P-962

MEASURING THE IMPACT OF FORCE STRUCTURE CHANGES ON ARMY CENTRAL SUPPLY AND MAINTENANCE RESOURCE REQUIREMENTS

John D. Morgan
Francis L. McDonald

June 1973

INSTITUTE FOR DEFENSE ANALYSES
COST ANALYSIS GROUP

IDA Log No. HQ 73-15230
Copy 73 of 95 copies

The work reported in this document was conducted under contract DAHC 15 73C 0200 for the Office of the Director af Defense Program Analysis and Evaluation. The publicatian of this IDA Paper does not indicate endorsement by the Office of the Director of Defense Program Analysis and Evaluation nor should the contents be construed as reflecting the official position af that agency.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Institute for Defense Analyses
Cost Analysis Group
400 Army-Navy Drive, Arlington, VA 22202

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
Measuring the Impact of Force Structure Changes on Army Central Supply and Maintenance Resource Requirements

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
IDA Paper P-962

5. AUTHOR(S) *(First name, middle initial, last name)*
Dr. John D. Morgan and Dr. Francis L. McDonald

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
June 1973	253	153

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. Task Order SA-59	IDA Paper P-962
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Office of the Director of Defense Program Analysis and Evaluation

13. ABSTRACT

This paper provides a basis for developing analytical methods to estimate resource requirements in Program 7 of the Army's Five Year Defense Program. Program 7, Central Supply & Maintenance, consists of the centrally managed Army wholesale or depot-type logistic operations as opposed to the Command or unit level supply and maintenance activities organic to combat and support organizations in the field. These analytical methods will be used by the Director of Defense Program Analysis and Evaluation (ODDPA&E) in studies of defense resource allocations related to Army Program 7.

The paper discusses the institutional framework and management systems employed by the Army to perform the central logistic support mission. Current Army systems for estimating central supply and maintenance requirements are examined in detail. Army studies on aggregate methods to estimate these requirements for planning purposes are also considered. Finally, the paper presents the results of preliminary feasibility work to develop new analytical methods to meet OSD's requirements.

DD FORM 1 NOV 1473

Unclassified

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

P-962

MEASURING THE IMPACT OF FORCE STRUCTURE CHANGES ON ARMY CENTRAL SUPPLY AND MAINTENANCE RESOURCE REQUIREMENTS

John D. Morgan
Francis L. McDonald

June 1973

INSTITUTE FOR DEFENSE ANALYSES
COST ANALYSIS GROUP
400 Army-Navy Drive, Arlington, Virginia 22202

Contract No. DAHC 15 73C 0200
Task Order SA-59

FOREWORD

This paper was prepared by the Cost Analysis Group of the Institute for Defense Analyses to provide a summary of work accomplished for the Office of the Assistant Secretary of Defense (Systems Analysis) under Task Order SA-59, dated 11 September 1972.

Research under this task order was designed to provide a basis for developing analytical methods to relate resource requirements of Army Program 7, Central Supply and Maintenance, to alternative force structures.

This paper contains comprehensive information on the institutional framework for the Army Central Supply and Maintenance System. It examines existing Army methods to compute Program 7 resource requirements, including special studies to develop budget models, and relates these Army activities to OSD budget model requirements. Finally, the paper presents the results of exploratory quantitative analysis work to relate logistic support variables to total resource requirements in specified program elements.

Based on the research performed under Task Order SA-59 the Office of the Director of Defense Program Analysis and Evaluation has provided Task Order PA&E-66, dated 8 May 1973, to the Institute for Defense Analyses to complete the development of these analytical methods.

ACKNOWLEDGMENTS

Members of the project team are indebted to many key people in Command, Comptroller and Logistics positions at Headquarters, Department of the Army, Army Materiel Command and United States Army, Europe. Without the uniformly outstanding cooperation of these individuals, this study could not have been conducted.

The project team is especially indebted to Major Philip J. Sands and his excellent staff in the Budget Division, Army Materiel Command. Their cooperation, assistance, and guidance greatly facilitated the accomplishment of this study.

CONTENTS

FOREWORD iii
ACKNOWLEDGMENTS v
LIST OF TABLES ix
LIST OF FIGURES xii
SUMMARY xiii

I. INTRODUCTION 1

A. Purpose 3
B. Approach and Scope 5
C. Program 7 8
D. The Survey of Previous Research 13

II. THE UNITED STATES ARMY CENTRAL SUPPLY AND MAINTENANCE SYSTEM 17

A. Background 17
B. Source and Uses of Funds 25
C. Centralized Programming and Workloading of Supply and Maintenance Activities 33
D. The U.S. Army Working Capital Funds 38

III. EXISTING SYSTEMS USED TO DEVELOP ARMY PROGRAM 7 RESOURCE REQUIREMENTS 55

A. The OSD and Army Planning, Programming, and Budgeting Systems as Related to Program 7 . . . 55
B. Estimating Program 7 Resource Requirements . . . 64
C. Applicability of Existing Army Systems to the Problem of Rapid Estimation of Program 7 Resource Requirements as a Function of Changes in Army Force Structures 93
D. Summary Comments 102

IV. U.S. ARMY STUDIES TO DEVELOP AGGREGATIVE PROGRAM 7 PLANNING AND BUDGET MODELS 103

A. The Command Analysis of OMA Funding Program . . 104
B. The Army Selected Analysis Model for Depot Maintenance 115
C. Other Models 119

V. QUANTITATIVE ANALYSIS 121

A. Introduction 121
B. The Commodity Commands Investigated 122
C. Relationship of Commodity Command Functions and Program 7 Resources 126
D. Least Squares Regression Analysis 134
E. Independent Variables and Functional Relationships at AVSCOM 135
F. Independent Variables and Functional Relationships at TACOM 158
G. Summary Comments 171

APPENDIX A - DEPOT MAINTENANCE CRITERIA 175

APPENDIX B - THREE EXAMPLES OF STATISTICAL MODEL DEVELOPMENT IN AMC 179

APPENDIX C - DATA REQUIREMENTS FOR FURTHER WORK ON AN ARMY PROGRAM 7 MODEL 187

GLOSSARY 205

BIBLIOGRAPHY 223

TABLES

1. FY 1973 Distribution of Total Obligational Authority, Five Year Defense Program, Department of the Army 4

2. Program 7 Army Central Supply and Maintenance, Fiscal Year 1973 10

3. Army Industrial Fund, FY 1973 43

4. Distribution of Budgeted Funds Among Categories Army Program Element 72207, Depot Maintenance Activities (NON-IF), FY 1973 46

5. Percentage Distribution, Rotary and Fixed Wing, Army Aircraft Systems 123

6. Functions and Measurable Outputs of Selected Program Elements 131

7. Theoretical Independent Variables Considered at AVSCOM 136

8. Theoretical Determinants of Resource Expenditures at AVSCOM 138

9. AVSCOM Acquired Data Sources 140

10. AVSCOM Program Element Expenses 141

11. Indices for Normalization to FY 1973 Costs 142

12. AVSCOM Weapon Systems and Independent Variables 143

13. Major Weapon System Depot Maintenance Costs, FY 1968-1973 146

14. Percent Distribution of Total Depot Maintenance Cost for AVSCOM Systems 147

15. Percent Distribution of Organic Depot Maintenance Cost for AVSCOM Systems 148

16. Percent Distribution of Contract Depot Maintenance Cost for AVSCOM Systems 149

17. Basic Hypothesized Functional Relationship for PE 71112 151

18. Alternative Hypothesized Functional Relationship for PE 71112 152

19. Hypothesized Functional Relationship for PE 71113 154

20. Percent Distribution of UH-1 Depot Maintenance Cost 155

21. Percent Distribution of All Army Aviation Weapon Systems 156

22. Percent Distribution of Rotary Wing Weapon Systems 156

23. Regression Equation for UH-1 Depot Maintenance Cost 157

24. Theoretical Independent Variables Considered at TACOM 159

25. Theoretical Determinants of Resource Expenditures at TACOM 159

26. TACOM Acquired Data Sources 162

27. TACOM Program Element Expenses 163

28. Hypothesized Functional Relationship for PE 71112 165

29. Hypothesized Functional Relationship for PE 71113-Option 1 167

30. Hypothesized Functional Relationship for PE 71113-Option 2 168

A-1. Criteria for Depot Maintenance of Army Weapon Systems 177

C-1. Summary of Operating Cost Data Requirements 199

C-2. Data Requirements Weapon Systems List 201

FIGURES

1. Army Materiel Command Major Organizations, 1 January 1973 19

2. Standard AMC Commodity Command Headquarters Organization 22

3. Standard AMC Depot Organization 23

4. Source and Distribution of Program 7 Funds 29

5. Program 7 Organizations, Functions, and Outputs . . 35

6. The Role of the U.S. Army Major Item Data Agency in Programming and Financing Logistic Support . . . 39

7. Program/Budget Review Schedule Calendar Year 1973 56

8. Format of Department of Defense Fiscal Guidance Paper 59

9. Major Procurement--Authorized Acquisition Objective 68

10. AVSCOM Function and Program Element Code Relationship 127

11. TACOM Function and Program Element Code Relationship 129

SUMMARY

This paper provides a basis for developing analytical methods to estimate resource requirements in Program 7 of the Army's Five Year Defense Program. Program 7, Central Supply and Maintenance, consists of the centrally managed Army wholesale or depot-type logistic operations as opposed to the Command or unit level supply and maintenance activities organic to combat and support organizations in the field. These analytical methods will be used by the Director of Defense Program Analysis and Evaluation (ODDPA&E) in studies of defense resource allocations related to Army Program 7.

Considering the level at which these resource allocation studies will be conducted and the nature of the study activity, the analytical methods must fit relatively rigid criteria to ensure their usefulness. As a minimum, these methods must:

1. permit rapid calculation of requirements and produce credible results so timely decisions can be made;
2. be aggregative in nature so that detailed data from lower levels in the Department of Defense will not be required;
3. consider all major categories of resources in the various program elements;
4. provide tools for separate analysis of each program element--not lump all factors into one Program 7 package; and
5. permit verification of the accuracy of the estimating procedures.

In developing the basis for these analytical methods it was necessary to conduct extensive research on the institutional framework and management systems employed by the Army to perform the central logistic support mission.

To enable the reader to more easily understand the flow of funds through the system, one chart traces the path of Program 7 funds from appropriation source to final use. The chart indicates Army organizations and general functions supported by individual program element funds, and finally, associates each logistic organization with its measurable output.

Centralized programming and workloading of central supply and maintenance activities is an important feature of the Army central logistic support operation. Therefore, this activity is reviewed in some depth. This is of special interest to the analyst who is considering aggregative methods for computation of central logistic support resource requirements.

Working capital funds are used extensively in performing Army Program 7 functions. These include industrial funds directed toward service activities and stock funds designed to provide materiel support. Although these funds represent financial management systems rather than direct functional activities requiring logistic resources, it is important to understand their role in the Army's central logistic support operation. Therefore, they are examined as part of the Army Program 7 institutional framework.

Current Army systems for estimating resource requirements were examined in detail. This was done not only to gain an understanding of the systems as a prerequisite for further research, but also to determine if these existing systems could be used in present or modified form to deal with the ODDPA&E requirement.

The OSD and Army Planning, Programming, and Budgeting Systems represent the frameworks within which Program 7 resource requirements currently are estimated and displayed. These systems,

therefore, are reviewed to set the stage for an examination of requirements and methods within each element of Program 7.

Before examining each program element, however, general systems for computing manpower, materiel, supplies, equipment, and construction requirements are reviewed. These systems are used throughout the Program 7 structure to relate requirements to workload factors. Then, each program element is examined to determine how the peculiar requirements for that functional area of logistic support are estimated. Finally, these methods are evaluated in terms of criteria established for a suitable OSD Program 7 budget model.

The Army has two major study programs underway with objectives similar to those of this study. These Army programs, as well as other smaller scale Army study efforts, were reviewed to determine their applicability to the ODDPA&E requirement.

We concluded that neither the methods currently used by the Army to estimate Program 7 resource requirements nor the separate studies provide a means for meeting the criteria set forth above. The Army methods and studies are appropriate for their intended purposes, but they either require large inputs of detailed workload or cost data not available at the OSD level, or they treat only segments of the central supply and maintenance program.

In examining the institutional framework of Army Program 7, we found that the central supply and maintenance system is highly centralized in some respects but retains many of the decentralized characteristics of the old Technical Services system from which the current structure evolved. For example, depot maintenance programming and financial accounting are centrally administered by the Army Materiel Command, but overseas commanders retain command control over the central logistic support resources, including depot maintenance facilities physically located in their command areas.

Army Materiel Command major subordinate commands are established on a commodity basis to manage the logistic support of distinct categories of materiel and equipment such as aircraft, tanks, weapons, electronics equipment, or missiles.* On the other hand, the Army, consistent with DoD policy, is attempting to maintain programming and accounting procedures that account for logistic support costs on a weapon system basis. This, of course, is difficult when materiel management is conducted, generally on a commodity basis, since any one weapon system normally would include components of several different commodity categories. For example, an aircraft such as the UH-1 helicopter contains electronic equipment and weapons in addition to the basic airframe and engines; a tank also has installed electronics and weapons. Therefore, on these two major types of Army weapon systems, at least three separate Army Materiel Command major subordinate commands have important managerial responsibilities to ensure that the central logistic support is adequate in terms of quantity and quality and is provided on a timely basis.

Thus, coordination of logistic support management activities is an unusually important aspect of the Army Central Supply and Maintenance System. This fact is highlighted, since it is a major factor to be considered in developing a basis for analytical methods for Program 7 resource allocation studies.

ODDPA&E must use these analytical methods in establishing relationships between alternative Army force structures and Program 7 resource requirements. Although force structures are generally defined in terms of units or total manpower, they are usually further defined in terms of major weapon systems. It follows that for ODDPA&E purposes, analytical methods could be most useful if developed in terms of weapon systems.

---

*Generally consistent with the old Technical Services management structure at the lower level.

A major difficulty in analyzing Program 7 as related to alternative force structures is that logistic support resources are aggregated by logistic functions performed rather than in terms of resources required to support individual force structure organizations or weapon systems. On the other hand, most of the central logistic management functions such as inventory control and procurement as well as the operating functions of depot maintenance and supply depot operations are concerned with major items of equipment and the components that are included in these major items. These major items, singly or in combination, constitute weapon systems or major support systems.

Research on this study indicates that current Army central logistic support management systems may permit the development of analytical methods on a weapon system basis in some program elements, but direct relationships may not be possible in others. For example, in exploratory quantitative analysis work, it was possible through regression analysis to develop a suitable force-related cost estimating equation for the UH-1 helicopter.* This equation relates total Weapon System Inventory times Flying Hours, clearly force-structure-related variables, to total annual Depot Maintenance Cost. On the other hand, with the limited amount of data available, it was not possible to develop a suitable equation on depot maintenance costs for the M-60 tank in terms of force-structure-relatable variables.

Exploratory quantitative analysis on the inventory control point and central procurement program elements also yielded mixed results. In some instances, it was possible to relate

---

*UH-1 Depot Maintenance Cost (In Millions of Dollars - Annually) = 34.9543 + .0122 (Annual Flying Hours (10^3) x End Year Inventory)

a force structure type variable to total program element costs.* In others, the best results were achieved with variables that are not measurable directly in terms of force structure, for example, total annual Stock Fund Sales.

Although the exploratory quantitative work did not yield immediately useful and generally applicable cost estimating equations in all areas examined, it does appear that further research should produce analytical methods to meet the criteria set forth above. It may be possible to develop "linking" variables to deal with the problem of relating force structure changes to resource requirements in some program elements.

For example, further study may reveal that it is possible to relate supply depot operations and logistic support management functions to the annual depot maintenance program. Depot maintenance is the largest single consumer of resources in Program 7. Since depot maintenance is clearly force-structure related, this could provide the linking variable to permit measurement of the impact of force structure changes on these program elements. An extension of this general approach also may produce methods to estimate requirements in the support-type program elements such as base operations.

Concluding Remarks

Summing up the above discussion and other factors addressed by the study, the research revealed that:

1. Previous research in central supply and maintenance is either not related to or cannot be adapted to deal directly with the problem posed by this task, namely, to develop analytical methods to measure quantitatively the impact of force structure alternatives on Army Program 7 resource requirements.

---

*The equation at the Aviation Systems Command was:

Inventory Control Point Budget (In Millions of Dollars - Annually) = 7.76 + .0226 (Annual Organic Depot Maintenance Budget) + .0004 (End Year System Inventory)

2. The current Army Central Supply and Maintenance System is structured to satisfy a wide range of logistic support responsibilities. Management systems generally are oriented toward commodity groups or materiel categories as opposed to individual weapon and support systems. Nevertheless, programming and costing systems are available in depot maintenance that potentially could provide identification of comprehensive resource expenditures by weapon and support systems.
3. Methods currently used to estimate Program 7 resource requirements are suitable for the cyclical DoD budgeting process. They are not sufficiently aggregative, however, and do not accumulate costs directly in terms of force structure parameters, which would permit them to be used for estimating rapidly the impact of force structure changes on Program 7.
4. Resource analysis of Program 7 requires consideration of resources provided in all programs of the Five Year Defense Program, not merely Program 7. Other major FYDP programs contain large amounts of resources that are managed by, and otherwise create workloads in, organizations funded under Program 7.
5. Using data relevant to two Army Materiel Command major subordinate commands, a methodology based upon cause and effect relationships has been employed on an exploratory basis to measure the impact of force structure changes on different categories of logistic resource requirements. When extended to all Program 7 activities, this methodology should provide a useful analytical tool for developing an OSD budget model to cover Army Program 7 requirements.

I. INTRODUCTION

The Secretary of Defense each year provides guidance to the military services and other defense agencies on forces and financing levels approved for planning, programming, and budgeting. This guidance is within the framework of the Department of Defense Five Year Defense Program, the ". . . official program which summarizes the Secretary of Defense-approved plans and programs for the Department of Defense."*

The Joint Chiefs of Staff and the military services submit force structure recommendations to the Secretary of Defense. However, in preparing his force guidance the Secretary relies heavily upon studies conducted in the Office of the Director of Defense Program Analysis and Evaluation (ODDPA&E).** These studies examine many alternatives and attempt to identify the most cost-effective combinations of forces to cope with the perceived military threats to the United States.

The Secretary of Defense's annual guidance on financing levels to be used in planning, programming, and budgeting is based upon the finally approved force structures. This fiscal guidance shows, by cost category, the budget ceilings for all Department of Defense programs.

This analysis and decisionmaking process requires suitable methodologies for estimating resource requirements in all cost categories. Cost estimates are important in trade-off analyses

---

*Department of Defense Instruction No. 7045.7, October 29, 1969, The Planning, Programming, and Budgeting System, p. 3.

**Prior to April 1973, this was the Office of the Assistant Secretary of Defense/Systems Analysis (OASD/SA).

to identify the differential costs among the alternative force structures. After the decisions have been made on forces, suitable cost estimating techniques are required to establish the proper fiscal guidance ceiling for each military service and the other agencies. These ceilings cover all financial requirements, not merely differential costs, as is the case with the trade-off studies.

The Director of Defense Program Analysis and Evaluation uses many techniques for estimating costs in force structure studies and to establish fiscal guidance. This is a complex problem, since force trade-off analyses must be conducted within severe time constraints. Time is not available to permit detailed estimation and validation procedures. This problem is especially acute in the logistic support category where it is difficult to identify costs of centrally managed logistic activities to individual operational force elements.

A major ODDPA&E responsibility is to maintain a capability independent of the military services to analyze service force structure requirements. This provides the Secretary of Defense independent judgments on forces that he may consider in conjunction with the recommendations of the military services.

In developing its proposals during a program/budget cycle, ODDPA&E may examine in detail 40 or 50 force alternatives in any one program area, such as strategic forces or general purpose forces. Considering the importance of the central logistic function, it is essential that reasonably accurate tools be available for estimating central supply and maintenance costs. Given the fact that about 12 percent of the Army budget is allocated to this function, it is conceivable that these costs could be a major factor in determining a particular force structure recommendation. This, in turn, could result in a decision by the Secretary of Defense to approve a specific Army force structure leading to many procurement,

construction, and personnel actions associated with the development or maintenance of that structure.

Budget ceilings emphasize the need for adequate tools to compute central logistic costs for alternative force structures. If a ceiling is to be applied to a total service budget, ODDPA&E force teams must assure that these logistic costs are estimated with a reasonable degree of accuracy. Otherwise, inaccurate estimates will be made of the funds available for combat forces.

A. PURPOSE

The purpose of this Research Paper is, "to provide the basis for developing analytical methods that will enable rapid and credible estimation of Army FYDP Program VII, Central Supply and Maintenance resource requirements as a function of changes in Army force structure."* Program 7** contains the resources for the Army worldwide central logistic support base essential to the operation and maintenance of combat and field support organizations.

In a study of Army Program 7, it is necessary to consider the relative size of the budget for Army Central Supply and Maintenance. Table 1 shows the relationship of the various Army FYDP Programs in FY 1973. Thus, the central logistic support function consumes a significant part of the Army financial resources--12 percent of total obligation authority (TOA) in FY 1973.

---

*OSD/Systems Analysis Task Order SA-59, Army Logistic Support Study, September 11, 1972.

**The Arabic numeral 7 will be used throughout this paper to refer to this major program in the FYDP. The Army uses the Arabic rather than Roman numbering system in referring to its FYDP.

Table 1. FY 1973 DISTRIBUTION OF TOTAL OBLIGATIONAL AUTHORITY, FIVE YEAR DEFENSE PROGRAM, DEPARTMENT OF THE ARMY

	Program	Percent of TOA
1.	Strategic Forces	3
2.	General Purpose Forces	30
3.	Intelligence and Communications	4
4.	Airlift and Sealift Forces	Less than 1
5.	Guard and Reserve Forces	10
6.	Research and Development	7
7.	Central Supply and Maintenance	12
8.	Training, Medical and Other General Personnel Activities	23
9.	Administration and Associated Activities	3
10.	Support of Other Nations	8
		100

Source: Department of the Army, FY 1969 to FY 1982 Army Five Year Defense Program, Program Summaries, 2 February 1973.

Program 7 of the FYDP poses a special problem in force structure studies and preparation of budget guidance. Resources programmed in the primary mission programs* are developed with reference to, and stated in terms of, individual and specific weapon and support system organization units and associated costs. Resources allocated to Program 7, on the other hand, are stated in the aggregate, representing total central supply and maintenance support for each Service.** Assessing the impacts of alternative force structures on primary mission program costs requires the addition or deletion of blocks of investment and operating costs directly associated with specific weapon and support systems. The relationship between central supply and maintenance resources and mission or combat forces covered in Programs 1 and 2, however, is not explicit in the format of Program 7. Furthermore, ODDPA&E does not have methodologies which enable them to analyze, credibly and rapidly, the impacts of alternative Army force structures on Program 7 resource requirements. This situation led to the formulation of this IDA task.

B. APPROACH AND SCOPE

Central logistic support for military forces has been the subject of much research and analysis; therefore, the initial step in this study was to conduct a careful review of a large body of previous logistic support research. This review was designed to determine if suitable analytical approaches already existed which could be applied to the problem under study.

When this review failed to uncover suitable methods, the study was directed toward an in-depth analysis of Army Program

---

*For example, Program 1, Strategic Forces, and Program 2, General Purpose Forces.

**Throughout this paper, the term "central logistic support" is used synonymously with the phrase "central supply and maintenance," the subject of Program 7.

7--its institutions, management systems, reports, and data files. The major objective was to identify those key variables that largely determine the amount of resources required in this Program. If these variables can be identified, it should be possible to develop a basis for analytical methods to relate Army Central Supply and Maintenance requirements to alternative Army force structures.

Basic to the problem addressed by this paper is an understanding of the institutional framework within which Army central logistic support is accomplished. Before meaningful quantitative relationships can be developed, the analyst must be aware of the scope and content of the central supply and maintenance system. He must acquire insights regarding the cause-and-effect relationships between activities within the system and resource expenditures. Thus, as part of this effort it was necessary to thoroughly examine the Army Central Supply and Maintenance System.

Having established a basic knowledge of the system, we examined the DoD and Army Planning, Programming, and Budgeting Systems as they relate to Program 7. This included a consideration of procedures presently employed by the Army to estimate central logistic support requirements. Clearly, various echelons within the Army must have methods for estimating supply and maintenance resource requirements in anticipation of changing workloads. Adequate comprehension of existing methods had to be developed to determine if they could be applicable to the study problem.

The review of the existing methods resulted in a determination that they could not be applied directly by ODDPA&E to the problem of evaluating the effects of alternative force structures on Program 7 resource requirements.

A review was also conducted of on-going Army studies to develop models for estimating on an aggregative basis central supply and maintenance requirements within the framework of

the planning, programming, and budgeting process. The Army modeling efforts were found to offer promise for future capabilities but they suffered from one or more of the following limitations:

- They were designed primarily for purposes other than analysis of impact of alternative force structures.
- They were oriented toward only one segment of the total central supply and maintenance program, such as depot maintenance.
- They were insufficiently comprehensive in coverage of resource categories within a given program area.
- They were based on input values not readily available at the OSD level.

With this knowledge of the institutional framework for Army Central Supply and Maintenance it was possible to perform an exploratory feasibility study relating selected variables to resource requirements in some Program 7 program elements. This was a very limited effort intended to aid in the formulation of some preliminary hypotheses and to establish whether it appears feasible to develop new quantitative methods for analysis of the impact of alternative Army force structures on Program 7. This feasibility study produced promising results.

To recapitulate, the approach taken in this study was as follows:

- Review related research to determine its applicability to the study problem.
- Examine DoD and Army Planning, Programming, and Budgeting Systems as related to Program 7 to determine how the systems currently operate.
- Study existing Army methods for computing Program 7 requirements to see if they could be used in developing an OSD budget model.
- Attempt to identify quantitative variables that largely determine Army central logistic support requirements.
- Investigate appropriate quantitative methods to prepare rapidly, credible estimates of Program 7 resource needs associated with various force structures. This included development of "first cut" cost estimating relationships (CERs) for two major Army weapon systems.

- Form conclusions regarding the feasibility of further work to develop a complete OSD budget model to compute Army Program 7 requirements. This model would be used in force structure studies and in analyses to determine proper fiscal guidance for Army Program 7.

Some basic constraints were established to provide the most useful results:

- Army Materiel Command activities were emphasized since most of the Program 7 funds are administered by that command.
- In the exploratory quantitative analysis work, information spanning six years was sought to provide a suitable historical base for analysis of variables.
- Emphasis was placed on aggregative techniques appropriate for top-management decisionmakers who must make timely decisions on major resource allocation problems.

The text of this paper is arranged to reflect a logical flow of the analysis. The remainder of the Introduction is devoted to a general description of Program 7 and its relationship to Army field logistic support activities plus a brief summary of the survey of previous research. Chapter II covers the institutional framework of the Army Central Supply and Maintenance System. Chapter III discusses the DoD and Army PPB Systems, describes existing systems for estimating Program 7-related resource requirements, and evaluates their applicability to the study problem. Chapter IV reviews current Army studies to develop aggregative resource-estimating methods for Program 7 requirements. Chapter V presents the results of the exploratory work to develop quantitative relationships between what appear to be resource-determining independent variables and financial requirements in different program elements.

C. PROGRAM 7

Program 7, Central Supply and Maintenance, consists of logistic support activities that are not organic to elements of other programs in the FYDP. It includes nondeployable

supply and maintenance depots, arsenals, a depot maintenance center, depot maintenance plants overseas, procurement agencies, national industrial plant reserve facilities, laboratories, test facilities, and command organizations charged with central logistic support management responsibilities.* Table 2 presents an overview of Program 7.

The organization, functions, resources, and outputs of each of the program elements are discussed in the following sections, as appropriate. Brief descriptions will suffice for this Program 7 overview.

Program Element (PE) 71111 Supply Depots/Operations, provides resources necessary to receive, store, issue, package, load, and unload materiel.

PE 71112, Inventory Control Points, provides for central logistic support management of assigned weapon/support systems, commodities, and associated items. Major functions include computing requirements, processing field requisitions, developing depot maintenance programs, provisioning materiel and equipment for new systems, and cataloging.

PE 71113, Procurement Operations, covers central procurement activities, contract administration not assigned to the Defense Contract Administration Service (DCAS) and quality assurance. Local procurement at post, camp, and station level is excluded.

As indicated in Table 2, the aforementioned elements are personnel intensive. Together they account for 19.6 percent of Program 7 total obligational authority (TOA) but 29.0 percent of total Program 7 personnel.

PE 72003 Munitions Facilities (IF), covers commodity management of nuclear and non-nuclear munitions, excepting Atomic Energy Commission components as well as fire control, test

---

*Department of Defense Handbook 7045.7, FYDP Program Structure. The Program 7 organizations include both industrially funded and non-industrially funded activities. Industrially funded activities are administered under a working capital fund concept so cost will equal revenue from operations.

