Net-Enabled Command Capability
SYSTEMS ENGINEERING PLAN
(SEP)
INCREMENT 1 MILESTONE B

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Prepared by:

Net-Enabled Command Capability
Joint Program Management Office (JPMO)
P.O. Box 4502
Arlington, VA 22204-4502

In Collaboration with the Joint Forces Command and the NECC Component Program Manager's for the Navy, Air Force, Army, Marine Corps and DISA.

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APPROVAL PAGE

Submitted by: _____ Date: 8/9/07

LAURA D. KNIGHT
Program Manager,
Joint Program Management Office (JPMO),
Net-Enabled Command Capability (NECC)

Concurred by: _____ Date: 8/9/07

DAVID B. BENNETT
Deputy, Program Executive Office,
Command and Control Capabilities (PEO, C2C),
Defense Information Systems Agency (DISA)

Concurred by: _____ Date: 10 Aug 07

for DAVID M. MIHELCIC
Chief Technology Officer (CTO)
Defense Information Systems Agency (DISA)

Concurred by: Diann L McCoy Date: 10 Aug 07

DIANN L. McCOY
Component Acquisition Executive (CAE)
Defense Information Systems Agency (DISA)

Concurred by: G. M. Hostage Date: 13 Aug 07

GILMARY M. HOSTAGE, III
Major General, USAF,
Director, Joint Capabilities Development/J8
U.S. Joint Forces Command (JFCOM)

Approved by: T J Harp Date 12 Dec 07

Timothy J. Harp
DASD(C3ISR & IT Acquisition)
Acting

EXECUTIVE SUMMARY

The Net-Enabled Command Capability (NECC) Systems Engineering Plan (SEP) defines the systems engineering methods, processes, and management mechanisms for executing the NECC program. The SEP will ensure that the development, integration, testing, certification, and deployment of NECC capabilities takes place in a disciplined, cost effective, and timely manner. The NECC SEP seeks to gain speed of delivery through agile, responsive development while still maintaining sufficient technical control required for integration and interoperability.

The NECC SEP addresses four major areas:

1. An overview of the SEP in the context of the overall NECC program
2. A description of the NECC Systems Engineering (SE) approach showing how the NECC SE process enables rapid delivery of capability to the Warfighter
3. A detailed description of the NECC SE process
4. The organizational, management, and governance mechanisms used to execute the NECC SE process.

Loosely coupled components called Capability Modules (CM) are the basic building blocks for NECC. NECC plans to develop CMs using an Adopt-before-Buy, Buy-before-Create (ABC) approach. Whenever possible, adopting existing capabilities or buying commercial capabilities to satisfy NECC requirements takes precedence over creating new capabilities.

The NECC SEP tailors conventional SE processes to allow CMs to mature independently and asynchronously of each other, resulting in more rapid delivery of capabilities to the Warfighter. However, this ability to mature independently and asynchronously is constrained by technical, programmatic, and doctrinal considerations. Although dependencies may exist between two CMs, adoption of a Service Oriented Architecture (SOA) approach minimizes the technical impact. Therefore, as long as the agreed upon interface to a CM is preserved, its internal implementation can change without affecting other CMs. Programmatic impacts and dependencies minimize when specifically addressed at several points in the NECC SE process. The NECC SEP also recognizes that Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) components will need to co-evolve, which will influence the evolution and maturity of a given CM.

The overall NECC SE process is comprised of three major sub-processes:

- **Requirements Analysis, Design, and Build Sub-Process:** This sub-process defines increment-specific NECC architectures and technical standards, maps increment-specific capability needs into system functional requirements, assesses the suitability of current Global Command and Control System (GCCS) Family of Systems (FoS) and other Command and Control (C2) capabilities for use in a specific increment, and designs and builds CMs.
- **Piloting, Test, and Evaluation Sub-Process:** This sub-process advances CMs through multiple maturity stages. It begins with development and moves through deployment to achieve certification for operations and to validate that the Warfighters' capability needs are

met. Piloting and testing activities performed within this sub-process are intended to gather evidence for certification decisions, support integrating CMs into more complex mission threads, gain early feedback from end-users and stakeholders, and evaluate architectural design.

- **Operations and Support Sub-Process:** This sub-process addresses deployment of certified CMs to the field. It includes deployment preparation, training support, and maintenance and run-time support of deployed CMs.

In addition to these major sub-processes, the NECC SE process contains two additional supporting sub-processes (Piloting Preparation and Implementation Preparation) that conduct early preparation and planning activities within their respective areas.

The NECC SEP emphasizes Warfighter involvement and feedback to give Warfighters the ability to influence CM development throughout the entire SE lifecycle. The NECC SE process also incorporates numerous interaction points with the United States Joint Forces Command (USJFCOM) Joint Combat Capability Developer (JCCD) process. The JCCD process captures the Warfighters' input to the materiel acquisition process by documenting capability needs.

An important component of the NECC SEP is the adoption of a new method of piloting, integrating, and certifying CMs. Certification of selected NECC capabilities takes place in NECC's Federated Development and Certification Environment (FDCE). The FDCE will speed up the process of certifying and accrediting C2 capabilities. However, it is not a selection or elimination methodology, but rather the FDCE is a tool that provides a distributed virtual environment. It also allows NECC stakeholders to remotely monitor, evaluate, and certify CMs as they advance through multiple maturity stages.

The following organizations share responsibility for managing and executing the NECC SEP. The Defense Information Systems Agency (DISA) has assigned a Program Executive Officer (PEO) for Command and Control Capabilities (C2C) the responsibility of the Joint Program Executive Office (JPEO) to execute the NECC Joint program. The NECC Joint Program Management Office (JPMO) has overall program and SE responsibility for NECC. The NECC Component Program Management Offices (CPMOs) have responsibility for developing CMs as assigned to them by the JPMO. The CPMOs also provide implementation and operations support to their respective Components. USJFCOM JCCD represents the Warfighters and has requirements oversight responsibilities for the program.

Governance of the NECC SE process is enabled by establishing and managing five Technical Baseline products: Requirements Baseline, Functional Baseline, Allocated Baseline, Product Baseline, and Deployed Baseline. The NECC SEP defines a number of control mechanisms that establish organizations and SE reviews intended to ensure proper and timely management of these Technical Baseline products. Four specific control mechanism categories are Risk Management, Configuration Management, Testing and Certification, and Systems Engineering Reviews.

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1 INTRODUCTION

The United States Joint Forces Command (USJFCOM), representing the Command and Control (C2) Warfighting community, prepared a Capability Development Document (CDD) that authenticates the need to upgrade present C2 capabilities. In parallel, the Department of Defense (DoD) acquisition community established the Net-Enabled Command Capability (NECC) program as a Joint Major Defense Acquisition Program (MDAP) and a Major Automated Information System (MAIS) program. The Defense Information Systems Agency (DISA) has assigned a Program Executive Officer (PEO) for Command and Control Capabilities (C2C) the responsibility of the Joint Program Executive Office (JPEO) to execute the NECC Joint program. In this capacity, DISA's JPEO reports to the Office of the Assistant Secretary of Defense for Networks and Information Integration (OASD(NII)) DoD Chief Information Officer (CIO), who has been delegated by the Defense Acquisition Executive (DAE) as the NECC Milestone Decision Authority (MDA). In turn, USJFCOM has established a Joint Combat Capability Developer (JCCD) as the DoD organization responsible for all capability needs of the NECC program.

The NECC Systems Engineering Plan (SEP) describes the NECC tailored Systems Engineering (SE) approach, the associated SE processes, and the technical organization and governance required to deliver NECC capabilities to the Warfighter.

The SEP document contains four major sections:

1. Introduction (An introduction to the NECC program and its major objectives)
2. NECC Systems Engineering (An overview of NECC's tailored SE approach and the major activities required to achieve NECC CDD objectives)
3. NECC SE process details (A description of the processes in place to execute "This Plan")
4. Technical Execution Organization and Governance (A description of how the NECC program is organized to execute "This Plan")

The NECC SEP is a living document that describes the current and evolving systems engineering strategy and processes for the NECC program. The SEP will be updated at each acquisition milestone and at the NECC Program Manager's (PM) discretion whenever the SE process requires significant modifications. When updates to the SEP are required, they will be documented in a Revision History page located just before the Table of Contents. The NECC Joint Program Manager (JPM) will approve changes to the SEP.

To maintain consistency with related NECC program documents, this SEP has been prepared as a virtual document. It contains hyperlinks to key supporting documents and diagrams where the reader may obtain up-to-date amplifying information about the topic under discussion. Appendix B provides reference information for these supporting documents and diagrams.

1.1 Program Background

1.1.1 Program History

In August 2003, the Joint Requirements Oversight Council (JROC) approved an Operational Requirements Document (ORD) for a new Joint Command and Control (JC2) Capability. The ORD states that JC2 Capability will provide:

"…a single Joint C2 architecture and capabilities-based implementation comprised of Joint mission capability packages and Service-unique applications based on Global Information Grid (GIG) Enterprise Services (GES) enabling shared access to Service/Agency/Joint-provided data sources. JC2 will support force-level planning, execution, monitoring, and assessment of Joint and multinational operations."

As stated in the JC2 Capability ORD, the Global Command and Control System (GCCS) "will evolve from its current state of Joint and Service Variants to a single Joint C2 architecture and capabilities based implementation comprised of Joint Mission Capability Packages (MCP) and Service unique applications based on global information grid services."

OASD(NII) approved JC2 Capability for entry into the Concept Refinement phase on 17 August 2004. OASD(NII) also directed the Institute for Defense Analysis to initiate and lead the JC2 Analysis of Alternatives (AoA) with support from the Center for Naval Analysis. DISA was designated the lead DoD component for completing all other Concept Refinement phase requirements leading up to an anticipated Milestone (MS) A decision. In September 2005, the MDA designated DISA as the lead component for the JC2 Capability development effort and initiated efforts to standup the NECC program's JPEO, Joint Program Management Office (JPMO), and Component Program Management Offices (CPMOs). The OASD(NII) Acquisition Decision Memorandum (ADM) issued 7 March 2006 approved MS A, authorized entry into the Technology Development (TD) phase, and renamed JC2 Capability as the NECC program.

1.1.2 Program Description

The NECC program is designated as an acquisition streamlining pilot program chartered to develop revised processes and products that enable a faster, more effective milestone review and rapid capability fielding. One of the primary advantages of the NECC program is the ability to transition existing C2 capabilities, while concurrently developing and deploying new or enhanced net-enabled Joint capabilities under the direction of a common JPEO. This approach affords the DoD the ability to select and rapidly implement "best-of-breed" solutions for the full spectrum of Joint C2 needs.

NECC's Acquisition Strategy identifies the JPMO as the program's system prime and system integrator, and the CPMOs as the NECC program's materiel developers. DISA, each Component, and each Service deploys, operates, and supports NECC capabilities for assigned Joint Warfighters. The SEP reflects these roles and responsibilities in its SE processes and their execution.

1.2 SEP Scope

NECC's SEP is applicable to all program increments and addresses the entire NECC program lifecycle, which includes system development and demonstration, production and deployment, and operations and support. For Increment 1, NECC applies the SE process to deliver capabilities that focus on the Combatant Commands (COCOMs), Joint Task Forces (JTF), and Service Component/Functional Component levels of a JTF. Increment 1 requirements primarily include Situational Awareness and Force Projection, which includes Adaptive Planning, Readiness, and cross-functional domain areas.

NECC Increment 1 constitutes a program baseline. Future increments will iteratively add capability to the NECC baseline until the program addresses all CDD requirements identified for

the eight MCPs (Force Projection, Force Readiness, Intelligence, Situational Awareness, Force Employment – Air/Space Operations, Force Employment – Land Operations, Force Employment – Maritime/Littoral Operations, Force Protection) and for the identified cross-functional MCPs.

1.3 SEP Purpose

To provide the capabilities identified in the CDD and to fulfill acquisition objectives, NECC developed a systems engineering approach tailored for rapid and incremental delivery and sustainment of net-centric capabilities. The approach is a mission-driven methodology that provisions for rapidly deploying individual units of capabilities and addresses concurrently transforming and transitioning the legacy C2 portfolio. NECC uses a multi-increment evolutionary acquisition strategy to deliver required capabilities. Each increment employs a multi-year, multi-spiral development approach that enables rapid design, development, integration, certification, deployment, operations, and support. The Military Services and their major C2 programs (including the GCCS Family of Systems (FoS)) are key partners in realizing the CDD objective of a single, net-centric, services-based C2 architecture.

This SEP is the NECC blueprint for technical execution of the NECC program. It was prepared in compliance with the Office of Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD(AT&L)) requirements. The SEP establishes activities and associated roles and responsibilities required for effective execution of the NECC program. The JPMO, as system prime and system integrator, and CPMOs, as materiel developers, shall comply with the SEP in carrying out their assigned responsibilities.

The NECC SEP describes:

- NECC's tailored acquisition/lifecycle approach
- SE process activities required to develop, deploy, operate, and support capabilities
- NECC's organizational structure and interactions required for SE process execution
- SE guidance for use throughout all phases of the program

1.4 Definitions

The following terms are used throughout the NECC SEP and are defined within the context of the NECC program.

- **Capability Definition Package (CDP):** A CDP is a decomposition of the CDD into prioritized packages. A CDP provides operational perspective, functional behavior, and performance details required to translate Warfighter capabilities into acquisition and engineering terminology for materiel solution development. A CDP contains performance and quality attributes that further define the required capabilities (or mission-specific objectives). A CDP allows the NECC JPMO to design, build, test, certify, and deploy materiel solutions (i.e., Capability Modules (CMs)) to meet the needs defined by that CDP.
- **Capability Module:** A CM is a collection of components that collectively provide a set of logically grouped, operationally relevant services distributed across one or more nodes. CMs may range in complexity from a single service supporting remote clients over the wide area network, to a large set of interacting services distributed to consumer sites across the globe.

A CM is the result of implementing part or all of a capability defined by a CDP. Multiple CMs may be combined to meet identified Warfighter requirements.

- **Capability Provisioning Activities[1] (CPAS):** CPAS are those activities that various NECC communities perform to develop, implement, test, evaluate, certify, and deliver net-enabled capabilities to the Global Information Grid (GIG). CPAS incorporates piloting, test, and evaluation activities that use the governance, infrastructure, and tools within the Federated Development and Certification Environment (FDCE) to support their activities.
- **Capability Provisioning Event (CPE):** A CPE is a piloting activity primarily focused on testing, evaluating, and certifying capabilities for operational utility and suitability. CPEs are intended to be more narrowly focused than Operational Concept Exercises (OCE) and generally require much less lead-time to prepare than an OCE.
- **Certification:** Certification is the NECC quality control approach for ensuring that a maturing CM meets minimum standards of performance, operational utility, net-readiness, interoperability, and security. Certification occurs when a certification authority (governance body) assesses that a CM has met the entrance criteria established for a FDCE maturity stage.
- **Development:** This term refers to that portion of the NECC SE lifecycle during which a CM is created from design documentation. A CM can be developed by adopting and modifying an existing capability, by acquisition of a Commercial-Off-The-Shelf (COTS) product, or by creating new software components.
- **Deployment:** This term refers to the period of time in the NECC SE lifecycle during which a CM is transitioned from the Product Baseline to the Deployed Baseline. The run-time CM is installed and begins operation at one or more Enterprise GIG Computing Nodes (GCNs) and local GCNs.
- **Engineered Mission Thread (EMT):** An EMT is an unambiguous description of a Warfighter's C2 business (or mission) process required to achieve specific mission objectives. One or more EMTs may be required to describe the total business processes associated with a CDP. The combination of one or more CMs accomplishes an EMT.
- **Federated Development and Certification Environment[2]:** The FDCE is a virtual environment that exists on the GIG and addresses the challenges associated with developing and certifying net-centric capabilities in support of CPAS. The FDCE provides governance, processes, and infrastructure to facilitate the progressive integration, refinement, testing, evaluation, and certification of selected capabilities in increasingly rigorous stages leading to an operational deployment. Infrastructure refers to other NECC CMs, legacy systems, databases, and GIG elements including enterprise services that create the relevant test setting. The "environment" is referred to as federated to emphasize that it is not controlled, operated,

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[1] CPAS and FDCE are closely related terms. The distinction between CPAS and FDCE is largely a matter of perspective: process activities (CPAS) versus supporting tools, governance, and infrastructure (FDCE). Both FDCE and CPAS define identical "stages" as a way of describing the maturity level of a capability. Throughout the SEP, maturity stages are consistently referred to as FDCE stages, but it should be understood that identical stages exist for CPAS.

[2] *ibid.*

or used by a single organization. The FDCE neither owns nor operates the nodes. However, the FDCE provides strict governance, administration, and day-to-day management for interconnections with infrastructure used by the FDCE processes.

- **Implementation:** Implementation is the set of engineering activities within the NECC Systems Engineering lifecycle after a CM has been placed into operational use in the field/fleet and is operated and maintained. Implementation includes all logistics support requirements (on-going training of end-users, providing and managing hardware, software, help desk, etc.).
- **Integration:** Integration refers to the systems engineering activities required to define, engineer, and implement capability performance in progressively broader contexts towards achieving a complete net-enabled Warfighter capability. Integration occurs at various levels with separate but related contexts. At the design-level, CM integration refers to the actions to define architecture and standards that enable CM interoperability along with associated design efforts. At the CMPO and JPMO level, integration refers to the engineering activities to ensure delivered products (CMs, etc.) work together with necessary infrastructure and other products to produce intended end-to-end results. At the Joint-Service level, integration refers to the operational activities to ensure that applicable Doctrine, Organization, Training, Material, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) elements function properly to deliver the Warfighter capability.
- **NECC Capability Development Spiral:** This term refers to NECC's repetitive SE process for designing, building, testing, certifying, and deploying a collection of CMs, which starts with the release of a CDP and ends with deployed CMs.
- **Operationally Relevant Environment:** An operationally relevant environment refers to the computing and network infrastructure required to reflect all significant operating environment aspects that may affect suitable performance of a CM in the intended deployed environment. This includes security considerations; Disconnected, Intermittent, and Limited (DIL) communications conditions; and interoperability with required data sources, consumers, and systems.
- **Piloting:** Piloting is a means of making maturing capabilities available to stakeholder parties for experimentation, testing, and evaluation. Unlike capability demonstrations, which are of limited and short duration, piloted capabilities must be made available on an ongoing and extended basis. Piloting is a specialized form of evaluation for use throughout CM development to elicit user inputs and to evaluate specific objectives in a technical or operational context. Piloting is also a method for evaluating architectural and design objectives throughout development.
- **Piloting, Test, and Evaluation (PT&E):** PT&E refers to the activities in the NECC SE Process Steps 7 and 8 (defined in subsections 3.1.7 and 3.2 below) used to test, evaluate (testing or piloting), and verify CM performance against stated requirements. PT&E incorporates Developmental and Operational Testing as well as piloting activities. It also encompasses the governance actions to advance products through the CPAS maturity stages leading to operational certification for use in Network Operations (NETOPS).
- **Requirements Analysis, Design, and Build (RA/D/B):** RA/D/B refers to that set of engineering activities required to analyze and decompose requirements into engineering

terms suitable for designing and building a capability that meets those requirements. RA/D/B begins when requirements are identified through the JCCD process and ends when a candidate CM(s) is available for test and evaluation.

- **Service Performance Specification (SPS):** A SPS represents a service's functional capabilities and performance requirements stated in engineering specification terms against which a Component Program Manager (CPM) develops and deploys a materiel solution. The SPS contains interface requirements; relevant physical, software, data, security, and technical operations requirements for an increment; and Joint/Service implementation requirements.

1.5 Standards and Guidelines

The Department of Defense Directive (DoDD), *The Defense Acquisition System 5000.1*, DoD Instruction (DoDI) 5000.2, *Operation of the Defense Acquisition System*, and other regulatory directives enumerated in Table 1 prescribe the NECC acquisition and systems engineering regulatory requirements. The table depicts the specific information requirement, directive establishing the requirement, and the status of the document (i.e., the date of the document). Some information requirements (e.g., manpower, budget, environmental, safety, occupational, health, and logistics) are established by law and require special documentation, reporting, and/or certification. As such, Table 2 shows the statutory requirements applicable to the NECC program.

Table 1: Regulatory Requirements

INFORMATION REQUIRED	SOURCE	STATUS
Initial Capability Document (ICD)	Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01F	N/A – The GCCS Mission Needs Statement (MNS) was accepted in lieu of a JC2 ICD
Capability Development Document	CJCSI 3170.01C	JROC approved, 7 June 2007
Acquisition Strategy	DoDI 5000.2	In draft
Analysis of Alternatives	DoDI 5000.2 Public Law (Pub L.). 107-248, Section 8088	The JC2 (NECC) AoA, conducted in May 2005 is still current.
System Threat Assessment (STA) Report	DoDD 5105.21	Designated Accrediting Authority will determine need and type of threat assessment; not required before MS B
Technology Readiness Assessment (TRA)	DoDI 5000.2	In draft
Information System Support Plan (ISP)	DoD I 4630.8, DoDD 4630.5 CJCSI 6212.01D	In draft To be approved by the Joint Staff J6
Command, Control, Communications, Computers, and Intelligence (C4I) Supportability Certification	CJCSI 6212.01D, DoDI 5000.2	Will be achieved as part of the FDCE. This is based upon the ISP but is not due until the Full Deployment Decision Review (NECC's equivalent to the Full Rate of Production Decision Review) in Fiscal Year 10

INFORMATION REQUIRED	SOURCE	STATUS
Interoperability Certification	CJCSI 6212.01D DoDI 5000.2	Will be achieved as part of the FDCE. This is based upon the ISP.
Affordability Assessment	DoDI 5000.2	Program Assessment & Evaluation (PA&E) to perform Aug 07
Cost Analysis Requirements Description (CARD)	DoDI 5000.2	Draft delivered to PA&E April 07
Increment 1 Capstone Test and Evaluation Master Plan (TEMP)	DoDI 5000.2	In draft
IA Strategy (IAS)	DoDI 5000.2 DoDI 8500.1 and 8500.2	In draft
MS A Exit Criteria Report	DoDI 5000.2	Complete
Program Protection Plan (PPP)	DoDI 5000.2	In draft

The three regulatory processes that form DoD's principal decision support mechanism include the Joint Capability Integration Development System (JCIDS); the Defense Acquisition System; and the Planning, Programming, Budgeting, and Execution (PPBE). The CJCSI 3170.01F, DoDD 5000.1, and DoDD 7045.14 prescribe these three regulatory processes. The procedures established in the JCIDS support the Chairman Joint Chiefs of Staff (CJCS) and JROC in identifying, assessing, and prioritizing Joint military capability needs. The documentation developed during the JCIDS process (i.e., the CDD) provides the formal communication of capability needs between the user(s) and the acquisition, test and evaluation, and resource management communities (collectively referred to as stakeholders). Guidelines and procedures for operation of the JCIDS are contained in CJCS Manual (CJCSM) 3170.01C.

Table 2: Statutory Requirements

INFORMATION REQUIRED	SOURCE	STATUS
Consideration of Technology Issues	10 United States Code (U.S.C.) 2364	Incorporated into the Acquisition Strategy
Market Research	10 U.S.C. 2377 15 U.S.C. 644(e)(2)	Incorporated into the Acquisition Strategy
Title 40 (Clinger-Cohen Act) Compliance	40 U.S.C. Subtitle III Sec. 8088, Pub. L. 107-248 (or successor appropriations act provision)	In draft
Registration of mission-critical and mission-essential information systems, RCS: DD- C3I (AR)2096	Sec. 8088(a), Pub. L. 107-248, (or successor appropriations act provision) Pub. L. 106-398, Section 811	System is registered.
Benefit Analysis and Determination (part of acquisition strategy)	15 U.S.C. 644 (e)	N/A; NECC will use modular contracting.

INFORMATION REQUIRED	SOURCE	STATUS
Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) (Including National Environmental Policy Act (NEPA) Compliance Schedule)	42 U.S.C. 4321	In draft
Technology Development Strategy (TDS)	Sec. 803, Pub. L. 107-314	Current TDS will be updated as necessary with change pages.
Independent Cost Estimate (ICE)	DoDI 5000.2	Performed by Cost Analysis Improvement Group (CAIG) or alternate needed by Aug 07
Acquisition Program Baseline (APB)	10 U.S.C. 2435	In draft
Operational Test Plan (OTP)	10 U.S.C. 2399	See TEMP for info.

1.6 Program Overview

The NECC program directs and oversees the DoD's principal C2 capability that will be accessible in a net-centric environment and will focus on providing the commander with the data and information needed to make timely, effective, and informed decisions. NECC draws from the C2 community to evolve current C2 capabilities into, and provide new capabilities for, a fully integrated, interoperable, and collaborative Joint solution. By design, NECC's approach accommodates the rapidly evolving Warfighter operational domain and commercial Information Technology (IT) development. NECC intends to achieve its primary acquisition objective of rapid deployment of capabilities through the incremental development, certification, and deployment of individual CMs vice developing and deploying a single system as a major block release.

1.6.1 Key Strategic Approaches and Objectives

An important aspect of NECC's approach is that the program employs an "Adopt-before-Buy, Buy-before-Create" (ABC) philosophy by which existing and/or evolving C2 capabilities are transitioned and matured through continuous CPAS. Additional key strategic approaches and objectives discussed in the following subsections further frame the NECC SE approach.

1.6.1.1 Rapidly Deploying Capability

NECC's primary acquisition objective is the rapid requirements definition, design, development, piloting, certification, and deployment of capabilities to meet Warfighter needs. NECC is not building a "singular monolithic system"; instead, it is rapidly developing and deploying individual units of functionality (i.e., CMs). Before fielding, CMs are subjected to a comprehensive test environment, which ensures that they will interoperate seamlessly to contribute to the aggregate requirements of the CDD. JCCD requirements development and the NECC SE process are designed to support this objective. The program is using a Director, Operational Test and Evaluation (DOT&E) approved waiver process to allow operational evaluation of CMs prior to the Initial Operational Test and Evaluation (IOT&E).

The NECC program anticipates a MS B decision in September 2007 followed by a MS C decision 2nd quarter FY 2008. Applying the approaches described in this SEP is expected to

result in initial operational deployment and utilization of NECC capabilities within less than one year of MS B.

1.6.1.2 GCCS FoS Transition to NECC

Existing GCCS FoS represent a significant capital investment that needs to be leveraged by the NECC program. In recognition of this fact, the NECC ADM dated 07 March 2006 directed DISA, with the Military Departments, to identify the criteria that will enable the transfer of program management responsibility from GCCS FoS programs to NECC's JPEO. The *GCCS FoS Management Transfer Plan (MTP)* received approval from the JPEO on 15 March 2007.

In addition to transitioning management responsibility, the NECC program also addresses transitioning GCCS FoS functionality. The NECC *GCCS FoS to NECC Functionality Transition Plan (FTP)* details the transition process. It addresses both technical and business considerations for migrating GCCS FoS capabilities to the NECC program. As stated in the NECC CDD, the transition "… will be successful when the Joint and Service systems have moved to NECC with no loss of current required capabilities.[3]"

Key to the GCCS FoS transition is a review and analysis of current GCCS FoS capabilities to identify and remove redundancy when and where required. In addition, a technical engineering review and comparison between GCCS FoS and NECC will be performed to identify gaps in legacy architecture and platform requirements. To successfully transition current GCCS FoS capabilities to the NECC net-centric architecture and prevent prolonged parallel implementation, a lifecycle management strategy will be developed as specific components are allocated to CMs and scheduled for transition. This SEP combined with the GCCS FoS FTP, as these documents evolve, will provide that strategy.

1.6.1.3 Architecture

NECC's architecture objective is to deliver a single integrated Joint C2 architecture for current and future Joint C2 services and capabilities, implemented in a Service Oriented Architecture (SOA) construct. Transitioning from today's stovepipe C2 systems to a single Joint SOA-based architecture spans several increments commencing with Increment 1. Each increment employs a specific architecture implementation that moves NECC closer to its objective. Beginning with Increment 1, NECC will incorporate lessons learned and artifacts from the NECC Provisional Technical Transition Architecture Specification as it evolves into the overall NECC Architecture.

NECC's Architecture Framework document establishes overarching guidance across five key architectural views: physical, software, data, information assurance, and technical operations. These five views will drive development of individual NECC incremental architectures. Key principles embodied in these five views include simplicity, enterprise relevance, service-oriented, leveraging of current C2 systems, interoperability, and operational suitability. Using a hierarchy of views to direct the incremental capability architectures will facilitate the development goal of loosely coupled CMs. It will also better enable the primary acquisition goal of rapid development and deployment of C2 capabilities.

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[3] NECC CDD, 7 June 2007

1.6.1.4 Testing and Certification

NECC will deploy individual, tested CMs and will ensure (in the operational context of EMTs) that end-to-end capabilities associated with an EMT execute successfully. For this reason, NECC focuses on testing and certification at an individual capability level, not at a system level. Even with such a focus, end-to-end multi-CM dependencies and interactions necessary to achieve the required mission thread behaviors must be engineered and tested. This objective moves away from a centralized, sequential testing and certification approach towards a more tailored approach to fit a specific capability and consider the capability's maturity.

A capability will accomplish its test and certification at the earliest possible opportunity by taking advantage of CPAS and the FDCE. Essential to this objective is the early and continuous collaborative involvement between the key participants: the materiel developer; requirements; Warfighter; PT&E; certification; and Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities (DOT_LPF) communities. Where appropriate, NECC will structure integrated piloting, Developmental Testing (DT), Operational Testing (OT), interoperability, integration, and security testing. Further discussion of NECC's piloting, test, and certification objectives are available in the NECC TEMP, the NECC CPAS Concept of Operations (CONOPS), and the Integration and Technical Piloting (I&TP) CONOPS documents.

The CPAS approach evolves a CM from initial development through the maturation process to the point at which the CM obtains certification to support Warfighter operations on the GIG. The CPAS iterative process encompasses activities needed to define, develop, integrate, test, evaluate, and certify capabilities ready for NETOPS.

The FDCE is the mechanism for accomplishing testing and certification. However, the FDCE is not a selection or elimination methodology, but instead provides a distributed virtual environment. It allows NECC stakeholders to remotely monitor, evaluate, and certify CMs as they mature. As a virtual environment, the FDCE is not a physically defined location, but is comprised of processes, tools, and infrastructure that includes hardware and software physically distributed on the GIG.

1.6.1.5 Information Assurance

NECC's Information Assurance Strategy defines respective Information Assurance (IA) objectives to ensure data integrity, service availability, transaction confidentiality, responsive authentication, and non-repudiation for transmitted and received information. NECC achieves this objective by employing security services developed by the Net-Centric Enterprise Services (NCES) program. This program will also implement IA controls specified in DoDI 8500.1, DoDI 8500.2 and/or Director of Central Intelligence Directive (DCID) 6/3 instructions. NECC relies on a responsive and efficient DoD Information Assurance Certification and Accreditation Process (DIACAP) compliant with a Certification and Accreditation (C&A) process to ensure IA. Further information on NECC's approach for achieving this objective is contained in the NECC Information Assurance Strategy (IAS)[4] document.

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[4] The IA Strategy document is currently being developed; a current copy may be accessed via this link: https://gesportal.DoD.mil/sites/necc/temp_dr/Shared%20Documents/IA%20Strategy/NECC%20IAS_v01%20(21Mar07).doc

1.6.1.6 Operations and Support

The NECC program strives to develop and deploy CMs to integrate and interoperate within Joint and Service operating environments. Achieving Joint and multi-Service capabilities is initiated at the beginning of the SE process and ends with an operationally Deployed Baseline. The JPMO leads the multi-component effort to define and manage the overall NECC architecture and design. Adherence to the SE process ensures that the design will successfully operate in an operationally relevant environment of the Deployed Baseline. For some CMs, this includes considerations such as operating under DIL communications conditions. The CPMs undertake the analysis, design, and development activities to ensure deployment, operations, and support integrate with their Components' processes. The JPMO provides increment-level logistics support functions necessary to maintain readiness and operational capability.

1.6.2 Roles and Responsibilities

The MDA, representatives from the Component Acquisition Executive (CAE), USJFCOM, and advisory members provide oversight of the NECC program. They are responsible for validating program objectives, resolving cross-Service acquisition issues, addressing funding realignment proposals, approving increment plans, and establishing program priorities. Oversight members represent the most senior oversight, resource, and acquisition authorities to assist the NECC program with strategic issues. Advisory members represent OUSD(AT&L); OUSD(Comptroller); and Director, PA&E.

NECC's JPEO has NECC program executive oversight responsibility. The NECC JPM and the NECC CPMs, which represent the Military Services' GCCS FoS programs and NECC materiel developers, report to the JPEO (See Figure 1). The NECC JPMO and CPMOs constitute the materiel developer team for acquiring, deploying, operating, and supporting NECC capabilities. The NECC JPM functions as a "system prime and system integrator" for increment requirements, systems engineering, integration, and increment-level performance responsibilities. Since USJFCOM represents the Warfighter, it has assigned JCCD as its execution arm for the NECC program. The CPMs function as materiel developers for individual capabilities that meet increment requirements, and they deploy, operate, and support capabilities for assigned Warfighters. The CPMs, as designated and tasked by the JPEO, are also responsible for integrating CMs into their respective operational facilities/platforms.

