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Original title on 712 A/B:
Multi-Echelon Modeling for Improved Supply Chain Performance

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**Multi-Echelon Modeling for Improved Supply Chain Performance**

**1. REPORT DATE**
01 JUN 2007

**2. REPORT TYPE**
N/A

**3. DATES COVERED**
-

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**

HQ AFMC/A8S 4375 Chidlaw Rd, Rm B204 WPAFB OH 45433-5006

**8. PERFORMING ORGANIZATION REPORT NUMBER**

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

**10. SPONSOR/MONITOR'S ACRONYM(S)**

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

**12. DISTRIBUTION/AVAILABILITY STATEMENT**
Approved for public release, distribution unlimited

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

**15. SUBJECT TERMS**

**16. SECURITY CLASSIFICATION OF:**

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**17. LIMITATION OF ABSTRACT**
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**18. NUMBER OF PAGES**
22

**19a. NAME OF RESPONSIBLE PERSON**
Air Force Materiel Command

War-Winning Capabilities ... On Time, On Cost

Multi-Echelon Modeling for Improved Supply Chain Performance

Selected Essential Item Stock for Availability Method (SESAME) to “right-size” DoD inventory

HQ AFMC/A8S
Mrs. Deb Hileman/Mr. Greg Gehret
11 Jun 07
DSN 787-4535

Unclassified Informational Brief

Integrity ~ Service ~ Excellence
Overview

• Why DOD needs multi-echelon modeling
• Background on Air Force Inventory Efficiency
• What is Multi-echelon modeling
• Multi-Service Effort to Implement Multi-Echelon Modeling using SESAME
• Status of SESAME, Multi-Echelon Model, Pilot at Ogden Air Logistics Center
• Summary
Why DOD needs multi-echelon modeling

**Pick one**

- BRAC expands DLA’s role
- Right-sizing DoD Inventory

“multi-echelon techniques are valuable and can lead to large improvements in cost and service”

“...fosters collaborative approach...”

• **Enterprise view of supply chain optimizes inventory levels system-wide**
  - The right level of the right part at the right location
  - Money, Money, Money…

- 1. Silver, Pike, Peterson, “Inventory Management and Production Planning and Scheduling”
- 2. CACIs (working with MCA’s SPO) website: “Readiness-based Sparing – Benefits”
Multi-Echelon Models
What do they do?

Historical perspective:
• Where we were: Pre COLT, very little mass AF/DLA collaboration
• Where we are: With COLT (single echelon), AF and DLA data collectively yields better performance for the same Cost
  • Where we need to be: Multi-echelon models will further improve performance bringing it closer to the mathematically optimal solution
Why Multi-Echelon Models
What do they look like?

Multi-Echelon Model
Accounts for ALL demands
Accounts for ALL re-supply times

Echelon 1: DLA’ Hub
San Joaquin, CA

Echelon 2: DLA’ Warehouse
Ogden-ALC (warehouse)

Echelon 3: AF’ Shop Supply Centers

ALC (SSC1)  ALC (SSC2)  ALC (SSC3)  ...  ALC (SSC28)

AF Maintenance  AF Maintenance  AF Maintenance  AF Maintenance

Re-supply Times
Demands

Locations of inventory
Background on Air Force Inventory Efficiency (AFIE) Pilot

• AFIE, response to PBD 422, focused on bullet 2:
  "Directs Army, Navy, Air Force, and DLA to plan to eliminate retail operations…"

• AFIE pilot began at OC-ALC Jun 03; ≈ 3K NIINs

• AFIE pilot began at OO-ALC Aug 04; ≈ 2.5K NIINs

• AFIE had two goals:
  – Reduce AF “duplicative” stock (save inventory $)
  – Maintain warfighter support (no degradation to support)
Customer Wait Time

- CWT relates how long maintenance has to wait for part
  - Affects scheduling and resource allocation at the ALCs
  - Affects timing of LRUs/SRUs repair for ALCs and bases
  - Affects PDM line (shop flow) at the ALCs
  - Affects MICAP Hours at the bases
San Joaquin, CA
- 1 DLA-owned (SDP “hub”)

Ogden ALC, UT
- 2 DLA-owned (warehouse)
- 1 AF-owned (SSC, forward located)
- 3 DLA-owned (hub or spoke??)
  - AF computed/DLA applies business rules
  - may/may not increase safety stock

AFIE population at OO-ALC as of May 07:
1) 2,350 NIINs
2) Demands: 635 units of demand/day
3) Dollars: $99,935 / day
*(Aug 05: DDR=760 and Daily Cost=$102K)
Background (cont’d)
Where We Are … AFIE – Support

Background Summary:

- AFIE may have reduced inventory; however, at a substantial degradation to warfighter support
- AFIE current business rules are not RBS
- AF/DLA working to inject RBS into AFIE
- This pilot offers a unique opportunity for DoD to ‘lean forward’ on BRAC recommendations
How can we “fix” AFIE?

Create a joint AF/DLA process that would link DLA inventory investments with AF support

Adding RBS to AFIE meets the full intention of PBD 422

Pictorially: AF/DLA collaborate to use best overall policies

RBS links all levels of stockage.

