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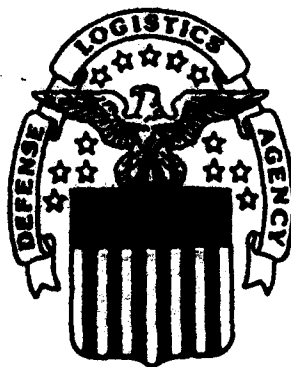
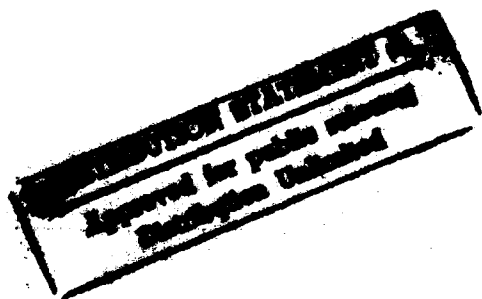
DLA-93-P00221

ANALYSIS OF ITEMS IN LONG SUPPLY

January 1993



OPERATIONS RESEARCH AND ECONOMIC ANALYSIS OFFICE



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DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

DLA-93-P00221

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SUPPLY**

January 1993

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DLA-LO

FOREWORD

The Defense Logistics Agency (DLA) Directorate of Supply Operations and the DLA Office of Policy and Plans directed that the 1985 Long Supply Study (Report # 85-07) be updated to establish a current baseline. This requirement has been driven by Department of Defense initiatives related to reducing supply system costs and inventory reductions as part of Defense Management Review Decisions 901 and 987.

The authors of this report are indebted to the staffs of the DLA Supply Management Division. In particular we would like to acknowledge the assistance of Ms. Nancy Rohr and Mr. Michael Pouy for their expertise in developing the definitions used in this study for long supply items. Additionally, our thanks is extended to the staff of the supply Centers for their data support.

Roger C. Roy
ROGER C. ROY
Assistant Director
Policy and Plans

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EXECUTIVE SUMMARY

This report documents the Defense Logistics Agency's (DLA) posture with respect to items which have been in a long supply status. The time period covered under this study includes Fiscal Years (FY) 1985 through 1991. This project establishes a current DLA baseline for items in long supply and represents an update to an earlier Long Supply Study (Report # 85-07) that had looked at FY 1977 through FY 1981 data.

The current time period (FY 85 to FY 91) covers a period when overall demands, as measured from an item level, have generally been declining. This is in sharp contrast to what was happening to demand patterns during the earlier study which spanned a time frame (FY 77 to FY 81) that experienced increasing demands. This is a key distinction that perhaps explains some of the major differences in the findings of these two studies.

First, the results of this study suggest that items which migrate into a long supply posture tend to recover very slowly. However, the previous long supply study indicated that items recovered rapidly from a long supply position. Second, this study identifies common characteristics, such as declining demand, lower standard unit prices, and longer procurement cycles which distinguish between those items which are in long supply and those which are not in that state. Additionally, this study was successful in establishing trend lines for predicting future buying patterns which discriminate between those items that are in long supply versus those which are not in a long supply position.

Overall, this study has evaluated over thirty unique parameters. Some of these have proved useful for projecting future buying patterns. However, the study team was not successful in finding any leading indicators of long supply which could be used for predictive purposes. Consequently, none of the parameters examined in this analysis proved to be statistically useful for indicating that a given item was likely to migrate to a long supply position.

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SECTION 1 INTRODUCTION

The Directorate of Supply Operations (DLA-O) and the Office of Policy and Plans (DLA-L) directed that an update to the original analysis of long supply (documented in Report No. 85-07) be accomplished. This requirement was driven by Department of Defense (DoD) initiatives stemming from Defense Management Review Decisions (DMRD) # 901 and # 987 for reducing supply system costs and inventories. This study was initiated in the first quarter of Fiscal Year (FY) 1992 and has been structured on the study plan that was approved in January 1992.

1.1 BACKGROUND

The Defense Logistics Agency's (DLA) previous study of long supply items attempted to answer three fundamental questions. The first and most essential question was to find out what items were in long supply and in what amounts. The second question was to find out if there were any item characteristics that could be used to predict an item's likelihood of either remaining in or migrating to a long supply position. The third and last question was to determine if there were any procedural changes that DLA could adopt which would permit the Agency to minimize the range and depth of items in long supply.

1.1.1 IDENTIFICATION AND QUANTIFICATION

Using the FY 1977 through FY 1981 long supply data, the previous study found that the Agency's long supply posture was not significant. Additionally, there was a high degree of variability in what items were in long supply from 1 year to the next. It was typical for hardware items to have only 33 percent of items remaining in long supply only 1 year after they first moved into a long supply position. After 5 years, the figure had fallen to only 6 percent.

1.1.2 LONG SUPPLY MIGRATION

The previous study also found that long supply for hardware items was too unstable to predict any future long supply status. Consequently, it would be uneconomical to have an aggressive disposal policy, since the Agency would have to reprocur the item if it were disposed of too soon.

1.1.3

LONG SUPPLY CONTROL PROCEDURES

Over this time period (FY 1977 through FY 1981), which represented a period of steadily increasing demands, long supply was not deemed to be a significant problem. Given this situation, it was not appropriate for the Agency to revise any control policies that would be intended to minimize long supply. Any such attempt would have been unwarranted and would have likely increased the number of backorders experienced by our customers during this period of rising demands.

1.2

SCOPE

The new study had been intended to update the Agency's baseline on long supply from where the previous study had stopped (i.e., as published in the Long Supply Study, Report # 85-07). Data requests were sent to the various supply centers in order to obtain detailed historical data files for the periods covering FY 1985 through FY 1991. Unfortunately, this extended historical period was only available for the electronic and general commodities. All of the remaining commodities (i.e., medical, textiles, industrial, and construction) only retained 1 year of data. Consequently, detailed trend analysis and assessment of migration patterns could only be accomplished for electronic and general items.

1.3

OBJECTIVE

The principal goal of this analysis has been to establish the current baseline on long supply by updating the previous 1985 study. This involves developing answers to the three essential questions. First, determine the current posture and extent of long supply in DLA. Second, ascertain whether or not there exist attributes which may be employed to predict the chance of an item moving into a long supply posture or continuing to remain in long supply. Finally, determine what control mechanisms exist which the Agency might employ to more effectively manage the long supply issue if such control is warranted.

SECTION 2 METHODOLOGY

This section will provide a synopsis of the study approach used for completing this project. Included in this description will be the definitions employed to assess what items were in a long supply posture. Additionally, classification breakouts for each type of item will be provided as well as a descriptive statistical picture of the study population. Lastly, there will be a brief overview of the statistical approach which has been taken on this project.

2.1 LONG SUPPLY DEFINITIONS

Central to this project have been the definitions of long supply. These definitions vary depending on how the item is presently managed. Throughout its life cycle, an item may change management categories. For example, an item may start out being managed as a **Nonstocked** item. Later on in the life of this item, as demand increases, it may migrate to a **Numeric Stockage Objective (NSO)** management category. Still later in the life of this item, if demand continues to increase, the item may move to the category of a **Replenishment** item. As items migrate to different management categories, one must apply the appropriate definition in order to estimate the long supply posture of the item.

