



Defense Acquisition Guidebook Systems Engineering Chapter Update

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**Office of the Deputy Assistant Secretary of Defense
for Systems Engineering**

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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.

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

- ***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***



Why Update the Defense Acquisition Guidebook (DAG) Chapter 4 on Systems Engineering?



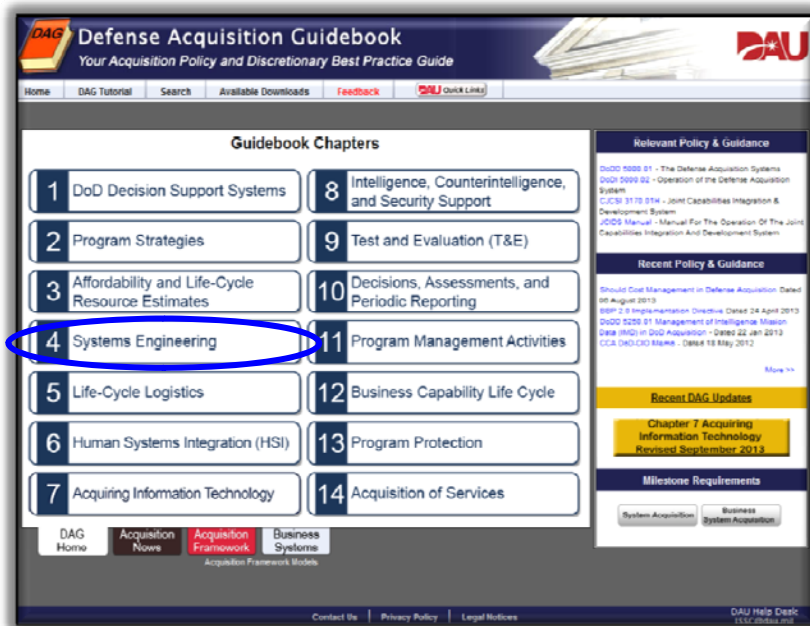
- **Improve guidance to fully reflect current policy and DASD(SE) initiatives**
 - Define systems engineering activities to support the updated Joint Capabilities Integration and Development System (JCIDS) (Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01H)
 - Reflect Better Buying Power initiatives
 - Respond to systems engineering systemic root cause analyses recommendations from program assessments
 - Incorporate Department-wide best practices; avoiding Service and domain-specific implementations
- **Improve currency, consistency, usability, and readability—less theory, more utility**
- **Emphasize the role of Systems Engineering in providing balanced solutions (managing cost, schedule and risk) that deliver needed capability to the war fighter**
- **Make DAG Chapter 4 a more effective tool for the Program Manager and the Systems Engineering Practitioner**



Update Approach and Participation



- Used a product-centered approach, where the product is the weapon system or capability under development
- Threaded policy, activities/processes, and product together
 - Policy (Direction / Requirement) → Process (How) → Product (What)
- Did not restate policy, rather clarified intent of policy and identified expectations



- Avoided inventing policy and removed preferences
- Minimized number of links (improved information flow)
- Included DoD-wide participation in the update
 - 24 organizations (DoD Services/Agencies)
 - 149 participants contributed as authors, collaborators, reviewers, and independent subject matter experts



The New DAG Chapter 4 Message and Framework



- SE provides balanced approach in delivering a capability to the warfighter
- SE supports program success through systematically increasing maturity and reducing risk over the acquisition life cycle

4.1 Introduction

- Systems Engineering Definition
- Why it's important

4.2 Systems Engineering Activities in the Life Cycle

- Description of Technical Maturity Points
- By-phase description of key technical activities
- Technical Reviews and Audits

4.3 Systems Engineering Processes

- Description of technical and technical management processes
- Design Considerations (include Specialty Engineering)