The JPEO is responsible for the following:

- Executive oversight of the NECC program
- GCCS FoS management—either transition existing GCCS FoS capabilities into the NECC baseline or retire the capabilities. (Refer to the *GCCS FoS Functionality Transition Plan (FTP)* for details on retiring GCCS FoS capabilities.)
- Serving as the focal point for addressing and resolving external program dependencies (such as GIG integration and NCES dependencies)

The NECC JPM is responsible for the following:

- Overall development and delivery of capabilities to satisfy each increment's identified CDD requirements (accomplished through tasking the CPMOs)
- Systems engineering, integration, and certification for each increment

- Cost, schedule, and performance objectives for each increment
- Ensuring integration and interoperability are accomplished across the uniformed Services and DISA in relation to CM re-aggregation and Service platforms/facilities

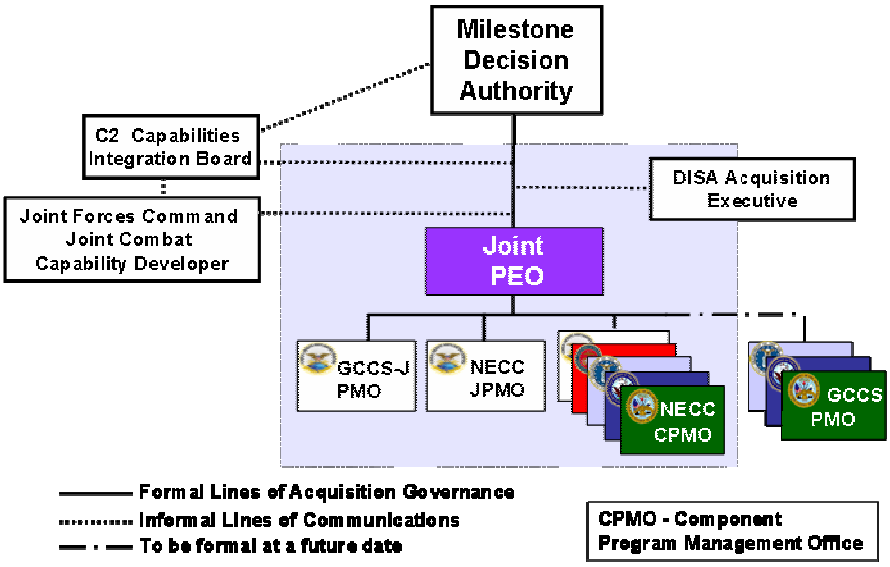

Figure 1: NECC Acquisition Organization

The CPMs are responsible for the following:

- Functioning as the materiel developer for capabilities assigned by the JPEO
  - Developing, testing, and deploying assigned capabilities for Joint/Service operation
  - Conducting security certification activities for assigned capabilities
  - Performing software maintenance as assigned
  - Ensuring component-specific systems integration as well as procuring hardware and software, and funding for implementation. This will also include coordination with the other CPMs to ensure proper integration and interoperability with other CPMs' systems.
- Executing NECC operations and support activities within their Component's environment
  - Performing software maintenance as assigned
  - Planning and systems engineering to prepare the materiel solution for technical and Doctrine, Organization, Training, Leadership and Education, Personnel, Facilities, and Policy (DOT_LPF-P) integration into the Component's warfighting operations
  - Deploying, operating, and supporting fielded operational capabilities, to include logistics and training support

Refer to Section 4 below for a more detailed discussion of the NECC program's organizational roles and responsibilities.

1.6.3 Program Schedule

The NECC CDD establishes a multi-increment program for delivering capabilities beginning in FY 2008 and ending in FY 2014 as reflected in Figure 2.

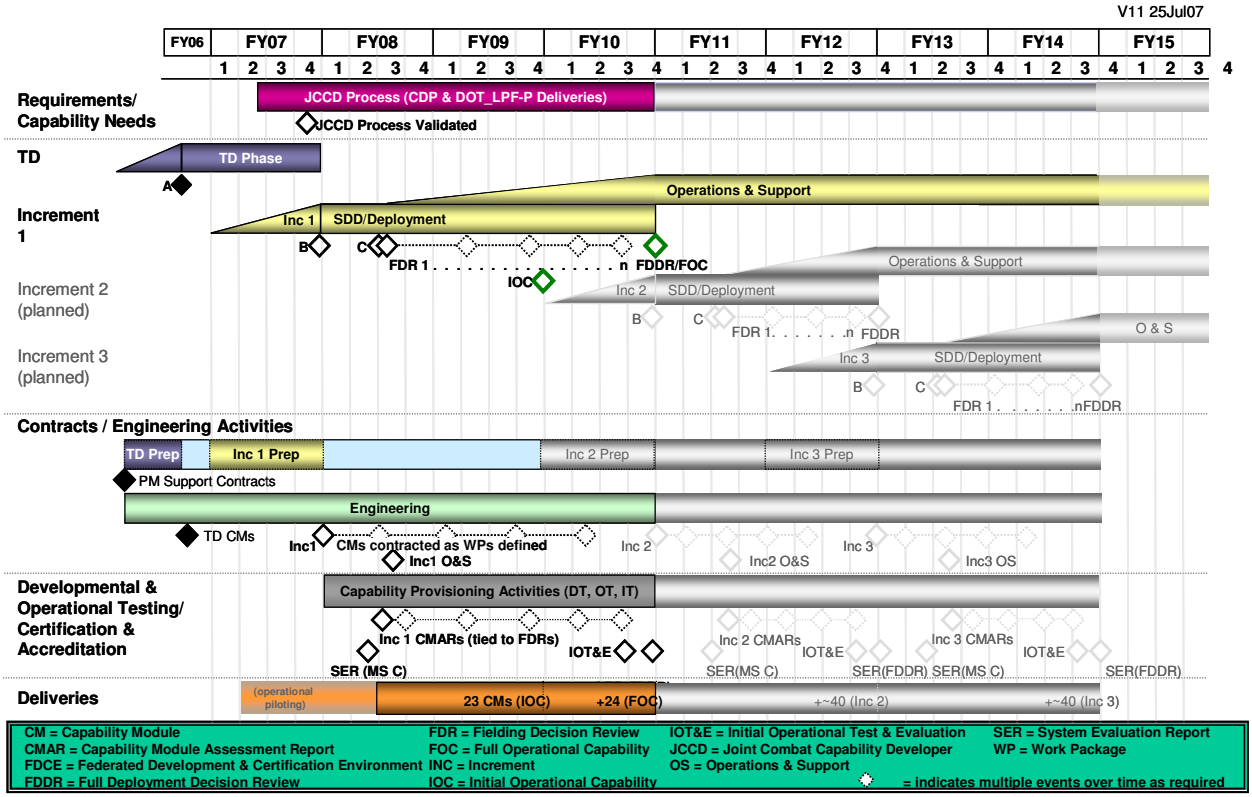

Figure 2: NECC Master Program Schedule

Within an increment, the SEP describes the set of engineering activities required to develop and deploy individual CMs using a NECC Capability Development Spiral approach. An increment is a defined collection of capabilities that are developed and deployed over a specific period of time (e.g., Increment 1 is from FY 2008 to FY 2010). A NECC Capability Development Spiral is a single execution of the SE process steps required to develop and deploy a set of CMs associated with a CDP. An increment has a number of NECC Capability Development Spirals depending on the number of CDPs required for that increment. For example, Increment 1 may have 25 spirals.

The NECC program has external dependencies on other programs and initiatives, such as the GCCS FoS transition, GIG development, NCES, and evolution of Military Service programs that are transitioning to use NECC. Other NECC program documents, such as the *GCCS FoS to NECC Functionality Transition Plan* and increment-specific architectures, identify and track those dependencies. However, the relative importance of external dependencies is frequently increment-specific. Therefore, increment-specific planning will identify and track these dependencies.

2 NECC SYSTEMS ENGINEERING APPROACH

NECC is an MDAP/MAIS Acquisition Category (ACAT) - 1D program and is required to follow DoDI 5000.2 policy. However, the development and provisioning of NECC net-centric services (vice systems) requires tailored systems engineering and acquisition processes to realize the flexibility, interoperability, and cost effectiveness of service-based acquisitions. This NECC SEP defines the technical efforts required to develop and deploy net-centric services within the DoDI 5000.2 acquisition and JCIDS frameworks.

The NECC program executes in a series of major program increments, with Increment 1 spanning three years. An increment consists of multiple spirals that overlap each other in time within the increment cycle. Each spiral, which provides only a subset of the total capability required for the increment, is developed, tested, and deployed. The sum of all the capabilities across all the spirals satisfies the requirements allocated to the increment. By using multiple overlapping spirals in this manner, the NECC program will deliver capability to the Warfighter at several points within an increment and not just at the end of the increment cycle. To accommodate this approach, the NECC SE process addresses increment-specific operational requirements and guides an overarching NECC Architecture Framework (see Figure 3).

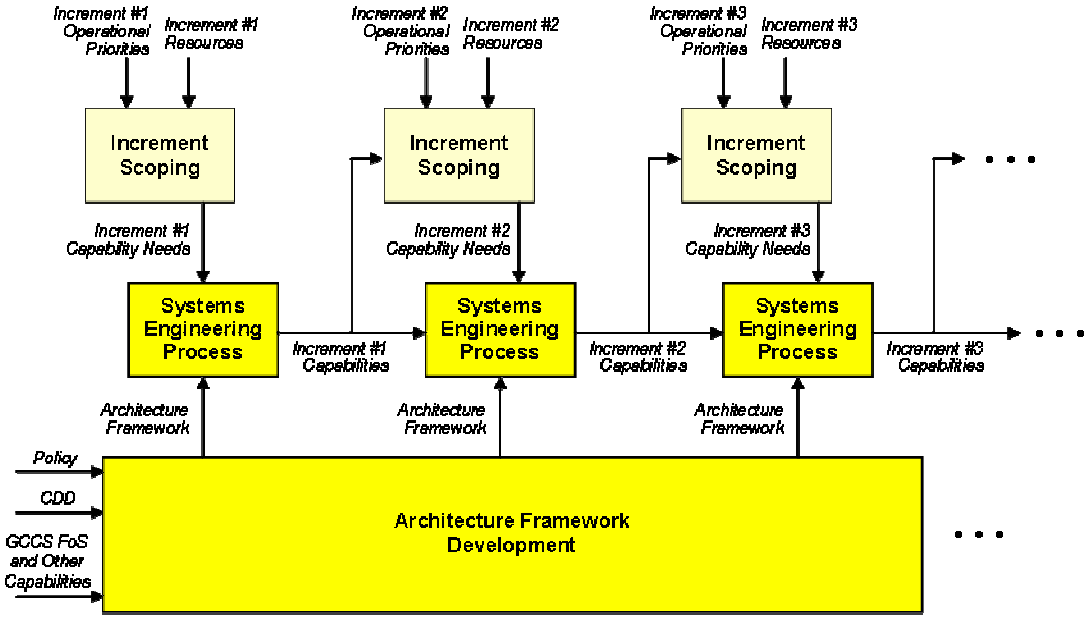

Figure 3: NECC Systems Engineering Process as it Spans Multiple Increments

Within each NECC increment, an SE process takes increment-specific requirements and generates increment-specific capabilities. The increment-specific requirements are determined by combining operational priorities (set by the JCCD process) with available resources to establish a set of operational requirements defined in the NECC CDD. The structure of the SE process is identical across increments. The only things that change across increments are capability needs, capabilities, and increment-specific Architecture Framework guidance.

The purpose of the Architecture Framework is to establish long-term NECC architecture objectives, ensure near-term architectural and systems engineering decisions align with long-term NECC architecture objectives, and guide the development of NECC increment-specific

architectures and designs. The NECC Architecture Framework is maintained throughout the life of the NECC program in response to changes as the program evolves. To the extent practical, the Architecture Framework addresses long-term objectives so that minimal modifications are required to the Architecture Framework document to capture changes as the program evolves. It is anticipated that most changes will be captured in increment-specific architecture artifacts.

The dynamic nature of Warfighter C2 operations coupled with the rapid pace of technology evolution necessitate more versatile and agile methods of systems engineering than a traditional SE waterfall approach. Additionally, the SEP is required to be compatible with NECC's DoD acquisition and oversight reporting processes. This is accomplished by providing continuous and meaningful indications of the detailed technical progress in terms of the program's overall cost, schedule, and system performance requirements.

USJFCOM produces the NECC CDD in accordance with the JCIDS process and partitions it into fully functional capability increments. The SEP addresses the CDD and the DoDI 5000.2 acquisition requirements at an increment level, to include Milestone approvals and program status accounting for stakeholders and oversight entities. Below the increment level, the SEP defines a process that methodically decomposes capability requirements into constituent spiral development efforts that deliver deployed CMs. The process that takes Warfighter requirements and delivers materiel solutions is the NECC Capability Development Spiral, as depicted in Figure 4. An increment will have one or more 'spirals' that deliver capabilities (i.e., CMs).

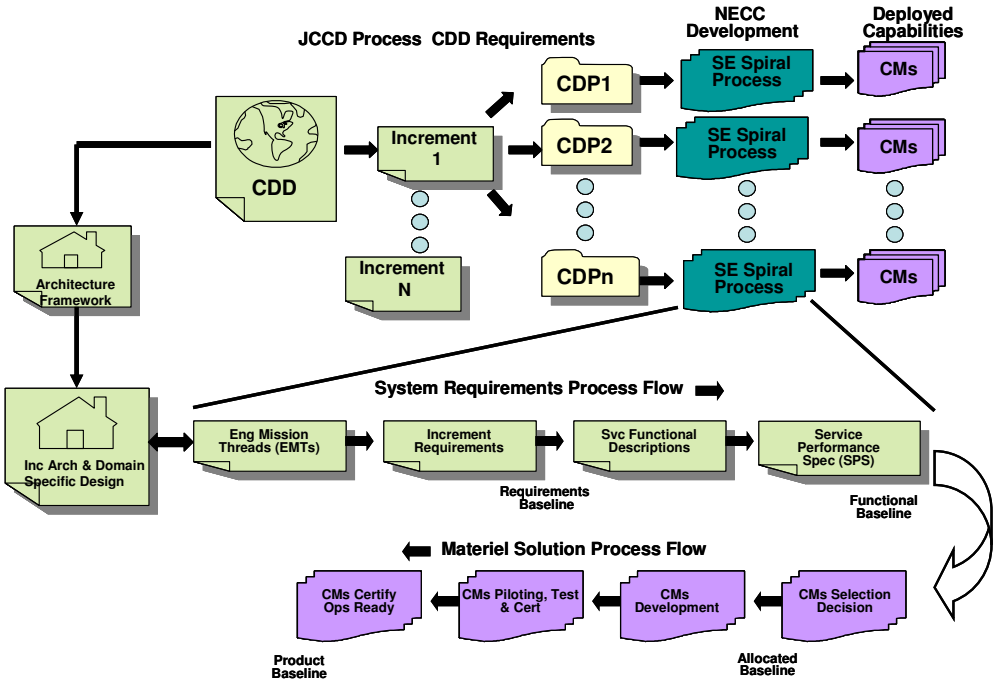

Figure 4: NECC Capability Development Spiral Overview

The SE process maintains requirements traceability to the CDP and the CDD through a number of techniques including Test, Evaluation, and Certification (TEC) Criteria and EMTs. This allows the program to recognize and quantify each individual capability's contribution to an increment, and to the overall set of deployed CMs. In this manner, NECC delivers operational capabilities to the Warfighter in a continuous stream while simultaneously fulfilling the DoDI

5000.2 requirements that govern acquisitions. This approach also enables a more efficient MS B and MS C review process. It incorporates much of the post deployment operations and support considerations into the development efforts being incrementally released, which leads to a full deployment decision review.

2.1 ECC's Tailoring of the Standard DoDI 5000.2 Processes

In developing this SEP, the NECC program used OUSD(AT&L)-prescribed guidance for systems engineering and DISA's SE process (which is based on Institute of Electrical and Electronics Engineers (IEEE) 1220) as references. Because the NECC program's acquisition strategy emphasizes rapid delivery of capability to the Warfighter, guidance and processes identified from these sources require tailoring to meet NECC program objectives. NECC briefed OUSD(AT&L) on the approach and structure of this SEP and received concurrence on NECC's modifications.

NECC tailored the DoDI 5000.2 as follows:

1. NECC manages its CDD operational requirements in small, prioritized incremental packages called CDPs. These packages move independently through the NECC SE process from operational requirements to deployed capabilities. The small size of the packages improves acquisition agility. It also implies that at MS B, NECC will not have a completed requirements baseline. Instead, the collection of the requirements allocated across the NECC Capability Development Spirals will form the Increment Requirements Baseline (see subsection 2.3.1.1 below).
2. Within an increment, NECC executes a number of NECC Capability Development Spirals, each of which must progress through the acquisition lifecycle phases. These overlapping spirals are in different acquisition phases. Due to this overlap, NECC will concurrently exist within three acquisition phases: System Development and Demonstration (SDD), Production and Deployment, and Operations and Support. This requires a modified MS B and MS C decision timeline to account for these concurrent activities
3. NECC will not conduct traditional SDD phase system-level reviews. Instead, NECC will schedule incremental systems engineering reviews based on an NECC Capability Development Spiral's progress, the collection of which satisfies the intent of traditional DoDI 5000.2 system level reviews.

The NECC SE process uses a spiral development approach on each CDP to specify, develop, test, certify, and deploy CMs. This process uses a top-down SE approach to decompose requirements and functions into smaller, independently managed (but federated) efforts to deliver interoperable capabilities more rapidly. Another key feature of the SE process is early and direct Warfighter involvement. At several points in the process, the Warfighter will assess the CM, beginning with the initial CM version and as the CM matures. An anticipated byproduct of this approach is concurrent requirements evolution during design efforts. The NECC program uses modified SE control techniques (risk management, configuration management, and design reviews) to account for these types of parallel activities.

From an overview perspective, the NECC SE process consists of five sub-processes: (1) RA/D/B; (2) Piloting Preparation; (3) Implementation Preparation; (4) PT&E; and (5) Operations and Support (see Figure 5). The high-level overview of the NECC SE process shown in Figure 5

establishes context for the discussion in the subsections that follow. Section 3 below and Figure 13 give more details about the specific activities that occur in the overall NECC SE process.

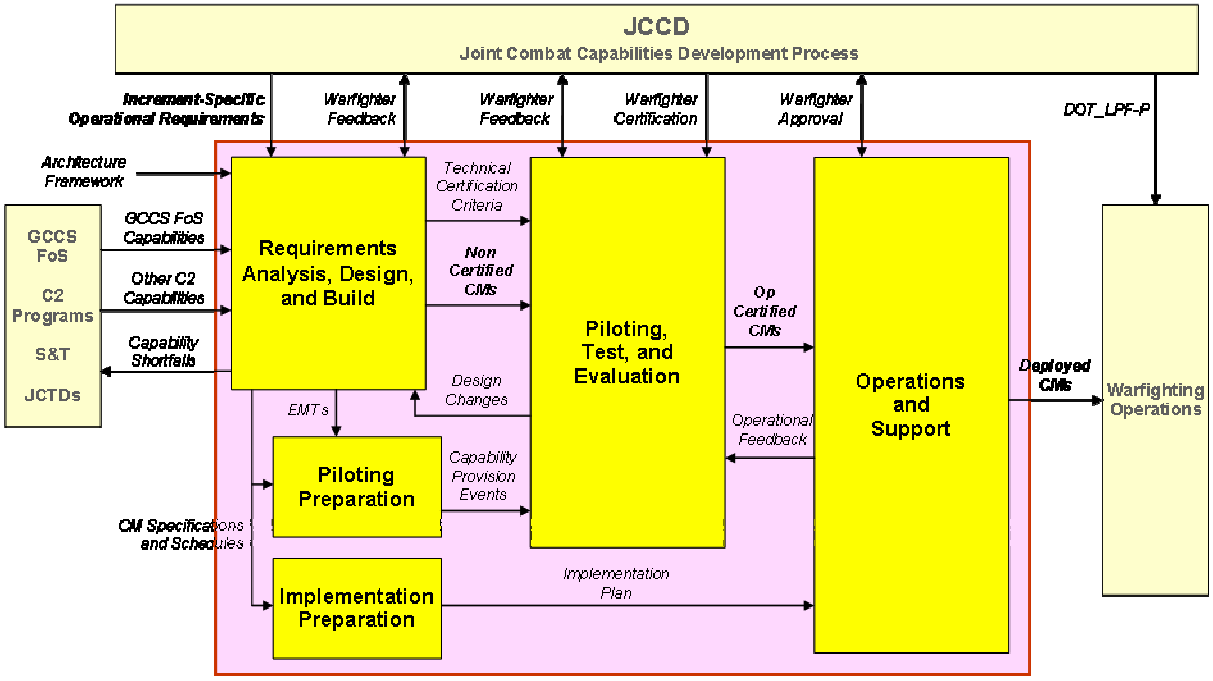

Figure 5: High-Level Overview of NECC's System Engineering Process

The purpose of the NECC RA/D/B sub-process is to take increment-specific operational requirements and perform the engineering activities required to design and build CMs. The function of the NECC PT&E sub-process is to support maturing CMs to achieve certification for operations. The purpose of the NECC Operations and Support sub-process is to provide and maintain certified capabilities to Warfighters for operational use. The objective of the Piloting Preparation sub-process is to provide upfront preparations and planning necessary to support downstream PT&E activities. The purpose of the Implementation Preparation sub-process is to provide upfront preparations and planning necessary to support downstream Operations and Support activities. Section 3 provides further detail on each of these five SE sub-processes.

The NECC SE process has a number of important characteristics. First, the mechanisms for Warfighter feedback and certification approvals (via the JCCD process) run throughout the entire SE process. These mechanisms can be via User Free Play (UFP), CPEs, and/or through working groups and Community of Interest (COI) forums. Second, the RA/D/B sub-process is designed to take inputs from GCCS FoS and other C2 programs to identify capabilities that can be leveraged in NECC. The RA/D/B sub-process also provides feedback to the Science & Technology/Joint Capability Technology Demonstration (JCTD) communities on NECC technology/capability shortfalls. Finally, the feedback loops, which are critical to the NECC SE process, that exist between the various SE sub-processes provides the mechanism for NECC stakeholders to influence RA/D/B activities before CMs move to formal operational testing and eventual deployment.

2.2 Increment Requirements and Architecture

2.2.1 Joint Combat Capability Development

USJFCOM's JCCD process captures the Warfighters' input to the materiel acquisition process by documenting capability needs. NECC's first significant tailoring of the DoDI 5000.2 processes occurs within this acquisition process. In the TD phase, the JCCD will develop a CDD as specified by the standard DoDI 5000.2 processes. However, NECC does not plan to develop a standard Capabilities Production Document (CPD) post MS B. Instead, NECC plans to replace the CPD with a set of smaller increment CDPs that provide operational architectures. In total, the collection of CDPs will replace the CPD.

A CDP provides operational perspective, functional behavior, and performance details necessary to build a field-ready C2 capability. The CDP contains a description of the desired capability, operational conditions, required Key Performance Parameters (KPPs) and Key System Attributes (KSAs), and applicable Department of Defense Architecture Framework (DoDAF) operational views. Details within each CDP define the process (activities, sequencing, organizations, and information exchanges); specify information requirements; and set performance requirements (timelines, scale, transaction rates, reliability, and survivability). A Joint team of JCCD, JPMO, and CPMO representatives assisted by selected Subject Matter Experts (SME) ensures that the information contained in the CDP is comprehensive and relevant for the intended purpose of developing CMs that achieve the CDP requirements.

2.2.2 NECC Architecture

Figure 6 denotes NECC's approach to developing architectural guidance to inform the systems engineering activities in the RA/D/B sub-process.

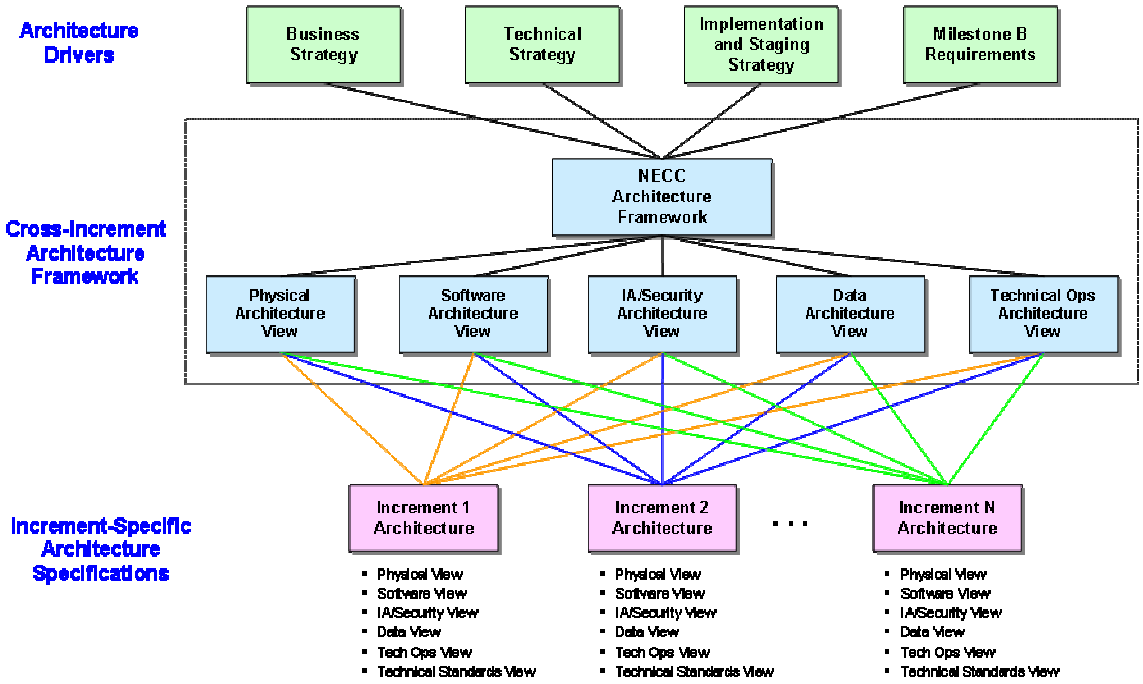

Figure 6: NECC Architecture Framework

As depicted in Figure 6, NECC provides two levels of architectural guidance: the NECC Architecture Framework, and increment-specific architecture specifications.

Source documents, such as the CDD, that fall under the category of "MS B Requirement," identify architectural drivers (see Figure 6). Identified architectural drivers include the following:

- NECC's objective to rapidly develop, certify, deploy, and support capabilities to the Warfighter
- Compliance with the DoD Net-Centric Data Strategy
- Adherence to the ABC acquisition strategy
- Approach for transitioning existing GCCS FoS functionality (Refer to the *GCCS FoS to NECC Functionality Transition Plan*[5] for more details)
- Leveraging capabilities provided by NCES and other Programs of Record (POR)
- Requirements to support DIL environments
- Compatibility with existing and planned Service infrastructure initiatives
- GIG Key Interface Profiles (KIPs)

These drivers heavily influence the resulting architectural guidance.

The NECC Architecture Framework describes the high-level architectural concepts and constructs that are applicable across all three planned NECC Increments. The development timeframe for these three increments is expected to last through the end of FY 2014. Due to this long duration, the NECC Architecture Framework is very general and high-level in nature. It is composed of five architectural views. A Physical View addresses concerns associated with physical components, such as GCNs and hardware. It also forms the basis for describing and constructing the physical topology of the Deployed Baseline. The Software View deals with software components, such as CMs, and the software services they provide. An Information Assurance/Security View provides details about functions including identification, authentication, authorization, identity management, non-repudiation, confidentiality, integrity, and overall security management. The Data View discusses approaches associated with implementing the DoD's Net-Centric Data Strategy. The Technical Operations View presents concerns associated with operating and maintaining the NECC IT infrastructure. Refer to the Architecture Framework document[6] for further information.

The Architecture Framework uses a CM as the fundamental construct for providing operational capabilities. A CM is a collection of components that collectively provide a set of logically grouped, operationally relevant services distributed across one or more nodes associated with the Deployed Baseline. CMs may range in complexity from a single service supporting distant

[5] FTP, v0.1.3, 5 May 2007, URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

[6] Architecture Working Group, Architecture Framework, 31, January 2007, Version 1.0, URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

clients over the wide area network, to a large set of interacting services distributed to consumer sites across the globe.

Increment-specific architecture specifications provide the detailed architectural guidance that applies to a given increment. As depicted in Figure 6, the increment-specific specifications will include increment-specific versions of the five views from the NECC Architecture Framework that describe in detail the approach for addressing the concerns identified for the timeframe of the given increment. In addition to these five views, increment-specific architecture specifications will include a Technical Standards View that will identify the specific technical standards, to include version numbers that CM developers must adhere to for the given increment.

An increment-specific architecture leads to the definition of a set of logical CMs, based on CDD Extension D requirements. These logical CMs are used in design and functional requirements development efforts. Logical CMs are placed into one of three categories: Warfighting, Data Services, and Core C2, which are grouped into domain areas as illustrated in Figure 7 and Figure 8. These graphics depict a notional categorization for Increment 1.

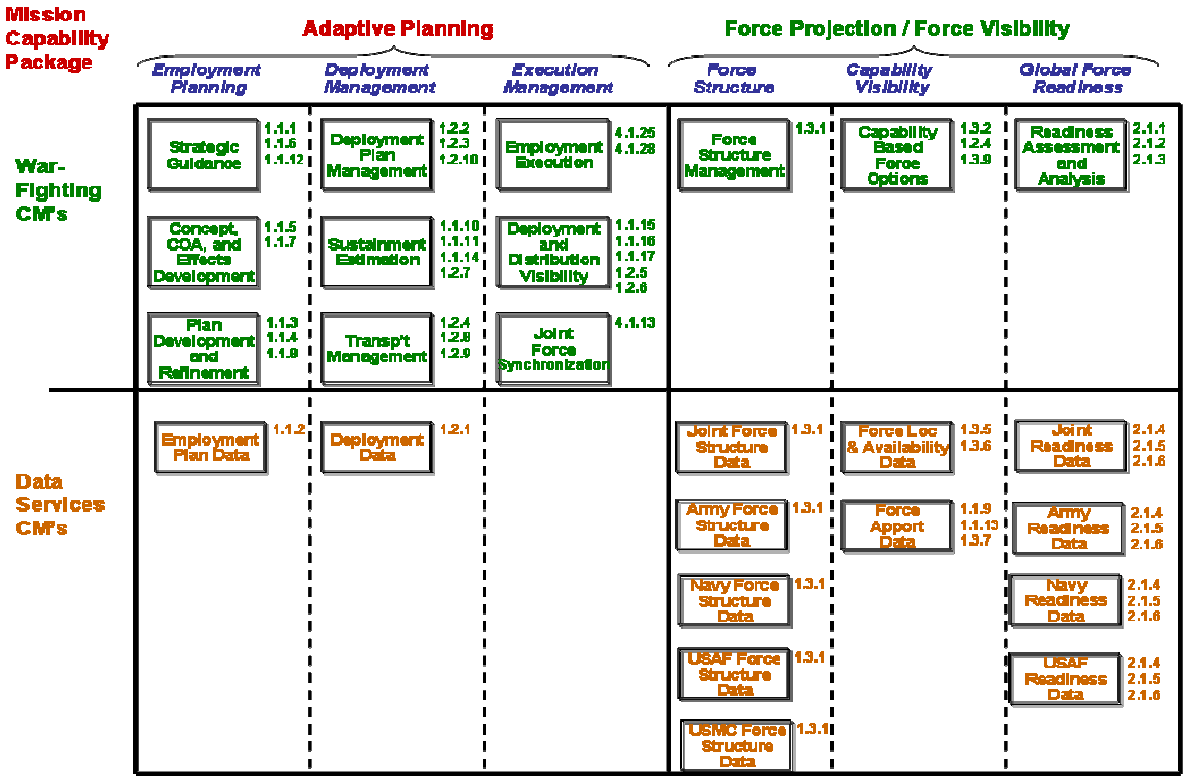

Figure 7: Increment 1 Logical Capability Modules

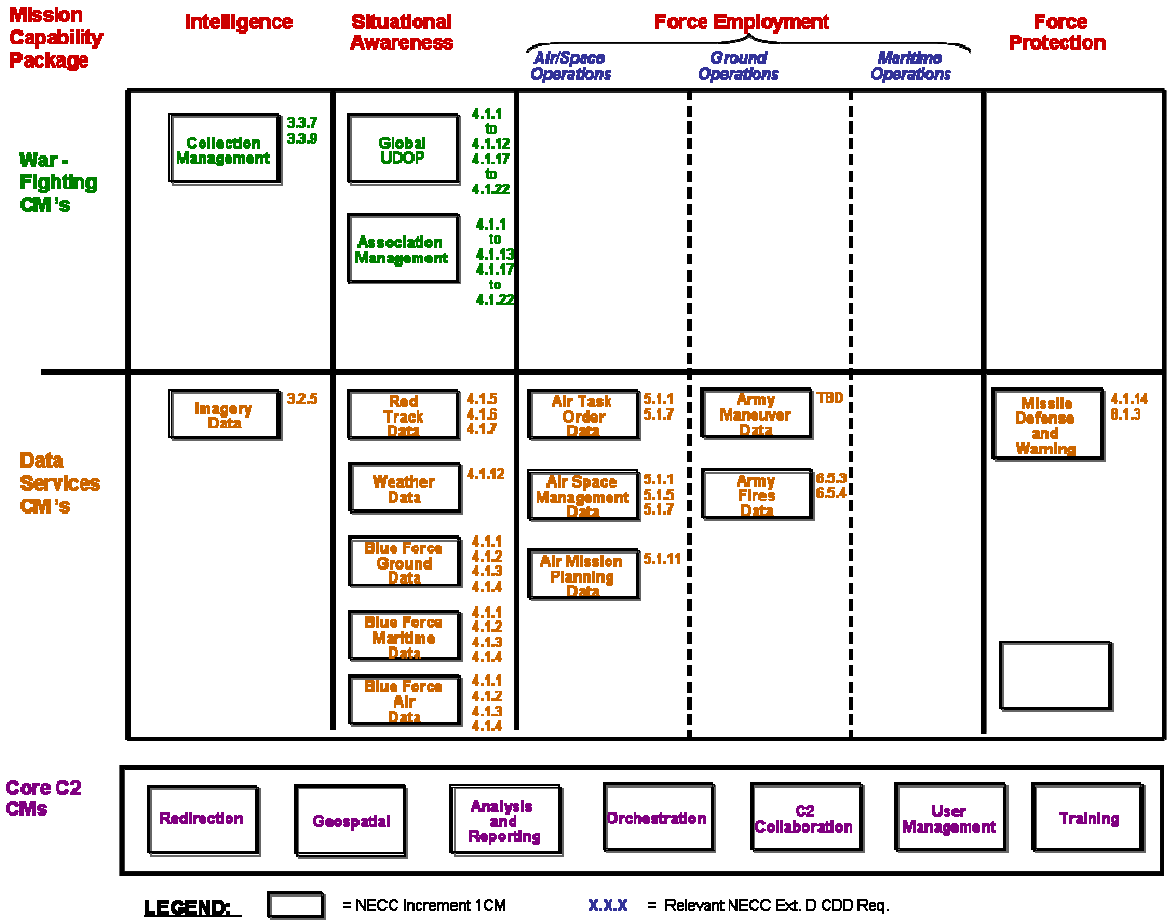

Figure 8: Increment 1 Logical Capability Modules (Continued)

2.3 NECC Baselines

The NECC JPM maintains configuration controlled baselines to manage and track technical and programmatic aspects of CMs and the overall program. This is accomplished through definition and control of five Technical Baselines (technical) and a Management Allocated Baseline (programmatic), which are discussed in the following subsections.

