Decision Support Systems for Objective Stock Positioning

5 November 2003
OVERVIEW

- History
- Inventory and Transportation Costs
- SSF Decision Support Systems
- Management of Risk
- Enterprise Logistics Chain Simulation
- The Logistics Modernization Program
- Neural Networks for Demand & Repair Forecasting
- Status & Summary
HISTORY

FY99 - FY00: AMSAA proposals to develop Decision Support Systems in support of Single Stock Fund
- Requirements determination methodologies
- Stock positioning / returns disposition
- Stock control
- Support structure alternatives
- Credit policies

FEB 00: AMC memorandum “Stock Positioning Optimization - Readiness Targeted System (SPORTS)” published
- Single Stock Fund policies to support readiness and customer wait metrics

MAR 01: DALO-SMP memorandum supporting “SPORTS”

FY01 - FY02: AMC funds AMSAA to develop Decision Support Systems for cost effective Single Stock Fund stock policies that support “SPORTS” objectives
- Assist in implementation
## SINGLE STOCK FUND (SSF) MILESTONES (MS)

<table>
<thead>
<tr>
<th>Pre-SSF</th>
<th>SSF MS I/II</th>
<th>Post-SSF MS III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red River</td>
<td>Red River</td>
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<tr>
<td>San Joaquin</td>
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</table>

### Pre-SSF Milestones
- Depot Reorder Point, Requirements Objective, Repair Action Point
- Fair Share procurement distribution to Principal Distribution Sites
- Item Manager requisition referrals

### SSF MS I/II Milestones
- Enterprise Reorder Point, Requirements Objective, Repair Action Point computed by summing:
  - Depot values
  - Below Depot - **local, uncoordinated**
    - Includes all AMC demands
  - Fair Share procurement distribution only to Principal Distribution Sites
- Item Managers and search matrix requisition referrals
- Local retention rules
- Ad hoc Enterprise repair rules

### Post-SSF MS III Milestones
- Multi-Echelon Enterprise Requirements Determination
- Distribution / Redistribution
- Requisition Referral
- Returns Disposition
  - **Enterprise Retention Levels**
  - **Local Retention Levels**
- Coordinated Repair
Optimized/Improved Requirements Determination required

or

Projected MS3 Benefits of $453M will not occur.

5 Nov 2003

AMSAA
FUNDAMENTAL LOGISTICS CHAIN TRADEOFFS

- Readiness & Customer Wait Time (CWT)
- Inventory / Repair / Procurement Costs
- Transportation Costs
INVENTORY COSTS

Shipping a unit from a location can affect:

- Readiness and Customer Wait Time for location’s customers
- Future replenishment costs at location
  - Administrative ordering cost
  - Transportation cost for replacement unit
- Future repair costs for reparables
- Storage costs, if different at depot and below depot
- Future redistribution decisions

Not All Stock and Excess Created Equally

Affects when locations hit Reorder Point / Repair Action Point
TRANSPORTATION COSTS

- Processing / Administrative Costs at Shipper(s)
- Packaging Costs
- Shipping Costs
  - CONUS Modes of Shipment
    - Truck
    - Rail
    - Air Freight ( < 2500 lbs )
    - Small Air ( < 99 lbs )
    - UPS ( < 70 lbs )
  - Function of weight, volume, and distance (often nonlinear)
  - Function of priority
  - Economies of dedicated routes, transshipment and crossdocking

- Receipt Costs
TRANSPORTATION COSTS - EXAMPLE

- 250 pound item by truck from Ft. Hood to Ft. Polk

- Processing cost at Hood: $81

- Receipt cost at Polk: $32

- Packaging cost: $0 (still in depot package)

- Shipping cost for:
  - 1 unit: $104.10 ($34.70 / hundred-weight)
  - 2 units: $154.00 ($30.80 / hundred-weight)
  - 3 units: $243.70 ($30.46 / hundred-weight)
  - 4 units: $243.70 ($25.64 / hundred-weight)
TRANSPORTATION COST DATABASE