Table 2. PROGRAM 7 ARMY CENTRAL SUPPLY AND MAINTENANCE, FISCAL YEAR 1973

PE Code	Title	Cost (Dollars in Thousands)	Percentage of Program 7 TOA[a]	Total Manpower End Year	Percentage of Program 7 Manpower[a]
71111	Supply Depots/Operations	255,555	9.7	25,732	18.9
71112	Inventory Control Points	140,347	5.3	7,787	5.7
71113	Procurement Operations	121,693	4.6	6,035	4.4
72003	Munitions Facilities (IF)	322,273		14,484	10.6
72004	Revenues- (Munitions Facilities-IF)	311,392			
72005	Weapons Facilities (IF)	125,730		5,511	4.0
72006	Revenues- (Weapons Facilities-IF)	120,811			
72007	Depot Maintenance Activities (IF)	488,357		20,804	15.2
72008	Revenues- (Depot Maintenance Activities-IF)	475,955			
72009	Missile Facilities (IF)	175,373		8,422	6.2
72010	Revenues (Missile Facilities-IF)	167,347			
72207	Depot Maintenance Activities (Non-IF)	574,730	21.9	6,944	5.1
72895	Base Communications (Logistics)	9,344	.4	575	.4
72896	Base Operations	238,915	9.1	15,443	11.3
72897	Training	7,251	.3	296	.2
72898	Command	199,828	7.6	9,241	6.8
78010	Second Destination Transportation	529,057	20.1	3,368	2.5
78011	Industrial Preparedness	320,758	12.2	558	.4
78012	Logistic Support Activities	77,056	2.9	6,713	4.9
78017	Maintenance Support Activities	156,230	5.9	4,687	3.4
TOTAL CENTRAL SUPPLY AND MAINTENANCE		2,666,992[b]	100.0	136,600	100.0

a. Percentages of Program 7 TOA were computed excluding industrial fund cost and revenue accounts, since they should "wash-out" as costs should equal revenue except for military personnel and capltal equipment costs. These latter total about 1 percent of Program 7. Furthermore, funds to purchase central supply and maintenance services from the lndustrial fund actlvities are included in other program elements.

b. In deriving this total it is necessary in the industrial fund accounts (PEs 72003 through 72010) to subtract the total shown in the applicable revenue account from the total in the cost account and include only the net amount in the Total Central Supply and Maintenance line.

Source: Department of the Army, FY69-82 Five Year Defense Program, Program 7 Central Supply and Maintenance, 2 February 1973.

and protective systems and equipment. Included are pilot and limited quantity manufacturing activities. PE 72003 has a sister account PE 72004 which is used merely to record revenues to cover the costs incurred in PE 72003.*

PE 72005, Weapons Facilities (IF), covers commodity management of weapons, self-propelled artillery, fire control mechanisms and associated maintenance and test equipment. Included are pilot and limited quantity manufacturing and depot maintenance facilities. PE 72006 is the revenue account for PE 72005.

PEs 72007, Depot Maintenance Activity (IF) and 72207, Depot Maintenance Activity (Non-IF), provide resources to maintain, repair, modify, overhaul and reclaim weapons and support systems and other commodities.** The industrial fund concept applied to the depot maintenance function has resulted in the establishment of two depot maintenance industrial fund accounts, PEs 72007 and 72008. In effect, customers "buy" depot maintenance from the PE 72007 account. Receipts are reflected as "revenues" in PE 72008, washing out costs that appear under PE 72007.

Active Army resources to purchase industrially funded depot maintenance are carried in PE 72207. This program also includes the resources for purchase of depot maintenance from civilian contractors and for overseas depot maintenance activities that are not administered under industrial fund procedures. Therefore, PEs 72007, 72008, and 72207 are strongly interrelated. Since PE 72008 is set up merely to record revenues, it need not be

---

*See the more comprehensive discussion of the industrial fund concept under the paragraph covering PEs 72007 and 72207.

**Army maintenance operations are divided into four categories: organizational; direct support; general support; and depot. Program 7 covers only depot-level maintenance. The other categories are financed through the major programs of the FYDP that contain the Army field combat, combat support, and service support organizations. AR 750-1, Army Materiel Maintenance Concepts and Policies, May 1972, describes, in detail, the types of maintenance covered under each category. Depot maintenance is performed in nondeployable industrial type facilities with complex, comprehensive capabilities unavailable in lower level maintenance organizations.

considered further in this study. It is important, however, to view PEs 72007 and 72207 together, since they cover all of the activities and resources for implementing the Army's depot maintenance program.

PE 72009, Missile Facilities (IF), provides resources for program management, technical supervision, and direction of development, acquisition, and logistic support of Army missile and rocket systems. These activities are all conducted through Hq. U.S. Army Missile Command, Redstone Arsenal, Alabama. PE 72010 is the applicable revenue account.

PE 72895, Base Communications-Logistics, covers installation, operation and maintenance of Army nontactical communications terminal and switching facilities primarily in the Army Materiel Command. Excluded are Defense Communications Service activities.

PE 72896, Base Operations, contains the resources for base support activities to maintain Program 7 installations. For example, this program element covers base maintenance and supply, vehicles, maintenance of housing and other facilities for enlisted personnel (except military family housing), electricity, gas and telephone facilities, and countless other similar activities.

PE 72897, Training, covers organic and contract services for maintenance, technical and administrative training, new-equipment training on weapon and support systems and other commodity groups.

PE 72898, Command, provides resources for command administration of Program 7 activities.

PE 78010, Second Destination Transportation, covers costs of shipping materiel and equipment that have become a part of Army inventories. Thus, the cost of shipping items from contractors who initially manufacture these items are not included here. They are included in the initial cost of the item.

PE 78011, Industrial Preparedness, provides resources necessary to assure the production capability required to support major procurement programs for current needs, mobilization, or other national emergency needs. For example, these resources could provide for the maintenance of standby facilities to produce munitions.

PE 78012, Logistic Support Activities, covers a large group of Army central logistic support activities that cannot be identified homogeneously to other program elements in Program 7. For example, resources to print forms for supply activities and to provide for production engineering on Army Stock Fund items are included here.

PE 78017, Maintenance Support Activities, provides for centralized planning and programming of depot maintenance, engineering services, maintenance publications and data, and related support activities.

D. THE SURVEY OF PREVIOUS RESEARCH

When this study was undertaken, it was recognized that much of the earlier logistic support research work was not oriented toward studies of the relationship of Program 7 to alternative force structures. Nevertheless, it was felt that a relatively comprehensive survey of previous research might yield insights useful in developing concepts on this problem.

The survey relied primarily upon bibliographies published by the Defense Documentation Center and the United States Army Logistics Management Center, Fort Lee, Virginia. Periodicals such as the Army Logistician and Logistics Spectrum were reviewed primarily for information on most recent developments in the field. Of the 96 titles examined, 46 were reviewed in depth. Although only 12 were found to be directly related to the subject of this study, many other references provided valuable background information on Army Central Supply and Maintenance. Appendix D contains the bibliography.

The results of the survey are summarized below, by category. The usefulness of the bibliography items in each category is evaluated in terms of the objectives of this paper.

- Manpower. Considerable work has been done in this area that attempts to develop ways to ensure optimum assignment of manpower spaces, by function, and to provide tools to predict manpower requirements for future programs and workloads. Numerous studies have been conducted to develop Staffing Guides to relate future workloads to manpower requirements. Studies have also been completed that attempt to develop management indicators relating workload accomplished to manpower resources applied.
- Cost-effectiveness. Many studies have been performed to develop more efficient systems for the management of assets. They address individual central supply and maintenance functions and activities with the objective of improving the cost-effectiveness of the operation of these functions. For example, considerable work has been done on systems for management of spare parts and secondary items. Numerous logistic models have been prepared to solve problems in provisioning, to improve supply support of field organizations, and generally to attempt to optimize logistic support operations.
- Lessons Learned Studies. A great deal of literature is available that relates to logistic support lessons learned through operations in the field. Most of these publications are reports from field commanders prepared on a regular cyclical basis. These publications are of value to central logistic support managers who are seeking ways to improve operations and deal with problem areas. They do not deal with aggregative requirements associated with alternative Army force structures.
- Cost Factor Studies. This group covers studies to develop cost factors for specific activities in central logistic support. For example, there are studies to identify the spare parts cost per mile of operation of combat vehicles and studies that relate to developing factors for total depot overhaul costs of commodities over their entire life cycle. These factors are designed to produce input values for other studies that may relate to long-range planning, procurement, or weapon system life-cycle costs.

The previous research reviewed for this paper was of value in developing the institutional framework of the Army's Central Supply and Maintenance System. However, this earlier research

did not provide methods or data that could be used to evaluate quantitatively the impact of alternative force structures on Program 7 resources. The major shortcomings singly or in combination were:

- Inappropriate orientation--not directed toward developing Program 7 and Army force structure relationships.
- Based on accumulation of large amounts of detailed data inappropriate to an aggregative model.
- Incomplete in coverage of Program 7 activities.
- Directed toward logistic support below the depot level.

II. THE UNITED STATES ARMY CENTRAL SUPPLY AND MAINTENANCE SYSTEM

A. BACKGROUND

To assess the impact of changes in force structures on Program 7 resources, it is essential to understand the Army's Central Supply and Maintenance System--its functions, organizations, logistic concepts and the nature and magnitude of the resources involved. This chapter first will describe briefly the Army's organizational structure and management concepts for logistic support; then, sources of funds and the means of applying and controlling these funds to produce logistic support outputs will be covered. This involves not only the flow of funds through the central supply and maintenance structure but also the management systems employed.

In the general area of central logistic support for operating forces, the Army has participated in three major reorganizations over the past 12 years--two directed by OSD and one Army-directed. These reorganizations have centralized authority and consolidated similar activities and functions to eliminate duplication of effort, responsibilities, and resources.*

The Army Materiel Command was formed in 1962 and assumed responsibility for CONUS inventory control points, depot maintenance facilities, and other central logistic support activities.

---

*The three reorganizations involved establishment of the Defense Supply Agency (1961), transfer of some contract functions to Defense Contract Audit Agency (1965) and organization of the Army Materiel Command (1962). Lt. Col. William C. Jenson and Major Nicholas J. Craddock, An Analysis of the Organizational Structure of the Depots in the Army Materiel Command, School of Systems and Logistics, AFIT, Wright-Patterson AFB, Ohio, August 1968.

Army commanders overseas, however, retained command responsibility for central supply and maintenance facilities in their theaters of operation. Thus, with the formation of the AMC, the Army took a large step toward centralizing virtually all of the central supply and maintenance functions required for support of operating forces. It did affirm, however, the principle that the Army commander overseas who has the responsibility to conduct combat operations or prepare for such contingencies, should have command control of all support resources in his area.

In January 1973, the Army Materiel Command was organized as shown in Figure 1. In addition to central supply and maintenance, AMC administers the research and development and major procurement functions of the Army. These latter functions, however, will not be covered in this study.

Figure 1 does not include many separate installations and activities such as Harry Diamond Laboratories, Natick Laboratories, International Logistics Center, Major Item Data Agency, the Army Class Manager activities and the Major Procurement Agencies and Offices. A large number of these activities exist to enable AMC to carry out its full range of Army research and development, major procurement, and central supply and maintenance responsibilities. Figure 1 shows only the major subordinate commands (MSC)* and the depots that perform the operating functions of central supply and maintenance.

On January 11, 1973, the Secretary of the Army and the Chief of Staff announced a series of major Army reorganization actions.** Those affecting AMC are listed below:

- Consolidation of the Munitions Command and the Weapons Command into an Armaments Command to be located at Rock Island, Illinois. (31 December 1973)

---

*The seven MSCs with materiel management responsibilities are referred to as commodity commands.

**See Office of Assistant Secretary of Defense (Public Affairs), News Release 21-73, Army Reorganization, January 11, 1973.

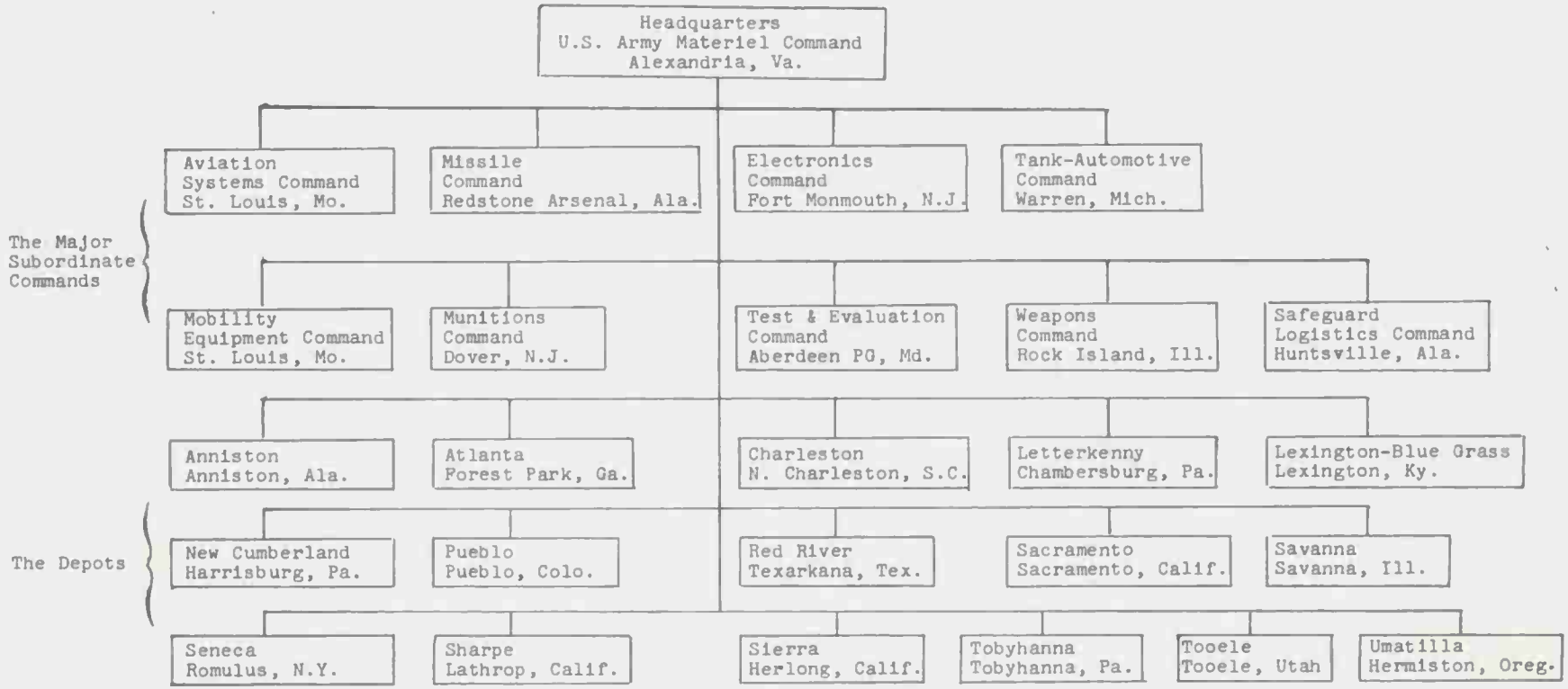


Figure 1. ARMY MATERIEL COMMAND MAJOR ORGANIZATIONS, 1 JANUARY 1973

- Conversion of the Mobility Equipment Command, St. Louis, Missouri, into the Troop Support Command, with some changes in its logistic support responsibilities. (30 April 1973 through 30 June 1975)
- Changes in missions and force reductions for Atlanta and Umatilla Army depots.
- Merging of the Safeguard Logistics Command into the U.S. Army Safeguard Systems Command, thus removing the former Command from AMC. (15 January 1973)
- Consolidation of maintenance support activities and establishment of the Maintenance Support Agency at Lexington-Blue Grass Army Depot. (30 November 1973)

As a result of the reorganization there will be some changes in the AMC structure as displayed in Figure 1. There will be very little change, however, in the missions and responsibilities of the Command.

Conceptually, the Army has continued to some degree the specialized approach to asset management that existed under the old Technical Services structure. However, there has been a strong effort to place the specialized asset management activities under centralized control and develop planning, programming, budgeting, accounting, and performance measurement procedures that are common to all categories of assets.

The titles of the commodity commands indicate their areas of specialization. Furthermore, they are all physically separate.* However, the commodity commands all operate under a uniform organizational structure prescribed by AMC and perform the same functions as related to the commodities assigned to them. Generally, these functions are to:

- Exercise integrated commodity management of assigned materiel.
- Conduct or manage research with respect to assigned materiel.
- Support other AMC or DOD elements having centralized management responsibility for specific weapon systems or items.**

*The two MSCs in St. Louis do not share the same facility.

**AMC Regulation No. 10-1, Organization and Function, Organization Control--Concepts, Policies, Responsibilities and Documentation, 22 September 1972.

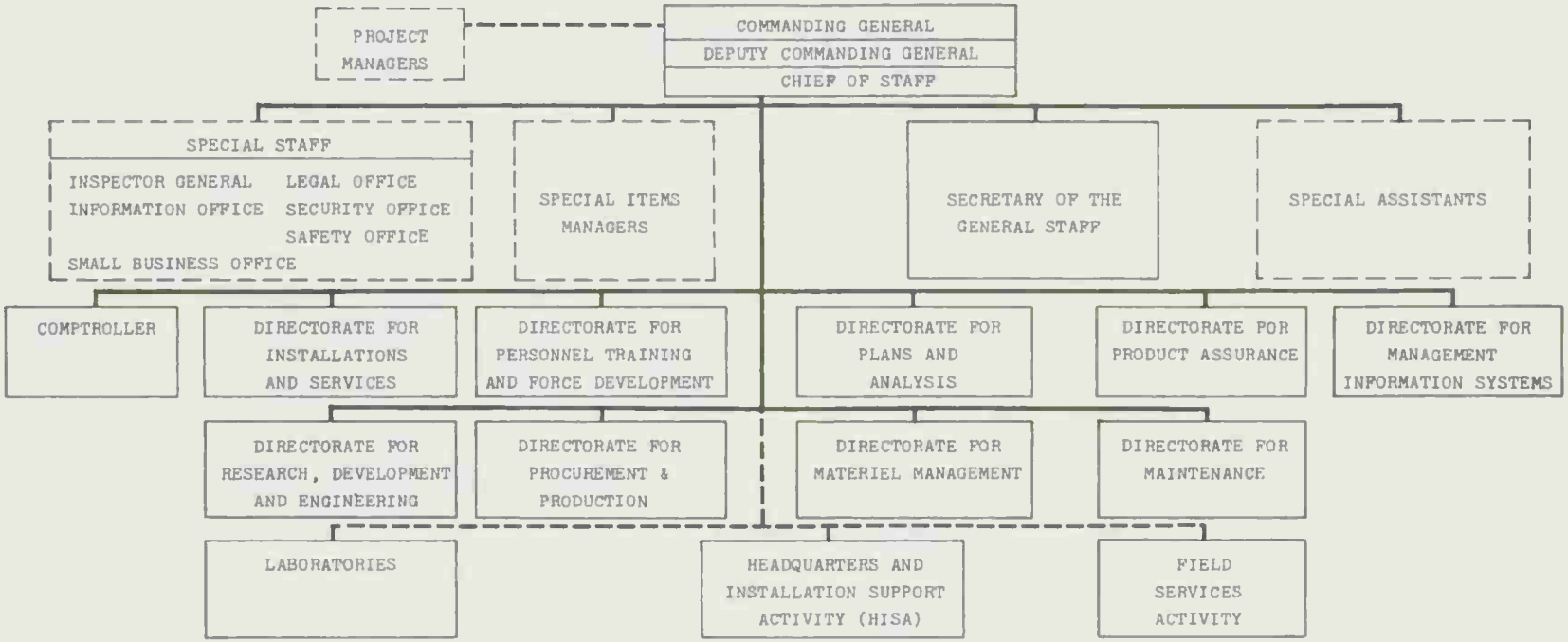
Figure 2 is the standard organizational structure for an AMC Commodity Command. These commands are structured so they may manage all aspects of materiel support "cradle to grave" for the commodities under their jurisdiction. It must be emphasized, however, that they are "managers"; they do not perform depot maintenance and do not operate supply depot activities. As far as Program-7-type activities are concerned, the commodity commands plan, program, budget, and perform materiel management functions.

The depots also have a standard organizational structure prescribed by AMC Regulation No. 10-1.* See Figure 3. As would be expected, the depots tend to specialize in types of materiel received, issued, and stored and on which they perform depot maintenance. Thus, Tobyhanna and Sacramento handle primarily electronics items. Letterkenny, although considered a multi-capability depot, concentrates on maintenance of missile components and tracked vehicles. Nevertheless, the depots report directly to the Commander AMC and have no command relationship with the commodity commands.

As stated earlier, in promoting centralized control and efficient management, the Army Materiel Command has developed common supply management, depot maintenance programming, and reporting and performance measurement procedures that apply throughout the Command. Furthermore, with the establishment of the Major Item Data Agency (MIDA), AMC has set up a control point for most of the activities such as planning, programming, workloading, financing, and accounting that are important to integrate the various specialized management and operating activities of the Command. MIDA will be discussed in greater detail later in this chapter.

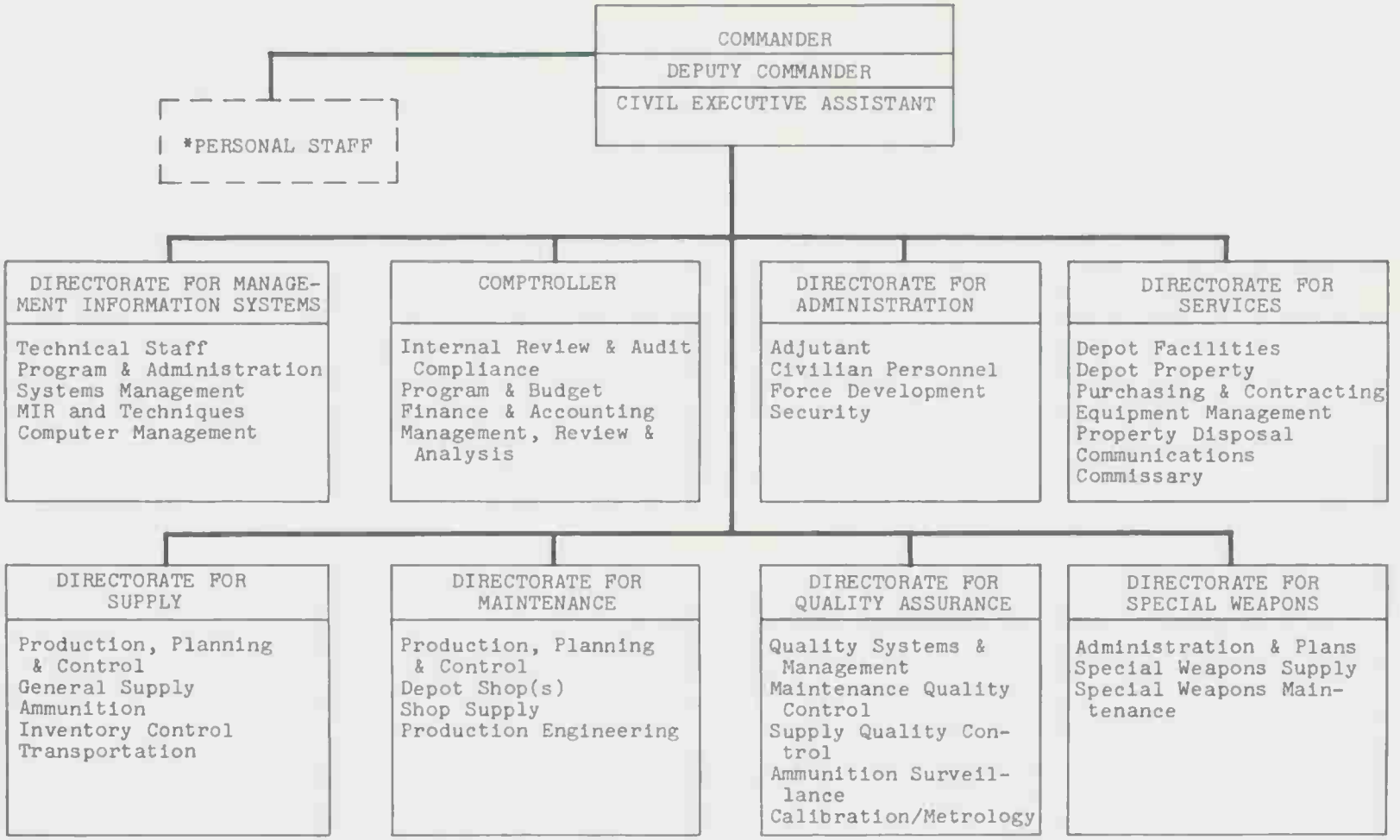
---

*The reorganization directed on January 11, 1973, will not change the standard commodity command and depot structures.



Source: AMCR 10-1, Organization and Functions, Organization Control--Concepts, Policies, Responsibilities and Documentation, 22 September 1972.

Figure 2. STANDARD AMC COMMODITY COMMAND HEADQUARTERS ORGANIZATION



*Organizationally attached to D/Admin for Administrative and Logistical Support

Source: AMCR 10-1, Organization and Functions, Organization Control--Concepts, Policies, Responsibilities and Documentation, 22 September 1972.

Figure 3. STANDARD AMC DEPOT ORGANIZATION

The discussion to this point has emphasized the Army Materiel Command. About 80 percent of all Program 7 resources are administered by that Command or by the Military Traffic Management and Terminal Service (MTMTS). Some Program 7 resources, however, support central supply and maintenance activities overseas.

For example, in Europe the U.S. Army Theater Army Support Command (TASCOM) exercises management control of all theater central supply and maintenance activities. This includes all supply and maintenance depots and the U.S. Army Materiel Management Agency (USAMMAE), which, in fact, is the inventory control point for Europe. Thus, in Europe the central logistic functions are organized in a manner similar to those in CONUS, if TASCOM can be considered a counterpart of AMC. In fact, TASCOM has major responsibilities for logistic support activities financed from Program 2 of the Five Year Defense Program and USAMMAE functions as the central administrator of central supply and maintenance support for Europe. Technically, the depots report directly to TASCOM, but they are workloaded by USAMMAE and perform their day-to-day operations under the technical supervision of that organization.

Overseas depot maintenance activities relate to the AMC Major Item Data Agency in a manner very similar to depots in CONUS. With the implementation of Direct Supply Support concepts the overseas depots find that they have less activity in regular issue and receipt of supply items.* A greater proportion of man-hours are devoted to maintenance of war readiness reserve stocks required by the Army's deployment plans for overseas-committed but CONUS-based tactical units.**

---

*Reference DA Pamphlet 700-22, Direct Support System, June 1972. This system is a comprehensive program to improve logistic support by shipping direct from CONUS depots to user units overseas.

**Conversations at meeting with USAMMAE commander and staff on 27 March 1973.

B. SOURCE AND USES OF FUNDS

The United States Army's Central Supply and Maintenance System operates by employing financial resources to produce outputs of materiel and services. Therefore, in describing the institutional framework for Army central logistic support, it is necessary to identify sources of funds for Program 7 and to review how these funds are applied to produce central logistic support for Army forces.

Program 7 of the Five Year Defense Program contains resources necessary for central logistic support of a wide variety of Army weapon/support systems and tactical and support organizations. These resources are hardware items such as vehicles, data automation equipment, materials-handling equipment, and services, for example, transportation, printing, and depot maintenance. Central supply and maintenance, however, as included in Program 7, is largely a service-oriented activity. Therefore, this FYDP Program is extremely manpower-intensive in terms of resources required to carry out the central supply and maintenance tasks.

The program elements in Program 7 represent functional activities. The dollars to support these activities are authorized by the Congress in conventional appropriations. After logistic support funds are appropriated, expenditure authorization documents flow down through the various levels of command in the Department of Defense in the regular government financial system. Ultimately, these funds are used to provide central logistic support, primarily through the functional activities of the Army Materiel Command and overseas theater logistic support organizations.

All programs within the Army Five Year Defense Program, not merely Program 7, impact to some extent upon the organizations that manage the Army central logistic support resources. This varies from the relatively minor effect of Program 9 (Administration and Associated Activities) to the major impact of Program 2 which

encompasses the Army general purpose primary mission force programs. For example, in recent years, even with the phase-down of Vietnam operations, about $1 billion has been expended annually to procure major items and supporting hardware for Program 2 General Purpose Forces. Somewhat smaller amounts have been expended in procurement programs for other Army FYDP programs, excluding Program 7. Although these costs are not shown in Program 7, the major items and associated support items, such as spares and repair parts, largely determine the workload in the Army Central Supply and Maintenance organizations. Throughout their life cycle they require management, procurement, repair and supply actions that must be financed from Program 7 resources.

Therefore, Program 7 cannot be treated in isolation in analyzing central logistic support as it relates to the Army mission or combat forces. For example, PE 72007, Depot Maintenance Activity-IF, contains about 15 percent of the civilian personnel financed under Army Program 7. The major workload for these employees is to repair and overhaul items initially purchased through the Army procurement appropriations and programmed in the force-oriented program elements of the FYDP. Army central logistic support personnel included in other program elements also devote a major portion of their time to workloads caused by requirements shown in programs other than Program 7.

Examples of centrally managed Army materiel items requirements that are included in FYDP programs, other than Program 7, are the following: Initial and Replenishment Spare Parts, Modification Kits and Spares, Support Equipment and Spares, Other Equipment, War Reserve Stocks, Vehicles, Stock-Funded Items, and Military Assistance Programs. These requirements are financed from the Procurement, Operations and Maintenance, and Military Assistance Program appropriations. The CONUS National Inventory Control Points (NICP) within the commodity commands and the Overseas Inventory Control Points (ICP) are the focal points for

logistic support requirements included in these other Programs that affect the Army Central Supply and Maintenance workloads. These NICPs and ICPs are the overall managers who must assure that proper supply and maintenance support is provided for Army weapon systems and combat organizations.

Figure 4 shows logistic support requirements and the sources of appropriated dollars to provide resources in the various Program 7 program elements. The arrows show how individual program elements receive support from the listed appropriations.

The distribution of FY 1973 dollars, shown by appropriation category and by Program 7 element, provides a picture of the relative magnitude of support from the different appropriations. Data for years other than FY 1973 show a similar distribution. Note that 82 percent of the direct financial support of Program 7 is from the Operations and Maintenance (OMA) appropriation. If the Military Personnel Appropriation is included, about 86 percent of Army Program 7 is financed from what are considered operating funds.