2.1.1 **NONSTOCKED ITEMS**

By definition, nonstocked items should not have issuable assets in our depots. If required, stocks for this class of items should be procured and delivered directly to the requisitioning customer. Consequently, an item which is currently being managed as a nonstocked item, will only be in a long supply position if its issuable asset quantity (IAQ) exceeds zero.

2.1.2 **NUMERIC STOCKAGE OBJECTIVE ITEMS**

This class of items represents those items deemed to be critical insurance items which may exhibit either a very limited historical demand or no demand whatsoever. Because they are considered critical items, a nondemand-based stockage level is assigned. If the IAQ exceeds the item's assigned NSO quantity by more than three times, the item is considered to be in long supply.

2.1.3 REPLENISHMENT ITEMS

Those items which have sufficient historical demand to warrant forecasting are considered to be replenishment items. For this class of items, if it's Retention Stock On-Hand or it's Excess Stock On-Hand exceed zero, then the item is considered to be in long supply. These asset positions were identified from the historical data records provided by the Defense Supply Centers.

2.2 STUDY POPULATION

The study population was determined based on the definitions established for three distinct categories of items. These categories (nonstocked items, numeric stockage objective items, and replenishment items) have unique definitions. The following paragraphs provide definitions appropriate to each category which were used in this study.

2.2.1 NONSTOCKED ITEMS

Nonstocked items consist of low demand items which DLA purchases for direct delivery to the customer. These items were identified by using the supply system codes (SSCs). If an item had an SSC equal to 2, the item is managed as a nonstocked item with local purchase used as the primary means of supply. If the SSC equals 3, the item is nonstocked and centrally procured. Finally, if the SSC was equal to 9, the item is semi-active which means that the item must be retained because stocks of the item are in use or on hand below the wholesale level.

2.2.2 NUMERIC STOCKAGE OBJECTIVE ITEMS

If an item typically experiences demands which are too low to forecast, and if the item is significant enough to be deemed an insurance item, then the item is stocked in a depot. The level of stock to which a supply center will manage this item is known as the NSO. All NSO items were identified first by eliminating nonstocked items, then by ascertaining if the item category code (ICC) was set to 2 (i.e., an NSO item subject to a mechanical change to replenishment), or if the ICC was equal to a B (i.e., an NSO item that is not subject to a mechanical change to replenishment).

2.2.3

REPLENISHMENT ITEMS

All items designated as replenishment based items represent those that have demand rates high enough to support the use of forecasting and safety level computations. This class of items was identified by first eliminating all items coded as being nonstocked (i.e., items having an SSC equal to 2, 3, or 9 were excluded) and then selecting those items which had an ICC set to 1 (i.e., demand oriented replenishment items), or an ICC equal to P (i.e., replenishment based program oriented items).

2.2.4

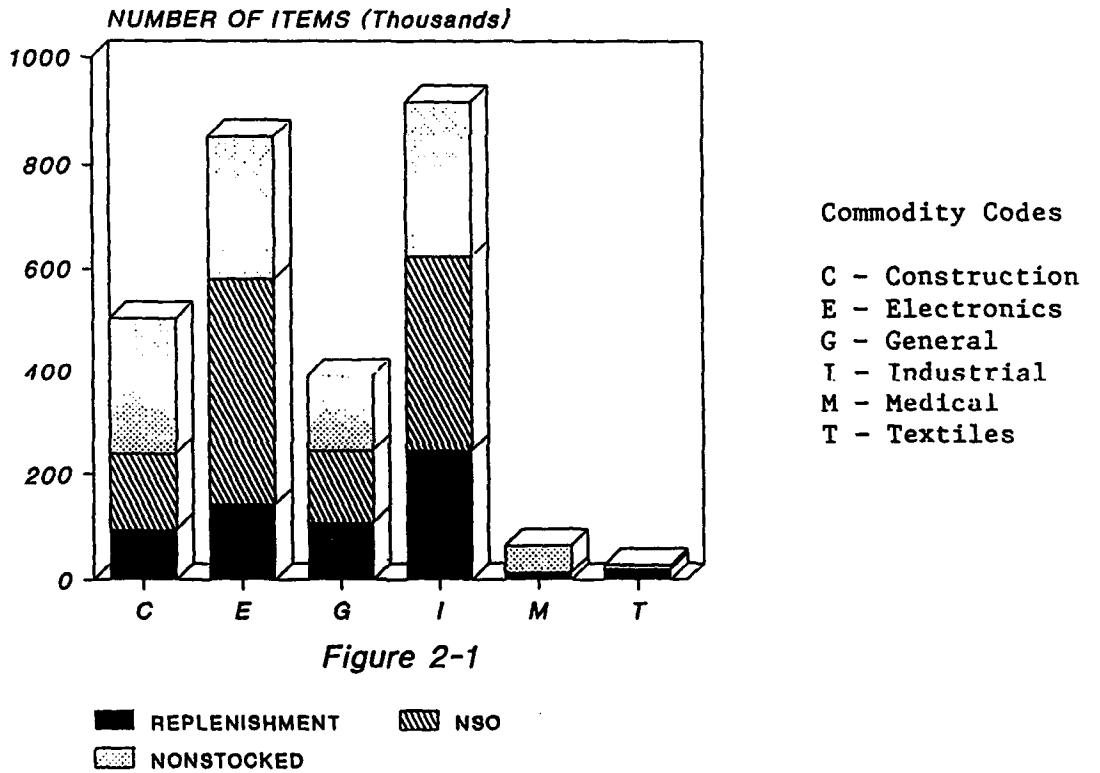
COMMODITY LEVEL BREAKOUT

Now that we have developed both the item selection and definitional logic required for fully quantifying the long supply posture of the Agency, we may apply these criteria to see exactly where the Agency stands on these items. These data are best viewed from the perspective of each commodity group. This is appropriate since it is the managing supply center which controls items and which has provided the study team with their respective stratification files.

From a commodity level perspective, Figure 2-1 lays out the basic distribution of items included in the study. This "snapshot" represents how the respective supply centers were managing their items as of September 1991. The data patterns indicate the type of management (replenishment, numerical stockage objective, or nonstocked) which is employed for a given group of items.

It is seen from this data that the supply centers vary in the proportions of their individual workloads that are assigned to specific item management categories. Since long supply is computed on a different basis for each category of item management, it is important to keep these distinctions in mind.

**NUMBER OF ITEMS INCLUDED
IN THE ANALYSIS BY COMMODITY**



Commodity Data as of September 1991

2.2.4.1

NSO Items Lead Long Supply

Applying the long supply definitions to their appropriate item management categories, those items which were identified as being in a long supply posture as of September 1991, have been identified. Figure 2-2 displays for each commodity, items which were found to have long supply. Across the four hardware centers (construction, electronic, general, and industrial), it was found that NSO items constituted the item management category with the largest percentage of items in a long supply posture.

