FRONT-END ANALYSIS: CORNERSTONE OF LOGISTICS

Presenter: Paul J. Nager, CPL
United Space Alliance
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FRONT-END LOGISTICS SUPPORT ANALYSIS

OVERVIEW

• WHAT IS ‘FRONT-END LOGISTICS SUPPORT ANALYSIS’?
• WHEN SHOULD IT BE PERFORMED?
• WHAT ARE THE BENEFITS OF PERFORMING FELSA AND WHY SHOULD IT BE DONE?
• HOW IS FELSA CONDUCTED?
• EXAMPLES
FRONT-END LOGISTICS SUPPORT ANALYSIS

DISCLAIMER NOTE: ALL HARDWARE ITEMS AND COST OR OTHER FIGURES ASSOCIATED WITH THEM IN THIS PRESENTATION ARE FICTIONAL AND ARE USED FOR ILLUSTRATIVE PURPOSES ONLY.
FRONT-END LOGISTICS SUPPORT ANALYSIS

2 DEFINITIONS OF LSA:

- LSA is an iterative analytical process by which the logistic support necessary for a new system is identified and evaluated. (Blanchard)

- LSA is the selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the system engineering and design process, to assist in complying with supportability and other ILS objectives. (Jones)

- Front-End LSA

- Logistics Support Analysis Record (LSAR)
FRONT-END LOGISTICS SUPPORT ANALYSIS

LSA GOALS AND OBJECTIVES

1. CAUSE LOGISTICS SUPPORT CONSIDERATIONS TO INFLUENCE DESIGN

2. IDENTIFY SUPPORT PROBLEMS & COST DRIVERS EARLY

3. IDENTIFY LOGISTIC SUPPORT RESOURCE REQUIREMENTS FOR SYSTEM LIFE

4. DEVELOP A SINGLE LOGISTICS SUPPORT DATABASE
FRONT-END LOGISTICS SUPPORT ANALYSIS

HOW THESE GOALS AND OBJECTIVES ARE ATTAINED

1. INFLUENCE DESIGN
   - IDENTIFY THE QUANTITATIVE CHARACTERISTICS
     • DEFINE PERTINENT QUANTITATIVE OPERATIONAL PARAMETERS
     • ESTIMATE THE SYSTEM/EQUIPMENT LIFE CYCLE COST (LCC)
   - OPTIMIZE THE SYSTEM/EQUIPMENT OPERATION AND SUPPORT (O&S) COST
     • EVALUATE ALTERNATIVE OPERATIONAL, MAINTENANCE, AND SUPPORT CONCEPTS (SIMPLIFY WHERE POSSIBLE)
     • PROVIDE QUANTITATIVE MODELING SUPPORT FOR DESIGN TRADE-OFFS
     • CONDUCT FORCE STRUCTURE/MANPOWER IMPACT ANALYSIS
FRONT-END LOGISTICS SUPPORT ANALYSIS

1. **INFLUENCE DESIGN (CONT.)**
   - OPTIMIZE THE SYSTEM/EQUIPMENT O&S COST
     - IDENTIFY & DOCUMENT THE OPTIMUM SYSTEM SUPPORT CONCEPT
     - ESTABLISH THE SYSTEM, SUBSYSTEM & ASSEMBLY MAINT. CONCEPT
       » MAINTENANCE SIGNIFICANT ITEMS LIST
       » LEVELS OF MAINTENANCE AND REPAIR VS DISCARD POLICY
       » DIAGNOSTIC CONCEPT (TESTABILITY REQUIREMENTS)

2. **IDENTIFY SUPPORT PROBLEMS AND COST DRIVERS EARLY**
   - DETERMINE SUPPORTABILITY, COST AND READINESS DRIVERS
   - CONDUCT SUPPORTABILITY RISK ASSESSMENT (SENSITIVITY ANALYSIS)
   - IDENTIFY LOGISTIC SUPPORT RESOURCE CONSTRAINTS
   - DETERMINE AVAILABILITY OF EXISTING SUPPORT RESOURCES
FRONT-END LOGISTICS SUPPORT ANALYSIS

