCA), Physical Configuration Audit (PCA), etc.)
- Key program events
  - Testing
  - Production and deliveries
  - Certifications
  - Training
  - Contract awards
  - Site activation
- Integration of SoS and/or FoS efforts such as
  - Space programs – space vehicle, ground segment, user segment, system integration
  - Ship programs – hull and modules, system integration

Detailed Schedule Sample*



*Note: This sample schedule not in compliance with DoDI 5000.02

FoS/SoS Complementary Program Schedule Sample*



*Note: This sample schedule not in compliance with DoDI 5000.02

Program Description

SEPs should include:

- Background - How did you get here?
- Summary of Acquisition Strategy
  - Contract types
  - Numbers of systems for purchase
- System description
  - System diagram illustrating key system components
  - SV-1
  - Key technologies to develop, as applicable
- Operational environment (CONOPS)
  - Interfaces
  - OV-1

Requirements

SEPs should include:

- **KPPs**
  - **Actual KPPs from draft or approved ICD, CDD, or CPD with rationale for thresholds and objectives**
  - **MS C and FRP SEPs - Progress made towards KPPs**
- **Statutory and Regulatory**
  - **Start with DoDI 5000.02 Enclosure 4, then tailor to program**
  - **Planned accomplishment/approval date and status, program responsibility, and approval authority**
  - **A plan to address Critical Program Information (Program Protection Plan (PPP)) (*New from DoDI 5000.02*)**

Requirements

SEPs should include:

- **Certifications**
  - **All program system-level planned certification requirements (*start with DoDI 5000.02 Enclosure 4 and next slide's content, then tailor to program*)**
  - **Planned accomplishment date (*not just MS X*), status, and program responsibility such as IPT or position**
- **Design considerations**
  - **Those design considerations which most impact the feasibility of the preferred system approach and described rationale (*start with DAG Ch. 4.4 (and below), then tailor to program*)**
  - ***New from DoDI 5000.02:*** **Waveform, Electromagnetic Spectrum, and Life-Cycle Signature Management**
  - ***Design considerations is where a program's trade-space truly exists***

Typical Certification Requirements (by Domain)

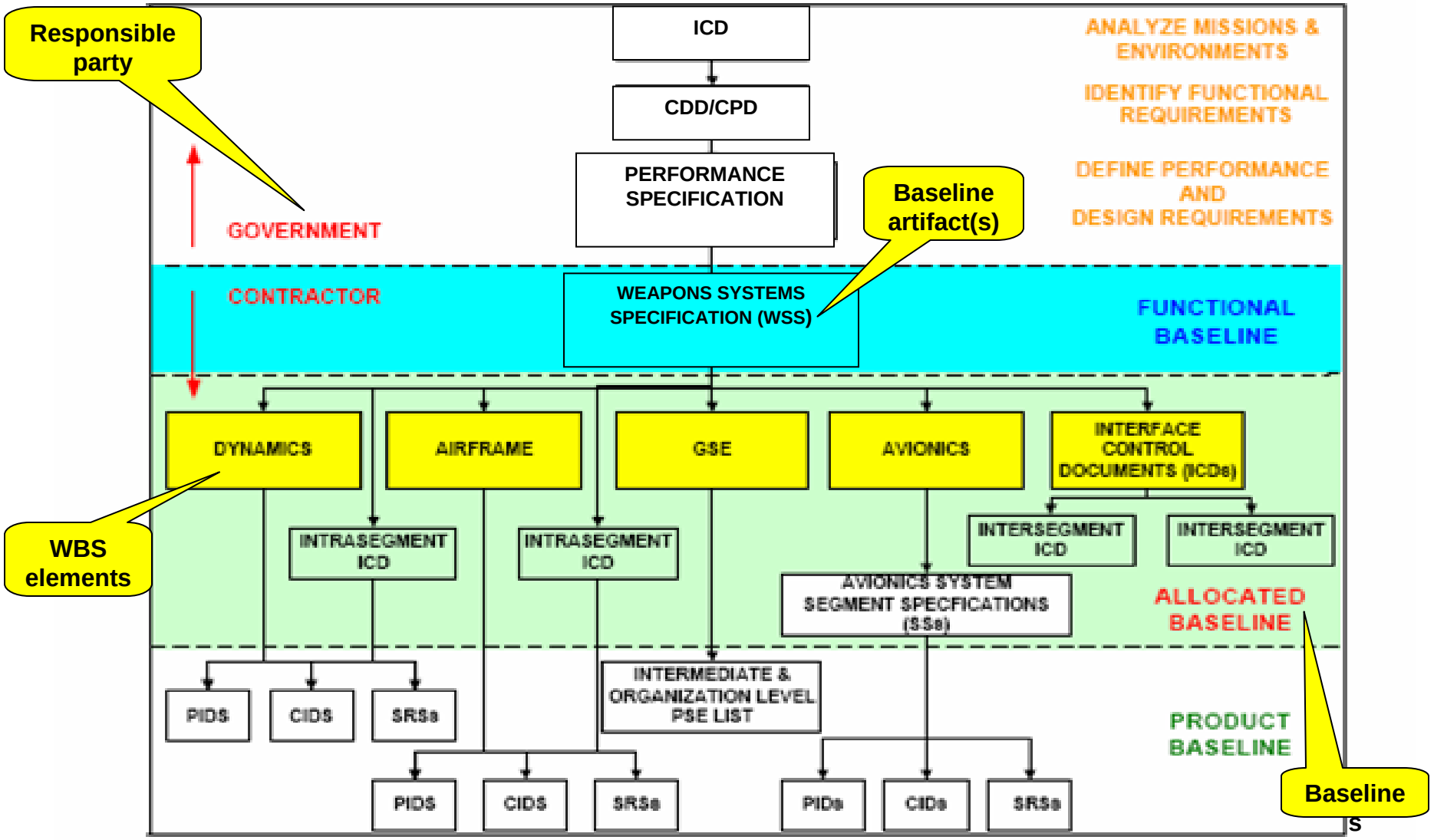
Common for Most Programs (as of 12/14/07)	
COMSEC	IPv6
DIACAP/Information Assurance	System Readiness for Dedicated OT&E
E3 Control & Spectrum Cert Rqmts (JCIDS)	Transportability
Intelligence	Supportability
GATM (or CNS/ATM)	Interoperability
Air & Space	**NII (Communications, C2ISR, and Business Systems)**
Airworthiness/Space Flight Worthiness	Business Mgmt Modernization Program (BMMP)
AIMS	COE/NCES
IFR & VFR	Fleet Readiness
Intra-Army Interoperability (IAIC)	GIG
Joint Interoperability	Joint Technical Architecture (JTA)
National Airspace Cert. of Authorization	**Sea**
Non-nuclear Munitions Safety Board	Carry-On Hardware Authorization
Nuclear	ILS
Primary Flight Reference	Manned Safety
Seek Eagle (Stores)	WSESRB Operational Authority
SIMCERT	Nuclear
SW Considerations - Airborne Systems & Equip	Nuclear Weapons
Land	Non-nuclear Munitions Safety Board
Anti-Tamper	**Missile-Rocket**
Intra-Army Interoperability (IAIC)	Insensitive Munitions (IM)
Spectrum Supportability	Performance-Oriented Package (POP)
TEMPEST	

