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DLA-92-P10148

STOCKAGE LOCATION POLICY ANALYSIS

August 1992

OPERATIONS RESEARCH AND ECONOMIC ANALYSIS OFFICE

DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

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DLA-LO

FOREWORD

The Directorate of Supply Operations (DLA-O) and the Office of Policy and Plans (DLA-L) directed that a comparative cost analysis be conducted for alternative stockage policies and that demand stability be evaluated over a multiple year procurement cycle. This was driven by the Defense Management Review Decision (DMRD) 901 which requires the Defense Logistics Agency (DLA) to reduce the cost of the supply system by stocking "closest to vendor." This new approach is directly opposite the Agency's historical policy of placing stock "closest to customer."

We are indebted to the staffs of the Supply Management Division (DLA-OS), the Depot Operations Division (DLA-OW), and the Transportation Division (DLA-OT) for their insight and data assistance at the various reviews conducted for this project. Additionally, our appreciation is expressed to Mr. Rick Jernigan (formally with the DLA Operations Research and Economic Analysis Management Support Office, Richmond, VA) for his initial analysis work which helped to confirm the degree of demand variability that exists across time.

ROGER C. ROY
Assistant Director
Policy and Plans

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EXECUTIVE SUMMARY

This study was designed to evaluate two critical areas. First, to assess the traditional assumption, which has been employed in virtually all DoD stockage location studies, that demand is geographically stable. Second, to compare the costs of the alternative stockage policies presuming that the DoD distribution system has fully implemented DMRD 902 (Depot Consolidation). Consequently,for purposes of this study, only three Primary Distribution Sites (PDS) were allowed as storage sites. These three sites were identified in a previous DLA study (Primary Distribution Site Location Analysis, DLA-91-P10173, August 1991) as Defense Depot San Jaoquin (Tracy and Sharpe), Defense Depot Memphis, and Defense Depot Susquehanna (Mechanicsburg and New Cumberland).

Results of the demand stability analysis reveal that demand is not geographically stable. Significant demand variability was found to exist for the Agency's "fast" moving items (i.e., those items which had an Annual Demand Frequency greater than six). In one case for a sample of 103,000 items, it was found that between 1988 and 1990, MROs to different customer regions within the Continental United States varied from a plus 12 percent to a minus 6 percent. Additionally, the quantities which were actually shipped varied from a minus 3 percent to a minus 29 percent.

The comparative cost analysis found that a "closest to vendor" stockage policy is potentially more economical than a "closest to customer" policy each and every year across a 3-year (1988 thru 1990) procurement cycle. Under the three PDS DoD distribution system which was evaluated, the "closest to vendor" policy

was observed to have a $55 million reduced cost for first destination transportation charges and depot receipt costs as compared with expenses incurred by the "closest to customer" policy. This contrasts quite favorably with the $27 million reduced cost for second destination charges experienced by the "closest to customer" policy. Therefore, on a comparative cost basis, the "closest to vendor" policy is the most favorable policy for the types of items which were evaluated by a two-to-one margin.

The study has not addressed readiness impacts which, in some cases, might be felt by various DoD customers as the Agency shifts to a "stock closest to vendor" policy. Further, implementation issues such as how to "best" realize savings on inbound transportation costsor how to "best" identify where a vendor's manufacturing facility or distribution point is located have not been examined. Moreover, because the internal control logic of the Agency's supporting automated information systems is structured to be consistent with a "stock closest to the customer" philosophy, effective implementation of a "stock closest to vendor" policy will require significant system changes.

SECTION 1
INTRODUCTION

The Directorate of Supply Operations (DLA-O) and the Office of Policy and Plans (DLA-L) directed the Operations Research and Economic Analysis Management Support Office (DLA-DORO) to conduct a comparative cost analysis for alternative stockage location policies and to evaluate demand stability. This was driven by the Defense Management Review Decision (DMRD) 901 which requires the Defense Logistics Agency (DLA) to reduce the cost of the supply system by stocking **closest to the vendor.** This new approach is directly opposite the Agency's historical policy of placing stock **closest to the customer.**

1.1 BACKGROUND

Historically, stock positioning studies across the Department of Defense (DoD) have consistently assumed that demands are geographically stable. Consequently, studies were conducted on the basis of limited time horizons (i.e., typically with 1 year or less of data). These previous studies often concluded that the DoD distribution system provided abundant storage capacity. Thus, these trade-offs resulted in what was, at best, a sub-optimal system.

In the late 1960s, the Defense Supply Agency (DSA) conducted an analysis known as the Stock Positioning and Transportation Study (SPATS) that was based on the use of 6 months of demand data. The study assumed that DoD demand was stable. However, the essential conclusion which was reached was that redistributing stocks to meet shifting geographic demand variations proved to be both costly and inefficient.

Later on during the mid 1970s, the DoD Materiel Distribution Study (DODMDS) employed 12 months of demand data. This study, also assumed that demands were stable. Four principal conclusions were made. The first was that there was a very high percentage of stock which was inactive. Second, that the continued existence of distinct consumable and repair item distribution systems could not be supported by cost tradeoffs between facility operating costs and those costs incurred by transportation. Third, that the colocated maintenance sites were significant contributors to the wholesale distribution system. Lastly, that through depot mission consolidation, system costs could be significantly lowered and DoD's excess storage capacity could be reduced to appropriate levels.

Then in the early 1980s the DoD Wholesale Interservice Depot Support Study (WIDS) was evaluated while using only 3 months of demand data. This effort assumed that demands were stable and concluded that the DoD wholesale distribution system was grossly sub-optimal with the typical DoD customer receiving materiel from 18 different depots. The study also concluded that the DoD distribution system had excess depot capacity.

The basic observations concluded by all of these studies were that the DoD distribution system is sub-optimal and had excess capacity. Further, that in order to supply the multiple stockage locations scattered across the United States, the contracting process would generate split shipments from the vendors into multiple locations. These observations were made while presuming that demand was stable. Consequently, none of these historical study efforts attempted to look at the additional system inefficiencies which could be expected if demand was not stable.

1.2 SCOPE

This current study effort has been charged with the task of evaluating, on a comparative cost basis, the alternative stockage location policies. This comparison will be made based on the assumption that depot consolidation initiatives under DMRD 902 have been fully implemented and that the DoD wholesale distribution system will operate from three Primary Distribution Sites (PDS) for the population of consumable items used in this study. Additionally, the study will evaluate demand stability assumptions.

1.2.1 STOCKAGE POLICIES

This study presents a comparative analysis of three alternative stockage policies; i.e., stock closest to customer, stock closest to vendor, and a hybrid policy. The hybrid policy is a combination of the other two policies in that each National Stock Number (NSN) item is permitted to "select" either the customer or vendor based policy. The selection depends upon which of the policies would have resulted in a lower cost for a base year for that item.

1.2.2 DEPOT LOCATIONS

The three PDS locations will be used. These sites were identified in a previous study (Primary Distribution Site Location Analysis, DLA-91-P10173, August 1991) as Defense Distribution Depot San Jaopuin (Tracy-Sharpe), Defense Distribution Depot Memphis, and the Defense Distribution Depot Susquehanna (Mechanicsburg-New Cumberland).

1.2.3 DEPOT CAPACITIES

The PDS storage and throughput capacities were not considered as part of this study.

1.2.4 STUDY ITEMS

The population of NSNs used in this study included 218,894 items. These items had an annual demand frequency greater than or equal to 12 in the base year of the study (1987). Excluded were: fuels, subsistence, hazardous, medical, and those items which are managed by a Numerical Stockage Objective (NSO). Selected NSNs account for 50 percent of new procurement receipts. These NSNs account for 70 percent of Materiel Release Orders (MROs) at the depots.

1.2.5 BASE YEAR OF ANALYSIS

The base year of the study was 1987. This served as the baseline from which each policy was projected over the next 36 months (1988 - 1990) to account for the maximum procurement cycle.

1.2.6 CLASSIFICATION OF SHIPMENTS

Receipt shipments were classified as being either **bin** or **bulk** with bin shipments weighing 70 pounds or less.