- FedEx / UPS / US Postal rates available on disk or web sites
- Defense Logistics Agency database for shipments from Principal Distribution Sites
- Military Traffic Management Command maintains only real time database for all Department of Defense Activity Address Codes
  - Negotiated rates
  - Standard tariffs
  - Method of shipment
  - Produces Bills of Lading
- Meeting with Military Traffic Management Command
  - Current access via e-mail
  - Fee for service

✓ AMC - Military Traffic Management Command negotiation for regular use
THE SSF DECISION SUPPORT SYSTEM JIGSAW

- RETURNS DISPOSITION
- REQUIREMENTS DETERMINATION
- REQUISITION REFERRALS
- DISTRIBUTION & REDISTRIBUTION

- READINESS,
- CUSTOMER WAIT TIME,
- INVENTORY COSTS,
- TRANSPORTATION COSTS
Decision Support System

Accepts as input the goals, tradeoffs, & constraints

Responds to changes in the goals, tradeoffs, & constraints
REQUIREMENTS DETERMINATION
DECISION SUPPORT SYSTEM

Goals / Objectives:

- Determine most cost effective asset levels and replenishment policies for Single Stock Fund sites to achieve Readiness, Customer Wait Time and Supply Performance Goals

Tradeoffs:

- Readiness, Customer Wait Time, Inventory Cost, Transportation Cost

Constraints:

- Centralized, coordinated, or local level calculations
Centralized Multi-Echelon Requirements Determination (Pull)
- Exact Multi-Echelon Readiness Based Sparing Model

Coordinated Multi-Echelon Requirements Determination (Pull)
- Single location computations with performance targets based upon multi-echelon performance and cost impacts

Enterprise Reorder Point, Requirements Objective, and Repair Action Point (Push)
- Distribution Decision Support System
- Optimistic in that it does not consider internal transport pipelines
- Most closely resembles what we do today

Ability to directly relate Supply Performance & Logistics Dollars to Readiness!
REQUIREMENTS DETERMINATION
BLUEPRINT

Coordinated Enterprise Computations

Multi-Echelon Trade-offs and Benefits

Post-SSF MS3
LMP Supply Planning

Get Performance Feeds from DLA

Data (Dmd & Rpr)

Performance (CWT/Fill Rate)

GCSS-A

RBS/SESAME

DS

DS

DS

Post-SSF MS3
LMP Supply Planning

Get Performance Feeds from DLA

Coordinated Enterprise Computations

Multi-Echelon Trade-offs and Benefits

Relate Dollars to Readiness

Data (Dmd & Rpr)

Performance (CWT/Fill Rate)
Cumulative Benefits $M
MS3 in Year 2

- $771M

Cumulative Benefits $M
No MS 3 or MS3 W/O RD* Change

- $318M

Optimized/improved Requirements Determination required

or Projected MS3 Benefits of $453M will not occur.
Excellence in Analysis

**MANAGEMENT OF RISK - NMCS REQUISITIONS**

Number of Not Mission Capable Supply (NMCS) Requisitions

Broken out by Cost of Part Requisitioned

<table>
<thead>
<tr>
<th>Cost of Part Requisitioned</th>
<th>Number of NMCS Requisitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$10</td>
<td>181,047</td>
</tr>
<tr>
<td>&lt;$50</td>
<td>112,946</td>
</tr>
<tr>
<td>&lt;$100</td>
<td>38,202</td>
</tr>
<tr>
<td>&lt;$500</td>
<td>54,397</td>
</tr>
<tr>
<td>&lt;$1K</td>
<td>11,212</td>
</tr>
<tr>
<td>&lt;$5K</td>
<td>12,042</td>
</tr>
<tr>
<td>&lt;$10K</td>
<td>2,491</td>
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<tr>
<td>&lt;$50K</td>
<td>2,491</td>
</tr>
<tr>
<td>&gt;=$50K</td>
<td>415</td>
</tr>
</tbody>
</table>

71% of NMCS Requisitions were for parts under $50.