*NUMBER OF ITEMS IDENTIFIED
IN LONG SUPPLY BY COMMODITY*

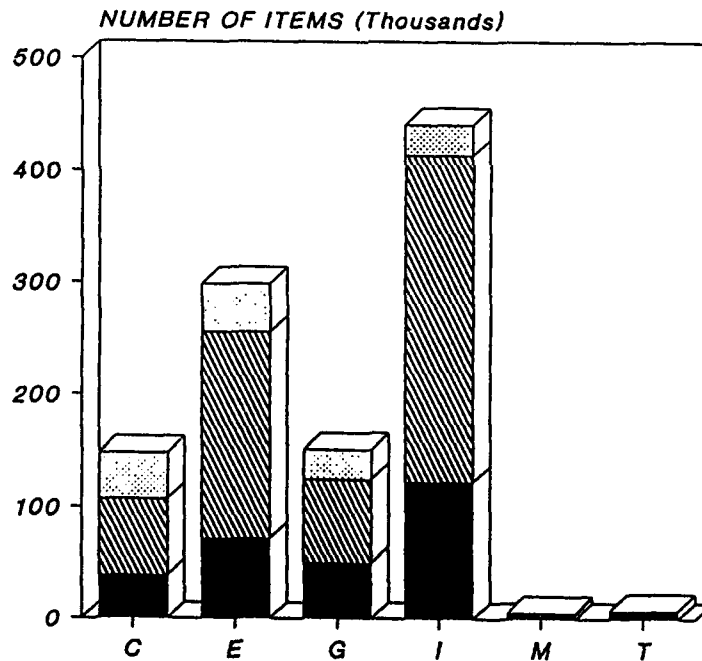


Figure 2-2

■ REPLENISHMENT ▨ NSO ▩ NONSTOCKED

Commodity Data as of September 1991

2.2.4.2

Industrial has Greatest Quantity

Whereas, the previous chart identified the number of items which were in a long supply posture by item management category for each commodity, it did not reveal the issuable asset quantities. If we examine this measure, the following chart reveals that the industrial commodity is overwhelmingly the "tall pole in the tent" as measured by quantity. This picture holds true for both replenishment managed items as well as NSO managed items.

DISTRIBUTION OF LONG SUPPLY QUANTITY BY COMMODITY

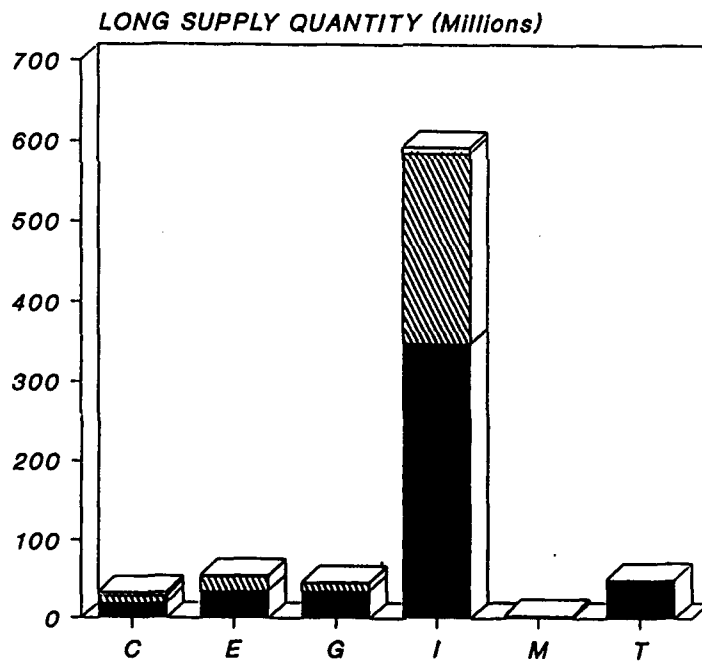


Figure 2-3

REPLENISHMENT NSO NONSTOCKED

Commodity Data as of September 1991

2.2.4.3

Dollar Value of Long Supply Assets

Although from Figure 2-3, the reader would be left with the impression that the only significant long supply problem was associated with the industrial commodity, this would not be an accurate picture. Instead, the reader should also consider the dollar value of the items which have been identified as being in a long supply position. If we examine the dollar value of those items which are in long supply, we will observe that the hardware commodities are now more evenly matched. These results are depicted in Figure 2-4. Once again, those items that are managed as NSO items tend to exhibit the greatest tendency towards being in a long supply position for the hardware commodities.

DISTRIBUTION OF LONG SUPPLY DOLLARS BY COMMODITY

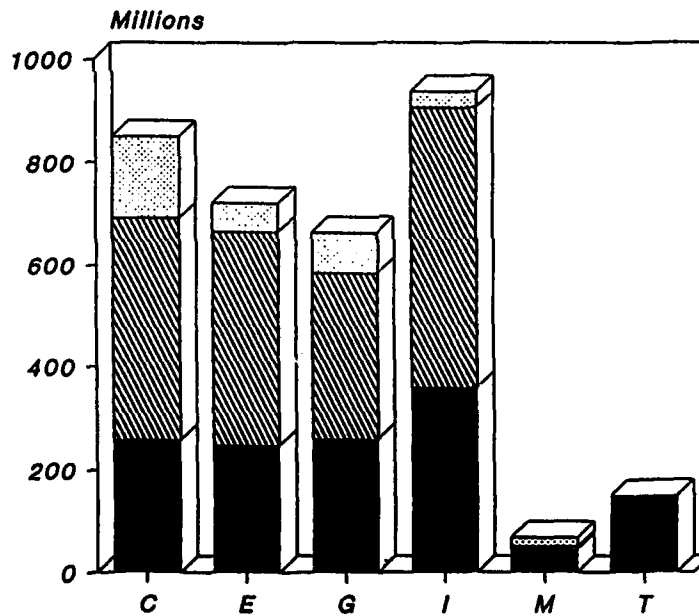


Figure 2-4

REPLENISHMENT
 NSO
 NONSTOCKED

Commodity Data as of September 1991

2.3

DATA ANALYSIS TECHNIQUES

All basic data analysis for this study has been accomplished through use of the SPSS data package. Various descriptive statistics have been used to enumerate data attributes. Additionally, analysis of variance has been used to develop relationships that might exist between specific item attributes and the item's likelihood of being in a long supply position.

SECTION 3 FINDINGS

This section will describe the key findings which emerged from this analysis. It will include an overview of some potential factors which were believed to contribute to the Agency's long supply posture. Additionally, both the status and stability of items with respect to long supply will be assessed. Finally, the chance of future buys on long supply items, as well as the likelihood of an item remaining in a long supply position, will be examined. This detailed level review conducted at the item level has been limited to two hardware commodities (electronics and general) since the other centers did not archive the necessary stratification files.

3.1 POTENTIAL FACTORS IN LONG SUPPLY

When this study was first initiated, there were several factors which were believed to be significant for possible linkage with an item being in long supply. This belief was held in spite of the fact that the earlier study (Long Supply Study, report # 85-07) had reached the conclusion that there were no factors influencing long supply. After continuing to pursue the possible linkage of factors with the Agency's long supply position, there were two that emerged as having an impact.

3.1.1 DEMAND VARIATION

A previous study conducted by this Agency, Impact of Decreasing Budgets and Item Transfers (DLA-91-P00218, June 1991), has developed insight on the issue of demand variation from a macro level perspective. Summarized from this study in Figure 3-1 are the annual demand dollars for the period of FY 1981 through FY 1990 for all hardware and medical items.

3.1.1.1 Demand History in Dollars

The obvious pattern which emerges is that the dollar value of demand was steadily increasing up until FY 1985 and has been decreasing since that peak. This rise and fall corresponds with the two long supply studies conducted by this Agency. The first study, which was completed in 1985, indicated that long supply was not a problem and that there was little likelihood of an item remaining in long supply during a period of increasing demands. However, our current study effort covers the period from 1985 through 1991, a time frame of declining demands, with items in long supply becoming a more significant problem area for the Agency.