Baseline Management

SEPs should include:

- **Planned technical baseline artifacts (e.g., specifications, drawings, etc.)**
  - **Functional**
  - **Allocated**
  - **Product**
- **Baseline artifact traceability from JCIDs documents, KPPs, and CONOPS through Work Breakdown Structure (WBS) activities to verification and validation (V&V) activities**
- **Summarized configuration management (CM) process (reference CM Plan, if applicable)**
  - **Responsible position(s) and decision authorities**
  - **Flow chart with inputs/outputs**
  - **Boards with members (e.g., Configuration Control Board (CCB))**
  - **Description of Government takes control of the product baseline**
  - **PM control of initial product baseline for all Class 1 changes after the system-level CDR (*New from DoDI 5000.02*)**

Sample Requirements Traceability



Use charts, figures, tables, and graphics to avoid confusing text

SEP Blooper

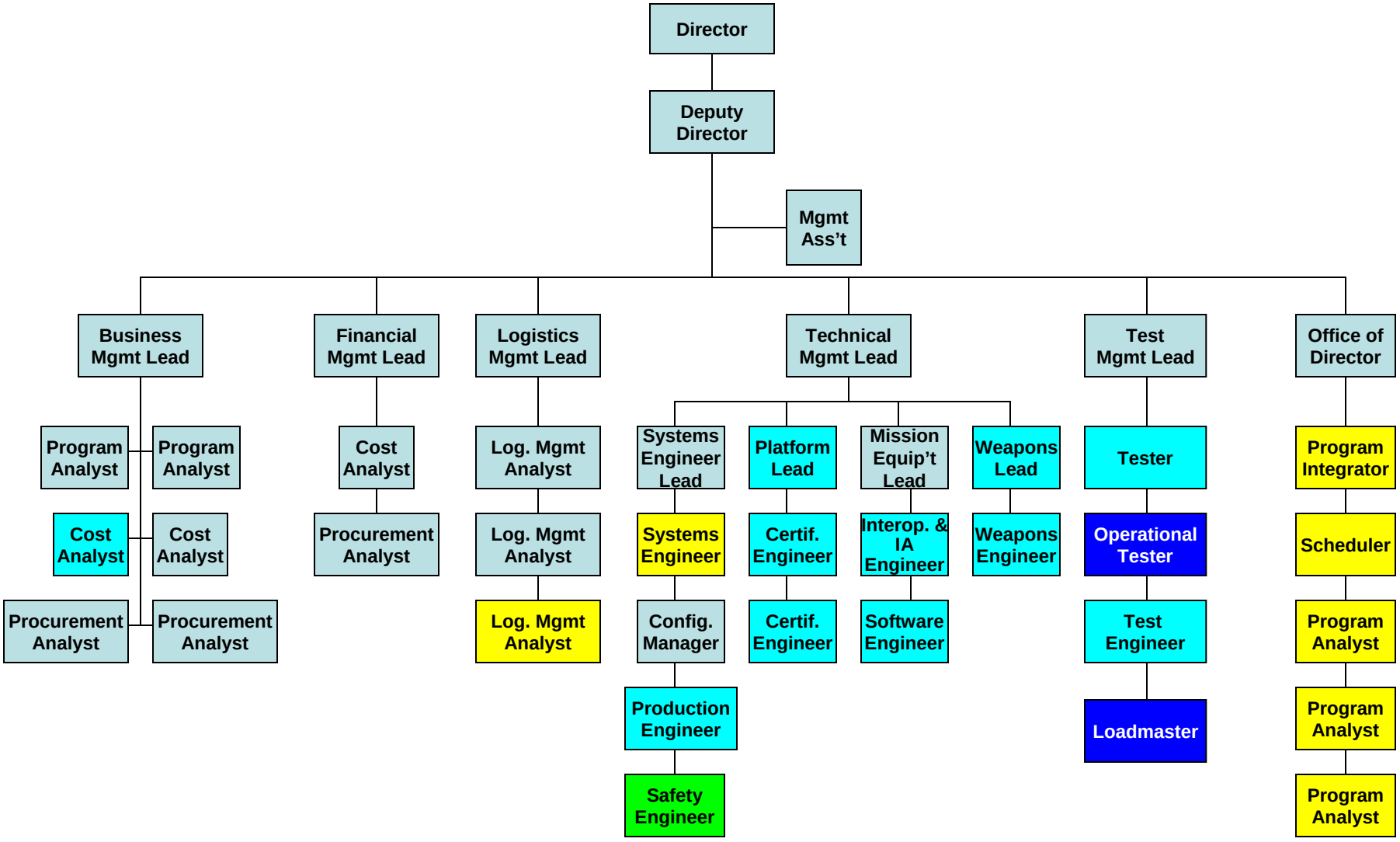
“Integrity is not an issue on the {Program}, because the program was put on contract during acquisition reform.”