1.2.7 TRANSPORTATION MODES

Five classes of transportation were considered; air small parcel, air freight, surface parcel, less-than-truckload (LTL), and truckload (TL) rates.

1.2.8 TRANSPORTATION SENSITIVITY

The transportation baseline excluded the Regional Freight Consolidation Centers (RFCC) while the transportation sensitivity analysis included the RFCCs.

1.2.9 TRANSPORTATION CLUSTERS

Customers and vendors were grouped on a geographic basis into regional clusters defined by previous transportation studies.

1.3 OBJECTIVE

The objective was to evaluate alternative stockage policies on a comparative cost basis. A secondary objective was to examine the demand stability, or variation as such, by looking at demands over a period of 36 months.

SECTION 2
DEMAND STABILITY ANALYSIS

This section will show that DoD demand is variable, thus contradicting the stable demand assumption of previous studies. This very fundamental assumption has structured almost every study into examining limited time periods (i.e., typically 1 year or less). The result of this position is that system dynamics within the DoD wholesale distribution system have been underestimated if, in fact, demand is variable. Consequently, an increase to system dynamics would result in an even more sub-optimized DoD distribution system with greater cost inefficiencies than what was found in the earlier studies.

To analyze demand, the study examined several facets of DoD demand behavior. In this vein, it is helpful to view DoD demand as an onion with layers of variability. Peeling back layers is analogous to moving through increasingly detailed views of demand variability. The outer most layer is at the macro view with dollars and quantities requisitioned from year-to-year for all customers. The next layer represents variation by individual commodity. The inner most layer depicts variation by time and geographic location for depot and customer clusters. The following segments will illustrate the variation in each of the peeled back layers of the DoD demand onion.

2.1 RECURRING AND NONRECURRING DEMANDS (1981-1990)

Peeling back the outer most layer (macro view) of the DoD demand onion was accomplished by examining recurring and nonrecurring demands. Recurring demands are those the customer expects on a regular basis and which the customer designates as such with each requisition. Nonrecurring demands are seen by the customer as special program requirements or one-time surges. The original intention of this demand classification was to filter out the nonrecurring demands in forecasting efforts. For these two types of demands the following analysis focuses on annual demand frequency, annual demand quantity, and annual demand dollars in showing that demand is variable at a macro level.

A previous DLA study (Impact of Decreasing Budgets and Item Transfers, DLA-91-P00218, June 1991), developed data which was used to address the issue of demand stability from a macro level perspective over time. Summarized in Table 2-1 is data derived for various commodities (Construction (C), Electronics (E), General (G), Industrial (I), and Medical (M)) for the 10-year period covering 1981 thru 1990.

Table 2-1. Recurring and Nonrecurring Demands (1981-1990)

YEAR	ANNUAL DEMAND FREQUENCY (MILLIONS)	ANNUAL DEMAND QUANTITY (BILLIONS)	ANNUAL DEMAND DOLLARS (BILLIONS FY 90 $)
81	16.888	1.057	3.647
82	17.605	1.096	4.182
83	18.155	1.111	4.375
84	19.089	1.150	4.876
85	18.410	1.222	5.217
86	17.269	1.165	4.707
87	17.151	1.017	4.683
88	16.122	0.915	4.175
89	16.932	0.826	3.955
90	16.804	0.819	3.949

2.1.1 ANNUAL DEMAND FREQUENCY

For almost all years, there exists significant changes in the annual demand frequency (ADF) on a year-by-year comparison. Over the entire 10-year period there exists a 15 percent change from the peak year (1984) to the minimum period (1988). Figure 2-1 displays these data.

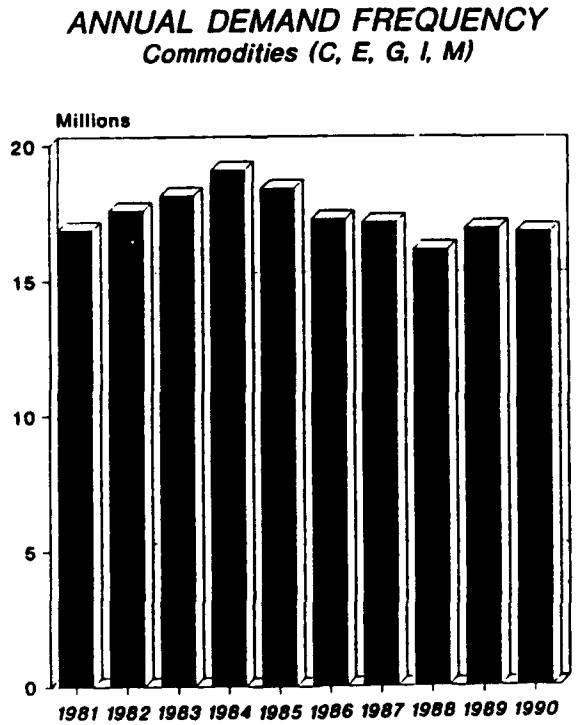


Figure 2-1

2.1.2 ANNUAL DEMAND QUANTITY

Once again, for almost all years, there exists significant changes in the annual demand quantities (ADQ) which were actually requisitioned. The 1 year (1990) in which demand quantities did not appear to shift significantly from the previous year includes the first 2 months of demands for Operation Desert Shield. However, over the entire 10-year period there exists a 33 percent decrease from the peak year (1985) to the minimum period (1990). Figure 2-2 displays these data.

ANNUAL DEMAND QUANTITY
Commodities (C,E,G,I,M)

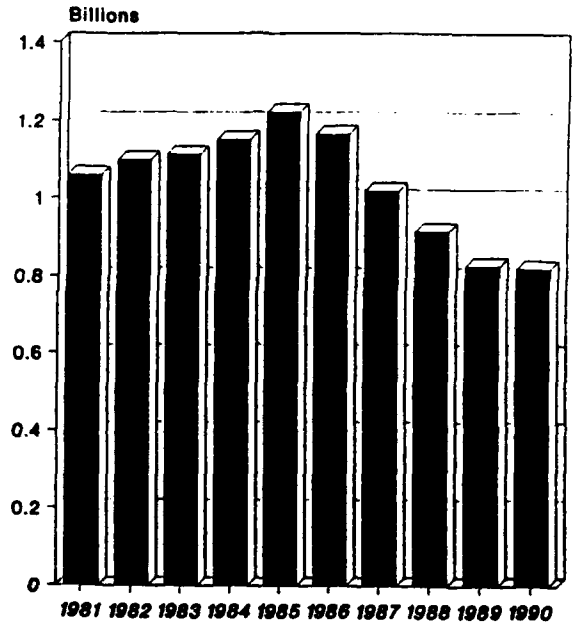


Figure 2-2

2.1.3 ANNUAL DEMAND DOLLARS

Examining the same data from a monetary perspective, we find that if we value the stock which was requisitioned in terms of constant Fiscal Year (FY) 1990 dollars, a very similar pattern emerges. Again, there exists significant changes in the annual demand dollars which were ordered by the Agency's customers. It seems that one of the 2 years (1990) in which demand dollars did not seem to shift significantly from the previous year, again includes the first 2 months of demands for Operation Desert Shield. However, over the entire 10-year period there exists a 30 percent change from the peak year (1985) to the minimum period (1981). Lastly, if we look at the same data from the peak year (1985) to the most current year (1990) which is included in the

data, there exists a 24 percent decrease in demand dollars even with demands from Operation Desert Shield. Figure 2-3 graphically displays these data.

ANNUAL DEMAND DOLLARS
Constant Fiscal Year 1990 $

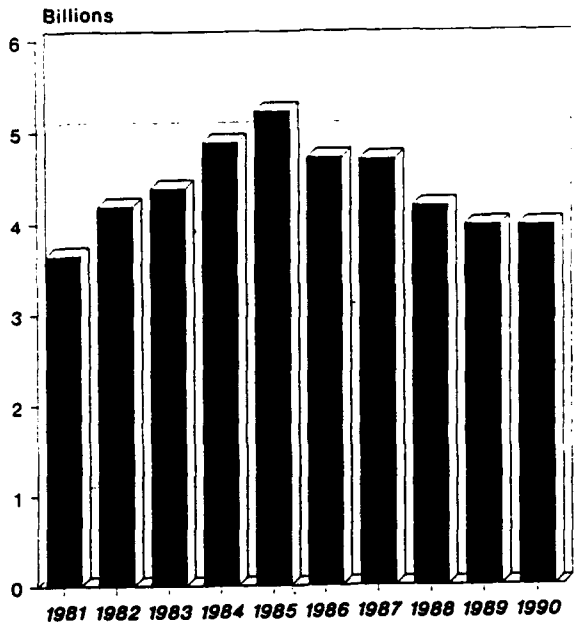


Figure 2-3

2.2 PROFILE OF COMMODITY ORIENTED DEMANDS (1985-1991)

Peeling back the second layer of the DoD demand onion was accomplished by examining individual commodity items. This analysis also shows demand is variable.