ANNUAL DEMAND DOLLARS
(billions) in Constant Fiscal Year 1990

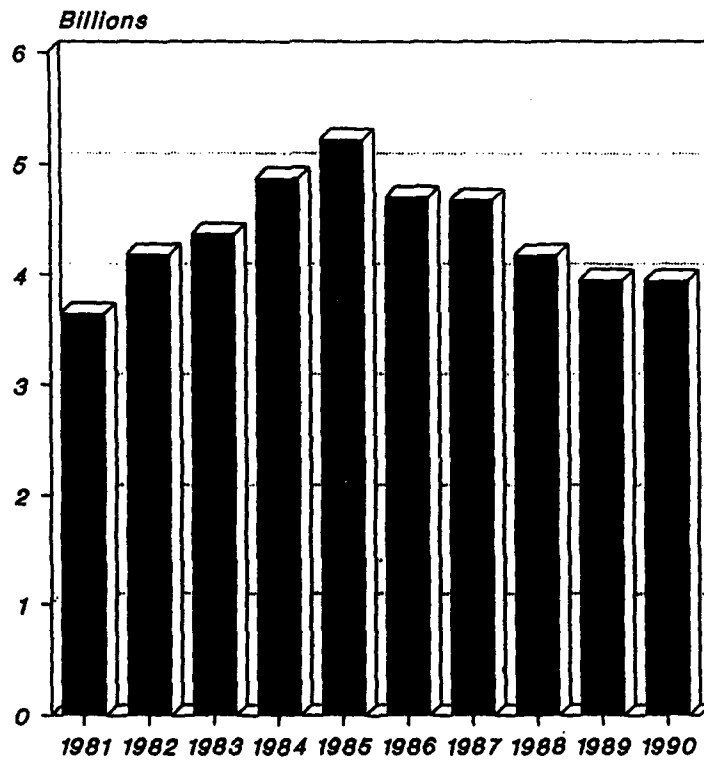


Figure 3-1

3.1.1.2

Demand Decrease in Electronic Items

Now if we continue to review the impact of demand variability on long supply items over the current study period (1985 - 1991), we will observe some interesting facts related to significant demand decreases. Figure 3-2 develops an interesting picture of the experience on electronics items. Displayed on this chart are historical profiles for two supply measures; namely, the annual demand frequency (ADF), and the annual demand quantity (ADQ). Each measure has been broken down into three groupings based on the length of time an item experienced long supply over this time period. Consequently, each measure has been screened into those items which never experienced long supply (0 years), or which were in a long supply posture that included 1 year but not more than 6 years, or those which were in a long supply status for the entire 7 years.

DEMAND DECREASED FOR ELECTRONIC ITEMS

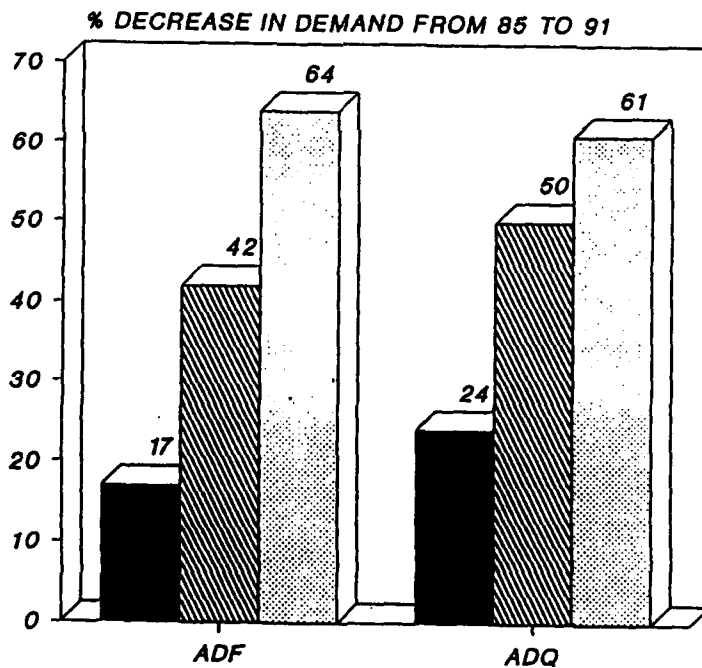


Figure 3-2

YRS IN LONG SUPPLY

0 1-6 7

Grouped by Annual Demand Freq. vs Qty.

Electronics items which experienced no long supply had an average decrease in their ADF of 17 percent over the 1985 to 1991 time frame. This contrasts with those items which were in long supply for a period of 1 to 6 years and which experienced a decrease in their ADF of 42 percent. Meanwhile, those items which remained in long supply the entire 7 years were found to have an average decrease of 64 percent. This same pattern held constant for the ADQ measurement.

It appears that one of the main factors influencing long supply during this time period has been the decreasing demand situation. We found that it was consistent that items which experienced significant decreasing demand tended to spend more time in long supply. This is not a startling finding.

3.1.1.3 Demand Decrease in General Items

If we now shift our view from electronics to the general commodity items, the reader will see similar patterns emerging in Figure 3-3. Once again, it can be seen that there is an apparent significant relationship between periods of declining demand and the long supply position of an item. Additionally, those items which had the greatest decline in average demand, seem to spend the longest time in long supply.

DEMAND DECREASED FOR GENERAL ITEMS

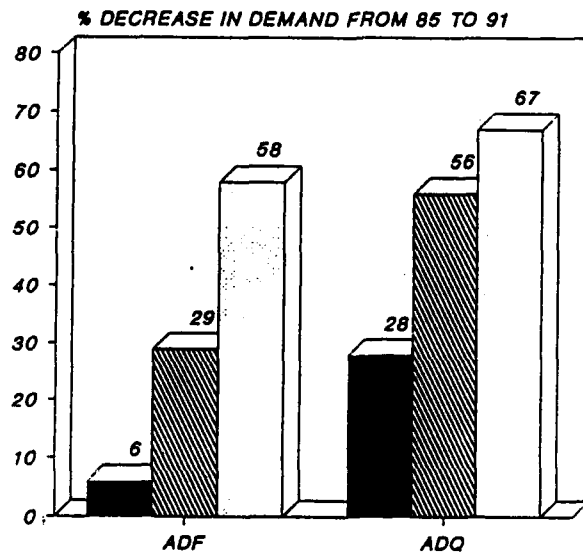


Figure 3-3

YRS IN LONG SUPPLY
 ■ 0 ▨ 1-6 □ 7

Grouped by Annual Demand Freq. vs Qty.

3.1.2

DIMINISHED MANUFACTURING SOURCES

Another factor which we suspected might strongly influence long supply was diminished manufacturing sources (DMS). This represents the situation that exists when the domestic industrial base for an item is projected to discontinue production. Often this is the situation with electronics items since the technology base for that type of hardware rapidly experiences major technological breakthroughs. Consequently, entire manufacturing processes are often revised on a 5 year window. Since the Agency needs to support DoD weapons systems that may be in service for 20 years or longer, a decision is often made to execute a life-of-type (LOT) buy in which 10 years of projected demand are purchased against a DMS type item. Figure 3-4 portrays the contribution of DMS long supply dollars to all electronics items that were in a long supply posture. It was concluded from this analysis for electronics (the commodity most likely to be impacted by DMS) that DMS was not a significant contributor to the long supply situation in the Agency.