Staffing

SEPs should include:

- Complete program office organizational (org) chart
- Key program office position descriptions including the roles, responsibilities, ***and*** authorities
- Position description text consistent with program office org chart (If LSE described in text, expect an LSE to be on the org chart)
- The workforce mix (***New from DoDI 5000.02***)

Sample Organization Chart

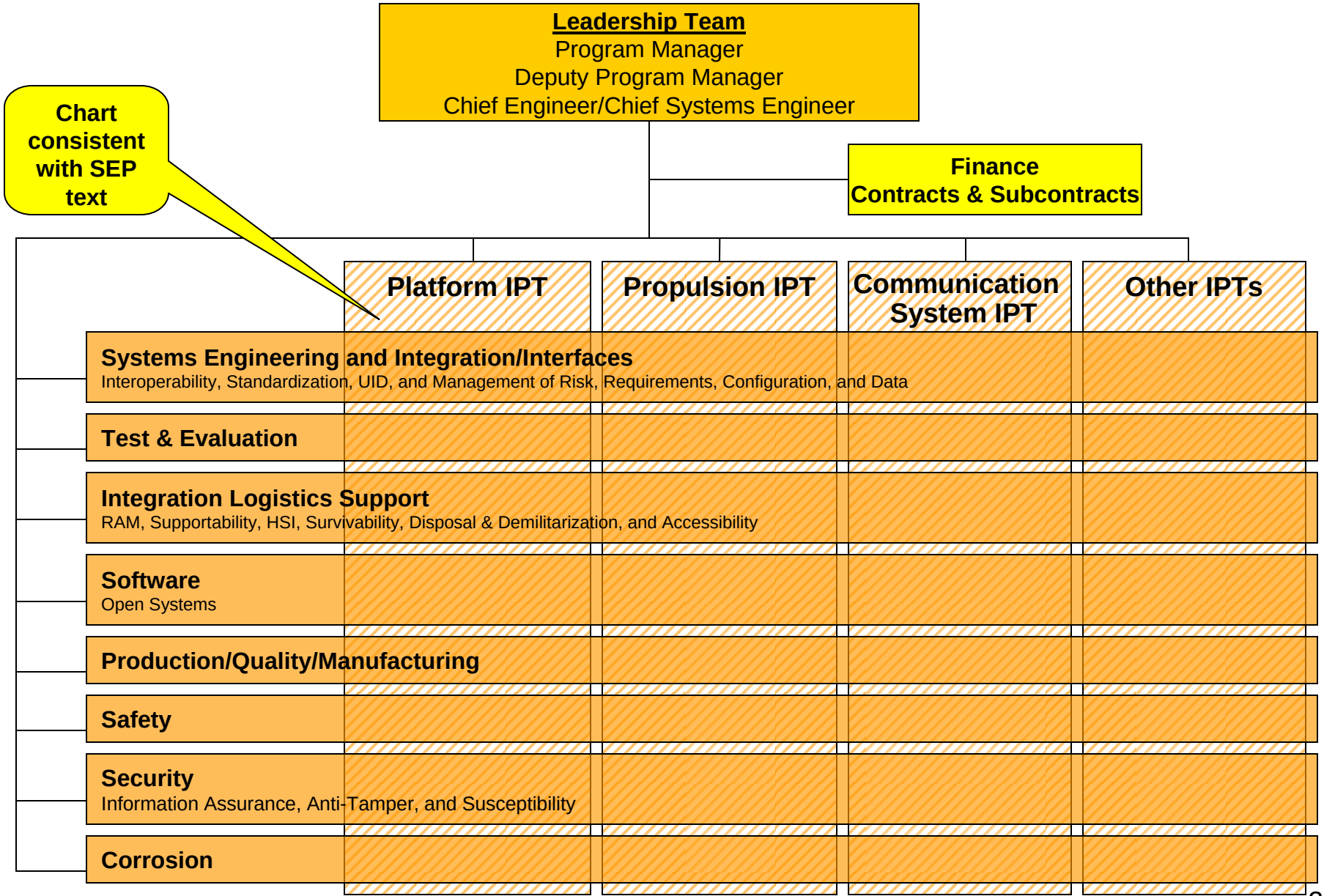


IPT Organization

SEPs should include:

- Complete IPT org chart
- IPT charter-like details for each identified IPT in org chart such as: chairperson, complete functional and/or positional membership, purpose, roles and responsibilities within, authority, and products
- IPT details consistent with IPT org chart (If Logistics IPT in org chart, expect a description of this IPT in the text)

IPT Organization Chart Sample



IPT Charter Sample

Program Y IPT Charter		
Charter Statement	**We accept total system performance and integration responsibility for the product that satisfies all EMD and production affordability/risk objectives and satisfies the product's performance requirements.**	
Key Responsibilities	**•Deliver all products within program/customer performance cost and schedule requirements** **•Provide IPT program management functions, including personnel supervision, technical management, subcontract management and business management for all development and production activities of the team** **•Develop and execute detailed specifications, plans and schedules including IMP/IMS for all team task and product deliveries** **•Manage performance through EVMS, TPMs and other metrics and risk assessments** **•Implement team SE and quality standards, thus ensuring**	
Key Products and Deliverables	**•EMD product – this should be "Functional, Allocated, and Product Baselines"** **•LRIP Configuration** **•IMP/IMS** **•Integrated Product Development and Manufacturing Plan** **•Verification Plan** **•Maintainability Demonstration**	**•Supportability Demonstration** **•EMD Test Package** **•DT&E Package** **•OT&E Package** **•Modeling and Simulation** **•Trade Studies** **•Block Plan (as appropriate)**
Key Team Members	**•Chief/Lead Systems Engineer (Chair)** **• IPT Leads (e.g. platform, propulsion, communications, etc.)** **•Functional Leads (e.g. SE, T&E, Logistics, etc.)** **•Suppliers**	**•DCMA Representative** **•Security Representative** **•Subcontract Manager** **•Resource and Services Lead** **•Program Controls Lead**

