Applying CMMI, Software Architecture Principles, and Process Improvement in a DoD Acquisition

SEPG Conference
March 2007
Presentation Overview

Brief background of the Common Link Integration Processing (CLIP) program

Discuss techniques used in acquisition to support CLIP’s goals and objectives

Lessons learned from the acquisition
CLIP Program Background
CLIP Background

- Cooperative Navy and Air Force program to develop common tactical data link (TDL) message processing software for air, ship, and shore platforms
- Provides non-invasive TDL functionality for TDL-disadvantaged platforms
- Facilitates communications between TDLs and IP-based communications to enable Network Centric Warfare
- Developed in 4 increments with increasing message processing and host platform interfaces
- Open, layer architecture design is Software Communication Architecture (SCA) compliant and can be hosted on multiple computing environments
CLIP Goals and Objectives

- Enhanced interoperability
- Lower cost and faster time to fielding
- Insulate Host from terminal/radio and TDL standards changes
- Provide a common link-independent host interface
- Architecture supports key architectural qualities
- Based on a software product line development approach
Acquisition Strategies Used for CLIP
Strategy Used in Acquisition

Pre-Contract

- Acquisition Planning Workshop
- DoD 5000 Acquisition Documents for Milestone B
- Development of an acquisition timeline
- CDRL development/definition

Contract monitoring

- Evaluation/Appraisal techniques
- Risk management
- CDRL review
Coordinated Use of SEI Methods and Training in CLIP Acquisition

Joint Training in Software Architecture, ATAM Evaluation, and CMMI

SCAMPI B appraisal (annual)

Software Product Line Approach

The ATAM-based evaluation should cover the ability of the architecture to support future increments.

Increment 1

Increment 2

Increment 3

When detailed design is complete

RFP Preparation

This QAW is conducted with government stakeholders.

Summarize Architecture Evaluation

Technical Proposals

Competitive Solicitation

QAW Report

QAW #1

RFP

Acq Planning Workshop

Source Selection

QAW Report

QAW #2

ATAM #1

Contract Award

Increment 1

ATAM #2

SAD

ATAM #3

SAD

Increment 2

Increment 3

Eval. Report #1

Eval. Report #2

Eval. Report #3

QAW Report

Software Architecture Documentation (SAD)

Increment 1

Increment 2

Increment 3

When detailed design is complete

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Summarize Architecture Evaluation

Technical Proposals

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QAW Report

QAW #1

RFP

Acq Planning Workshop
Key DoD 5000 Acquisition Documents

- Acquisition Strategy/Plan (AS/AP)
- Test and Evaluation Master Plan (TEMP)
- Source Selection Plan (SSP)
- System Engineering Plan (SEP)
- Request for Proposal (RFP)
System Engineering Plan

Initially tried to model CMMI v1.1
Next tried mapping EIA-632 to the program’s CDRLs—too complicated/confusing and resource intensive
Guided by OSD for System Engineering Plan
Revised System Engineering Plan focused on 4 process areas
  • Risk management
  • Measurement and analysis
  • Architecture evaluation (technical solution)
  • Interface control (product integration)
Request for Proposal - 1

Section B

- Identified program milestones and associated exit criteria with ties to award fee

Statement of Work (SOW)

- IEEE/EIA 12207 Software Life Cycle Processes
- Capability Maturity Model Integration (CMMI)
- Quality Attribute Workshop (QAW)
- Architecture Tradeoff Analysis Method (ATAM)
Sections L and M

- Technical solution, Program Management Plan (PMP), Process Improvement Plan (PIP), Integrated Master Schedule (IMS), Risk Management Plan (RMP)

Contract Data Requirements List (CDRLs)

# IEEE/EIA 12207 Software Life Cycle Processes

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<th>Software Integration</th>
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<td>Software Qualification Testing</td>
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CMMI Requirements - 1

- CMMI- SE/SW/IPPD/SS v1.1 (staged representation)

- Prime contractor shall have or obtain and maintain a minimum of SEI CMMI maturity Level 3 (Note: not current SEI guidance)

- Contractor team (subcontracted and interdivisional work) shall have a minimum combined maturity level of CMMI Level 2 rating

- If Contractor and team not at required levels at contract award, it shall be achieved within 12 months
CMMI Requirements - 2

On-site Government appraisal of Contractor’s processes no later than 9 months after contract award

- Compare proposal to actual CLIP program processes/practices
- Baseline capabilities for future

PIP

- For achieving and maintaining the required process discipline
- Commitment to process improvement
- Identifies current assessed CMMI levels of Contractor and team

Annual SCAMPI B appraisals

- Verify Contractor is following their processes
- Measure continuous process improvement
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CLIP Timeline