The arrows from the Program 7 elements are directed to the organizations that manage the resources programmed in these program elements. The importance of Army Materiel Command organizations in the use of these resources is evident. However, large amounts of support costs for overseas central supply and maintenance organizations are included in FYDP programs other than Program 7; for example, in Europe, with the exception of Command expenses at the Theater Army Support Command (TASCOM); Headquarters U.S. Army Transportation Command, Europe (TRANSCOM); and U.S. Army Materiel Management Agency, Europe; all Base Operations and Command costs are included under FYDP Program 2.* This is consistent with the Army policy that these activities in

*Of course, funds are provided in program elements 71111, 71112, 71113, 72207, 72895, 78010, and 78012 to carry out Program 7 primary mission activities. With the exception of PEs 71112 (USAMMAE), 71113 (TASCOM), and 72895 (UK Depots), these funds finance depot supply and maintenance activities.

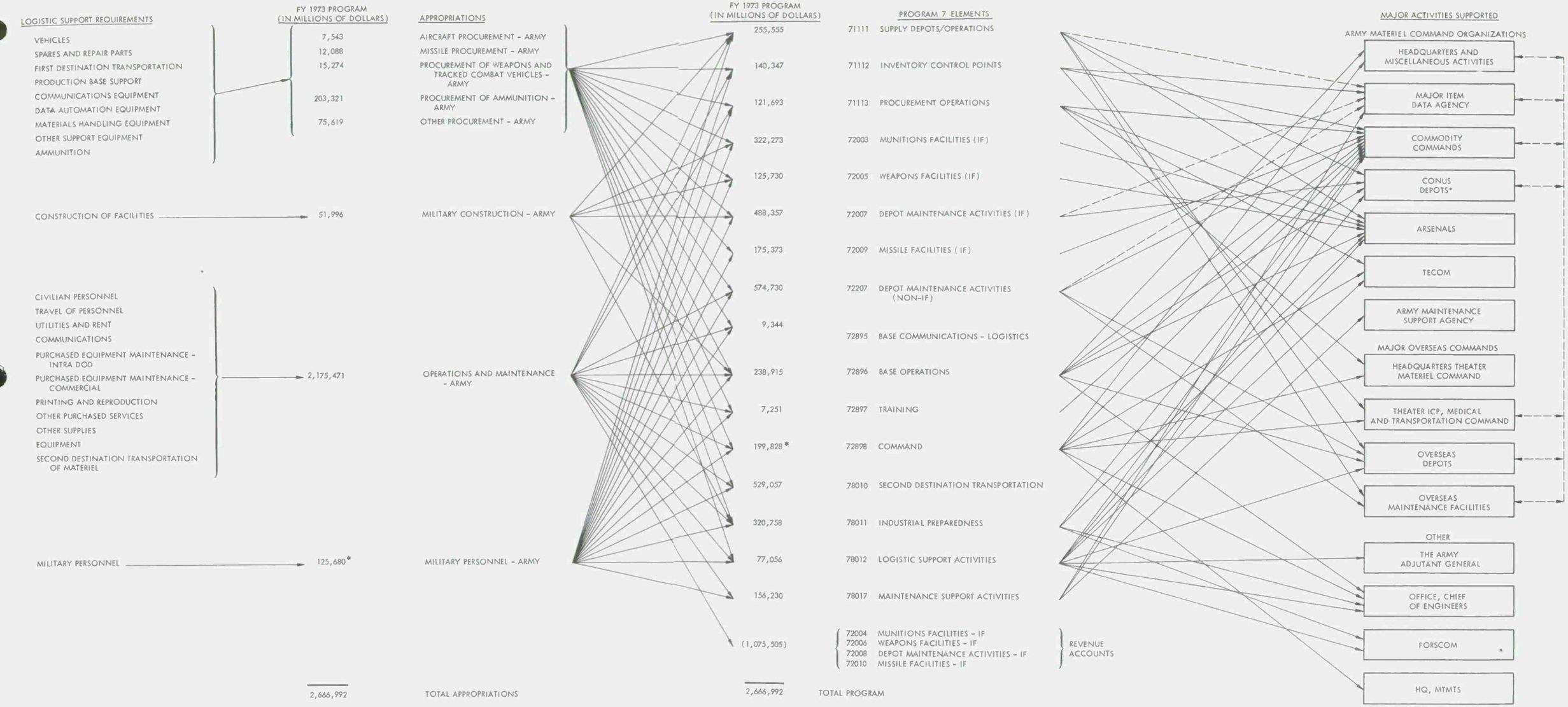
Europe, although performing central logistic support functions, are under the command of the Commander, USAREUR.

Because of the special characteristics of PE 72895, Base Communications-Logistics, and PE 78010 Second Destination Transportation, there are no arrows on Figure 4 to indicate distribution of resources from these program elements to Major Activities Supported.

PE 72895 includes the resources for installation, operation, and maintenance of Army nontactical communications facilities that support Army Central Supply and Maintenance activities worldwide. Thus, relatively small individual amounts of PE 72895 resources are allocated to virtually all Program 7 organizations.

PE 78010 covers second destination movement of Army supplies and equipment worldwide. Under the Army financial management system, each Major Army Command budgets for its own PE 78010 requirements except for over-ocean movements of supplies and equipment. The budget for these latter requirements is prepared by the Director of Army Transportation and the funds are administered by the U.S. Army Finance and Comptroller Information Systems Command. Therefore, virtually all of the organizations shown in Figure 4 utilize, to a greater or lesser extent, resources provided in PE 78010. Furthermore, a very large number of other Army organizations included in other major programs of the Army Five Year Defense Program use PE 78010 resources in carrying out their normal activities.

Some clarification is required at this point on the Army Industrial Fund (AIF) accounts, although these accounts will be discussed in more detail in a later section of this chapter. As shown on Figure 4, the AIF accounts include PEs 72003, Munitions Facilities (IF); 72005, Weapons Facilities (IF); 72007, Depot Maintenance Activities (IF); and 72009, Missile Facilities (IF); with their corresponding revenue accounts, PEs 72004, 72006, 72008, and 72010.



* THESE TOTALS INCLUDE $8,052,000 FOR ARMY MILITARY PERSONNEL ASSIGNED TO THE DEFENSE SUPPLY AGENCY.
SOURCE: DEPARTMENT OF THE ARMY, FY 69 - 82 FIVE YEAR DEFENSE PROGRAM, 2 FEBRUARY 1973, AND AR 37 -100 -73, THE ARMY MANAGEMENT STRUCTURE, EFFECTIVE 1 JULY 1972, FEBRUARY 1972.

* INCLUDES US ARMY AERONAUTICAL DEPOT MAINTENANCE CENTER, CORPUS CHRISTI, TEXAS

** DOLLAR DATA ARE FROM THE 2 FEBRUARY 1973 ISSUE OF THE DEPARTMENT OF THE ARMY FIVE YEAR DEFENSE PROGRAM

4-23-73-17

Figure 4. SOURCE AND DISTRIBUTION OF PROGRAM 7 FUNDS

These industrial fund accounts (PEs 72003, 72005, 72007, and 72009) include all costs for performing work that is administered under industrial fund procedures. In accounting terminology, these program elements show "cost of services sold" and represent the "seller" side under the working capital fund concept. Costs in these accounts should be offset by revenues shown in the corresponding revenue accounts listed above, except for the "unfunded" costs. Characteristic of the DoD industrial fund concept, the rates charged to "customers" of the industrial fund activities (other than foreign governments) do not include the cost of military personnel or the capital structures, that is, buildings, land, and capital equipment.* These are referred to as "unfunded" costs.

The Army depots and arsenals perform work for several activities other than the regular Army; for example, the Army National Guard, the Military Assistance Program and the other services. Therefore, in addition to revenue for work on Army equipment, revenues are included in PEs 72004, 72006, 72008, and 72010 for payments from these other activities to cover costs incurred in the "seller" program elements for work on their equipment and other services performed. Thus, the industrial fund program elements including both the cost and revenue categories represent "wash" accounts that should balance to zero except for the costs of the military personnel and the capital structure.

The funds contained in PE 72207 are used by the inventory managers as customers to purchase depot maintenance for Army equipment from the industrially funded Army depots and from contractors. Funds in this program element also support the Army depot maintenance activities overseas. These latter

---

*Foreign governments who purchase services are charged a higher rate to cover all costs.

activities are not included under the Army Industrial Fund. Contractual depot maintenance in the Army also is excluded from industrial fund coverage.

The Directors for Materiel Management (DMM) in the commodity commands have customer responsibilities relating to PE 72007 because they play a large role in establishing the requirements for industrially funded depot maintenance to support the systems and items they manage. They work with the Directorate for Maintenance (DM) in planning depot maintenance support and with both the Directors for Maintenance and for Procurement and Production in handling contracts for depot maintenance with civilian contractors.

The Directors for Maintenance in the commodity commands work most directly with the various depot maintenance activities that provide the necessary services to Army and other organizations.

On Figure 4, dotted lines run from PEs 71111, 72007, and 72207 to the Major Item Data Agency (MIDA). These lines denote the program and financial administration and coordination functions of the AMC Major Item Data Agency located at Letterkenny Army Depot, Chambersburg, Pennsylvania.

It is true that functional support of the program elements as shown by the solid line arrows flows to the organizations shown on Figure 4; however, MIDA has centralized workloading responsibilities that are quite important in the implementation of Army central logistic support programs. MIDA issues the detailed program directions for workloading AMC supply and maintenance activities during the operating year and maintains centralized program visibility. There is a more comprehensive discussion of MIDA activities in Section C of this chapter.

Dotted coordination lines are also shown on the right of the column headed "Major Activites Supported" on Figure 4. These lines connect the organizations that conduct almost continuous formal and informal coordination in planning, programming, budgeting, and implementing the Army's Central Supply and Maintenance Program.

Program 7 provides resources for several Army activities that would not normally be considered part of a central logistic structure. Some of these activities are listed in the lower part of the "Major Activities Supported" column and the arrows indicate the type of support they receive. For example, resources for printing responsibilities of the Army Adjutant General are provided through PE 78012. The Forces Command (FORSCOM) receives resources from PEs 78011 and 78012 to support industrial preparedness planning and property disposal activities. The Office of the Chief of Engineers uses resources from several program elements for operation of field offices, industrial preparedness planning, and facilities investigations and studies.

Figure 5 shows, in greater detail, the nature of functions performed by some of the organizations listed as Major Activities Supported in Figure 4. Figure 5 pertains only to organizations that constitute the major elements of the worldwide Army Central Supply and Maintenance structure. Opposite each of these organizations are one or more statements to show more specifically the functions of these important activities.

The last column on Figure 5 shows some of the more important outputs of the major Army Central Supply and Maintenance activities. This list is obviously incomplete, but it does identify outputs that demonstrate the nature of the logistic support work performed by the listed organizations. These outputs are the kinds of variables that must be considered in a study directed toward evaluating the impact on Army Central Supply and Maintenance of Army force structure changes.

C. CENTRALIZED PROGRAMMING AND WORKLOADING OF SUPPLY AND MAINTENANCE ACTIVITIES

In the U.S. Army there exists a complex and comprehensive network of activities that provide central supply and maintenance support to mission and support organizations. In CONUS, as discussed earlier, the Army Materiel Command exercises control

over virtually all central logistic support functions. As the Army's primary central logistic support agency, AMC also plays an important role in supporting overseas commands, although the logistic agencies themselves, in theater, are under the command of the Theater Army Commander.

The Army's concept of command responsibilities for central logistic support overseas creates requirements for careful coordination among various interested logistic agencies--theater commanders, AMC, Headquarters, Department of the Army (DA) and others. Whether, in actual operation, this results in a more complex network of logistic support than a completely centralized system is a question of judgment. All logistic support activities must be coordinated, regardless of the command structures involved. Command prerogatives in this case may be more a question of form than substance, but this study made no attempt to reach conclusions on this question.

Another area which may or may not contribute to complexity is the fact that Army contract depot maintenance is not included in the Army Industrial Fund. This does, however, introduce another feature of nonuniformity in the total network of central supply and maintenance.

Finally, the command relationships within AMC result in important coordinating requirements. The six commodity commands, the Test and Evaluation Command, and the 16 CONUS Army depots all report direct to Headquarters, AMC. It is true that there is a degree of specialization among the depots and, in some cases, unique relationships of depots to commodity commands--for example, the ammunition depots to the Armament Command. Nevertheless, in the formal command structure, none of the depots reports directly to a commodity command, the agency that is primarily responsible for developing depot workload requirements.*

---

*The U.S. Army Aeronautical Depot Maintenance Center (ARADMAC), Corpus Christi, Texas, reports directly to AVSCOM. Although, technically, ARADMAC is not a depot, it is the primary depot maintenance facility for Army aircraft and uses about 25 percent of the Army's depot maintenance funds.

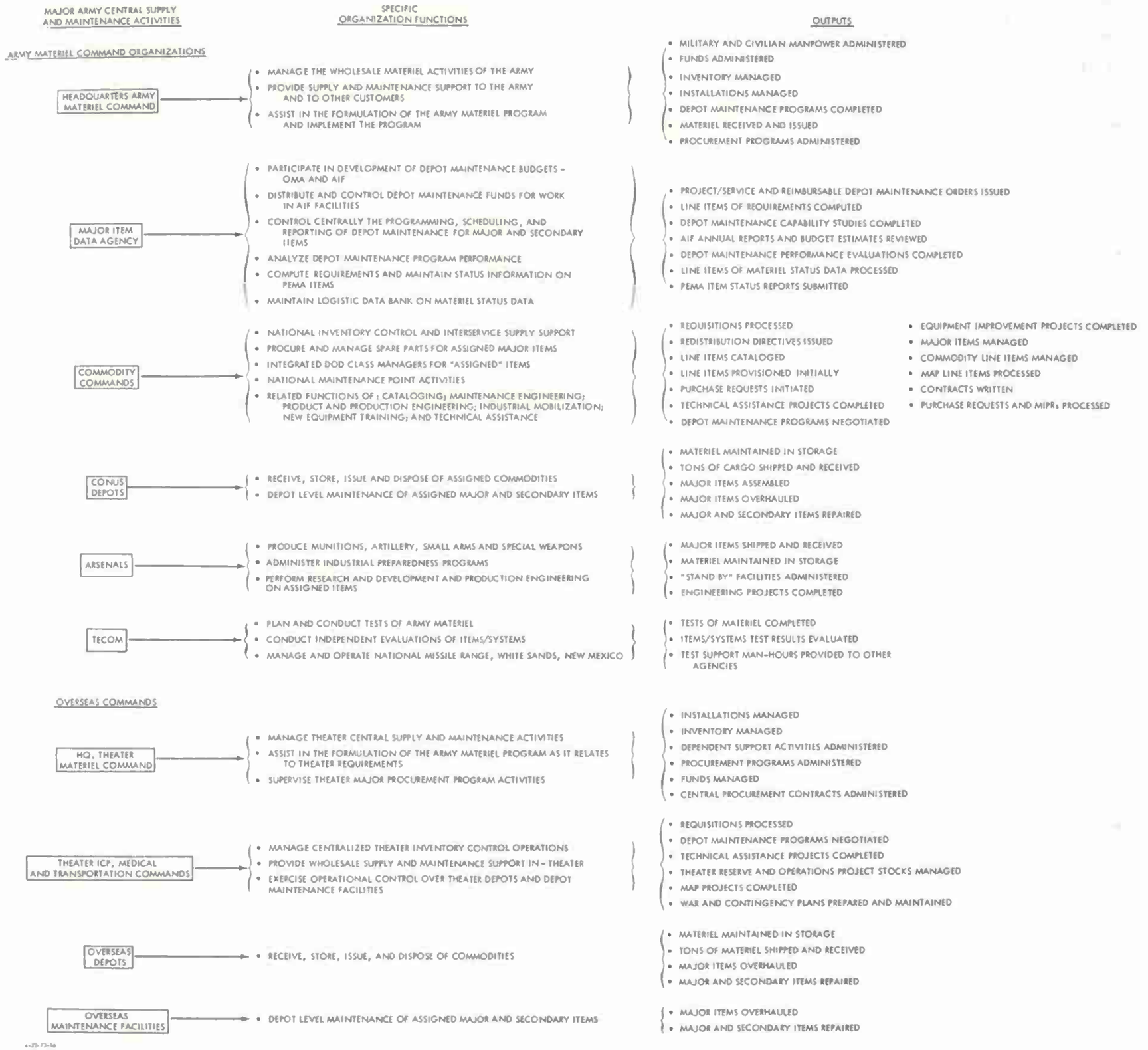


Figure 5. PROGRAM 7 ORGANIZATIONS, FUNCTIONS, AND OUTPUTS

The fact that AMC is responsible for the Army's Research and Development and Major Procurement programs does not appear to affect the complexity of the central supply and maintenance operation. Most staff functions at Headquarters, AMC, and subordinate command activities have easily identifiable major mission responsibilities (either Program 6 or Program 7). The only problems arise in regard to Headquarters, AMC support functions, such as the Comptroller and the Directorate for Personnel, Training, and Force Development, since they support both Program 6 and Program 7 activities.

The Army has chosen to deal with its complex central logistic support coordinating requirement by formation of the Major Item Data Agency (MIDA) supported by extensive data automation capabilities linking operating agencies. Figure 6 shows generally the central logistic support programming and workloading network that revolves around MIDA.

Primary operating control of MIDA is exercised by the AMC Deputy Commanding General for Logistics Support. The AMC Deputy Commanding General for Materiel Acquisition controls those MIDA functions related to determination of programmed force requirements.*

MIDA operations are heavily dependent upon data automation capabilities that are being steadily improved under the Army SPEEDEX program for depots and the ALPHA program for NICPS. These capabilities are essential for effective worldwide depot maintenance programming, scheduling, and reporting for major and secondary items. As computer modernization programs are implemented more and more "real-time," "on-line" capabilities are being achieved. MIDA utilizes large computer storage and retrieval capabilities in performing its role to provide logistical data required for the worldwide management of procurement of equipment and missiles, principal and other selected items.

*AMC Regulation No. 10-17, Organization and Functions, U.S. Army Major Item Data Agency, 19 November 1970, Paragraph 3.

In addition to its workloading responsibilities, MIDA is responsible for ensuring that the commodity commands' efforts are integrated to achieve proper weapon system support. Two or more commodity commands may have management responsibility for different components of a given weapon system. MIDA must assure that depot maintenance programs are properly coordinated to produce a serviceable complete end item. Thus, in some respects MIDA performs a "system manager" type responsibility.

Figure 6 shows that MIDA also performs other functions in carrying out its responsibilities for managerial assistance and operational support to Headquarters, AMC. These include (1) workloading of the depot supply operations activities, (2) participating with Headquarters, AMC on coordinated actions related to recommendations for expansion or contraction of AMC depot maintenance capabilities, (3) analyzing AIF budgets and rate structures, (4) computing program requirements and costs as needed, and (5) maintaining the Army Standard Line Item Numbering System.

D. THE U.S. ARMY WORKING CAPITAL FUNDS

In previous sections of this chapter, the Army's central logistic support structure and management concepts, the sources and uses of Program 7 funds, and the key role of MIDA have been discussed. To develop further understanding of the U.S. Army Central Supply and Maintenance institutional framework, it is necessary to review the employment of the working capital fund concept in Army logistic support operations.

Working capital funds are revolving funds that cover Department of Defense activities in which an internal DoD buyer-seller relationship is established. The purpose of placing activities under these procedures is to promote efficiency. The procedure requires greater understanding of cost elements and, it is hoped, supplies the seller with an incentive to provide

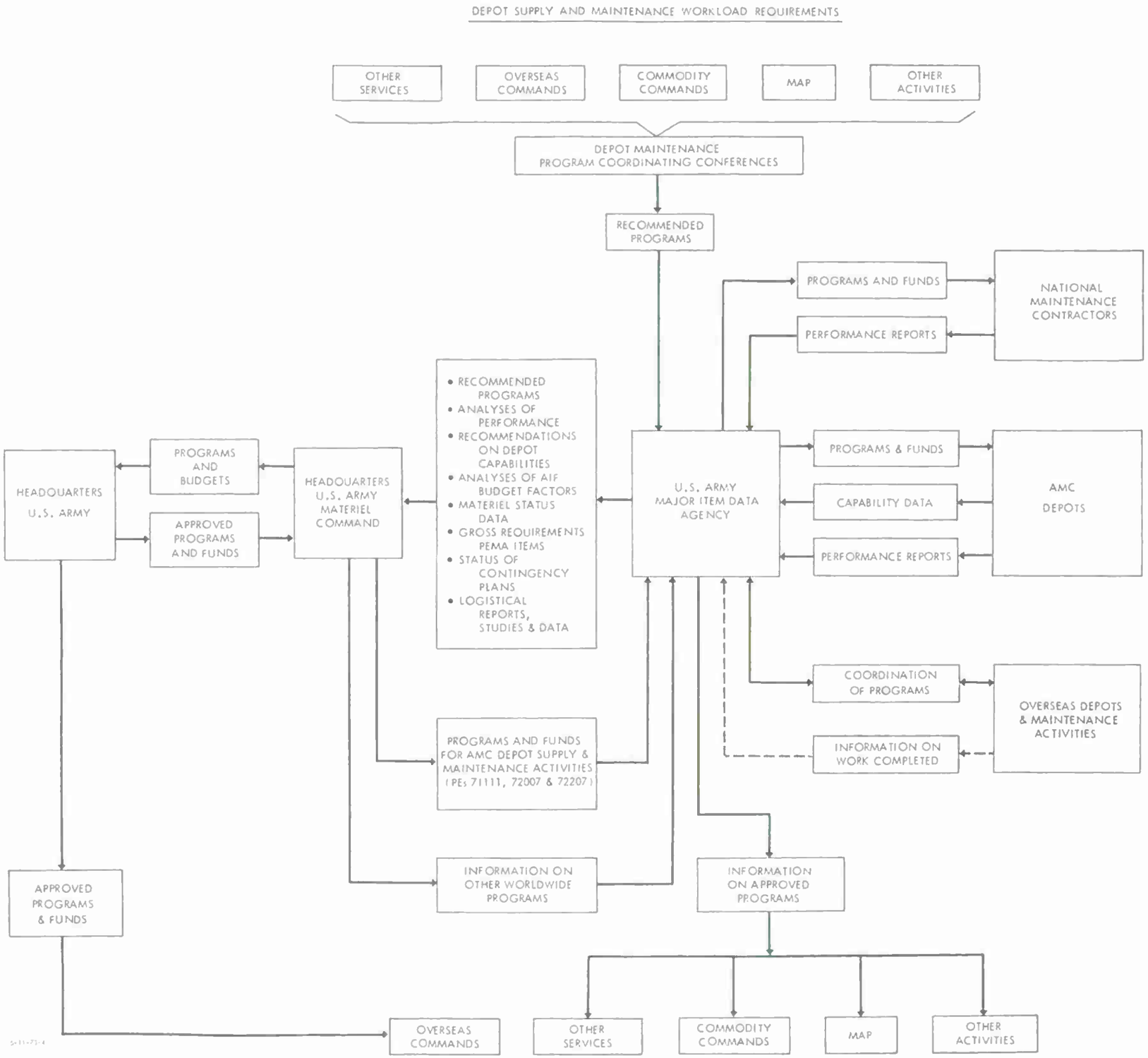


Figure 6. THE ROLE OF THE U.S. ARMY MAJOR ITEM DATA AGENCY IN PROGRAMMING AND FINANCING LOGISTIC SUPPORT

items or services at a minimum cost. There should also be an incentive to the buyer to procure only minimum essential requirements, since they must be "purchased" with allocated funds.

There are two types of DOD working capital funds--stock funds and industrial funds. Stock funds cover materiel items. Industrial funds normally cover services only, but in the Army the industrially funded arsenals produce materiel items as well.

Stock funds and industrial funds are used extensively in performing the Army central logistic support function. Because of the importance of these funds, the next section contains a discussion of the applications of the industrial fund concept in the Army Materiel Command. Following that is a brief discussion of stock funds.

1. Industrial Funds in the Army Materiel Command

As stated earlier, several program elements have been established in Program 7 of the Five Year Defense Program to cover AMC industrially funded activities. AMC administers all of the resources in the "seller" industrial fund program elements except for Army activities associated with the Military Traffic Management and Terminal Service (MTMTS). In other words, AMC activities provide all of the services programmed under these Program 7 program elements and, in some cases, produce materiel. On the customer side, however, AMC activities purchase most, but not all, of the programmed services. Other customers of AMC industrially funded services include such activities as the Air Force, Navy, Military Assistance Program, and Army National Guard.

AMC finances its own requirements for industrially funded depot maintenance services by using OMA funds and small amounts from other appropriations it administers. The work performed by these depot maintenance activities for customers external to AMC are financed through financial reimbursement from these other activities to cover the costs incurred.

Table 3 shows the various activities of the Army Industrial Fund, including FY 1973 revenues, costs, and manpower data.* As stated earlier, all Army industrial fund activities are administered by AMC except for the Military Traffic Management and Terminal Service. MTMTS is administered directly out of the office of the Director of Army Transportation. The MTMTS is responsible for all DoD surface traffic management and seaport terminal operations in CONUS. The costs it incurs for these operations are covered by reimbursements from customers who use the services. The only exception is that the Headquarters, MTMTS is financed directly from Program Element 72898, Command, in the Army Five Year Defense Program.

Table 3 shows that AMC manages industrially funded depot maintenance, research and development activities and missile, munitions, and weapons facilities.

The depot maintenance activities already have been discussed. These include Lexington-Blue Grass, Tooele, Anniston, Charleston, Letterkenny, New Cumberland, Pueblo, Red River, Sacramento, Sharpe, and Tobyhanna Army Depots and the Army Aeronautical Depot Maintenance Center, Corpus Christi, Texas.

Table 3 shows that $392,789,000 of the depot maintenance industrial fund revenue in FY 1973 came from Army Operations and Maintenance funds. In fact, this total includes $27,776,000 to cover industrially funded operations in addition to depot maintenance at Lexington-Blue Grass Army Depot. This depot conducted a test program to determine the feasibility of placing all depot operations in AMC under industrial fund procedures.**

*U.S. Army FY 1974 Industrial Fund Budget, October 1972.

**On February 26, 1973, OSD approved extension of the Army Industrial Fund to include all depot operations in CONUS depots, effective July 1, 1973.

Table 3. ARMY INDUSTRIAL FUND, FY 1973[1]
(IN THOUSANDS OF DOLLARS)

Billings Revenue By Customer and Appropriation	AIF Consolidated	Military Traffic Management and Terminal Service	U.S. Army Materiel Command IF Activities - Consolidated	Depot Maint. Activities USAMC[2]	R&D Industrial Funded Activities USAMC	Missile Facilities USAMC	Munitions Facilities USAMC	Weapons Facilities USAMC
Department of the Army	1,336,496	112,536	1,223,960	464,896	186,651	157,339	299,254	115,820
Operation & Maintenance	678,508	86,422	592,086	392,789	24,535	97,059	53,217	24,486
Procurement Appropriation	269,240	--	269,240	39,840	25,626	18,534	126,307	58,933
Research and Development	281,604	664	280,940	2,762	111,465	40,316	110,435	15,962
Military Personnel	17,303	16,200	1,103	--	1,103	--	--	--
Military Construction	1,387	146	1,241	210	243	611	176	1
Military Assistance Programs	6,568	6,344	224	52	--	--	--	172
Army National Guard	4,673	490	4,183	4,133	47	--	3	--
Transfer Appropriations	5,755	555	5,200	53	3,730	819	355	243
Army Industrial Fund	29,986	1,715	28,271	2,147	19,877	--	5,510	737
Army Stock Fund	41,426	--	41,426	22,904	--	--	3,251	15,271
Other	46	--	46	6	25	--	--	15
Department of the Navy	28,276	22,966	5,310	3,403	720	--	463	724
Department of the Air Force	51,944	36,420	15,524	8,405	2,898	--	1,107	3,114
U.S. Marine Corps	3,934	1,284	2,650	1,540	127	--	632	351
Department of Defense	17,946	3,399	14,547	1,623	9,613	700	2,606	5
Other Government Depts. and Agencies	10,529	1,810	8,719	149	332	5,450	2,783	5
Non-Appropriated Funds, Individuals & Others	17,310	6,831	10,479	41	9,420	773	187	58
Grand Total Revenue	1,466,435	185,246	1,281,189	480,057	209,761	164,262	307,032	120,077
Cost of Goods & Services Produced								
Materials, Supplies, & Parts Used	250,975	6,531	244,444	147,709	24,812	7,928	34,205	29,790
Salaries and Wages	862,592	63,581	801,989	265,635	117,598	129,768	215,152	73,836
Contractual Services	275,828	105,743	167,107	54,160	52,513	10,145	43,551	6,738
Other Costs	67,074	9,391	57,683	11,336	14,755	16,421	13,153	2,018
Total	1,456,469	185,246	1,271,223	478,840	209,678	164,262	306,061	112,382
Change in Work in Process from Prior Year	9,966	--	9,966	1,217	83	--	971	7,695
Grand Total Costs	1,466,435	185,246	1,281,189	480,057	209,761	164,262	307,032	120,077
Unfunded Costs								
Military Personnel	34,396	10,252	24,144	2,586	9,114	5,837	5,874	733
Depreciation on Plant & Equipment	77,731	6,413	71,318	14,189	16,084	11,750	20,295	9,000
Other	72,582	--	72,582	71,583	320	--	499	180
Total Unfunded Costs	184,709	16,665	168,044	88,358	25,518	17,587	26,668	9,913
Manpower - End Strengths								
Civilian - Graded	34,166	3,470	30,696	5,476	5,640	7,188	10,296	2,096
Civilian - Wage Board	33,065	1,490	31,575	19,968	2,663	957	4,088	3,899
Total Civilian	67,231	4,960	62,271	25,444	8,303	8,145	14,384	5,995
Military - Officer	1,271	331	940	127	250	276	238	49
Military - Enlisted	2,026	392	1,634	55	733	306	527	13
Total Military	3,297	723	2,574	182	983	582	765	62
Total Manpower	70,528	5,683	64,845	25,626	9,286	8,727	15,149	6,057

1. The sources for the data displayed on this table are the Army Industrial Fund Annual Budgets, FY 1974 both consolidated and for individual activities submitted to support the FY 1974 U.S. Army Budget as of 1 October 1972.