Data from an ongoing DLA study,(Long Supply Study, DLA-XX-P00221) was used as it provides a history of demands from a commodity level. The time period for this analysis was 7 years (1985-1991) based on using 1985 (i.e., the year of a previous Long Supply Study (DLA-85-07, August 1985) as a baseline. Since only two commodities (Electronics and General) maintain historical data across that timeframe, our review was restricted to those two commodites.

2.2.1 ELECTRONIC ITEMS

Examining the data depicted in Figure 2-4, the reader will observe that data has been grouped into three major categories for each of the two demand parameters (ADF and ADQ). These three categories represent logical groupings for depicting an NSN's history over these 7 years with respect to being in an excess

position. Consequently, any given NSN may never be in a long supply posture (i.e., in which case it has zero (0) years in long supply) or it may always be in long supply (i.e., in this case it is counted under the seven (7) years category), and lastly it might experience intermittent periods as being in excess (i.e., in this case it is counted against the one-to-six (1-6) year grouping of items). The overall picture for electronics is that demand has changed significantly for all categories of items.

PROFILE FOR THE ELECTRONICS COMMODITY
1985 THRU 1991

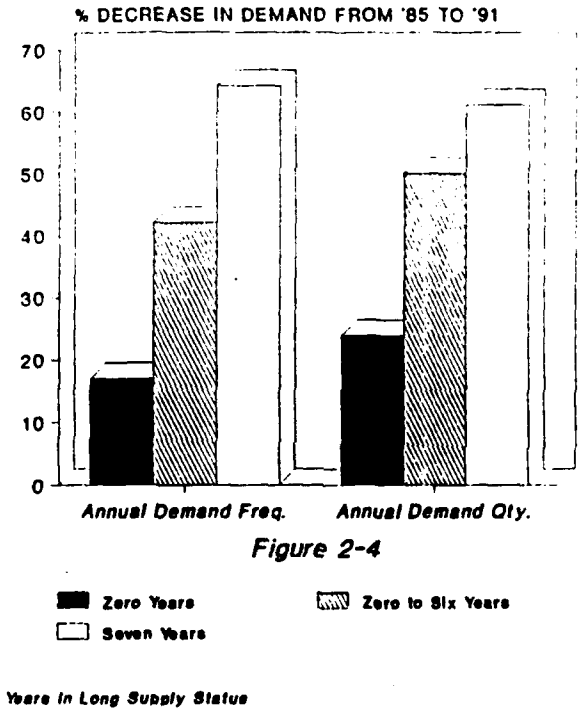


Figure 2-4

2.2.2 GENERAL ITEMS

Examining the data depicted in Figure 2-5, the reader will observe that data for this commodity has been grouped into the same categories as was electronics. Although demands for the ADF parameter have not changed by as much as was observed under electronics, the ADQ parameter has decreased by more. However, in all cases there have been significant changes across the 7-year period and in all groupings demands have consistently decreased. Consequently, just as in electronics, one must conclude that this commodity has also experienced a significant change in demand.

PROFILE FOR THE GENERAL COMMODITY
1985 THRU 1991

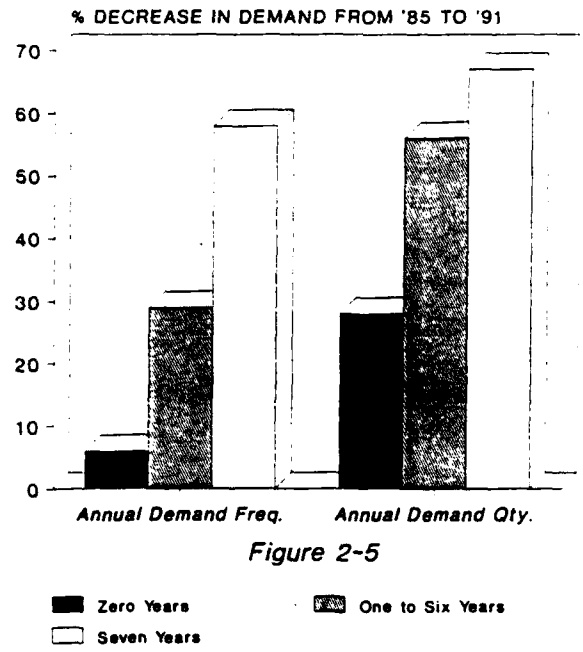


Figure 2-5

2.3 WORKLOAD AND SHIPPING VOLUME ANALYSIS

Peeling back the inner most layer of the DoD demand onion was accomplished by examining variability from the perspective of geography. By looking at how workload volumes have varied by depot and how the shipping volumes to customer clusters has changed, the study shows that demand varies at this layer as well.

The depots selected for the analysis included the traditional six Agency depots. All customers were grouped into clusters or zones which were based on the eleven RFCCs. Finally, this analysis was completed using two populations of NSNs. The first set was based on 103,000 items that comprised the Agency's Bulk Stockage Location Study (DLA-91-P81076, June 1991). The second set was based on the approximately 219,000 items employed under this current study effort.

2.3.1 VOLUME ANALYSIS BY DEPOT

Examining the first population group of NSNs (103,000 items), one will observe from Figure 2-6 that MRO workloads have shifted. These shifts range from a plus 10 percent to a minus 3 percent over this 2-year comparison (FY 1988 versus a 1-year period extending from the fourth quarter of FY 1989 thru the third quarter of FY 1990). Now if we examine how the MRO workload

volume compares with the actual ship quantities for these same items, we find that shipping volumes (as measured in quantities) have changed more dramatically. In this case, quantities have decreased from a minus 12 percent to a minus 20 percent depending on the depot location.

VOLUME ANALYSIS BY DEPOT
Sample Size = 103 Thousand Items

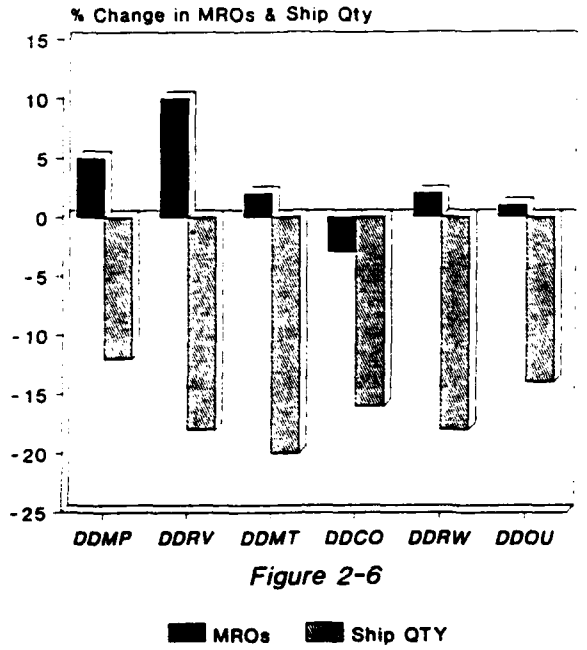


Figure 2-6

Compares FY 88 to FY 90

Now if we review the data for the second population group comprising the almost 219,000 items used for the current study, we will see very similar trends. Here we find that MROs have changed between a plus 9 percent and a minus 7 percent while the actual ship quantities have varied between a plus 2 percent and a minus 23 percent. It would seem, based on this workload volume analysis from a depot perspective, that DoD demands are variable across time, as well as by depot location. These results are depicted in Figure 2-7.