Low $ Parts are causing Army Weapon Systems to be Not Mission Capable

LTTF and Army Science Board Recommend Readiness Based Sparing as Long Term Solution!
MANAGING RISK FOR ONE ITEM

Reorder Point 15
= 0

Safety Level = 15 Units

Lead Time Demand Distribution = Normal
Mean Lead Time Demand = 15 Units
Standard Deviation

PROBABILITY LEAD TIME DEMAND = X

X = Demand During the Lead Time

RISK OF BACKORDERS

For The Additional Safety Level Units

<table>
<thead>
<tr>
<th>Additional Safety Level Cost</th>
<th>Decrease in Risk of Backorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Cost per Unit Stocked = $1,000

Safety Level Cost = $0

Probability of NOT Filling all Demands During the Lead Time

50.0%
MANAGING RISK FOR ONE ITEM

Reorder Point $18 = 3$

Safety Level

Lead Time Demand Distribution = Normal
Mean Lead Time Demand = 15 Units
Standard Deviation = 4 Units

Probability Lead Time Demand = Cost per Unit Stocked

= Probability of Filling all Demands During the Lead Time
= Probability of Not Filling all Demands During the Lead Time

X = Demand During the Lead Time

Safety Level Cost = $3,000
Stock Availability = 77.3%

For The Additional Safety Level Units Stocked:
Additional Safety Level Cost = $3,000
Decrease in Risk of Backorders = 27.3%
Cost per 1% Reduction in the Risk of Backorders = $110

Safety Level Cost = Stock Availability = 77.3%

RISK OF BACKORDERS

X = Demand During the Lead Time

0 5 10 15 20 25 30

0% 2% 4% 6% 8% 10%

0 5 10 15

0% 20% 40% 60% 80% 100%

-15 -10 -5 0 5 10 15

0% 20% 40% 60% 80% 100%

50.0% 22.7%
MANAGING RISK FOR ONE ITEM

Reorder Point $\mathbf{21} = 6$

Safety Level $= 6$

Lead Time - Timing Distribution = Normal
Mean Lead Time Demand = 15 Units
Standard Deviation = 4 Units

Probability Lead Time Demand = 21
Cost per Unit Stocked = $1,000

Probabilities

- Probability of Filling all Demands During the Lead Time
- Probability of NOT Filling all Demands During the Lead Time

Safety Level Cost = $6,000
Stock Availability = 93.3%

For The Additional Safety Level Units Stocked:

- Additional Safety Level Cost = $3,000
- Decrease in Risk of Backorders = 16.0%
- Cost per 1% Reduction in the Risk of Backorders = $188

RISK OF BACKORDERS

Safety Level Units

- 93.3%
- 16.0%
- 6.7%

Cost per Unit Stocked

- $1,000
- $3,000
MANAGING RISK FOR ONE ITEM

Reorder Point $= 24$
Safety Level $= 9$

Lead Time Demand Distribution = Normal
Mean Lead Time Demand = 15 Units
Standard Deviation = 4 Units

Lead Time Demand Distribution = Normal
Mean Lead Time Demand = 15 Units
Standard Deviation = 4 Units

Safety Level Cost $= 9,000$
Stock Availability $= 98.8$

For The Additional Safety Level Units Stocked:
Additional Safety Level Cost $= 3,000$
Decrease in Risk of Backorders $= 5.5$
Cost per 1% Reduction in the Risk of Backorders $= 545$

$X = \text{Demand During the Lead Time}$

Probabilty of Filling all Demands During the Lead Time
Probabilty of NOT Filling all Demands During the Lead Time

Safety Level Cost $= 9,000$
Stock Availability $= 98.8$

For The Additional Safety Level Units Stocked:
Additional Safety Level Cost $= 3,000$
Decrease in Risk of Backorders $= 5.5$
Cost per 1% Reduction in the Risk of Backorders $= 545$

$X = \text{Demand During the Lead Time}$

Probabilty of Filling all Demands During the Lead Time
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For The Additional Safety Level Units Stocked:
Additional Safety Level Cost $= 3,000$
Decrease in Risk of Backorders $= 5.5$
Cost per 1% Reduction in the Risk of Backorders $= 545$
### MANAGING RISK FOR ONE ITEM