DAG Chapter 4 Outline

<<https://acc.dau.mil/dag4>>



4.0 Overview

4.0.1 Purpose

4.0.2 Contents

4.1 Introduction

4.1.1 Systems Engineering Policy and Guidance

4.1.2 Systems Engineering Plan

4.1.3 Systems Level Considerations

4.1.4 Engineering Resources

4.1.5 Certifications

4.1.6 Systems Engineering Role in Contracting

4.2 Systems Engineering Activities in the Life Cycle

4.2.1 Life Cycle Expectations

4.2.2 – 4.2.7 Acquisition Phases

4.2.8 – 4.2.17 Technical Reviews and Audits

4.3 Systems Engineering Processes

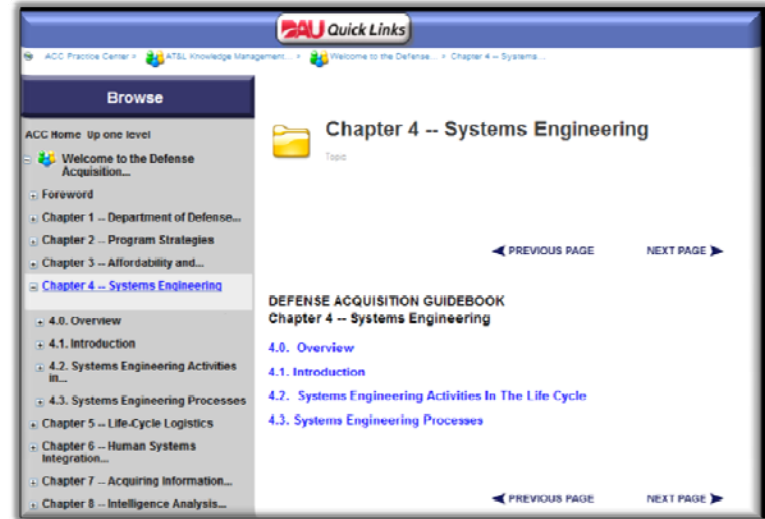
4.3.1 Systems Engineering Processes Overview

4.3.2 – 4.3.9 Technical Management Processes

4.3.10 – 4.3.17 Technical Processes

4.3.18 Design Considerations (includes 24 subsections, one for each design consideration)

4.3.19 Tools, Techniques, and Lessons Learned





New DAG Chapter 4 Major Content Changes



- **Focused on target audience being Program Manager and Systems Engineering practitioners**
- **Consolidated and strengthened Systems Engineering Plan (SEP) Outline content in 4.1.2**
- **Added new content:**
 - 4.1.3 Systems Level Considerations (includes Software)
 - 4.1.5 Certifications
 - 4.1.6 Systems Engineering Role in Contracting
 - 4.3.19 Sustainability Analysis
- **Added Technical Maturity Points table**
- **Added detailed SE technical reviews and audits information (4.2.8-4.2.17)**
- **Enhanced Design Considerations section 4.3.18:**
 - Streamlined Parts Management and Standardization
 - Added new subsections: Anti-Counterfeiting; Intelligence; Operational Energy; and Packaging, Handling, Storage, and Transportation (PHS&T)
 - Added guidance for Producibility (under Producibility, Quality, and Manufacturing Readiness)
- **Removed/reduced topics covered in other DAG chapters**
 - Earned Value Management and Integrated Baseline Reviews (IBR) content removed, both found in Chapter 11 Program Management
 - Test and Evaluation content reduced, found in Chapter 9 Test & Evaluation
- **Removed phase-specific systems engineering 'V's**