2.3.1 Technical Baselines

As shown in Figure 9, NECC's SE process establishes five Technical Baselines for an increment: Increment Requirements Baseline, Functional Baseline, Allocated Baseline, Product Baseline, and Deployed Baseline. Generating the engineering artifacts required to populate these Baselines occurs both at the increment level and at the NECC Capability Development Spiral level. An increment's architectural and domain design activities begin early in an increment's timeline and provide the overarching technical and design guidance required by the NECC Capability Development Spiral. The increment-specific architecture and domain-specific design considers the relevant operating environment required for the capabilities. For example, for CMs that must operate under DIL conditions, the increment-specific architecture and domain-specific design produce the design-level information necessary for an approach that will meet

requirements for operating under DIL conditions. Each baseline element provides a progressively more detailed description of NECC capability required to meet CDD requirements and evolves with the release of individual CDPs.

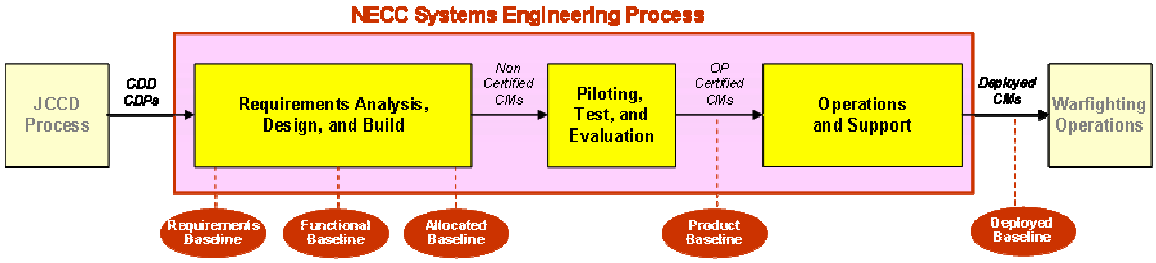

Figure 9: NECC Technical Baselines

Developing the Increment Requirements and Functional Baselines begins with the release of the first CDP. It continues until the last CDP is received and inducted into the NECC SE process, which occurs post MS B. Allocated Baseline development begins by selecting a candidate CM materiel solution for the first NECC Capability Development Spiral within an NECC Increment and ends when the last CM is selected. Product Baseline development begins when NECC certifies a CM as operationally ready for the increment and ends when all CMs associated with an increment have entered into operational service (see Figure 10).

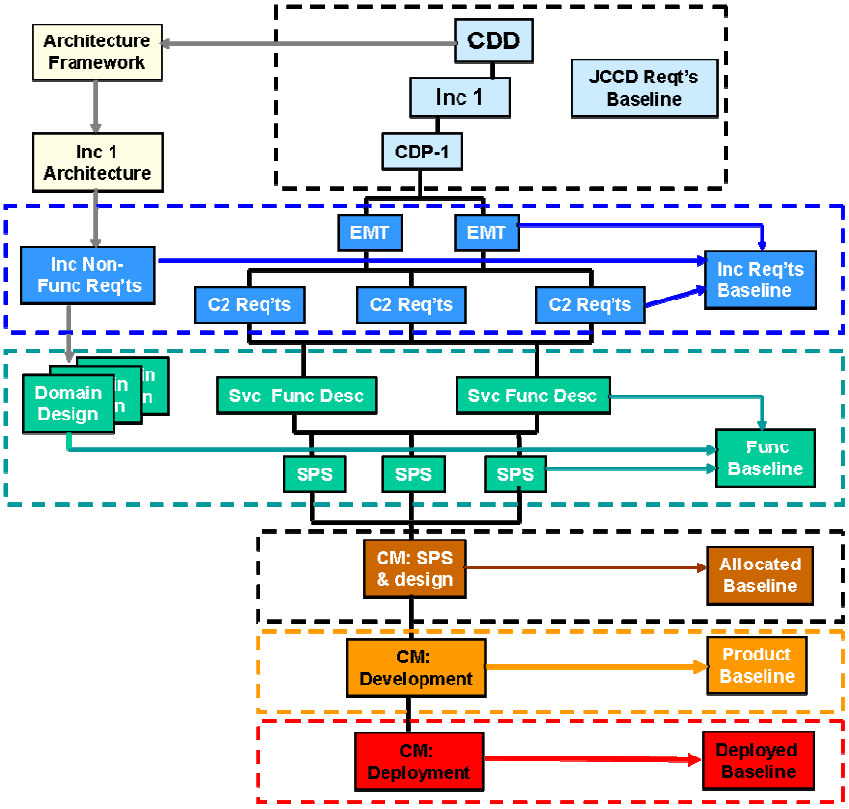

Figure 10: Technical Baseline Structure

CMs are transitioned from the Product Baseline into the Deployed Baseline when they have successfully progressed through the FDCE maturity stages and are ready for operational deployment.

After these five Technical Baselines are initially established, they will evolve as required through a structured configuration management process to incorporate emergent and deferred requirements, and to reflect the extension over time of the Deployed Baseline to additional local nodes.

2.3.1.1 Increment Requirements Baseline

Increments are self-contained portions of the system-level CDD. The Increment Requirements Baseline is NECC's version of a traditional System Specification (A-Spec), but is enhanced with the technical content needed to develop NECC services. An Increment Requirements Baseline is applicable to each NECC Increment. It is also comprised of the complete set of systems engineering and architecture products to define the business (operational) processes, relevant operational environment, and C2 requirements derived from the operational requirements of the CDD (as apportioned to the increment). The Increment Requirements Baseline will be updated to stay current with evolving NECC design decisions and will be configuration managed through NECC Configuration Management processes.

2.3.1.2 Functional Baseline

The NECC Functional Baseline represents the complete set of functional and performance specifications derived from the functional analysis of the business processes (EMTs), architecture requirements, and domain-specific functional considerations. The Functional Baseline applies to each increment and describes functional and performance requirements in a web services context. This Baseline is similar in content and level of detail to a traditional End Item Specification. The Functional Baseline is modified to account for requirements in terms of web services functions and performance requirements instead of overall system functions and performance requirements. Although, the Functional Baseline also reflects end-to-end functional requirements associated with multiple services interacting to meet a larger mission thread requirement. The resultant elements of the Functional Baseline are called SPSs and are used in subsequent SE process steps to engineer the intended performance of the materiel solutions. The Functional Baseline will be under configuration management control. Therefore, changes to this Baseline will be governed through the NECC Configuration Control Board (CCB) process. Through developing the Functional Baseline, the SPS(s) will be tracked to their associated CMs.

2.3.1.3 Allocated Baseline

The NECC Allocated Baseline is the set of approved candidate CMs and their allocated SPSs (from the Functional Baseline). It also includes additional implementation and interoperability requirements unique to the domains and architecture considerations. The Allocated Baseline is not established until the JPEO approves the candidate materiel solution (candidate CM). Subsection 3.1.4 covers the methodology and process for allocating, designing, and approving candidate CMs. The Allocated Baseline is constructed as candidate CMs are approved for development, but is not complete until all functional requirements of the increment have been allocated to an approved candidate CM. Once a candidate CM is approved for development and enters the Allocated Baseline, it is controlled through the NECC CCB, follows configuration

management processes as a configuration item, and contains details similar to a standard sub-system specification.

2.3.1.4 Product Baseline

The Product Baseline is comprised of the NETOPS certified "as-built" materiel solutions (CMs) and the supporting data packages (training manuals, source and object code if applicable, and certification and test reports) as defined in the work package used for the development effort. This Baseline also contains version-specific information about backward compatibility and interoperability with other C2 systems and NECC CMs. The Product Baseline is constructed continuously as CMs are certified for NETOPS. It also requires updates as changes to the CMs are made resulting from Operations and Support maintenance and support actions. The Product Baseline is controlled by the NECC CCB, which will determine the disposition of changes to a CM or forward to the appropriate CCB subgroup for disposition.

2.3.1.5 Deployed Baseline

The Deployed Baseline is the actual physical distribution of NECC CMs to enterprise and operational sites. The Deployed Baseline will reflect known and evolving requirements for distributing NECC capabilities to nodes and sites. It will also form the basis for informing other elements of the SE process about operational and environmental considerations. To support effective Joint Technical Operations Control Center (JTOCC) technical operations, an increment's Deployed Baseline will require updates and configuration management during actual CM deployment and operations.

2.3.2 Management Allocated Baseline

The JPMO will use the Management Allocated Baseline as a tool for apportioning NECC efforts across the Military Service/Agency Components. It supports resource management and notional scoping efforts in advance of formal decisions. The JPMO will use the Management Allocated Baseline in support of Planning, Programming, and Budgeting analysis and associated CPMO efforts. As a resource planning enabler, the JPM collaborates with the CPMs to develop a Management Allocated Baseline that assigns an increment's set of logical CMs to the program's CPMs. It neither restricts the JPEO in making an Allocated Baseline CM decision nor prevents another CPM from responding to a candidate CM request as part of the Allocated Baseline discussion above. The Management Allocated Baseline will evolve as required to reflect actual CM development responsibility decisions made during execution of the SE process.

2.4 Requirements Analysis, Design, and Build Sub-Process

The JCCD process identifies Warfighter capability needs and other requirements that are then allocated to a particular increment. Once allocated, the requirements must be further analyzed and refined into engineering terms so that a materiel solution can be designed and built. This is the purpose of the RA/D/B sub-process, which uses guidance from the NECC Architecture Framework to design an appropriate solution, and evaluates existing capabilities from a number of sources (GCCS FoS, other C2 systems, JCTDs, etc.) as candidate solutions. The outputs of the RA/D/B sub-process are physical CMs that satisfy the requirements allocated to the increment under consideration. These physical capabilities are then ready for PT&E activities to

determine how well they meet the increment's stated objectives. Subsection 3.1 below contains additional detail about the RA/D/B sub-process.

2.5 PT&E Sub-Process

The NECC CPMs and JPM are responsible for ensuring CM performance and certifying CM maturity levels from development to deployment on the GIG. NECC plans and employs integrated test and evaluation techniques in addition to piloting events in the FDCE to produce the verification and certification data needed to advance through the FDCE maturity stages. The planning for PT&E identifies objectives that will evaluate the functional, performance, and interoperability (with current C2 systems) characteristics of each CM. It will also aid in identifying and resolving integration issues early and often throughout the CPAS. Piloting events are used to selectively evaluate architecture and design characteristics in support of NECC CM certification objectives.

A notable characteristic of the NECC PT&E sub-process is that it enables individual CMs to progress at their own maturation speed and to be individually evaluated in technical and mission terms towards certification. This technique procedurally mitigates the artificial delays associated with maturation of a larger build, but retains attention to key functional and technical dependencies at the CM level. The I&TP CONOPS[7] contains additional detail about the types of piloting events and the associated procedures. The TEMP details how the piloting framework is used to conduct formal DT and OT events.

NECC CPAS encompass activities required to develop, integrate, test, evaluate, and certify net-enabled capabilities ready for deployment on the GIG. The NECC CPAS enables faster and more integrated development efforts by using development, test, and certification environments that are more responsive and collaborative than system integration laboratories used in traditional C2 system development. CPAS affords greater access and transparency to developers, testers, users, and the certification community. It also enables maximum reuse of test plans and procedures, mitigates redundant testing, and consolidates testing requirements across the developmental, operational, and certification test communities.

The FDCE is a key component to support PT&E. It is the main development, PT&E, and integration resource for the NECC program. It provides the processes and supporting infrastructure needed for robust and continuous conduct of net-centric CPAS. Through the FDCE, users are able to provide continuous and early feedback, as well as conduct requirements validation and certification at the earliest opportunity. For more information, review the NECC CPAS CONOPS,[8] which contains more detail about the FDCE and the requirements for entry into each maturity stage.

The output of the PT&E sub-process is a net-enabled capability certified for deployment to the GIG for NETOPS. In order to be certified for GIG operations, a CM must advance through the three FDCE maturity stages (Figure 11). At each stage, the CM must meet defined certification

[7] I&TP CONOPS, v(add reference when available)

[8] CPAS CONOPS, v0.11.2, 16 April, URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

criteria that include technical maturity, net-readiness, interoperability certification, and security accreditation.

To the extent feasible and desirable, NECC CPAS will leverage Under Secretary of Defense for Intelligence (USD (I)) Distributed Development and Test Environment and Joint System Baseline Assessment events. As requested by the JPMO, the CPMOs, and USJFCOM, the Joint System Team (JST) will engage the Joint Warfighting Center (JWC) to insert CPAS into scheduled exercises using the Joint Experimentation, Joint Test and Evaluations, and Advanced Concept Technology Demonstration (JETA) process established by USJFCOM 1025.1-M.

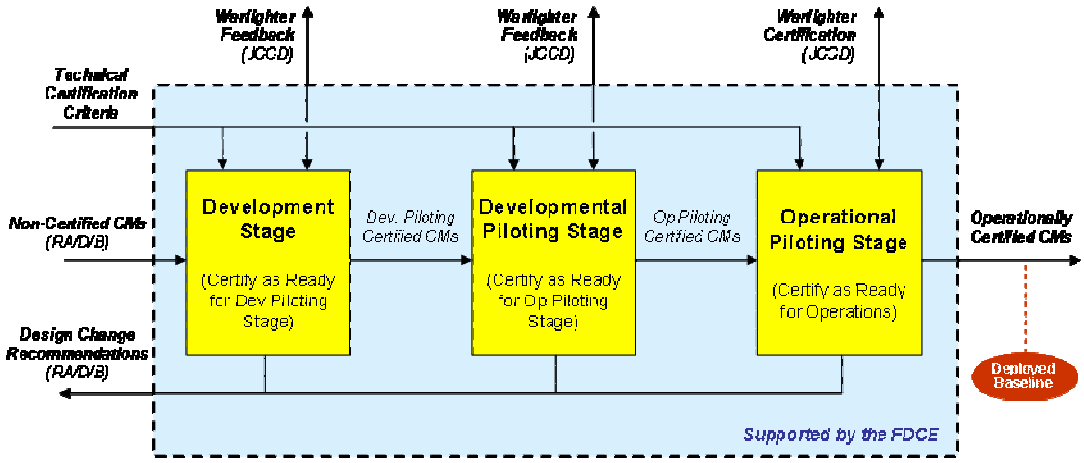

Figure 11: NECC FDCE Stages

The three FDCE stages are as follows: (Refer to the NECC CPAS CONOPS[9] for more details on the entrance criteria for each stage.)

1. **The Development Stage** is the entry stage for CM development and certification. This stage focuses on initial CM development, debugging, and technical exploration. The entrance criteria for this stage are set as low as possible to minimize the barriers to participate.
2. **The Developmental Piloting Stage** is the second stage of maturity for CM development, integration, and certification. The purpose of this stage is to test and certify the net-ready status of CMs. At this stage, operational users can begin to use CMs to provide early feedback on operational utility. The entrance criteria for this stage focus on a sufficient level of technical stability and standards conformance to ensure that the CM is well behaved.
3. **The Operational Piloting Stage** is the final stage of maturity for CM development and certification prior to deploying the capability. The purpose of this stage is to evaluate, report, and support the fielding decision. This stage also validates that Joint Warfighter needs are met. At this stage, CMs have matured sufficiently to participate in operational events/experiments and have addressed all security accreditation requirements. The entrance criteria for this stage include net-ready compliance and satisfaction of performance requirements.

[9] CPAS CONOPS, v0.11.2, 16 April , URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

The roles and responsibilities of the communities involved in the CPAS activities will vary depending on the FDCE maturity stage. Requirements for graduating a CM from one stage to the next are contained in the CM TEC Criteria. Organizational responsibilities for asserting and approving compliance with TEC Criteria requirements are described in the TEMP and JST charter. Subsection 4.4.5 describes participation as a CM advances through these three stages.

The JST serves as the primary management body for overseeing the planning and execution of CM CPAS verification activities leading to CM deployment. JST maintains test teams for CM test and evaluation, develops System Evaluation Plans as annexes to the TEMP, and prepares Assessment Reports to recommend and support the CM's deployment and the overall evaluation of the CM at the CDP and increment level. A more detailed discussion of JST governance roles and responsibilities is in subsections 4.4.5 and 4.4.6.

2.6 Operations and Support Sub-Process

NECC, as a program, continuously implements, tests, and deploys CMs in a series of overlapping spirals. This approach has significant implications for full lifecycle considerations and differs from a traditional large system development that waits until all required components of the system are ready before deployment can occur. In NECC, capabilities incrementally deploy as soon as they are mature enough to do so, thus making required capability available to Warfighters as quickly as possible.

Due to the dynamic nature of the NECC program and the rapid rate of deployment, issues such as operations and support require consideration early in the development cycle and updating as development proceeds. Early consideration of such factors is vital to successfully achieving the agility required to meet changing Warfighter needs.

Deployment planning begins shortly after the initiation of the RA/D/B sub-process. This ensures that the SE process addresses lifecycle support issues. Two specific outputs of early deployment planning are an Implementation Strategy and an Implementation Plan. Both require updates as development progresses to guide downstream operations and support activities.

As guided by the Implementation Strategy and Implementation Plan, NECC CM deployment is a shared effort between the JPMO and the CPMOs. When a CM meets all relevant testing and certification criteria in the FDCE, receives its C&A, and graduates from the Operational Piloting stage it is placed in the JTOCC CM configuration controlled repository. After JTOCC verifies that the CM-specific support package was disseminated to the CM support infrastructure, the CM is made available to the worldwide user community. Refer to NECC's Increment 1 Technical Operations Architecture[10] for further information on NECC's deployment approach.

For CPMOs, deployment consists of those activities that directly provide capabilities to Warfighters within the Components' environments. These activities include training, logistics provisioning, and deploying required hardware and software. A CPMO's deployment preparation activities begin during the creation of the Implementation Strategy by clearly identifying the operational environment and platform applicability for the planned CMs.

[10] NECC Increment 1 Draft Technical Operations Architecture, 10 Apr 2007, Version 0.1

It is important to note that the final approval to add or update Service C2 capabilities within a command lies with the Operational Commander. Although NECC may make new capabilities or versions available, inherent in the Operational Commander's decision, as represented by the Joint Capability Developer's (JCD) Operational Fielding Decision Memorandum (OFDM), is the determination to accept or reject a capability in light of its potential degradation to current capability. There may be occasions when it is necessary to implement mandatory enterprise wide CM deployments or upgrade CMs for interoperability reasons.

Once deployed, CMs require technical operations, logistics, training, and related operational support services. NECC operations support capitalizes on the net-centric concept that software services are accessible via network access independent of a specific Warfighter platform[11]. Specifically, a Warfighter will generally access NECC CMs through standard web access software (e.g., browser) instead of client platform-specific NECC software. Likewise, net-centricity means that a CM's physical location (i.e., on the network and within a specific computing platform) is independent of a user's location. Thus, NECC operations support is substantially different from traditional client-server oriented C2 systems where most of the mission application software is co-located with the Warfighter on the same network and within the Warfighter's computing platform.

NECC's operations support includes rapid, continual deployment of capabilities to the GIG; monitoring and managing the execution of those capabilities; and Help Desk services to support users. Through the JTOCC, operations support collects, tracks, and converts problem reports to Change Requests for proper adjudication when necessary. The primary physical location for the hardware that forms the NECC JTOCC will be at a Defense Enterprise Computing Center (DECC). However, the JTOCC will be net-centric, offering its capabilities to participants via the GIG no matter where they and their parent organizations are physically located.

NECC operations support includes CM execution monitoring. Such monitoring focuses on service availability and compliance with stated Service Level Agreements (SLA) as well as key functional attributes such as access to data sources. NECC technical operations are the primary interface to the JTF–Global Network Operations (GNO). Therefore, it addresses issues relating to GIG network access and performance, as well as the interface to the DISA NETOPS Centers for monitoring and managing network operations.

NECC's Help Desk support is a multi-tier approach with a single point of entry for users. For software problems or system and software shortfalls, the Help Desk documents the issues using an automated, web-accessible tracking system. This will allow users, NECC SE staff, JCCD staff, and CPMO/configuration management staff access to problem reports as well as track-to-completion status of problem reports. The NECC Help Desk also provides access to online training, documentation, and an online knowledge database. This allows Help Desk personnel and end-users to search for similar issues and potential resolutions.

2.7 GCCS FoS Transition to NECC

NECC leverages the significant investment made in the GCCS FoS by transitioning appropriate GCCS FoS component capabilities into the NECC Allocated, Product, and Deployed Baselines.

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[11] NECC Increment 1 Draft Technical Operations Architecture, 10 Apr 2007, Version 0.1

NECC increments will co-exist with current GCCS capabilities not yet transitioned. Figure 12 depicts the means by which current GCCS FoS C2 systems gradually phase out as their capabilities migrate to NECC. The *GCCS FoS to NECC Functionality Transition Plan*[12] provides details for this process. This migration is intended to occur without degrading the functional capabilities currently available to the Warfighter. GCCS FoS capabilities will migrate into NECC through a series of NECC Capability Development Spirals. The GCCS FoS transition process will determine when specific FoS capabilities are retired. Due to capability overlap between NECC and the current GCCS FoS, there will be residual legacy capability that becomes redundant and subject to retirement. This will take place after relevant GCCS FoS functionality has been successfully migrated and verified through the appropriate level of Operational Test Activity (OTA) acceptance.

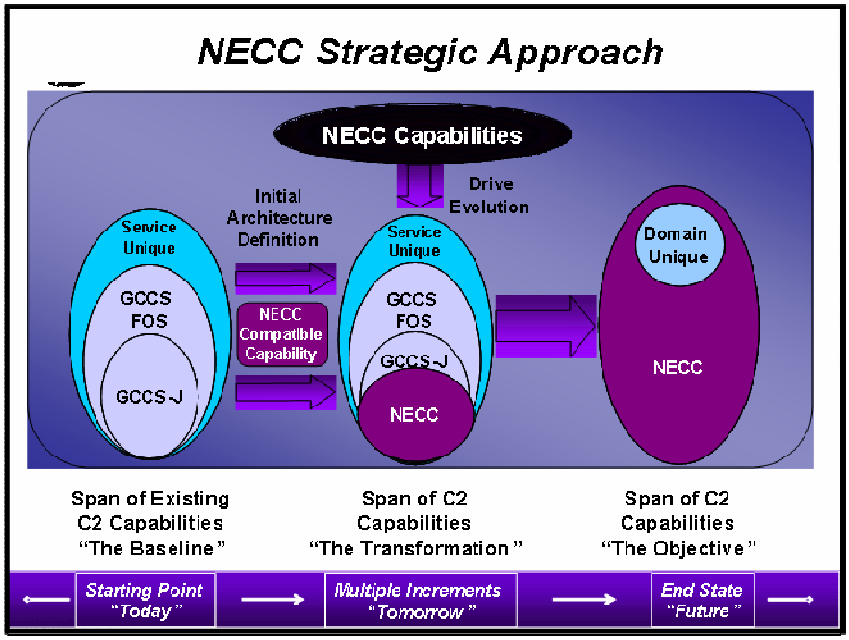


Figure 12: Strategic Approach for Transitioning GCCS FoS Capability

2.8 NECC Partnerships

This subsection describes the developmental partnerships necessary to support successful achievement and execution of NECC program activities. The objective of developmental partnerships is to leverage and incorporate developmental efforts and capabilities that exist or are evolving across the community. The baseline of developmental partnerships is reflected in the Management Allocated Baseline described in subsection 2.3.2 above. Establishing these partnerships and the associated/required systems engineering needed to baseline the functional and technical relationships between the partners is a key activity of the TD phase in preparation for executing full-scale design and development during the SDD phase.

[12] FTP, v0.1.3, 5 May 2007, URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

2.8.1 Developmental Partnerships

This subsection defines key terms for NECC partners. The JPEO has overall responsibility for the strategic approach to partnership activities. The NECC JPM is responsible for executing specific aspects of the activities.

- **NECC Tier 1 Development Partners:** Tier 1 partners are those development efforts and products produced under direct funding of the JPEO/JPMO. The exact nature of these partnerships evolves as appropriate to reflect programmatic relationship(s) implemented by higher authority.
- **NECC Tier 2 Development Partners:** Tier 2 partners are those development efforts not directly funded by NECC, but produce software that can be incorporated into the NECC baseline capability that the CPMOs implement. Tier 2 partners will follow NECC architecture and development guidance, but will not be under direct technical control of the JPEO/JPMO.
- **NECC Tier 3 Developmental Partners:** Tier 3 Development Partners are those third party efforts/programs/systems that produce and deploy a capability or product/data that NECC will consume and against which NECC requirements can be allocated. Memorandum of Agreements (MOAs) and SLAs that establish necessary functional, technical, and procedural relationships will primarily characterize these partnerships.

2.8.2 Partnership Governance

NECC requires an open, robust, and responsive mechanism for establishing and documenting partnership agreements, managing the business and technical aspects of those agreements, and communicating continuously and completely across the entire community of partner stakeholders. Governance of NECC partnerships will follow a multi-Service management construct that mirrors those used in the rest of the NECC program. The multi-Service Program Management Direction Team (PMDT), which is described in subsection 4.1 below, will be the primary agent for identifying technical and developmental partnerships through the SE process. The JPEO and NECC JPM will negotiate and approve partnership authority, roles, and responsibilities in coordination with the associated multi-Service management team. The NECC Board of Directors will have an oversight and adjudication role. An NECC partnership business model will be established during the TD phase. It will support execution of the necessary financial and programmatic relationships associated with executing developmental partnerships. The NECC SE Working Group (WG) will establish and execute a process for communicating and coordinating with the community of NECC partners. It will be based upon the DISA SE process Customer Communication Strategy (CCS), with the objective of complete visibility of the state of NECC partnerships to all stakeholders. The CCS is a required artifact for every DISA program. The CCS will exploit available net-centric tools for distributed visibility and management. Structured face-to-face meetings will also support communication.

2.8.3 Strategic Partnerships

Success of the NECC program is dependent upon cultivating and executing significant strategic partnerships across the many elements of the NECC Stakeholder community. It will also establish partnerships across the DoD organizations whose participation and support is necessary

to achieve NECC process changes. In addition to developmental partnerships, NECC will develop and manage the following strategic partnerships:

- Test & Evaluation (T&E) partnerships with Service and DoD DOT&E communities via a T&E Working-level Integrated Product Team (WIPT)
- Security accreditation partnerships with service and DoD accreditation agents via an IA WIPT
- Partnership with operational community via JCCD
- Industry partnerships via an Industry Advisory Panel
- Data engineering partnerships via the Office of the Secretary of Defense (OSD)
- COI forums and the Joint Battle Management Command and Control data engineering process

The intent is to formalize the partnerships with MOAs, which will be posted on the Defense Knowledge Online (DKO) portal (and in the interim, on the Defense Online (DOL) portal).

3 NECC SYSTEMS ENGINEERING PROCESS

The NECC SE process focuses on agile, responsive development and rapid delivery of capabilities. This requires trading traditional SE processes to gain speed of delivery while still maintaining sufficient technical control required for integration and interoperability of capabilities. This tradeoff accepts evolving baselines and designs that produce early systems engineering decisions at the increment and CM level. In return, CM development begins significantly earlier than with traditional SE processes. Each NECC Capability Development Spiral is, in fact, a mini-system development guided by an increment-specific architecture and domain-specific design information. Increment level guidance ensures that each NECC Capability Development Spiral has sufficient operational and technical direction for delivering the required capabilities without waiting for a full set of baseline and design information. Rigor and thoroughness required in CM development, integration, and certification is an integral part of NECC's SE process. Additionally, by accelerating the systems requirements process and deploying individual CMs when certified for NETOPS, the NECC program is able to provide continuous Warfighter capability upgrades and increased C2 capabilities across the Joint Forces.

NECC Capability Development Spirals follow the end-to-end mission-driven process depicted in. Figure 13. The SE process describes the engineering lifecycle from understanding user requirements through requirements analysis and CM development to CM piloting, integration, and certification, which leads to a deployment decision for operations. An important note in the following discussion is that CMs are *candidate* CMs until they become actual materiel solutions as an output of Process Step 8. Prior to Process Step 8, CMs are only candidates because they are in various stages of development and test. These candidates may not be the actual deployed materiel solution until those SE process activities are completed.

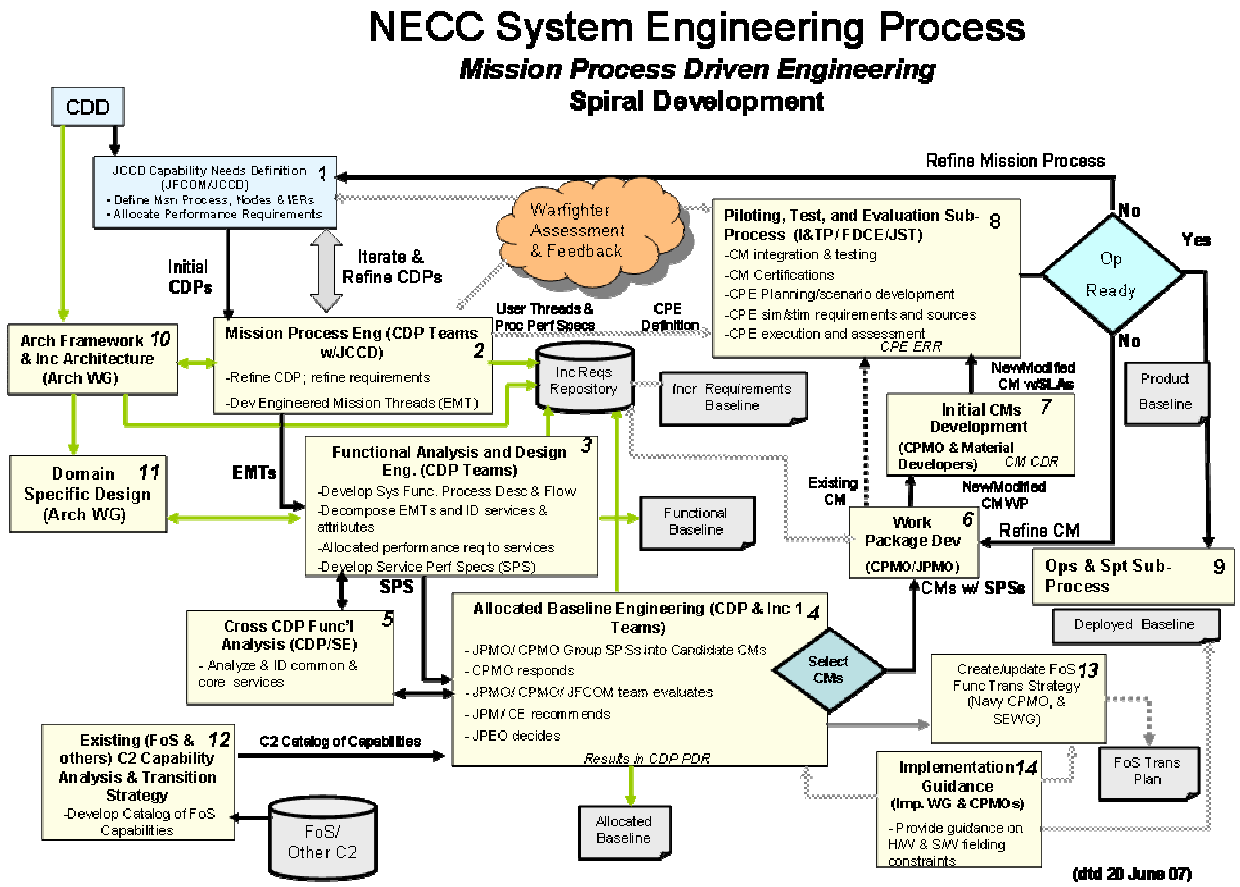


Figure 13: Detailed View of NECC Systems Engineering Process

(Note: for a larger picture of Figure 13, see Appendix C)

To provide clarification of the activities in Figure 13, a synopsis of the overall process is required. Upon receiving a CDP from USJFCOM (Process Step 1), the NECC SE staff analyzes and decomposes the required capabilities. The team translates the operational requirements into EMTs (done with members of the JCCD for Warfighter input) and SPSs. Developers use these two products in Process Steps 2 and 3, as guided by the architecture and domain-specific design results of Process Steps 10 and 11. Next, the JPMO-led team assembles individual SPSs into logical groupings (Designs) to inform the ABC selection activity. An analytical comparison between the proposed logical grouping and existing or proposed solutions is accomplished. The results are then used in the final selection of the candidate CMs and the preferred materiel developer (CPMO), which completes Process Step 4. Next, the JPMO, CPMO, and the selected materiel developer jointly define the scope of work, which is documented in a work package (Process Step 6). CM development is performed as part of Process Step 7. This process step produces a CM for verification against allocated requirements and architectural compliance standards. The PT&E sub-process (Process Step 8) validates compliance, which leads to approval for NETOPS on the GIG. Once approved, the SE process extends into an Operations and Support sub-process that includes implementation (Process Step 9). This sub-process addresses Joint and Service-unique deployment aspects of providing the capabilities to the entire intended user base.