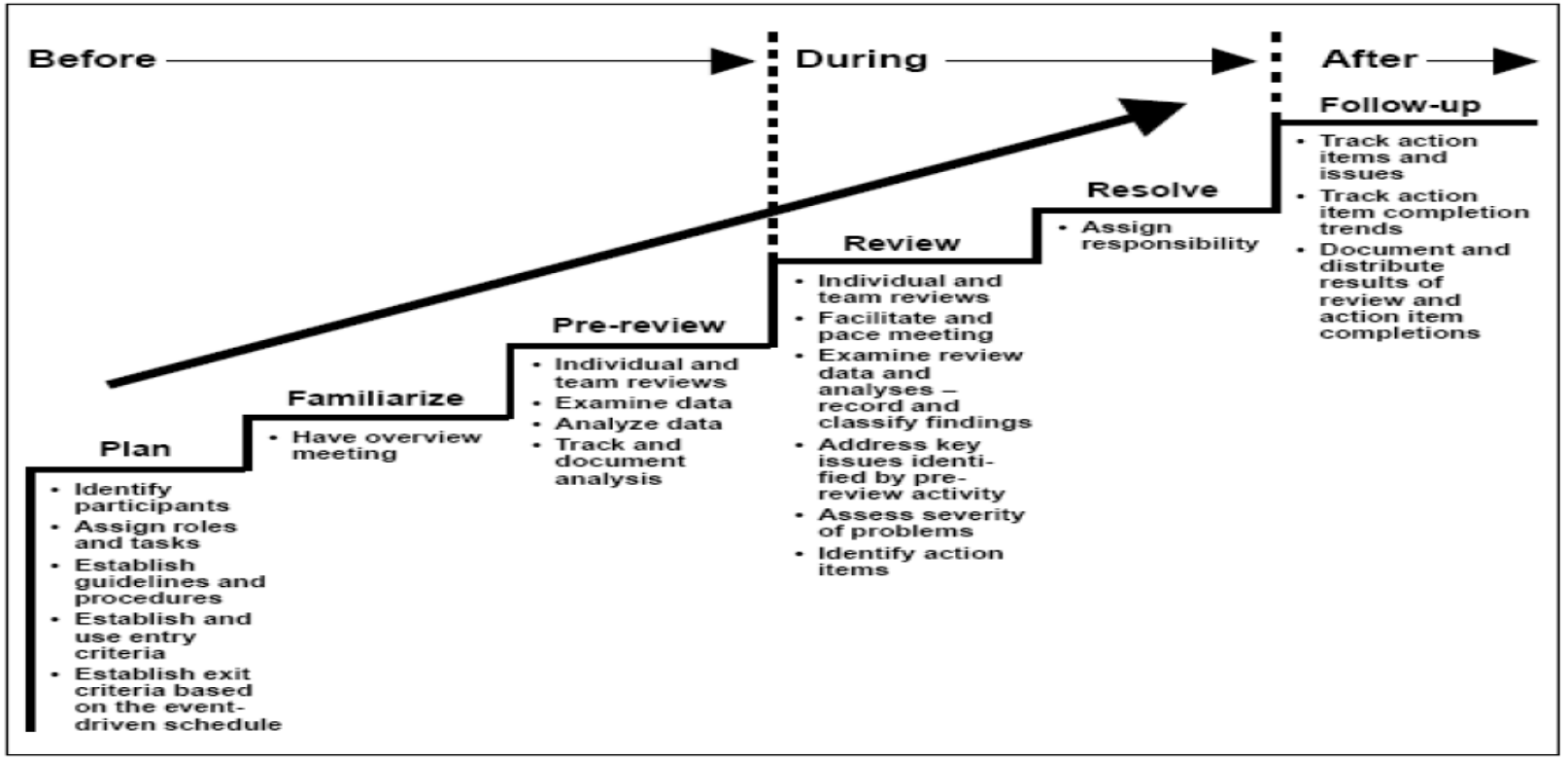
SEP Blooper

“The … Program Manager and Systems Engineer monitor integration activities to ensure that the KPPs and the KSAs are *not* achieved.”