2. Includes All Depot Operations at Lexington-Blue Grass Army Depot.

Table 3 revenue entries are based on industrial fund billings to customers. The total value of customer orders in a given year will always be at variance with customer billings, since orders are placed for total work packages and billings are made progressively as costs are incurred. To gain an understanding of the ratio of Army depot maintenance work performed by industrially funded facilities, it is necessary to examine the OMA budget. This budget shows the value of work OMA expects to finance or has financed in prior years in depot maintenance facilities, regardless of when billing actions were completed.

The following table shows the breakdown of the PE 72207, FY 1973 OMA budget as submitted to OSD on October 2, 1972.* The figures shown here have changed since the budget submittal, primarily because of OSD program/budget decisions. Nevertheless, the relationships among different categories of work remain about the same.** (See Table 4.)

In the table below Military Assistance Program (MAP) orders for depot maintenance totalling $31,665,000 are included in the reimbursements figure.† Most of the MAP orders were filled in FY 1973 by overhaul in CONUS

---

*Department of the Army Annual Budget Estimates, FY 1974, October 2, 1972.

**Information was not available at the time of this study to permit preparation of Table 4 showing the impact of all changes subsequent to October 2, 1972.

†It is anticipated that MAP work will, in fact, approach $50 million in FY 1973, when final data are tabulated.

Table 4. DISTRIBUTION OF BUDGETED FUNDS AMONG CATEGORIES ARMY PROGRAM ELEMENT 72207, DEPOT MAINTENANCE ACTIVITIES (NON-IF), FY 1973

(IN THOUSANDS)

Direct Army Work Performed in AMC Industrially Funded Depots		309,624
Depot Maintenance Work Purchased by Army from Other Services' Industrially Funded Depot Maintenance Facilities		15,108
Total Direct Army Depot Maintenance Performed in DoD IF Facilities		324,732
Direct Army Depot Maintenance by Commercial Contract		
CONUS		132,333
Overseas - Pacific	3,947	
Europe	41,590	45,537
Total by Commercial Contract		177,870
Direct Army Depot Maintenance by Army Non-IF Facilities		72,197
Net Adjustment for Planned Pay Raises, Overtime and Similar Expenses in Organic Maintenance Facilities, IF and Non-IF		25,157
Total Direct Army Depot Maintenance Funded by PE 72207		599,956
Plus Reimbursable Work		57,658
Total Depot Maintenance Funded by PE 72207		657,614

industrially funded facilities or by provision of items previously overhauled in these facilities. OSD directives require that these MAP orders on PE 72007 industrially funded facilities first be financed by PE 72207. Reimbursements are then made to the account from MAP. This also applies to some other types of reimbursable work for other countries, although the work is not financed by MAP.

The depot maintenance by commercial contract includes work done by contractors both in their own facilities and in government-owned facilities. A small part of the Non-IF depot maintenance is in the ammunition depots, Sierra, Seneca, Umatilla, and Savannah, which are the only CONUS depots not included under the Army Industrial Fund.* The remainder is performed overseas.**

Table 4 reveals that about 57 percent of the Army's depot maintenance requirements financed from the Operations and Maintenance Appropriations are fulfilled in industrially funded CONUS facilities, 31 percent by contractors and 12 percent in Non-IF facilities, primarily overseas.†

---

*These depots will be placed under the Army Industrial Fund on 1 July 1973 with the implementation throughout AMC of the industrial funding of all depot operations. The ammunition depots perform very little maintenance. They are primarily involved in receipt, storage, and issue of ammunition.

**From the point of view of financial management it is important to bear in mind that all depot maintenance activities organic-IF, organic Non-IF and contractual (Non-IF) are required to maintain uniform depot maintenance cost accounting and production reporting systems prescribed by AR 37-55, June 1972. This permits unit price comparisons among facilities for use in preparation of budgets and economic analyses.

†Relative percentages were computed from the data: 324,732 + 177,870 + 72,197 = 574,799. This disregards the 25,157 adjustment expenses for organic facilities but it was not possible to determine distribution of these expenses by IF and Non-IF facilities. In fact, the percentages shown above, therefore, for the organic facilities are slightly low and for contract slightly high.

Returning to Table 3, the total depot maintenance billings for FY 1973 to OMA were programmed to be $392,789,000. It can be assumed that this includes about $58 million of reimbursable work accounted for through PE 72207. Billings to customers other than Army OMA as shown on Table 3 total $87,268,000. To these must be added the $58 million of reimbursables to give a complete summary for all nondirect Army OMA work performed. This gives the following totals for depot maintenance industrial fund billings in FY 1973: U.S. Army OMA $334,789,000; reimbursable and work for other Army customers $145,268,000; Total $480,057,000. Thus, about 70 percent of the IF depots' work is performed for the U.S. Army OMA as a customer. Total work for all Army customers is $464,896,000 less $58 million reimbursable or $406,896,000. This is about 85 percent of the IF depots' workload.

The discussion to this point has dealt with the parts of the Army Industrial Fund that cover the Military Traffic Management and Terminal Service and the depot maintenance activities. Of the other Army industrially funded activities shown on Table 3, the R&D industrially funded activities are included in Program 6 of the FYDP and are not covered by this study. The remaining activities, Missile, Munitions, and Weapons Facilities, however, are in Program 7.

PE 72003 relates to the industrially funded Army munitions facilities--Picatinny, Frankford, Edgewood, Rocky Mountain, and Pine Bluff Arsenals. These Arsenals manufacture some munitions, although about 95 percent of the Army munitions requirements are fulfilled by production in government-owned contractor-operated facilities. As noted earlier, effective July 1, 1973 the munitions and weapons facilities will be combined and placed under the new Armament Command, Rock Island, Illinois.

From Table 3 it can be seen that the primary customers for the industrially funded munitions facilities are OMA, the Army Procurement and Research and Development appropriations, the Army Industrial Fund itself, the Army Stock Fund, and other U.S. Government activities. The OMA customer funds are used primarily for two purposes--to pay the civilian personnel who staff the arsenals and to cover property disposal activities. Also, this appropriation purchases engineering services on operating equipment.

About one-third of the Army procurement appropriations money going to these arsenals is for munitions manufactured at the arsenals. The remainder is for engineering services in relation to munitions on which procurement programs are underway. The 95 percent of the Army's munitions requirements that are met through procurement from government-owned contractor-operated facilities are financed directly from the Ammunition Procurement appropriation. These facilities are not included under the Army Industrial Fund.

The Army Research and Development appropriation purchases engineering services and laboratory work from the industrially funded munitions facilities. The other customers purchase a variety of services, including disposal of radioactive materiel and sources, operation of the DoD Plastics Technical Evaluation Center, production engineering on stock fund items, operation of a clothing impregnation facility, and disposal of chemical munitions.

The weapons facilities under PE 72005 include Watervliet and Rock Island Arsenals. As with the munitions facilities, the OMA appropriation finances base operations and civilian personnel costs at these Weapons Command facilities. Procurement funds are largely for initial issue gun tubes, gun mounts, and fire control mechanisms manufactured at the arsenals. All Army gun tubes are manufactured at Watervliet Arsenal.

The Research and Development appropriation purchases engineering services on new weapons. The Army Stock Fund orders are primarily for replacement of gun tubes, since these are handled through the Fund.

The missile facilities under PE 72009 encompass essentially the Headquarters, Army Missile Command. This is a one-base command at Redstone Arsenal, Alabama. This command has no manufacturing capability and is composed of administrative facilities and laboratories.

OMA, as a customer of the missile facilities, pays for the civilian personnel who staff the command and purchases engineering services on operating missile equipment. Procurement appropriation funds purchase engineering services on missile items in production, and Research and Development funds pay for such services on systems under development.

2. The Army Stock Fund and the Army Materiel Command

The Army Stock Fund is a working capital fund administered largely through the Army Materiel Command. For the purposes of this study it is not necessary to analyze in depth the operations of this fund; however, it is important as an institutional element in Army Central Supply and Maintenance. An analyst working on logistic problems should understand the stock fund concept as applied in the Army, although the fund itself need not be considered in force structure studies or in preparation of Program 7 annual fiscal guidance.

There is no individual program element covering the stock fund as is the case with industrially funded depot maintenance. It is merely a management device used to procure, manage, and issue expense items. The fund utilizes its own working capital to purchase these items from private industry and from other government activities (primarily DoD). They are held in inventory until required by a customer, such as Army depot maintenance activities, then they are sold to the customers. Funds received

from the customer are used to replenish working capital so additional required items may be procured.

DODI 7040.5 September 1, 1966, as amended, defines expense and investment type materiel. Briefly, expense type materials are those that are consumed in use. Investment type materiel includes major items, reparables, and installations that are generally more expensive and are longer life assets. The Army Stock Fund deals only with expense materiel. Investment materiel is financed through the Army procurement appropriations and includes both principal and secondary items. Principal items are major end items such as an aircraft or tanks managed as major assets in the Army logistic systems. Secondary items fit one of the following criteria:

- Mandatory return to depots for repair and overhaul is prescribed, as would be the case, for example, with vehicle engines and transmissions.
- The asset costs over $1,000 and is an end item, for example a lathe, as opposed to being a part of another major assembly.

All materiel items that are not principal or secondary items as described above are in the Army Stock Fund unless, of course, they have been transferred to the Defense Supply Agency, the General Services Administration, or another military service for procurement. Carburetors, for example, are included in the Army Stock Fund because they can be repaired in maintenance organizations below the level of the depot and cost less than $1,000.

Under the Army's procedures, a surcharge is applied in computing the cost of stock fund items to the customer. This surcharge covers first and second destination transportation, obsolescence of inventory, pilferage, and property disposal costs. It does not cover the cost of receiving, packaging, storing, and issuing the materiel in Army supply depots. These costs are paid from PE 71111 OMA funds.

The Army Stock Fund contains the following divisions:

- The Army Materiel Command Division - a wholesale type division composed of the seven AMC NICPs.*
- The AMC Installations Division - this provides retail-level support for the depots and other activities that perform maintenance functions. Also, this division supports seven general hospitals, commissaries, clothing sales stores, and one Research and Development Activity.
- CONARC Division - all CONUS posts, camps, and stations.**
- USAREUR Division - theater depot level support.
- USARPAC Division - four subaccounts: Okinawa, Hawaii, Korea, and Japan.
- Alaska Command.
- Southern Command.

In a "vertical" stock fund one manager owns all of the materiel, regardless of its location. In a "horizontal" stock fund, an intermediate level is introduced into the system. This intermediate level buys from the higher level for subsequent resale to users.

The Army operates its stock fund on the horizontal basis. For example, the USAREUR Stock Fund Division buys items from the AMC Division and places these items in its depots. Central post supply type activities using OMA funds purchase these items from the depots (USAREUR Division) to meet final customer needs. Under the vertical stock fund concept used in the Air Force, there is no buying and selling among stock fund activities. Once an item is procured, it remains in the single stock fund division, regardless of its physical movement, until it is sold to a user. Of course, this customer also uses his Operations and Maintenance appropriation dollars to buy the item.

---

*There will be minor changes in these Divisions when the reorganization directed by the Secretary of the Army's letter of January 11, 1973, is completed.

**Subject to minor change with the Army reorganization directed on January 11, 1973.

The AMC Division is composed of the following seven subdivisions by materiel category:

Weapons and Fire Control
Ground Forces Support (Construction)
Electronics
Air Materiel
Tank and Automotive
Missiles
Special Weapons and Chemicals.

The other categories of stock fund materiel, all items administered by the Defense Supply Agency, are managed by Army Class Manager Agencies (ACMAs) located at New Cumberland Army Depot. Following are these categories:

Industrial Supplies
Clothing and Textiles
General Supplies
Petroleum and Allied Products
Subsistence
Medical, Dental, and MAP Support Materiel.

The Army Industrial Fund includes employees who perform the services provided by that Fund. The Army Stock Fund does not employ personnel. The required functions associated with the Fund are carried out by employees financed in the regular Program 7 PEs such as 71111, Supply Depots/Operations, and 71112, Inventory Control Points. The Fund is not only a buyer and seller of materiel, but is also a customer of the Depot Maintenance Industrial Fund for services performed on some stock fund items that require depot maintenance and for engineering services related to stock fund items.

III. EXISTING SYSTEMS USED TO DEVELOP ARMY PROGRAM 7 RESOURCE REQUIREMENTS

The existing governmental budget process requires the preparation of estimates of future resource requirements for approved programs. Therefore, systems currently exist for preparing these estimates and evaluating the impact on programs of workload changes which occur over time. This chapter examines these current methods for estimating logistic support resource requirements and evaluates their applicability to the problem addressed by this study.

First, this chapter reviews the general OSD and Army planning, programming, and budgeting process as it relates to Program 7. Then systems and procedures employed to estimate each category of logistic support requirements are described. Finally, these methods are evaluated in terms of the OSD/DDPA&E need for suitable ways to estimate rapidly and credibly Army logistic support requirements associated with alternative force structures.

A. THE OSD AND ARMY PLANNING, PROGRAMMING, AND BUDGETING SYSTEMS AS RELATED TO PROGRAM 7

Figure 7 lists the key OSD and Headquarters, U.S. Army actions in the annual planning, programming, and budgeting process. These must be explained briefly before the PPBS as a whole can be related to Program 7.

The first item on Figure 7 is "Update Five Year Defense Program (FYDP)." In addressing this item, it is necessary to consider the OSD budget review process which took place from October through December 1972.

Item	Action	Date
1	Update Five Year Defense Program	January
2	OSD issues defense planning and programming guidance	February
3	Army submits Program Objectives Memorandum to OSD, including proposed program in FYDP format	May
4	Army submits results of selected analyses directed by OSD in September, 1972	May
5	OSD issues budget guidance for preparation of FY 1975 budgets	June
6	OSD issues tentative program decisions and Army provides comments to OSD	July
7	OSD issues program decision memorandums	August
8	OSD issues list of topics identified for selective analysis	September
9	Update Five Year Defense Program	September
10	Army submits FY 1975 budget to OSD	October 1
11	OSD conducts hearings on FY 1975 budget	October - November
12	OSD issues program budget decisions and Army submits reclamas as appropriate	November - December
13	OSD and Army staffs complete preparation of FY 1975 Army budget material and submit to Office of Management and Budget/ Executive Office of the President	December

Figure 7. PROGRAM/BUDGET REVIEW SCHEDULE CALENDAR YEAR 1973

On October 1, 1972, the Army submitted its budget to the OSD/Comptroller for Fiscal Year 1974 which would begin on July 1, 1973. For the next three months a thorough review ensued in which virtually all major staff offices in OSD and Headquarters, U.S. Army, became involved. The OSD/Comptroller was the office of primary responsibility. However, he worked closely with OASD/SA,* especially on questions relating to force structures. All budgets were subjected to an intensive line item examination, including analyses by members of the staff of the President's Office of Management and Budget. In the end, necessary adjustments were made throughout the budget to bring it under the ceiling which the President had determined would be the amount of funds to be requested of the Congress for the Department of the Army.

After the U.S. Army budget for FY 1974 was submitted to the Congress as part of the total DoD budget, the action listed as item 1 on Figure 7 could take place. Specifically, the Army reviewed its FYDP and made the adjustments necessary to include the effects of decisions made in the October-December 1972 budget adjustment process. This generally included changes in all years and all major programs because line item changes in the FY 1974 budget often would have an impact not only on that year but also on subsequent years shown in the FYDP. Many adjustments also were made in the current year, FY 1973, column of the FYDP as up-to-date experience was taken into consideration in the FY 1974 budget review.

The updated Five Year Defense Program represents a new baseline for future planning, programming, and budgeting. All programs were priced-out by the Army in micro-analytic detail. Latest cost factors were applied to all program elements.

---

*This was prior to reorganization of OASD/SA to ODDPA&E.

Therefore, when ODDPA&E undertook the examination of future force structure alternatives, a relatively firm baseline program, including Program 7, was available.

The schedule calls for OSD to issue the Defense Planning and Programming Guidance (DPPG) in February. This is a comprehensive four-part document covering the following areas:

- DoD policy guidance on strategy and forces.
- Materiel support planning guidance.
- Fiscal guidance.
- Guidance on content of the Program Objectives Memorandums to be submitted by the services.

The DPPG formally initiates the near-year force structure planning phase. It establishes the necessary parameters for such planning, including financial ceilings and other constraints. The DPPG sets the stage for the total analytical effort which will culminate in the FY 1975 DoD program and budget.

Figure 8 is a copy of the format for the fiscal guidance in the DPPG.* The fiscal guidance for Program 7, Central Supply and Maintenance, is contained under the General Support Category on the Logistics line. In the February 1973 DPPG, separate fiscal guidance tables were issued for each year 1975 through 1979.

Throughout the period of late February through April there is almost constant coordination and dialogue between ODDPA&E and the services. Therefore, the Army generally has a good indication of the direction of OSD thinking on major issues and the OSD staff can anticipate the positions the Army will take on these issues as the planning process is underway.

In May, the Army submits its Program Objectives Memorandum (POM) outlining the programs the Army wishes to implement within

---

*The official title of this document is FYDP Update Program, FY 1975-79.

FYDP UPDATE PROGRAM--FY 1975-79

(TOA in FY 1974 Budget Dollars--In Billions)

	Army	Navy	Marine Corps	Air Force	Defense Agencies & Other	Total DOD
Strategic Forces						
Offensive						
Defensive						
Control & Surveillance						
Subtotal Strategic Forces						
General Purpose Forces						
Land Forces						
Tactical Air Forces						
Naval Forces						
Mobility Forces						
Subtotal General Purpose Forces						
Total Major Mission Forces						
Other Programs						
Intelligence & Security						
Centrally Managed Communications						
R&D						
Support to Other Nations						
Geophysical Activities						
Total Other Programs						
General Support						
Base Operating Support						
Medical						
Personnel Support						
Training						
Command						
Logistics						
Total General Support						
Miscellaneous Costs						
Retired Pay Appropriation						
Family Housing & Homeowner's Program						
Undistributed Contingencies						
Total Miscellaneous Costs						
GRAND TOTAL						

Figure 8. FORMAT OF DEPARTMENT OF DEFENSE FISCAL GUIDANCE PAPER (Dollar Data Omitted)

the guidance provided by the DPPG. Alternative programs also may be proposed, contingent upon allocation of additional resources. The POM is a very lengthy, detailed document showing in program element detail Army programs for the next five years.

The Army also submits, in May, the results of selected analyses directed by OSD in September 1972. These analyses address special major problem areas that the OSD staff believes are important in the allocation of defense resources.

In June, the OSD/Comptroller issues the Budget Guidance for preparation of the FY 1975 DOD budgets. Much of the required directions are contained in the OASD/Comptroller Budget Guidance Manual, DODI 7110-1-M, however, supplementary guidance directed toward the specific budget to be submitted in October is necessary.

From May to July, the ODDPA&E force teams develop and price-out many force structure alternatives. The ODDPA&E staff also drafts tentative program decisions in various areas of the service programs. Upon approval by the Secretary of Defense, these tentative program decisions are forwarded to the services for comment. Finally, in August, the Secretary of Defense issues the Program Decision Memorandums (PDM) covering forces and programs. These provide the final, firm guidance on force structures and other issues necessary for preparation of the FY 1975 budget.

Shortly after the PDMs are issued, OSD provides the list of selected analysis topics. The results of these analyses will be submitted in May 1974.

With the publication of the PDMs, the major decisions have been made for the budget cycle. Then the FYDP can be updated to include the effects of these decisions. Since the Army budget should be in the final preparation stage, it is also possible to incorporate up-to-date cost data into the FYDP.

It appears from the schedule shown in Figure 7 that little time is provided to update the FYDP and submit the Army budget after issuance of the PDMs. However, it must be recognized that most of the decisions are made with the issuance of the tentative program decision papers. There is a continuous dialogue among the staffs from June through August. Therefore, Army activities know the content of most of their programs before the PDMs are issued. Only the more controversial or "harder" areas remain unsettled until a PDM is received. Even then, however, there are further revisions in the review period when plans and programs can change.

As discussed earlier in this section, the Army is engaged in the intensive annual OSD/OMB review of the budget from early in October to the middle of December. Finally, in late December, with the submission of the FY 1975 Department of Defense budget, including the Army section, the planning, programming, and budgeting process for calendar year 1973 will terminate.

Army Central Supply and Maintenance requirements are considered throughout this entire process. Logistic support costs must be analyzed in conjunction with the study of all force structure alternatives by both the ODDPA&E and Army staffs. Reasonably accurate estimating techniques must be used; otherwise, likely alternatives may be discarded because the analyst assumes they cannot be supported. On the other hand, alternatives may be adopted that, in fact, cannot be supported with the resources made available under the fiscal guidance ceiling.

Extensive planning, workload, and cost data on logistic support are included in the POM and the annual budget. These data are essential in the updating of the FYDPs in January and September, as well as in the preparation of the annual budget and the apportionment request. This latter document is submitted to OMB in June each year through the OSD/Comptroller

to secure release of funds for operations in the new fiscal year that starts on 1 July.

The Army maintains centralized controls over its planning, programming, and budgeting activities that respond to OSD requirements and provide inputs to OSD under the DoD PPBS. Army Chief of Staff Regulation No. 15-17 established the Select Committee (SELCOM) with the following statement of purpose:*

> The Committee will review, coordinate and act, or recommend action, on all matters relating to programming, budgeting and the use of Army financial resources.

The Assistant Vice Chief of Staff is Chairman of this committee. Members include essentially the three-star General Officer level Deputy Chiefs and Assistant Chiefs of the Army Staff for the resources areas--Personnel, Logistics, Comptroller, R&D, and Military Operations, and Force Development. This group considers guidance and analyses; reviews Army programs and budgets; and makes program, budget, and funding decisions at the top management level.

The Select Committee is supported by two Major-General-level committees--The Program Guidance and Review Committee (PGRC) and the Budget Review Committee (BRC).

The PGRC develops proposed program guidance, reviews and analyzes Army programming actions and makes recommendations to the chairman of the SELCOM. Thus, the PGRC, chaired by the Director of Planning and Programming Analysis, Office of the Army Assistant Vice Chief of Staff deals with the planning and programming phases of the PPBS, generally in the framework of the medium- and long-range Army programs and associated resource requirements.

---

*CSR No. 15-17, Boards, Commissions and Committees, Select Committee, 6 March 1970, as amended.

The Budget Review Committee chaired by the Director of Army Budget has a shorter range perspective. This committee reviews and analyzes budget submissions, including operating budgets and budget execution documents of the major Army commands. It assists the Comptroller of the Army in justifying budgets. The Committee serves as the Chief of Staff's senior management review and analysis group for OSD Program Budget Decisions during October to December as the Department of Defense budget evolves into the completed document to be submitted by the President to the Congress in January.

Within the Army staff, the Assistant Chief of Staff for Force Development (ACSFOR) is the focal point for three major areas of interest in this study--force structure studies and guidance, materiel authorizations for TOE and TDA type organizations, and manpower planning and programming. In force structure studies, the Office of the Assistant Vice Chief of Staff provides general policy guidance; however, ACSFOR conducts the necessary analyses, including examination of alternatives under various guidelines leading to recommendations for the future year Army force configuration.

The Comptroller of the Army is the focal point for the Army budget and for the preparation of the Army's Five Year Defense Program. Functional staff offices, however, such as the Assistant Chief of Staff for Force Development, Deputy Chief of Staff for Logistics, and Deputy Chief of Staff for Personnel, have the Program Directors who perform the operational functions of planning, programming, and budgeting for the resources included in Program 7 of the FYDP. These are the Program Directors who work on a continuous basis with the Army Materiel Command and other Army organizations involved in central logistic support.

Army PPBS actions are keyed to the schedule portrayed in Figure 7. ACSFOR and other planning agencies on the Army staff

conduct continuous planning studies related to force structures, manpower authorizations, R&D activities, personnel programs, equipment authorizations, and studies related to activities encompassed by Program 7. Program 7 studies are largely a product of the DCS/Logistics staff with input from the Army Materiel Command, Overseas Commands, and other Army agencies involved in the central logistic support process.

There is considerable interaction between the Army staff and the Joint Chiefs of Staff to ensure that Army planning is consistent with the comprehensive multiservice planning performed by the JCS. Consistent with PPBS milestones, the appropriate Army staff agencies lay out five year programs and participate in the development and defense of the annual Army budget and apportionment requests.

The key offices referred to above supervise and coordinate the entire PPBS process. It is appropriate now to examine existing Army methods for computing Program 7 resource requirements that will be reviewed, evaluated, and ultimately approved through the planning, programming, and budgeting system.

B. ESTIMATING PROGRAM 7 RESOURCE REQUIREMENTS

This section describes the Army systems and procedures for estimating logistic support requirements.

Before undertaking an examination of Army methods, one fact must be emphasized. There is no intent in this chapter to judge or evaluate these existing methods as techniques for estimating the year-to-year Army resource needs for performing the central supply and maintenance functions. The sole purpose is to determine if these methods can be used to deal effectively with the ODDPA&E problem which is the subject of this study.

There are two aspects to the problem of determining Program 7 resource requirements. First, there are methods for computing these requirements on a gross basis without regard to fund limitations. Second, there are methods for determining the

requirements to be financed within the constraints of a budget ceiling. It is necessary to consider both aspects of this problem. Unconstrained computational methods must be examined, since they may provide statistical or mathematical approaches useful to this study. On the other hand, the preparation of requirements estimates under budget constraints must be considered, since all historical data on Army Central Supply and Maintenance activities reflect, to some extent, experience in a fund-constrained environment.

1. The Army Structure and Composition System (SACS)

The Army Structure and Composition System which produces the so-called "SACS File" is a core element in the entire logistic requirements computation process. This system is literally a series of computer programs that tie together selected ACSFOR management information systems and computer maintained files. These systems and files relate to various resource areas which are addressed continuously in the Army PPBS process.

Five major files are used in the Army Structure and Composition System. Each of these files is derived from separate management systems having other uses in addition to supporting the SACS.

- Force Accounting System (FAS) - This includes units that comprise the current, budget, programmed, and planned (objective) Army forces. As of May 1973, the current force is the FY 1973 force; the budget force is FY 1974; the programmed force is FY 1975-1979; and the objective force is FY 1975-1982. This file shows units and manpower authorizations but no data on equipment.
- The Army Authorization Documents System (TAADS) - This includes all Army unit documents reflecting tailored authorized quantities of personnel and equipment. This file provides the authority for requisitioning and distributing resources to all active Army and Reserve Component units. It contains the Modification Tables of Organizations and Equipment (MTOE) and Tables of Distribution and Allowances (TDA) for all Army organizations.

MTOEs are the standard TOEs for combat, combat support, and service support units of the Army in the Field, modified if necessary, to meet the unique operational requirements, constraints or environments of individual units. The TDAs cover authorizations for nondeployable general support and all other categories of Army organizations. They are tailored for each specific noncombat mission, since these units are unique.*

- Tables of Organization and Equipment (TOE) - This file includes prototype organizational structures displaying wartime minimum essential personnel and equipment required for prescribed missions of each type of Army combat, combat support, and service support unit.
- Basis of Issue Plans (BOIP) - These are unit requirements for new equipment items under development to enter the Army inventory but not yet reflected in TOEs.
- Shorthand Note Control System (SHNCS) - This is the system by which SACS output requirements data may be adjusted late in the SACS computational cycle without changing the data in the systems providing basic input to SACS. For example, Shorthand Notes are used to substitute different new equipment items for those in a current MTOE, TOE, TDA, or BOIP to adjust quantities to reflect decisions very recently made on procurement objectives for major items.

The above listed files in the SACS are updated continuously. Unit activations, deactivations, and reorganizations, for example, are incorporated into the FAS file as soon as programmed or planned for a specific date. TOEs and TDAs are continually evolving because of changes in doctrine and missions and because of projections of availability of new equipment for Army units. These facts must be incorporated into the SACS input files so that current data are available at all times.

Complete tabulations relating to manpower and materiel are prepared for the development of the annual Program Objectives Memorandum, the Army budget, and for the request for apportionment in June each year. These data are necessary for the computation of Program 7 requirements.

---

*AR 310-34, Equipment Authorization Policies and Criteria and Common Tables of Allowances, June 1970, prescribes policies and procedures for establishing equipment allowances to be included in TAADS authorization documents.

Manpower and forces summaries permit the interested Army activities to relate current inventory levels to required future positions. Thus, for both military and civilian personnel, it is possible to estimate requirements associated with future programmed force structures and determine intermediate actions necessary to achieve proper force levels.

2. Systems for Developing Materiel Requirements

The outputs of the SACS files permit the Deputy Chief of Staff/Logistics to develop his gross requirements for materiel items to support the current and planned forces. Figure 9 shows how this process is carried out. In the first column the bar entitled "Initial Issue Quantity" shows the totals by major item required in Army TOE and TDA units according to their projected wartime authorized equipment lists. These data are outputs of the SACS files. To these, DCS/Logistics staff personnel must add operational readiness float, operational project stocks, pipeline stocks, and combat consumption or war readiness reserves.*

The second column shows how the Authorized Acquisition Objective (AAO) is computed. The AAO or approved total Army equipment level includes, first, the materiel on hand or due in from depot maintenance less forecast losses. To this total the following are added: (1) production offset, the items financed from available funds but not yet delivered from procurement sources; and, (2) the authorized new-buy quantities to achieve the gross requirements as shown in the first column.

---

*Operational readiness float includes items given to combat units to replace TOE items sent to direct support maintenance activities for repair and overhaul. Operational project stocks are items prepositioned overseas or in CONUS for contingency purposes. War readiness reserve stocks are items maintained in storage to meet immediate wartime requirements for combat usage and are not related to operational project stocks.