The NECC SE process ensures integration and interoperability between individual spirals (the bottom-up development) and within the increments (top-down design). It uses comprehensive architectural products that include both technical views (physical, software, data, IA, and technical operations) and domain-specific designs. The architectural guidance (developed in Process Step 10) and domain-specific design products (developed in Process Step 11) are used extensively through the requirements analysis and functional analysis/design portions of the RA/D/B sub-process (Process Steps 1-5) to enable effective traceability, interoperability, testability, and supportability of the materiel solutions. These products are also used through the materiel solution development, RA/D/B's build portion (Process Steps 6 and 7), and to inform the PT&E sub-process within the broader SE process.

The SE process includes analyses of existing C2 capabilities (both GCCS FoS and others) in Process Step 12 to support an ABC decision as well as transition planning for NECC capabilities. The results of these analyses are documented and maintained in a Catalog of Capabilities (see subsection 3.6 below) that is used in the materiel solution decision activity, then in subsequent transition planning (Process Step 13) as NECC capabilities subsume or replace existing portfolio capabilities. Joint/Services implementation guidance on deployment, operations, support, and training originate from the Implementation WG (Process Step 14) as part of the Operations and Support sub-process and are used throughout the spirals.

There are several important NECC SE process tenets.

- Increment-specific architecture and design requirements provide the top-down SE guidance necessary for effective, rapid development and deployment of individual CMs.
- Early and frequent Warfighter involvement in shaping CMs to meet their needs from CM selection through development and integration leads to successful certification and deployment. Warfighters address integration and other implementation items in addition to functionality.
- Individual CM development provides the opportunity to rapidly learn and adapt to technology advancements, changing Warfighter requirements, or address unforeseen development challenges.
- Existing GCCS FoS and other C2 systems provide, as part of the ABC decision activity, a clearer understanding of the cost, schedule, risk, and performance implications.
- Spiral capability development, which occur a number of times within an increment, permits a continual stream of feedback information to ongoing and future spirals.

Although Figure 13 depicts a single pass through a NECC Capability Development Spiral, it is important to note that, within an increment, there will be a number of concurrent NECC Capability Development Spirals in progress at any given time. These concurrent spirals represent opportunities to learn, adapt, and share lessons learned from the overall SE process and piloting/testing efforts in near real-time across the spirals. These closely spaced spirals offer a nearly continuous opportunity for inclusion of emerging Warfighter requirements. At the same time, concurrent spirals present technical and programmatic management challenges to coordinate, resource, and resolve issues, which are recognized in the Section 4 governance and roles/responsibility discussion. Based on a notional JCCD CDP development schedule for Increment 1, there could be up to 25 NECC Capability Development Spirals paced approximately six weeks apart.

Figure 14 shows an example of three concurrent spirals, which exhibits the SE process sequencing and their responsible JPMO and CPMO organizations.

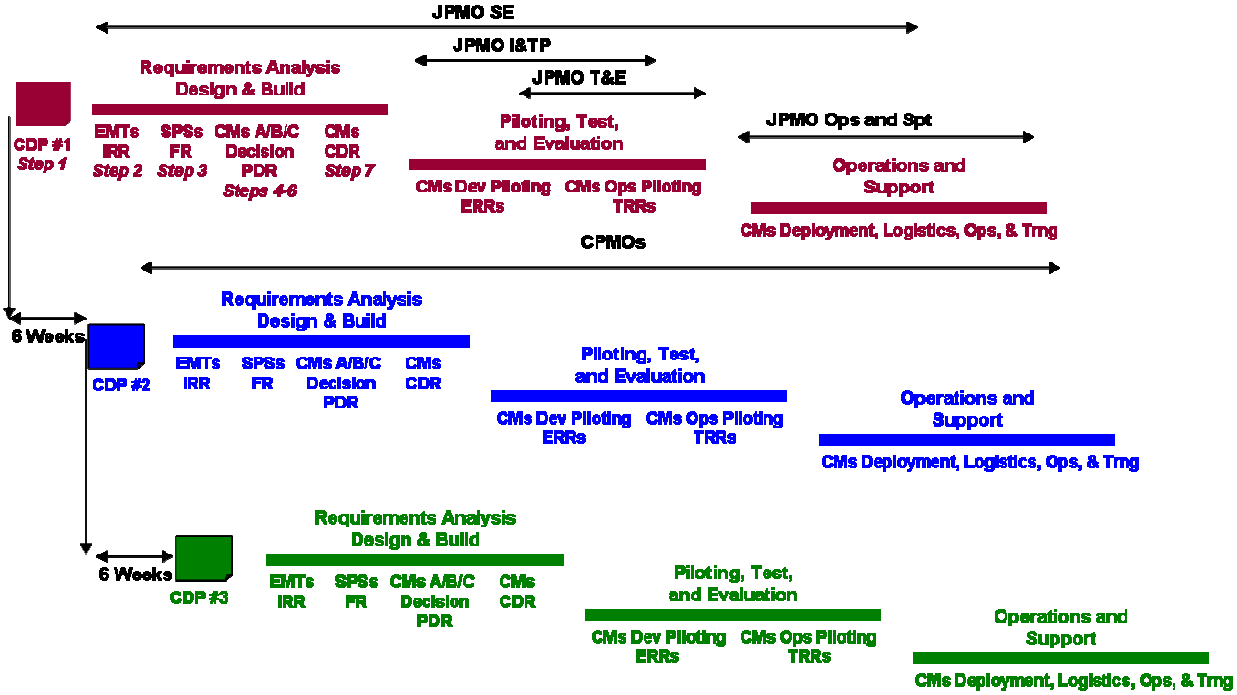


Figure 14: Concurrent NECC Capability Development Spirals within an Increment

The staggered but continuous nature of CDP development enables constant feedback to improve subsequent products while sustaining a level workload for the resources to retain the knowledge base of skilled staff. The learning, adaptation, and lessons learned benefits stated previously become obvious in this example. NECC is anticipating a learning curve effect as the program becomes more experienced with the SE process. Eventually, it will move towards a steady-state continuous output of C2 capabilities in sync with Warfighter needs. Cooperation and collaboration between the JPMO/CPMOs/Testing/Certification communities helps execute effective NECC Capability Development Spirals. Section 3 (process) and Section 4 (governance) establishes the framework for that cooperation and collaboration.

3.1 Requirements Analysis, Design, and Build Sub-Process

The RA/D/B sub-process addresses (1) defining increment-specific architecture and technical standards, (2) mapping increment-specific operational requirements into functional requirements, (3) assessing the suitability of leveraging/exploiting current GCCS FoS and other C2 capabilities in the specific increment, and (4) designing and performing the initial build of NECC CMs. [back to section 2.4]

3.1.1 JCCD Capability Needs Definition (Process Step 1)

NECC JCCD Capability Needs Definition activity (Process Step 1) begins the NECC Capability Development Spiral by developing a CDP to more fully describe or decompose CDD capability needs. A CDP is the product of the JCCD Capability Needs activity that further refines the capabilities with definitions and performance parameters. It provides operational context via use

case narratives and selected DoDAF architecture views necessary for materiel developers to begin the systems engineering process. The CDP consists of (1) a process definition of a capability in terms of activities, operational nodes, and information exchanges described in Operational Views (OVs); (2) tables of stated and derived requirements; and (3) use case narratives.

Each CDP focuses on a small subset of the overall NECC capability and provides the operational context for that subset. A CDP, in addition to stating operational concepts and processes, contains performance and quality attributes, which further define the required capabilities (or mission specific objectives). This will allow the NECC JPMO to define, develop, and implement limited scope materiel solutions to support the needs defined in the CDPs in a timely and continuous fashion.

The NECC Warfighting sponsor (USJFCOM JCCD) uses the CDD, Joint Capability Areas (JCA), and other Joint doctrine sources as well as direct inputs from the COCOMs and Service Warfighter SMEs to develop the CDPs. In addition, the JPMO CDP engineering team and JCCD engage in continuous technical coordination during CDP development to ensure critical attributes of the capability contain sufficient detail. Each of the capabilities called out in the CDPs will have associated specifications required for developing materiel solutions that support Warfighters' mission processes in Process Step 3 of the RA/D/B sub-process.

Upon completing an initial CDP draft, the JCCD coordinates with the Joint Staff, COCOMs, and Services prior to USJFCOM's approval of the CDP. As each CDP is released, the NECC System Engineering team begins to further refine and decompose the CDP in the next steps of the SE process (see the Mission Process Engineering activity description, Process Step 2).

In executing Process Step 1, the JCCD (as the Warfighter advocate) must carefully balance at least three competing sources of requirements: emerging Warfighter operational needs, documented CDD requirements, and transitioning of GCCS FoS capabilities. For example, if emerging operational needs are over-emphasized, then CDD requirements and FoS transition will suffer. Such an imbalance may introduce baseline and schedule instability, and requirements growth. To properly balance these competing requirements sources, Process Step 1 will explicitly evaluate new operational requirements against CDD requirements and transitioning GCCS FoS capability.

3.1.2 Mission Process Engineering (Process Step 2)

The NECC Mission Process Engineering activity (Process Step 2) objective is to describe a CDP activity flow in a set of derived EMTs. The product of Process Step 2 (an EMT) is a detailed description of the *user's* process, not a description of the materiel solution that enables the user's process. An EMT is an unambiguous description of a Warfighter's C2 business process required to achieve a specific mission objective. A joint team of JPMO systems engineers, architects, testers, integrators, piloting staff, CPMO systems engineers and JCCD representatives (to include Warfighter SMEs) develops the EMTs. The threads use a Business Process Modeling Notation (BPMN) to depict process flow and use cases to describe activities and actors as well as information inputs, outputs, and triggering events. An EMT may include requirements for both the materiel solution as well as non-materiel elements (e.g., DOTMLPF-P).

As part of the NECC design effort, an EMT has functional and performance requirements allocated across specific activities. These C2 requirements are tailored to meet specific mission

objectives or needs and are systematically guided by the NECC Architecture Framework. The EMTs and architecture products are continuously integrated activities given the mutual dependency between architecture and the detailing of the design by the JPMO systems engineers.

In Process Step 2, EMTs and C2 requirements provide the technical details needed to perform functional analysis that results in identifying both singularized service functions and performance requirements. The SE process builds on EMTs and other requirements to identify cross-functional or core services early in an increment. Additionally, integration, piloting, test, and evaluation participants use EMTs to define functional and performance objectives, and the business (user) process steps to create relevant evaluation scenarios for the full suite of testing.

The JPMO Chief Engineer (CE) approves EMTs, which becomes part of the configuration controlled NECC Requirements Baseline as discussed in Section 2. EMTs will be used to support testing and developing training CONOPS and Tactics, Techniques, and Procedures (TTP) throughout the NECC lifecycle. Once created, an EMT will be preserved in a repository of EMTs for later reference and re-use. The Technical Baselines, which contain the requirements that formed the basis for EMTs, are maintained to reflect changes in the evolving NECC design. An Increment Requirements Review (IRR) will occur at the end of Process Step 2. See subsection 4.4.3 below for more detail on entrance and exit criteria for the IRR, as well as participants. As the NECC operational sponsor, USJFCOM should concur that the EMTs developed in this step are ready to progress in the process to Functional Analysis and Design Engineering.

3.1.3 Functional Analysis and Design Engineering (Process Step 3)

The NECC Functional Analysis and Design Engineering activity (Process Step 3) objective is to define the functional services and their associated performance requirements that support the activities called out in the EMTs (in Process Step 2).

The JPMO systems engineers decompose EMTs into a comprehensive set of functional descriptions that represent the services and execution flows required to support the Warfighters' business processes. Service functional descriptions are analyzed and derived further into singularized services and associated functional capabilities and performance characteristics. Architectural guidance and domain specific design guidance from Process Steps 10 and 11, including requirements for supporting DIL conditions if appropriate, again influence the development of Process Step 3 products. Functional analysis efforts could reveal that a single service supports more than one EMT, or that several individual services are duplicative and may be replaced by a single service. In Process Step 11, domain specific design implications are also considered. Once these analysis efforts are completed, an individual service's functional capabilities and performance requirements are developed and documented in a SPS.

SPSs are the specifications against which a CPM develops a candidate CM. In addition to the service functional capabilities and performance requirements, the SPS contains interface requirements; the increment's relevant physical, software, data, security, and technical operations requirements; and Joint/Services implementation requirements. Once the JPMO CE approves the SPS, it becomes part of the NECC's Functional Baseline for the increment.

As an example, Figure 15 is a notional high-level representation of Process Steps 1, 2, & 3 activities. It shows requirements traceability from a CDP to EMTs and SPSs. For example, in the box labeled EMT 1-1, the first number indicates that this EMT is associated with CDP#1

Situation Awareness, which includes a Blue Force Location (BFL) capability, and the second number indicates that this EMT is one of three EMTs associated with the BFL capability. For another example, in the box labeled SPS 1/1-1, the 1/1 indicates that this SPS is derived from EMT 1-1 and is tagged as service #1. Additionally, the italicized *SPS 1/1-1* notation indicates that this individual service is used in more than one EMT (in this example, it is also used for EMT 3-1).

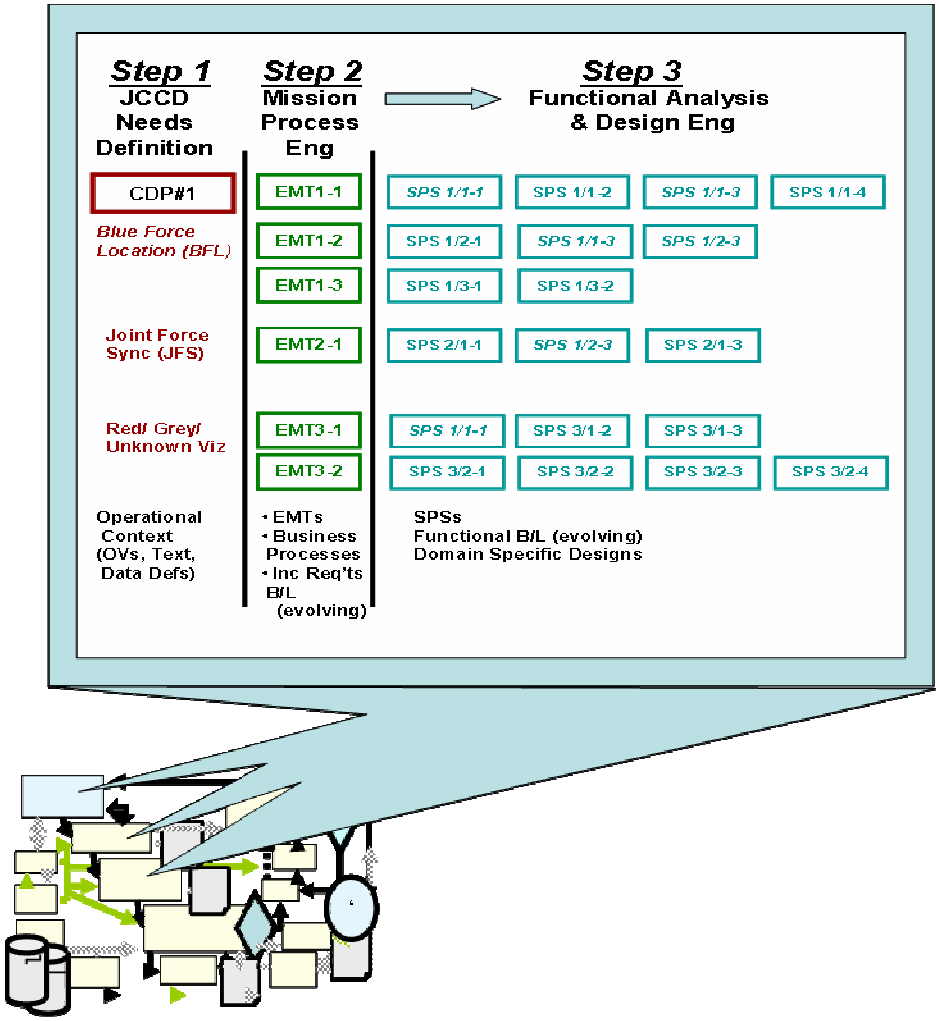


Figure 15: Notional Representation of Work Efforts within Process Steps 1-3

3.1.4 Allocated Baseline Engineering (Process Step 4)

The NECC Allocated Baseline Engineering activity (Process Step 4) objective is to allocate functional and performance requirements into best-value materiel solutions (CMs) based on an ABC decision by the JPMO. Requirements traceability from the CDP through the EMT to the SPS is maintained through this allocation approach. Process Step 4 (See Figure 16) is equivalent to an "Initiate Selection – Response – Developer Selection" decision conducted within the NECC program. This begins with Process Steps 4A and 4B in which a candidate work package is generated with the information necessary for a CPM to understand the its scope. In Process Step 4C, a CPM responds to the JPMO with more detailed information, including a proposed

CM design, cost, and schedule. This response is evaluated (Process Steps 4D and 4E) and results in two decisions: a candidate materiel solution is selected and a source selection decision (Process Steps 4F and 4G).

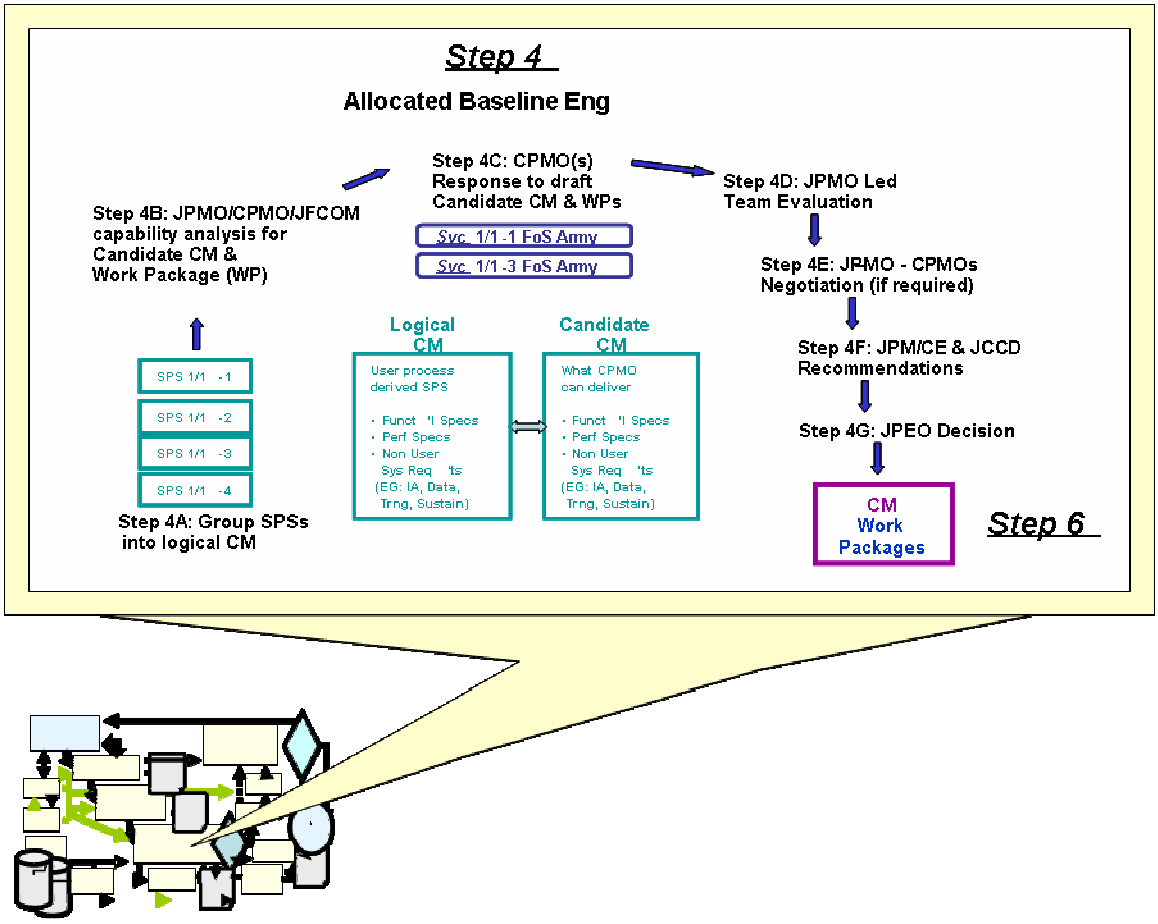


Figure 16: Allocated Baseline Engineering (Process Step 4)

3.1.4.1 Initiate Selection (Process Steps 4A and 4B)

Process Step 4 begins with the JPMO assigning Process Step 3 SPSs to logical CMs (see subsection 3.1.3) based on similarities amongst the SPSs. Next, the JPMO, with support from appropriate CPMOs, USJFCOM, and SMEs, takes a logical CM and compares it against available materiel solutions from NECC's repository of C2 systems (developed from GCCS FoS) and other relevant systems, Advanced Concept (AC) /JCTD, and other C2 PORs. Relevant C2 solutions are analyzed for their suitability to the logical CM's SPSs, including additional performance growth if required, to meet the CM's SPSs. The analysis will include risk assessment and may include a "hands on demonstration" of the proposed solution. The analysis includes understanding the interfaces and dependencies of the proposed CM (and maturity of these dependencies) to evaluate the risk and complexity in meeting the operational requirements. This analysis requires collaboration between the JPMO, CPMOs, and JCCD to determine the best CM solutions from a technical, cost, schedule, and programmatic perspective. This analysis produces a candidate materiel solution CM with a preliminary assessment of compliance with increment architecture and domain specific design requirements (see Figure 17). It also produces

an understanding of related EMT(s) interoperability and implementation compatibility. Based on the analysis, the JPMO-led team generates a draft work package containing the necessary information that defines the JPMO's expectations for development, certification, and deployment activities associated with Process Steps 7, 8, and 9. The JPMO-led team will also incorporate certification requirements and test verification criteria in the work package. JPMO then forwards the candidate CM, draft work package, and required response information to the CPMO to whom the CM was assigned (or lead CPMO for CMs requiring more than one CPMO to perform development). The previously established Management Allocated Baseline provides a starting point for identifying the cognizant CPMO. However, deliberations during Process Steps 4A and 4B may result in adjustments to the participating CPMO(s) based upon alignment with materiel approaches and subsequent agreements with associated changes to the Management Allocated Baseline.

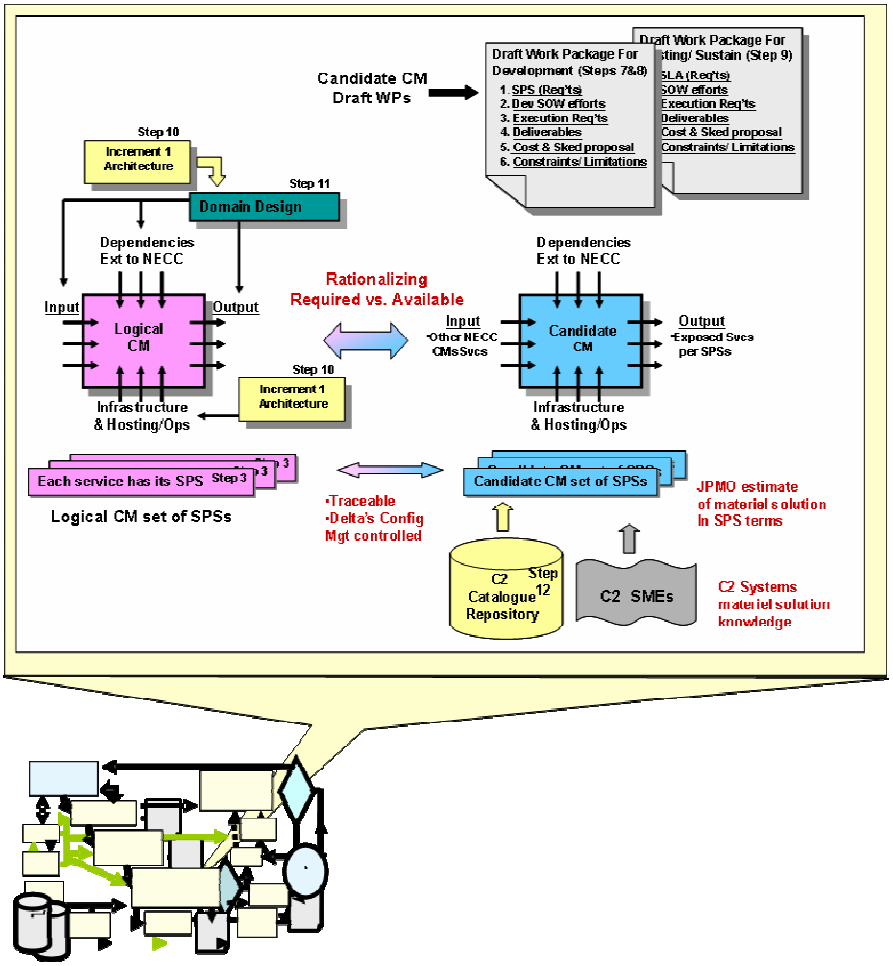


Figure 17: Candidate CM Definition Process Steps

3.1.4.2 Response (Process Step 4C)

Based on an agreed-to CM allocation, the JPM will forward the candidate CM and its draft work package to the appropriate CPMO(s). Required response information for a materiel solution description includes design information, changes to the SPSs (if required), development and piloting plan, hosting/deployment plan, work package changes, cost and schedule proposal, CM

materiel development team, risks, and assumptions/constraints/limitations. The CPMO conducts required engineering and programmatic analysis to provide a refined materiel solution response to include the information that the JPMO requested.

3.1.4.3 Evaluation (Process Step 4D and 4E)

The JPMO evaluates the response with assistance from JCCD (for the Warfighter perspective) and SMEs. Factors to be evaluated include alignment with meeting priority Joint capabilities; potential interoperability risks; proposed performance against the requirements (SPS); materiel solution maturity; compliance to increment-specific architecture standards; CM developer team capabilities and past performance; and cost, schedule, and risk assessments. The evaluation team will make a recommendation to the JPM if negotiations are required to resolve uncertainties that arose from the team's evaluation. The JPMO evaluation team forwards its evaluation report to the JPM and NECC CE for their consideration.

3.1.4.4 Selection Decision (Process Steps 4F and 4G)

The Process Step 4 team (including representatives from the JPMO, CPMOs, and the JCCD) develop their recommendations based on factors including Preliminary Design Review (PDR) results, business considerations, operational considerations, lifecycle affordability, tier partnerships, and others. Their recommendations are reviewed and approved by the JPM and CE prior to forwarding them to the JPEO who makes the ABC decision. The selected CM, its relevant technical information, and developer are then added to the configuration controlled NECC Allocated Baseline. The JPEO, in conjunction with the CPMs, then announces the selection to the NECC community. As CMs are selected, relevant technical information is added to the PDR for the overall increment. This enables the NECC program to monitor the increment's overall development status by using the sum of the CM development statuses, and to update the Catalog of Capabilities with information to reflect the selection or retirement of capabilities resident in the current GCCS FoS.

3.1.4.5 Additional information

For Increment 1, the program anticipates that the "Adopt" decision (leveraging existing materiel solutions primarily from the GCCS FoS) will be the predominate decision coming out of Process Step 4. This condition results in a number of Increment 1 NECC Capability Development Spirals that have a predetermined materiel solution. As a result, this simplifies the selection process steps. In those cases where there is a predetermined materiel solution, the JPMO proceeds directly to preparing the request for a response package and forwards it to the CPM who is the materiel developer of that predetermined capability.

A candidate materiel solution may not completely meet a CM's functional and performance specifications as stated in its SPS, but it may still have significant military utility for the Warfighter. For example, assume that a logical CM SPS requires the ability to handle 100,000 Blue Force tracks, but the CPM's proposed materiel solution can presently handle only 60,000 tracks. Given sufficient time and funding, the CPM can scale up to 100,000 tracks so the CPM's proposed materiel solution is a viable candidate even though it does not immediately satisfy the SPS requirements. An additional example might be one in which compliance with architecture guidance must be traded against cost, schedule, and performance. In cases where the proposed materiel solution does not completely satisfy the SPS, USJFCOM will evaluate the proposed

materiel solution from a Warfighter acceptance perspective. JPM/CE and USJFCOM will jointly make a decision about a materiel solution based on acceptable cost, schedule, and performance. Then reconciliation occurs between the required SPS and the delivered capability. The reconciliation outcome is captured in a configuration controlled SPS deviation/waiver that documents any variance between the SPS and the delivered capability, thus preserving traceability back to the EMT and CDP. The NECC CCB shall approve the deviations/waivers.

Additional procedural details necessary for internal execution of Process Step 4 activities will be documented in a Process Step 4 Standard Operating Procedure (SOP) as a working annex to the SEP.

3.1.5 Cross CDP Functional Analysis (Process Step 5)

The NECC Cross CDP Functional Analysis activity (Process Step 5) will analyze the results of the Functional Analysis and Design Engineering activity as well as the architecture and design specification activities for potentially common functions (CMs and/or software services) that could be used to support multiple mission-specific capabilities (i.e., CDPs). The purpose of the Cross CDP Functional Analysis activity is to define new CMs or refine previously defined CM and service specifications to provide reuse of support functionality as required in multiple mission areas.

The NECC SE process addresses two general capability types: direct Warfighter C2 capabilities and supporting architecture-derived core capabilities, such as C2 collaboration and analysis and reporting. Since the SE process is designed to provide a continuous stream of capabilities, it is likely that services defined for an earlier CM will be applicable to a subsequent capability development effort. Likewise, the technical knowledge gained in functional analysis (Process Step 3) and materiel solution selection (Process Step 4) activities could improve future SPS development efforts or identify a need for the developing common services for use by multiple CMs.

A JPMO led cross-functional SE team will use the EMTs and SPSs resulting from the Mission Process Engineering activity (Process Step 2), the Functional Analysis and Design Engineering activity (Process Step 3), and architecture and design specifications to perform assessments which are then fed back to Process Steps 3 and 4 activities. The result of this feedback could be in the form of additional CM definitions, SPSs, or recommendations for modification to existing CMs or SPSs. The specifications and recommendations resulting from this Cross CDP Functional Analysis activity must be reviewed by the Architecture Working Group and approved by the NECC CE via the Engineering Review Board (ERB).

The timely and continuous feedback of critical information will reduce development efforts, enhance interoperability, and facilitate service reuse. The JPMO cross-functional team may revise specific SPSs to provide more generalized capability that can be designated as core services for all or a subset of NECC capabilities. This analysis is performed under the direction of the JPMO (systems engineering) with inputs from JCCD and SMEs as determined by the NECC Lead Systems Engineer.

3.1.6 Work Package Development (Process Step 6)

The NECC Work Package Development activity (Process Step 6) objective takes the CM decision from Process Step 4 and establishes a contractual Statement of Work (SOW) required

for delivering and supporting the CM. (Note that a draft work package is created in Process Step 4; the draft work package is finalized as an output of Process Step 6.) The work packages will be structured to reflect the activities and roles appropriate to the designated CM Partnership Tier as described in subsection 2.8 above. Following a Process Step 4 CM decision, the selected CPM and the JPM will construct two work packages: (1) one for development including piloting, test, and evaluation; and (2) a second one for hosting, operations, and support (see Figure 18).

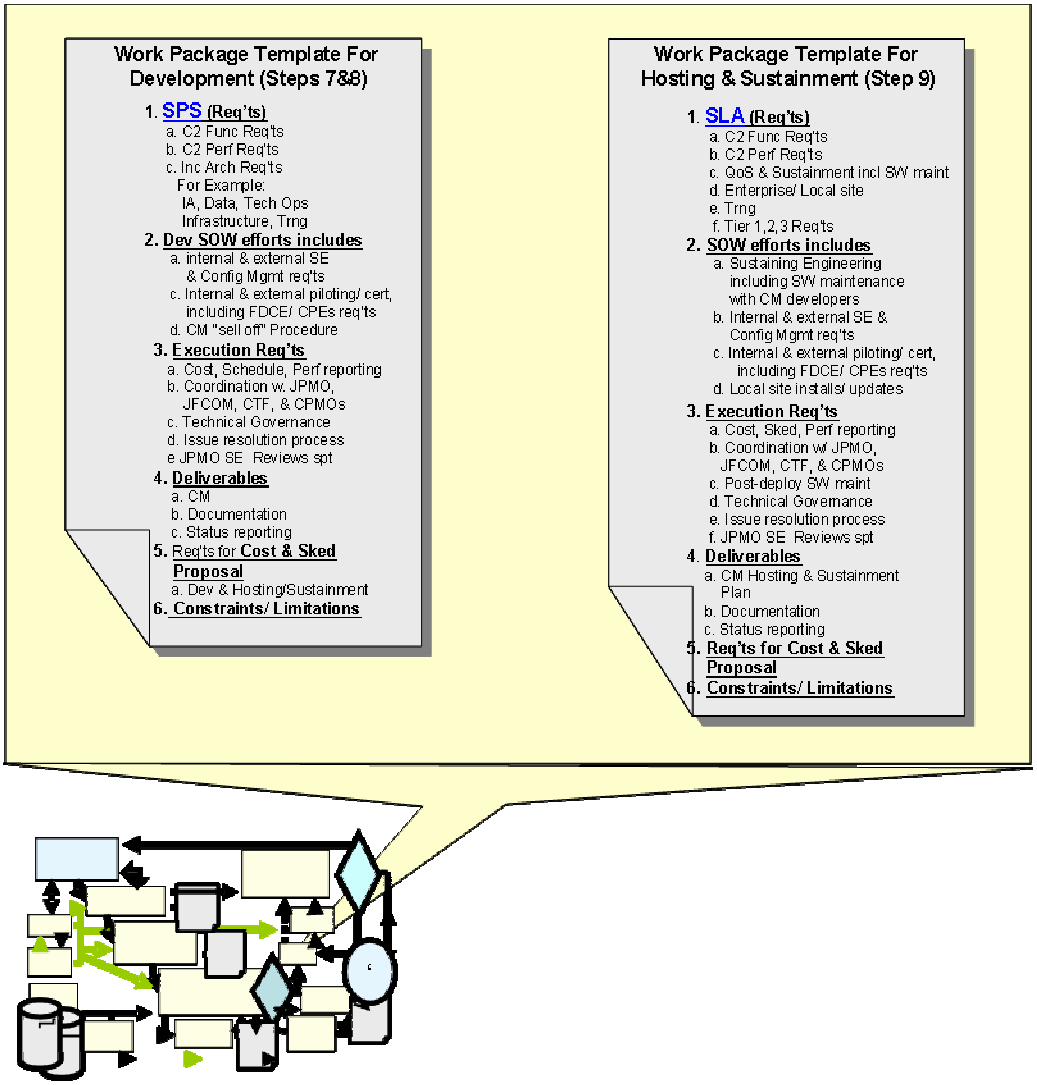


Figure 18: Work Package Template for Hosting, Operations, and Support (Process Step 9)

The work package for Hosting, Operations, and Support may be negotiated later in the process as appropriate to hosting, operations, and sustainment decisions that are made during development. For a given CM, the work package for Hosting, Operations, and Support (Process Step 9) may be assigned to a different CPM than was assigned the development work package (Process Steps 7 and 8).