3. **IDENTIFY LOGISTIC SUPPORT RESOURCE REQUIREMENTS FOR SYSTEM LIFE**

- ESTIMATE THE MANPOWER & PERSONNEL REQUIREMENTS
- DEFINE TRAINING REQUIREMENTS
- DEFINE TRANSPORTABILITY REQUIREMENTS
- DEFINE FACILITY REQUIREMENTS
- IDENTIFY AND DOCUMENT NEW OR CRITICAL LOGISTICS SUPPORT RESOURCES
  - PECULIAR TOOLS AND SUPPORT/TEST EQUIPMENT
  - TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT
  - COMMON TOOLS AND TEST EQUIPMENT
FRONT-END LOGISTICS SUPPORT ANALYSIS

FROM

Design the System

Design the Support

Combine System and Support

SEQUENTIAL ENGINEERING

TO

Design the System

{[analysis] [redesign] [update]}

Design the Support

Integrated System and Support

CONCURRENT ENGINEERING (INTEGRATED)
FRONT-END LOGISTICS SUPPORT ANALYSIS

- By End of Concept Studies:
  - 70%

- By End of System Definition:
  - 85%

- By End of Full-scale Development:
  - 90%

Decision Affecting Cost

System Life Cycle (Years)

$
FRONT-END LOGISTICS SUPPORT ANALYSIS

FRONT-END LSA IN SUPPORT OF ACQUISITION MILESTONES AND PHASES

PHASE 0
Determination of Mission Need

PHASE I
Concept Exploration and Definition

PHASE II
Demonstration and Validation

PHASE III
Engineering and Manufacturing Development

PHASE IV
Operations and Support

MILESTONE 0
Concept Studies Approval

MILESTONE I
Concept Demonstration Approval

MILESTONE II
Development Approval

MILESTONE III
Production Approval

MILESTONE IV
Major Modification Approval

PDR CDR

FRONT-END LSA

FRONT-END LSA
FRONT-END LOGISTICS SUPPORT ANALYSIS

HOW FRONT-END LSA IS PERFORMED

- FRONT-END ACTIVITIES AND PRODUCTS
  - PARTICIPATE IN USE STUDY
  - FORM BASELINE COMPARISON SYSTEM (BCS)
  - DATA GATHERING
  - ASSIST IN FORMING THE MAINTENANCE CONCEPT
  - EVALUATE ALTERNATIVES
  - CONDUCT REPAIR LEVEL ANALYSIS
  - PERFORM SENSITIVITY ANALYSIS
  - TRADE STUDIES/COMPARATIVE ANALYSIS
  - ESTIMATE MANPOWER & FORCE STRUCTURE IMPACTS
  - ESTIMATE LCC AND O&S COSTS
  - IDENTIFICATION OF COST AND SUPPORT DRIVERS
FRONT-END LOGISTICS SUPPORT ANALYSIS

REMEMBER,
THIS IS AN

ITERATIVE
PROCESS!

– MOST/MANY OF THESE ACTIVITIES AND PRODUCTS MUST BE REPEATED OR UPDATED AS THE DESIGN MATURES AND DATA IMPROVES

• THE BETTER THE DATA, THE BETTER THE ESTIMATES
FRONT-END LOGISTICS SUPPORT ANALYSIS

**EXAMPLE**

**SUPPORTABILITY, COST, & READINESS DRIVERS**

**RELIABILITY DRIVERS:**

<table>
<thead>
<tr>
<th>LINE REPLACEABLE UNIT</th>
<th>FAIL/OP LIFE</th>
<th>%/SYSTEM FAILURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER SUPPLY</td>
<td>651</td>
<td>17.02%</td>
</tr>
<tr>
<td>RELAY CARD ASSEMBLY</td>
<td>616</td>
<td>16.66%</td>
</tr>
<tr>
<td>DC/DC CONVERTER</td>
<td>369</td>
<td>9.83%</td>
</tr>
</tbody>
</table>