AF
DLA
RBS (AF & DLA)

RBS with DLA

Performance Target
Warfighter

Adding RBS to AFIE meets the full intention of PBD 422
How can we “fix” AFIE (cont’d)

Execution

• RBS model will set a better mix (breadth and depth) of “consumable” levels
  – Lack of part means waiting DLA procurement Lead Time

• Near immediate impact to maintenance:
  – LRUs/SRUs repaired in timely fashion

Reduced LRU repair time = increased Ao
How can we “fix” AFIE (cont’d)

CWT on Consumable Items Affects Many Weapon Systems

• EBOs on Line Replaceable Units (LRUs) are the basis for calculating Aircraft Availability (Ao)

• The relationship between Ao and EBOs:

\[
\frac{\text{EBOs}}{\text{Number of Aircraft}} \approx -\ln(\text{Ao})
\]

CWT is related to EBOs:

\[
\text{ECWT (in days)} = \frac{\text{EBOs}}{\text{Daily Demand Rate}}
\]

Minimizing ECWT on consumables  
Minimizing EBOs on consumables  
Minimizing EBOs on LRUs  
Maximizing Aircraft Availability
Inventory Systems... future supply chain
what would SESAME do?

San Joaquin, CA
1. DLA-owned (SDP “hub”)

Ogden ALC, UT
2. DLA-owned (warehouse)
3. DLA-owned (forward located)

SESAME (IPT)

1. Level\(_1\) = EOQ\(_1^\prime\) + ROP\(_1\)
2. Level\(_2\) = EOQ\(_2^\prime\) + ROP\(_2\)
3. Level\(_3\) = EOQ\(_3^\prime\) + ROP\(_3\)

*Level\(_1\), Level\(_2\), and Level\(_3\): determined by SESAME (via marginal analysis trade-offs)*

**EOQ\(_1\), EOQ\(_2\), and EOQ\(_3\): determined by SESAME**
ROP\(_1\), ROP\(_2\), and ROP\(_3\): determined by SESAME

Simultaneously determines the right levels at the right locations to achieve the targeted ECWT at the least DoD cost

* another option in SESAME is to use Expected Fill Rate in lieu of Level

* * EOQ\(_1\) can be either an input to SESAME or computed by SESAME (as Wilson EOQ)
SESAME is a Multi-Echelon, Multi-Indenture Inventory Model that determines the Optimal Range and Depth of Spares and Repair parts at all locations in order to meet either a Weapon System/End Item Budget Constraint or Operational Performance Target.
Find **Least Cost** set of spares by location, which achieves backorder/CWT target

*Tradeoff*, over all items at all locations, **Backorder/CWT Reduction** at User Echelon for increased **stock cost**
Data needed for SESAME Pilot
geneneral flow diagram

Already known factors:
• NSNs
• Unit Price
• Cube (dimensions of part)
  • May need default value ???
• Target Logistics Delay Time (i.e. CWT goal)

Factors still to get:
• Demand Rate (for each location)
  • DLA: 2, 3, 4
  • AF: 5, 6, 7, 8, … , n
• OST between each location (for all the arrows)
  • DLA: 1, 2, 3, 4
  • AF: 5
Using SESAME on Ogden’s AFIE items

DoDAAC FB2029
26 SSCs (Shop Supply Centers)

M22 (1)
M33 (2)
M44 (3)
M77 (4)
M99 (5)
M44 (6)
M09 (7)
MRR (8)
MCC (9)
MBR (10)
M88 (11)
MFF (12)
MGG (13)
MJJ (14)
M44 (15)
M44 (16)
MNN (17)
MOQ (18)
MPP (19)
MRR (20)
MRR (21)
MSS (22)
MTT (23)
MUH (24)
MWW (25)
MWW (26)

DDJC
San Joaquin, PA

DDSP
Susquehanna, PA (aka New Cumberland)

DDBC
Barstow, CA

DDDC
San Diego, CA

DDDK
Korea

DDGM
Guam

DDHU
Hill, UT

DDPH
Pearl Harbor, HI

DDPW
Puget Sound, WA

DDSA
Sasebo, Japan

DDAA
Anniston, AL

DDAG
Albany, GA

DDCN
Cherry Point, NC

DDCO
Columbus, OH

DDCT
Corpus Christi, TX

DDDE
Germersheim, Germ

DDJF
Jacksonville, FL

DDKS
Kuwait

DDNV
Norfolk, VA

DDOO
Ok City, OK

DDRT
Red River, TX

DDRV
Richmond, VA

DDSI
Sigonella, Italy

DDWG
Warner Robins, GA

*NPBT
Ingleside, TX

18 additional DoDAACs

AF Maintenance

* Navy NHIM site

97 additional DoDAACs
Multi-Service Effort to Implement Multi-Echelon Modeling

- DLA recognized a gap in the Wholesale tool-set for Retail management and stood up a multi-service IPT to investigate implementing Multi-Echelon Modeling
- The Multi-Service IPT supports a plan to fill the gap in the DLA tool-set by using an existing Service (Army) model while DLA works the long-term Inventory Policy Optimization (IPO) implementation in BSM
- The use of a proven RBS tool, Selected Essential Item Stock for Availability Method (SESAME) was accepted by the IPT
- The IPT recommended use of SESAME to determine AF/DLA levels for OO-ALC AFIE items (2530 Items)
Status of SESAME implementation

• Analysis completion expected end of Jun 07
• Implementation Alternatives/Issues Determination
• Brief AF and DLA to obtain implementation approval with discussions on metrics
  – Already have GO support for the initiative
  – Tools exist within BSM to change levels settings
• Further expansion across USAF remains TBD
SUMMARY

• Timeline for DLA to have multi-echelon modeling capability still unknown
  – Limited Service budgets won’t allow us to wait

• In the interim use SESAME
  – Proven multi-echelon Army model
  – No new development, can use “off-the-shelf”

• Potential to generate BRAC savings

• Implementing near-term is “Do-able” based on out pilot results

Improve warfighter support without increasing costs