Processes

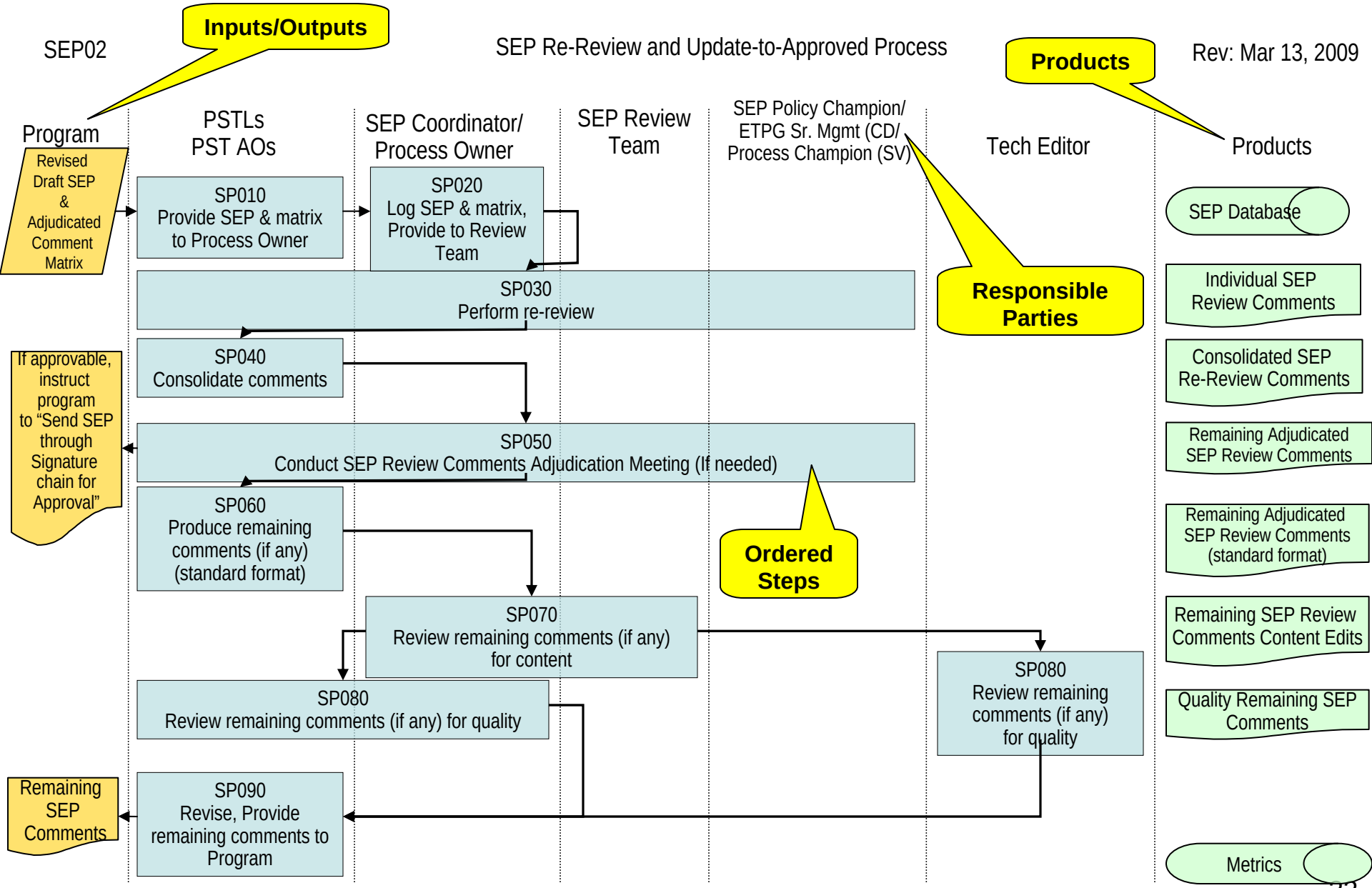
SEPs should include:

- Flow-chart of all processes (e.g., flow, decision points, etc.)
- Roles, responsibilities, and authorities of those involved with process
- Products of process and what happens to them next



Execute to the planned processes

Sample Process



Technical Reviews

SEPs must include:

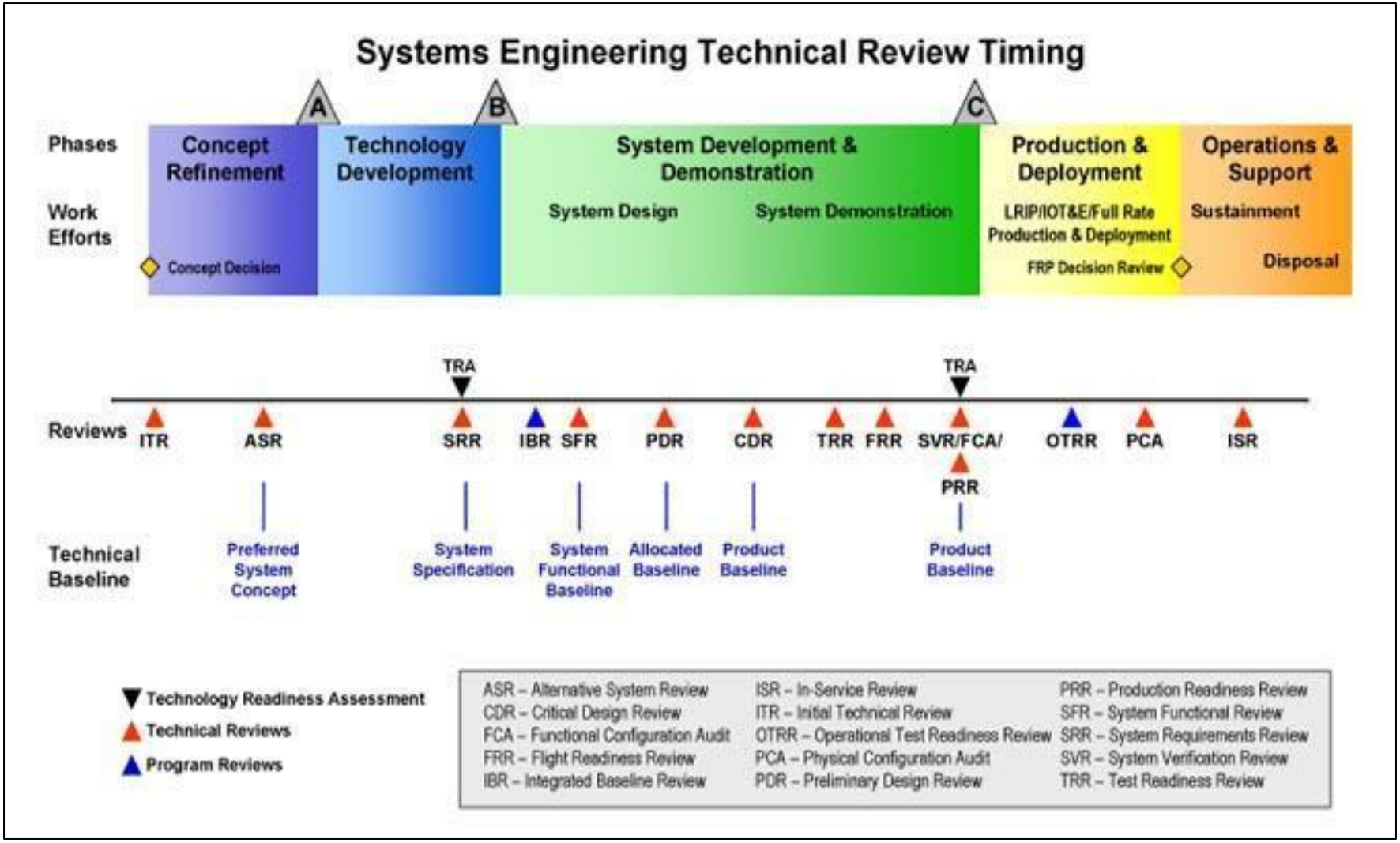
- A planned technical review description which is
  - Consistent
  - Complete
  - Program-specific
  - *Tailored from guidance*
- A planned technical review description which has a
  - Purpose and description
  - Anticipated chairperson position(s)
  - Anticipated functional or positional membership to include
    - Program office
    - Contractor(s)
    - Program stakeholders
    - *Program-independent SMEs*
  - Entry criteria for system-level reviews which include key sub-system technical review successful completions
  - Entry and exit criteria which are program-specific and tailored-from-guidance