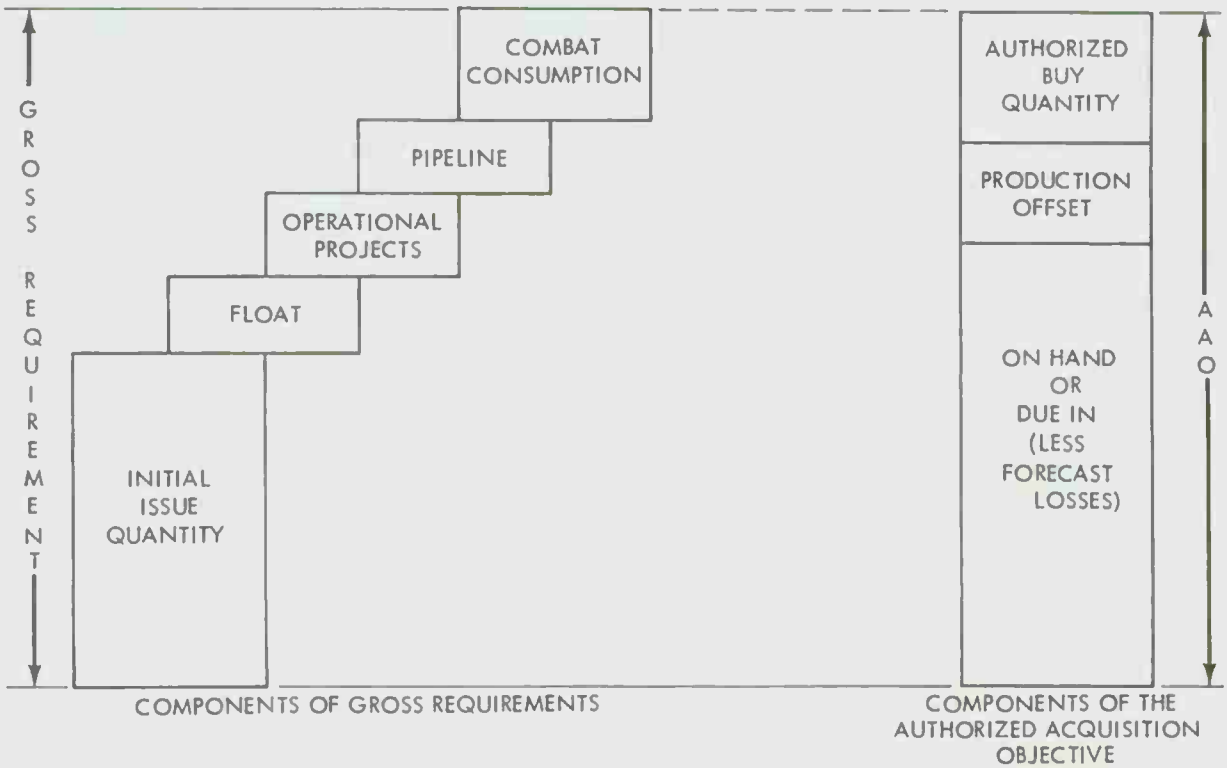


Figure 9. MAJOR PROCUREMENT--AUTHORIZED ACQUISITION OBJECTIVE

The Authorized Acquisition Objective includes separate data for each of the fiscal years encompassed by the Army Five Year Defense Program. Thus, it provides total authorized equipment levels by year against which planning, programming, and budgeting actions can take place. The AAO is a section of the Army Materiel Plan, Part I (AMP-I), which is prepared in the Army Materiel Command in close coordination with DCS/ Logistics, Department of Army. AMP-I also includes data on asset inventories projected by future year and planned deliveries by year.

The AMP-I is a very important document related to Program 7. As mentioned above, it represents a target for equipment levels that should be attained on a time-phased basis in Army TOE and TDA units. Normally, the FYDP will show the investment funds for procurement of equipment and materiel items in programs other than Program 7. Most major items will be used to equip organizations shown in Program 1, Strategic Forces, and Program 2, General Purpose Forces.

Program 7, of course, will have some procurement funds authorized in its various program elements, but AMP-I is most important to Program 7 for other reasons. First, the major procurement contracts are negotiated and administered by AMC procurement personnel financed through PE 71113. Second, the assets in the Army inventory are usually processed at one time or another in their life cycles through the supply depots the operating expenses of which are covered by PE 71111. Third, wholesale asset management is carried out by personnel financed through PE 71112. Finally, the AMP-I shows the depot maintenance program performed in the immediate prior year, and the programs for the current and four future years by individual item. Since AMC includes unserviceable items as available to meet AMP-I AAO requirements, any additional required assets must come from new procurement. It is necessary, however, to program depot maintenance on unserviceables to achieve the desired force readiness posture.

On the basis of the AMP-I, the Army can prepare its annual materiel budgets and requests for apportionment of procurement dollars. The Army Master Priority List (DAMPL) provides essential guidance in these actions. This list, published annually by the DA Deputy Chief of Staff for Military Operations, assigns a priority for manning and equipping to all Army TOE and TDA organizations. The logistic part of the DAMPL is published annually in AR 11-12, Basic Logistics Priorities. An ACSFOR Priorities Board has been established to review all materiel programs and ensure that RDT&E and procurement budgets are prepared consistent with these priorities.*

The procurement budgets and requests for apportionment are prepared and defended on a line-item basis by appropriation. In the Army logistic system, asset information is not directly reported by program element. Therefore, the distribution of existing asset information relating either to on-hand, budgeted, or programmed assets for the out-years is made by statistical allocation techniques. With high cost major items such as aircraft, it is possible to identify specifically the program elements involved, but for most assets, the statistical method must be used in preparing the FYDP type information.

This method is necessary, since a massive detailed accounting system would be required to identify countless assets by program element from the time the asset was initially planned for procurement until it was disposed of. Therefore, when a "buy" program is established the assets on the list are distributed to program elements by a computer model. This model is programmed to consider AAO requirements by the program elements and priorities established in the Army Master Priority List.

---

*Chapter 9, AR 11-8, Principles, Objectives, and Policies of the Army Logistic System, August 1970.

3. Systems for Developing Manpower Requirements

Systems for estimating manpower requirements are of considerable importance, since over 136,000 personnel were authorized in Program 7 activities in FY 1973. Some of the questions addressed here are: How are manpower requirements developed? How are they reviewed and approved? What is the basis for the final allocations of manpower authorizations from Headquarters, U.S. Army to the major Army Commands and from these commands to their subordinate organizations? What are the roles of the various activities in this process?

In the Army manpower system there are two separate subsystems--one for military and one for civilians. Because methods of administering these two categories are quite different they will be discussed separately.

a. Civilian Manpower Programming System. To a large extent, the civilian manpower programming system involves incremental programming and budgeting procedures. At any time there exists an approved program for the budget year and for subsequent "out-years." For the current and budget year, the programs maintained by ACSFOR are very detailed, showing civilian manpower by organization, program element, and category, i.e., U.S. direct hire, U.S. wage board, foreign national direct hire, and foreign national indirect hire. For the "out-years" ACSFOR maintains the information by program element and by Command, by category. In the commands, the programmed strengths are maintained for all years by organization as well as by the ACSFOR aggregations.

The Army administers comprehensive manpower utilization and validation programs to assist program managers in computing realistic estimates of manpower requirements. These programs cover all Program 7 organizations.

AR 570-4, Manpower Management: Policies, Procedures, and Responsibilities, 10 October 1969, requires that a comprehensive

manpower survey be conducted of all organizations at least once every four years. In AMC, these surveys are conducted by teams from Headquarters, Army Materiel Command, for each of its organizations every two or three years. Similar surveys are conducted in other commands that use Program 7 resources.

Each commodity command and depot also has work measurement personnel who analyze individual positions in organizations and their applicable workloads to develop engineered and other types of work measurement standards and to aid the local commander in achieving the most effective distribution of his manpower resources. This local work measurement group reviews each of its command's activities once every 14 to 18 months.

Manpower surveys involve thorough in-depth studies of each organization and each position.* Performance data are accumulated, and Army standard yardsticks are applied when available to provide a quantitative approach to the calculation process. Finally, the survey teams prepare recommendations on staffing levels required to perform organizational missions.

DA Staffing Guides are developed for Army-wide major fixed-support TDA units. Within Program 7, guides are available for two types of activities, Military Traffic Management and Terminal Service Activities, and U.S. Army Depots.** These Guides cover most activities as listed in the Army Management Structure† for organizations covered by the Guides. Methods are

---

*See Department of the Army Pamphlet 570-4, Manpower Procedures Handbook, March 1970.

**DA Pamphlet No. 570-516, Military Traffic Management and Terminal Service Activities, 11 December 1972 and DA Pamphlet No. 570-566, U.S. Army Depots, 26 April 1971.

†AR 37-100, The Army Management Structure, published each year to show structure for current fiscal year.

provided for computing all manpower requirements associated with the relevant workload. For example, in depot supply, yardsticks for quality control inspection activities are provided for manpower needed on the basis of line items inspected per month. Analyses were based on data contained in the Depot Operations Cost and Performance Report (RCS CSGLD-1198) prescribed by AR 740-6. In motor pool operations, yardsticks for manpower requirements are based on miles driven per month.

Copies of all manpower survey reports are forwarded to ACS FOR where the Staffing Guides are published and maintained. Normally, analysts update the Guides on a three year cycle, but do it more often if required. Thus, the manager in the field and the manpower management specialists have available staffing guidance based on Army-wide experience which assists in determining manpower requirements for command missions. This information materially assists in the development of manpower requirements for accomplishing the workload planned for each Program 7 activity. It also is useful in determining a more equitable distribution of personnel if the command does not receive sufficient manpower authorizations to perform all of its missions according to the standards. This manpower analysis activity is underway continuously in the Program 7 organizations and represents the efforts at the lowest level to determine valid manpower requirements versus workload.*

In considering the Army's manpower validation and utilization procedures, it is important to bear in mind two factors.

---

* U.S. General Accounting Office Report B-178238, April 12, 1973, stated that existing methods used in the AMC major commodity commands to determine the effect of workload changes in civilian manpower authorizations are inadequate. The report stated that the Army Maroun System "holds promise as a method whereby management will be able to analyze and confirm the validity of manpower requirements and budgets." The Maroun System is discussed in the next chapter.

First, the published DA staffing guides provide basic tools for use on manpower surveys to determine and support manpower requirements for widely varying workloads. They are not directives on specific staffing. Each individual activity differs to some extent from similar activities in other commands. Therefore, on-the-spot analyses are required for the final determination of staffing levels. Second, if manpower authorizations are inadequate to perform all missions, the local commander must assess his priorities and apply his limited manpower resources to perform the priority missions using the outputs of the manpower studies solely as a guide in his decision-making.

b. Military Manpower Programming System. Military manpower programming in Program 7 is quite different from the system for civilians. The Army military personnel program is centrally controlled. Although individual command military manpower requirements are reviewed and approved in a manner similar to those for civilians and are covered under the manpower staffing guides, most military personnel funds are retained at Headquarters, Department of the Army. Therefore, AMC and other major commands are not required to adhere to military man-year or funding limitations as is the case with civilian manpower. They are limited only by the number of military spaces authorized to the command by Headquarters, Department of the Army, and by availability of personnel provided by the regular Army assignment system.

This is not intended to imply that the military authorizations are relatively static. Program 7 activities will be required to adjust military as well as civilian strength consistent with changes in workload and budget constraints. Since only 8-1/2 percent of the personnel in Program 7 is military, however, and many of these are in management positions, the strength authorizations do tend to be more stable than those for civilians.

Proper programming of military personnel requires a careful study and identification of positions that have a peculiar requirement for a military incumbent. Generally, AMC positions (and Program 7 positions in other commands) are staffed with civilian personnel unless such a peculiar requirement exists.

When positions that require military personnel have been identified, requests for authorizations can be submitted at any time from subordinate units to the major command and from that command to Headquarters, Department of the Army. These requests will be approved or disapproved, depending on need and priority, as spaces are available within the overall Army military manpower ceiling. After the spaces are authorized, they are subject to regular review, just as civilian spaces, to ensure that they continue to be required.

4. Systems for Developing Equipment, Parts, Supplies, and Other Cost Requirements

This chapter has discussed Army procedures for developing and implementing major materiel and manpower programs. These procedures apply to all Program 7 elements. In addition to items financed from the procurement appropriations and manpower and associated resources, such as money for travel, most of the Program 7 elements include funds for equipment and supplies. In some of the elements, funds are also provided for stock-funded repair parts, modification of equipment, and purchased services. These funds are for the requirements of the AMC commodity commands and depots and other organizations financed from Program 7 resources. As indicated earlier, most of the funds for spares, modifications, supplies, and equipment are carried in the combat and combat support organization program elements in other Programs of the FYDP.

Most equipment items are authorized on a line-item basis in each AMC organization concerned. Equipment items costing more than $1,000 generally are financed from the Other Procurement Appropriation-Army. Normally, items costing less than

$1,000 will be procured with OMA funds. After organizations have received their initial levels of supplies, fund estimates for future needs are usually based on experience data. This also applies to stock-funded spare parts. However, funds for modifications and purchased services would be approved on a case-by-case basis.

Earlier, reference was made to one of the components of the SACS file called the TAADs file. This file contains TOE and TDA personnel and equipment authorization information on all Army organizations. AR 310-49, The Army Authorization Documents System (TAADS), August 1972, contains the procedures for preparing and processing proposed TOEs and TDAs on new organizations and for proposing changes to existing TOEs and TDAs.* All Program 7 organizations must follow these procedures to establish the basic authorizations for the equipment needed to perform this mission. Once their authorizations** have been approved, their requirements are considered, along with those of all other Army organizations in the regular budgeting and program implementation processes.

Funds for hardware resources, supplies, and services are requested in the regular annual budget submissions from Program 7 organizations. These requests are subjected to the customary budget review process through the major command (AMC, USAREUR, USARPAC); Headquarters, Department of the Army; OSD; OMB; and the Congress. Ultimately, funds are appropriated and authority is provided to Program 7 activities to procure the needed resources.

---

*AR 310-34, Equipment Authorization Policies and Criteria and Common Tables of Allowances, June 1970, provides necessary guidance for determining allowances to be approved for various types of organizations.

**All Program 7 activities are TDA organizations.

5. Systems for Developing Military Construction Requirements

Military construction projects are developed, reviewed, and approved on a line-item basis for the entire Army. In January of each year, the major commands submit a five year list of construction projects within financial guidance provided by the Department of Army. The Construction Requirements Review Committee on the Army Staff reviews all projects and arrays them by order of priority.* The objective is to develop a balanced program, recognizing priorities and OSD and DA guidance.**

The Committee distributes the projects by program element after an approved list has been determined. Thus, there may be large or small projects in any one program element in any one year, depending on the stated military construction requirements and the outcome of the review process. Needless to say, there are many program changes throughout the review and approval cycle until funds are appropriated by the Congress for Program 7 construction projects.

Having reviewed methods for determining requirements for general categories of resources, it is necessary to examine special applications of these methods within each Program 7 element.

6. Systems for Individual Program Elements

a. Program Element 71111, Supply Depots/Operations. In addition to manpower, resources within this program element

---

*AR 415-15, MCA Program Development, 8 May 1969.

**In FY 1973 and FY 1974 the Army is emphasizing "soldier-related" programs consistent with the All Volunteer Army force concept. Administrative facilities enjoy relatively low priorities.

include vehicles and other base maintenance and support equipment required to operate the AMC, USAREUR, and USARPAC supply depots. Included are the funds needed to modify the maintenance and support equipment as dictated by changing requirements, to overcome deficiencies, or to incorporate technological improvements. Construction funds may be programmed for facility requirements. In addition, this program element contains Operations and Maintenance funds to support the day-to-day activities of the depot supply and distribution organizations.

About $6 million of central procurement funds are required each year for new vehicles, such as fork lifts and warehouse tractors, and for materials-handling equipment. This is to replace existing equipment that has completed its period of usefulness or to provide new equipment to handle increased workload. Other procurement funds are programmed for such items as generators, pallets, and data automation equipment. Modernization projects to provide automatic storage and retrieval systems in Army depots are included in this program element; however, these are funded from the OMA appropriation rather than Other Procurement.

By far the largest requirement in PE 71111 is for civilian personnel. The general method for estimating requirements and receiving funds for civilian personnel was discussed above. A few comments are appropriate, however, regarding the civilian manpower authorization system as it operates specifically within this program element.

As noted earlier, the Army has published a Staffing Guide for U.S. Army Depots. This Guide provides detailed yardstick criteria for computing manpower requirements in all sections of the depot supply and distribution operation, including management and administrative personnel. These yardsticks are based on variables such as line items processed, approved manpower strengths of supported units, numbers of containers to be packed, and short tons processed. All yardsticks are based

on actual historical performance reports and substantiated by manpower survey data. Thus, the Staffing Guide provides the basic information to compute manpower requirements, provided suitable forecast workload data can be applied.

In the regular annual budget cycle, each AMC Commodity Command and the overseas materiel management activities are required to provide estimates of the workloads they will levy on the depots in the supply depots operation. These estimates are based on program data received from Headquarters, Department of the Army on forces to be supported (SACS File) and historical data in the NICPs and ICPs on procurement and requisition activity. These estimates are reviewed and adjusted by the Headquarters, AMC staff. The final workload estimates, projected through the years covered by the FYDP, become the program data used to determine PE 71111 manpower requirements in each year.

During the operating year, MIDA determines the workloads for the depots for supply and distribution activities as well as for depot maintenance. Therefore, historical experience is developed on the validity of earlier workload estimates by the NICPs and ICPs. These data aid the analysts at various levels of command in developing and refining estimates of future workloads.

In recent years, about $90 million per year has been required for Other Purchased Services in the OMA portion of PE 71111. A large part of these funds is used for the financing of personnel employed by contract in overseas areas. These are foreign nationals hired through foreign government agencies (indirect hire). About $15 million of Other Purchased Services funds in FY 1973 are for the industrially funded supply depot operation at Lexington-Blue Grass Army Depot.* The

*When the supply and distribution activities at all AMC depots are placed under industrial fund procedures on 1 July 1973 there will be a significant increase in this total.

remainder of the funds is primarily for payment of contractors who perform supply depot operations in their own facilities in support of Army missions. Handling and storage of chemical munitions is an example of such support.

The requirement for Other Supplies represents a relatively large item in the PE 71111 OMA area, averaging about $25 million per year. It covers stock fund items that the supply and distribution activities must use in conducting their operations. This includes packaging supplies and containers used to pack and ship or store materiel.

The last remaining major resource area is for officers and enlisted personnel financed from the Military Personnel Appropriation. This covers military personnel on duty in the Directorates for Supply in the U.S. Army depots. The method for securing military space authorizations was discussed above.

b. Program Element 71112, Inventory Control Points. This program element encompasses essentially the activities of the Directorates for Materiel Management in the AMC Commodity Commands and the counterpart organizations in overseas commands. The OMA appropriation finances all but a negligible part of the costs incurred in PE 71112.

Most of the workload in the Commodity Command Directorates for Materiel Management is managerial, analytical, or administrative in nature. This is a qualitative decisionmaking and problem-solving effort difficult to measure in terms of units of work produced. Therefore, estimating techniques for manpower requirements differ somewhat from those employed in PE 71111 at the depots.

As discussed earlier, the Army makes extensive use of the manpower survey system to estimate manpower requirements associated with planned workloads. These on-the-job audits are the most important methods used to determine manpower needs in PE 71112. Since commodity commands manage widely differing

categories of materiel items, each NICP must be analyzed individually to determine manpower needs. It is quite difficult to develop factors that would apply across-the-board in all AMC PE 71112 activities.

At the NICPs, the manpower survey analyst examines past history on workload versus assigned manpower. For example, data are available on man-hours expended in processing requisitions, numbers of consumption and replacement items handled per employee, and line items cataloged over an historical time period. The skilled manpower analyst can relate these factors to future workload projections to develop estimates of future manpower needs. Admittedly, this involves local appraisal and "best judgment" techniques rather than straightforward application of quantitative methods.

About $26 million is required each year for Other Purchased Services. Those funds are used primarily to finance the indirect hiring of civilian personnel in overseas areas and to pay for the Missile Command (MICOM) NICP operations. Since all of MICOM is administered under industrial fund procedures, it is necessary for PE 71112 in the Army FYDP to show the costs of operating the NICP activities in that commodity command as Other Purchased Services, i.e., purchased services from the Army Industrial Fund (AIF). The remainder of OMA expenses in PE 71112 is for utilities, rents, personnel travel, and supplies and equipment totaling about $8 million each year.

The final item in PE 71112 is for Army officer and enlisted personnel assigned to the Directorates for Materiel Management. These personnel are financed from the Military Personnel Appropriation as previously discussed.

c. Program Element 71113, Procurement Operations. All of the resources required in this program element come from the OMA and Military Personnel appropriations. With the exception of Other Purchased Services virtually all of the costs incurred are for pay and allowances and travel of personnel.

In estimating future manpower requirements in PE 71113 activities the system employed is similar to that used in PE 71112. Work measurement and manpower survey groups conduct on-the-job audits relating historical man-hours expended to work-load indicators such as purchase requests handled or line items or dollars on contracts. Thus by application of workload factors developed within the individual commodity command and program data it is possible to prepare manpower requirement estimates.

As with the inventory control point function, PE 71112, professional judgment must be applied to complete the final estimates of manpower required. Although historical data can provide good indicators, each function must be analyzed to determine variations in future versus past programs. There can be significant changes in complexity of functions due to changes in procurement programs in the planning period. The impact of these changes can best be assessed on a qualitative basis by a skilled manpower analyst.

The other expenses in PE 71113 cover military personnel and administrative requirements such as travel, automated data processing (ADP) rentals, supplies, and equipment, except for about $28 million yearly in Other Purchased Services. As with the PE 71112 costs, these services cover the operation of the U.S. Army Missile Command procurement offices since that entire command is financed through the AIF. Edgewood Arsenal is also under the AIF so its procurement operations are covered under this category of OMA expenses.

d. Program Elements 72003, Munitions Facilities; and 72005, Weapons Facilities. These program elements will be reviewed together since they share common characteristics. Both have supply and maintenance and research, development, and engineering missions. They are industrially funded so that their requirements for personnel, facilities, and equipment are largely determined by forecasts of future customer orders.

During the period FY 1973 through FY 1979, PEs 72003 and 72005 annually will include $2 million to $3 million in Other Procurement and $3 million to $9 million in Military Construction funds. Most of these funds are required for the installation of pollution control equipment and facilities.

During the period FY 1973 through FY 1979, customer orders for the Munition Facilities annually will vary from $278 million to $311 million. In the Weapons Facilities, they will run $86 million to $121 million. In both cases, the higher totals are in FY 1973 with the lower totals in dollar orders applying in the later years.

Civilian manpower requirements are computed in the traditional manner for industrial facilities. Standards have been developed for production activities in both program elements. Based on these standards it is possible to estimate manpower requirements to handle the forecast workload. In the managerial and administrative positions heavy reliance is placed on the manpower survey methods.

In the Munitions Facilities most of the man-hours of civilian personnel are devoted to research and development and industrial engineering. As noted earlier, only 5 percent of the Army's ammunition requirements are filled from the Army Munition Facilities. On the other hand, most of the civilian personnel in the Weapons Facilities are engaged in manufacturing gun tubes and maintenance of weapons.

Military manpower strengths are forecast to be level in both program elements throughout the FY 1973-1979 time period. This is based on the assumption that military personnel will continue to be assigned in management-related positions as at present. Thus, changes in workload will not directly affect these requirements.

In the PE 72003 and 72005 industrial facilities the customary operating expenses will be incurred for materials, utilities, rents and other purchased services required to operate and

maintain these facilities. These expenses are estimated on the basis of past experience, current and projected cost rates, and forecast workload. These expenses plus the costs for civilian personnel are compiled into regular unit charges covering labor, materials, and overhead for the services and items provided customers by these industrially funded facilities.

e. Program Elements 72007, Depot Maintenance Activities (IF); and 72207, Depot Maintenance Activities (Non-IF). The Army fulfills its depot maintenance requirements in two ways: First, in organic Army depot maintenance facilities organized under the Army Industrial Fund in CONUS and non-industrially funded facilities overseas. Second, by commercial contract both in CONUS and overseas. Depot maintenance performed under commercial contract is not handled through the Army Industrial Fund.

Thus PE 72007 shows the costs of providing depot maintenance support to customers who "purchase" services from the CONUS activities. PE 72207 contains the resources used by the AMC commodity managers to purchase this industrially funded depot maintenance support. PE 72207 also includes the resources used by these managers and managers in overseas inventory control points (ICPs) to finance depot maintenance performed in non-industrially funded depots and on commercial contract.

In estimating depot maintenance resource requirements, the initial program document (the AMP-I) is the output of the SACS file as discussed earlier in this chapter. This Plan shows total materiel requirements necessary to achieve the Army's Authorized Objectives equipment levels considering existing inventories. It also includes expected new items from procurement and items coming from depot maintenance. It includes a materiel distribution plan and schedule for depot maintenance.

The Department of the Army in cooperation with AMC also provides guidance on the cycle for depot maintenance on major items such as aircraft, aircraft engines, tanks, personnel

carriers and other combat vehicles. In peacetime, aircraft depot overhaul is prescribed on the basis of elapsed calendar time, hours flown since last overhaul, and the results of technical inspections. On ground combat vehicles it is based on mileage. On wheeled vehicles and some other major items an historical experience factor is used to compute requirements.* Repair requirements are also generated for aircraft and other vehicles due to crash and battle damage.

The AMC Commodity Commands have available quarterly reports of flying hours, mileage driven, and similar data. This permits them to forecast future depot maintenance requirements for major items of equipment related to the Army Materiel Plan, Part I. Secondary item requirements are computed on the basis of Supply Control Studies.** Headquarters, AMC provides the Commands with comprehensive information on planned modification programs, reclassifications of equipment, and other programs that could affect depot maintenance requirements. Overseas commanders also have data required to prepare their estimates of requirements to support their own forces, present and planned, for submission to CONUS Commodity Commands.

The complete depot maintenance requirements computation process is carried out twice yearly--once in conjunction with the preparation of the annual Army budget and once to permit development of the annual apportionment request.

For each cycle DA forwards the relevant outputs of the SACS to AMC which, in turn, forwards them to MIDA where gross requirements are computed. These requirements are sent to the commodity

---

*The standard equation is:

$$\frac{\text{Unserviceables Generated Annually}}{\text{T/O\&E \& TDA Authorizations}} = \text{Historical Experience Factor for Computing Requirements}$$

**See Chapter 4, AR 710-1, Centralized Inventory Management of the Army Supply System, Change 1, 30 December 1970.

commands who "apply assets" to come up with their net requirements. In applying assets, the commodity commands assume that all assets not on their accountable records are serviceable.* All assets in the depot, whether serviceable or awaiting repair, also are included, except for those awaiting property disposal action. The commands then consider assets programmed to enter the inventory through funded procurement programs and deduct a percentage of assets that it is assumed will be lost due to various causes.

With these asset requirement calculations, it is possible to prepare a U.S. Army depot maintenance program covering the entire five-year period encompassed by the FYDP. This program considers asset positions and forecasts of depot maintenance requirements based on cyclic maintenance requirements of equipment as discussed above.

AMC Commodity Commands consider worldwide requirements and prepare the necessary input data for the items for which they have logistic management responsibility. MIDA performs the functions of compiling requirements and showing them in a draft Part II of the Army Materiel Plan (AMP-II), by materiel category.

Once the worldwide depot maintenance requirements have been compiled, AMC sponsors a depot maintenance coordinating conference to resolve issues and determine a final recommended program. This final draft AMP-II shows the total program that can be financed and includes a section listing, in order of priority, requirements that could not be financed within budget guidance constraints provided earlier by the Department of the Army. The final printout of the AMP-II shows by major Army command the scheduling of the entire Army depot maintenance program.

---

*Assets on the accountable records of the commodity command are shown according to condition code. Normally, these are the assets that are currently in the depot system.

In projecting costs for depot maintenance, work standards are used to develop man-hour requirements and a depot maintenance labor rate to translate the man-hours into dollar values. These work standards are developed through prescribed industrial engineering techniques.

The labor rates that are used in these calculations are weighted. In addition to the cost of direct labor, they include indirect labor associated with the depot maintenance activities, consumable materiel costs, and other overhead costs. Methods employed to cover industrially funded and nonindustrially funded work are essentially the same. Both types of depot maintenance activities are governed by AR 37-55, Uniform Depot Maintenance Cost Accounting and Production Reporting System, 1 July 1972. This prescribes uniform methods for estimating program costs and permits comparison among activities of costs to perform the same kinds of work.

After all requirements have been computed, forecast maintenance costs to fulfill the part of the proposed program to be performed in CONUS industrially funded depots are reflected in PE 72007. The budget requirements for PE 72207 are developed to include sufficient appropriated funds for the industrial fund customers to purchase these services and for the work to be performed overseas and under commercial contract.

The manpower survey technique applies to depot maintenance as well as to the other Army Central Supply and Maintenance activities. Systems described for computing hardware resource requirements and other costs also apply. Related to the purposes of this paper, the major distinction between the depot maintenance program elements and the other elements in Program 7 is the ability to relate direct depot maintenance costs to materiel categories and, in most cases, to individual weapon systems and, in turn, to force structure changes.*

---

*Discussion later in this chapter will address the problem of allocating indirect costs or costs to repair common items to individual weapon systems.

f. Program Element 72009, Missile Facilities (IF). This program element is unique in that it provides resources entirely for the support of the U.S. Army Missile Command, Redstone Arsenal, Alabama. Furthermore, the Command itself performs essentially three functions: administration of missile procurement programs with all actual production performed by civilian industry; provision of comprehensive industrial engineering support in connection with the major procurement programs; and, conduct of extensive research and development activities related to missile weapon systems.