A CM development work package's scope varies based on whether the required materiel solution SPS is a modification of an existing materiel solution (Adopt decision); a procurement of an

existing Commercial-Off-The-Shelf (COTS)/Government-Off-The-Shelf (GOTS) capability (Buy decision); or a new capability (Create decision). For example, a CM that reuses an existing capability (or a slight modification of an existing capability), may proceed directly to the PT&E sub-process for integration and certification. Work packages created in this step will address cost, schedule, performance requirements; compliance and technical guidance standards; and shared resource coordination. The CPMO and JPMO staff may merge work packages for multiple capabilities to reduce redundant efforts.

Two key materiel developers management elements included in each work package are Earned Value Management (EVM) requirements and contract management requirements. The requirement for EVM execution and reporting are part of a work package's Execution Requirements and Deliverable tasks as depicted in Figure 18. Contract management requirements are included in a work package SOW, Execution, and Deliverables tasks. The CPMs, in executing a CM work package, will include EVM and contract management requirements in their industry materiel developers' contracts/task orders. JPMO Program Control, who has overall NECC EVM and contract management responsibility, will provide these requirements for Process Step 6 work package development. These program control measures will be tracked and aggregated to fulfill the needs of the various oversight stakeholders.

Consideration of a CM's hosting environment, such as bandwidth limitations, could affect a materiel solution's delivered performance against its stated requirements (SPS). This is a recognized occurrence in the commercial world, which led to the use of SLAs that contractually formalizes the customer's performance expectations (the "What") without prescribing how the service is to be provided (the "How"). Warfighters have a similar need to understand the guaranteed delivered performance of a capability. The SE process leverages the commercial world's SLA construct by quantifying a CM's delivered capability performance required by a hosting organization into a NECC SLA. The SLA is then maintained under configuration management control, thereby, ensuring requirements traceability from the SLA through the SPS to the EMT/CDP.

The JPMO CE recommends work packages while the JPM and CPM sign off to accept the recommendation. A work package represents the "contract" between two Government entities. Variations to a work package are treated as a change order, require NECC CCB approval, and will be maintained through NECC change control procedures.

3.1.7 Initial CM Development (Process Step 7)

The NECC Initial CMs Development activity (Process Step 7) objective is to engineer a materiel solution against the set of performance specifications and requirements stated in the work package (from Process Step 6). The CPM, through the Component's contracting organization, acquires industry partners (materiel developers) to develop, integrate, test, and deliver a CM ready for developmental/operational piloting and certification activities. The output of Process Step 7 is a CM that meets its SPS, fulfills the terms of the work package, and contains the associated data package to include the results of technical evaluations. The CM may also have approved and documented SPS deviations/waivers as discussed in subsection 3.1.4. Process Step 7 is complete when a selected CM meets the criteria in the tailored CM TEC Criteria for graduating to the Developmental Piloting stage. As such, Process Step 7 corresponds to the

FDCE Development Stage. This stage uses a variety of piloting and self-certification mechanisms, as described in the TEMP, to demonstrate compliance with TEC Criteria.

Process Step 7 represents considerable engineering efforts for a CPM to undertake. It requires analysis and decomposition of SPS requirements for assignment to selected industry materiel developers; a design effort leading to a CM Critical Design Review (CDR); development, integration, and test of the individual services that comprise the CM; and subsequent integration and test of the CM's services against the stated SPS requirements in relevant technical and operational environments. In Process Step 7, design activity continues to inform and refine the relevant domain-specific design through feedback from ongoing analysis, interaction with Warfighters and other DOTMLPF-P stakeholders, and piloting activities. Development may continue through testing, because integration and test activities could reveal deficiencies within a CM requiring resolution before proceeding into the PT&E sub-process. Development also includes effort required to meet Developmental and Operational Piloting entrance criteria, participate and assess Piloting and Integration events, and incorporate required software changes into the CM that result from piloting efforts. In short, for a CM that decomposes into a number of services, Process Step 7 represents a microcosm of most, if not all, of the activities in the overall NECC SE process. Managing CM development can be a significant effort, which will vary according to the needs of a particular CM.

Figure 19 represents a notional Army CPM-developed capability that provides Blue Force data services through two materiel solution services from the GCCS-Army FoS, labeled "Svc 1/1-1 FoS Army" and "Svc 1/1-3 FoS Army." The "Svc 1/1-1" notation provides traceability to the SPS tagged as SPS 1/1-1. The annotation "exposed service point" is a discoverable, observable, and measurable web interface that establishes where a CM's performance is tested. This Blue Force capability requires two services to satisfy its assigned SPSs. Each service undergoes its own development effort that, when integrated with the other service, provides the functional and performance capabilities required.

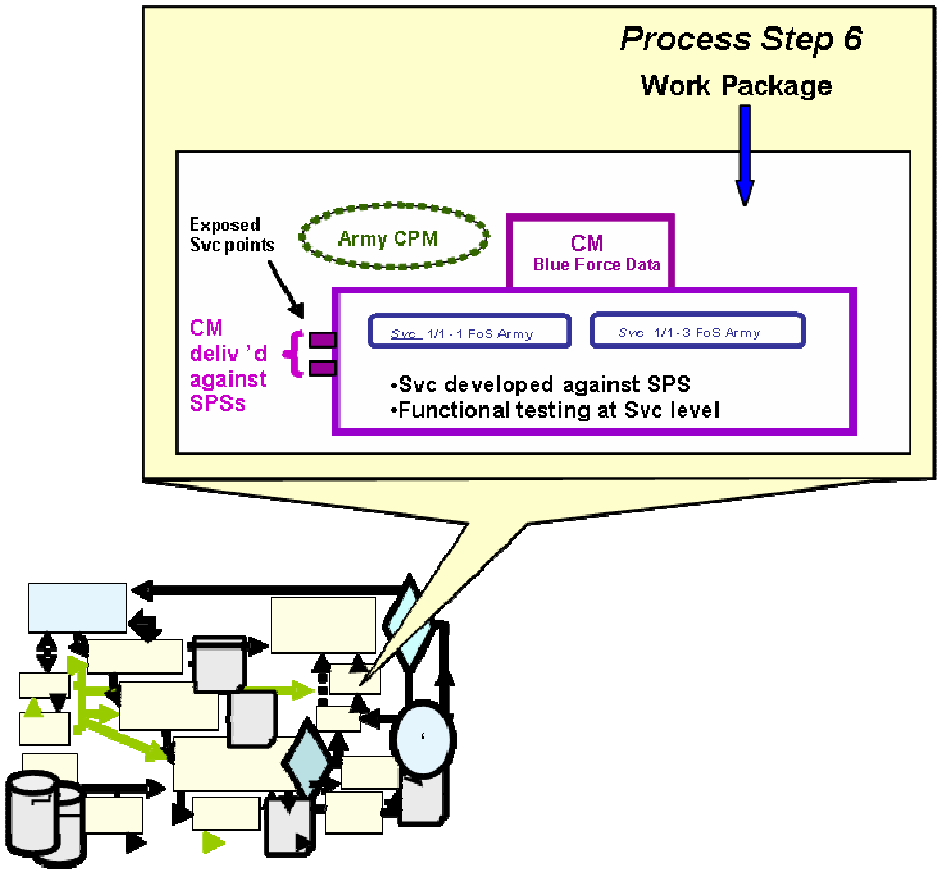


Figure 19: CM Development Overview (Process Step 7)

The CPM, with support from industry materiel developers, maintains information about the capability in the FDCE, coordinates service access with other NECC CPMs and external service providers, performs the required development tests, and interacts with other developers and CPMs as required. While the CM is in development, including piloting activities, the CPM's materiel developers interact with the CPMO, JPMO, I&TP, T&E, and Configuration Management staff as part of Process Step 7 and PT&E integration and test activities.

CM developers have three enablers that aid in producing a product that meets needed capabilities. The first enabler is to use Warfighters to aid in evaluating capabilities early and often throughout the development and piloting maturity stages. Developers are encouraged to use the piloting technique known as UFP to allow Warfighters access to CMs and to provide quantitative and qualitative feedback to developers. The JPMO's I&TP staff will aid in planning, executing, and administering UFP events. The second enabler is the FDCE, which provides test processes and relevant test environments, and access to dependent services and other CMs to allow evaluation of individual CMs in a system context. These two enablers create a continuous learn-and-adapt atmosphere for producing capabilities useful to the Warfighter in a responsive manner. A final enabler is the feedback/lessons learned from individual developments that are made available to the general developer community through the FDCE.

Figure 20 provides a notional representation of several different CMs. CM #1 illustrates where a single materiel solution service, Svc 1/1-2 FoS DISA, satisfies two SPSs. CM #2 illustrates where a number of services are required to satisfy the assigned SPS with several of the services coming from Advanced Concept Technology Demonstration (ACTD) programs and one service is a new development. CM #3 illustrates where one service satisfies three SPSs.

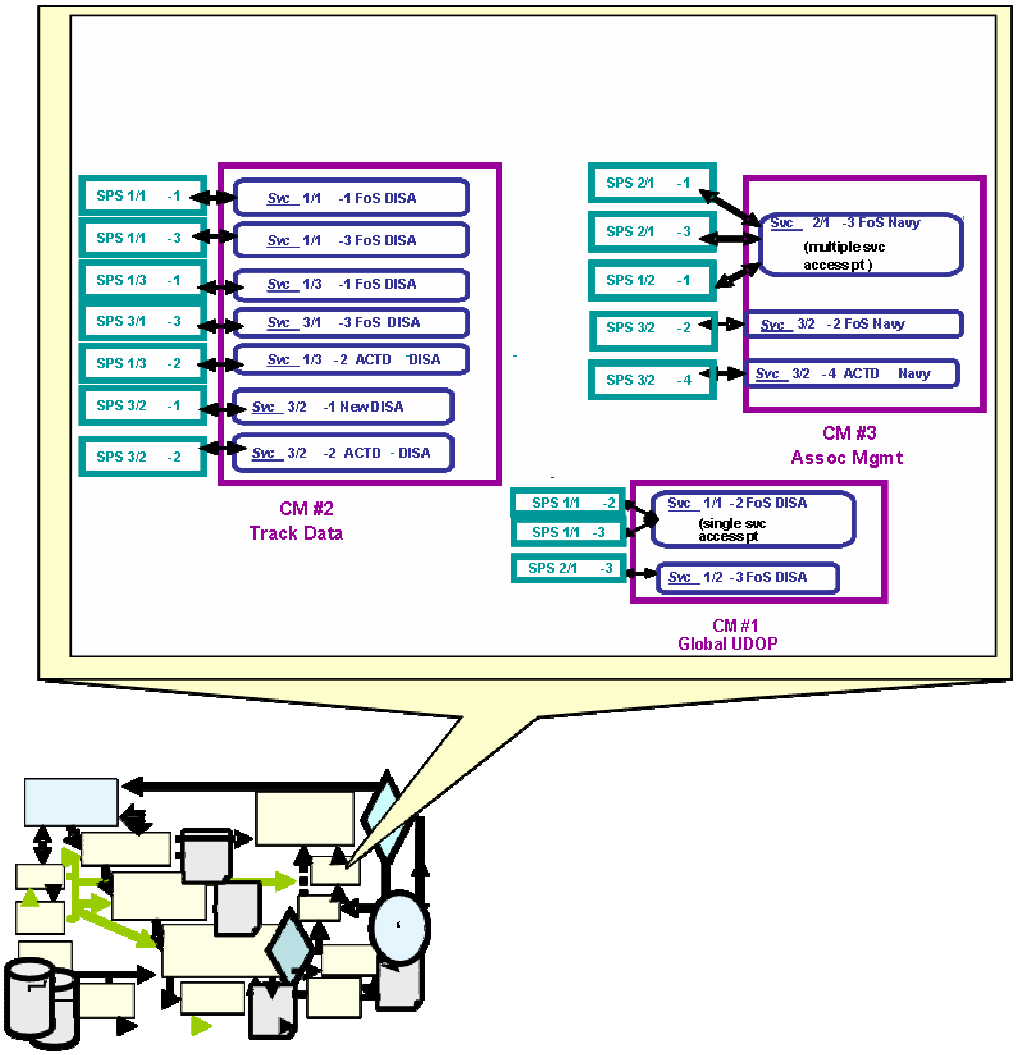


Figure 20: Notional CM Development Examples

Note that a Process Step 4 JPEO decision could result in a CM materiel solution that possesses a level of maturity that warrants "bypassing" Process Step 7 and proceeding directly to the PT&E sub-process.

Additional procedural details necessary for internal execution of Process Step 7 activities will be documented in a SOP developed by each CPMO and submitted as a working annex to the SEP.

3.2 Piloting, Test, and Evaluation Sub-Process (Process Step 8)

The purpose of the PT&E sub-process is to support maturing CMs through the three FDCE maturity stages in order to achieve certification for NETOPS on the GIG. This is accomplished through a tailored mix of testing and piloting events that collectively provides the information to support an individual CM's advancement through the maturation stages and subsequent deployment decisions. Figure 21 shows an overview of the PT&E sub-process.

PT&E operates as follows: (1) CMs enter the Development Stage (as minimally mature capabilities) during Process Step 7. In this stage, CMs are evaluated and integrated, which leads to a certification as ready for Developmental Piloting. (2) CMs then progress through the Developmental Piloting Stage (technically mature capabilities) leading to certification as ready for Operational Piloting. Finally, (3) CMs in the Operational Piloting Stage (operationally mature capabilities) are assessed to support a decision to certify as ready for NETOPS. The PT&E sub-process evaluates and certifies individual CMs as they are delivered based on their respective CM TEC Criteria. This sub-process also enables rapid re-evaluation of CMs when Warfighter requirements change as part of the evolving technical baseline. The PT&E sub-process ensures each product is assessed against relevant technical and operational requirements and delivers continuous streams of Warfighter capabilities. Process Step 8 activities develop test and piloting scenarios that are informed by design information from Process Steps 2, 3, and 4. As a result, these scenarios will likely trigger a Process Step 7 corrective action under a Test, Analyze, Fix, and Test (TAFT) approach.

An essential element in PT&E assessment is the traceability of piloting events back to Warfighter and architectural requirements. Piloting events leverage EMTs and their associated use cases as one source for generating test cases. These test cases form the basis for CPAS scenarios against which CMs are exercised and tested from several perspectives. Some of these include performance, usability, interoperability, satisfaction of stated CDP requirements, and suitability for lifecycle operations and support. A CM is tested and certified in the context of the EMT(s) that it is designed to support. It is also consistent with the appropriate operational business model(s). The scheduling for EMT testing will have to consider the maturity of the applicable contributing CMs. It is highly likely that a CM will be certified for use in a number of EMTs associated with one or more CDPs.

Each of the three FDCE maturity stages has an internal PT&E sub-process, as shown in Figure 21, and uses piloting and testing to evaluate performance and integration characteristics of CMs with the results assessed, analyzed, and provided to support decisions for advancing to the next maturity stage. This is repeated for each maturity stage, is iterative and in a closed-loop for feedback, and stays within the stage until the CM has met the final criteria necessary for graduation to the next FDCE stage.

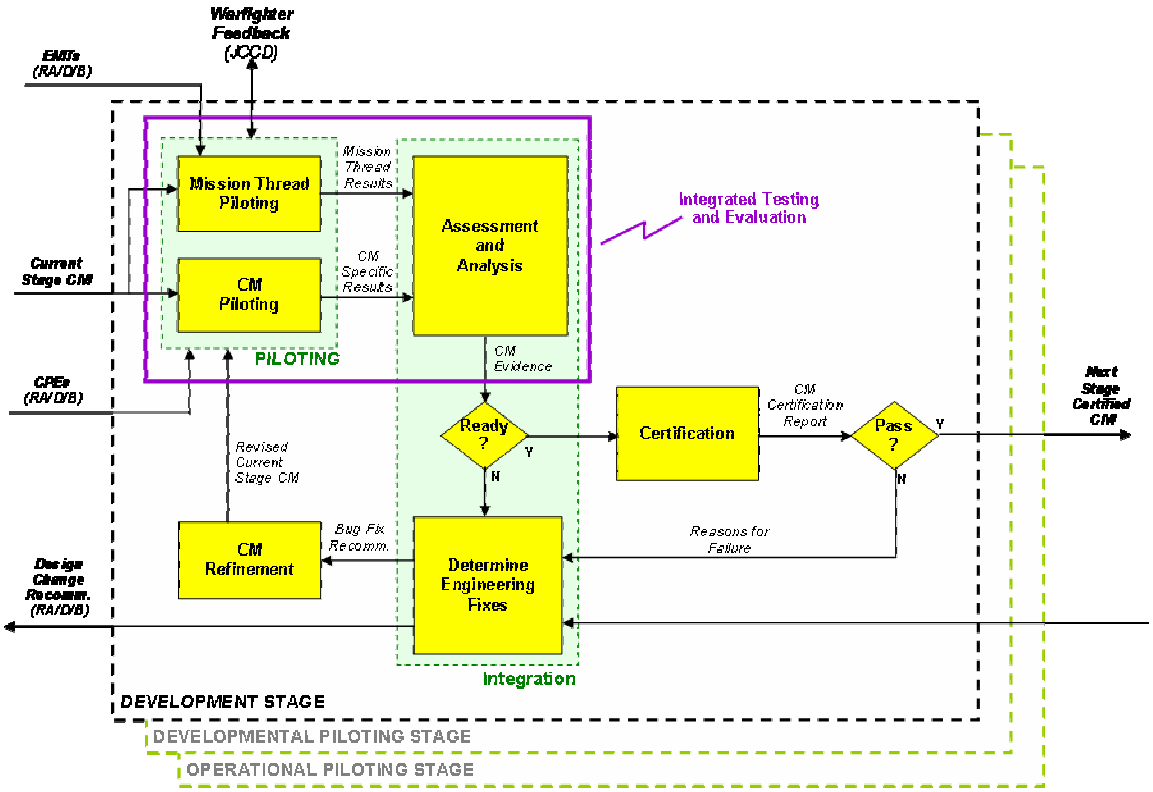


Figure 21: Piloting, Test, and Evaluation Sub-Process

The PT&E sub-process measures actual capability performance against the requirements defined in the CM TEC Criteria, which reflect required technical and functional elements of relevant KPPs as well as technical and functional requirements associated with Domain Specific Design and SPSs. Although KPPs are assigned to each major increment, performance is measured against individual CMs and groups of CMs performing in a particular mission context. Critical Operational Issues, Measures of Performance (MOP), Measures of Effectiveness (MOE), and Measures of Suitability (MOS) are established at an increment's top level (the CDP and EMT). Their corresponding derivative measures (e.g., additional issues) will cascade down to individual CMs as necessary. As CMs mature through the FDCE stages, their individual and group contributions to the increment's MOPs/MOEs are calculated and aggregated to form the program's overall status against the KPP threshold/objective values. The JPMO conducts compliance assessments with each evaluation against an EMT, and resolve overall compliance upon completion of all EMTs in a given CDP. Additional procedural details necessary for internal execution of Process Step 8 activities will be documented in a SOP.

3.2.1 Piloting

The primary means of evaluation and assessment throughout the PT&E sub-process is piloting. In NECC, piloting makes capabilities available to the NECC community for experimentation, testing, and evaluation. Piloting is an evaluation technique used to enhance traditional testing and verification activities as well as a method to evaluate architecture and design considerations.

It is important to note that although these activities are done primarily in the PT&E sub-process, it is possible to conduct piloting events during CM initial development (Process Step 7) if a CPMO desires piloting-type feedback.

There are three types of piloting events.

- **User Free Play** events are a type of piloting activity where individual Warfighters, requirements/doctrine providers, and other stakeholders use the FDCE to evaluate CMs through loosely structured free play. Details are contained in the UFP SOP.
- **Capability Provisioning Events** are a type of piloting activity that primarily focuses on technical and operational test and evaluation of new capabilities. The objective of CPEs is to clearly articulate assessment objectives and collect quantitative and qualitative data that support evaluation of these objectives. Details are contained in the CPE SOP.
- **Operational Concept Experiment/Event** is a piloting activity focused primarily on evaluating new operational concepts and capabilities. These events allow materiel developers and test teams to evaluate capabilities in relevant operational testing environments. Details are contained in the OCE SOP.

Prior to any piloting events, the JPMO conducts piloting preparation activities. Piloting takes the form of a process-class. The purpose of the Piloting Preparation sub-process (Figure 22) is to take the JST developed Systems Evaluation Plan and Detailed Test Plans produced during the RA/D/B sub-process and provision for an overall piloting infrastructure required to support execution of the planned piloting events. Then, the JPMO creates specific plans for piloting events (both CM specific events and mission thread events) to be used in support of subsequent certification and deployment decisions. The NECC community will contribute to minimizing the piloting preparation workload by exploiting a set of pre-established piloting infrastructure, operational scenarios, and support personnel. Additional details are contained in the I&TP CONOPS within the Systems Integration Framework discussion.

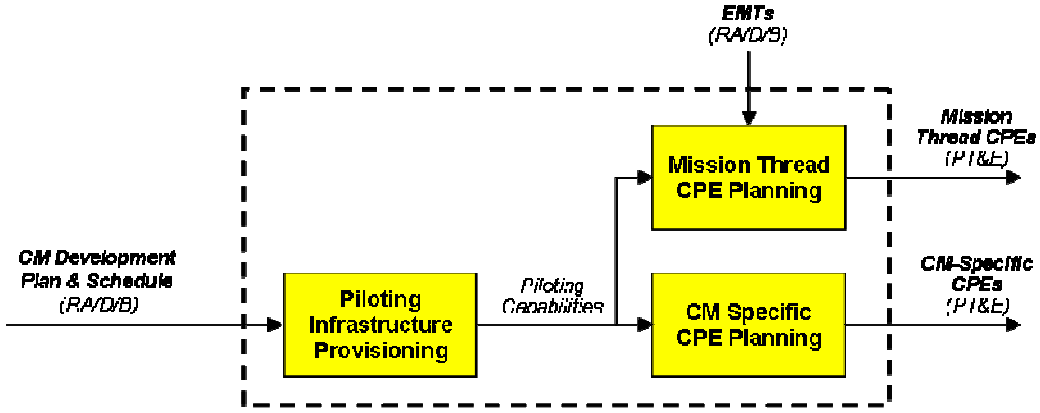


Figure 22: Piloting Preparation Sub-Process

Figure 23 shows how requirements are related to CMs, and how the CMs are evaluated through the FDCE maturity stages. As the diagram indicates, within the three maturity stages, all three types of piloting events may occur. Generally, piloting in the earlier maturity stages will allow for rapid design feedback and analysis leading to improved CM performance in the later stages.

Piloting in the later stages is focused on providing deployment decision information needed by the JPM and JPEO. (Note: See Appendix D for a larger picture of Figure 23.)

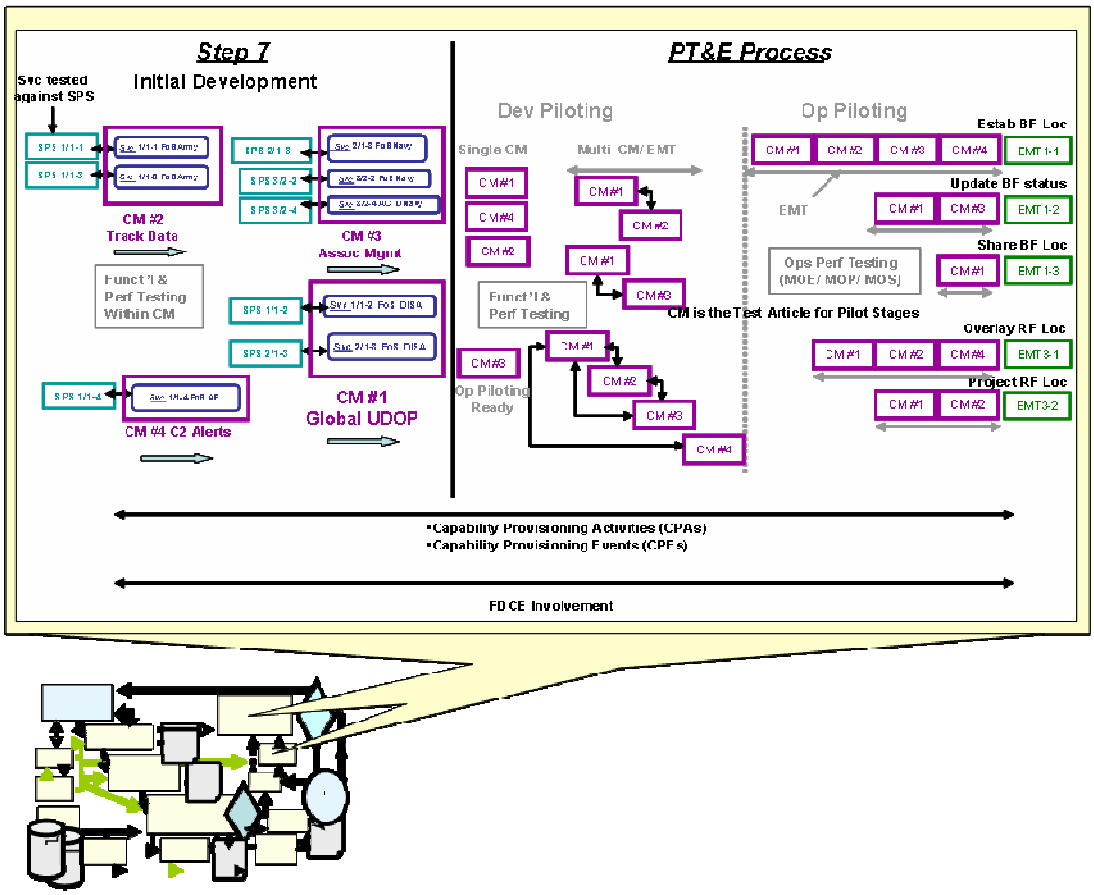


Figure 23: Notional Activities Leading to Certification and Deployment

3.2.2 Integration

The multiplicity of dissimilar interfaces that is characteristic of today's C2 systems significantly increases the complexity of systems integration and rarely leads to simple systems integration solutions. Point solutions, or direct interfaces, do not solve the basic integration problem, which is the lack of a consistent architectural framework within which applications can be more easily integrated and reused. An architectural framework is needed which allows components and services to be assembled for the rapid and dynamic delivery of solutions. Inexpensive, ubiquitous access to the Internet, with a corresponding growth in the GIG, has created the possibility of entirely new business models for expedited delivery of solutions. The models include systems development where heterogeneity is fundamental to the environment, accommodating a variety of hardware, operating systems, middleware, languages, and data stores. The SOA paradigm takes these issues into consideration and ultimately leads to simplified integration with fewer resource requirements.

NECC is using the SOA approach as an architecture strategy to address many of the challenges associated with the rapid implementation of capabilities. The advantages of SOA are achieved by separating the task or function being performed from the software or system being used to

perform the task. Achieving the benefits promised by SOA requires new IT strategies, IT governance processes, enterprise architecture skills, and software development models.

Today, the DoD often develops and deploys information systems that are operated as monolithic stovepipes based on tightly coupled technology platforms supporting a cohesive, but tightly coupled, set of operations and functions. When the need to share data arises, it is typically implemented in an opportunistic manner using tightly coupled, proprietary technologies one link at a time. These dissimilar interfaces have led to the DoD's current situation where the enterprise is left with the overwhelming task of understanding and managing a complex, costly, brittle, and heavily intertwined network of point-to-point links between systems.

The SOA approach will help NECC migrate incrementally from the existing environment to one that is much more flexible, agile, and net-centric. By designing around open standards interfaces and commonly used functions, the SOA approach allows modules to be re-useable and loosely coupled. This avoids the typical systems integration costs incurred by point-to-point interfaces, which is an N-squared problem that becomes unmanageable and unaffordable as the complexity of the system increases. While there is still significant engineering effort required to ensure that components work together (interoperate), the expensive and exponential integration costs of tightly coupled approaches can be avoided. An SOA approach is more about interactions and interoperability among network components than the classic interface integration of current implementations.

A precise definition of integration for an SOA-based architecture involves much more than simply combining systems or software modules together. Within the context of NECC, integration refers to the systems engineering activities required to define, engineer, and implement capability performance in progressively broader contexts towards achieving a complete net-enabled Warfighter capability. Integration occurs at various levels with separate but related contexts. At the design-level, CM integration refers to the actions to define architecture and standards that enable CM interoperability along with associated design efforts. At the CMPO and JPMO level, integration refers to the engineering activities required to ensure delivered products (CMs, etc.) work together with necessary infrastructure and other products to produce intended end-to-end results. At the Joint-Service level, integration refers to the operational activities to ensure that applicable DOTMLPF-P elements function properly to deliver the Warfighter capability.

Within PT&E, the following types of integration are characterized by testing or piloting events as depicted in Figure 23:

- **Within CM Integration** is also known as "CM Integration" or "within CM service-to-service integration." The CPMO has the lead role in accomplishing the integration activities of this category and they are focused on the services, functions, performance, and interfaces within the CM boundary. It can also be thought of as internal capabilities integration—integrating the NECC capability being developed or revised.
- **Inter-CM Integration** can also be referred to as "CM-to-CM Integration." The JPMO's I&TP staff perform the lead role for inter-CM integration. The next level up from Within CM Integration, Inter-CM Integration focuses on external capabilities integration—integrating with other capabilities. These activities ensure interoperable and effective interfaces between CMs as well as other external systems (i.e., NCES, Service C2 systems, etc.) and target the form, fit, and function of NECC capabilities as a critical focus.

- **EMT Integration** or "Full Operational Mission Integration" is also led by the JPMO's I&TP staff. Activities in this category address the integration of the NECC capability being developed, revised, or adopted with operational supportability requirements against the full mission defined in the mission thread.

Figure 24 is a condensed representation of a CM and the inputs, outputs, and controls used to evaluate the functional, performance, and interoperability characteristics achieved from the PT&E sub-process.

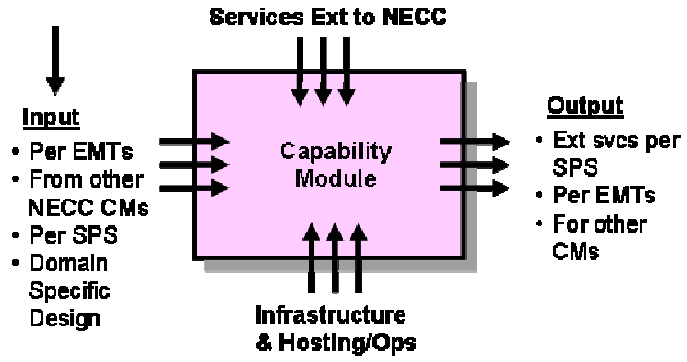


Figure 24: CM Integration and Test Environment

The inputs comprise the specifications (SPSs) and mission context (EMTs), and include dependent interfaces from other CMs as required. The outputs are externally exposed services per specification, mission context, and dependent CMs. The controls are made up of external NECC services and infrastructure, hosting, and operations. As a CM is evaluated in this context, a comprehensive characterization of its integrated performance is determined.

3.2.3 Certification

Certification is the NECC quality control approach for ensuring that a maturing CM meets minimum standards of performance, operational utility, net-readiness, interoperability, and security. Certification occurs when a certification authority (governance body) assesses that a CM has met the entrance criteria established for a FDCE maturity stage. As described in the TEMP, the Tailored CM TEC Criteria serves as the single integrated point of reference for identification of all graduation requirements between the FDCE stages up to, but not including deployment decisions covered by the governance as described in Section 4. The entrance criteria for each stage are defined in the CPAS CONOPS[13]. The overall certification approach is also defined in the NECC TEMP[14].

3.2.4 CM Refinement

The NECC SE process recognizes and accounts for incremental requirements releases along with the desire to deploy individual capabilities quickly and continuously. These systems engineering

[13] CPAS CONOPS, v0.11.2, 16 April 2007 URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

[14] TEMP, v0.5.4, 25 May 2007, URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

features require a process that allows for rapid updating, product modification, and re-certification as required. CMs are expected to be certified against at least one CDP, but will likely have utility across multiple future CDPs. CMs may also be employed with multiple concurrent instances of the same CM. This will necessitate rigorous configuration management and coordination between the JPMO and the CPMOs. The CM refinement activity within the PT&E sub-process is designed to re-certify CMs rapidly as their use is expanded due to CDP modifications or applicability to additional CDPs. This will be accomplished at the direction of the NETOPS certification authorities, and will likely involve an operational piloting event using updated mission threads and/or an updated CM. Since the PT&E sub-process allows a CM to enter any FDCE maturity stage for which entrance criteria are met, the CM will be re-evaluated in the shortest time possible without sacrificing the quality of the evaluation or creating unnecessary rework for the developer. CM's that do not require additional development may be recertified against additional mission threads without reverting to Process Step 7. Actual additional CM development would result in Process Step 7 (Development Stage, RA/D/B SE process phase) activity, and would result in delivery of an updated CM version. As a result, this will require tailored certification based on appropriate risk assessment process by the JST.