Technical Reviews

SEPs must include as per newly released DoDI 5000.02:

- **Preliminary Design Review (PDR) – Required**
  - **Before MS B: PDR Report to the MDA for MS B**
  - **After MS B:**
    - **PDR Report to the MDA**
    - **Post-PDR Assessment and ADM**
- **Critical Design Review (CDR) – Required**
  - **Post-CDR Report to the MDA**
  - **Post-CDR Assessment and ADM**

Systems Engineering Technical Reviews*



*** The new DoDI 5000.02 has changed this chart considerably!**

*Can be found at https://acc.dau.mil/CommunityBrowser.aspx?id=144143

Technical Review Details

Purpose

Review	Purpose	Criteria	Participants
System Requirements Review (SRR)	Assesses the technical readiness to enter System Development and Demonstration (SDD)	**Trigger:** Precedes and supports MS B. **Entrance:** Preliminary system specification, technology development activities, SEP, CARD, and Acquisition Strategy all completed and documented **Exit:** Meeting minutes published; all assigned action items completed and/or action plans documented to the Chair's satisfaction	**Chairperson(s):** **Program Office functions:** PM, Lead SE, IPT leads, etc. **Contractor functions:** PM, Lead SE, IPT leads, etc. ***Program-Independent SME orgs:***
Preliminary Design Review (PDR)	Assesses the system allocated baseline and readiness for full detailed design	**Trigger:** At completion of functional allocation activities and prior to completion of detailed design. **Entrance:** Completed allocated baseline as documented in design specification for each hardware and software configuration item **Exit:** Meeting minutes published; all assigned action items completed and/or action plans documented to the Chair's satisfaction; Work schedule and resources for technical design approved	**Chairperson(s):** **Program Office functions:** PM, Lead SE, IPT leads, etc. **Contractor functions:** PM, Lead SE, IPT leads, etc. ***Program-Independent SME orgs:***

Tailored entrance and exit criteria

Chairperson, program participants, stakeholders, and *program-independent SMEs*

Tailor your entrance and exit criteria and include program-independent SMEs

SEP Blooper

“The current program office Chief Engineer and IPT leads will thus be dual *hated* to support future development …”

SE Integration with Program Management

SEPs should describe:

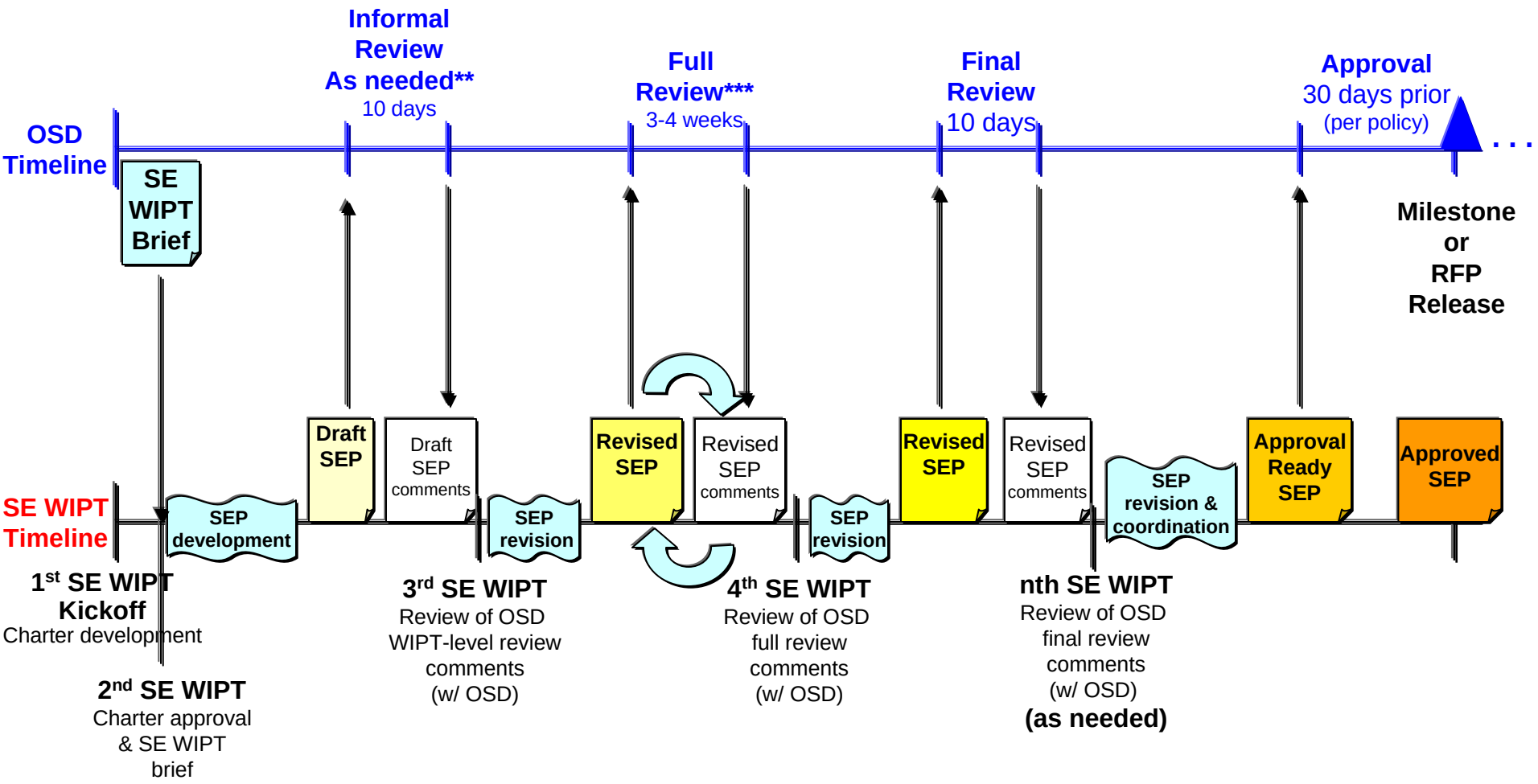
- **SE efforts and events within IMP, IMS, and EVM**
- **SE participation in risk management decisions and SE-related risks, as applicable**
- **Production/Manufacturing and Reliability Planning (*New from DoDI 5000.02*)**
- **Requirements verification through Test and Evaluation**
- **Logistics / Sustainment Planning with early consideration of Data Assets (*New from DoDI 5000.02*)**
- **Integrating SE into contracts**
- **IUID Plan now summarized or annex to SEP (depending on milestone) (*New from DoDI 5000.02)***