Thus, most of the costs incurred at MICOM are for civilian and military personnel expenses with the civilians financed entirely from the Army Industrial Fund. The procedures for estimating civilian and military manpower requirements described earlier in this chapter apply to MICOM personnel.

The Other Procurement appropriation finances some relatively small equipment requirements each year. Also, there are non-periodic construction requirements. These investment type costs, however, are all relatively small throughout the period encompassed by the FYDP.

g. Program Element 72895, Base Communications (Logistics). About 50 percent of the costs in this program element are to finance communication services purchased and equipment leased from commercial communication common carriers. About 40 percent to 45 percent is for civilian personnel. The small amounts remaining cover military personnel, supplies, equipment, travel, and other procurement items. Occasionally, military construction costs may be incurred due to a one-time communications facility construction project.

Costs for communication services and equipment are estimated for future years primarily on the basis of past experience plus data available on future workload changes at the facility or planned rate changes by commercial contractors. Civilian and military manpower requirements are estimated as described above.

h. Program Element 72896, Base Operations. Base Operations receives resources from several appropriations. In the investment category, the Other Procurement appropriation finances several groups of miscellaneous items such as generators, vehicles, tractors, calibration equipment, and similar assets required to operate the various installations included under Program 7. In FY 1973, $27 million in Other Procurement funds were authorized to procure ADP equipment under the AMC five-year computer system development program. With the exception of the special ADP requirements, Other Procurement resources are programmed for PE 72896 based on past experience with equipment. Military construction averages $2 to $5 million annually for essential facility needs.

OMA is programmed to finance more than 10,000 civilian personnel in PE 72896 over the FY 1973-1979 time period. These personnel, plus an average of 2,000 military personnel, staff the many activities required to fulfill the needs for base support of mission organizations.

Reimbursements are important in the Base Operations program element. Since the Army Five Year Defense Program is prepared on a direct obligation basis, reimbursements are not shown. However, in relating workload to resource requirements, reimbursable work must be considered, since this workload requires manpower and other resources as does the direct workload.

In FY 1974, Army OMA direct obligations in PE 72896 are budgeted at about $170 million. In addition, reimbursements will total $72 million. The largest customers reimbursing PE 72896 are the Army Industrial Fund and the Army RDT&E appropriation. The reimbursable support provided ranges across the full spectrum of Base Operations activities. However, the major support is ADP and finance and accounting. These latter total $34.4 million. AIF activities on Program 7 installations must reimburse PE 72896 for services under the working capital fund concept. This also applies to the RDT&E appropriation, since OMA does not directly finance activities in Program 6.

i. Program Element 72897, Training. PE 72897 includes resources for two categories of training. First, there is training of Army test and maintenance personnel by contractor field teams related to new equipment coming into the Army inventory. Second, about 275 Army civilian personnel financed through this program element are employed to conduct follow-on training after the contractor field team support has phased out.

Requirements under PE 72897 are determined on a case-by-case basis related to maintenance training support requirements.

j. Program Element 72898, Command. Military and civilian personnel are the principal resources included in this program element. These are the personnel who staff Headquarters, AMC; Headquarters, Military Traffic Management and Terminal Service; and the Program 7 Mid-Management Headquarters in CONUS and Europe.*

Travel, utilities and rents, and communications are significant expenses in this account. About $30 million in Other Purchased Services funds are programmed each year for MICOM (industrially funded) for maintenance of office and ADP equipment and other services by contract.

Requirements in this program element are based on historical experience, manpower surveys, and analysis of forthcoming command program changes.

k. Program Element 78010, Second Destination Transportation. Although almost 1,300 military and over 1,500 civilian personnel are included in this program element, 83 percent of the programmed resources are for purchase of Army transportation services. This includes direct purchase from commercial line-haul transportation companies and reimbursement to the Military Airlift Command, the U.S. Postal Service for airlift of mail, the Military Sealift Command, and the Military Traffic Management and Terminal Service. The costs for operation of the Floating

*For example the AMC Commodity Commands and USAMMAE in Europe.

Aircraft Maintenance Facility are also included in this program element.

PE 78010 requirements are estimated by a complex system from the lowest activity levels through the Director of Army Transportation, Department of the Army. Estimates, split into all categories of movements, are prepared in great detail on the basis of experience and future planned activity levels.

About $2 million of Other Procurement funds are programmed each year in PE 78010. These are centrally budgeted to finance equipment requirements in overseas water ports operated by the Army but not under the Army Industrial Fund.

1. Program Element 78011, Industrial Preparedness. Ninety percent of the resources in this program element are of the investment category. Of this total--that ranges from $250 million to $500 million per year--only about one percent is for construction. The remainder is from the Army procurement appropriations with the Procurement of Ammunition account financing the bulk of the PE 78011 resources over the FYDP time period. Manpower authorizations total only about 550 persons per year.

The resources in this program element are to provide the industrial base, both government owned and privately owned, necessary to support current, wartime, and other contingency requirements. Therefore, PE 78011 resource needs are based on thorough studies of Army procurement and contingency plans as related to existing industrial facilities. Resources for PE 78011 are programmed on a case-by-case basis, in accordance with priorities, to fulfill deficiencies determined as a result of these studies.

m. Program Element 78012, Logistic Support Activities. PE 78012 covers all central logistic services not specifically related to other programs under Program 7. Therefore, it includes a wide range of activities with numerous methods for computing requirements. Virtually all of the resources in

this program element are directly financed from OMA, although about $1 million per year are required for military personnel performing duty in PE 78012 activities. Reimbursements are very significant in this program element, constituting almost 60 percent of the total workload requirements.

Among the major activities covered by this account (with the average annual costs shown) are: production engineering on major procurement items, $25 million; production engineering on stock fund items, $11 million; Army Adjutant General printing of forms and publications in the supply system, $6 million; property disposal (provides $60 million annually of reimbursable funds to PE 78012)*; defense standardization programs, $11 million. In addition to the reimbursement for property disposal, PE 78012 is reimbursed from the major procurement accounts for production engineering and receives about $10 million annually on sales of supplies to commercial contractors.

The main OMA resources in this account for accomplishing the above activities are: civilian personnel; printing and reproduction funds; other purchased services; and other supplies. Civilian personnel requirements are computed under the standard AMC system. Other resources are estimated based on past experience and an analysis of workload changes that can be expected due to overall Army program changes. In some instances, this requires a case-by-case study of individual requirements. Many miscellaneous AMC organizations are financed through this program element so planned reorganizations impact directly on it. Other major actions, such as the change in property disposal responsibility, will cause major adjustments in resource needs.

---

*This responsibility will be transferred completely to the Defense Supply Agency by 1 July 1974 and will no longer be covered in this account.

n. Program Element 78017, Maintenance Support Activities. The resources in this program are provided initially from the OMA and Military Personnel - Army appropriations. Major categories are military personnel, civilian personnel, travel, printing and reproduction, and other purchased services.

Since this program element covers maintenance programming and planning support and technical and engineering services, most of the MIDA personnel and significant numbers of the personnel in the Directorates for Maintenance at the commodity commands are carried in PE 78017. Maintenance publications and engineering data are financed here, accounting for a significant part of the contracts under Other Purchased Services.

Contract and organic technical services personnel are included in PE 78017. They provide technical assistance to field organizations in performing maintenance on weapon systems and other major items.

Manpower studies, past experience, and analysis of program changes determine the requirements estimates in PE 78017. These requirements tend to be relatively stable over time as there is a continuing need for maintenance program management, engineering, and technical support to field activities.

C. APPLICABILITY OF EXISTING ARMY SYSTEMS TO THE PROBLEM OF RAPID ESTIMATION OF PROGRAM 7 RESOURCE REQUIREMENTS AS A FUNCTION OF CHANGES IN ARMY FORCE STRUCTURES

The objective of this paper is to develop a basis for new analytical methods to relate Army Program 7 resource requirements to changes in force structure. These methods must satisfy the following criteria:

1. Permit rapid calculation of requirements and produce credible results so timely decisions can be made.
2. Be aggregative in nature so detailed data from lower levels in the Department of Defense will not be required.

3. Consider all major categories of resources in the various program elements.
4. Provide tools for separate analysis of each program element--not lump all factors into one Program 7 package.
5. Permit verification of the accuracy of the estimating procedure.

The Army Planning, Programmming, and Budgeting System has been reviewed in the preceding sections of this chapter. This included a description of the means employed to compute Program 7 resource requirements in each program element. The Army currently is working on some models to aid in rapid estimation of these requirements. The most important of these model efforts will be discussed in the next chapter.

To date, however, the Army has not developed a model or set of models that would satisfy the criteria set forth above. Furthermore, none of the models under development considers all major categories of resources in the various Program 7 elements. The only existing or planned system that would meet this last criterion is the formal Army PPB system.

Following are specific comments on different groups of program elements related to the applicability of the current PPB system to the OSD needs for Program 7 modeling methods.

1. Program Elements 71111, Supply Depots/Operations; 71112, Inventory Control Points; and 71113, Procurement Operations

When the established criteria are applied to the existing methods for PEs 71111, 71112, and 71113, it is clear that these methods are not suitable to meet the study objective. Manpower program estimating equations could be aggregated by program element. However, the independent variable program data, such as number of reparables to be processed, line items on contracts, and short tons shipped and received in warehouses, are not available at the OSD level, except for the one

program structure covered by the latest budget. This type of program data would not normally be available above the AMC Commodity Command level for any other given level of activity or force structure.

In the hardware and service areas, it would be most time-consuming to attempt to determine by line item, or even by cost element in each program element, the variations in requirements with different force structures. Detailed studies would be necessary and the studies could be conducted only at levels below OSD. Admittedly, the SACS file includes a wealth of information of this nature in computer storage. However, the current system requires a great deal of detailed manual effort to ensure that all logistic support requirements associated with a single given force structure are properly covered.

The existing methods are appropriate when line-item detail is required, such as in developing a budget that will be subjected to careful review by congressional appropriations committees. They are also appropriate for permitting equitable distribution of available resources to competing mission activities. These methods in PEs 71111, 71112, and 71113 are not oriented, however, toward the identification of the resources required to support individual force units or weapon systems; nor are they appropriate for use by OSD in making rapid general evaluations of impacts of alternative force mixes on the Army central logistic support structure. For these analyses, a more aggregative method is required to fit the generalized frameworks of the Program 7 elements.

2. Program Elements 72003, Munitions Facilities (IF); 72005, Weapons Facilities (IF); and 72009, Missile Facilities (IF)

Comments set forth above for PEs 71111, 71112, and 71113 apply generally to all of the Program 7 elements so the rationale will not be repeated for each. Only unique features that apply to one or more elements will be considered further in determining applicability of existing methods to the general objective of this study.

Major functions of these three industrially funded activities are to perform research, design, and development; production and maintenance engineering; national procurement of assigned major items and related quality assurance. Limited pilot production is also performed at the munitions and weapons facilities. Inventory control point and product management functions are performed at the missile facilities.

Although these industrial fund activities are carried in Program 7, substantial amounts of work are performed for customers whose resources are provided directly in other FYDP major programs. These major programs include Program 1, Strategic Forces; Program 2, General Purpose Forces; Program 5, Guard and Reserve Forces; and Program 6, Research and Development.

Since workload in these program elements is a function of customers' orders, a model to estimate impact of force structure changes on these program elements must consider impact of these changes on customer orders. Existing systems permit the analysis of major procurement workloads as related to major items and perhaps to weapon systems. This may apply to both the active and National Guard and Reserve forces. In the RDT&E and production and maintenance engineering areas, however, existing systems involve project-by-project workloading that is not necessarily directly relatable to force structures.

To satisfy the study criteria, new methods must be developed to evaluate the effect of force structure changes on these program elements.

3. Program Elements 72007, Depot Maintenance Activities (IF); and 72207, Depot Maintenance Activities (Non-IF)

To determine if existing Army depot maintenance requirement estimating systems fit the criteria set forth in Section C, it is necessary to consider in greater detail the Army

Materiel Plan - Part II, and the depot maintenance reporting system.*

The AMP-II contains several volumes of program data to fit the requirements of various activities involved in planning and administering the Army's depot maintenance program. The worldwide program for each fiscal year in the five-year FYDP period can be reviewed by each of the following major groupings:

- Total programs by AMC and each Major Overseas Command
- Total programs for each AMC Commodity Command
- Programmed requirements by program element by major commodity group – that is, aircraft, automotive, combat vehicles, missiles, et al.
- Programmed requirements by customer by program element.

The data in all of the above categories are split between organic and contract and direct OMA versus reimbursable work. This worldwide type data is in the "A" series summary reports.

The "B" series of reports presents greater detail by commodity command. Here, each command's program in terms of dollars is displayed by major items, by customer, and by priority of the items for maintenance. Once again, the information is split between organic and contract. A second display shows by major item the quantities programmed with total and unit costs, plus information on unserviceable assets available. Finally, the data are broken out by Federal stock number (FSN) in each category of major item.

---

*AR 750-4, The Army Materiel Plan - Part II, Depot Materiel Maintenance and Support Activities, 27 September 1967, as amended. The AMP-II includes requirements for PE 72897, Training, and PE 78017, Maintenance Support Activities, as well as PE 72207. AR 37-55, Uniform Depot Maintenance Cost Accounting and Production Reporting System, June 1972, contains the instructions on the basic depot maintenance reporting system including activities encompassed by PEs 72007, 72207, 72897, and 78017. Accounting and reporting for PE 72007 are also governed by AR 37-110, Accounting, Reporting, and Responsibilities for Industrial Funded Installations and Activities, June 1965.

This brief explanation reveals the depth of detail in the depot maintenance programming system. All of the information is entered into the Depot Maintenance Data Bank (DMDB) and represents the basis for validating each procurement request order number (PRON) when received from the commodity commands.

AMC Regulation 750-28 requires that a separate PRON be prepared for each Weapon/Support System code.* This is consistent with Par 1-6 of AR 37-55 which requires all depot maintenance workload to be identified by weapon/support system or commodity group. This includes common-use components that may apply to more than one weapon or support system. Thus, data are available within the (DMDB) located at MIDA on work accomplished consistent with the requirements of AR 37-55.

At first glance, it would appear that this programming and reporting system could provide the information required to comply with the criteria for the OSD model. Unfortunately, the list of specific weapon/support systems and end items identified in the Army programs for possible inclusion in the AR 37-55 list totals over 4,000 items or systems. Furthermore, discussions at AMC indicate that in many cases it has been impossible to allocate accurately costs to repair common-use components to a weapon/support system.

The existing systems for programming and reporting Army depot maintenance do not provide outputs that directly fit the criteria for an OSD model. Further study is required to determine if aggregation techniques may be developed that would permit the use of the outputs of the current system for model building purposes and satisfy the OSD need.

4. Program Elements 72895, Base Communications (Logistics); and 72896, Base Operations

These two program elements are grouped together since they perform essentially the same kind of functions--base type

*Par 2-7a AMCR 750-28, Depot Maintenance Program Scheduling, Workloading and Reporting System, draft of November 1972.

support to the primary mission organizations performing the major central supply and maintenance activities. These functions are not homogeneous. They range from maintenance of motor vehicles and operation of food service facilities to provision of communication support and engineering analysis of construction projects.

The existing Army PPB systems are not only very detailed in these program elements but offer no methods for aggregation of resources as related to force structure. Intermediate methods, based on existing systems, might be developed to relate PE 72895 and PE 72896 resource requirements to strength of the Army or other aggregative variables. However, additional analysis will be required to determine if such methods could be developed to meet the OSD needs.

5. Program Element 72897, Training

Presumably, the existing methods for computing resource requirements in PE 72897 involve a case-by-case examination of current Army needs for upgrading the skills of maintenance personnel and a review of maintenance training needs associated with new equipment coming into the inventory. In fact, it appears that this program approaches being a "level-of-effort" activity virtually unrelated to force structure.

Regardless of the nature of the real programming and budgeting process, systems involving case-by-case needs are inappropriate for an OSD level model. It may be true, especially considering the relatively small amount of resources in this program element, that it could be "straight-lined" in an OSD model. On the other hand, it might be appropriate to combine this program element with others in a final model.

6. Program Element 72898, Command

Due to the nature of the Command functions, existing Army systems to compute manpower requirements encompass practically all of the resources in this program element. Earlier

discussions indicated why these methods are not appropriate for direct employment in an OSD Program 7 model.

On the other hand, PE 72898 requirements should be a function of the missions assigned to Program 7 and magnitude and complexity of the central supply and maintenance workloads. These in turn, on an aggregative basis, should relate in some measureable fashion to Army force structure. Therefore, it may be found that existing systems may provide data or may include estimating techniques that could prove useful in developing the OSD model. Further study is required to reach conclusions on this question.

7. Program Element 78010, Second Destination Transportation

PE 78010 existing systems involve extremely detailed calculations at all levels of command to build up estimates of transportation requirements. These estimates are based on many variables other than force structure, i.e., activity rates, force deployments, logistic support concepts, and others.

These existing systems clearly are not suitable for use at the OSD level. New methods must be devised to meet the criteria set forth above. In view of the many variables other than force structure that affect this account, there is considerable uncertainty whether a direct estimating relationship can be developed to measure impact on this program element of force structure changes. It may be necessary to incorporate other information on alternative force structures to develop an operable method for PE 78010.

8. Program Element 78011, Industrial Preparedness

The requirements in this program element are a function of national defense policies on maintenance of "stand-by" industrial facilities, Army contingency plans, the characteristics of future weapon systems, munitions, and other major items and available resources. Existing systems for computing PE 78011 requirements rely heavily on case-by-case analysis of programs by facility and by materiel categories.

These systems are far too detailed for direct usage in an OSD model. Nevertheless, requirements for future years should relate to the type of force structure contemplated for the Army in those time periods. It may be possible, therefore, to develop an aggregate method building upon some of the current methods employed by the Army in this program element.

9. Program Element 78012, Logistic Support Activities

This program element covers a heterogeneous package of requirements, some of which would probably change directly with different Army force structures, some of which are almost entirely "level-of-effort," and others that would change only indirectly as a result of force structure changes. It is clear that existing diverse and mainly project-by-project resource estimating methods could not be used at the OSD level.

Considerable further study would be required to determine if suitable methods can be developed in this program element to satisfy the criteria set forth above.

10. Program Element 78017, Maintenance Support Activities

The requirements in this program element are divided almost equally between manpower-intensive OMA and Military Personnel expense categories and the services of a similar nature procured on contract. Presumably, these requirements are developed on a project-by-project basis related to current and planned Army weapon systems. Although these existing systems are too detailed for use in an OSD model, the program element requirements should be relatable to weapon systems and in turn to force structures. On the other hand, if one assumes that PE 72007 and PE 72207 depot maintenance requirements are relatable to force structure changes, it may be appropriate to combine PE 78017 requirements with depot maintenance and treat all of them with one technique in the model.

D. SUMMARY COMMENTS

The Army Planning, Programming, and Budgeting System involves extremely detailed procedures to develop and review the heterogeneous resource requirements included in Program 7. These procedures are appropriate within the framework of the comprehensive cyclical planning, budgeting, and resource management processes employed in the Department of Defense. They cannot be used, however, in current or modified form to meet the ODDPA&E need for a macro budget model to estimate Program 7 resource requirements. The Army PPB System deals with large amounts of input and output data inappropriate to an OSD model that must employ aggregative relationships.

Many Program 7 resource requirements clearly will not change directly with changes in Army force structures. On the other hand, large blocks of these costs, such as depot maintenance, supply depot operations, procurement, and others, should change in some measurable fashion with force structure changes.

Although current methods for estimating Army Program 7 resource requirements are not directly usable in meeting the ODDPA&E requirement, they include subsystems that may be employed for model building purposes. For example, the depot maintenance workloading and performance accounting systems produce outputs that should be usable in developing cost-estimating relationships. Chapter IV discusses two important Army studies that use data from these systems in developing aggregative relationships. Chapter V describes exploratory quantitative analysis work by the IDA project team using some of the outputs of these systems.

IV. U.S. ARMY STUDIES TO DEVELOP AGGREGATIVE PROGRAM 7 PLANNING AND BUDGET MODELS

For several years, the Army has been conducting studies to develop aggregative models for estimating resource requirements. These efforts have been related to the emphasis on modern planning, programming, and budgeting systems initiated under Secretary McNamara and follow-on programs to change DoD accounting systems. These follow-on programs have been designed to convert DoD accounting from pure financial recording to managerial accounting systems that would provide more appropriate information for decisionmaking.*

In this chapter two active Army projects in model development will be discussed. One project, sponsored by the Comptroller of the Army, is attempting to develop cost estimating relationships that relate mission outputs to operating costs. The other is being conducted by the Deputy Chief of Staff for Logistics, Headquarters, Department of the Army. This latter project is developing new aggregative model methods to relate depot maintenance costs to alternative Army force structures. Both projects are directed toward achieving new capabilities in estimating Army resource requirements within the framework of DoD planning, programming, and budgeting.

---

*See DoD Directive 7000.1, "Resource Management Systems of the Department of Defense," August 22, 1966; also DoD Instruction 7045.11, Improvement and Use of Output Information in the DOD Planning, Programming, and Budgeting System, December 17, 1970, as amended, and OMB Circular A-44, "Management Review and Improvement Program," May 24, 1972.

A. THE COMMAND ANALYSIS OF OMA FUNDING PROGRAM

The Command Analysis of OMA Funding (CAOMAF) program is an on-going activity that has evolved from Army efforts over the past four years to develop aggregative techniques for relating mission outputs to OMA and Military Personnel Appropriation (MPA) funding levels.

As with other Department of Defense agencies, the Army has historically used the "incremental" approach in preparing its annual budgets for operating expenses. Under this concept, the budgeting agency assumes that approved funding levels are appropriate for carrying out the current year program. The agency then examines the program data for the future budget year and identifies areas of changes in workloads. At this point, estimates are made of the additional costs or reductions involved in the future as compared to the current year program. Current year costs are adjusted to include these changes and the new total becomes the budget for the future year.

The CAOMAF program is based on a quasi "zero base" approach. It attempts to develop suitable equations on the basis of past experience to permit the computation of total OMA and MPA requirements for a new budget without the need to identify impacts of individual program changes. In fact, the CAOMAF program to date does not constitute a complete "zero base" approach because no attempt has been made to validate the historical data base in terms of true resource needs. In other words, it is assumed that the historical costs incurred were appropriate to the workload accomplished. A complete "zero base" approach would attempt to develop equations based on data that had been analyzed and possibly adjusted to show resources required to perform a given workload with a suitable level of efficiency in operations. Thus, there would be an attempt to prepare a data base reflecting optimum resource utilization.

The CAOMAF program developed from earlier work to test the feasibility of the aggregative equation approach for estimating OMA requirements. During FY 1970, the Comptroller of the Army conducted the "Currier Study." This study developed static* and variable cost factors for Program 4 and base operations at the program element and major command levels. The concept of this study was that Army man-years was the key variable determining OMA funds required to support a given force.

A follow-on (Maroun) study in FY 1971 attempted to isolate causes for variances in OMA base operations support costs at Continental Army Command (CONARC) installations.** This study also adopted the basic concept of relating costs to the number of active Army military personnel. The analysis concentrated on comparing costs by element of expense to develop workload-related cost factors. The primary objective of the study was to identify high variance installations and the reasons for variances. An important secondary objective was to establish a method for relating base operations funding levels to measures of installation outputs. This was to develop cost factors that would be useful for financial management and planning.

The Chief of Staff, U.S. Army, on 25 March 1971, directed that the analysis work undertaken in the initial Maroun study be continued and extended worldwide to both mission and base operations OMA and MPA costs. In May 1971, AMC was requested to proceed with a project to accomplish the objectives of the

---

*An Army term defined as relatively fixed costs to maintain a functional activity, regardless of changes in workload--a relatively inelastic cost, although not necessarily "fixed" in a cost-accounting sense.

**Major General Autrey J. Maroun was designated as a Special Assistant to the Comptroller of the Army to direct this study. Later studies in the program were also referred to as Maroun studies, but early in 1972 the Comptroller of the Army established the formal CAOMAF title for the continuing program.

Maroun effort.* AMC's Phase I report was published on 15 December 1971 and the Phase II report on 30 April 1972. Shortly before the Phase II report was published, the Comptroller of the Army established CAOMAF as a permanent program, integral to the Army's Planning, Programming, and Budgeting System.**

In AMC, Phase I of the Maroun study involved a massive effort to accumulate OMA and MPA data for the period FY 1965 through FY 1972. Data were normalized to a FY 1972 base by application of economic indexes. Priority effort was directed to PEs 71111, 71112, 71113, 72207, 72896, 78010 and 78011. These program elements represent more than 80 percent of the total AMC OMA program. Work under the CAOMAF program continues to emphasize these program elements, although efforts are underway to cover the rest of the program elements in Program 7.

The stated concept of the Maroun system was that it was designed to correlate money, manpower, and workload. When one of the key elements is changed by management or the decision-maker, the other two should change correspondingly.† Following were the principal guidelines for the first two phases of these studies in AMC:

---

*A complete statement of Maroun System goals is: "Long range and intermediate goals. The long range goal of the Maroun System is to establish resource cost and workload estimating relationships for each OMA functional area. Resource requirements could then be estimated by relating these standards to appropriate output measures. Intermediate objectives are aimed at forming a framework for functional area analysis by identifying valid output measures and developing statistical factors and equations based on historical cost trends." Reference Paragraph 4b, Phase II Report of the AMC Maroun System, 30 April 1972.

**Department of the Army Letter, subject "Command Analysis of OMA Funding, RCS CSCAB-306", 14 March 1972, prescribed the policy procedures, and reports for the FY 1973 segment of the continuing program. DA Letter, same subject, 27 April 1973, provided instructions for FY 1974.

†Phase I Report of the AMC Maroun System, Headquarters USAMC, AMCCP-BP, 15 December 1971.

1. Use correlation/regression equations and per capita or per unit cost curves to determine:
   (a) Static cost
   (b) Minimum economic workload
   (c) Maximum workload
   (d) Variable cost factors.
2. Correlate mission output measures to total and direct expenses.
3. Develop total cost equations and per capita/unit cost curves for each function by commands, installations, and agencies.
4. Develop cost factors for summary elements of expense for:
   (a) Civilian salaries
   (b) Supply and equipment
   (c) Services and other.
5. Compare constant dollar costs and cost per unit of output.
6. Equate all dollars for FY 1965 - FY 1971 to constant FY 1972 dollars.
7. Apply inflation factors at summary element of expense level.
8. Identify "linking factors" between output measures and the total strength of the Army, with participation and assistance from DA Staff and within AMC capability.
9. Employ existing reporting, data collection, and management control systems to maximum extent.

1. The Data Base

Under Phases I and II, a comprehensive data base was constructed for OMA and MPA expenses covering the period

FY 1965 - FY 1972.* Direct and reimbursable expenses were reported for 27 individual accounts in the Army Management Structure (AMS). This encompassed Program 7 elements 71111, 71112, 71113, 72207, 72896, 72897, 72898, 78010, 78012 and 78017 plus program elements in Major Programs 1, 2, 3, 5, 8 and 9 for which AMC had some funding authority.

Direct and reimbursable expenses were reported for each Army Management Structure (AMS) account for each fiscal year. The expenses are broken out by recurring and nonrecurring (one-time) expenses. Expenses were further broken out by: Civilian Salaries; Supplies and Equipment; Contract Services (AIF and Non-AIF); and All Others. Direct and indirect military personnel expenses were reported.

Workload data were reported utilizing existing systems for compiling this type data in Army Management Structure Accounts.

Two major problems in developing the data base were the following:

1. To insure that the base included data on the very large reimbursable programs administered by AMC. In 1971, AMC had billings for about $100 million under the International Logistics program alone.
2. To restructure data as necessary for the various fiscal years to make it consistent with the Army budget and accounting structure in FY 1972.

---

*MPA expenses have been collected in AMC, but they have usually been excluded in analyses of cost estimating relationships. Military personnel constitute a very small part of total AMC manpower and a large number of the military positions are managerial or staff. This does not apply, of course, in other U.S. Army Commands that also are implementing the CAOMAF program. AMC does include military personnel in analyses that relate only to manpower requirements.

Efforts to refine and improve the data base continue. Furthermore, each year the data base will be updated to current year dollars by application of appropriate economic indexes to the data for each previous year.

2. Methodology

Simply stated, the CAOMAF methodology is to develop, refine, and normalize the data base, then attempt to develop cost estimating relationships through linear regression analysis. This requires studies in each program element to determine whether reasonable correlations exist between cost and selected independent variables (workload). A basic assumption is that the relationships will be bivariate normal.

Cost estimating relationships (CERs) will be prepared for each AMC installation. The Command CERs will be composites of the installation factors.

3. Results to Date

To date, a major achievement of the CAOMAF effort has been the compliation of the normalized data base covering a reasonable period of time for regression analysis. A great deal of effort has been expended by skilled accountants, budget personnel, and other analysts to develop appropriate data on a consistent structure from FY 1965 through FY 1973. Admittedly, considerable judgment was required to develop consistent data for the earlier years but this would be expected. Several important accounting structural changes were made in those years and, without a requirement for collection of data for CAOMAF type studies, many of the data were transferred to permanent storage or destroyed.

In terms of developed cost estimating relationships, the paragraphs which follow describe the results by program element.

a. PE 71111, Supply Depots/Operations. Acceptable CERs have been developed for AMC, in total, and for major field elements. These CERs employ Short Tons Handled as the independent

variable. AMC has found that Army Military Man-Years is a suitable independent variable to relate to Short Tons Shipped and Received as a dependent variable in a command equation for PE 71111 at the AMC level. Then Short Tons becomes the independent variable to explain total PE 71111 expenses.

b. PE 71112, Inventory Control Points. Two output measures were initially considered: total number of Federal Stock Numbers Managed; and total number of Requisition Line Items Processed (RLIP). Only the RLIP output measure was tested, because it was concluded that no significant causative relationships could be established between changes in FSNs managed and changes in resource imputs or active Army Military Man-Years.