3.3 Operations and Support Sub-Process (Process Step 9)

The rapid pace at which NECC envisions deploying new capabilities creates significant deployment and operational support challenges. To simplify downstream deployment and operational support, NECC includes a collection of processes and activities that occur at various points throughout the overall SE process. These closely coordinated activities ensure that deployment issues are considered early in the development cycle and are revisited at appropriate times as a CM matures from concept through deployment and ongoing after-deployment support.

The activities described in this subsection are an expansion of the Operations and Support Sub-Process (Process Step 9) in the overall SE process shown in Figure 13. Note that the Operations and Support Sub-Process is primarily a CPMO-driven set of activities, although close coordination is required with the JPMO and affected CPMOs. The scope of this sub-process includes all activities required to deliver, operate, and deploy capabilities to the Warfighter. This includes platform integration, procuring hardware and software, deployment, logistics, training, operations monitoring and troubleshooting, and support. The deployment activities essentially constitute the activities required to convert the Product Baseline into the Deployed Baseline.

Figure 25 shows the overall Operations and Support sub-process, whose purpose is to deploy certified CMs and provide the requisite training, operations, and run-time support. This sub-process contains four major activities:

1. Implementation Governance
2. Deployment and Logistics support
3. Training Preparation and Support
4. Technical Operations Support

After a brief discussion of the upfront deployment planning as part of the Implementation Preparation activities, the remaining subsections will discuss the activities shown in Figure 25 in more detail.

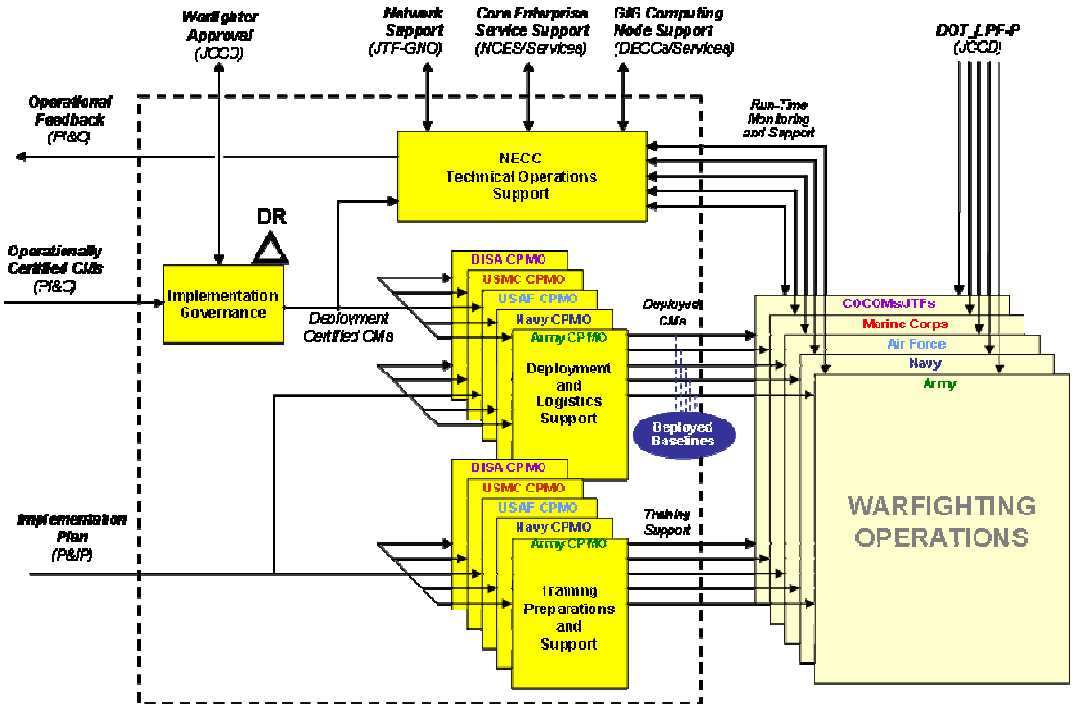


Figure 25: Operations and Support Sub-Process

3.3.1 Implementation Preparation Sub-Process

Successful deployment and post-deployment support depends heavily upon adequate up-front planning early in the development cycle. Figure 26 shows the activities for that planning. The objective is to perform the planning and coordination necessary to successfully deploy, train, operate, and support NECC CMs as they become certified for operations.

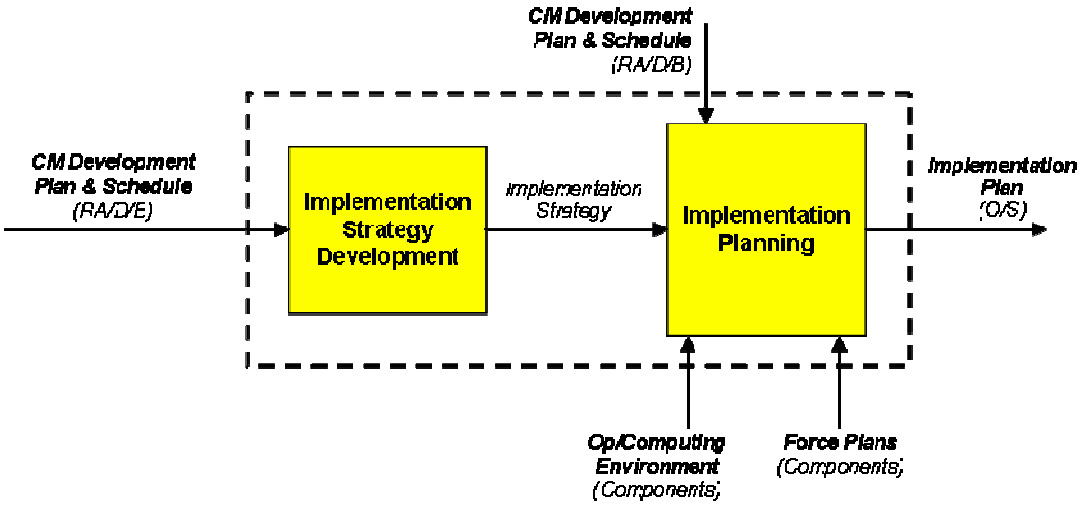


Figure 26: Implementation Preparation Sub-Process

Implementation Preparation consists of two activities:

1. Development of an Implementation Strategy: The Implementation Strategy ensures that CM deployment, operations and support, and training requirements are documented and included in the early activities of the RA/D/B sub-process (Process Steps 1, 2, 3, and 4 of Figure 13), which define the needed capabilities and initial design of the materiel solution.
2. CM Implementation Planning: Implementation planning uses the products generated in the SE process to begin planning for deployment, operations, and support of the planned NECC Deployed Baseline. CM Implementation planning will include mapping a capability to specific sites and platforms. It will also document relevant site and platform constraints that will affect deployment and effective use of the capability and also results in a notional topology for a Deployed Baseline. This effort is conducted in conjunction with the NECC Increment 1 architecture activity and results in the development of Component Technical Implementation Profiles (CTIPs) to document these considerations.

The output of the overall Implementation Preparation set of activities is an Implementation Plan that guides downstream operations and support activities. It also addresses how multiple concurrent instances of a CM will be implemented and supported. The Implementation Plan is an input to the Operations and Support sub-process and is a supporting plan for successfully accomplishing the activities shown in Figure 25.

3.3.2 Implementation Governance

In principle, NECC plans to deploy operationally certified CMs as quickly as possible. However, various non-technical factors must be evaluated before deploying a CM. For example, some operationally certified CMs might not be deployed immediately due to deployment issues, training issues, and op-tempo concerns.

The purpose of the box labeled “Implementation Governance” in Figure 25 is to make timely and informed decisions about deploying operationally certified CMs, and to coordinate communication of the results of those decisions. A Fielding Decision Review (FDR) is used as the forum for making implementation decisions. Results are communicated to the NECC CE and CPMO representatives for dissemination to the affected communities.

It is important to note that CMs developed by one CPMO allow other CPMOs to deploy them, or at least use them, too. For example, the Army CPMO might develop a Fires Situation Awareness CM that the Marine Corps, Navy, Air Force, and DISA deploy to various echelons from Enterprise GCNs to Local GCNs. Each Component, in coordination with the JCCD and COCOM developers, determines the optimal delivery, operations, and support methods appropriate for the Warfighters for which they are responsible. Thus, because of the significant interdependencies that will exist as NECC CMs are reused, it is vital that decisions affecting deployment be collaboratively made and communicated, which is a function of the Implementation Governance activity.

3.3.3 Deployment and Logistics Support

The scope of the tasks within the Deployment and Logistics Support activity, shown in Figure 25, includes logistics provisioning and deploying any required hardware and software. Within

this activity, the JPMO and CPMOs are responsible for accomplishing two primary tasks as described in the NECC Increment 1 Technical Operations Architecture:

1. Managing the process of deploying NECC CMs to Enterprise Computing sites (JPMO) or to Military Service-specific operational sites (Service CPMOs)
2. Providing post-deployment logistics support

During actual deployment, the responsible CPMO will use the Implementation Plan as guidance for understanding what additional hardware and software may be required to support the capability, and the type(s) of deployment required (enterprise, local, or client site). The CPMO may perform a site survey to ensure that the selected site(s) can support the requirements for hosting and accessing a particular CM.

Service CPMOs may choose to deploy some or all of the CMs from the Product Baseline, depending on the specific needs at their Service-specific sites. The actual physical distribution of NECC software to enterprise and operational sites is the updated Deployed Baseline.

3.3.4 Training Preparation and Support

Each NECC CM will include a combination of embedded and web-based training materials for those CMs with a user-facing interface. In the Training Preparations and Support activity shown in Figure 25, NECC CPMOs will address additional training preparations including:

1. Addition of service-specific training extensions
2. Preparation of classroom training materials, if appropriate
3. Planning and scheduling supported training sessions (again if appropriate)

Under this activity, CPMOs will also provide training support to their Services when and where appropriate.

3.3.5 Technical Operations Support

The primary purpose of NECC Technical Operations Support activities is to provide run-time support and monitoring of NECC services and CMs, and to help support operational customers who are using NECC capabilities for training and in actual operations. The NECC Technical Operations Support activity consists of three components:

1. A help desk function that assists operational users with basic issues related to accessing and/or using NECC capabilities
2. A run-time administration function that ensures NECC CMs are running properly and meeting any SLAs that they are required to achieve
3. A real-world error/bug reporting function that reports problems encountered in the field that were not observed during the PT&E sub-process.

3.4 Architecture Framework (Process Step 10)

The objective of the Architecture Framework and Increment Architecture activities in Process Step 10 is to describe the NECC architectural concepts and constructs that constrain the materiel solutions provided by CM developers. Process Step 10 includes the development of two major

products: the NECC Architecture Framework, and NECC Increment-Specific Architecture Descriptions.

The purpose of the NECC Architecture Framework is to describe the high-level architectural concepts and constructs that are applicable across all three planned NECC increments. The development timeframe for these three increments is expected to last through the end of FY2014. Due to this long duration, the NECC Architecture Framework is very general and high-level in nature.

For each increment, an NECC Increment-Specific Architecture Description is also developed to provide the detailed architectural guidance that applies to a given increment of development. The Increment-Specific Architecture is built to comply with the general guidance in the Architecture Framework and to reflect major architectural decisions that have been made for a specific increment. Since the development timeframe of an NECC increment is of a much shorter duration, the Increment-Specific Architecture provides much more specificity than the Architecture Framework.

Both the Architecture Framework and the Increment-Specific Architecture Descriptions are composed of five architectural views, where each view is a “representation of a whole system from the perspective of a related set of concerns." The five views are described further in subsection 2.2.2 above.

3.5 Domain Specific Design (Process Step 11)

The objective of the Domain Specific Design activities in Process Step 11 is to describe the design concepts and guidance that apply to CMs within a specific mission area (e.g., situational awareness). Process Step 11 also shows how the CMs within a domain must interact with each other and with other NECC and non-NECC components to meet the operational capabilities required by the CDD. Domain Specific Design products are built to comply with the increment-specific architecture guidance discussed above and further constrains the materiel solutions CM developers are to provide to meet CDD requirements within a domain. The Domain Specific Design products give the context needed to inform the Functional Analysis and Design Engineering activities in Process Step 3.

3.6 C2 Capability Analysis and Transition Strategy (Process Step 12)

NECC maintains a Catalog of Capabilities that contains functional, technical, and programmatic data on systems that could serve as materiel solutions for NECC CMs. Information to populate this catalog was obtained via interviews with SMEs for the GCCS FoS, ACTDs, JCTDs, and other non-FoS C2 systems. The data is used to determine if existing capability can be leveraged to implement capabilities contained in the NECC CDD.

During Process Step 12, SPS requirements for each CM are compared with catalog data to locate C2 systems with common functional characteristics. For those qualifying candidates, the technical and programmatic profiles of those candidates are examined to find potential materiel providers that best fit the overall NECC architectural and program plans. The catalog maps GCCS FoS capabilities to corresponding NECC CMs so that the appropriate legacy GCCS FoS components can be retired once the NECC CM is deployed. Redundant capabilities are also tracked and scheduled for retirement when replaced by NECC CMs.

3.7 Requirements Traceability

NECC will use a commercial requirements management product as its requirements traceability and mapping tool for populating the NECC Technical Baselines repository, which includes an increment's technical requirements. This repository contains the engineering artifacts and data elements associated with the Technical Baselines as well as other designated technical information from the JPMO and CPMOs. It will also support generation of a requirements traceability matrix for PT&E purposes.

3.8 SE Process Artifacts

This subsection is intended to be included in a later SEP revision. It will identify in general the expected artifacts that will come out of the SE process (reviews, EMTs, baselines, lessons learned, etc.). Refer to Table 4, Table 5, Figure 2, Figure 4, Figure 13, and Figure 40 for specific examples of some of the expected process artifacts.

4 TECHNICAL EXECUTION ORGANIZATION AND GOVERNANCE OVERVIEW

Rapid capability deployment requires a technical organization and governance constructs that foster an agile, rapid response to Warfighter needs. This necessitates a SE process that centers on a multi-spiral development approach and evolving Technical Baselines. This section addresses NECC's technical execution and governance approach to providing sufficient direction and oversight without compromising flexibility and agility at an individual capability level.

The NECC program has two technical execution levels: (1) the program formulation and increment execution level for which the JPM is responsible; and, (2) the CM development for which the CPMs are responsible (see Figure 27).

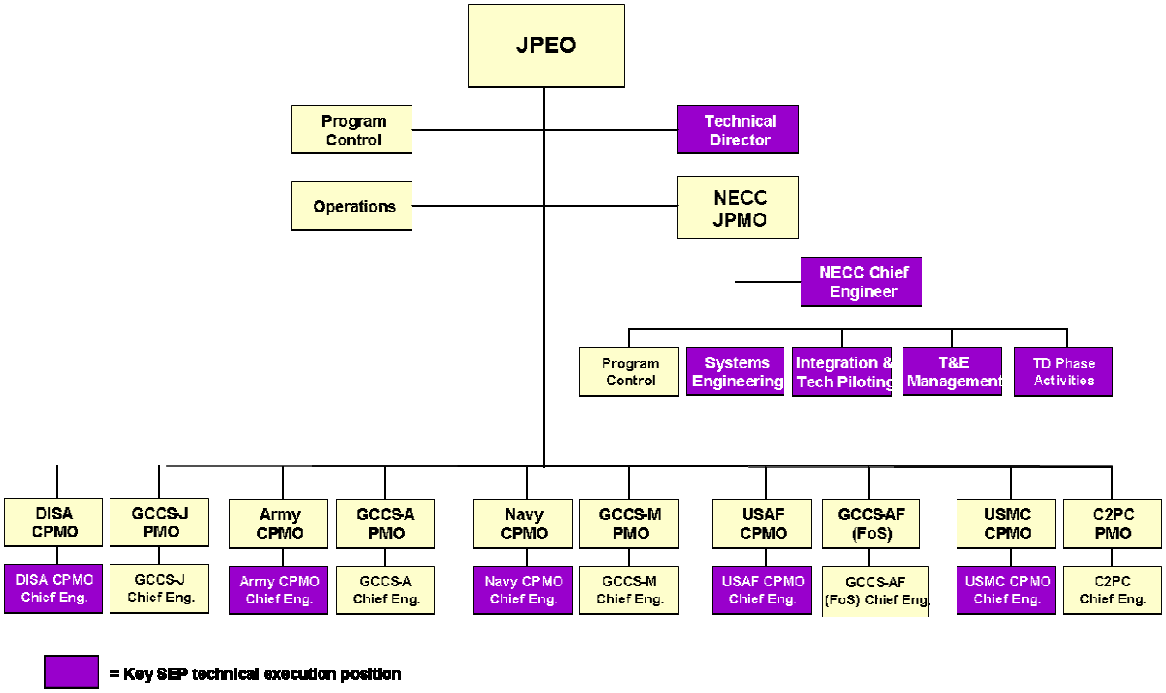


Figure 27: Systems Engineering Components of the JPEO

As the purple boxes in Figure 27 show, elements of the JPEO, JPMO, JCCD, and the CPMOs make up the NECC Systems Engineering organization. The NECC CE has overall responsibility for the Technical Baselines at the program and increment level, which includes systems engineering, integration and test, deployed capability performance, and configuration control of the deployed capabilities. The CPMs' CEs have similar responsibilities for their assigned CMs. The Technical Director provides technical leadership and guidance to the JPEO. The Technical Director is also responsible for ensuring that NECC SE plans and activities are conducted in a manner consistent with JPEO directives and applicable OSD technical policies and procedures.

4.1 Program Management Direction Team

To assist the JPM with program formulation and increment execution, the JPEO established and chartered a PMDT. The PMDT consists of the JPM, NECC CE, CPMs, and their CEs, subordinate top-level WG chairs, the Lead OTA who represents the Army Test & Evaluation Command (ATEC), and a JCCD representative. In collaboration with the CPMs, the JPM formulates NECC program strategy and execution approaches which are then presented to the JPEO for approval. The JPEO empowers the PMDT to make decisions that are in the best interest of the NECC program. The team forwards issues and problems that are irresolvable, as well as those that involve requirements, to the JPEO for resolution. Figure 28 depicts the PMDT structure. To simplify the figure, CPMO working groups are not shown.

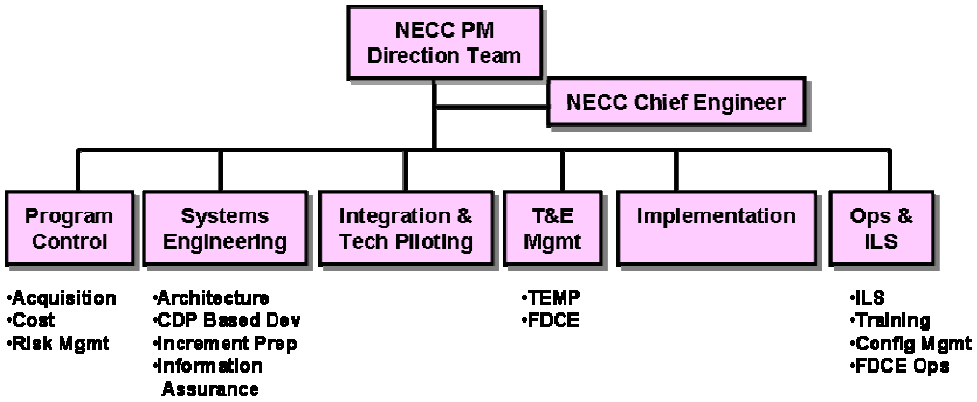


Figure 28: NECC PMDT Working Groups Organization

The PMDT/WGs construct enables collaboration and integration across the technical disciplines, domain knowledge, and stakeholders required for prudent information sharing and decision-making. Each WG has its own charter, with membership from the JPMO, CPMOs, and USJFCOM that reports to the PMDT. The JPM and the CPMs use the working group structure in Figure 28 to set up their individual CPMOs to include Program Control, Systems Engineering, Integration & Technology Piloting, Test & Evaluation, Implementation, and Ops & Integrated Logistics Support (ILS).

4.2 WIPT Organization

The NECC program uses WIPTs extensively to assist with stakeholder participation in program strategy, tailoring program documentation and plans, and to resolve issues in a timely manner. There are five formal NECC WIPTs: Test & Evaluation, Acquisition, Cost Performance, Information Assurance, and Architecture. The WIPTs contain members from across their

respective functional areas and include the JPEO, OUSD(AT&L), ATEC, Joint Chiefs of Staff, USJFCOM, and OASD(NII) oversight staff as well as empowered representatives from each of the Military Services and requirements sponsors participating in NECC. The WIPTs are responsible for developing singular "community" positions and continuously advising the JPM on program strategy, planning, and execution. The overall NECC acquisition and SE processes are significantly different from traditional system-of-systems developments, and necessitate modified business practices in every functional program area. NECC depends heavily on the WIPTs for the extensive acquisition and technical tailoring needed to enable developing and delivering NECC services.

The JPMO's representatives, who report to the PMDT, lead the WIPTs. The PMDT coordinates efforts across the WIPTs, and provides direction to each individual team as required. NECC expects that external stakeholder issues and concerns will be worked constructively through the WIPTs and that team participants will be empowered to speak authoritatively for their host organizations. Throughout System Development and Demonstration, NECC will use WIPTs to assist with developing and implementing the changes across the functional areas to equip the DoD with the means of acquiring net-centric C2 capabilities. Table 3 lists the WIPT members.

Table 3: NECC WIPT Membership

NECC Working-level Integrated Product Team Membership					
	Test & Evaluation	Acquisition	Cost Performance	Information Assurance	Architecture
ASD (NII)	X	X	X	X	
ATEC	X	X	X	X	
CPMOs	X	X	X	X	X
DAA	X			X	
DISA Corp Bd DOT&E	X X	X	X	X	X
JCS	X	X	X	X	
JITC	X	X	X	X	
JPEO C2C	X	X	X	X	X
JPMO	X	X	X	X	X
JSIC	X			X	X
NCES	X			X	X
OSD (AT&L)	X	X	X	X	
USA	X	X	X	X	X
USAF	X	X	X	X	X
USJFCOM JCCD	X	X	X	X	X
USMC	X	X	X	X	X
USN	X	X	X	X	X

4.3 NECC Technical Execution Roles and Responsibilities

Executing a NECC Capability Development Spiral involves the total NECC program with each organization having specific roles[15] and responsibilities. A roles and responsibilities matrix is constructed at the NECC Capability Development Spiral level as well as the increment level.

[15] The source for NECC roles and responsibilities is the *Terms of Reference (TOR) for the Net-Enabled Command Capability Program* document, dated 12 April 2007. The latest information from the TOR, which has not been signed as of the date of this SEP version, was used to develop the information in this subsection. Should there be any conflict between the TOR and this subsection, the TOR shall supersede the information in this SEP.

Using the SE process as a workflow, there are four types of roles and responsibilities: Lead, Participate, Support, and Observe. Figure 29 depicts these roles and responsibilities for a NECC Capability Development Spiral. As shown in the figure, the JPMO, as NECC's system prime and system integrator, leads RA/D/B Process Steps 2 through 6, and leads the PT&E Process Step 8. The CPMOs, as CM developers, lead the RA/D/B Process Step 7 and the Operations and Support Process Step 9, including software maintenance (as tasked by the JPMO through WPs). The JST is the lead for operational testing. The MDA makes the deployment decision for a CM. USJFCOM serves as an advisor to the MDA on deployment decisions. USJFCOM's JCD will provide an OFDM to the MDA based on operational and DOTMLPF-P considerations.

The NECC program envisions leveraging Military Service mission domain expertise by establishing Functional Area Managers. The Functional Area Managers will be organized around mission areas analogous to the MCPs identified in the CDD. The JPEO will designate a CPMO/Agency to act as the Functional Area Manager for an assigned mission space. This approach will help bring domain knowledge and consistency to the design, selection, and development of the individual CMs. More details on the Functional Area Manager role will be provided in a subsequent SEP revision.

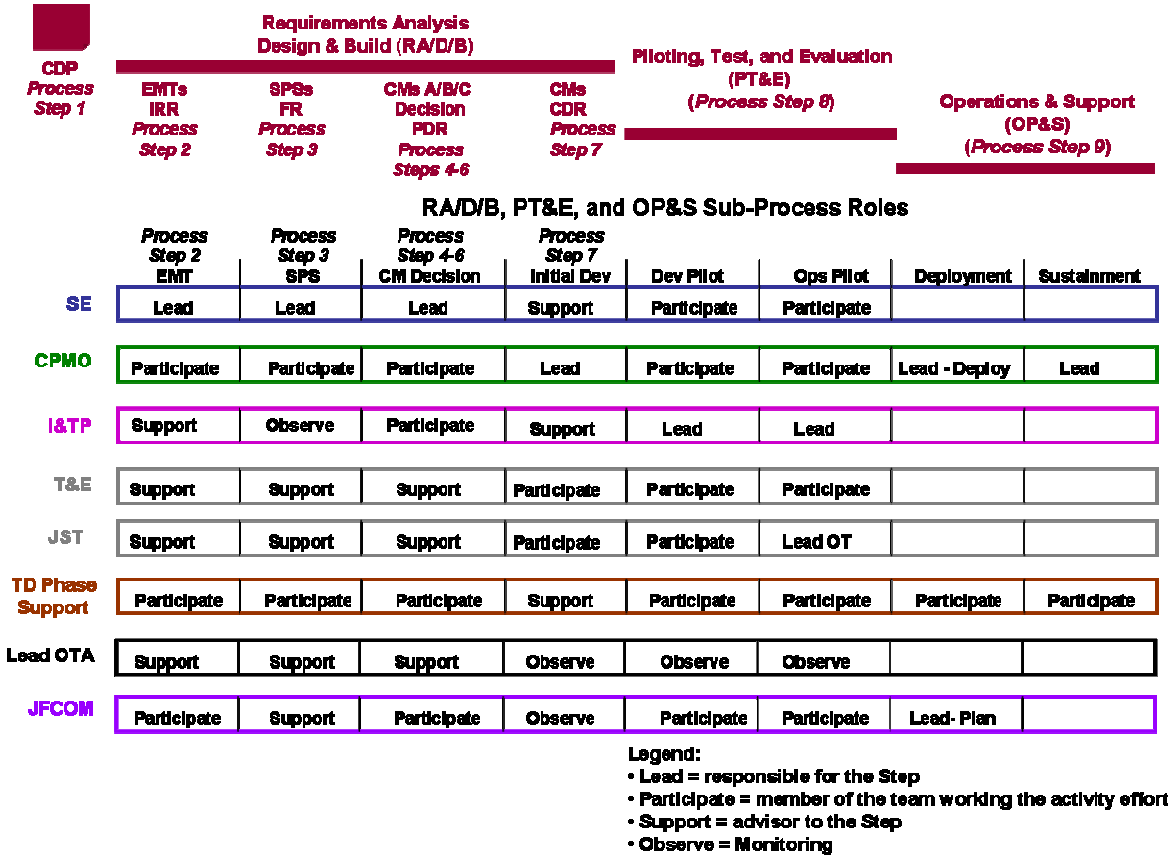


Figure 29: Roles and Responsibilities for a NECC Capability Development Spiral

Figure 30 depicts an increment-level roles and responsibilities matrix for deployed CMs. At the increment level, the JPMO leads the systems engineering and integration activities for deployed

capabilities. The CPMOs, as the materiel developers, participate at the increment level and have the lead responsibility for their assigned deployed CMs.

Increment 1 Roles & Responsibilities

	Sys Engineering	System Integration	Sustainment
	Increment Req'ts & Perf: KPP; MOE/MOP/MOS	EMTs Functionality & Perf	Field Capabilities Ops & Sustainment
SE	Lead	Participate	Participate: Sustaining Eng
CPMO	Participate	Participate	Participate
I&TP	Participate	Lead	
T&E	Support	Participate	
TD Phase Support	Lead- Trng & Sustain Objectives	Participate	Lead

Note:
- SE responsible for meeting KPPs at the EMT level and higher.
- SE Leads Eng Review Bd in support of Increment's CCB (JPM leads)
- I&TP responsible for integrating CMs that meet EMTs end to end performance
- Ops & ILS Leads Increment's Config Mgmt
- I&TP/ T&E participates in Field's bug fixes & improvements

Legend:
- Lead = responsible for the Step
- Participate = member of the team working the Step's effort
- Support = advisor to the Step
- Observe = Monitoring

Figure 30: Roles and Responsibilities for an Increment

4.3.1 JPEO

The JPEO is responsible to the MDA for overseeing the evolution of current DoD C2 systems into an integrated, Joint, net-centric, C2 capability for the Warfighter that supports both Joint and coalition operations. The JPEO delegates authority to the NECC JPM to formulate and execute the NECC program with support from the CPMs as materiel developers.

JPEO responsibilities include:

- Providing executive level lifecycle management and monitoring for consistent and effective program management across the C2 portfolio, including NECC
- Coordinating with the DISA CAE for oversight and approval of NECC-related statutory, regulatory, and contract reporting information as well as required milestone documents prior to submittal to the final approval authority
- Collaborating with USJFCOM as the operational sponsor, in coordination with OSD and the Joint Staff, Services, and Agencies to address issues related to NECC program requirements, operational effectiveness, and operational suitability

4.3.2 JPM and JPMO Roles and Responsibilities

NECC's JPM reports to the JPEO as NECC's System Prime and System Integrator. The JPEO has delegated authority to the NECC JPM for formulation and execution of the NECC program. This includes GCCS FoS migration planning, architecture development, systems engineering, integration and test, deployment, and operations and support for operationally ready capabilities.

JPM responsibilities include:

- Articulating program objectives and status to the NECC COIs as well as to the JPEO
- Directing efforts to achieve cost, schedule, and performance objectives as stated in the APB
- Achieving KPPs, KSAs, and CDD requirements
- Developing and configuration controlling the Technical Baselines (Increment Requirement, Functional, Allocated, Product Baselines, and Deployed Baselines)
- Defining an increment's CMs
- Recommending materiel solutions (CMs) and preferred providers (CPM) for an increment to the JPEO
- Performing operations and support to include sustaining engineering at the increment level

To assist in carrying out this role, the JPM established a NECC CE position along with five functional areas: Program Control, SE, I&TP, T&E Management, and TD Phase Support, as shown in Figure 31. Figure 29 and Figure 30 depict roles and responsibilities of the SE, I&TP, T&E, and TD Phase Support functions at the increment and CM level.

(Note: Other than the PM, DPM, and CE roles, Figure 31 shows functional areas rather than specific organizational relationships because the JPMO organization will evolve as the program progresses. JPEO will reassess a specific organization beneath the NECC PM following MS B. Nevertheless, regardless of the actual organizational reporting structure, the program must accomplish the functions shown.)

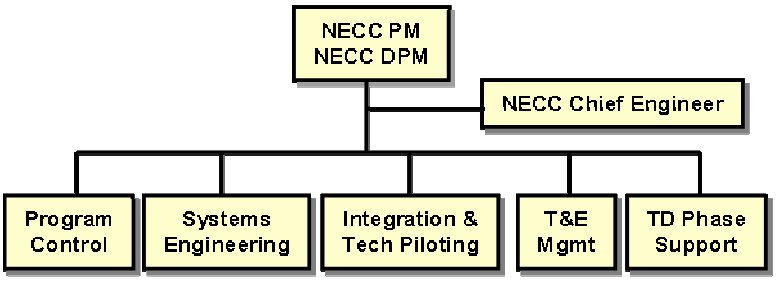


Figure 31: NECC JPMO Functional Relationships

4.3.2.1 NECC Chief Engineer

The NECC CE, as the senior technical manager for NECC, reports to the JPM. The CE is responsible for the NECC Architecture, and an increment's development, deployment, and operations and support activities. The JPM has delegated authority to the NECC CE to carry out the technical component of the JPM's assigned responsibilities stated in subsection 4.3.2 above. The CE executes assigned responsibilities through the JPMO organization.