Referencing

- **Key documents often referred to in SEP**
  - Initial Capabilities Document (ICD), CDD, and CPD
  - CONOPs
  - Acquisition Strategy
  - Risk Management Plan (RMP)
  - Configuration Management Plan (CMP)
  - Integrated Master Plan and Schedule (IMP & IMS)
  - Test and Evaluation Master Plan (TEMP)
- **Summarize then refer to key documents**
  - Via hotlink to accessible site
  - Include CD with references

SEP Development Timeline*

Note: Planning should be thought-through and take place long before it is documented in a SEP



*Not to scale **Informal Review: Showstopper only review ***Full Review: Detailed review

How to use your SEP

- Helping set up a new program? Use SEP Preparation Guidance to ensure much is considered before SE plans are finalized.
- New to the program? Read the SEP to understand the program's system-level technical planning.
- Going to a technical review? Check the SEP's documented entry and exit criteria prior to conduct and participation.
- Working in a program office? Refer to the SEP for SE process descriptions, roles, responsibilities, and expected products.
- Going to an IPT meeting? Check the SEP for which positions and functions who should be invited/present
- Have an approved SEP? Execute to it!

Summary

A SEP should:

- ✓ reflect well-thought-through, actual technical planning for a Government program office
- ✓ respond to and comply with SE and SEP policy, noting those from new DoDI 5000.02
- ✓ be written by the right people on the right timeline
- ✓ follow guidance and use charts, figures, tables, graphics, and hotlinks as much as possible
- ✓ guide conduct of IPTs/WIPT meetings, technical reviews, and process usage

Execute to the Plan!

For More Information

❖ Contact us:

- Sharon Vannucci, 703-695-7853
  Sharon.Vannucci@osd.mil
- Lisa M. Reuss, 703-602-0851x128
  Lisa.Reuss.ctr@osd.mil

❖ Refer to:

http://www.acq.osd.mil/sse/pg/guidance.html

Additional Slides

SEP Bloopers

- **"The …staffing *decreases* over the next two years as the …systems engineering effort is completed and the testing effort ramps up."**
- **"Task analyses conducted by *human and engineers* provide qualitative data to support …."**
- **"Fifteen (15) trade studies are planned during the SDD phase. These trade studies are undefined at this time."**
- **"Integrity is not an issue on the {Program}, because the program was put on contract during acquisition reform."**
- **"The … Program Manager and Systems Engineer monitor integration activities to ensure that the KPPs and the KSAs are *not* achieved."**
- **"The current program office Chief Engineer and IPT leads will thus be dual *hated* to support future development …"**

A SEP is not A SEMP*

- SEP – Government's artifact of technical planning
- SEMP (Systems Engineering Management Plan) - Contractor's artifact of technical planning

- SEP – Interactions between Government and prime and/or key sub-contractors
- SEMP – May include interactions between Government and prime contractor but more likely includes interactions between prime and sub-contractors

- SEP – Ideally provided to contract bidders with Government's RFP
- SEMP – Ideally part of response from contract bidders to Government's RFP with SEP alignment as appropriate

- SEP – Over the acquisition and sustainment lifecycle of a system (with emphasis on upcoming phases, but still summarizing previous accomplishments)
- SEMP – Over the period for which a contractor is on contract

*For more details on this and other SEP FAQs, go to http://www.acq.osd.mil/sse/docs/sepfaqs.html

SE WIPT Planning Guidelines

Homework:

- Are participants sufficiently knowledgeable of acquisition and SE policies, related references, guidance, and training? (See backup slide for more details)
- Do planning participants understand SEP purpose? (Remember, the SEP captures, integrates, and communicates both government and contractor systems engineering plans and processes.)
- Are participants sufficiently knowledgeable of program goals *and* constraints?
- Are reference documents available to the planning team?
  - **Appropriate programmatic information for current acquisition phase; any drafts of programmatic information for upcoming phase**
  - **Technology Development Strategy (TDS) and/or AS**
  - **Requirements documents (e.g., ICD, CDD, and CPD)**
  - **Concept of Operations (ConOps)/Concept of Employment (ConEMP)**
  - **Technical and programmatic results of previous phases, as applicable**