To date, AMC has been unable to develop a suitable CER in PE 71112. The single output measure RLIP cannot be statistically validated. AMC has reached two conclusions with respect to this problem:

(1) PE 71112 is a conglomerate of different basic mission activities and more discrete groupings of mission activities may be necessary for suitable results.

(2) A single output measure at the PE 71112 level may not be meaningful since only a small portion of expense is influenced by changes in the level of output in terms of RLIP.

c. PE 71113, Procurement Operations. No meaningful correlations have been found between workload and expenses at the program element level. Number of Procurement Actions executed and number of Contracts Administered have been analyzed separately as independent variables in PE 71113 subaccounts. These produced unsatisfactory results. The latest work at AMC involves using these two independent variables in a single equation. This approach appears promising, although further study is required.

d. PE 72896, Base Operations. In this program element, AMC has found that Post Population Profile* and Army Military Man-Years are both good independent variables to explain expenses, although the former variable gives the best results.

e. PE 78010, Second Destination Transportation. Total Tons Shipped in PE 71111, Supply Depot Operations, proved to be a good independent variable to explain total Short Tons Moved in PE 78010. A suitable equation was also developed using total Army Military Man-Years to explain PE 78010 Short Tons moved.

An AMC-summarized CER was developed for PE 78010 using Short Tons moved in second destination transportation as an independent variable. Statistically, this CER met the necessary criteria to be a proper explainer of PE 78010 costs; however, when applied to FY 1973 data it varied from the AMC budget by almost 13 percent.

AMC is not satisfied with its current CERs in this program element and is continuing to study ways to develop better relationships.

f. PE 72207, Depot Maintenance Activities (Non-IF). In depot maintenance it was found that using Number of Items to be completed in any one year as the independent variable gave good results in an equation to explain PE 72207 costs. However, it was necessary to run separate equations within commodity classes by commodity command (contract maintenance) and MIDA (organic maintenance). Furthermore, it was necessary to identify separately the number of major items and the number of secondary items undergoing depot maintenance. The AMC estimate

---

*Post Population Profile is the total of all military and civilian personnel who receive some kind of support from the installation. This includes garrison, tenants, satellite activities, students, and trainees as well as retirees and dependents who live on or in the vicinity of the installation. Reference Section XII, AR 37-100-74, The Army Management Structure, November 1972 and Figure 2-2, Change 3, AR 570-3, Manpower Utilization and Requirements, 15 December 1972.

represented a summing-up of the outputs of the various subordinate activity CERs.

Thus to utilize these CERs in force structure studies it would be necessary to estimate several elements of workload data associated with each alternative as well as compute several equations. AMC studies have indicated that an "equivalency" method may offer a solution to this problem. This method would equate each workload of each commodity to equivalent units by selecting one of the commodities as a standard and taking the ratio of cost per unit of each of the other commodities to the cost per unit of the standard. The resulting equivalent factor states that a specific number of items of each commodity can be maintained for one of the standards. These factors would be multiplied by their associated workloads to obtain equivalent workloads.

AMC hopes that further study of the "equivalency" approach may provide the means of linking PE 72207 expenses to Army Military Man-Years at the AMC level. However, using Number of Items to be maintained in this program element would require considerable data on future workloads for computation of financial requirements.

At the program element level, it has been found that Army Military Man-Years lagged one year is a statistically suitable independent variable in an equation to explain PE 72207 costs. Thus, Army Military Man-Years for FY 1972 is a good variable to use to estimate total PE 72207 costs in FY 1973. Further study of this relationship, however, is necessary to determine if it is adequate for aggregative force structure studies.

g. PE 78017, Maintenance Support Activities. The regression analysis in this program element indicates that using Total PE 72207 Expenses as the independent variable produces the most satisfactory results in estimating PE 78017 expenses. AMC maintenance personnel, however, believe that this is not a suitable equation because only a small amount of PE 78017 funds

is spent in support of depot maintenance operations. They believe that PE 78017 expenses should vary in direct proportion to field equipment densities plus new weapons being planned and developed.

h. PE 72897, Training. Workload data were insufficient to permit the development of any output measure in this account. Current AMC thinking is to treat this as a "level of effort" account with stable financial requirements.

i. Other Program Elements in Program 7. Analyses were conducted in the other Program 7 elements including those for which no workload data were available, for example, Command. Although in some cases suitable equations were developed at subactivity level, it was not possible to develop suitable CERs at the program element or AMC level. AMC has concluded that in some cases it may be possible to develop useful CERs based on more complete data and continued analyses. In others, it has been concluded that the regression analysis approach is not suitable and other methods must be considered.

4. Comments

The CAOMAF program has been discussed in some detail because it enjoys a relatively high priority in the AMC Comptroller Staff activity. Equations based on CAOMAF studies are contained in OMA budget submissions to compare the results of these estimating methods with the formal budgets prepared in the conventional manner. Members of the Headquarters, U.S. Army Staff maintain that the incorporation of CAOMAF outputs has helped the Army in the budget justification process.*

*Discussions with a member of Comptroller of the Army staff, December 14, 1972.

As would be expected, there are mixed views in AMC regarding the utility of the CAOMAF program. At the working level, there appears to be a fear that the system could be developed to the point that it would be used to prepare budgets under a "zero base" budget concept. Many budget analysts believe this would result in budgets that do not properly consider program revisions and changes in Army policies.* The Army, in fact, is conducting tests in Commands other than AMC to determine if a CAOMAF type program could be used for zero base budgeting.

Currently, AMC is placing the greatest emphasis on developing good CERs at the commodity command and installation level rather than aggregate AMC. Priority effort is being applied to variance analysis and the outputs of these CAOMAF studies are being used to reprogram funds among activities. There is increasing emphasis on carefully evaluating workloads and then relating resources to workload as opposed to merely comparing stated financial requirements from one year to the next. Thus, in AMC CAOMAF is looked upon primarily as a tool for financial management rather than a device for measuring the impact of alternative force structures on Program 7 requirements.**

If the CAOMAF program produces suitable CERs by program element using an independent variable such as Army Military Man-Years, these outputs could be useful in force structure studies. At present, however, the types of workload data that have produced suitable CERs, i.e., Short Tons Moved and Number of Items to Undergo Depot Maintenance, are not appropriate for an OSD model. As discussed earlier, this type of data on alternative forces is not available at the OSD level.

---

*For example in a peacetime environment there should be greater emphasis on readiness of reserve forces. The historical data base might not produce the proper relationships to incorporate changing priorities of this type.

** Discussions with Directorate of Budget Staff, Headquarters AMC, May 11, 1973.

B. THE ARMY SELECTED ANALYSIS MODEL FOR DEPOT MAINTENANCE

The Army Deputy Chief of Staff for Logistics Selected Analysis Model is designed to estimate depot maintenance costs by materiel category for alternative force structures. It predicts costs through the future year period encompassed by the latest Army POM. Work on this model was initiated in Fiscal Year 1972 when OSD included this requirement on its list of topics for selected analysis by the military services.*

The original Selected Analysis Model used a regression analysis method to compute the total Army depot maintenance program based on costs estimated to be incurred on thirty key weapon/support systems. Historical data for the period FY 1966 through FY 1972 were used to develop the cost estimating relationship. The regression equation was developed by relating the depot maintenance costs for these key systems to the total depot maintenance program for that period.

This model produced results that were useful in computing probable impacts of alternative force structures on Program 7 resource requirements. It did, however, have deficiencies that prevented the model from producing suitable analyses of impacts. For example, it did not consider losses from inventory and new procurements. Also, it did not allocate to weapon systems the costs of maintenance on common-use components that are generally repaired and overhauled for stock.

Late in FY 1973, the Army undertook the development of a new Selected Analysis Model referred to as the Phase III model.**

---

*See discussion in Section A of Chapter III on the role of Selected Analyses in the DoD PPB System.

**The regression model had gone through two phases of development up to this time.

The Phase III model no longer employs the regression analysis approach based on historical data on costs incurred to maintain major weapon systems. This model, in fact, is a computational system to calculate the gross maintenance requirements for alternative force structures on an item-by-item basis for each major and supporting secondary item that is eligible for depot maintenance. It involves a comprehensive computer program that extracts information from various existing data files to produce statements of quantitative impacts of different force structures. Thus, the Army has ceased to use the cost estimating equation method and has turned to a system of computer processing of data and routine calculations to produce the desired outputs.

1. Methodology

a. The SACS file contains the basic force structure data covering all Army organizations for each fiscal year under consideration. Adjustments are made as desired by ACSFOR to the basic SACS force structure file to develop the force structure alternatives. This constitutes the initial input to the model.

b. Asset requirements are computed for each alternative and each fiscal year. This represents the sum of authorization quantities for TOE and TDA units, repair cycle float, operational readiness float, operational project stocks, war reserve stocks, and level and pipeline stocks.

c. Worldwide on-hand assets in all condition codes are tabulated and compared with requirements for the current year. The only exception is that assets coded uneconomical to repair or being torn down to obtain components are omitted.

d. At this point the model has a baseline position against which to compute future activity and requirements. The AAO is known from the SACS file. On hand serviceable and unserviceable asset quantities are known as of the end of the current year.

Annual generations are computed by use of factors in the standard AMC systems for all materiel categories. Subsequent fiscal year asset positions are projected for the baseline force and extracted from the AMP-I for the planning force.

e. Once the quantities of assets that will undergo depot maintenance in each year have been computed, the remaining step is to apply cost data to develop the Program 7 budget requirement. This is accomplished by inputing the experienced average unit-funded cost shown in AMC files for each major and secondary item. In this operation, component repair costs are allocated to the individual major item weapon systems, consistent with the requirements of AR 37-55.

f. The model considers constraints that are incorporated into the calculations by specific guidance inputs such as funding levels and priorities. It also considers internally identified constraints such as depot capacities. These factors may require specific analysis and adjustment during the calculation process as the impacts of these constraints become known.

2. Outputs

The major outputs of the model shown by fiscal year are the following:

1. Summary of Direct Army depot maintenance requirements, by materiel category, for five years.
2. Summary of depot maintenance resource shortage to meet TOE/TDA requirements.
3. Summary of resource requirements to reduce the unserviceable asset position to the maximum allowable unserviceables.

In addition to computing PE 72207-funded depot maintenance workloads and costs, the model projects requirements for maintenance support activities, maintenance engineering,

technical assistance and publications, and training (PEs 72897 and 78017). Planned refinements for future incorporation into the model include consideration of new materiel acquisitions, new equipment modifications, and product improvement efforts and the relationship of these activities to maintenance support activities, training, and publications.

The model will compute requirements for the year, allocate the available funds to the individual items by three priority categories, determine the impact of the unfunded backlog on readiness, and carry this unfunded backlog forward for assessment of requirements the next year. Furthermore, it is planned to incorporate a capability within the model to make trade-off assessments between new procurement of items and repair, based on unserviceable asset positions.

The model computes only Direct Army depot maintenance requirements; however, the input data on depot capacities do take into consideration current levels of work in the reimbursable category. Additionally, the model incorporates contract as well as organic depot maintenance into the analysis.

When computer programming has been completed, it is assumed that about 24 hours would be required to make a complete depot maintenance calculation for one force structure alternative. This clearly should provide a proper response time for force structure analyses.

3. Comments

It is not possible at this time to determine if this model would be directly useable in computing Army depot maintenance resource requirements for OSD/DDPA&E studies. Several components remain to be developed. Also, further information is required on the kinds of force structure inputs that could be accepted in the model. In other words, would the OSD alternatives be developed in such a manner that Army SACS file data could be adjusted to reflect these alternatives and then put into the model. Furthermore, it remains to be seen if computer programming

can produce compatible inputs from the various required data sources. Finally, the model, directly and indirectly, through its input sources requires the manipulation of rather large amounts of detailed data. It appears that during model operation several "decision points" may appear when analysis by subject area specialists will have to be applied to permit calculations to proceed. For example, decisions may have to be made as organic depot capacities become constraints on achievement of programs. Even with priorities input to the model, human judgment will surely have to be applied in many instances to complete the operation of the model. Thus, it appears that the 24-hour turnaround time may prove optimistic.

In conclusion, this model offers excellent potential for force structure analysis. If the various data sources can be properly integrated, the model should produce the desired outputs for the Army staff. Further study is required before its applicability to the OSD/DDPA&E problem can be determined.

C. OTHER MODELS

The Army has other models under development or being utilized in central logistic support agencies. For example, AMC Commodity Commands and MIDA engage in model building through their operations analysis staff offices. These models, however, generally deal with specific segments of Program 7 requirements or are for management purposes. Three of these projects are described briefly in Appendix B.

In addition, there are numerous publications containing cost and workload factors that can be applied in special situations. The DA DCS/Logistics uses FM101-10, Consumption Factors on Supplies Per Man Year, in developing cost estimates for special staff studies.* The Army Force Planning Cost

*Discussions in DCSLOG Directorate of Financial Resources, December 8, 1972.

Handbook (Colstals Model) contains broad factors that can be applied to develop "order of magnitude" estimates of budget requirements for various Army activities.

These publications, however, do not provide a complete integrated aggregative model for Program 7 application. The two models discussed earlier in this chapter are the only known comprehensive efforts to develop total Program 7 or total depot maintenance estimating capabilities associated with alternative force structures.

V. QUANTITATIVE ANALYSIS

A. INTRODUCTION

Analytical methods to relate Army Central Supply and Maintenance resource requirements to changes in Army force structures must be quantitative in nature. Furthermore, if they are to "enable rapid and credible estimation"* of Program 7 requirements, which total over $2.5 billion annually, they must involve some form of modeling procedures. Extensive and detailed calculations are not feasible in dealing with this requirement. This subject was discussed at length in Chapter III when the applicability of existing central logistic support requirements systems was discussed.

To explore the possibilities of developing suitable quantitative methods, feasibility studies were conducted at two AMC commodity commands--AVSCOM and TACOM. These studies were designed to accomplish the following:

- Identify quantitative variables that appear to relate Program 7 resource expenditures to force structures.
- Determine if these variables can be used in equations to estimate the cost impact of Army force structure changes on Program 7 logistic requirements.
- Develop "first cut" depot maintenance cost estimating equations for the UH-1 helicopter and the M-60 tank as a test of the feasibility of developing equations for individual weapon systems.**

---

*OASD/SA Task Order SA-59, Army Logistic Support Study, September 11, 1972.

**This is based on the assumption that force structure changes can be measured in terms of changes in weapon system inventories.

This chapter discusses the results of this exploratory research. Consistent with the purpose of this effort, the feasibility of developing functional relationships rather than the accuracy of these relationships was emphasized.

The general approach to this quantitative analysis was as follows:

- The functions, measurable outputs, and accounting records of two commodity commands,* AVSCOM in St. Louis, Missouri, and TACOM in Warren, Michigan, were investigated.
- Command organizational structures and costs were normalized to an FY 1973 base.
- Based on knowledge of the Army Central Supply and Maintenance System, a set of variables was identified. (Variables finally selected must have a strong causal effect and be suitable for forecasting purposes at the OSD level.)
- The necessary data relating to these variables were acquired. The time period investigated was FY 1968-1973 for AVSCOM and FY 1969-1973 for TACOM.
- The historical data were then used to develop functional relationships through least squares statistical regression analysis.

B. THE COMMODITY COMMANDS INVESTIGATED

Since AVSCOM and TACOM utilize 65 percent of the total AMC depot maintenance budget, they were appropriate candidates for the feasibility study. AVSCOM is responsible for life-cycle development and central logistic support management of all Army rotary-wing and fixed-wing aircraft. Most of AVSCOMs logistic support efforts are to provide life-cycle management services to rotary-wing aircraft (see Table 5).

---

*Will also be referred to as Major Subordinate Commands (MSCs).

Table 5. PERCENTAGE DISTRIBUTION, ROTARY AND FIXED WING, ARMY AIRCRAFT SYSTEMS

Aircraft Type	1955	1967	1969	1971	1972	1973
Rotary Wing	38%	74%	80%	83%	86%	89%
Fixed Wing	62%	26%	20%	17%	14%	11%

Following is the list of systems for which AVSCOM has end item and secondary item responsibility.*

Rotary-Wing Systems

UH-1	Iroquis
AH-1G	Cobra
OH-13	Sioux
OH-23	Raven
OH-6A	Cayuse
OH-58A	Kiowa
CH-34	Choctaw
CH-37	Mojave
CH-47	Chinook
CH-54	Tarhe

Fixed-Wing Systems

O-1	Bird Dog
OV-1	Mohawk
U-1/RU-1	Otter
U-6/RU-6	Beaver
U-8/RU-8	Seminole
U-9/RU-9	Aero Commander
U-10	Courier
U-21/RU-21	Ute
T41B	Mescalero
T42A	Cochise

*AVSCOM currently has four systems in the developmental stage: Heavy Lift Helicopter (HLH), Advanced Attack Helicopter (AAH), Utility Tactical Transport Aircraft System (UTTAS) and TOW Cobra. These are funded primarily with RDT&E money (Program 6).

TACOM is primarily responsible for the life-cycle development and central logistic support management of all Army tank and automotive systems. The systems for which TACOM has end item and secondary item responsibility can be divided into three groups: tactical wheeled vehicles (self-propelled and towed), combat vehicles, and other.*

Tactical Wheeled Vehicles**

1/4-to-25-ton trucks, vans, personnel carriers
2-1/2-to-15-ton tractors
1/4-to-45-ton trailers
3-to-60-ton semitrailers

Combat Vehicles†

- Armored Cars, Light, With and Without Cupola
- Armored Carriers, Full Track (Personnel and Cargo)
- Tractors, High-Speed, Full-Track (13 to 22 ton)
- Tanks Light/Medium
- Armored Reconnaissance Vehicles
- Airborne Assault Vehicle
- Recovery Vehicles
- Combat Engineer Vehicle
- Bridge Launcher

---

*TACOM currently has three systems in the development stage: Mechanized Infantry Combat Vehicle (MICV), Armored Reconnaissance Scout Vehicle, and XMI Tank System. These are funded primarily with RDT&E money (Program 6).

**About 70 percent of the total inventory for tactical wheeled vehicles consists of 1/4-ton, 1-to-1/4-ton, 2-to-1/2-ton and 5-ton trucks (all body types).

†As of 1 July 1972, TACOM assumed end item responsibility in addition to the secondary item responsibility, which it already had, from ARMCOM (formerly WECOM) for the M-41 series tank, M-48 series tank, M-60 series tank, M-88, and M-551.

Other Vehicles*

- Construction Equipment
- Materials Handling Equipment

In addition, TACOM has responsibility for management of secondary items peculiar to ARMCOM (formerly WECOM) self-propelled weapon systems. For instance, TACOM manages engines, transmissions, and other components for the following vehicles:

- M-55, Heavy, Full Track, Self-Propelled Howitzer with 155MM Gun
- M-108, Heavy, Full Track, Self-Propelled Howitzer with 105MM Gun
- M-110, Medium, Self-Propelled Howitzer with 175MM Gun
- M-44, Self-Propelled Howitzer with 155MM Gun
- M-52, Self-Propelled Howitzer with 105MM Gun
- M-109, Full Track, Self-Propelled Howitzer with 155MM Gun
- M-107, Self-Propelled Field Artillery Gun, 175MM
- M-53, Self-Propelled Field Artillery Gun 155MM.

Figure 2 shows the standard organizational structure for an AMC commodity command. An MSC has four primary mission directorates: Materiel Management; Maintenance; Procurement and Production; and Research, Development, and Engineering. In addition, there are other command, staff, and support activities which are necessary to operate the MSC.** The division and branch structures within the Directorates for Materiel Management and Maintenance are oriented toward major asset categories. Figures 10 and 11 show the AVSCOM and TACOM organizational structures with an identification of supporting program elements and associated manpower.

---

*As of 1 July 1973, TACOM will assume responsibility for this equipment from TROSCOM (formerly MECOM) under the reorganization of the Army.

**For instance, Comptroller, Management Information System Office, Program Office, Plant Activity Sites, and HISA.

C. RELATIONSHIP OF COMMODITY COMMAND FUNCTIONS AND PROGRAM 7 RESOURCES

If Program 7 resources are considered inputs to the commodity command, a relationship should exist between the command outputs, services performed, and these inputs. A relationship between the MSC services performed and the force size and level of activity should then lead to a relationship between Program 7 resources and the force size and level of activity.

There are two distinct approaches to determining the relationship between Program 7 resources and the force structure variables. The first involves basically three steps: (1) approximation of the relationship between Program 7 resources and the MSC outputs, services performed; (2) approximation of the relationship between MSC outputs, and force size and level of activity; (3) combining of these two relationships to approximate the relationship between Program 7 resources and the force structure variables.

The second approach would circumvent the relationship between MSC outputs and force size and level of activity, and approximate directly the relationship between the Program 7 resources and the force structure variables.

Table 6 shows several measurable outputs for the directorates within an MSC. The task of relating these outputs to respective input program elements within Program 7, and then to the force structure or particular weapon systems is formidable. In fact, there is no evidence to suggest that MSCs are attempting to obtain full accountability of effort or services in terms of weapon systems, except for depot maintenance program elements as required by AR 37-55.*

---

*AR 37-55, Uniform Depot Maintenance Cost Accounting and Production Reporting System, Headquarters, Department of the Army, June 1972.

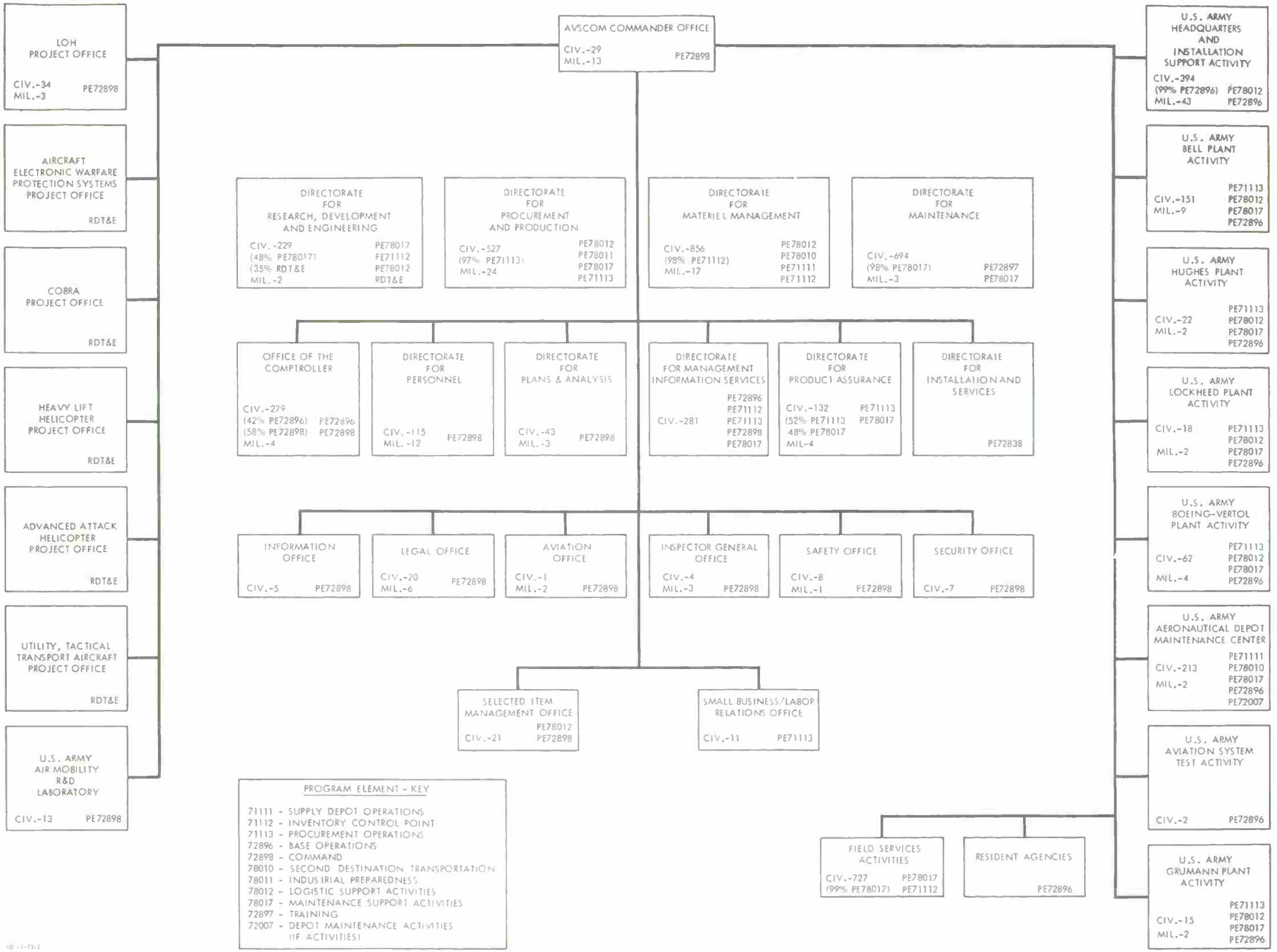


Figure 10. AVSCOM FUNCTION AND PROGRAM ELEMENT CODE RELATIONSHIP

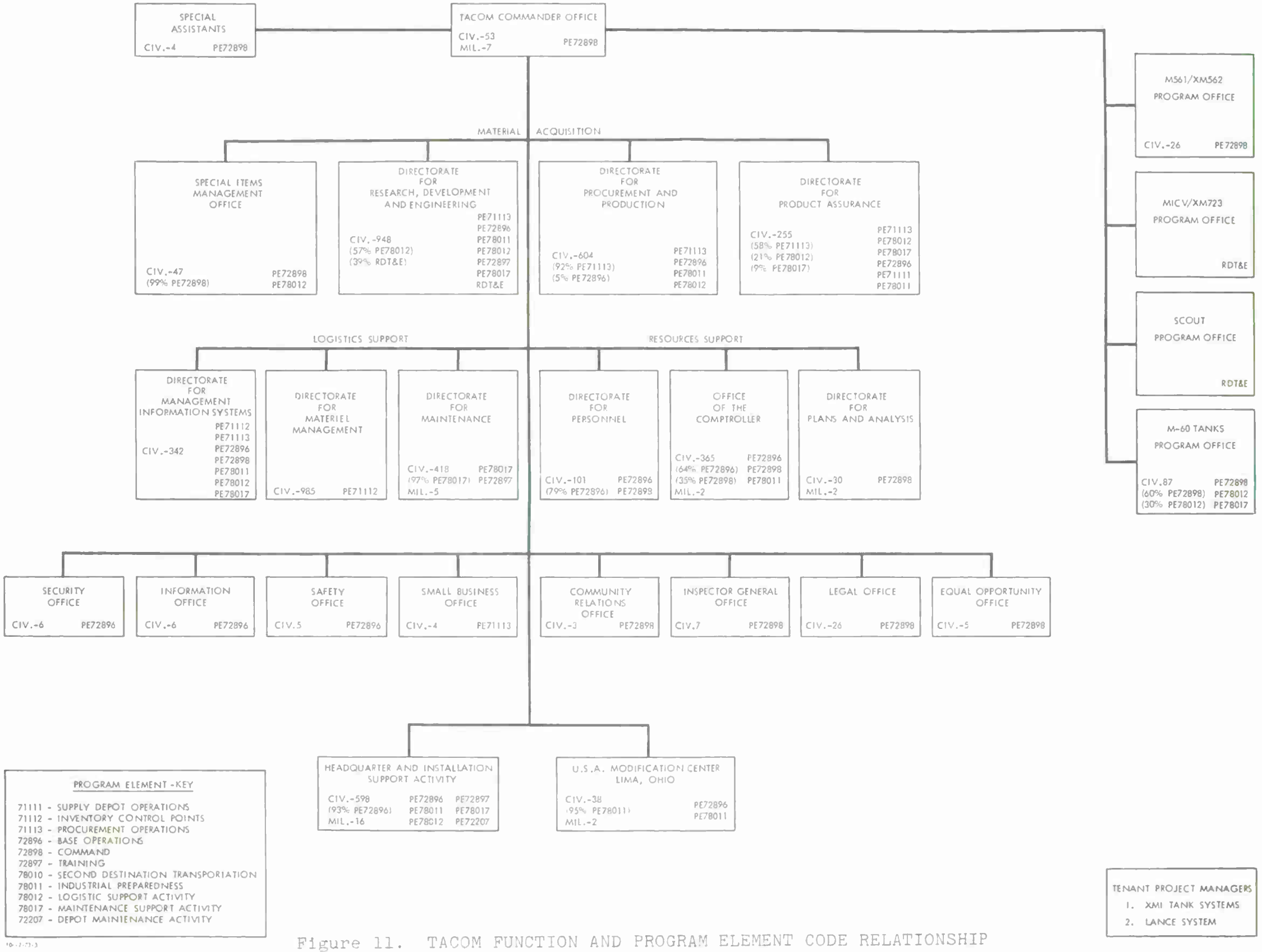


Figure 11. TACOM FUNCTION AND PROGRAM ELEMENT CODE RELATIONSHIP

Table 6. FUNCTIONS AND MEASURABLE OUTPUTS OF SELECTED PROGRAM ELEMENTS

Program Element	Name	Function	Measurable Outputs
71112	Directorate for Materiel Management	• System Support Mgmt. • Item Management • Technical Services • Determine Material Rqmts. • Provisioning New Systems • Schedule Flow Material • Configuration Control • Engineering Services • Inter-Service Support • Cataloging and Standardization • Rebuild Direction • Determine Organic/Contract Maintenance Mix	• Number of Weapon/Support Systems Managed • Purchase Requests Initiated • Requisitions Processed • Redistribution Directives Issued • Line Items Cataloged • Technical Orders Issued • Material Improvement Projects Initiated • New Line Items Entering System • Line Items Dropped from System • Number of Supply Control Centers • Line Items of Requirements Computed • Line Items Provisioned Initially • Configuration Changes Processed • MAP Line Items Processed • Distribution or Redistribution Actions Processed • Disposal Directives Issued • FSNs Managed • Rebuild Work Directives and Amendments Initiated
71113	Directorate for ment and Production	• Procurement Operations • Procurement Planning • Negotiate Contract • Contract Administration • Quality Assurance • Production Surveillance	• Procurement Actions Expected • Contracts Written • Contracts Administered/Under Surveillance • Inspection Reviews Performed
72896	Base Operations	• Manage and Maintain the Installation • Provide General Services to Tenants	• Material Receipts and Issues • Purchase Requests Processed • Population Served/Military & Civilian • Vehicle Miles Driven • Maintenance Man-Hours
72898	Command	• Direct Operations of the MSC • Provide Necessary Staff Support to Commander & Directorates of the MSC	• Population Served/Military & Civilian • Personnel Actions • Funds Administered • Man-Days of Computer Programming • Legal Actions Accomplished • Number of Computerized Reports Processed
78017	Directorate for Maintenance	• Centralized Programming and Planning Support • Technical & Engineering Services/Contract & Organic • Organic Program Development, Scheduling and Reporting	• Man Years of Technical and Engineering Support • Number of Maintenance Manuals Published • Number of Illustrations • Number of PRONs Processed • Number of Maintenance Programs Workloaded

Even if the data for the measurable MSC outputs existed, they would be difficult to use in evaluating the impact of alternative force structures on Program 7. These data, for example, the number of requisitioned line items initiated and processed, are developed for the management and control of internal workload. To compute the effect of alternative force structures on MSC outputs and then to calculate the associated Program 7 resources would require a complex computerized transfer program. Furthermore, it would be impossible to assess rapidly the impact of alternative force structures if MSC output information had to be prepared on each proposed force structure.