VOLUME ANALYSIS BY DEPOT
Sample Size = 219 Thousand Items

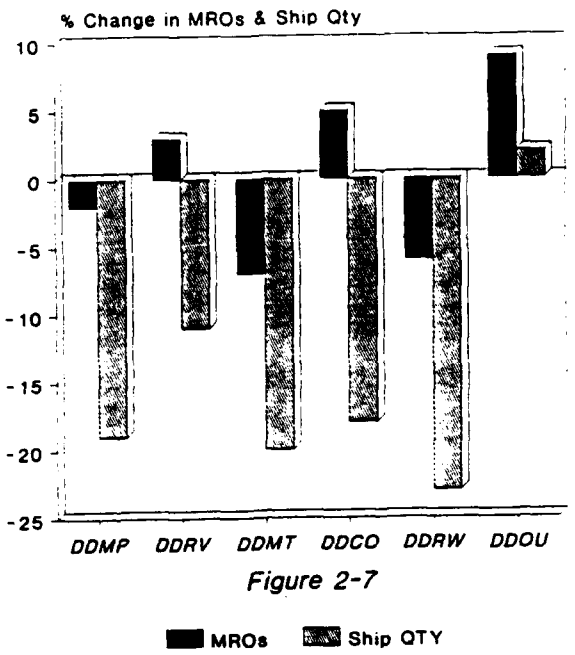


Figure 2-7

Compares FY 88 to FY 90

2.3.2 VOLUME ANALYSIS BY CUSTOMER CLUSTER

Shown in Figure 2-8 are the results for the first population group based on the 103,000 NSNs used in the Bulk Stockage Location Study (DLA-91-P81076). The RFCC clusters have been used to define customer regions for the purpose of identifying if variability exists from a geographic perspective. (The reader should not interpret this figure or the next one as representative of shipping traffic which has been moved through an actual RFCC operation center). Once again, we observe that for this population group there appears to exist variability in demands as measured from a geographic perspective. Here one sees that MROs have varied from a plus 8 percent to a minus 6 percent. These MROs, in turn, were comprised of their respective ship quantities which varied from a minus 3 percent to a minus 29 percent depending upon the customer cluster.

VOLUME ANALYSIS BY CUSTOMER CLUSTER
Sample Size • 103 Thousand Items

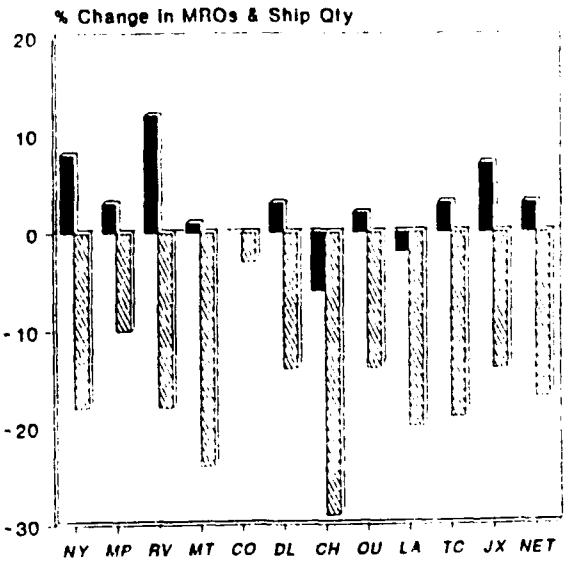


Figure 2-8

Proceeding with the next population group based on the approximately 219,000 NSNs used under the current study for evaluating alternative policies, one finds the same patterns which have emerged with previous data. Depicted by Figure 2-9, one observes that MROs shipped to specific geographic clusters have varied between a plus 4 percent and a minus 16 percent over the time period which is indicated. Similarly, their respective ship quantities have gone through variation with a shift that goes from a minus 3 percent to a minus 26 percent. Certainly it would appear that these changes are significant and that DoD demand variability across different geographic locations over time should be considered.

VOLUME ANALYSIS BY CUSTOMER CLUSTER
Sample Size = 219 Thousand Items

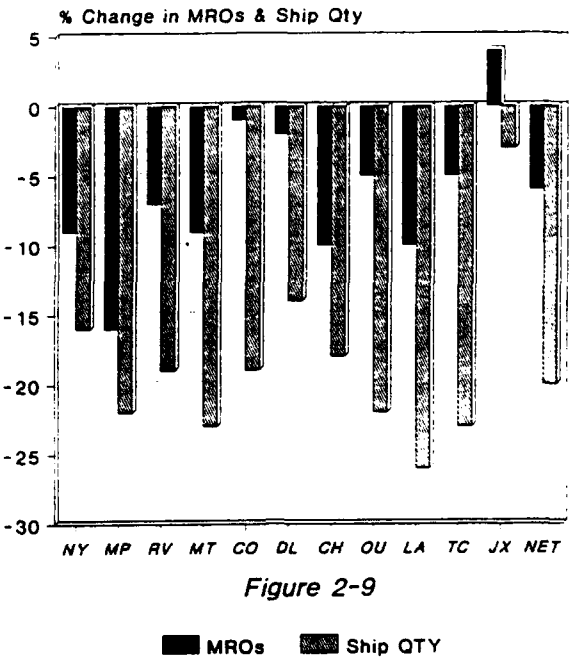


Figure 2-9

Compares FY 88 to FY 90

2.4 DEMAND STABILITY CONCLUSIONS

After examining DoD demand stability at three very different layers of detail, the conclusion is that demand is not stable. From a macro level, demand has been shown to vary by dollars and quantities requisitioned from year-to-year. At the more detailed level of an individual commodity, demand has also proven to be variable. Finally, from a depot or customer cluster, demands have also shifted by time and geographic location. From this analysis it may be concluded that DoD demand is not stable for the types of items evaluated under this project.

SECTION 3
COMPARATIVE COST ANALYSIS

This segment of the study estimated costs which the government could be expected to incur under various stockage policy alternatives. The analysis shows that a policy to **stock closest to the vendor** out-performed other stockage policies by a significant margin. This comparative cost analysis was just that -- for comparative purposes only -- results should not be interpreted in absolute terms. Instead, results from this part of the analysis should be viewed as indicative of which policy consistently dominates under the three PDS depot architecture. Additionally, this study effort should indicate why it is that one policy dominates, and identify the relative costs (savings) by which any given policy out-performs others.

3.1 STOCKAGE LOCATION POLICIES

The study team has examined two principal policies plus one additional strategy which represents a hybrid of the other two policies. One of the two main policies which was examined was that of **stock closest to the customer**. This represents the Agency's, as well as DoD's, main historical policy with respect to stockage location decisions. The other main policy evaluated was that of **stock closest to the vendor** which represents the new policy that DoD has been directed to move towards under DMRD 901 except on those items for which alternative stockage policies can be rationally supported (e.g., cost, readiness, safety). Finally, the third policy considered was the **hybrid policy** in which each NSN is optimized in the base year (FY 1987) on costs for both the vendor and customer options; i.e., allowing each NSN to have a separate policy which is either customer or vendor based.

3.2 ISSUES

There are several critical issues with which the Military Departments and Defense Agencies must grapple given that the DoD is moving towards the **stock closest to the vendor** option on a significant percentage of stocked items. Among these is the fact that existing information systems have all been structured to support the historical policy of **stock closest to the customer**. This has introduced a "bias" to the data which our data systems capture. It will require a significant effort to change such structure in our data systems (e.g., distinguishing a vendor's corporate address from the manufacturing or distribution location which is known as "place of performance").

These changes will require the need to revise the Standard Automated Materiel Management System (SAMMS) as well as the Agency's contracting process. Additionally, the Agency's Transportation Division (DLA-OT) will need to evaluate the impact of single site stockage on the RFCC operations. Further, the Agency's Supply Management Division (DLA-OS) together with the Depot Operations Division (DLA-OW) will need to address the

magnitude of the long supply and dead stock problem under various inventory reduction initiatives since this stock degrades available capacity at PDS sites. Although none of these issues are "show stoppers" with respect to the Agency evolving to a **stock closest to the vendor** strategy, the Agency must make these changes rationally and in a cost effective manner if the service levels to our customers are to be maintained.