NECC CE responsibilities include:

- Providing overall NECC technical leadership
- Establishing the NECC technical strategy and guidance
- Achieving NECC's end-to-end technical performance as stated in the CDD

- Leading the PMDT's Systems Engineering Working Groups (SEWGs)
- Resolving NECC-wide technical issues
- Representing NECC to the external technical community including industry

4.3.2.2 JPMO SE Functional Area

NECC's Lead Systems Engineer reports to the NECC CE and is responsible for all SE functions, including NECC's technical baseline development. The NECC Lead SE responsibilities include:

- Developing and maintaining the NECC Architecture, including IA, Data, and Increment-specific architectures
- Developing and maintaining the NECC Technical Baselines, including performing capabilities needs analysis, functional analysis, and requirements allocation activities
- Developing, maintaining, and enforcing the NECC SE process
- Conducting SE technical reviews (i.e., Increment Requirements, Functional, and Preliminary Design Reviews)
- Achieving the requirements established in an increment's Technical Baselines, including resolution of performance issues between CPMs at the CM level
- Developing and maintaining the GCCS FoS-to-NECC functionality transition database and the GCCS FoS FTP
- Overseeing system-wide integration issues which impact operations and support across CMs
- Identifying and tracking cross-CM dependencies
- Supporting the increment-level ERB chaired by the NECC CE
- Managing SE, including SEP maintenance, associated systems engineering, and specialty engineering processes

4.3.2.3 JPMO I&TP Functional Area

The JPMO I&TP functional area contains activities that are designed to elicit user feedback and verify a CM's technical and operational maturity. Responsibilities falling within this functional area include:

- Leading, conducting, and coordinating designated piloting and integration events, including those called out in the NECC TEMP, JST-developed Systems Evaluation Plan, and experiments
- Managing the portion of CPAS associated with CM PT&E
- Performing EMT level integration and technical piloting for individual and multi-thread CMs
- Planning, executing, overseeing, and reporting on integration and piloting activities, which may range in scope from unstructured, single-CM, UFP events to full-scale, multi-CM events involving operators in Joint exercises
- Verifying CM technical and operational maturity

- Verifying CM-to-CM integration as required to fulfill operational requirements, as well as compliance with the NECC architecture such that piloting events are technically and operationally relevant
- Coordinating with the CPMs' materiel developers, Systems Engineers, and T&E representatives to ensure adequate planning, resourcing, execution, and reporting for piloting events
- Participating in the requirements development and functional analysis portions of the SE process to ensure I&TP planning considerations are addressed

4.3.2.4 JPMO T&E Management Functional Area

The JPMO T&E Management functional area encompasses responsibility for coordination with the JST to conduct T&E activities. Responsibilities falling within this functional area include:

- Establishing and coordinating T&E WIPT activities to serve as the governance body for TEC processes
- Developing and maintaining a TEC Criteria for use in testing, evaluating, and certifying CMs
- Developing and maintaining the NECC TEMP

4.3.2.5 JPMO TD Phase Support Functional Area

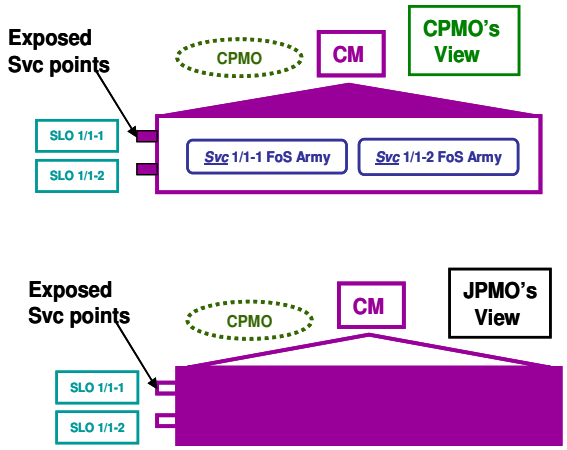
The JPMO TD Phase Support functional area encompasses operations and ILS management responsibilities, and operations and support lifecycle in coordination with the CPMs. Specific responsibilities falling within this functional area include:

- Providing NECC program and increment-level logistics support, to include developing a product support strategy and performing required logistics analyses, planning, and documentation
- Managing NECC enterprise-wide operations including Operations Center and Help Desk functions
- Developing an NECC training strategy and training plan in addition to providing program-level support for training activities
- Developing and maintaining NECC's ISP
- Developing and administering NECC's configuration management policy, procedures, and governance structure across the enterprise
- Establishing and executing NECC's configuration management activities for an increment

4.3.3 CPM and CPMO Roles and Responsibilities

NECC's CPMs, as the NECC's materiel developers, report to the JPEO and support the JPM in achieving an increment's required capabilities. The CPMs are responsible for providing materiel solutions as defined by the NECC SE process, approved by the JPEO, and executed by work packages. The CPMs will use their Services' contracting authority and organization to select industry partners who will develop, deliver, operate, and support the capabilities required to meet

NECC's requirements. At the CM level, the CPM responsibilities are similar to the JPM's increment-level responsibilities (see Figure 32).



Capability Module (CM) Characteristics:

1. **Provide service(s) that meet SPS requirements.**
2. **Supports one or more CDPs and EMTs.**
3. **Is the Piloting Stages test article.**
4. **Satisfies SPS requirements at the "exposed" service(s) point (s) on the CM boundary.**
5. **Can have internal services which support "exposed service(s) that are not "exposed".**

CPM & JPM Responsibilities:

1. **CPM has overall cost, schedule, performance responsibilities; as well as CM's Sys Eng, Sys Integration, & Config Mgmt responsibilities.**
2. **JPM responsible for CM to CM and EMT integration**
3. **JPM manages CMs at the CM boundary and Not inside the CM**

Figure 32: CPM and JPM Roles and Responsibilities for CMs

A CPM's responsibilities include:

- Developing CMs to meet the CDD requirements that were allocated to the assigned work package
- Operating and supporting assigned CMs, including post-deployment software maintenance, configuration management, and sustaining engineering as tasked in hosting, operations, and sustainment work packages
- Achieving CM cost, schedule, and performance objectives as stated in the APB
- Developing CMs that successfully contribute to meeting an increment's KPPs and KSAs
- Maintaining the CM's internal technical baselines
- Collaborating with the JPM to establish the work package(s) required to produce the assigned CMs
- Integrating (within all levels described in subsection 3.2.2 above), testing, and supporting efforts leading to certification of assigned CMs
- Deploying operationally ready CMs into their Component environment, regardless of which CPMO developed the CM, and providing local site operations and support (the standard environment is defined in the Software View of the NECC Architecture Framework in subsection 2.2.2)
- Serving as a Functional Area Manager as assigned by the JPEO

The effort to define, design, develop, integrate, test, and deploy a CM comprised of multiple services requires significant work. In recognition of the effort involved, CPMs have established

Program Management Offices (PMOs), similar in structure to the PMDT/JPMO. Each CPMO has a similar set of roles to the JPMO, as depicted in Figure 33 through Figure 37. The CPMO CE roles and responsibilities are further delineated below. Remaining CPMO roles and responsibilities are similar to those described in subsection 4.3.2 and are not discussed further.

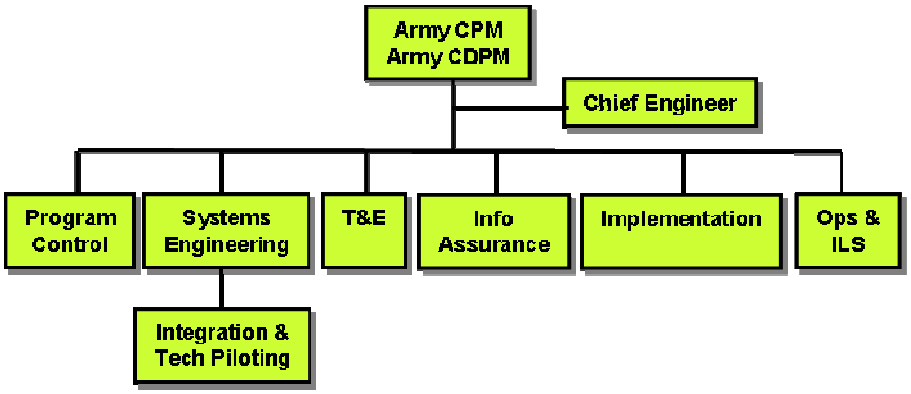


Figure 33: Army CPMO Organization for NECC Support

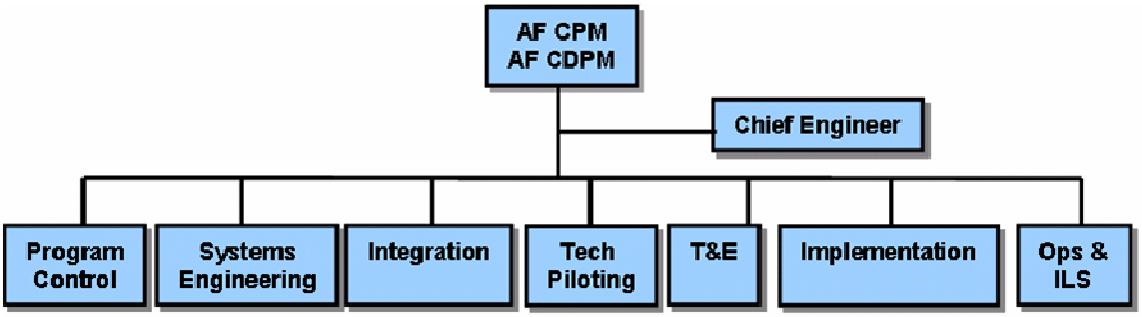


Figure 34: Air Force CPMO Organization for NECC Support

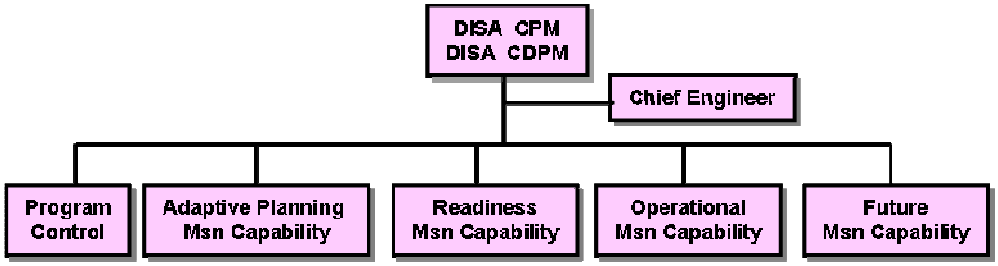


Figure 35: DISA CPMO Organization for NECC Support

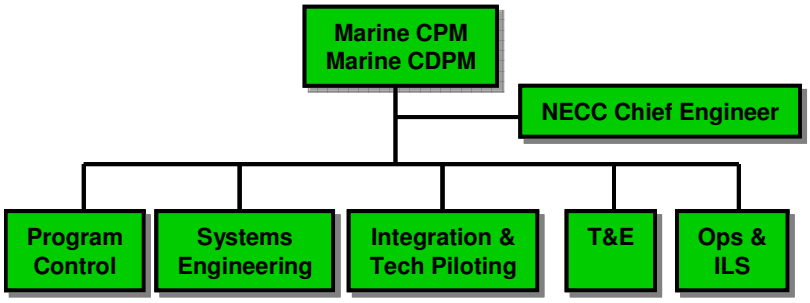


Figure 36: Marine Corps CPMO Organization for NECC Support

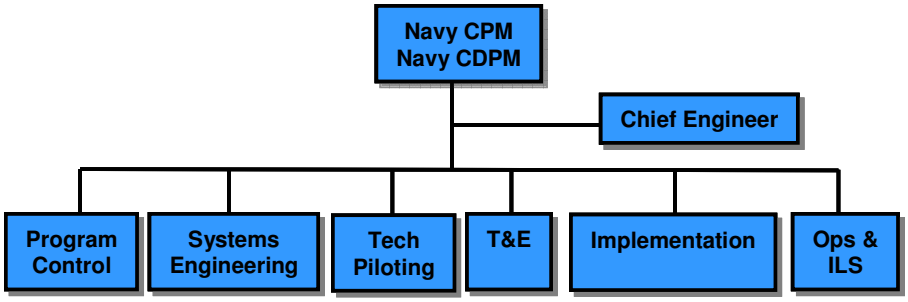


Figure 37: Navy CPMO Organization for NECC Support

4.3.3.1 CPMO Chief Engineers

A CPMO CE, as a Component's lead technical manager, reports to the CPM and is responsible for complying with the NECC Architecture Framework and its increment-specific architectures in the rapid development, deployment, operations, and support of assigned CMs. The CPM has delegated authority and responsibility to the CPMO's CE to carry out the technical component of the CPM's assigned responsibilities. The CPMO CE provides technical leadership for applying the SE process to the CPMO's assigned CMs and for resolving any associated technical conflicts. The CPMO CE will collaborate with the NECC CE on technical topics that extend beyond the scope of an individual CM.

CPMO CE responsibilities include (also see Figure 29 and Figure 30):

- Applying the NECC Architecture, including IA, Data, and Increment-specific architectures to assigned CMs
- Developing and maintaining an assigned CM's Technical Baselines
- Applying the NECC SE process to assigned CMs
- Conducting SE technical reviews to include at least one CDR
- Performing CM integration and testing in support of JPMO validation of the CM
- Performing configuration management at the CM level and participating in NECC's overarching configuration management efforts
- Performing CM lifecycle operations and support engineering

- Establishing and running a CM CCB/ ERB
- Participating in NECC CCBs and ERBs
- Participating in PMDT
- Participating in WGs and WIPTs as required
- Leading WGs as directed by the NECC CE

4.4 NECC Technical Governance

- NECC employs a tailored form of traditional governance mechanisms to account for the unique needs of a systems development process that deploys capabilities in a continuous stream of individual modules instead of as an entire system. The governance of NECC technical efforts allows decisions to be made at the lowest possible level with a clear chain of accountability throughout the process. Figure 38 shows the governance mechanisms that NECC will use.

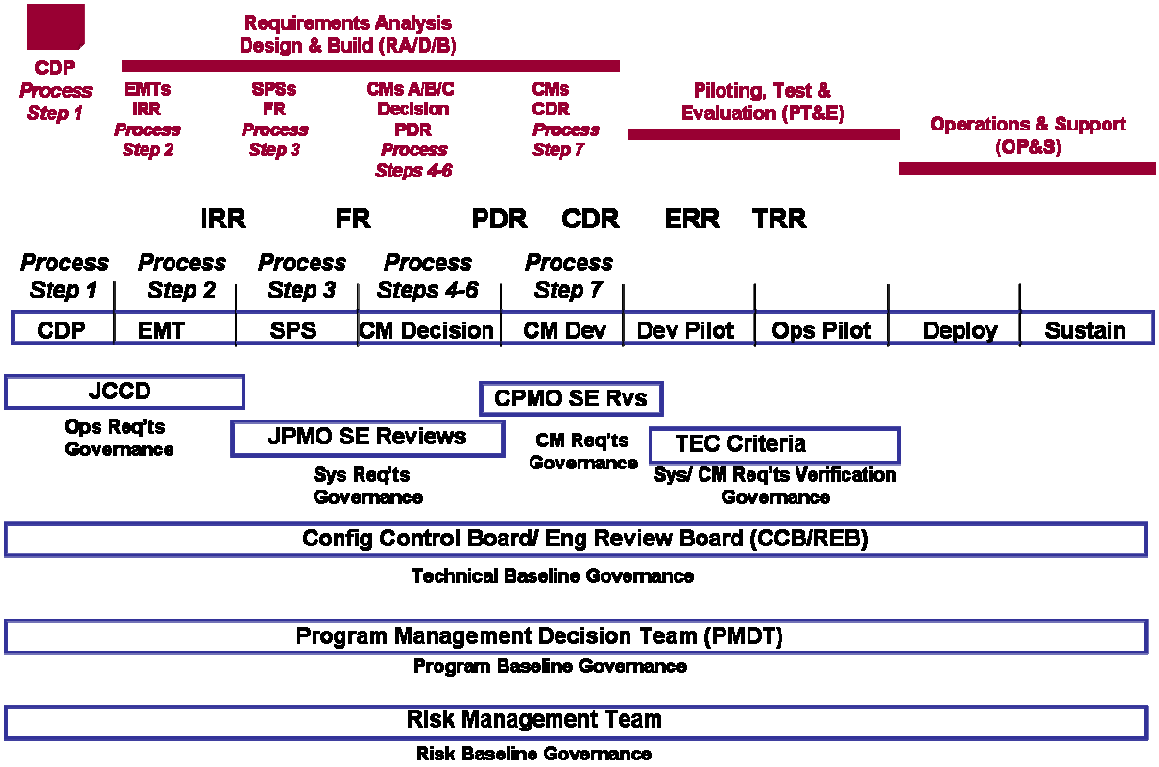


Figure 38: NECC Technical Governance Mechanisms

These NECC technical governance mechanisms include:

- A JCCD process for governance of operational requirements
- NECC SE reviews for governance of system requirements and design
- CPMO SE reviews for governance of CM requirements and design
- TEC Criteria for governance of requirements verification

- CCBs/ERBs for governance of the technical baselines
- A PMDT for governance of the program baseline
- A Risk Management process for governance of the risk baseline

4.4.1 Operational Capability Requirements Governance

The JCCD organization, shown in Figure 39, represents the execution arm for NECC operational sponsorship and capability development. The JROCM (Memorandum) 167-03 delegated ORD approval authority, for non-KPP adjustments, to USJFCOM. This authority is exercised through the JCCD process. JCCD's MCP Branch, in conjunction with the JPEO, defines CDPs while JCCD's Coordination Cell influences the prioritization of CMs for NECC CPEs.

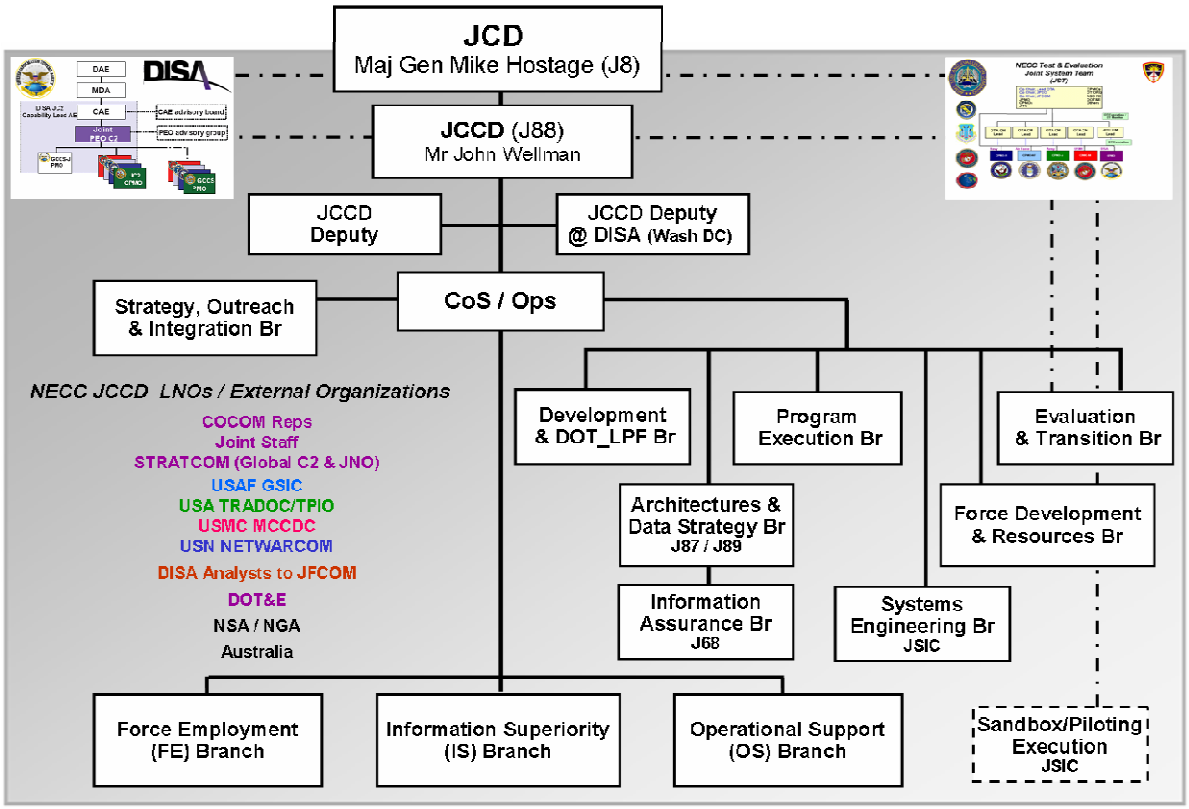


Figure 39: NECC JCCD Organization

In collaboration with the Joint Staff and COCOMs, Services, and Agencies (C/S/A), JCCD's mission is to:

- Lead the effort to collect, assess, prioritize, document, and articulate JC2 capability needs relative to the NECC mission space
- Set requirement parameters (from core and extensions) for delivering CDPs
- Develop, coordinate, and maintain all requirements-related documentation required to define, justify, and support NECC program acquisition strategies
- Represent the collective interests of the Joint Warfighting operational community (C/S/A) to the NECC program materiel development and PPBE communities

- Coordinate and resolve all non-materiel issues related to NECC program development, deployment, and other relevant processes

4.4.2 Evolving Technical Baselines Governance

A key characteristic of NECC's SE process is developing and managing an increment's concurrently evolving requirements and design baselines. In traditional waterfall systems engineering, a requirements baseline is developed and approved prior to the derivation of a Functional Baseline. Prior to conducting a PDR and establishing an Allocated Baseline, the Functional Baseline is completed and approved.

In contrast to this traditional approach, NECC baselines are updated as an increment's CDPs are approved and inducted into the SE process. The method for evolving NECC Technical Baselines was discussed in subsection 2.3 above. Figure 40 illustrates the evolution of NECC Technical Baselines and shows the SE reviews that are conducted as part of NECC's overall end-to-end SE process. Since an increment's Requirements Baseline evolves during execution, there is no completed increment Requirements Baseline to support a MS B decision. Instead, as explained in subsection 2.1 above, the collection of the requirements allocated across the NECC Capability Development Spirals will form the Requirements Baseline.

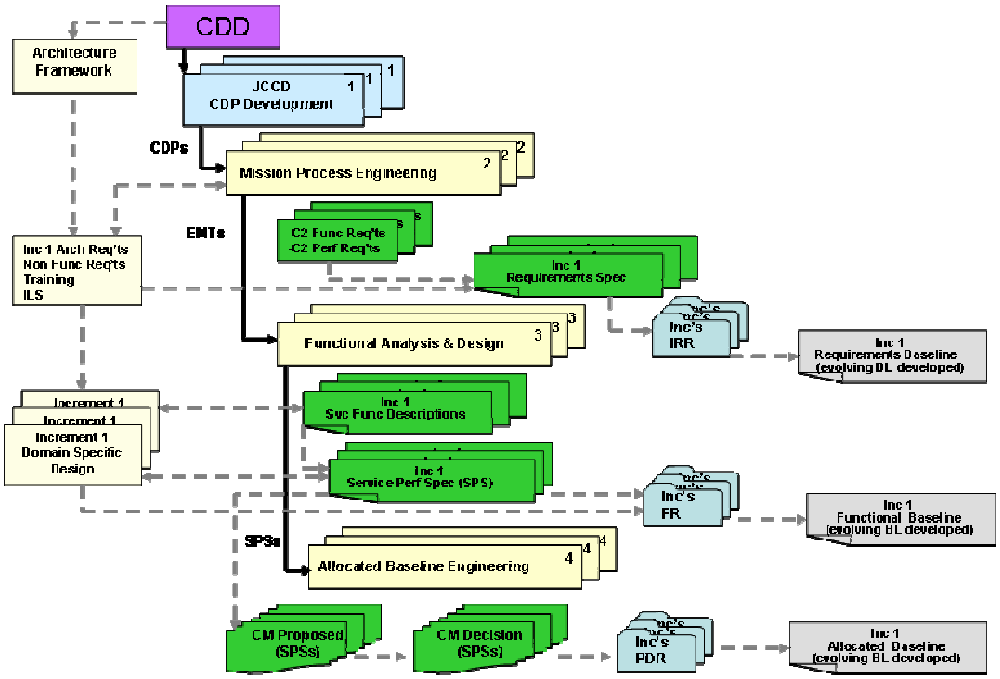


Figure 40: NECC SE Review from IRR through PDR

Allowing Technical Baselines to evolve is one of the SE process trades that NECC made to enable rapid capability development and deployment. To offset the adverse impact of evolving baselines, NECC uses increment-specific architectures (Physical, Software, Data, IA, and Technical Operations) and domain specific designs to provide adequate design guidance for defining a CM's technical requirements. Additionally, NECC has developed domain designs that are mission-area specific, such as for Situational Awareness, which provide additional design information that supports a CM's technical requirements development.

4.4.3 Systems Engineering Reviews

NECC's SE reviews are focused on the technical objectives of a review and not on the overall programmatic objectives associated with a traditional "big system" SE review. The intent of NECC's SE reviews is to validate and approve the technical requirements and engineering artifacts associated with that particular review and incorporate the approved information into the baselines. For SE reviews, the NECC Lead Systems Engineer drafts, for approval by the NECC CE, the review's charter, approval authority, participants, and entrance criteria. Table 4 establishes the entrance and exit criteria, chairperson, and participants for NECC SE reviews.

Table 4: NECC SE Reviews

Review	Chair	Participants	Entrance Criteria	Exit Criteria
Increment Requirements Review (IRR), Multiple IRRs for an Increment	NECC Chief Engineer	JPMO, CPMOs, JFCOM, JPEO, ASD (NII), JST, DISA	1. Prelim/updated Inc Req'ts 2. Proposed C2 Increment req'ts 3. Proposed Arch derived Increment req'ts for: Physical, Software, Data, IA, and Technical Operations 4. Proposed ILS related req'ts 5. Updated risk assessment 6. Updated logistics documentation	1. Can the Increment req'ts, as described, satisfy CDD/ CDPs? 2. Are Increment req'ts sufficiently detailed and understood to enable functional analysis & design activities? 3. Are the risks known and manageable for design and development? 4. Are increment baseline products identified and documented?
Functional Reviews (FR), Multiple FRs for an Increment	NECC Chief Engineer	JPMO, CPMOs, JFCOM, JPEO, ASD (NII), JST, DISA	1. Updated IRS 2. Prel/ updated Funct'l baseline 3. Proposed Service Perf Specs (SPSs) 4. Proposed Domain Specific Design(s) 5. Updated risk assessment 6. Updated logistics documentation 7. Supporting analyses, e.g. enterprise integration, human factors, etc. and plans are complete. 8. System Evaluation Plan (SEP) draft	1. Can the SPS, as described, satisfy CDD/ CDPs? 2. Are SPSs sufficiently detailed and understood to enable capability modules development? 3. Are the domain specific design sufficiently detail and understood to enable capability modules development? 4. Are the risks known and manageable for design and development? 5. Are the functional baseline products adequately documented?
Preliminary Design Reviews (PDR), Multiple PDRs for an Increment	NECC Chief Engineer	JPMO, CPMOs, JFCOM, JPEO, ASD (NII), JST, DISA, Capability Module Developer(s)	1. Updated IRS 2. Prel/ updated Allocated baseline 3. Capability Modules' (CMs) SPSs and Design 4. Defined external dependency relationships with other CMs or external systems/ services 5. Established CM's interface requirements 6. Capability Module's risk assessment 7. Capability Module's implementation/ ILS and hosting docs 8. Configuration Mgmt Plan 9. System Evaluation Plan (Including Piloting plans) updated	1. Do the Capability Modules dev effort & design indicate ops certification success? 2. Do the CMs, as describe satisfy the SPSs/EMTs? 3. Do the CMs, as describe, satisfy the domain-specific design? 4. Are the risks known and manageable for Dev/ Ops Piloting/ 5. Are the CMs' schedule executable? 6. Are the allocated baseline products adequately documented?
Critical Design Review (CDR), One per Capability Module	CPMO Chief Engineer	JPMO, CPMOs, JFCOM, JPEO, ASD (NII), JST, DISA, Capability Module's Developer(s)	1. Critical PDR issues closed out 2. Updated SPSs, if required. 3. Updated Capabiliy Module detail design 4. Updated external dependencies and interface requirements 5. Current Risk Assessment. 6. Updated implementation/ ILS and hosting docs 6. Updated Detailed Test Plans	1. Does the Capability Module detail design indicate ops cert success? 2. Does the CM, as describe satisfy the SPSs/EMTs? 3. Does the CM, as describe, satisfy the domain-specific design? 4. Are the risks known and manageable for Dev/ Ops Piloting/ 5. Is the CM schedule executable? 6. Are the allocated baseline products adequately documented?

In addition to the above SE reviews, the NECC JPM will conduct additional technical reviews including DISA's Systems Engineering Readiness Reviews (SERR) and independent technical reviews. Table 5 shows the anticipated independent technical reviews, review chair, expected participants, and frequency of reviews. A NECC SERR occurs at least once within an increment; an independent technical review occurs when directed by the JPM, JPEO, or MDA.

Table 5: Independent Reviews

Review	Chair	Participants	Results	Frequency
Systems Engineering Process Assessment (SEPA)	DISA/GE32	DISA/CTO DISA/GO NECC/JPMO	Status of SE activities & recommendations from GE32	Yearly
Technology Readiness Assessment (TRA) review	OSD/DDRE & DISA/CTO	JPMO prepares assessment and CTO provides independent review and report forwarded to DDRE	Approval of TRA for milestone decision approval or recommendations for further assessment of technology maturity	MS-B
Net-Centric Review	NII	JPMO CTO	Assessment of compliance with Net-Centric Checklist and list of actions	Yearly
IPRs & OIPTs	OSD & DISA	JPMO and other NECC stakeholders	Feedback on program status & recommendations for going forward	As requested (expected to be at least quarterly)

This subsection will be expanded in a later SEP revision to generally describe items that are to be addressed in the reviews (DIL considerations, cost containment, etc.).

4.4.4 Configuration Control Boards and Engineering Review Boards

The NECC program employs two levels of CCBs: one at the Program/Increment level (referred to as the NECC CCB) chaired by the JPM, and one CM level CCB per CPMO chaired by the CPMs. The Program/Increment CCB controls NECC's Technical Baselines, including Product Baseline capabilities to be delivered by individual CMs. The CM level CCBs control the internal baselines for individual CMs.

The NECC Program/Increment level CCB membership includes representatives from the JPMO, USJFCOM, and each CPMO as depicted in Figure 41.

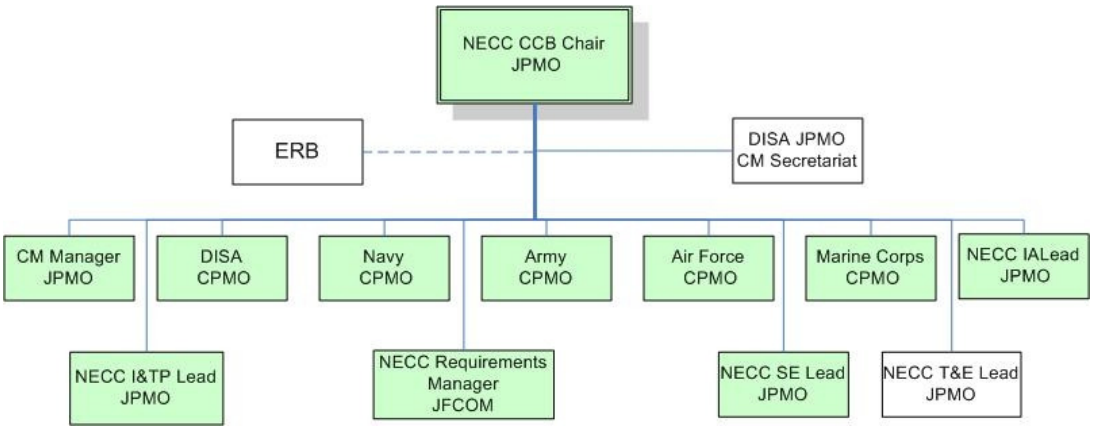


Figure 41: NECC Program/Increment Configuration Control Board Organization

The NECC Program/Increment CCB has the following responsibilities:

- Establish, maintain, approve, and manage the Technical Baselines that are under formal configuration management control
- Review, assess, and dispose of Change Requests (CR). (The NECC Program/Increment CCB uses an ERB, chaired by the NECC CE, to conduct a technical review of certain CRs before determining their disposition.)
- Function as the responsible authority for approving changes to a CM's Product Baseline
- Establish the CM level CCBs, one per CPM for the CMs under the CPM's purview, that is similar in function to the NECC Program/Increment CCB (When a CM CCB encounters a configuration control item that affects other CMs or the NECC Technical Baselines, then the CPM will elevate the issue to the NECC Program/Increment CCB.)
- Ensure that interface and interoperability issues are identified and resolved in a timely manner

The NECC Configuration Management Plan is in an early development stage but will be updated for Increment 1.

4.4.5 Governance of the FDCE Stages

The decision authority who approves a CM's advancement through the FDCE maturity stages changes as the maturity level changes. Regardless of the approval authority, NECC's I&TP functional area governs the conduct of CPAS piloting events. This includes all types of piloting, from UFPs to CPEs and eventually OCEs.

The governance authorities for each CPAS maturity stage (refer to subsection 2.5 above for a definition of each stage) are as follows:

1. **The Development Stage** focuses on initial CM development, debugging, and technical exploration. The JPM and CPMs are both resources to draw from during this CPAS stage. Testers observe and review results for verification and reports findings to a governance body chaired by the NECC I&TP staff. As the chair of this governance body, the JPM is the

decision authority for transitioning a CM to the Developmental Piloting stage. At a minimum, this governance body is comprised of representatives from SE, T&E, Ops & ILS, CPMOs, USJFCOM, and IA.

2. **The Developmental Piloting Stage** focuses on testing and certifying a CM's net-ready status. The responsibility to plan and manage piloting events during this stage falls within the NECC I&TP functional area. The JST stands-up CM Test Teams (CMTT) to execute (as necessary) T&E activities, review test results for verification, and make a transition recommendation. The JST chairs the governance body and is the decision authority for transitioning a CM to Operational Piloting. This body includes representatives from I&TP, SE, T&E, CMTTs, TD Phase Support, CPMOs, USJFCOM, and IA.
3. **The Operational Piloting Stage** focuses on a CM's operational maturity and utility. For this CPAS stage, I&TP and T&E serve the same roles as in the Developmental Piloting Stage. The MDA chairs the governance body and is the decision authority[16] within the governance body for deciding whether a CM is ready to be placed into operational use. The governance body includes representatives from the JPM, USJFCOM, CPM, OTA, JPEO, and OASD(NII) organizations.

The roles and responsibilities of the communities involved in the FDCE stages are as follows:

- **Development Stage**
  - The JPM is the governance body chair and decision authority for transitioning a CM to Developmental Piloting
  - CPMOs and their selected materiel developers develop and test CMs, and prepare test reports
  - Warfighters participate in informal evaluations of CMs to provide feedback on CM performance to the JPMO and CPMOs
  - JST audits test reports to verify data that supports T&E stakeholder needs and prepares recommendations to support transitioning a CM to Developmental Piloting
- **Developmental Piloting Stage**
  - The JST is the governance body chair and decision authority for transitioning a CM to Operational Piloting
  - CPMOs and their selected materiel developers perform the bulk of the CM test and evaluation and prepare test reports
  - Warfighters participate in informal evaluations and piloting events for CMs to evaluate CM performance
  - JPMO I&TP plans and manages piloting events and prepares piloting event reports
  - JST audits test results and establishes/assigns CMTTs to perform CM testing when appropriate and prepares a recommendation to transition CM(s) to Operational Piloting

[16] It is expected that the MDA will delegate decision authority and the chair position to the CAE or JPEO.