Available Systems Engineering Planning References and Related Guidance*

- ***DoDI 5000.02 Enclosure 12***
- ***Defense Acquisition Guidebook* (DAG)**
  - **Chapter 4 – Systems Engineering**
  - **Chapter 5 – Acquisition Logistics**
  - **Chapter 9 – Test and Evaluation**
- **AT&L-sponsored SE Community of Practice (CoP) - http://acc.dau.mil/se**
- ***SEP Preparation Guide***
- ***SE WIPT Charter Template***
- ***Guide for Integrating Systems Engineering into DoD Acquisition Contracts***
- ***Risk Management Guide for DoD Acquisition***
- ***SoS Systems Engineering Guide: Considerations for Systems Engineering in a System of Systems Environment***
- ***DoD Guide for Achieving Reliability, Availability, and Maintainability***
- ***Integrated Master Plan/Integrated Master Schedule Preparation and Use Guide***

*For more on references and guidance, go to http://www.acq.osd.mil/sse/pg/guidance.html

Available DAU Systems Engineering Planning and Related Training

Education, training, and experience certification standards for DoD Systems Engineers are reflected in current Systems Planning, Research Development, and Engineering (SPRDE) Career Field/Systems Engineering (SE) and Program Systems Engineer (PSE) Career Paths

- **SPRDE Core Courses***
  - **SYS 101 (Online)**
  - **SYS 202 (Online)**
  - **SYS 203 (Classroom)**
  - **SYS 302 (Classroom)**
- **Continuous Learning Modules (Online)**
  - **CLE-003 Technical Reviews**
  - **CLE-009 Systems Safety in Systems Engineering**
  - **CLE-011 M&S in Systems Engineering**
  - **CLE-017 Technical Planning**
  - **CLE-301 Reliability and Maintainability**
  - **CLM–017 Risk Management**

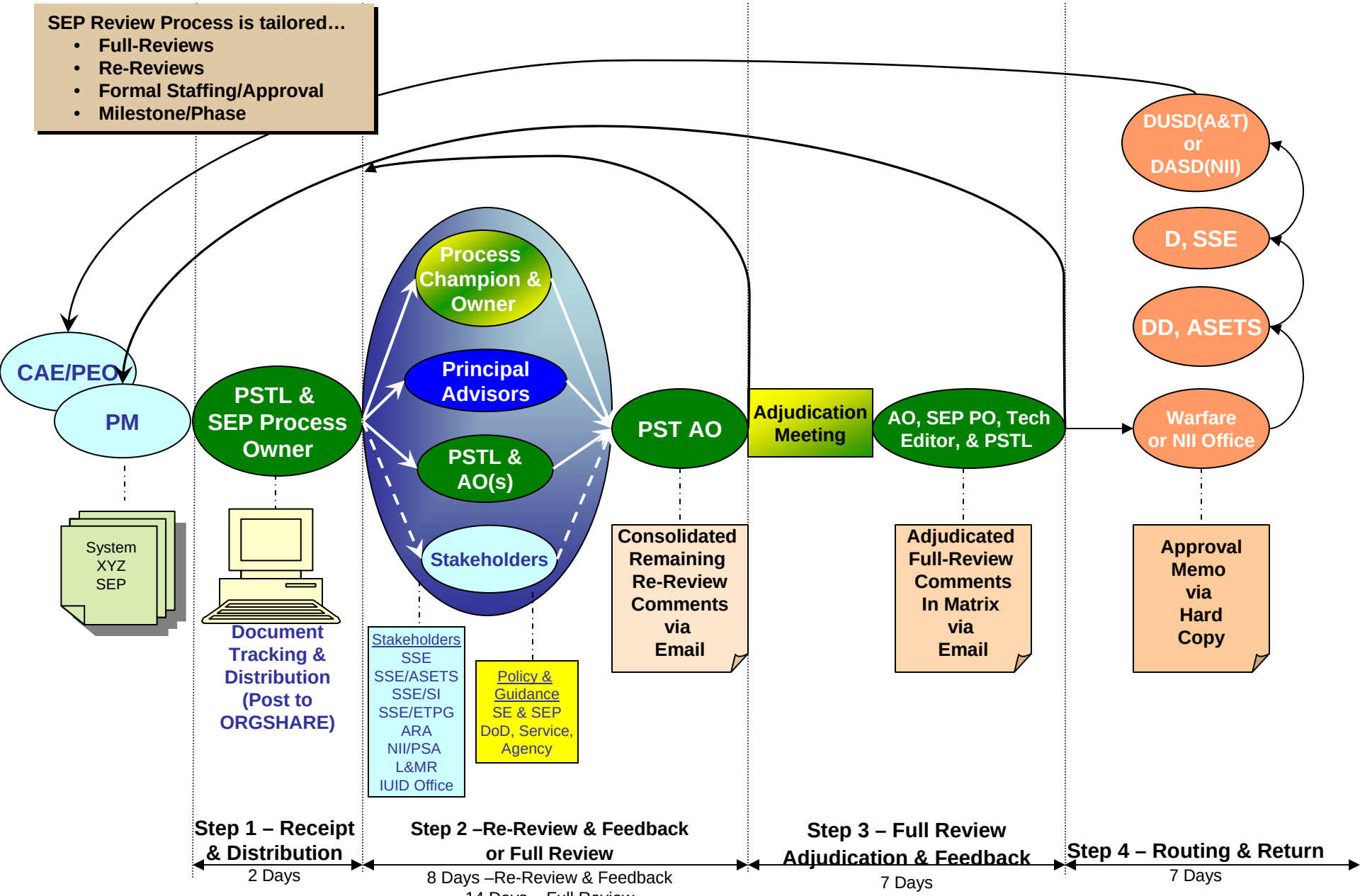
*For more on DAU SPRDE courses, visit http://www.dau.mil/schedules/schedule.asp?crs=SYS

Other Training and Resources

- **Other online training**
  - CLE 001 Value Engineering
  - CLE 013 Modular Open Systems Approach to DoD Acquisition
  - CLE 036 ECPs for Engineer
  - CLE 038 Corrosion Prevention and Control Overview
  - CLM 021 Introduction to Reducing Total Ownership Costs R-TOC
- **Other Web-based Resources**
  - Best Practices Clearinghouse found at https://bpch.dau.mil/

SEP Review Processes

02/25/09



Quicklook & Re-Review: 10; Full Review: 36; Approval: 30 (Working Days)