#### Reorder Point

**Reorder Point** 27  

**Safety Level** 12

<table>
<thead>
<tr>
<th>Lead Time Demand Distribution</th>
<th>Safety Level Cost</th>
<th>Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>$12,000</td>
<td>99.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean Lead Time Demand</th>
<th>= 15 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Deviation</td>
<td>= 4 Units</td>
</tr>
</tbody>
</table>

#### Probabilities

- **Probability of Filling all Demands During the Lead Time**: 80%
- **Probability of NOT Filling all Demands During the Lead Time**: 20%

#### Additional Safety Level Units

- **Additional Safety Level Cost Stocked**: $3,000
- **Decrease in Risk of Backorders**: 1.1%
- **Cost per 1% Reduction in the Risk of Backorders**: $2,727

#### Safety Level Cost

- **Safety Level Cost**: $12,000
- **Stock Availability**: 99.9%

#### Risk of Backorders

- **RISK OF BACKORDERS**
  - **Safety Level Units**:
    - 0%: 1.2%
    - 1%: 0.1%
  - **Cost per Unit Stocked**: $1,000

#### X = Demand During the Lead Time

<table>
<thead>
<tr>
<th>X</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>5</td>
<td>2%</td>
</tr>
<tr>
<td>10</td>
<td>4%</td>
</tr>
<tr>
<td>15</td>
<td>6%</td>
</tr>
<tr>
<td>20</td>
<td>8%</td>
</tr>
<tr>
<td>25</td>
<td>10%</td>
</tr>
</tbody>
</table>

#### Graphs

- Probability distribution of demand during the lead time.
- Graph showing the risk of backorders with safety level units.
MANAGING RISK FOR ONE ITEM

Reorder Point 30
= 15

Safety Level =

Lead Time Demand Distribution
= Normal
Mean Lead Time Demand = 15 Units
Standard Deviation = 4 Units

Probability LEAD TIME DEMAND =
Cost per Unit Stocked =

Probability of Filling all Demands During the Lead Time
Probablility of NOT Filling all Demands During the Lead Time

X = Demand During the Lead Time

Safety Level Cost = $15,000
Stock Availability =

For The Additional Safety Level Units Stocked:

Additional Safety Level Cost = $3,000
Decrease in Risk of Backorders = 0.12%
Cost per 1% Reduction in the Risk of Backorders = $25,000

Safety Level Cost =
Stock = 99.99%

X = Demand During the Lead Time
# OVER ALL 4 ITEMS: COST = $24,700 STOCK AVAILABILITY = 84.1%

<table>
<thead>
<tr>
<th>Item #1</th>
<th>Item #2</th>
<th>Item #3</th>
<th>Item #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocked = 19 Units</td>
<td>Stocked = 19 Units</td>
<td>Stocked = 19 Units</td>
<td>Stocked = 19 Units</td>
</tr>
<tr>
<td>Cost = $19,000</td>
<td>Cost = $1,900</td>
<td>Cost = $1,900</td>
<td>Cost = $1,900</td>
</tr>
<tr>
<td>Availability = 84.1%</td>
<td>Availability = 84.1%</td>
<td>Availability = 84.1%</td>
<td>Availability = 84.1%</td>
</tr>
</tbody>
</table>

PROBABILITY LEAD TIME DEMAND

For the same total cost, Increased Stock Availability by shifting stock from a higher cost item to lower cost items.