EXTENT OF DIMINISHED MANUFACTURING SOURCES (DMS) ON ELECTRONIC ITEMS IN LONG SUPPLY

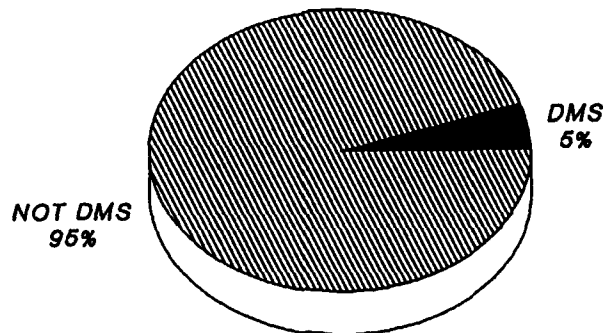


Figure 3-4

*DMS Life-of-Type (LOT) Buys for Items
No Longer Available from US Vendors*

3.2

STATUS ACROSS TIME

Keeping in mind that there exist dynamics in the demands exerted by customers against specific items, the study team thought that it would be revealing to look at the long supply posture by commodity across time. For the two commodity groups on which we had data for the full 7 years (1985 to 1991), we found that approximately one-third of each population group (electronics and general) was never in long supply (see Figures 3-5 and 3-6). However, a notable distinction was found in that the electronics commodity had proportionately more than twice as many items which were always in long supply as compared to the general commodity. Although we have noted (Section 3.1.2) that DMS was not the major contributor (only 5 percent) to the long supply situation with electronics, it is our suspicion that due to the rapid advances in technology, this commodity will likely have a high probability of excess stocks as the military departments continue to upgrade their electronics systems. This continual upgrading of electronics systems, while required to meet potential threats, has the tendency to cause relatively new technology items to migrate into long supply.

*DISTRIBUTION OF ELECTRONIC ITEMS
VERSUS LONG SUPPLY*

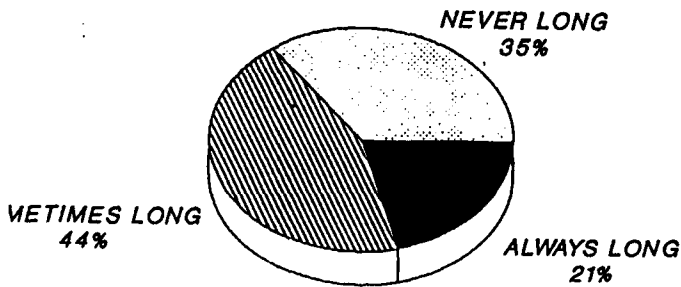


Figure 3-5

*DISTRIBUTION OF GENERAL ITEMS
VERSUS LONG SUPPLY*

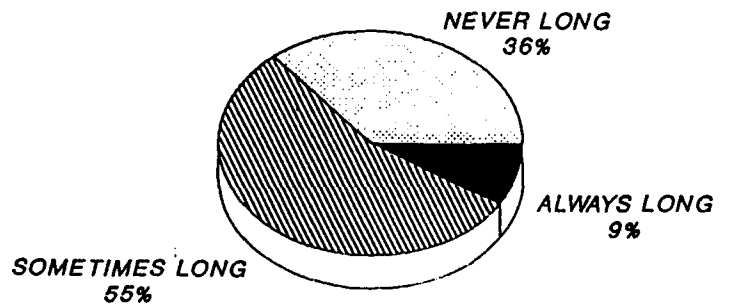


Figure 3-6

3.3

STABILITY OF LONG SUPPLY

The previous 1985 published long supply study concluded that there was no inherent stability of items under long supply. This conclusion had been reached based on the Agency's history during the years 1977 through 1981. We have found the exact opposite situation to be true in today's environment for the period covering 1985 through 1991.

3.3.1

ELECTRONIC ITEMS

Displayed in Figure 3-7 are the two state probabilities for electronic items. The top curve displays the probability of an item which was in a long supply state during the base year of 1985 and which continued to remain in this state during the succeeding 6 years. For example, an item which was in long supply in 1985 would have had a probability of 1.0 of being in that state since that was exactly where it was at that point in time (i.e., the event was certain). Whereas by the following year the probability of that item remaining in long supply had decreased to 0.87, since some items had migrated out of long supply.

The lower curve, which is plotted on Figure 3-7, tracks the probability of migration into a long supply position given that the item was not in long supply in the base year 1985. Consequently, if the item was not in long supply in 1985, then it had a 0.0 probability of being in long supply at that point. However, in the following year (1986), the item had a 0.12 probability of migrating into a long supply position.

These data for electronics items indicate that items tend to shift or migrate very slowly both into and out of a long supply position over this time period. It appears that this migration follows a smooth and somewhat predictable pattern from year to year. These curves for electronics also indicate that a prior history of long supply would appear to be a good predictor of future long supply.

STABILITY OF ELECTRONIC ITEMS VERSUS LONG SUPPLY

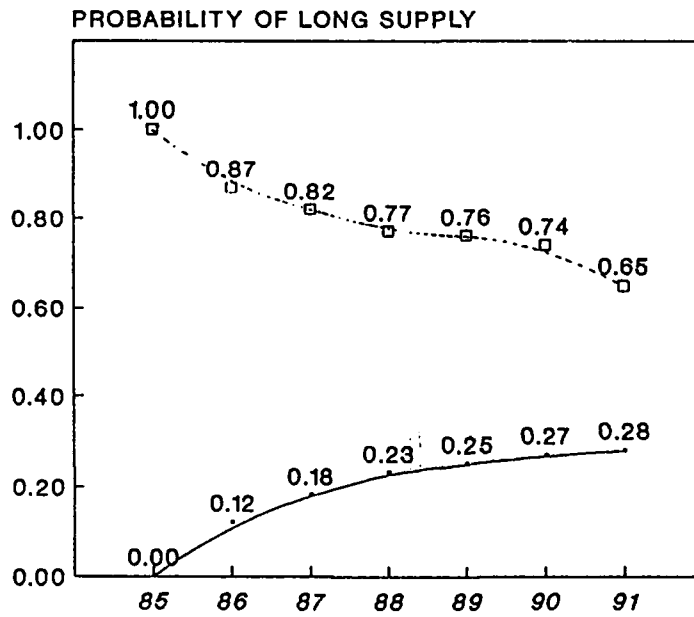


Figure 3-7

FOR ITEMS:

— NOT LONG IN 1985 -□- LONG IN 1985

Base Year is FY 1985

Our analyses using 1986 or 1987 as the base year have indicated that selecting a different base year has only minimal impact on the shape of these curves for electronics items. These charts are provided in Appendix A of this report. Additionally, stability graphs broken out by the type of management classification (i.e., nonstocked, NSO, or replenishment) used for the item are also provided in the Appendix.

3.3.2 GENERAL ITEMS

When we examined the general commodity, we found the situation to be predictable but less so as compared with electronics. Figure 3-8 highlights this increased variability for general items. Once again, the top line displays the probability of an item remaining in long supply at that point in time given that in the base year (1985) it was in that posture. Consequently, by 1991 an item which had been in long supply at the start, would now have a 0.63 probability of still being in a long supply mode. Again, shifting the base year from 1985 to a more recent date does not radically change the basic shape of these curves. These charts are provided in Appendix A.

