System of Systems Analysis of Future Combat Systems Sustainment Requirements

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FCS Sustainment

Design the system to be sustainable by the force

Design the System-of-Systems to sustain the force

Development of an individual system
Current Army force structure

Development of a System-of-Systems
Future Force – Unit of Action

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Agenda

- FCS and Army Transformation
- Supportability Performance
- Analysis Process and Examples
- Process Enablers
- Lessons Learned
- Questions
Leading Transformation

• The US Army “At War and Transforming”
  – 781,000 to 480,000 active duty since 1990
  – Forces currently deployed in 120 countries
  – Army’s transformation effort announced in Oct 1999
  – Leading implementation of network-centric operations
  – Driving Joint interdependency and standards

• FCS: Transformation in Multiple Dimensions
  – Warfighting, logistics, technology, business

FCS is a Complex System of Systems in a Transformational Warfighting Context

General Peter J. Schoomaker
Chief of Staff, U.S. Army
Reaffirming the Government’s Key Program Tenets

- Create opportunity for **Best of Industry** to participate
- Leverage government **Technology** base to maximum extent
- **Associate** on-going enabling efforts with LSI-Led activity
- **Collaborative Environment** from design through life cycle
- As a minimum, **Commonality** at subsystem/component level
- Design/plan for **Technology Integration and Insertion**
- Maintain and shape the **Industrial Base** for the future
- Retain **Competition** throughout future force acquisition
- **Appropriate Government Involvement** in procurement processes
- Consistent and continuous **Definition of Requirements**
- Maintain and shape government acquisition community
- Program **Affordability - Balance** performance and sustainment
- One team operating with **Partnership and Teamwork**

*The tenets remain constant: Applying them to the Current and Future Force*
Future Combat Systems

Manned Systems
- Infantry Carrier Vehicle
- Mounted Combat System
- Recon and Surveillance Vehicle
- Non-Line of Sight Cannon
- Non-Line of Sight Mortar
- FCS Recovery and Maintenance Vehicle
- Command and Control Vehicle

Unmanned Air Vehicles
- Class I
- Class II
- Class III
- Class IV

Unmanned Ground Vehicles
- Unattended Ground Sensors
- NLOS LS
- Unattended Munitions
- Intelligent Munitions System
- Unmanned Ground Vehicles
- ARV RSTA
- ARV Aslt
- Small (Manpackable) UGV
- Armed Robotic Vehicle
- MULE: (Transport)
- MULE: (Countermine)
- ARV-A (L)

Medical Treatment and Evacuation

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Supportability Performance

• **Supportability Performance Objectives**
  – Reduced Logistics Footprint
  – Reduced Demand for Maintenance
  – Reduced Demand for Supply

• **Enabled by**
  – Personnel Efficiencies
  – Improved Reliability/Availability
  – Lower Maintenance Ratio
  – Increase in Crew-performed Maintenance
  – Lower Consumption Rates
  – Part and supply Commonality
  – Self-Sustainment
  – Networked Sustainment
Supportability as a Quality of Firsts

• **See First**
  – The Networked Sustainment system “sees” supportability concerns before the warfighter

• **Understand First**
  – Networked Sustainment system understands the impact/influence of supportability concerns on the force

• **Act First**
  – Networked Sustainment system automatically presents Courses of Action (COAs) to the User to resolve supportability concerns
  – Automated initiation of COAs

• **Finish Decisively**
  – Networked Sustainment enables resolution of supportability concerns with minimal impact to force operation

• **Sustainment Concerns = need for and status of:**
  – Resupply
  – Maintenance
  – Combat Health Support
  – Human Resource Support
Sustainment Performance Analysis

- Integrate Army doctrine for supportability functionality into the FCS requirements baseline
- Apply FCS Networked Sustainment concept to the accomplishment of supportability functions in the UA

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Requirements Tree

Analysis establishes a strong foundation to support requirements development.
Analysis Focus

Product A
The set of Functions that define how FCS sustains the UA.