3.3 STUDY ASSUMPTIONS

This study, as in all studies, is governed by several assumptions. In this analysis, assumptions may be generally categorized into seven principal areas. These areas are described in the following paragraphs.

3.3.1 SAMPLE OF HIGH MOVERS

It was found that the population of approximately 219,000 items which were used in this study comprised fully 50 percent of new procurement receipts and 70 percent of the materiel release orders (MROs) during the base year of the study. The study team concluded that this population would be sufficient to conduct the comparative cost analysis.

3.3.2 PRIMARY DISTRIBUTION SITES

The study assumed that the DoD directed depot consolidation efforts under DMRD 902 would be fully implemented. This meant that the depot distribution architecture would standardize on the three PDS locations previously identified in the Primary Distribution Site Location Analysis (DLA-91-P10173). Consequently, in this study stockage locations were restricted to Defense Distribution Depot San Jaoquin located at Tracy/Sharpe, California, Defense Distribution Depot at Memphis, Tennessee, and Defense Distribution Depot Susquehanna at Mechanicsburg/New Cumberland, Pennsylvania. This assumption restricted the comparative cost analysis to a perfect PDS system and did not attempt to evaluate historical cost differences between these policies based on a 30 depot architecture.

3.3.3 UNIT COSTS

The two unit costs which had been considered for possible use in the study were **issue** and **receipt** costs at the depots. Since this study is a comparative cost analysis, it was decided to use only **receipt** costs. The total cost to **issue** the MROs would be the same across all policies. However, **receipt** costs were used in the study since their contribution to total cost would vary by policy.

The study used generic unit costs for binnable shipments (i.e., 70 pounds or less) and for bulk shipments (i.e., over 70 pounds). The generic unit costs used were obtained from the Primary Distribution Site Location Analysis (DLA-91-P10173). These equated to $13.97 for a binnable receipt and $38.35 for a bulk receipt.

3.3.4 DEPOT CAPACITIES

It was assumed that all depot capacities were unconstrained. This was applied to both the storage and the throughput capacities for each PDS location. The main reason for adopting this assumption was that the study was conducted as a comparative cost analysis, as opposed to an operational analysis which would have to be structured to account for specific site capabilities.

3.3.5 TIME HORIZON

Prior stockage location studies have virtually all presumed that DoD demand at the wholesale level was stable. Consequently, they selected very limited time horizons for their study efforts (i.e., one year or less). In light of the results presented in Section 2 of this report, Demand Stability Analysis, this study has not assumed that demand was stable. Therefore, the study team opted to select FY 87 as base year. This would serve as our baseline within which each policy would be "optimized" based on cost. Further, the team selected the maximum procurement cycle (36 months) covering the fiscal years of 1988 thru 1990 in order to capture any variability which would likely impact stockage location decisions.

3.3.6 TRANSPORTATION

The study team assumed that transportation cost tradeoffs between the policies would be adequately represented by using transportation rates specific to five transport modes; i.e., this included three modes for parcel shipments which represented air small parcel, air freight, surface parcel and two transport modes for truck shipments based on the use of less-than-truckload (LTL), and truckload (TL) rates. Additionally, the study group assumed that grouping customers and vendors by the geographic clusters, previously developed by the transportation team at DLA-DORO, would suffice for estimating mileages. Figure 3-1 thru Figure 3-3 layout how the Continental United States (CONUS) has been configured into 78 clusters with 2 zones being designated as Containerized Collection Points (CCP) for overseas shipments. All distances were based on mileages from customers and vendors to the three PDS locations.

It was also assumed that the transportation baseline would not include the impacts of RFCCs. A sensitivity analysis would be conducted to estimate these impacts. Lastly, overseas transportation charges were not included in the analysis.

Southeastern United States Transportation Clusters

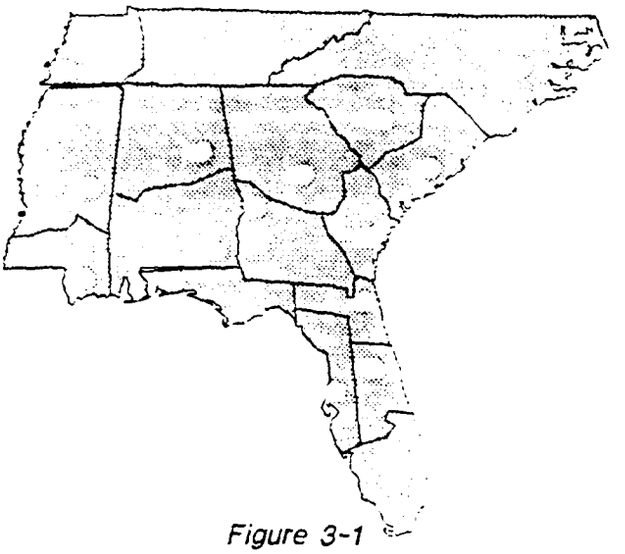


Figure 3-1

Northeastern United States Transportation Clusters

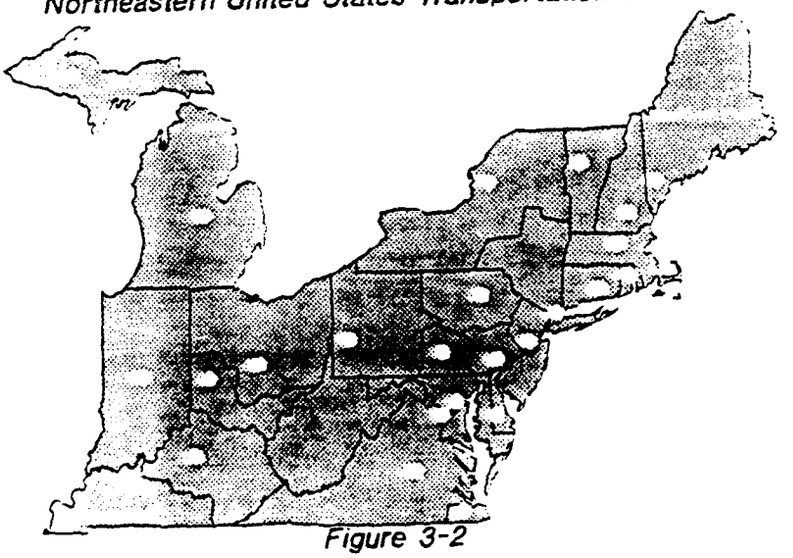


Figure 3-2

Western United States Transportation Clusters

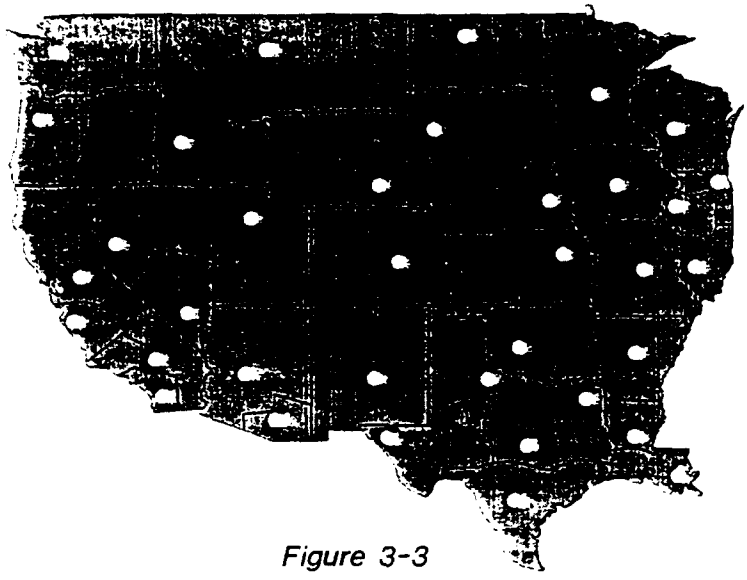


Figure 3-3

3.3.7 RETAIL IMPACTS

The study has assumed that there will be no impacts on retail operations. This implies that there will be no degradation to readiness and/or safety as the Agency transitions to a **stock closest to the vendor** policy. Additionally, it is assumed that there will be no required change in the levels of intermediate stocks maintained by the Military Departments for the items evaluated under this project.