STABILITY OF GENERAL ITEMS VERSUS LONG SUPPLY

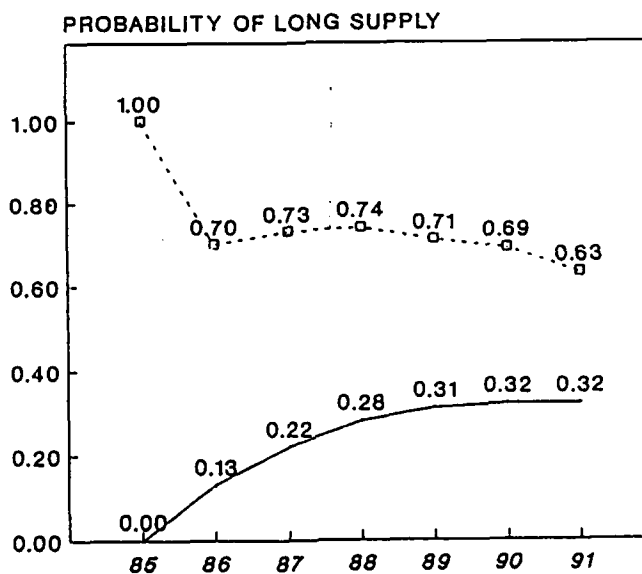


Figure 3-8

FOR ITEMS:

-- NOT LONG IN 1985 -o- LONG IN 1985

Base Year is FY 1985

3.4

PROBABILITY OF FUTURE BUYS

Another way of evaluating items in long supply was to determine their buy positions. Specifically, we were interested in how long it took for a long supply item to return to a buy position. What we found was that long supply items tend to recover to a buy position very slowly.

3.4.1

ELECTRONIC ITEMS

Figure 3-9 develops for electronics items the cumulative probability of a buy over time. The upper curve tracks those items which were not in a long supply position in the base year (1985). This contrasts markedly with the lower curve that displays the same information for those items which were in a long supply situation during the base year.

For example, an electronics item which was not in long supply during the base year (1985) would typically have a 25 percent chance of being bought during that year. This compares to only a 3 percent chance of a buy being executed for an item that was in long supply. These trends continued to generally hold up as we looked at alternative base years (see Appendix A for additional data dealing with procurement cycles and prices).

FUTURE BUYS OF ELECTRONIC ITEMS
VERSUS LONG SUPPLY

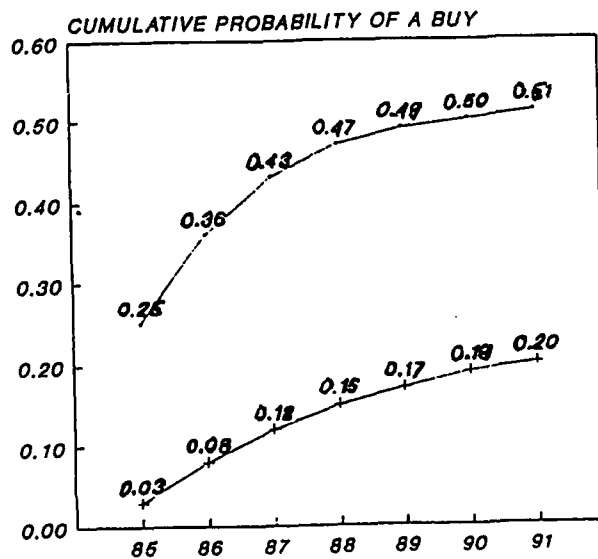


Figure 3-9

FOR ITEMS:

— NOT LONG IN 1985 + LONG IN 1985

Base Year is FY 1985

3.4.2

GENERAL ITEMS

As the study team looked at the general commodity, we found very similar trends for purchasing. Figure 3-10 displays the buy probability curves for those items which were not in long supply during the base year (1985) as well as those that were found to be in a long supply position. Although the cumulative buy probabilities tend to be slightly higher as compared with the electronics items, the overall buying patterns are very similar. Once again, we found that these trends follow purchasing patterns that are very nearly identical as the base year shifts (see Appendix A for additional data on procurement cycles and prices).

FUTURE BUYS OF GENERAL ITEMS
VERSUS LONG SUPPLY

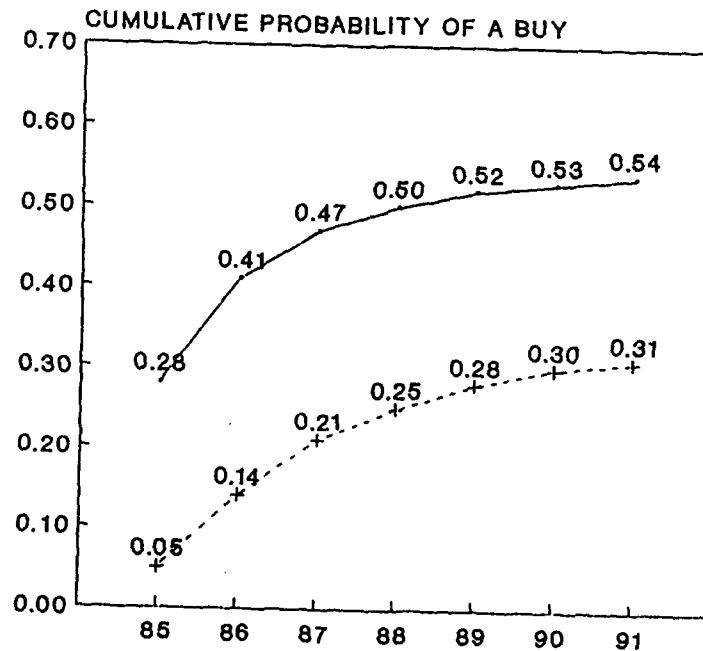


Figure 3-10

FOR ITEMS:

— NOT LONG IN 1985 -+- LONG IN 1985

Base Year is FY 1985

3.5

PREDICTORS OF LONG SUPPLY

One of the stated goals for this study was to attempt to develop predictors of the likelihood of future long supply. Given that the tendency for an item to be in long supply appears to be nonlinear, the study team decided to use the logistics regression model (see Appendix A for details). This model was appropriate for two major reasons. The first was that it may be easily used with categorical data (e.g., is an item in long supply or is it not (yes or no)). The second reason was that this model may be constrained to values between 0.0 and 1.0 which represent the limits on probabilities. By using this approach, the study team found that the best predictor (see Appendix A for the complete listing of all parameters examined) for an item being in long supply next year was whether it was in long supply last year. Although this is not surprising, it does represent a departure from what the 1985 study had found. This finding was true for both electronic and general items and we suspect that this situation would hold true for the other hardware commodities.

SECTION 4 CONCLUSIONS

The study has concluded that items which migrate into a long supply posture tend to recover very slowly. This is empirically true for the two commodities (electronics and general) which were studied in detail and we suspect it holds true for the other hardware commodities. This conclusion represents a significant departure from the previous long supply study published in 1985. The earlier study had indicated that items recovered rapidly from a long supply position. However, this earlier conclusion had been based on a period of time (1977 - 1981) when demand was experiencing growth. This is not the case in DoD today when demand has continued to decline since 1986. Consequently, it should not be surprising that today as items move into long supply they recover more slowly.