- **Operational Piloting Stage**
  - The MDA[17] is the governance body chair and decision authority for transitioning a CM to deployment
  - CMTTs, as assigned by the JST, develop and execute detailed test plans
  - Warfighters participate in piloting events to evaluate CM performance
  - JPMO I&TP plans and manages piloting events and prepare piloting event reports
  - The CMTT prepares a CM Assessment Report to recommend and support a deployment decision
  - USJFCOM serves as an advisor to the MDA on deployment decisions. USJFCOM's JCD will provide an OFDM to the MDA based on operational and DOTMLPF-P considerations.

4.4.6 Test, Evaluation and Certification Governance

NECC employs a test team approach to coordinate and manage CM maturation activities through the CPAS stages. The management structure is:

- The Lead OTA (ATEC), JPMO, and JCCD tri-chair the JST. Other members include representatives from JPMO, CPMOs, Joint Interoperability Test Command (JITC), Joint Systems Integration Command (JSIC), OASD(NII), DOT&E, Designated Accrediting Authority (DAA), and others as appropriate. The JST develops and maintains a T&E plan that addresses T&E requirements for the increment and CDP. It also stands up and monitors CMTTs, and serves as the governance body for CM test and evaluation activities.
- The CMTTs are comprised of OTA and CPMO representatives who develop and implement detailed tests plans to test and evaluate CMs.
- The Lead OTA for the CMTT prepares Capability Module Assessment Reports (CMARs) at the conclusion of CM T&E activities to support the deployment decision for a CM.

The TEC Criteria is a core element of NECC's TEC strategy. It consists of an exhaustive inventory of possible CM evaluation criteria elements identified within the NECC CDD. The purpose of the TEC Criteria is to define the net-ready, information assurance, interoperability, performance, and mission capability criteria to support developmental and operational testing as well as piloting events for CMs. These criteria verify and validate that each CM is compliant with established policies, regulations, and documented operational requirements. Each criterion traces back to a specific capability or CDP-derived requirement.

The TEC Criteria provides a tool to help ensure that the following functions perform consistently and repeatedly:

- Testing is performed in an operationally relevant and distributed test environment to include, when appropriate, DIL environments
- Interoperability tests are certified

[17] It is expected that the MDA will delegate decision authority and the chair position to the CAE or JPEO.

- Conformance tests and service capabilities are verified
- Service capabilities are validated by an independent agent
- Interim authority to operate is provided
- Security test and evaluation is performed

Each criterion is tied back to a specific requirement. In some cases, the criterion will spell out specific legislation or DoD policy, such as conformance to the mandated standards in the current DoD Information Technology Standards Registry (DISR). Other criteria are a direct result of CDP requirements that the CM is attempting to fulfill. The CDP also provides performance standards that establish the basis for criteria to be included in the TEC Criteria.

The TEC Criteria is customizable to support the unique requirements of individual CMs and overall NECC objectives. It helps organize the criteria and requirements used to evaluate a CM at each maturation stage. For each CM, the TEC Criteria identify and select only those criteria that are appropriate for each FDCE maturity stage.

4.4.7 GCCS FoS Functionality Transition into the NECC Baseline Governance

Transitioning GCCS FoS functionality into NECC is another key objective of the NECC program. The GCCS FoS transition strategy is to leverage existing capabilities, where it makes prudent business sense, based on analysis and decision maker judgment. The same roles, responsibilities, and technical governance discussed in subsections 4.3 and 4.4 for developing CMs are applied to GCCS FoS components as they are considered for inclusion within the NECC Technical Baselines. Further information on the GCCS FoS functionality transition may be found in the *GCCS FoS to NECC Functionality Transition Plan.*

4.5 Baseline Management

NECC employs the following processes for managing its technical baselines: Requirements Management, Risk Management, Configuration Management, External Dependency and Integrated Master Scheduling processes. These processes are described below.

4.5.1 Increment Requirements

Managing NECC's operational and technical requirements baselines so that they are in alignment with program objectives requires agile, responsive management processes. USJFCOM established the JCCD organization for managing NECC's operational requirements. NECC JPMO uses Process Steps 2 through 4 and the Technical Baselines for establishing NECC's technical requirements, the Systems Engineering Reviews for approving technical requirements, and a CCB for managing technical requirements baselines.

JCCD Capability Needs Process

JCCD Capability Needs Process (CNP) enables USJFCOM, in collaboration with the C/S/As, to fulfill its mission to serve as the advocate for the Warfighter within the NECC program. Figure 42 illustrates the CNP phases that facilitate making DOTMLPF-P recommendations to the materiel developer, the C/S/As, and the Joint Staff.

Figure 42: JCCD Capability Need Process Phases

The Identify phase focuses on the Warfighter, who provides inputs to the JCCD to identify capability needs. These inputs are verified, assessed, and prioritized in the next three CNP phases and translate into specific DOTMLPF-P recommendations. In the Develop phase, the acquisition community, with JCCD assistance, uses these requirements to develop materiel solutions to address the identified needs. Some requirements may be addressed with non-materiel solutions. In such cases, DOTMLPF-P changes will be documented and, as required, submitted to the Joint Staff and/or C/S/As for resolution. The JCCD will participate in T&E activities to ensure that useful military capability is validated (Validate phase) prior to the capability being deployed (Deliver phase).

Refer to the JCCD Management Plan[18] for further information on CNP.

NECC Technical Requirements Management

The NECC SE process, described in subsections 3.1, 3.2, and 3.3, translates CDD operational requirements into a corresponding set of technical requirements. Subsections 4.3 and 4.4 address management and baseline governance.

NECC will use the Configuration Management process to ensure that requirements are properly tracked. The NECC Configuration Management Plan identifies more detailed procedures and items to be tracked for each increment. The Configuration Management process will also populate an NECC Technical Baselines repository. This repository includes an increment's technical requirements and contains the engineering artifacts and data elements associated with the Technical Baselines as well as other designated technical information from the JPMO and CPMOs. The NECC Technical Baselines repository will also support the generation of a Requirements Traceability Matrix (RTM) for T&E purposes.

4.5.2 Risk Management

DoD risk management involves the major activities of risk identification, risk analysis, mitigation planning, mitigation plan implementation, and tracking. Risk management for NECC incorporates these activities and bases them on DoD and industry best practices tailored to meet the needs of the NECC acquisition process. The NECC Risk Management Plan[19] (RMP) discusses the formal, forward-looking, and continuous risk management process that controls risks through risk mitigation planning and implementation rather than on risk avoidance, transfer,

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[18] JCCD Management Plan, Final Draft 7 Dec 06; Appendix A, p. A-1, https://gesportal.dod.mil/sites/necc/JCCD/default.aspx?RootFolder=%2fsites%2fnecc%2fJCCD%2fShared%20Documents%2fNECC%20JCCD%20Indoctrination&View=%7b965E7E59%2d36DB%2d4B1A%2dBA56%2d270B330F1224%7d

[19] Risk Management Plan , 20 July 2007, Version 1.0.0, URL: https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

or assumption. The procedures outlined in the DoD Instruction 5000.2, *Operation of the Defense Acquisition System*, and guidance set forth in the Risk Management Guide for DoD Acquisitions, Sixth Edition serve as the basis for this approach.

The NECC's PMDT manages and directs NECC cost, schedule, performance, issue resolution, and risk mitigation activities. The PMDT is responsible for implementing the NECC program's risk management process, and provides the forum for proposing new risk areas for analysis and mitigation. The JPM assigns a Risk Management Coordinator (RMC) to track and monitor all identified program risks, and periodically provide reports and recommendations to the PMDT for management consideration and mitigation. NECC risk management objectives include:

- Providing visibility into project threats/risks using a structured process
- Identifying increased risk due to development dependencies
- Integrating planning and deployment efforts
- Enabling stakeholders to address shared risks collaboratively
- Focusing management and technical resources on priority risks
- Providing a disciplined approach to program planning
- Providing a reporting and archiving system for risk information
- Controlling potential high-level risks consistent with program cost, schedule, and performance objectives

As shown in Figure 43, NECC's risk management and mitigation process follows an identification (risks identified can also be submitted by the larger NECC community for review), analysis, mitigation planning and implementation, and monitoring construct.

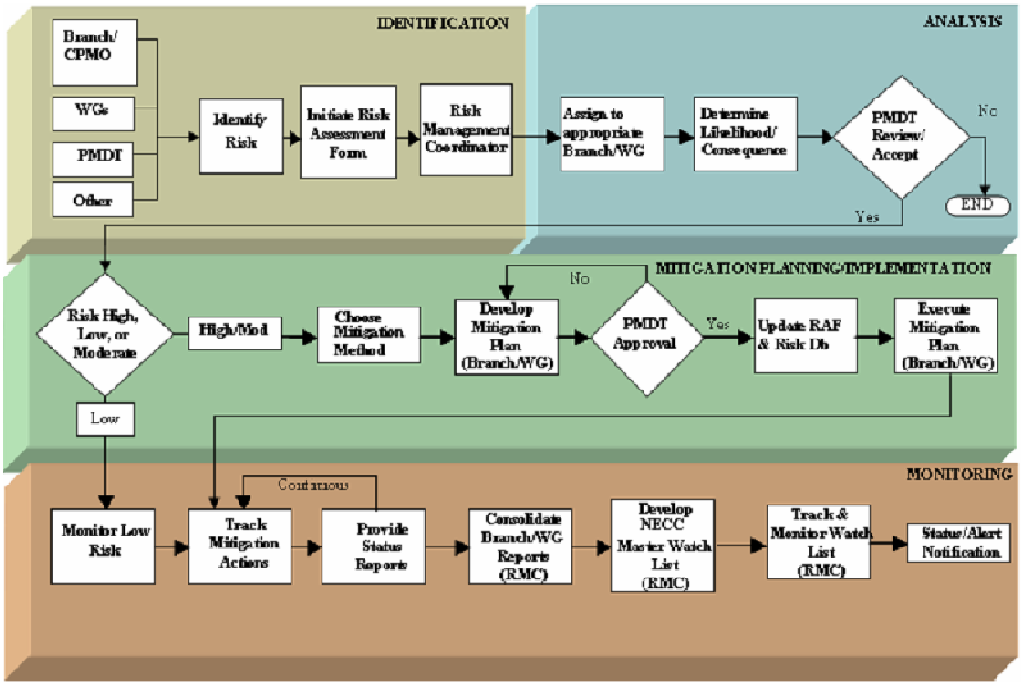


Figure 43: NECC Risk Management Process

The process and strategy provides *centralized* risk management identification, guidance, and system review throughout the acquisition process with *decentralized* risk planning, assessment, handling, and monitoring of individual risk events.

The basic risk management approach identifies high impact risk events, assesses existing actions, and recommends new actions to control risk events in order to avoid serious program impacts. NECC's risk management approach will mitigate risks and/or develop contingency plans in all program elements.

NECC uses the Risk Management Information System (RMIS) to support the NECC Risk Management Process, and to facilitate communicating, planning, and coordinating risk management activities. RMIS is an automated tool for tracking, monitoring, managing, and reporting risks.

4.5.3 Configuration Management

The JPMO establishes and manages the overarching NECC Program Configuration Management. In this capacity, the JPMO develops and implements configuration management policies and procedures that span across the materiel developer community. In this role, the JPMO has the authority to establish NECC's critical configuration items, such as CMs. The JPMO manages and controls CMs and their related artifacts as they move through the FDCE stages. CM-related artifacts are accessible via the FDCE.

The CPMOs, in their role as materiel developers, implement NECC Program Configuration Management policies and procedures that maintain adequate configuration control over CMs and their associated engineering software and hardware artifacts. While the JPMO does not dictate how the CPMOs will accomplish their configuration management responsibilities, the NECC SDD Phase CM Plan will provide a minimum set of guidelines that support NECC goals. The CPMOs will establish a Local CCB responsible for: (1) adjudicating CRs and maintaining configuration control of assigned CMs, (2) approving code changes that affect version numbers at the third or fourth digit, (The NECC CCB must approve changes that affect the first and second digit of a CM's version or changes that may affect the CM's interface), and (3) providing detailed information and recommendations on issues that must be elevated to the NECC CCB level.

The NECC CPMO materiel developer organizations include the Components' C2 system commands and agencies as well as other capability providers. Configuration management supports these materiel developers in maintaining, tracking, and providing status accounting of the configured environments and of the documents and other products that are part of the piloting environment. JPMO's TD Phase Support functional area maintains a configuration management repository at Space and Naval Warfare (SPAWAR) Systems Center (SSC) Charleston that supports NECC in conducting configuration management across the program.

Once a CM successfully completes the Operational Piloting maturity stage, it transitions to Technical Operations for pre-deployment staging in the repository. By this time, the JPMO, through its control process, has established a baseline for the CM. The baseline CM product resides in the configuration management repository at SSC Charleston. This baseline includes all software and CM related documents such as Technical Manuals, System and Database Administrator Guides, Operational User Manuals, Installation Procedures, Software Version

Descriptions (SVD), and Training Support Packages. Refer to the NECC Configuration Management Plan[20] for further information.

4.5.4 External Dependency Management

NECC is supported by and dependent upon external programs and agencies such as DISA's GES and NCES. These services enable shared access to Service, Agency, Joint-provided sources, and National Geospatial Agency's (NGA) map services. NECC's Acquisition Strategy addresses external dependency partnerships that include establishing MOAs between NECC and these other programs/organizations. An MOA contains, among other elements, the required NECC external dependency technical information specifics, needs schedule, governance mechanisms, and an issue resolution process. The NECC CE is responsible for overseeing the generation of technical content for an MOA while the PMDT reviews and approves negotiations. MOA execution monitoring is a JPMO Program Control responsibility that requires support from affected JPMO and CPMO organizations. The JPMO SE and TD Phase Support staff and their CPMO counterparts represent the predominant participants in monitoring MOAs.

4.5.5 Integrated Master Schedule and the Work Breakdown Structure

NECC employs an ANSI 748-compliant EVM system that includes the use of an IMS. The IMS is integrated with the program Work Breakdown Structure (WBS) to include the significant technical and programmatic activities across the program as well as selected CPMO and infrastructure deliverables. The IMS is used to track overall program progress against planned progress and is controlled through a formal configuration management process. Development of key systems engineering artifacts (e.g., CDPs, work packages, and EMTs) will be tracked with the IMS such that programmatic critical paths are identifiable. The IMS will be the authoritative source for program schedule status.

[20] The Configuration Management Plan is in an early development stage.

APPENDIX A – ACRONYMS

Acronym	Definition
ABC	Adopt-before-Buy, Buy-before-Create
AC	Advanced Concept
ACAT	Acquisition Category
ACTD	Advanced Concept Technology Demonstration
ADM	Acquisition Decision Memorandum
AoA	Analysis of Alternatives
APB	Acquisition Program Baseline
ATEC	Army Test & Evaluation Command
BFL	Blue Force Location
BPMN	Business Process Modeling Notation
C&A	Certification and Accreditation
C/S/A	COCOM/Service/Agency
C2	Command and Control
C2C	Command and Control Capabilities
C4I	Command, Control, Communications, Computers, and Intelligence
CAE	Component Acquisition Executive
CAIG	Cost Analysis Improvement Group
CARD	Cost Analysis Requirements Description
CCB	Configuration Control Board
CCS	Customer Communication Strategy
CDD	Capability Development Document
CDP	Capability Definition Package
CDR	Critical Design Review
CE	Chief Engineer
CIO	Chief Information Officer
CJCS	Chairman of the Joint Chiefs of Staff
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
CJCSM	Chairman of the Joint Chiefs of Staff Manual
CM	Capability Module
CMAR	Capability Module Assessment Report
CMTT	Capability Module Test Team

Acronym	Definition
CNP	Capability Needs Process
COCOM	Combatant Command
COI	Community of Interest
CONOPS	Concept of Operations
COTS	Commercial-Off-The-Shelf
CPAS	Capability Provisioning Activities
CPD	Capabilities Production Document
CPE	Capability Provisioning Event
CPM	Component Program Manager
CPMO	Component Program Management Office
CR	Change Request
CTIP	Component Technical Implementation Profile
DAA	Designated Accrediting Authority
DAE	Defense Acquisition Executive
DCID	Director of Central Intelligence Directive
DECC	Defense Enterprise Computing Center
DIACAP	DoD Information Assurance Certification and Accreditation Program
DIL	Disconnected, Intermittent, Limited-bandwidth
DISA	Defense Information Systems Agency
DISR	DoD Information Technology Standards Registry
DKO	Defense Knowledge Online
DoD	Department Of Defense
DoDAF	Department of Defense Architecture Framework
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DOL	Defense Online
DOT&E	Director, Operational Test and Evaluation
DOT_LPF-P	Doctrine, Organization, Training _ Leadership and Education, Personnel, Facilities, and Policy
DOTMLPF-P	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy
DT	Developmental Testing
DT&E	Developmental Test and Evaluation
EMT	Engineered Mission Thread
ERB	Engineering Review Board

Acronym	Definition
EVM	Earned Value Management
FDCE	Federated Development and Certification Environment
FDR	Fielding Decision Review
FoS	Family of Systems
FTP	Functionality Transition Plan
FY	Fiscal Year
GCCS	Global Command and Control System
GCN	GIG Computing Node
GES	GIG Enterprise Service
GIG	Global Information Grid
GNO	Global Network Operations
GOTS	Government-Off-The-Shelf
I&TP	Integration and Technical Piloting
IA	Information Assurance
IAS	Information Assurance Strategy
ICD	Initial Capability Document
ICE	Independent Cost Estimate
IEEE	Institute of Electrical and Electronics Engineers
ILS	Integrated Logistics Support
IMS	Integrated Master Schedule
IOT&E	Initial Operational Test and Evaluation
IRR	Increment Requirements Review
ISP	Information System Support Plan
IT	Information Technology
JC2	Joint Command and Control
JCA	Joint Capability Areas
JCCD	Joint Combat Capability Developer
JCD	Joint Capability Developer
JCIDS	Joint Capability Integration Development System
JCTD	Joint Capability Technology Demonstration
JETA	Joint Experimentation, Joint Test and Evaluations, and Advanced Concept Technology Demonstration
JITC	Joint Interoperability Test Command
JPEO	Joint Program Executive Officer

Acronym	Definition
JPM	Joint Program Manager
JPMO	Joint Program Management Office
JROC	Joint Requirements Oversight Council
JROCM	Joint Requirements Oversight Council Memorandum
JSIC	Joint Systems Integration Command
JST	Joint System Team
JTF – GNO	Joint Task Force - Global Network Operations
JTOCC	Joint Technical Operations Control Center
JWC	Joint Warfighting Center
KIP	Key Interface Profile
KPP	Key Performance Parameter
KSA	Key System Attribute
MAIS	Major Automated Information System
MCP	Mission Capability Package
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MNS	Mission Needs Statement
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOS	Measure of Suitability
MS	Milestone
MTP	Management Transfer Plan
NCES	Net-Centric Enterprise Services
NECC	Net-Enabled Command Capability
NEPA	National Environmental Policy Act
NETOPS	Network Operations
NGA	National Geospatial Agency
OASD(NII)	Office of the Assistant Secretary of Defense for Networks and Information Integration
OCE	Operational Capability Event
OFDM	Operational Fielding Decision Memorandum
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense

Acronym	Definition
OT	Operational Testing
OTA	Operational Test Activity
OTP	Operational Test Plan
OUSD(AT&L)	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
OV	Operational View (DoDAF)
PA&E	Program Assessment and Evaluation
PDR	Preliminary Design Review
PEO	Program Executive Officer
PESHE	Programmatic Environment, Safety, and Occupational Health Evaluation
PM	Program Manager
PMDT	Program Management Direction Team
PMO	Program Management Office
POR	Program of Record
PPBE	Planning, Programming, Budgeting and Execution
PPP	Program Protection Plan
PT&E	Piloting, Test, and Evaluation
RA/D/B	Requirements Analysis, Design, and Build
RMC	Risk Management Coordinator
RMIS	Risk Management Information System
RMP	Risk Management Plan
RTM	Requirements Traceability Matrix
SDD	Systems Development and Demonstration
SE	Systems Engineering
SEP	Systems Engineering Plan
SERR	Systems Engineering Readiness Review
SEWG	Systems Engineering Working Group
SLA	Service Level Agreement
SME	Subject Matter Expert
SOA	Service Oriented Architecture
SOP	Standard Operating Procedure
SOW	Statement of Work
SPAWAR	Space and Naval Warfare
SPS	Service Performance Specification

Acronym	Definition
SSC	SPAWAR Systems Center
STA	System Threat Assessment
T&E	Test and Evaluation
TAFT	Test, Analyze, Fix, and Test
TD	Technology Development
TDS	Technology Development Strategy
TEC	Test, Evaluation, and Certification
TEMP	Test and Evaluation Master Plan
TOR	Terms of Reference
TRA	Technology Readiness Assessment
TTP	Tactics, Techniques, and Procedures
UFP	User Free Play
USC	United States Code
USD(I)	Under Secretary of Defense for Intelligence
USJFCOM	United States Joint Forces Command
WBS	Work Breakdown Structure
WG	Working Group
WIPT	Working-level Integration Product Team

APPENDIX B – APPLICABLE DOCUMENTS

Note: Access to the links listed below will depend on your user access privilege to them as well as to the storage of this document when saved.

Acquisition Strategy:

Acquisition Strategy, v1.0, 16 July 2007.

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

Architectural Framework:

Architecture Framework, 31 January 2007

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

Configuration Management Plan:

SDD Phase CMP, v1.0, 27 July 2007

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

IA Strategy:

Information Assurance Strategy, v1.0, 19 July 2007

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

Integration and Tech Piloting CONOPS:

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

JCCD Management Process:

https://gesportal.dod.mil/sites/necc/JCCD/default.aspx?RootFolder=%2fsites%2fnecc%2fJCCD%2fShared%20Documents%2fNECC%20JCCD%20Indoctrination&View=%7b965E7E59%2d36DB%2d4B1A%2dBA56%2d270B330F1224%7d

NECC CPAS CONOPS:

CPAS CONOPS, v0.11.2, 16 April 2007

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

NECC GCCS to NECC Functionality and Transition Plan:

FTP, v1.0, 13 August 2007

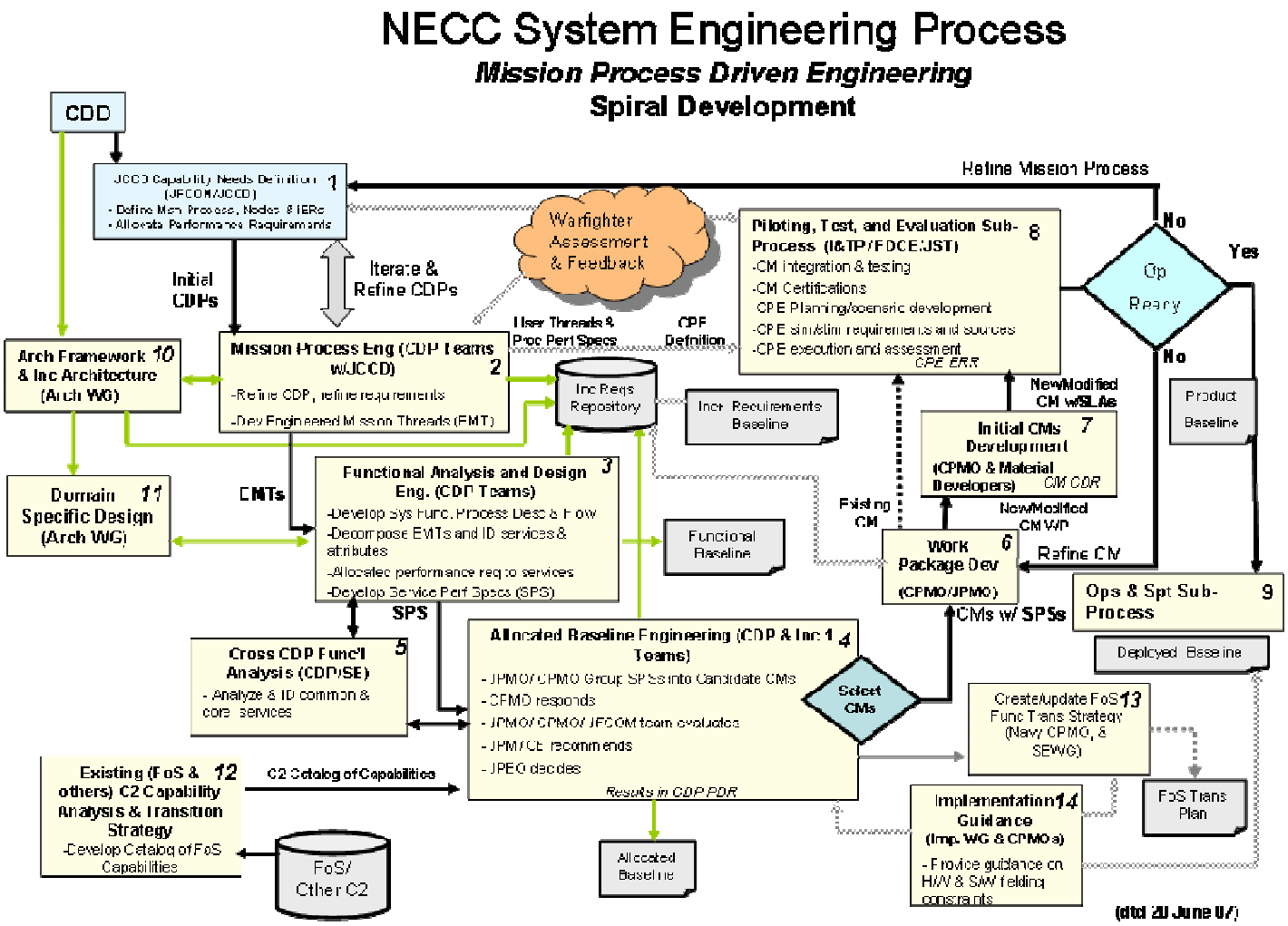
https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

NECC TEMP:

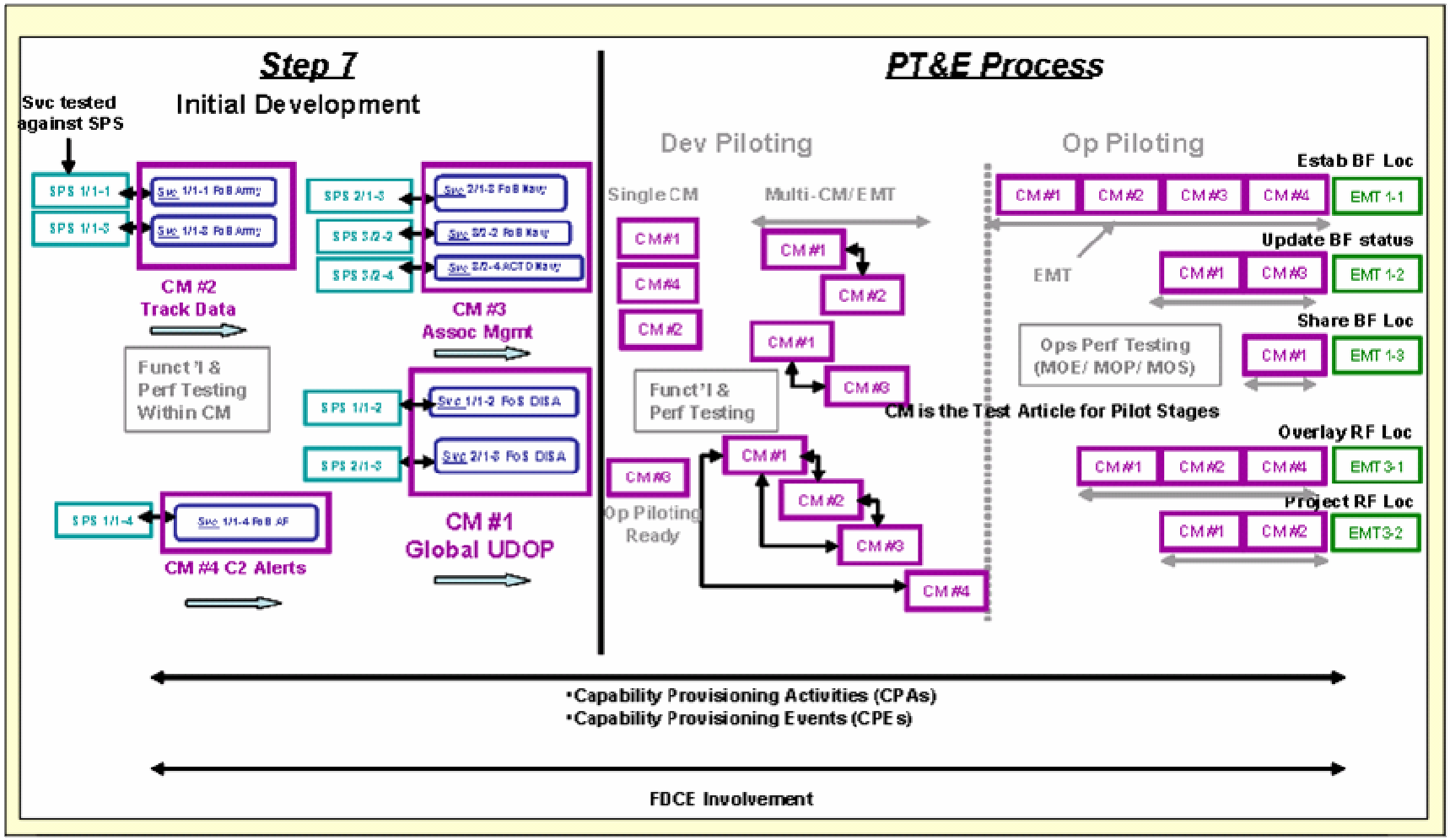
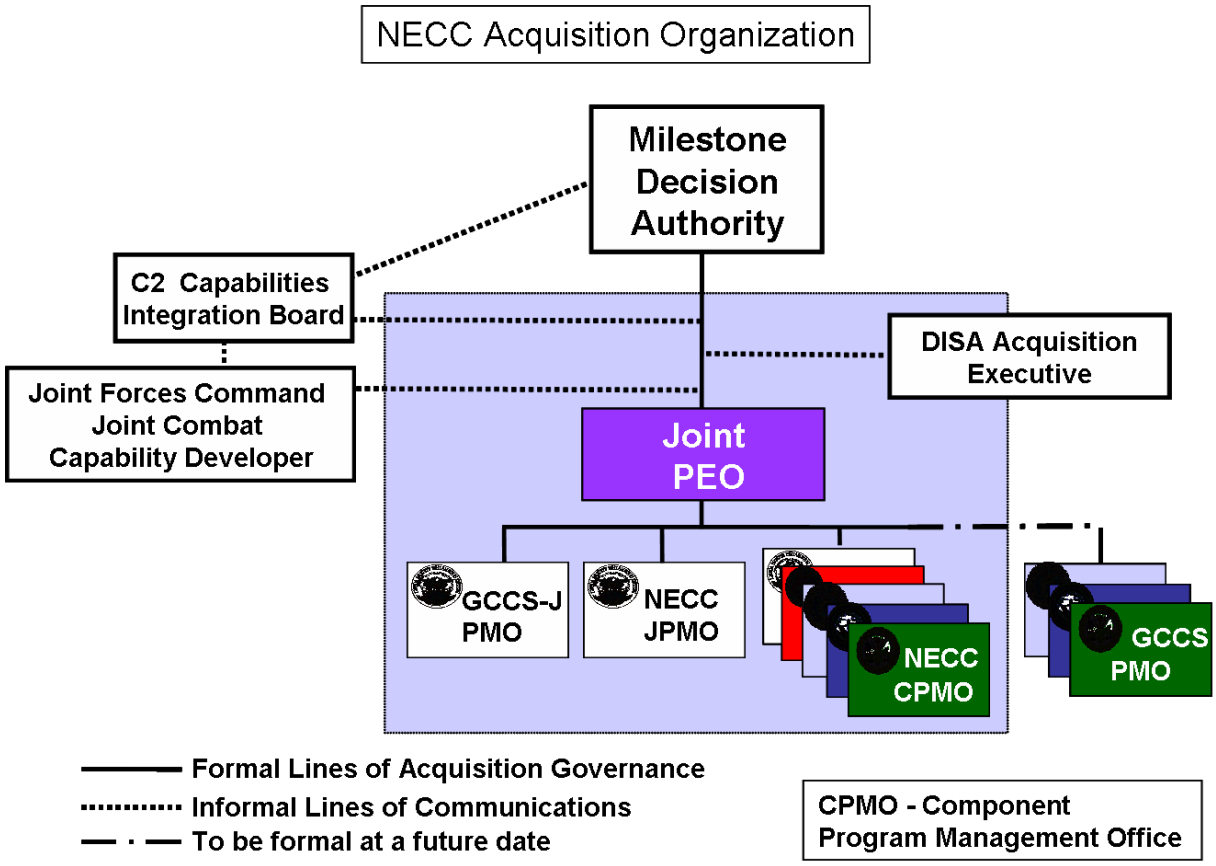
TEMP, v1.0, 6 August 2007

https://gesportal.dod.mil/sites/necc/doc_status/default.aspx

APPENDIX C – NECC SYSTEMS ENGINEERING PROCESS [BACK TO FIG 13]



APPENDIX D – NOTIONAL ACTIVITIES LEADING TO CERTIFICATION AND DEPLOYMENT [BACK TO FIG 23]



APPENDIX E – NECC ACQUISITION ORGANIZATION