3.4 COSTING METHODOLOGY

The approach used to develop the comparative costs for the competing policies was built on using three types of costs, a maximum procurement cycle of 36 months, and five unique transport modes. This methodology was centered on the determination of ton-miles and the number of shipments received by a depot under each policy. This technique is reasonable for comparing stockage location policies at a macro level, but would not be sufficient to make stockage decisions at the micro level of individual NSNs.

3.4.1 COSTS MODELED

The accounting process used to estimate costs for this analysis was at a commodity item level. Depicted in Figure 3-4 is a pictorial representation of the basic materiel flow from the vendor through the depot and on to the customer. This flow identifies the three costs which are estimated under this study.

Those costs are: the first destination transportation charge, the depot receipt cost, and the second destination transportation charge.

Cost Flows As Modelled

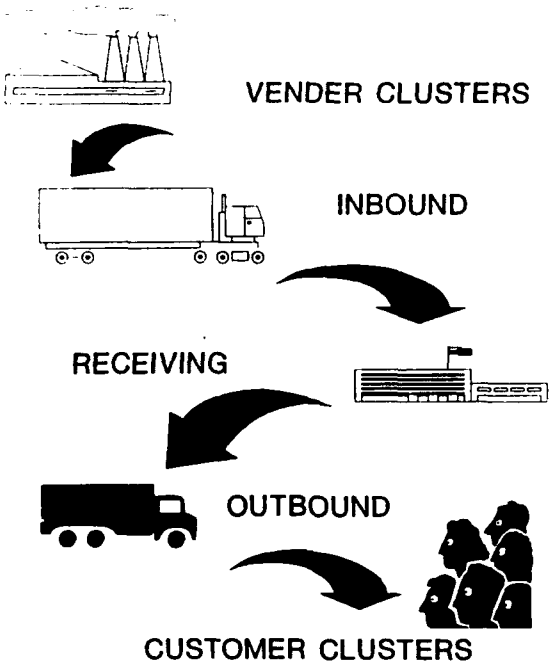


Figure 3-4.

3.4.1.1 FIRST DESTINATION COSTS

The cost of the shipment was estimated based on a straight ton-mileage calculation using transportation rates appropriate for the weight class. All mileages were estimated from each vendor's corporate headquarters to the receiving depot. The historical receipt data on the DLA Integrated Data Bank (DIDB) was used to provide the quantity of the item received for each shipment as well as to identify the Federal Supply Code for Manufacturer (FSCM). It was the FSCM (also known as the Commercial and Government Entity Code (CAGE)) which was used to identify the corporate address for each contract. The corporate address was then mapped into the closest grouping of vendors based on the zones previously identified (i.e., see section 3.3.6). This cost represents an estimate of what a vendor **should have** paid on a given contract.

3.4.1.2 DEPOT RECEIPT COSTS

Using the generic unit cost estimates (i.e., see section 3.3.3) for binnable and bulk receipts, the receipt counts were calculated for each policy. In general, the **stock closest to the customer** policy exhibited multiple shipments for most contracts which resulted in a higher overall receipt cost as compared to the **stock closest to the vendor** option. The latter policy

typically had just a single receipt for any given contract over the items which were evaluated under this project.

3.4.1.3 SECOND DESTINATION COSTS

Using the DIDB historical data, MROs were shipped from a servicing depot to the customer who had been grouped into a regional cluster based on the use of three-digit postal zip codes (i.e., see section 3.3.6 for an explanation of the clusters). Priority requisitions one thru three were treated as an Issue Priority Group (IPG) I. This meant that the shipment went by air (i.e., air parcel if the weight was not more than 99 pounds, or air freight if the shipment was over 99 pounds and the distance was 400 miles or more, or by truck if over 99 pounds and within the 400 miles). All other shipments were costed at either surface parcel rates (shipments not over 70 pounds), less-than-truckload (LTL) rates (applies to those shipments over 70 pounds but less than 10,000 pounds), and finally truckload (TL) rates for all other shipments (those exceeding the 10,000 pound class). The cost to ship an MRO overseas was not captured in this analysis.

3.4.2 PROCUREMENT CYCLE

Since virtually all previous stockage location studies had presumed that the wholesale DoD demand rate had been stable, these earlier studies had examined only 1 year or less of data. Therefore, it was not immediately apparent as to how much data the study team should examine to account for any variability which exists in the system. Eventually, the study team decided that the "best" time period which should be examined would span an entire maximum procurement cycle, which has historically been defined to be 36 months. Consequently, the study team took the base year of the study (FY 1987) plus the next full procurement cycle which included the 1988 thru 1990 fiscal years (i.e., this period was selected so as to exclude the effects of Operation Desert Storm/Shield). This selection permitted the study team to optimize (based on cost) the stockage locations based on the FY 1987 history and subsequently to **feed forward** those optimized decisions to see how well they performed over the next maximum procurement cycle.

This locking in of stockage location decisions applied to the **stock closest to the customer** option. However, for the **stock closest to the vendor** strategy, stockage location decisions were allowed to **float** from year-to-year based on the location of the vendor which received the contract award. For the **hybrid** policy, each NSN was "optimized" based on the "best" system cost obtainable for that NSN under the base year (FY 1987) history after examining both stockage policies (customer and vendor) for

that NSN. This representation of the procurement cycle and the contract award process was determined to be the most effective representation of each policy for a comparative analysis.

3.4.3 TRANSPORTATION STRUCTURE

The baseline structure for transportation costs was based on the premise that the RFCCs were excluded although the two Container Consolidation Points (CCPs) were in operation. This alternative was evaluated on a sensitivity basis to include an estimate of costs if the RFCCs and the CCPs were both operating. This was accomplished at a superficial level by the application of transportation factors derived from current RFCC operations. Specifically, the outbound costs were reduced to a level of 0.9433 from their non-RFCC levels while inbound costs were reduced to a 0.8092 level. These operating cost factors were believed to be consistent with the anticipated RFCC consolidation that is expected under depot consolidation.

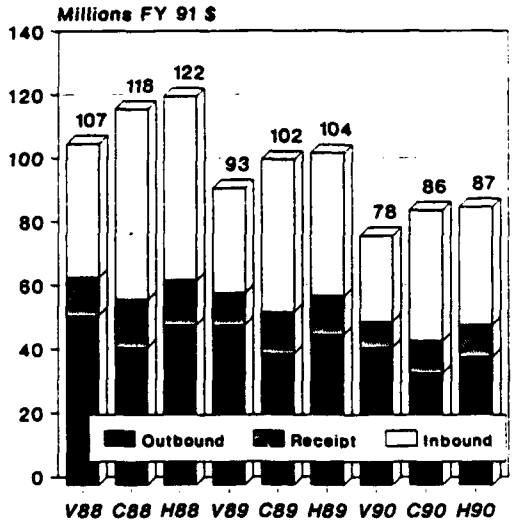
SECTION 4
OUTCOME OF COMPARATIVE POLICY ANALYSIS

The results of this part of the analysis have been structured into three overall topics. In the first case, the results of the cost analysis are reviewed for each policy. This, in turn, is followed by the results of the transportation sensitivity with respect to the RFCC issue. Finally, the topic of PDS workload is addressed from the perspective of the distribution of NSNs at each PDS location for each evaluated policy.

4.1 COMPARATIVE COST ANALYSIS

Results of the comparative cost analysis are portrayed in Figure 4-1 for each policy across a maximum procurement cycle of 36 months. These costs have been stratified into their three components (i.e., outbound, receipt, and inbound) with their annual totals appearing at the top of each cost bar. These totals are the result of the transportation baseline analysis which excluded the RFCCs. Additionally, these totals represent the average cost which resulted from the six replication computer runs that were analyzed (see Appendix C for results of the statistical analysis). In all cases and across all years the **stock closest to the vendor** policy outperformed other policies based on cost. These differences between the **vendor** based policy and the other policies were statistically significant.