Additionally, the analysis indicates that there were no leading indicators of long supply among the parameters that were examined. Consequently, on a statistical basis it does not appear likely that the Agency could use any of the examined parameters to forecast future migration of an item into long supply.

Finally, the study team has been successful in establishing trend lines for predicting future buying patterns. These trend lines have been established for the electronic and general commodities. While somewhat similar, these trend lines are unique to these classes of items; and they each discriminate by whether or not the items are in long supply or not in that state.

**APPENDIX A
TECHNICAL SUPPORT DATA**

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**APPENDIX A
TECHNICAL SUPPORT DATA**

This appendix provides additional supporting data as backup information. The data has been grouped into three areas. The first group deals with long supply stability issues. The second part provides additional summary data on buying patterns. Lastly, the third section provides summary statistics on various parameters which were believed to be related to items migrating into a long supply posture.

A-1.1 LONG SUPPLY STABILITY

Earlier in the report (Section 3.3), we presented the results of analysis that developed the probability that an item would remain in a long supply position or continue not being in long supply given the base year 1985. We've found these trends to be fairly consistent in their essential pattern for alternate base years. Figures A-1 and A-2 portray these additional analyses for the electronics and general commodities. Once again, the upper curves represent those items that were in long supply at the start of their respective base years. Conversely, the lower curves depict probabilities of items migrating into long supply given that they were not in long supply during the base year.

**STABILITY OF ELECTRONIC ITEMS
FOR DIFFERENT BASE YEARS**

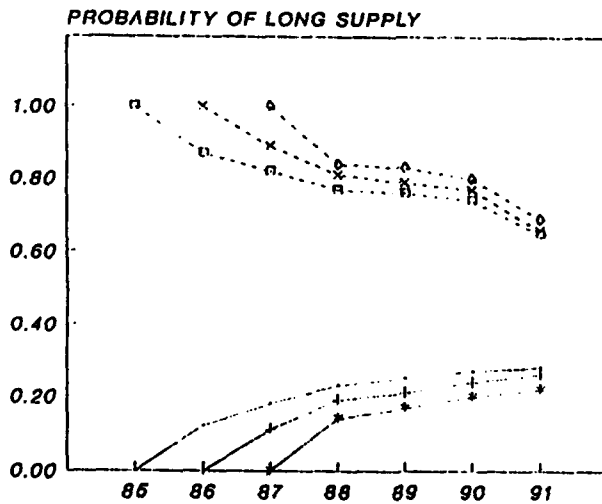


Figure A-1

FOR ITEMS:
 --- NO LONG 86 - - - NO LONG 87 - · - NO LONG 88
 ○ · LONG IN 86 * · LONG IN 87 · · LONG IN 88

Alternate Base Years: FY 85/86/87

**STABILITY OF GENERAL ITEMS
FOR DIFFERENT BASE YEARS**

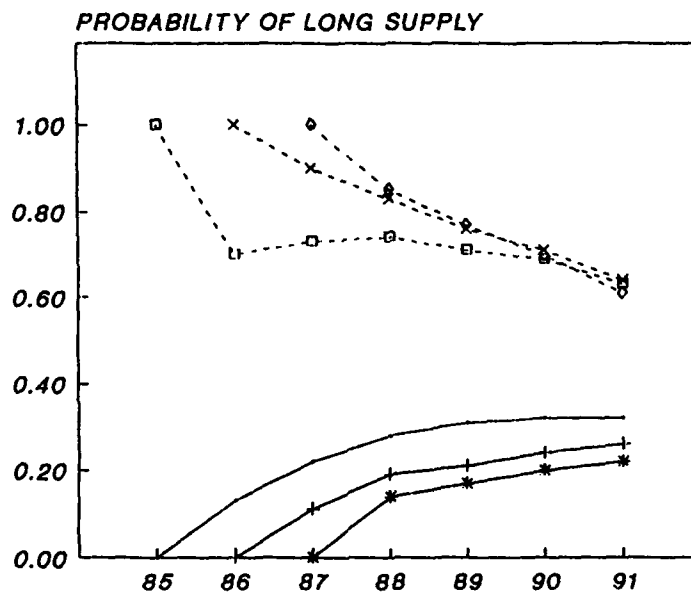


Figure A-2

FOR ITEMS:
 — NO LONG 85 + NO LONG 86 * NO LONG 87
 -□- LONG IN 85 -x- LONG IN 86 -o- LONG IN 87

Alternate Base Years: FY 85/86/87

A-1.2

BUYING PATTERNS

Previously (Section 3.4), we provided information on buying patterns. Here we have analysis results related to purchasing. More specifically, we analyzed the procurement cycles and unit prices of items. These have been stratified into three categories based on an item's exposure to long supply. The first group is labeled as 0 and represents items that were never in long supply during the time period which was analyzed (1985 to 1991). The second deals with those items that were in long supply anywhere from 1 to 6 years and this group is labeled accordingly. Lastly, the third group covers those items that remained in a long supply posture the entire 7 years.

Figures A-3 and A-4 indicate that long supply items tend to have longer procurement cycles for the electronics and general commodities. These data appear to be consistent across these two commodities for the time period covered by the study.