# OVER ALL 4 ITEMS: COST = $24,700 STOCK AVAILABILITY = 92.5%

<table>
<thead>
<tr>
<th>Item #1</th>
<th>Item #2</th>
<th>Item #3</th>
<th>Item #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocked = 18 Units</td>
<td>Stocked = 23 Units</td>
<td>Stocked = 22 Units</td>
<td>Stocked = 22 Units</td>
</tr>
<tr>
<td>Cost = $18,000</td>
<td>Cost = $2,300</td>
<td>Cost = $2,200</td>
<td>Cost = $2,200</td>
</tr>
<tr>
<td>Availability = 77.4%</td>
<td>Availability = 97.7%</td>
<td>Availability = 96.0%</td>
<td>Availability = 96.0%</td>
</tr>
</tbody>
</table>

PROBABILITY LEAD TIME DEMAND

OVER ALL 4 ITEMS:

COST = $24,700
STOCK AVAILABILITY = 84.1%

COST = $24,700
STOCK AVAILABILITY = 92.5%
MANAGEMENT OF RISK - NMCS REQUISITIONS

Number of Not Mission Capable Supply (NMCS) Requisitions

Broken out by Cost of Part Requisitioned

Notional Impact on NMCS Requisitions when shift the same Inventory Dollars from More Expensive Items to Less Expensive Items

Significant Decrease in the Overall Number of NMCS Requisitions

(All Army Logistics Intelligence File Records Nov-00 to Oct-01)
• Each Point Represents a “Least Cost” Solution
• Use for Performance or Budget Target
• Decreasing Marginal Returns
RESULTS WITH ALTERNATIVE SUPPORT STRUCTURES

Structure Achieved Dollars / Weight Reductions at Division ASLs for all alternatives

<table>
<thead>
<tr>
<th>Structure</th>
<th>Over All ASLs</th>
<th>Over the 17 Division ASLs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>RO Dollars</td>
<td>RO Weight</td>
</tr>
<tr>
<td>Base Case Current</td>
<td>$323.8M</td>
<td>10,986K</td>
</tr>
<tr>
<td>Alternative #1 New Corps ASL</td>
<td>- 5%</td>
<td>+ 0%</td>
</tr>
<tr>
<td>Alternative #2 New Corps ASL, No Non-Div ASLs</td>
<td>+ 22%</td>
<td>+ 6%</td>
</tr>
<tr>
<td>Alternative #3 DOL Supply Echelon</td>
<td>- 1%</td>
<td>+ 5%</td>
</tr>
<tr>
<td>Alternative #4 New Corps ASL, DOL Supply Echelon</td>
<td>+ 4%</td>
<td>+ 6%</td>
</tr>
</tbody>
</table>

Comparable Results for Non-Division ASLs

5 Nov 2003
RWT / OST SENSITIVITY ANALYSIS - ALTERNATIVE

**Base Case:**
- RWT (Depot to Corps ASL) 13 Days
- OST (Corps ASL to Hood ASLs) 13 Days
- OST (Corps ASL to Non-Hood ASLs) 13 Days
- Over all ASLs: $323.81 M, 10,986 K, 681K
- Over the 17 Division ASLs: $155.4 M, 7,453K, 382K

**Alternative #1:**
- Depots:
  - Hood DOL 13 Days
  - Non-Hood DOL 13 Days
- Corps ASL (Hood) 1 Day
- 13 Days
- Substantially reduces Division ASL "logistics footprint"
- Risk of increasing overall dollar value of III Corps ROs if not able to achieve 2 day OST

<table>
<thead>
<tr>
<th>Alternative</th>
<th>RWT (Depot to Corps ASL)</th>
<th>OST (Corps ASL to Hood ASLs)</th>
<th>OST (Corps ASL to Non-Hood ASLs)</th>
<th>Over all ASLs</th>
<th>Over the 17 Division ASLs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>$323.81 M</td>
<td>$155.4 M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10,986 K</td>
<td>7,453K</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>681K</td>
<td>382K</td>
</tr>
<tr>
<td>Alternative #1.1</td>
<td>13 Days</td>
<td>1 Day</td>
<td>2 Days</td>
<td>- 5%</td>
<td>- 65%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0%</td>
<td>66%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ 3%</td>
<td>63%</td>
</tr>
<tr>
<td>Alternative #1.2</td>
<td>13 Days</td>
<td>2 Days</td>
<td>2 Days</td>
<td>- 3%</td>
<td>- 60%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ 1%</td>
<td>- 65%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ 4%</td>
<td>60%</td>
</tr>
<tr>
<td>Alternative #1.3</td>
<td>13 Days</td>
<td>2 Days</td>
<td>5 Days</td>
<td>+ 1%</td>
<td>- 54%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ 4%</td>
<td>62%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+ 8%</td>
<td>57%</td>
</tr>
</tbody>
</table>
Goals / Objectives:
- Best distribution of stock from an AMC buy or repair program
- Economically redistribute assets to maintain field readiness in anticipation of future demand
- When / What / Where to redistribute