**COST DRIVERS:**

<table>
<thead>
<tr>
<th>LRU</th>
<th>UNIT COST</th>
<th>COST/OP LIFE</th>
<th>%/SYSTEM COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROCESSOR ASSY</td>
<td>$32,150</td>
<td>$17,182,000</td>
<td>18.37%</td>
</tr>
<tr>
<td>POWER SUPPLY</td>
<td>$3,680</td>
<td>$18,957,000</td>
<td>17.58%</td>
</tr>
<tr>
<td>AFT MODULE</td>
<td>$7,265</td>
<td>$9,235,000</td>
<td>6.34%</td>
</tr>
</tbody>
</table>
FRONT-END LOGISTICS SUPPORT ANALYSIS

EXAMPLE: SUPPORTABILITY TRADE-OFF

Alternative Maintenance Concepts (System Level):

1. Two-Level: Organizational: Remove/replace LRUs at failure
   Depot: Repair LRUs

2. Three-Level: Org: R/R LRUs
   Intermediate: Screen LRUs/Discard selected failed LRUs
   Depot: Repair selected LRUs

3. Contractor Repair: Org: R/R LRUs
   Contractor: Repair LRUs
EXAMPLE: ALTERNATIVE MAINTENANCE CONCEPTS OPERATIONS & SUPPORT COST SUMMARY (SYSTEM LEVEL)

1. TWO-LEVEL = $18,783,800

2. THREE-LEVEL = $22,326,100

3. CONTRACTOR REPAIR = $35,155,600
FRONT-END LOGISTICS SUPPORT ANALYSIS

EXAMPLE: LEVEL OF REPAIR ANALYSIS (LORA)

COST SUMMARY ($,000)

<table>
<thead>
<tr>
<th>LRU</th>
<th>CONTRACTOR REPAIR</th>
<th>DEPOT REPAIR</th>
<th>DISCARD</th>
<th>RECOMMEND</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROC. CCA</td>
<td>920</td>
<td>937</td>
<td>973</td>
<td>CONTRACTOR</td>
</tr>
<tr>
<td>INTERFACE CCA</td>
<td>876</td>
<td>859</td>
<td>892</td>
<td>ORGANIC DEPOT</td>
</tr>
<tr>
<td>HIGH SPD PROC</td>
<td>925</td>
<td>908</td>
<td>947</td>
<td>ORGANIC DEPOT</td>
</tr>
<tr>
<td>CABLE ASSY</td>
<td>767</td>
<td>815</td>
<td>743</td>
<td>DISCARD</td>
</tr>
<tr>
<td>POWER SUPPLY</td>
<td>1,895</td>
<td>1,950</td>
<td>2,015</td>
<td>CONTRACTOR</td>
</tr>
</tbody>
</table>
EXAMPLE: SENSITIVITY ANALYSIS

Life Cycle Cost, $ Millions

Baseline .90 .80

Unit Cost Sensitivity

Investment Costs  Oper & Sup Cost
FRONT-END LOGISTICS SUPPORT ANALYSIS

EXAMPLE:

SENSITIVITY ANALYSIS

<table>
<thead>
<tr>
<th>LCC IN $ MILLIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
</tr>
<tr>
<td>130</td>
</tr>
<tr>
<td>120</td>
</tr>
<tr>
<td>110</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
</tbody>
</table>

% CHANGE IN VARIABLES

- 25%  BASELINE  + 25%

MTBF  ❁ AOH  ❁ UNIT COST
FRONT-END LOGISTICS SUPPORT ANALYSIS

SUMMARY
- MUST BEGIN "UP FRONT"
- MAKES OTHER LOGISTICS ACTIVITIES MORE WORTHWHILE
- AN ITERATIVE PROCESS
- VERY DYNAMIC AND ALLOWS FOR CREATIVITY
- ANSWERS MANY QUESTIONS:
  - WHICH DESIGN IS MORE SUPPORTABLE?
  - HOW WILL THIS IMPACT MY MANPOWER/FORCE STRUC?
  - FORECAST SPARING QUANTITIES AND LOCATIONS
  - ESTIMATE OF LCC AND O&S COSTS
  - IS THE REPAIR CONCEPT SENSITIVE TO _____ (VARIABLE)?
  - WHAT ARE MY COST AND SUPPORTABILITY DRIVERS?
- TRULY A "VALUE-ADDED" FUNCTION