All aspects of the Earned Value Management System were addressed

1) System Requirements Document
2) Quality Attribute Workshop
3) System Architecture and Requirements Allocation Description
4) Software Development Plan
5) Program Management Plan
6) Configuration Management Plan
7) Process Improvement Plan
8) Risk Management Plan
9) Requirements Traceability Matrix
10) System Engineering Management Plan

LEGEND
System Requirements Review(SRS), Integrated Baseline Review(IBR)
Preliminary Design Review(PDR), Critical Design Review(CDR)
Test Readiness Review(TRR), Program Acceptance Test(PAT)
System Integration Test(SIT), CLIP Acceptance Test(CAT)
Delivery Readiness Review(DRR)

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Contract Monitoring Activities

Quality Attribute Workshop
  • Requirement development and refinement

Annual SCAMPI B appraisals

Architecture Tradeoff Analysis Method
  • Technical solution

Joint training

Peer review participation

IPT communications/participation
Coordinated Use of SEI Methods and Training in CLIP Acquisition

Acquisition Planning and Preparation

Competitive Solicitation

Source Selection

Contract Performance Phase

Acq Planning Workshop

QAW #1

RFP

QAW Report

RFP Preparation

This QAW is conducted with government stakeholders.

Competitive Solicitation

Source Selection

Software Architecture Principles, and Process Improvement in a DoD Acquisition

Increment 1

Increment 2

Increment 3

Joint Training in Software Architecture, ATAM Evaluation, and CMMI

SCAMPI B appraisal (annual)

Software Product Line Approach

The ATAM-based evaluation should cover the ability of the architecture to support future increments.

When detailed design is complete

Software Architecture Documentation (SAD)

ATAM #1

ATAM #2

ATAM #3

Eval. Report #1

Eval. Report #2

Eval. Report #3

QAW Report

Contract Award

QAW #2

SAD

SAD

SAD
Quality Attributes Workshop

Provides a common forum for discussing quality attribute requirements and architectural implications

Gain stakeholder buy-in

Two QAWs were held

- Pre-RFP QAW – used to develop/refine requirements and develop technical evaluation questions and criteria for RFP
- Post-contract award QAW – used to gain a shared vision for the CLIP architecture and support requirement refinement
SCAMPI

Annual SCAMPI B appraisals of the contractor will be performed to determine their conformance to their processes.

Introduction to CMMI training course was taken by CLIP Program Office and Contractor personnel.

Six CLIP Program Office participated on SCAMPI B appraisal team.

SCAMPI evaluation team also include a SSTC SEPO representative and one of the contractor’s sub-contractor.
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<td>Engineering</td>
<td>Requirements Management, Requirements Development, Technical Solution, Product Integration, Verification, Validation</td>
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<tr>
<td>Support</td>
<td>Configuration Management, Process and Product Quality Assurance, Measurement and Analysis, Decision Analysis and Resolution, Organizational Environment for Integration, Causal Analysis and Resolution</td>
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Legend
PAs covered.
Architecture Tradeoff Analysis Method

Increase communication among stakeholders

Clarify quality attribute requirements

Identify software risks early in the development cycle

Provide documented basis for architectural decisions
Risk Management

The Risk Management Plan was the first CDRL submitted and signed off on because of its importance to the program

Joint risk management process

Monthly Risk Review Boards

Open communication (risk is not a 4-letter word)

Value to the program by providing visibility to other program offices and senior management
CDRL Implementation Concerns

Delivery aspects of CDRLs

- Frequency
- Date of First Submission
- Date of Subsequent Submission are filled in

Ability of the program office to support the reviews

How are communications between CDRL developers and the associated program office IPT representatives?

The review process was revised between PDR and CDR milestones to improve the process to make sure the content of the documents satisfied the expectations of both sides.
Lessons Learned
RFP and Proposal Review Lessons

Cost realization of proposals
Source selection plan
Number of CDRLs and which are important
Having a concept of a technical solution
Software estimation and productivity factors
Proposal presentations
Contract Monitoring Lessons

Identify a few important metrics

Direct team focus to concentrate on metrics

Software estimation and productivity factors
Summary

Pro-active planning at the RFP stage lays the foundation for the contract monitoring phase

Cost proposals are very difficult to develop and even more difficult to provide cost realism to, so the program office needs to convey as clear and complete a picture of the acquisition, as possible, in the RFP.

Identify the three or four most important items for the government program office to try to accomplish during the acquisition and focus on those items.

Communication between the program office and the contractor’s team needs to be continuously after contract award, like risk management, so that expectations can be set appropriately within the program, as well as for those external to the program.
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