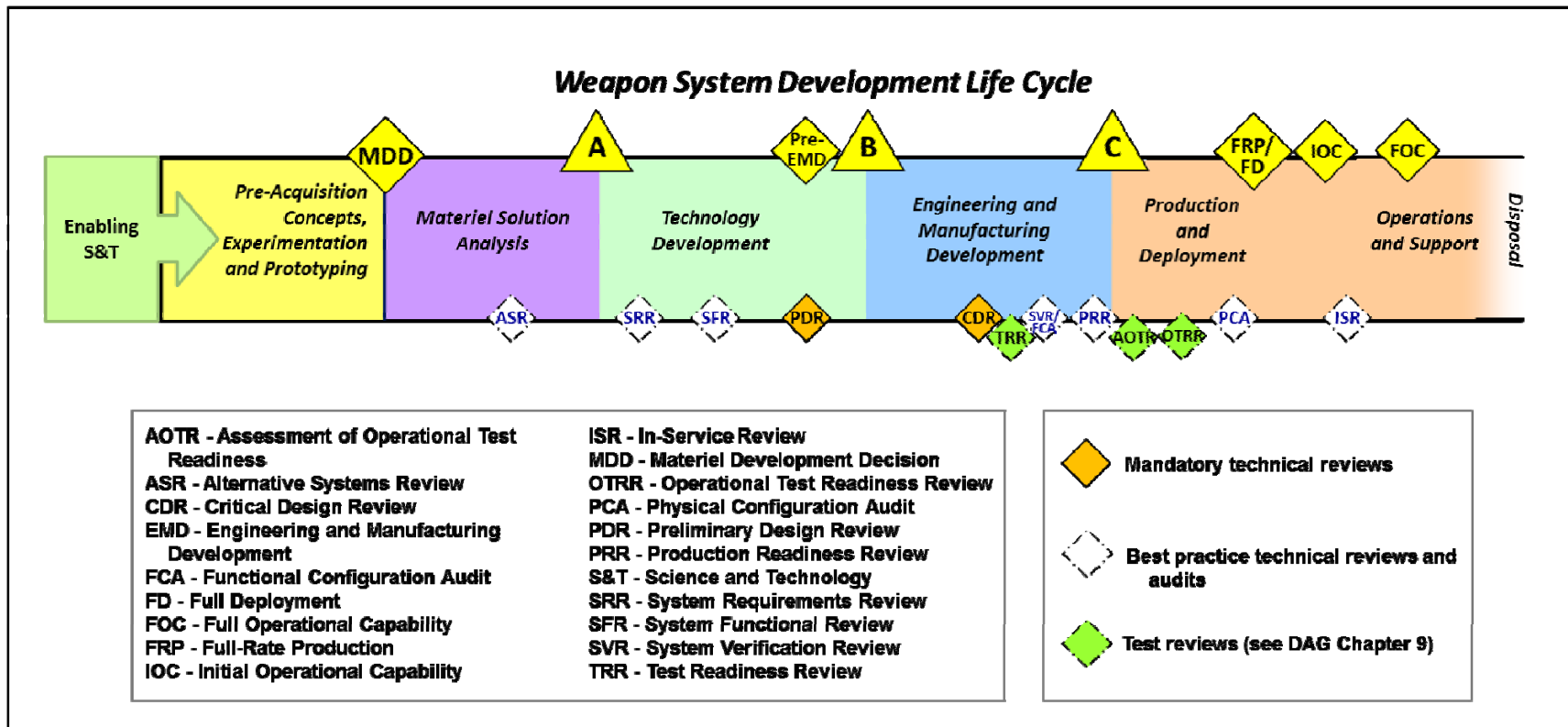
Other Changes Between DAG Chapter 4 Versions



Metric	DAG Chapter 4 (October 2012)	DAG Chapter 4 (February 2013)
Page Count	197	250 (minus table of contents)
Links	825 (478 external, 347 internal to DAG Chapter 4)	359 (external only)
Sections	7 (4.0 – 4.6)	4 (4.0 – 4.3)
Diagrams	14 (includes 5 different 'V' diagrams)	34 (includes life cycle diagram depicted 17 times; removed phase specific 'V' diagrams)
Design Considerations	22	24
SE Processes	16	16 (Implementation Process includes design and realization)



Systems Engineering in the Weapon System Life Cycle



Reference: DoD Instruction 5000.02, Operation of the Defense Acquisition System (December 8, 2008)



Technical Maturity Points (1 of 4)



DoD Acquisition Milestone/Decision Point & Technical Review/Audit	Objective	Technical Maturity Point
Material Development Decision (MDD)	Decision to assess potential materiel solutions and appropriate phase for entry into acquisition life cycle.	Capability gap met by acquiring a materiel solution.
<i>Alternative Systems Review (ASR)</i>	Recommendation that the preferred materiel solution can affordably meet user needs with acceptable risk.	System parameters defined; balanced with cost, schedule, and risk.
Milestone A	Decision to invest in technology maturation and preliminary design.	Affordable solution found for identified need with acceptable technology risk, scope, and complexity.



Technical Maturity Points (2 of 4)



DoD Acquisition Milestone/Decision Point & Technical Review/Audit	Objective	Technical Maturity Point
<i>System Requirements Review (SRR)</i>	Recommendation to proceed into development with acceptable risk.	Level of understanding of top-level system requirements is adequate to support further requirements analysis and design activities.
<i>System Functional Review (SFR)</i>	Recommendation that functional baseline fully satisfies performance requirements and to begin preliminary design with acceptable risk.	Functional baseline established and under formal configuration control. System's functions decomposed and defined to lower levels in order to start preliminary design.
<i>Preliminary Design Review (PDR)</i>	Recommendation that allocated baseline fully satisfies user requirements and developer ready to begin detailed design with acceptable risk.	Allocated baseline established such that design provides sufficient confidence to support 2366b certification.
Pre-Engineering and Manufacturing Development (Pre-EMD) Review	Determination that program plans are affordable and executable and that the program is ready to proceed to EMD phase source selection.	Systems engineering trades completed and have informed program requirements. Competitive prototyping and the development of the preliminary design have influenced risk management plans and should cost initiatives.