Tradeoffs:
- Readiness, Customer Wait Time, Inventory Costs, Transportation Costs, Stock at Different Locations

Constraints:
- Assets eligible for distribution / redistribution

Push System

Principal Distribution on Site Approach

Compute an Enterprise Reorder Point, Requirements Objective, and Repair Action Point, then Distribute
POSSIBLE DISTRIBUTION / REDISTRIBUTION RULES

- Use SESAME to minimize CWT in multi-echelon SSF
  - Air Force approach

- Recursive fair share
  - Extension of fair share to multi-echelon system
  - Multiple Supply Performance Analyzer (SPA) runs
    - Enterprise run for AMC assets
    - Depot and Below Depot runs to determine assets for each SSF echelon
  - Fair share distribution of echelon assets
REQUISITION REFERRAL
DECISION SUPPORT SYSTEM

Goals / Objectives:

- Determine the most cost effective AMC assets to be used to satisfy a customer requisition

Tradeoffs:

- Inventory Cost, Transportation Costs, Time / Readiness Impacts

Constraints:

- Which assets, at which locations, are candidates for shipment to customer

SAP APO Global Available to Promise is Rule Based with No Cost, Demand, or Inventory Level Inputs
AMSAA’s Asset Redistribution Model

- Developed for Objective Supply Capability
- Internal transportation cost database
- Only Below Depot excess to be used to satisfy requisitions

Modifications to Asset Redistribution Model

- Allow backshipping through current Principal Distribution Sites
  - Established routes and consolidated shipments
- Extension to reparable items
- All AMC assets available to satisfy requisitions
- Input transportation costs from Military Traffic Management Command
RETURNS DISPOSITION DECISION SUPPORT SYSTEM

Goals / Objectives:

- Determine whether AMC should accept a return, and where that asset should be placed

Tradeoffs:

- Inventory Costs, Transportation Costs, Readiness

Constraints:

- AMC return / credit policies

Enterprise and Local Economic Retention and Return Levels
ENTERPRISE LOGISTICS CHAIN SIMULATION
Why A Simulation?

- Precision required to evaluate alternatives.
- Virtual Real-World. More effective and efficient analyses.
- Analytical Models Inadequate.
- Evaluate Individual DSS against historical data.
- Too many factors affect Optimal Control.
- SSF Log Chain & alternatives too complex for one analytical model.
- Less Time & Cost than a demo.

Tool for evaluating any emerging WLMP Business Rules
Simulation Capabilities

Depot

Multi-Echelon Logistics Chain

GS

DS

ORG

REPLENISHMENT FROM
Maintenance
Procurement
Requisitioning

REPORTS
Weapon Sys Performance
Supply Performance
Customer Wait
Customer Satisfaction
Inventory Costs
Transportation Costs

INTERFACE WITH
SSF DSS/AMC Models
(SESAME,VSLEOQ/SPA,
Req Referral Rules)

LMP Business Rules
when determined

CURRENT
Alternative
Future
SSF Rules

DEMANDS
Historical / Monte Carlo
Some Simulation Features

- **Up to a five echelon logistics chain.**

- **Model, if necessary, end item, Line Replaceable Unit, and Shop Replaceable Unit levels of detail.**

- **Demand forecasting and updating of requirements computations and asset distributions.**

- **Steady state and transient analyses.**

- **Variability of parameters.**

- **Infinite source and finite source failures.**

- **Reports number of shipments between stock points and to customers.**
### Illustration of Evaluation Capabilities