POLICY COST COMPARISONS
Transportation Baseline (No RFCC)



	V88	C88	H88	V89	C89	H89	V90	C90	H90
Inbound	42	60	58	33	48	45	27	41	37
Receipt	12	15	14	10	13	12	8	10	10
Outbound	53	43	50	50	41	47	43	35	40

Figure 4-1

Now if we examine these costs in somewhat more detail, we can develop an estimate of where cost offsets exist between the **stock closest to the vendor** option and the **stock closest to the customer** alternative (i.e., the third policy, known as the **hybrid** strategy, proved to be the most inefficient over a full procurement cycle and will not be stressed further in this report). Displayed in Table 4-2 are the chief cost elements for the two primary stockage options. These data have been developed from the individual annual cost elements previously displayed under Figure 4-2. Here it becomes quite apparent that since the **stock closest to the vendor** policy resulted in a cost offset of **$55 million** over 3 years for **inbound** and **receipt** costs, and the **stock closest to the customer** strategy obtained a cost offset of **$27 million** for the **outbound** transportation, that the **vender** strategy "wins" from a cost-based perspective by a **two-to-one** margin.

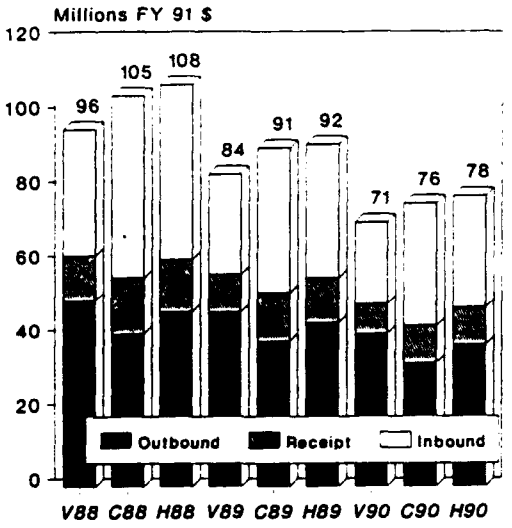
Table 4-2. Policy Cost Offsets (FY 91 $ Millions)

	INBOUND + RECEIPT	OUTBOUND
Vendor Policy	132	146
Customer Policy	187	119
Offsets	55	-27

4.2 TRANSPORTATION SENSITIVITY ANALYSIS

The baseline analysis used a transportation structure which excluded the effects of the RFCCs under the depot consolidation initiatives for the three PDS architecture. To properly consider the impact which the RFCCs could have on the results of this stock location study, it was deemed appropriate to consider a sensitivity analysis predicated on the continued use of RFCCs. As previously noted (i.e., see section 3.3.6), it was necessary to estimate how the system would change for both the inbound and outbound transportation cost. The greatest impact is believed to exist on the inbound side of RFCC operations. Displayed in Figure 4-2 are the results of this sensitivity evaluation for 1 year (FY 1988) of the analysis. This indicates that with the use of RFCCs, overall policy costs decrease by approximately 10 percent per policy. Consequently, the continued use of RFCCs would not alter the apparent fact that the stock closest to the vendor strategy is the most cost effective policy for the set of NSNs evaluated in this study.

POLICY COST COMPARISONS
Transportation Sensitivity (with RFCCs)



	V88	C88	H88	V89	C89	H89	V90	C90	H90
Inbound	34	49	47	27	39	36	22	33	30
Receipt	12	15	14	10	13	12	8	10	10
Outbound	50	41	47	47	39	44	41	33	38

Figure 4-2

4.3 WORKLOAD ANALYSIS

This section of the comparative policy analysis has attempted to use the available data to provide a preliminary assessment of the effects that DLA might expect as DoD evolves to a **stock closest to the vendor** strategy for those items which warrant the policy change. To accomplish this, the study team looked at workload from two perspectives. First, in terms of how many NSNs out of the study population of 218,894 items would be stocked at either one, two, or three PDS locations. Then we examined the distribution of these NSNs across the three PDS locations.

Shown in Figure 4-3 is a summary for each policy of those NSNs which at the end of the maximum procurement cycle (36 months) were found to be stocked at either one, two, or three PDS locations. It should not be too surprising that under the **stock closest to the customer** strategy, the majority of NSNs are found to be stocked across all three of the designated PDSs. Likewise, one should not be surprised that since DLA's vendor and industrial base is heavily concentrated in the East and upper Mid-West, that the majority of items evaluated under the **stock closest to the vendor option** were found to be stocked at a single stock point. Finally, the **hybrid** policy, which is a **mixture** of the two main policies, has a stockage location distribution which is mid-way between the other two policies.

PDS WORKLOAD DISTRIBUTION OF ITEMS
By Stockage Policy

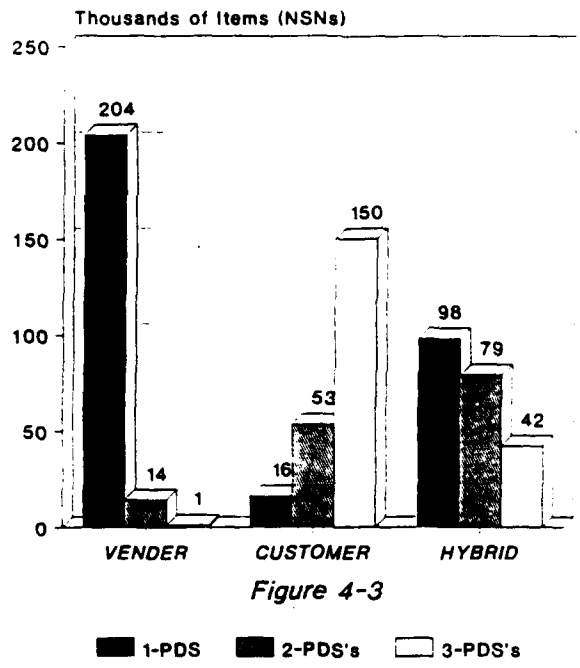


Figure 4-3

To properly see the workload implications of the previous data, one must view the same data from a slightly different perspective. The data must now be examined from the perspective of which PDS locations they would actually be assigned to for each policy. This information is displayed in Figure 4-4. In this case the reader should note that the NSN totals at the top of the bar-charts no longer will add to the study population of 218,894 items (i.e., this is because those NSNs which are stored at either two or three PDS locations will now be counted multiple times under this chart). The conclusion that one may reach from this data is that under the **stock closest to the vendor** strategy, most NSNs will be stored in the Eastern PDS and that the Western PDS will have a minimal workload based on the Agency evolving to the **vendor based** policy for the NSNs considered under this study. This distribution of NSNs, which portrays a heavy concentration of stocked items in the Eastern United States, should not be surprising given the location of the country's industrial base for most items.