Technical Maturity Points (3 of 4)



DoD Acquisition Milestone/Decision Point & Technical Review/Audit	Objective	Technical Maturity Point
Milestone B	Decision to invest in product development, integration, and verification as well as manufacturing process development.	Critical technologies assessed able to meet required performance and are ready for further development. Resources and requirements match.
Critical Design Review (CDR)	Recommendation to start fabricating, integrating, and testing test articles with acceptable risk.	Product design is stable. Initial product baseline established.
System Verification Review (SVR)	Recommendation that the system as tested has been verified (i.e., product baseline is compliant with the functional baseline) and is ready for validation (operational assessment) with acceptable risk.	System design verified to conform to functional baseline.
Production Readiness Review (PRR)	Recommendation that production processes are mature enough to begin limited production with acceptable risk.	Design and manufacturing are ready to begin production.



Technical Maturity Points (4 of 4)



DoD Acquisition Milestone/Decision Point & Technical Review/Audit	Objective	Technical Maturity Point
Milestone C	Decision to produce production-representative units for operational test and evaluation (OT&E).	Manufacturing processes are mature enough to support Low-Rate Initial Production (LRIP) and generate production-representative articles for OT&E.
<i>Physical Configuration Audit (PCA)</i>	Recommendation to start full-rate production and/or full deployment with acceptable risk.	Final product baseline established. Verifies the design and manufacturing documentation matches the item to be fielded, following update of the product baseline to account for resolved OT&E issues.
Full-Rate Production Decision Review (FRP DR) or Full Deployment Decision Review (FD DR)	Decision to begin full-rate production and/or decision to begin full deployment.	Manufacturing processes are mature and support full-rate production and/or capability demonstrated in operational environment supporting full deployment (i.e., system validated through OT&E).



Summary



- **Systems Engineering supports program success through systematically increasing maturity and reducing risk over the acquisition life cycle**
- **A robust Systems Engineering capability across the Department requires attention to policy and practice**
- **The updated DAG Chapter 4 provides the Program Manager and the Systems Engineering Practitioner with more effective guidance for implementing systems engineering**



For Additional Information



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Systems Engineering: Critical to Defense Acquisition



Innovation, Speed, Agility
<http://www.acq.osd.mil/se>



DAG Chapter 4 Version Comparison



Content	DAG Chapter 4 (October 2012)	DAG Chapter 4 (February 2013)
Major Sections	7 (4.0 to 4.6) Note: 4.0 included SE definition and SE Policy and Guidance	4 (4.0 to 4.3) <ul style="list-style-type: none"> Expanded 4.1 Intro to include SE definition and SE Policy and Guidance Removed 2 sections related to tools (embedded content into 4.1 Intro and 4.3 SE Processes) Moved 1 section on Design Considerations (embedded into 4.3 SE Processes)
SEP Outline	<ul style="list-style-type: none"> Content split between two locations: <ul style="list-style-type: none"> 4.1 SE Overview 4.5 SE Execution: Key SE Tools and Techniques Missing guidance on mandatory table for Certifications 	<ul style="list-style-type: none"> Consolidated into one section, 4.1.2 Systems Engineering Plan Strengthened content supporting SEP Outline (e.g., Technical Performance Measures, Design Considerations) Added new section 4.1.5 Certifications
Technical Reviews and Audits	<ul style="list-style-type: none"> Embedded in phases throughout 4.3 Summary in 4.5.9 	<ul style="list-style-type: none"> Detailed information on SE Technical Reviews and Audits, 4.2.8-17 Separated out from phases, focused on technical maturity and risk Changed ASR based on CJCSI 3170.01H demand signal Removed ITR, IBRs, TRR
Design Considerations	22 in section 4.4	24 in section 4.3.18 <ul style="list-style-type: none"> Combined Parts Management and Standardization Moved Software to 4.1.3 Systems Level Considerations 4 New: Anti-Counterfeiting, Intelligence, Operational Energy, PHS&T Added guidance for Producibility (under PQM)
Added content		<ul style="list-style-type: none"> Added 4.1.3 Systems Level Considerations Added 4.1.6 SE Role in Contracting Added 4.3.19. Sustainability Analysis
Non-SE content	<ul style="list-style-type: none"> Earned Value Management (EVM) Integrated Baseline Reviews (IBR) (one per each acquisition life cycle phase) Test and Evaluation (T&E) content 	<ul style="list-style-type: none"> Removed EVM, covered in DAG Chapter 11 PM Activities Removed IBRs, covered in DAG Chapter 11 PM Activities T&E content reduced, linked to DAG Chapter 9 Test & Evaluation