#### Comparison of Two Different Sets of Business Practices

<table>
<thead>
<tr>
<th>Enterprise ROP/RO/RAP Computation</th>
<th>Current SSF MS I/II Business Rules</th>
<th>One Nominal/Notional/Possible Implementation of the AOD Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computed by summing a Depot value (SPA/VSLEOQ) and a Below Depot value (not VSLEOQ).</td>
<td>Depots as computed by VSLEOQ. Below Depot as determined locally.</td>
<td>Enterprise ROP / RO / RAP computed by SPA / VSLEOQ.</td>
</tr>
</tbody>
</table>

- Enterprise ROP/RO/RAP Computation
  - Computed by summing a Depot value (SPA/VSLEOQ) and a Below Depot value (not VSLEOQ).
  - Depots as computed by VSLEOQ. Below Depot as determined locally.

- Procure When
  - Enterprise assets < Enterprise ROP
  - Enterprise assets < Enterprise ROP

- Initial Distribution Of Procured Assets
  - Depots are lowest echelon considered for distribution of assets arriving from procurement.
  - Below Depot locations considered for distribution of assets arriving from procurement.

- Distributed based on percentage
  - Distributed based on deficit to fair share level. Below Depot filled to their fair share level before depots.

- Replenishment
  - Below Depot requisition Depot if their assets < ROP.
  - Stock movements between Depots & Below Depot considered inter-depot transfers.
Sample Simulation Results

Current Business Rules Nominal Implementation of the AOD Concept

Suppliers

Two Depots:
- Lines Stocked: 36
- Quantity RO: 234
- Dollar Val RO: 940k
- Customer Wait: 21.0
- Supply Avail: 81.1%

Two DS/SSAs:
- Lines Stocked: 31
- Quantity RO: 136
- Dollar Val RO: 1230k
- Customer Wait: 15.4
- Supply Avail: 47.6%

Customers

Suppliers

Two Depots:
- Lines Stocked: 36
- Quantity RO: 234
- Dollar Val RO: 940k
- Customer Wait: 11.9
- Supply Avail: 84.7%

Two DS/SSAs:
- Lines Stocked: 27
- Quantity RO: 178
- Dollar Val RO: 1050k
- Customer Wait: 14.1
- Supply Avail: 72.7%

Customers

Averag e quantity shipped per year

30 fewer shipments per year

$180 K cheaper RO

3 Nov 2003
Simulation can be used to evaluate AMC / Logistics Modernization Program Business Rules as they evolve

- Can tie Business Rules to Readiness & Supply Performance

Implementation will depend on Logistics Modernization Program capabilities and configuration

- Met with Lead AMC Integration Support Office to discuss implementation
- Logistics Modernization Program implementation plan for Single Stock Fund Decision Support Systems premature

Selected Essential-Item Stock for Availability Method in Logistics Modernization Program; Supply Performance Analyzer and Variable Safety Level / Economic Order Quantity models offline

Logistics Modernization Program “Global Available-To-Promise” functionality does not explicitly consider the costs for inventory or transportation

Logistics Modernization Program should establish an automatic interface to Military Traffic Management Command shipping cost database
NEURAL NETWORKS FOR FORECASTING

Logistics Modernization Program contains several simple and complex demand forecasting techniques that are widely used in industry.

Implementation of Single Stock Fund introduces more complexity to forecasting demand on AMC.

Several large companies have achieved improvements in demand forecasting by using emerging, state-of-the-art Neural Network and Data Mining techniques.