DISTRIBUTION OF ITEMS BY PDS

By Stockage Policy

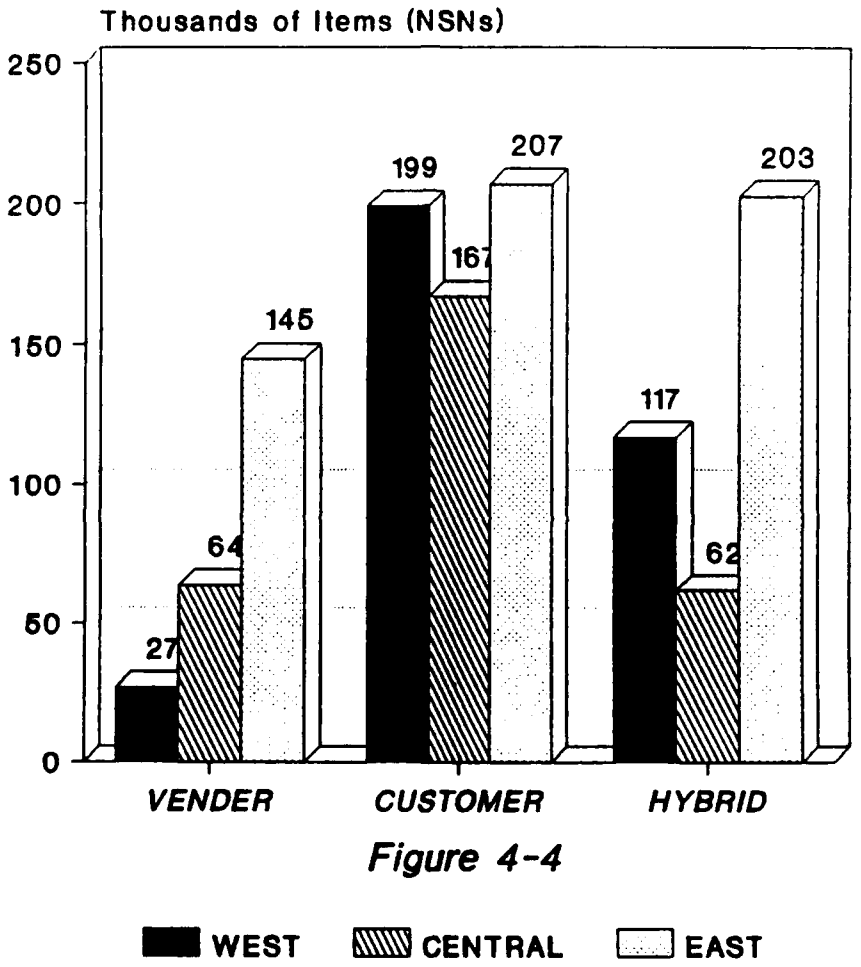


Figure 4-4

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

Four of the key conclusions observed from this analysis center on the following topics: DoD demand patterns, alternative policy costs, distribution of workload by policy, and transportation insights. Additionally, there exists a fifth conclusion which deals with issues associated with implementation of a **stock closest to the vendor** policy.

5.1 DoD DEMAND PATTERNS

We have concluded that sufficient empirical data exists to support the fact that at the wholesale level the demand patterns of DoD are not stable over time or by geographic location for the types of items evaluated in this project. Additionally, the degree of instability appears to increase as the demand "onion" is peeled back. This was observed from the dollar level, on down through requisitions and materiel release orders, and ultimately to the actual quantities of a particular NSN which are shipped to individual customer regions. This observation will likely become even "truer" as the DoD force structure redeploys and contracts in the next several years. One conclusion to draw from this study is that the less stable the demand patterns for items are, the more likely the vendor policy will be cost effective.

5.2 ALTERNATIVE POLICY COSTS

Given the set of NSNs over which the study was conducted, the **stock closest to the vendor** strategy was the "best" policy based on the comparative cost analysis. This observation was statistically significant at the 95 percent level. Indications were that the **vendor** based option significantly out-performed the **customer** option each year. Further, over a 36 month procurement cycle the inbound and receipt costs by a 2-to-1 margin accounted for the difference. We therefore recommend that the **stock closest to the vendor** policy be adopted as the default stockage policy in DLA. We further recommend that studies be performed on groups of items that do not appear to meet the demand stability test, items such as subsistence, clothing and textiles, or industrial maintenance.

5.3 DISTRIBUTION OF WORKLOAD BY POLICY

Consistent with the distribution of the nation's industrial base in CONUS, the **stock closest to the vendor** strategy could be expected to place most high activity NSNs at a single storage site. In the study population of almost 219,000 items, less than 10 percent of the items were found to warrant stocking in more than a single PDS location over the maximum 36 month procurement cycle. Additionally, most of the items would have migrated to the Eastern PDS location based on the distribution of vendors. The Western PDS location was found to have the least items stocked under the **vendor** based alternative because of the lack of

an industrial base in that region for most items covered by the analysis. Under the **customer** option, approximately 70 percent of the items covered in the study were stocked at all three PDS locations, and the Western PDS had almost as many items as did the Eastern site.

5.4 TRANSPORTATION INSIGHTS

Although generic unit costs for binnable and bulk receipts were considered by the analysis, the dominant cost factors for all policies were transportation. This is easily seen by examining the costs displayed under Figure 4-1 which depict the outbound and inbound transportation costs as the major players. On a statistical basis, the **vendor** based strategy consistently outperformed the **customer** alternative over the full 36-month procurement cycle. The cost offsets due to reduced inbound transportation charges under the **vendor** option more than compensated for the cost offsets obtainable under the **customer** based policy for outbound traffic charges.

These projected cost offsets under the **vendor** based policy are due to two principal reasons. The first is that on a given contract, instead of having multiple shipments to several depots (i.e., which frequently happens under the **customer** based strategy), the vendor simply ships to a single site. The second reason, is that under today's **customer** based policy, the inbound traffic charges are typically hidden within the contract price because most contracts are issued as **Free-on-Board (FOB) destination** awards. Consequently, the government does not have visibility of what that first destination transport charge truly costs. In this analysis, the study team has estimated what this inbound leg "should" cost based on the use of standard traffic rate tables.

5.5 POLICY IMPLEMENTATION

The key concept which needs to be kept in mind as the Agency moves under the DMRD 901 directive towards the **stock closest to the vendor** strategy is that this process must be **evolutionary.** For at least 50 years, the government has supported the military departments under the alternative option of the **stock closest to the customer** approach, and that strategy will continue to be used for selected items. Consequently, our entire business structure, which includes all of our automated information systems, exhibits a built-in bias towards the **customer** based strategy. This means, that as the Agency **evolves** to the new stock positioning logic which is **vendor** based, our information systems must become "smarter." This translates into identifying where the vendor's manufacturing or distribution point (e.g., which may be a port of entry) is actually located. We therefore recommend that as the new policy is implemented, the Agency's information systems be updated to capture actual vendor place of performance.

APPENDIX A

LIST OF ABBREVIATIONS

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Abbreviation	Definition
AIS	Automated Information System
C	Construction Commodity
CCP	Containerized Collection Point
DCR	Destination Cross Reference Code
DDCO	Defense Depot, Columbus, Ohio
DDMP	Defense Depot, Mechanicsburg, Pennsylvania
DDRC	Defense Depot, Region Central
DDRE	Defense Depot, Region East
DDRW	Defense Depot, Region West
DDRV	Defense Depot, Richmond, Virginia
DDTC	Defense Depot, Tracy, California
DDOU	Defense Depot, Ogden, Utah
DLA	Defense Logistics Agency
DoDAAC	Department of Defense Activity Address Code
E	Electronics Commodity
FINS	Freight Information System
FOB	Free On Board
G	General Commodity
GBL	Government Bill of Lading
GT	Guaranteed Traffic
I	Industrial Commodity
IPG	Issue Priority Group
LTL	Less Than Truckload
M	Medical Commodity
MRO	Materiel Release Order
MTMC	U.S. Army, Military Traffic Management Command
PDS	Primary Distribution Site
RFCC	Regional Freight Consolidation Center
SAMMS	Standard Automated Materiel Management System
SPLC	Standard Point Location Code
T	Textile Commodity
TCN	Transportation Control Number
TL	Truckload
UMMIPS	Uniform Materiel Movement and Issue Priority System
UPS	United Parcel Service

APPENDIX B

BIBLIOGRAPHY

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APPENDIX C

POLICY COST COMPARISON STATISTICS

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POLICY COST COMPARISON STATISTICS

Year Comparison	Policy Pair Comparison	Test Value	(Significant (yes/no)
FY 1988	Vender to Customer	23.20	yes
	Customer to Hybrid	9.56	yes
	Vender to Hybrid	22.20	yes
FY 1989	Vender to Customer	36.60	yes
	Customer to Hybrid	5.35	yes
	Vender to Hybrid	31.72	yes
FY 1990	Vender to Customer	18.53	yes
	Customer to Hybrid	5.20	yes
	Vender to Hybrid	15.85	yes

Test Statistic: Difference of Means, alpha = 0.05, degrees of freedom = 10
and Student's t-statistic = 2.228

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13. ABSTRACT *(Maximum 200 words)*

The study was charged with the tasks of evaluating alternative stockage policies and to assess Department of Defense (DoD) demand stability assumptions at the wholesale level. Three policies were analyzed under a DoD distribution system that fully implemented depot consolidation. The first policy evaluated was the "stock closest to the customer" option which represented the historical strategy. The second was the "stock closest to the vender" option which represents the DoD directed strategy under Defense Management Review Decision (DMRD) # 901. A third policy was also examined which represented a hybrid of the previous two stockage location strategies. Lastly, the project examined the fundamental assumption that DoD demand was stable at the wholesale level.

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