PROCUREMENT CYCLES FOR ELECTRONIC ITEMS

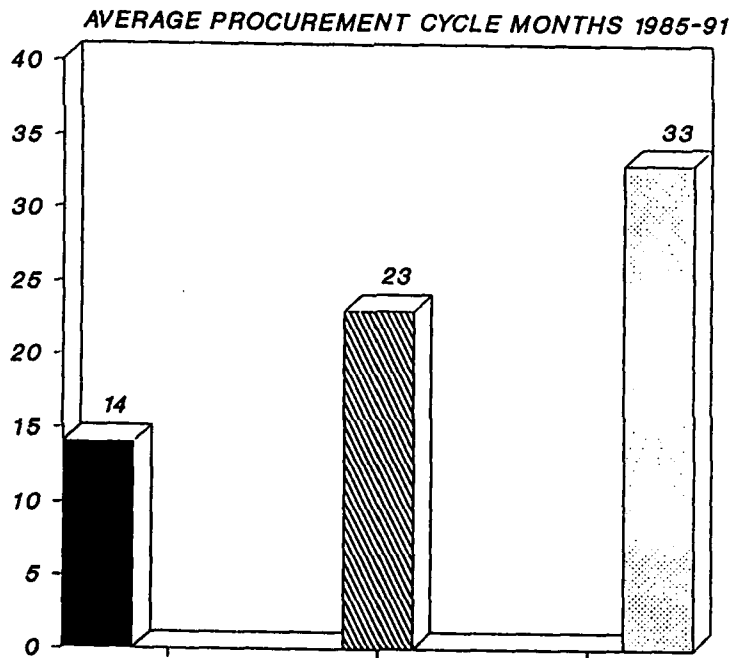


Figure A-3

YEARS IN LONG SUPPLY
■ 0 ▨ 1-6 □ 7

PROCUREMENT CYCLES FOR GENERAL ITEMS

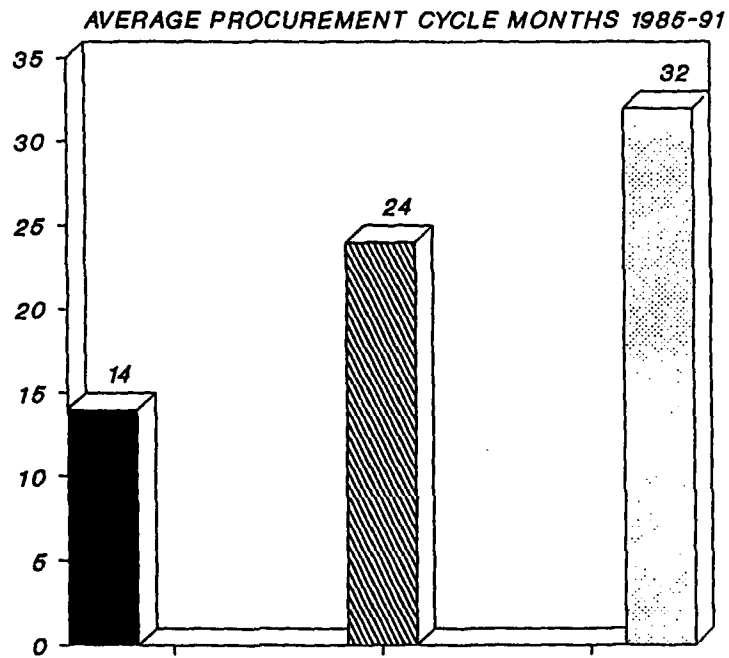


Figure A-4

YEARS IN LONG SUPPLY

■ 0 ▨ 1-6 □ 7

A-1.3

AVERAGE STANDARD UNIT PRICE

Proceeding on with the analysis of unit prices, the next two figures depict the average standard unit price. Once again, we have used the same labels for the stratifications indicated as was previously used. Figure A-5 portrays the experience of electronics while Figure A-6 depicts the typical prices for the general commodity.

**AVERAGE STANDARD UNIT PRICES
FOR ELECTRONIC ITEMS**

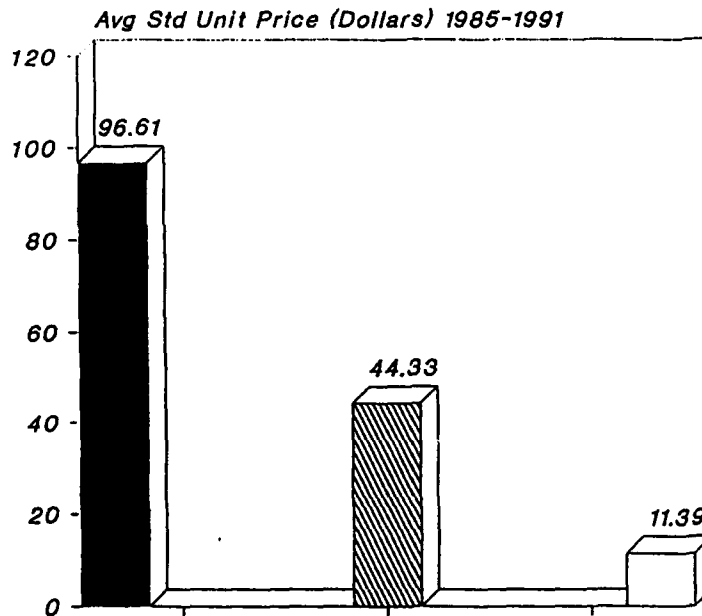


Figure A-5

YEARS IN LONG SUPPLY
0 1-6 7

**AVERAGE STANDARD UNIT PRICES
FOR GENERAL ITEMS**

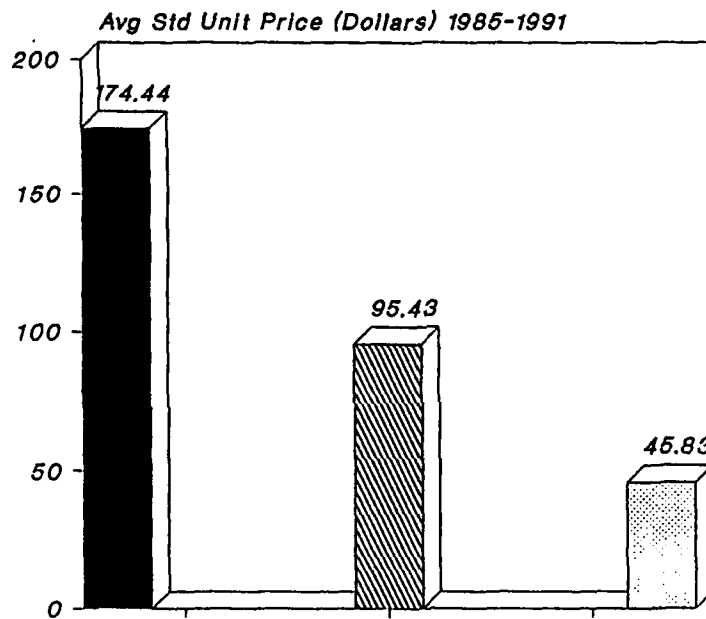


Figure A-6

YEARS IN LONG SUPPLY

0 1-6 7

A-1.4

POTENTIAL PREDICTORS

Elsewhere in the report (Section 3.5), we reported the main result on our statistical analysis of potential predictors for long supply. We used a logistics regression model to determine which set of variables "best" predicted long supply in 1991. This model was chosen since it readily incorporates categorical data and also accommodates the non-linearity of probability functions. The logistics regression model assumes an "s-shaped" curve for an exponentially constrained prediction equation. This feature allows the various event probabilities to approach either 0.0 or 1.0.

Using the r-statistic derived from the logistic regression model, we found, not surprisingly, that a history of long supply in the previous year was the best predictor for long supply in the following year. This was found to be true for both the electronics and the general commodities with both having a test statistic equal to about 0.6 (this is significant for this model which has been constrained to values between 0.0 and 1.0). Table A-1 identifies the four top predictors identified under this project. The test statistic is provided for each parameter and for both commodities which were evaluated. Table A-2 lists all other parameters which were evaluated and were found to be statistically insignificant.

| <i>Table A-1. Top Predictors of 1991 Long Supply</i> | | |
|--|-----------------------------------|--------------------------------|
| PREDICTOR | ELECTRONIC ITEMS (r-statistic) | GENERAL ITEMS (r-statistic) |
| 1990 Long Supply (0=no, 1=yes) | 0.6085 | 0.5995 |
| Number of Contiguous Years in Long Supply | 0.5407 | 0.5144 |
| Total Number of Years in Long Supply | 0.5400 | 0.4937 |
| 1985 to 1990 Long Supply | 0.5118 | 0.4892 |

Table A-2. Other Parameters Evaluated

Supply Status Code
Unit Price
Age of Item Code
Item Category Code
Procurement Cycle Code
Safety Level Code
Tracking Signal Code
Weapon System Indicator Code
Administrative Leadtime Days
Production Leadtime Days
Operating Level Months
Procurement Cycle Months
Safety Level Months
Last Disposal Year
Average Requisition Quantity
Issuable Asset Quantity
Mean Absolute Deviation
Numeric Stockage Objective Qty
Quarterly Forecasted Demand
Quarterly Forecasted Returns
Safety Level Quantity
Other Was Reserve Materiel Req
OWRMR Protectable
Annual Demand Quantity
Annual Demand Frequency
Stocked Buy Qty
Total Buy Qty
DMS Code (1=Yes or 0=No)
Last Buy Date
Management Assume Year

**APPENDIX B
BIBLIOGRAPHY**

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BIBLIOGRAPHY**

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