- Wal-Mart, USAIR, Wrangler, Sears, Pep Stores

Joint AMSAA and University of Delaware proposal to investigate Neural Network / Data Mining / Artificial Intelligence methodologies for demand forecasting.
STATUS

COMPLETED:

- AMC Enterprise Logistics Chain Simulation
  - Modules easily added for emerging Business Rules and logistics alternatives
- Shipping Cost Database Research (ALL DSS)
  - MTMC maintains only credible real time shipping data
- Identification of Decision Support System Alternatives to be analyzed
- Development of Neural Network Proposal for Forecasting Demand in the SSF
- Transshipment in Asset Redistribution Model (Requisition Referral)
- III Corps Stock Positioning Study
- Initial Meetings with LAISO and LMP regarding implementation
- AMC Enterprise Requirements Determination Blueprint

5 Nov 2003

Readiness Based Sourcing at Ft. Rucker
PENDING:

- Distribution SESAME  (*Distribution/ Redistribution/ Requirements Determination*)
- Recursive Multi-Link  (*Requirements Determination*)
- Coordinated single location policies  (*Requirements Determination*)
- Asset Redistribution Model (ARM) Modifications  (*Requisition Referral*)
- Simulation interfaces to Decision Support Systems  (*All DSS*)
- Local Retention Levels  (*Returns Disposition*)
- Rules for when to Redistribute  (*Distribution/ Redistribution*)
- Transportation Cost Database  (*ALL DSS*)
- Implementation in Logistics Modernization Program
- Support Structure Alternatives Analyses
SUMMARY

- Multi-Echelon Logistics Chain offers better opportunities to tie logistics dollars and supply performance to readiness goals

- Single Stock Fund decisions should tradeoff Readiness / Customer Wait Time / Supply Performance, Inventory Cost, Transportation Cost
  - Transportation Cost Database needed

- Proposed development of four Decision Support Systems
  - Requirements Determination
  - Distribution / Redistribution
  - Requisition Referrals
  - Returns Disposition

- Simulation of AMC Enterprise Logistics Chain developed and tested
  - Evaluate AMC Business Rules and Practices
  - Evaluate Decision Support System Alternatives
  - Evaluate emerging Logistics Modernization Program Business Rules & Practices
  - Flexible tool for future AMC Enterprise Logistics Analysis

- Logistic Modernization Program Implementation Challenges
  - Solution not yet directly extended to Below Depot locations
  - Below Depot Stock, Return/Retention and Redistribution Policy

- Neural Networks for Supply Chain Forecasting
Backup
Charts
SOME SIMULATION INPUTS

- **Force Structure**

- **Weapon System Characteristics:**
  - Quantities, Mean Time Between Failures, Mean Time To Repair, etc.

- **Secondary Item Characteristics:**
  - Mean Time Between Failures, Repair Cycle Times, Order and Ship Times, Acquisition Lead Times, Replacement Task Distributions, Maintenance Task Distributions, Unit prices, Essentiality Codes, etc.

- **Business Rules:**
  - Requirements Determination
  - Procurement / Distribution
  - Redistribution
  - Requisition Referral
  - Repair
**SIMULATION OUTPUTS**

- Computed by location, by end item, by time period, etc.

- Examples of current output types:
  - Weapon system performance
  - Customer support
  - Supply performance
  - Transportation metrics
  - Assets and requirements
  - Procurement
  - Maintenance

- Relatively easy to add additional outputs
Readiness Based Sparing at Ft. Rucker

• AMCOM given control of inventories at Ft. Rucker and Ft. Bliss (Sept. 2002).
• AMCOM CG requested AMSAA recommend RBS ASL/PLL for Ft. Rucker (Dec. 2002).
• AMSAA developed Rucker ASL and provided results to Ft. Rucker (May 2003).
• AMCOM approved RBS recommendations and implemented RBS AWCF ASL (Oct. 2003).

Stock Impact
• Less lines (754 fewer unique lines)
  ➢ Eliminates lines with no demands and lines that are not mission essential
• Reduced cost
  ➢ Current $129.2 M   RBS $92.3 M   Reduction of $36.9 M
• Comparison to current stock
  ➢ Developed Access tool to facilitate AMCOM ASL review process.

Highlights
• RBS ASL based on Operational and Supply Availability requirements
• Used most accurate, recent and complete data available
  ➢ Tailored specifically for Ft. Rucker
  ➢ MCTBF and MTTR based on five years of contractor data on equipment status
  ➢ Repair Cycle Times by NSN from SAMS
  ➢ National Stock Availability from MILSTEP
  ➢ Demand data from ILAP