Product B
Product A validated against the CSS Battle Book

Product C
Product B captured in the SOS Specification

Product D
Product C captured in the Prime Item Development Specifications

System of Systems Spec
Prime Item & CI Development Specs
Preliminary Design
CI / CSCIs
Component Verification
Build

ORD, O&O, ASR, SEP, CDD

Requirements & Design
Integration & Verification

System of System Verification
Subsystem Integration Verification

Army Operational Validation

ORD, O&O, ASR, SEP, CDD

Requirements developed by:
- Army
- LSI / Suppliers

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Requirement Decomposition Process

Existing FCS Operational Analyses
- Architecture
- Integrated Processes

Army Doctrine
- Combat Service Support (CSS)
- Army FM 4-0
- Army Universal Task List (AUTL)
- Army FM 7-15

Outputs*:
- System Functional Requirements
- System Performance Requirements
- System Interface Requirements
- System Design Constraints

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Example – Human Resources Support

Combat Services Support
- Human Resources Support
  - Manning the Force
- Personnel Readiness Management
  - Replacement Operations Management
  - Personnel Accounting
- Personnel Information Management

Army Universal Task List
- Provide Human Resources Support
  - Man the Force
- Conduct Personnel Readiness Management
- Conduct Replacement Operations
- Provide Career Management
- Provide Personnel Information Management
- Manage DOD/DA Civilian Personnel

Distribute soldiers to subordinate commands based on documented manpower authorizations and the commander’s priorities. ART 6.6.1.1 involves the critical manning tasks of predict, resource, monitor, assess, and adjust.

- Upon prediction of a critical personnel manning vacancy based upon .... the FCS Networked System shall identify the vacancy to the Commander.
- Upon notification of a vacancy ... the FCS Networked System shall recommend assignments to fill critical personnel manning requirements.
- The FCS Networked System shall prioritize critical personnel manning data for the Commander’s assessment.
- The FCS Networked System shall collect critical personnel manning data in accordance with AR 220-1.
- The FCS Networked System shall recommend adjustment of critical personnel to distribute soldiers to subordinate UA commands.

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## Example – Dental Support

### Combat Services Support

<table>
<thead>
<tr>
<th>Health Service Support</th>
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<tbody>
<tr>
<td>Functional Areas</td>
</tr>
<tr>
<td>Medical Evacuation &amp; Regulation</td>
</tr>
<tr>
<td>Hospitalization</td>
</tr>
<tr>
<td>Health Service Logistics</td>
</tr>
</tbody>
</table>

### Army Universal Task List

<table>
<thead>
<tr>
<th>Provide Force Health Protection</th>
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<tbody>
<tr>
<td>Provide Combat Casualty Care</td>
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<tr>
<td>Provide Medical Treatment</td>
</tr>
<tr>
<td>Provide Hospitalization</td>
</tr>
</tbody>
</table>

### Dental Services

- Operational Care
- Emergency Dental Care
- Essential Dental Care
- Comprehensive Care

- Preventive Dentistry Support

Out of Scope For Unit of Action

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Prevent and treat dental disease and injury. ART 6.5.1.3 includes providing operational dental care, which consists of emergency dental care and essential dental care, and comprehensive care which is normally only performed in fixed facilities in CONUS or in at least a Level III facility.

- Provide Emergency Dental Treatment
  - Collect Emergency Dental data
  - Communicate Emergency Dental Data to MC4
- Provide Preventive Dental Support
  - Collect preventive Dental data
  - Communicate preventive Dental Data to MC4

Out of Scope For Unit of Action

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Analysis Summary and Results

- Original Sustainment requirements analysis based only on the ORD resulted in approximately 1100 requirements
- Incorporation of CSS and AUTL field manuals into the analysis process
- CSS/AUTL analysis clarified functionality not obvious in original ORD analysis
  - Human Resources
  - Information Management
    - Medical Support
    - Resupply
    - Maintenance
  - Planning functions
    - Resupply
    - Maintenance
- CSS/AUTL analysis derived an additional 950 SoS requirements
  - Represents 1/3 of the Sustainment Requirements in the specification

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Key Factors to a Successful Analysis

- The right mix of people … and personalities
  - Systems Engineers
  - System Designers
  - Logisticians
  - Soldiers
  - Facilitators

- Leadership commitment to a common set of goals
- Adequate planning and schedule
- Participants want to do the job and appreciate the value
- Maintain tangible results in-sight
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Lessons Learned

• It pays off when the time is taken to do the job right

• Indications the job was done right
  – Endures the “test of time”

• Sustainment analysis at the front end of the program as a major influence
  – Historically unusual for this level of Sustainment requirements analysis this early in a program
  – Sustainment requirements constitutes ~30% of System-of-System requirements on FCS

• Culture change within the Sustainment community … bigger culture change outside the Sustainment community
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