Systems Engineering (SE) in Early Development Planning for the Automated Aerial Refueling (AAR) Project

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Background

- AFRL AAR II Program Developing Requirements
  - System and Segment Level
  - Safe KC-135 Fleet Refueling Via Boom and Receptacle
    - Minimal Tanker Modifications
  - Future Unmanned Aerial Vehicles (UAV)
  - Rationale & Sensitivity Analyses Included
    - Since Future Transition Platform Not Yet Defined

- Three AAR Segments
  - Tanker
  - Receiver
  - Mission Control Station (MCS)
    - Operated by an Air Vehicle Operator
Presentation Outline

- AFRL Science & Technology (S&T) SE
- Early Development Planning for Future Platforms
- Automated Aerial Refueling (AAR) Project
- Functional and Segment Level Physical Architecture
- Configuration Item Architecture and Requirements
- AAR Preferred System Concept (PSC)
- AAR System/Subsystem Design Description (SSDD)
- Benefits of S&T SE to Support Development Planning
Draws upon AFRL’s Process Based Framework
- Uniquely Tailored to AFRL’s S&T Mission
  - SE Rigor Appropriate to S&T Program
- Recognizes that Technology Must be “Systemized” to Enable Capability
- Facilitates Technology Transition -- Turning Technology into War Winning Capabilities
- Enables Necessary S&T Influence Across Acquisition Life Cycle
  - What We Do Today Is the Basis of Future System Acquisition
S&T SE Process Consistent With Defense Acquisition Guide SE Processes

DAG Technical Mgmt Processes
- Decision Analysis
- Tech Planning
- Tech Assessment
- Requirements Mgmt
- Risk Mgmt
- Configuration Mgmt
- Data mgmt
- Interface Mgmt

“What We Do”
- Requirement Development
- Determine Requirements
- Establish S&T Criteria
- Logical Analysis
- Develop Technology Alternatives
- Design Solution
- Perform Value Analysis
- Develop and Demonstrate Technology
- Implementation
- Integration
- Verification
- Analyze and Deliver Project Results
- Validation

“How We Do It”

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AFRL S&T SE And The Acquisition Life Cycle

AF Requirements Generation
- Air Force Strategy, OPsCs, CRRA, CFMPs, Air Force S&T Strategy, Technology Horizons, Wargaming
  + Center Near-Term Requirements
  + MAJCOM Near-Term Requirements

Development Planning

AFRL Supports DP by:
- Providing Technology SMEs to XR-led DP Teams
- Further Decomposing Needs/Gaps into S&T Reqmts for Materiel Solutions
- Assisting with Analytical-Based Decision Assessments, Analysis of Alternatives, Studies and Strategies
- Performing Technology and Manufacturing Risk Assessments

Information & Knowledge

Capability Needs/Gaps

S & T Portfolio

JCIDS
CBA

Tech Push

Early SE
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AAR
National AAR Team

AARII Team Combines War fighters with Nationally Recognized Technologists

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AAR

Business Decisions
Agreement to pursue a material solution

Engineering Support
Preferred System Analysis
Preferred System Concept
Technology Maturation and Prototyping
System Level Specs
Preliminary Design
Completed Design

Material Solution Analysis
Technology Development

Uncertainty

Formal Program Start

“Pre-Milestone A and Early-Phase Systems Engineering”
Jan 2008

Systems Engineering is effective when it informs, and is informed by, other Acquisition process owners

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Will Accomplish:

- Systems Engineering Technical Reviews
  - System Requirements Reviews
  - System Functional Reviews
  - Technology Readiness Assessments
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Functional and Segment Level Physical Architecture

Inputs

System Requirements

Segment Requirements

DOORS

Collaborative Inputs

Operational Architecture

Functional Architecture

Segment Level Physical Architecture
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Configuration Item
Architecture and Requirements

Inputs

- System Requirements
- Segment Requirements

DOORS

Collaborative Inputs

- Operational Architecture
- Functional Architecture
- Segment Level Physical Architecture

PSC Activities

CORE

- Preliminary Receiver HWCI Architecture
- Preliminary Receiver CSCI Architecture
- Receiver HWCI Requirements
- Receiver CSCI Requirements

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PSC Design Process

1. Establish Design Objectives & Constraints
2. Conceptual Design
3. Establish Working Baseline Design
4. Engineering Design Analysis & Studies
5. Establish Preliminary Design
6. Working Baseline Maintains Configuration Control During Design & Analysis
7. Preliminary Design Established When Baseline Design Satisfactorily Closes
8. System/Subsystem Design Description (SSDD)
10. Failure Modes, Effects and Criticality Analysis (FMECA) Report
11. AAR Program Memorandums

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Path Ahead and Summary

- Some Refinement of PSC Working Baseline
  - Additional Analyses/Trades
  - Performance Characterization
  - Interface Definition

- Create SSDD

- Present final PSC design at Final System Requirements Review (FSRR)
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Benefits of S&T SE to Support Development Planning

- SE is Fundamental to Establishing the Right Technology Effort to Meet Customer Needs
- AFRL’s SE Process Uniquely Tailored to S&T Mission
- Understanding Critical Operational Needs/Gaps Crucial to Fully Understanding Requirements
  - Which is Critical to Selecting Appropriate Technology-Based Solutions
- Iterative Requirements Development Process is the Keystone to Overall Success
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