A suitable alternative to this complex procedure would be to develop relationships between the force structures and the MSC inputs, Program 7 resources required to accomplish the MSC's tasks. The MSC's mission can be viewed as performing assigned tasks to support the Army force structure. The program element resource requirements would be the dollars budgeted and expended to perform the various tasks. If there are changes in the force structure over time, the resources used should reflect these changes.

The Army generates and computes requirements on the basis of programmed weapon system inventories and levels of activity, as well as the location and priority of units.* If there is a direct relationship between requirements generation and Program 7 resources used, it should be possible to identify in equation form the relationship between the force structure and the Program 7 resources required. This approach appears to be compatible with the historical program element data for commodity commands and the available force structure information.

---

*There is a detailed discussion of the methodology used to compute Program 7 resource requirements in Chapter II. The discussion concerning the "SACS FILE" and the Authorized Acquisition Objective is especially relevant.

D. LEAST SQUARES REGRESSION ANALYSIS

Least squares regression analysis was used to quantify functional relationships based on historical data gathered at AVSCOM and TACOM. This is a standard cost analysis approach to the derivation of cost estimating relationships (CERs). To use this technique, the analyst must first identify a set of independent and randomly distributed variables that theoretically explain the variations in a dependent variable. A cause-and-effect relationship must exist between the independent and dependent variables selected. In addition, information on these variables must be available and suitable for forecasting purposes at the OSD level.

Basically, least squares regression analysis involves the fitting of a line to a scatter of data points. This produces a regression equation which describes the average relationship between the independent and dependent variables.* In other words, the regression equation describes the variability or elasticity of program elements in Program 7 with respect to changes in the force structure over time. It permits rapid estimation of program element resource requirements as a function of selected variables and provides a statistical basis for the acceptance or rejection of an hypothesized relationship. A simple linear regression equation has the following form,

$$PE\ \$ = A_0 + A_1X$$

where

PE $ = the dependent variable, program element resource requirements

A_0 = constant term

*At this point, it must be emphasized that the results of the statistical regression analysis are only as good as the basic historical data used to derive the CER. Regardless of the degree of mathematical sophistication used in developing the regression equation, it cannot compensate for a faulty or inconsistent historical data base.

A_1 = regression coefficient which is constant and measures the extent of the effect that X has on PE $

X = the independent variable, the force structure, or weapon system parameter.

The following presentation of the quantitative results will include a discussion of the selected independent variables, each MSC's data base and sources of data, and a listing of the CERs. There are two sections--one each for AVSCOM and TACOM.* The CERs should be viewed as illustrations of the feasibility of this approach to estimating Program 7 resource requirements and not as precise estimators of future resource requirements.**

E. INDEPENDENT VARIABLES AND FUNCTIONAL RELATIONSHIPS AT AVSCOM

Table 7 lists actions and activities or policy-controllable variables that may affect significantly the amount of required Program 7 resources. This list includes primary variables used in alternative force structures; secondary variables that are affected by changes in the primary variables; and variables that may not be considered major factors in the choice of alternatives, but do have an impact on Program 7 resources. The listed variables are not all independent, statistically or otherwise. Any model which requires independence and attempts to combine many of the variables may produce spurious results.

The hypothesized functional relationships between the measures of resource expenditures for program elements in

*Section E pertains to AVSCOM and Section F pertains to TACOM.

**The CERs presented in this study are based on data which reflect the large U.S. Army participating in the Vietnam conflict. The future U.S. Army will be smaller and operating within a lower budget. Therefore, one should be aware of the fact that use of these CERs to predict future resource requirements might entail estimations outside the range of actual data. The degree of confidence one can have in an estimate decreases outside the range of actual data.

Table 7. THEORETICAL INDEPENDENT VARIABLES CONSIDERED AT AVSCOM

Code	Independent Variables	Dimension
1	Weapon System Inventory	Number
2	Weapon System Activity	Flying Hours
3	Depot Assets (Inventory Worth)	Dollars
4	Number of Systems Managed	Number
5	Stock Fund Sales	Dollars
6	Investment in Initial Spares	Dollars
7	Investment in Replenishment Spares and Modifications	Dollars
8	Total Assets	Dollars
9	Fleet Worth	Dollars
10	Intensity of Usage of Equipment (Flying Hours x Inventory)	Number
11	OR, NORM, NORS	Rate
12	Utilization Rate (Flying Hours per Aircraft)	Rate
13	Weapon System Deployment Pattern	

Program 7 and the independent variables are shown in Table 8. These postulated relationships are based on judgments derived from the research covered in Chapters II and III. This table implies that variation in a program element should be explained by the independent variables aligned with it, and that a cause-and-effect relationship exists.

The independent variables used in the hypothesized relationships for AVSCOM are described as follows:

- Weapon System Inventory. The average total number of aircraft on hand. This does not include those deactivated and in storage. For the evaluation of Program 7 resources, it appears that the total number of aircraft on hand may be the best independent variable because AVSCOM must manage and repair all aircraft in the active inventory.

- Weapon System Activity. A measure of the flying hour program of the inventory.

- Depot Assets. The dollar value of the assets controlled or stored at the various depots performing work for AVSCOM.

- Number of Systems Managed. A measure of the number of aircraft systems managed by AVSCOM.*

- Stock Fund Sales. A measure of workload within Program 7. Stock fund sales cover expense type materials--those that are consumed in use.

- Investment in Initial Spares. The funds spent during the initial provisioning of a system.

- Investment in Replenishment Spares and Modifications. AVSCOM has the major responsibility for determining the required investment in spares, for processing spares procurement actions, and for managing spares for the Army Aviation System's inventory.

- Total Assets. The dollar value of the assets controlled and stored by AVSCOM.

---

*To develop a true factor for the number of systems managed, one would have to derive a weighting scheme which would reflect the overall importance of the given system in the inventory and the complexity of effectively managing the system and the various items that comprise it.

Table 8. THEORETICAL DETERMINANTS OF RESOURCE EXPENDITURES AT AVSCOM

Code	Independent Variables	Dimension	Hypothesized Functionally Related Variables[a]
A	PE 71111	Dollars, Manpower	1,2,3,5,6,7,8
B	PE 71112	Dollars, Manpower	1,2,3,4,5,6,7,8,9G
C	PE 71113	Dollars, Manpower	1,2,3,4,5,6,7,8,9,E
D	PE 72896	Dollars, Manpower	3,A,B,C,F
E	PE 72207 (Contract)	Dollars	1,2,7,11,F
F	PE 72007 (Organic)	Dollars	1,2,7,11,E
G	PE 72207	Dollars	1,2,7,10,11
H	PE 78017	Dollars, Manpower	1,2,G,12

a. The numbers listed here refer to the list of variables presented in Table 7.

- Fleet Worth. The dollar value of the active aircraft systems managed by AVSCOM. This value is calculated by multiplying the active inventory figure for a particular system by its average unit flyaway cost.

- Intensity of Usage of Equipment. A combinational variable of inventory multiplied by flying hours which measures the intensity of operational employment of aircraft systems.

- OR, NORS, NORM. The OR (operationally ready) and NORM (not operationally ready because of maintenance problems) rates are probably associated more with DSU and GSU maintenance procedures than with depot maintenance. The NORS (not operationally ready because of supply problems) rate should have an impact on the Materiel Management and Maintenance Directorates in the AMC Commodity Commands.

- Flying Hours per Aircraft. A combinational variable of Flying Hour Program divided by Inventory. It is a measure of the utilization rate of aircraft systems. This may be used when the utilization rates of certain systems are changing because of changes or differences in mission assignments.

- Weapon System Deployment. The deployment pattern of the Army Aviation Systems has an impact on second destination transportation, supply support, and maintenance support.

1. The AVSCOM Data Base

Data used in this analysis for the program element costs at AVSCOM and for the independent variables cover the six-years FY 1968 through 1973. Table 9 contains some of the useful data sources at AVSCOM. These sources have been divided into two categories: prime and verification. The prime data were used as measures of the variables of interest, while the verification data were used as checks. Although the verification data were not always aggregated in the same manner as the prime data, they provided quality control checks and increased the credibility of the prime data.

The expenses or resource expenditures by program element at AVSCOM for the time period FY 1968-1973 are shown in Table 10. The source for PEs 71111, 71112, 71113, 72896, and 72898 were the AVSCOM/CSCAB-205 Prior Year Report and the AVSCOM/CSCAB-218

Table 9. AVSCOM ACQUIRED DATA SOURCES

Data Level Source	Item	Parameter	Years	Program Element Applicability	Prime Data	Verification Data
Department of Army	Maroun Study	Dollars, Manpower	1968-1971	71111, 71112, 71113	X	
Department of Army AMC	Manpower Authorization	Manpower	1968-1973	71111, 71112, 71113		X
RCS-AMCMR-123	Army Aircraft Inventory Status & Flying Time	Weapon System Inventory, Flying Hour Program	1968-1973	All	X	
RCS-AMCMR-127	Army Aircraft Status Report	OR, NORS, NORM	1968-1973	All	X	
RCS-SAV-CR-101	Statistical Reference Book	Depot Inventory Dollars	1968-1973	All	X	
AVSCOM-CSCAB-218	Status of Funds Report	Dollars	1968-1973	71111, 71112, 71113		X
AVSCOM-CSCAB-205	Prior Year Report	Dollars, Manpower	1968-1973	71111, 71112, 71113	X	
AVSCOM-CSFOR-78	Manpower Utilization and Requirements	Manpower	1968-1973	71111, 71112, 71113		X
AVSCOM Internal Records	Depot Maintenance Financial Analysis	A/C Maintenance Dollars	1968-1973	72207, 72007	X	
AVSCOM Internal Budget Records	AVSCOM Obligations	Modifications & Replenishment Spares Dollars, Stock Fund Sales Dollars	1968-1973	71111, 71112, 71113	X	

Table 10. AVSCOM PROGRAM ELEMENT EXPENSES[a]
(Dollars in Millions)

Program Element	Fiscal Year					
	1968	1969	1970	1971	1972	1973
71111[b,c]	6.2	7.1	7.3	8.4	5.1	6.7
71112[b]	15.8	16.6	15.9	15.7	15.4	14.2
71113[b]	12.0	13.6	14.4	13.8	13.4	12.8
72896[b]	8.5	7.7	7.4	7.2	10.0[d]	10.6[d]
72898[b]	9.5	12.5	10.6	9.1	8.4	7.4
78017[b]	39.5	46.4	35.8	31.5	37.1	34.5
72207[e] (Contract)	110.0	177.1	208.3	172.2	114.3	84.9
72007[e] (Organic)	150.6	171.9[f]	132.4	119.8	123.6	103.9
72207[e] (Total)	260.6	349.0	340.7	292.0	237.9	188.8
TOTAL[g]	352.1	452.9	432.1	377.7	327.3	275.0

a. Expenses have been normalized to FY 1973 functions, organizational structures, and 1973 dollars.

b. The source for FY 1968-1972 was AVSCOM/CSCAB-205 Prior Year Report. For FY 1973, the source was AVSCOM/CSCAB-218 Status of Funds Report.

c. The 71111 expense shown here reflect supply depot operations at ARADMAC and the small AVSCOM Commercial Preservation/Storage and Cannibalization effort at Davis-Monthan AFB, Tucson, Arizona. The other depots which perform supply depot operations for AVSCOM are funded with AMC 71111 expense money through MIDA.

d. AVSCOM was assigned the area support function in July 1971 when it took over the Granite City Depot. Granite City provides support to AVSCOM; TROSCOM (formerly MECOM); ALMSA (Army Logistics Management Systems Agency); and Army, Air Force Motion Picture Center. This amounts to about $3.4 million.

e. The source was informal internal accounting records within the Directorate for Maintenance at AVSCOM.

f. This was the year that the Army Industrial Fund (AIF) was implemented. This figure includes money obligated against some FY 1968 programmed work which had not been completed by 1 July 1969. When the AIF was implemented, it meant that funds had to be obligated against the programmed workload. Prior to the inception of the AIF, the work was paid for when it was done. It was a pay as you go basis. The FY 1968 programmed workload, against which FY 1969 dollars had to be obligated, amounted to about $28 million.

g. This total does not represent total Program 7 expenses at AVSCOM. It excludes PEs 78010, 78011, 78012, and 72897.

Status of Funds Report. The source for all depot maintenance costs was informal internal accounting records within the Directorate for Maintenance.

For fiscal years 1968 through 1973, there were no significant changes in the organizational structure at AVSCOM.* There was a financial change as of 1 July 1972 when the PE funding of certain offices in the comptroller organization was changed from 72896, Base Operations, to 72898, Command. The structure for FY 1973 was used as a base. Therefore, the normalization of PE expense data for all years incorporated this change in funding between PEs 72896 and 72898.

All of the expense data were normalized to a 1973 base. For PEs 71111, 71112, 71113, 72896, 72898, and 78017, the AMC civil service salary scale was used. The AMC wage board indices were used for contract maintenance, and the AMC composite salary (graded salaries and wage board) indices for organic maintenance. The normalization indices--multiplication factors applied to the data of each year--are shown in Table 11.

Table 11. INDICES FOR NORMALIZATION TO FY 1973 COSTS

Fiscal Year	1968	1969	1970	1971	1972	1973
Civil Service Factor	1.399	1.319	1.181	1.114	1.053	1.000
Wage Board Factor	1.296	1.228	1.159	1.110	1.055	1.000
Composite Factor	1.358	1.283	1.177	1.113	1.054	1.000

*However, because of a lack of data, it was impossible to incorporate into the 1973 normalization the assumption by AVSCOM of the Area Support Mission handled at the Granite City Army Depot on 1 July 1971. The depot activities were curtailed in July 1971 and AVSCOM assumed responsibility for the Granite City installation, including the area support function. Historical cost information was not maintained in a manner which would allow the isolation of support costs specific to the depot activities. Granite City provides support to AVSCOM; TROSCOM (formerly MECOM); Army Logistics Management Systems Agency (cont.)

Table 12. AVSCOM WEAPON SYSTEMS AND INDEPENDENT VARIABLES

Weapon System Independent Variables (DOLLARS)		Fiscal Year 1968	1969	1970	1971	1972	1973
UH-1							
Average Inventory[a]		3818	3960	4357	4284	4175	4032
Flying Hours	(Thousands)	2349	2489	2623	2092	1361	1022
Flying Hours/Aircraft		683	622	610	487	324	256
Replen./Mod. Inv.[b]	(Millions)	164.9	61.3	36.4	26.2	22.1	11.7
AH-1G							
Average Inventory		310	626	677	559	680	756
Flying Hours	(Thousands)	47	270	399	318	193	104
Flying Hours/Aircraft		150	430	600	570	280	140
Replen./Mod. Inv.	(Millions)	4.5	17.7	7.4	9.9	3.4	4.8
CH-47							
Average Inventory		445	492	503	484	481	430
Flying Hours	(Thousands)	202	242	262	196	114	59
Flying Hours/Aircraft		500	500	500	400	240	140
Replen./Mod. Inv.	(Millions)	141.2	50.9	48.1	16.2	14.3	15.1
OH-6							
Average Inventory		468	863	732	586	457	435
Flying Hours	(Thousands)	81	406	454	288	142	54
Flying Hours/Aircraft		170	470	620	490	310	120
Replen./Mod. Inv.	(Millions)	27.8	16.8	4.1	.3	2.0	2.4
OH-58							
Average Inventory		--	10	392	923	1474	1813
Flying Hours	(Thousands)	--	--	76	263	307	387
Flying Hours/Aircraft		--	--	190	280	210	210
Replen./Mod. Inv.	(Millions)	--	.3	2.4	3.2	3.2	2.4
OH-13							
Average Inventory		744	713	697	531	97	51
Flying Hours	(Thousands)	293	192	124	83	21	3
Flying Hours/Aircraft		380	270	180	160	220	60
Replen./Mod. Inv.	(Millions)	1.0	.5	2.9	.02	--	--
OH-23							
Average Inventory		1050	1014	991	838	417	169
Flying Hours	(Thousands)	511	443	372	236	75	22
Flying Hours/Aircraft		490	440	380	280	180	130
Replen./Mod. Inv.	(Millions)	1.6	1.9	.1	--	--	--
OV-1							
Average Inventory		217	238	266	273	267	263
Flying Hours	(Thousands)	75	92	97	74	52	29
Flying Hours/Aircraft		350	390	360	270	190	110
Replen./Mod. Inv.	(Millions)	12.1	14.4	4.7	.7	.2	13.4
O-1							
Average Inventory		822	696	646	505	121	51
Flying Hours	(Thousands)	451	404	350	265	68	2
Flying Hours/Aircraft		550	580	540	520	560	40
Replen./Mod. Inv.	(Millions)	1.8	1.3	2.2	--	--	--
U-6/RU-6							
Average Inventory		557	543	536	477	316	149
Flying Hours	(Thousands)	178	184	177	147	84	27
Flying Hours/Aircraft		320	340	330	310	270	180
Replen./Mod. Inv.	(Millions)	.5	--	3.3	--	--	--

a. The source for inventory and flying hours, by system, was RCS-AMCMR-123, Army Aircraft Inventory Status and Flying Time.

b. Replen./Mod. Inv.--Replenishment Modifications Investment.

As mentioned earlier, there was little evidence of accountability of costs to specific weapon systems in the various directorates within AVSCOM, except for the maintenance function. The program element expense data represent aggregations of costs associated with several weapon systems. The principal weapon systems managed at AVSCOM from FY 1968 to 1973 were UH-1, AH-1G, CH-47, OH-6, OH-58, OH-13, OH-23 (all rotary wing aircraft), OV-1 (Fixed Wing), and U-6/RU-6 (Fixed Wing).

Some of the independent variables associated with these principal AVSCOM-managed weapon systems are shown in Table 12. During the six-year period FY 1968 through FY 1973, the UH-1 system was the largest and most active system in the direct Army inventory. The UH-1 inventory remained relatively stable. The U-6/RU-6, OH-13, OH-23, OH-6, and O-1 inventories decreased significantly in the last three years. OH-58 inventory has increased. CH-47, AH-1G, and OV-1 inventories appear to have stabilized.

The depot maintenance costs, organic and contract, for these principal AVSCOM-managed weapon systems are shown in Table 13.* They account for 90 percent of the total AVSCOM depot maintenance program. The overwhelming importance of the UH-1, AH-1G, and CH-47 in the Direct Army inventory is shown by the fact that since 1971 these systems have accounted for about 85 percent of the total AVSCOM depot maintenance program. The UH-1 is by far the major consumer of AVSCOM-managed depot maintenance resources. The percentage distributions of total, organic, and contract depot maintenance costs, by weapon system, are shown in Tables 14, 15, and 16, respectively.

(ALMSA); and the Army, Air Force Motion Picture Center. The area support costs amounted to about $3.4 million in PE 72896 Funds for 1972 and 1973.

*The depot maintenance costs for common exchangeable items were identified and prorated to the appropriate weapon system.

Table 13. MAJOR WEAPON SYSTEM DEPOT MAINTENANCE COSTS[a]
FY 1968-1973
($ Millions)

Weapon System	Maintenance Category	Fiscal Year					
		1968	1969	1970	1971	1972	1973
UH-1	Organic[b]	89.1	106.9	76.9	52.3	58.0	42.1
	Contract[b]	36.9	84.7	115.3	106.6	60.7	34.0
	Total	126.0	191.6	192.2	158.9	118.7	76.1
AH-1G	Organic	4.1	10.0	11.5	20.3	20.8	18.8
	Contract	.4	1.8	5.6	1.0	1.4	.1
	Total	4.5	11.8	17.1	21.3	22.2	18.9
CH-47	Organic	43.3	30.4	23.2	23.4	27.3	22.4
	Contract	33.8	40.9	36.0	36.4	31.4	35.2
	Total	77.1	71.3	59.2	59.8	58.7	57.6
OH-6	Organic	--	.9	5.5	6.1	7.1	6.3
	Contract	3.1	20.7	23.1	14.0	5.5	.4
	Total	3.1	21.6	28.6	20.1	12.6	6.7
OH-58	Organic	--	--	.05	2.1	3.0	9.3
	Contract	--	--	.25	.45	2.0	.5
	Total	--	--	.30	2.55	5.0	9.8
OH-13	Organic	.5	1.7	2.1	2.0	.54	.02
	Contract	6.5	2.3	2.8	1.3	.06	--
	Total	7.0	4.0	4.9	3.3	.60	.02
OH-23	Organic	1.5	5.0	1.4	.33	--	--
	Contract	5.0	5.5	3.3	2.4	.1	--
	Total	6.5	10.5	4.7	.73	.1	--
OV-1	Organic	3.3	4.4	2.1	2.3	3.6	1.5
	Contract	5.5	6.9	4.1	1.3	2.4	1.6
	Total	8.8	11.3	6.2	3.6	6.0	3.1
O-1	Organic	2.6	2.1	.7	.45	--	--
	Contract	3.4	1.4	1.8	.40	--	--
	Total	6.0	3.5	2.5	.85	--	--
U-6/RU-6	Organic	2.7	1.3	.9	.8	--	.06
	Contract	1.9	1.1	2.0	1.6	.05	--
	Total	4.6	2.4	2.9	2.4	.05	.06
Total for Systems Considered		243.6	328.0	318.4	273.6	223.9	172.3
Total at AVSCOM		260.6	349.0	340.7	292.0	237.9	188.8
Percent Considered		93.1	94.0	93.5	93.7	94.2	91.3

a. Costs are normalized to 1973 dollars.
b. The source for this data was informal internal accounting records within the Directorate for Maintenance at AVSCOM.

Table 14. PERCENT DISTRIBUTION OF TOTAL DEPOT MAINTENANCE COST FOR AVSCOM SYSTEMS [a]

Weapon System	Fiscal Year					
	1968	1969	1970	1971	1972	1973
UH-1	48.5	55.5	57.5	55.7	50.6	41.3
AH-1G	1.7	3.6	5.1	7.4	9.4	10.3
CH-47	29.7	20.6	17.6	20.9	25.0	31.2
CH-54	2.0	2.0	1.5	2.1	3.0	4.9
CH-37	.5	.5	.4	.1	--	--
CH-34	.9	.9	1.5	.6	.1	--
OH-6	1.4	6.6	8.5	7.1	5.4	3.6
OH-58	--	--	--	.9	2.2	5.3
OH-13	2.7	1.2	1.4	1.2	.3	--
OH-23	2.5	3.0	1.4	.2	--	--
OV-1	4.3	3.6	1.8	1.3	2.6	1.7
O-1	2.3	1.0	.8	.3	--	--
U-1/RU-1	.9	.7	.8	.4	--	--
U-21/RU-21	.2	.4	.4	.5	1.1	.9
U-6/RU-6	1.7	.7	.8	.8	--	--
U-8/9/10/RU-8/9/10	.7	.5	.5	.5	.3	.7
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Total Cost (Dollars in Million)	260.6	349.0	340.7	292.0	237.9	188.8

a. The source for this data was informal internal accounting records within Directorate for Maintenance at AVSCOM.

Table 15. PERCENT DISTRIBUTION OF ORGANIC[a] DEPOT MAINTENANCE COST FOR AVSCOM SYSTEMS

Weapon System	Fiscal Year					
	1968	1969	1970	1971	1972	1973
UH-1	59.5	64.4	60.5	46.2	47.3	41.4
AH-1G	2.7	6.0	9.6	17.9	17.2	18.5
CH-47	28.9	18.3	18.3	20.6	22.6	22.2
CH-54	--	--	--	.3	.2	--
CH-37	--	.2	.3	--	--	--
CH-34	.3	.2	.6	1.2	--	--
OH-6	--	.5	4.3	5.4	5.9	6.2
OH-58	--	--	--	1.9	2.7	9.1
OH-13	.4	1.0	1.7	1.8	.5	--
OH-23	1.0	3.0	1.1	.3	--	--
OV-1	2.1	2.6	1.7	2.1	3.2	1.5
O-1	1.7	1.2	.5	.4	--	--
U-1/RU-1	.9	.7	.3	.1	--	--
U-21/RU-21	.2	.2	--	.3	.2	.4
U-6/RU-6	1.8	.9	.6	.7	--	--
U-8/9/10/RU-8/9/10	.4	1.0	.5	.8	.2	.7
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Total Cost (Dollars in Million)	150.6	171.9	132.4	119.8	123.6	103.9

a. The source for this data was informal internal accounting records within Directorate for Maintenance at AVSCOM.

Table 16. PERCENT DISTRIBUTION OF CONTRACT DEPOT MAINTENANCE COST FOR AVSCOM SYSTEMS[a]

Weapon System	Fiscal Year					
	1968	1969	1970	1971	1972	1973
UH-1	33.5	47.8	55.3	61.9	53.8	41.1
AH-1G	.4	1.2	2.7	.6	1.2	.1
CH-47	30.7	23.0	17.2	21.2	27.7	42.5
CH-54	6.6	3.4	2.4	3.2	5.8	11.0
CH-37	1.4	.5	.6	.1	--	--
CH-34	1.8	1.1	2.0	.3	.2	--
OH-6	2.8	11.6	11.0	8.1	4.8	.6
OH-58	--	--	.1	.3	1.8	.6
OH-13	5.9	1.3	1.4	.7	--	--
OH-23	4.5	3.1	1.6	.2	.1	--
OV-1	4.5	3.9	2.0	.7	2.1	1.9
O-1	3.0	.8	.8	.2	--	--
U-1/RU-1	1.4	.8	1.0	.6	--	--
U-21/RU-21	.4	.6	.5	.6	2.0	1.6
U-6/RU-6	1.7	.7	1.0	1.0	--	--
U-8/9/10/RU-8/9/10	1.4	.2	.4	.3	.4	.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Total Cost (Dollars in Million)	110.6	177.1	208.3	172.2	114.3	84.9

a. The source for this data was informal internal accounting records within the Directorate for Maintenance at AVSCOM.

2. AVSCOM Program Element Cost Estimating Relationships

a. Program Element 71112. The basic hypothesized functional relationship for PE 71112 is presented in Table 17. The primary functions of the Directorate for Materiel Management at AVSCOM are to manage items and systems; develop the rationale for requirements set forth in the maintenance budget; and manage the investment in equipment modifications and replenishment spares. Most of the workload is managerial, analytical, or administrative in nature. This involves qualitative decisionmaking and problem-solving.

The CER for PE 71112 uses resources managed as the independent variable. The variations in two variables, total annual Organic Depot Maintenance Costs and end year total Weapon System Inventory, explained 94 percent of the variation in total PE 71112 annual expenses over the time period FY 1968-1973. The regression equation with a comparison of the actual PE 71112 expenses and the expenses estimated by the equation are presented in Table 17. The standard errors of the coefficients are indicated in the parentheses immediately below the coefficient.

In Table 18 an alternative functional relationship for PE 71112 is presented. The use of annual Total Depot Maintenance Costs as opposed to organic or contract could prove to be superior in predicting future resource requirements, because significant changes may occur in allocating depot maintenance workload between organic and contract facilities.

The use of total annual Organic Depot Maintenance Costs as one of the independent variables will prevent the direct estimation of PE 71112 requirements on the basis of force structure variables, unless these costs can first be estimated for each alternative force structure. The total Weapon System Inventory variable is a force structure variable. If the CER shown on Table 17 is to be used in evaluating alternative force structures, an equation relating total annual Organic Depot Maintenance Costs to a force structure variable is needed.

Table 17. BASIC HYPOTHESIZED FUNCTIONAL RELATIONSHIP FOR PE 71112

$$\begin{pmatrix} \text{PE 71112} \\ \text{Directorate for} \\ \text{Materiel} \\ \text{Management} \end{pmatrix} = f$$

1. Weapon System Inventory[a]
2. Weapon System Activity
4. Number of Systems Managed
5. Stock Fund Sales
7. Investment in Replenishment Spares and Modifications
8. Total Assets
9. Fleet Worth
11. OR, NORS, NORM Rates
F. Organic Maintenance

REGRESSION EQUATION

PE 71112 ($ Million) = 7.76 + .0226 Organic Depot Maintenance (.0053) + .0004 Total Weapon System Inventory (.0001)

$R^2 = .94$

$F = 20.74$

Fiscal Year	Actual PE 71112 Dollars (Millions)	Estimated PE 71112 Dollars (Millions)
1968	15.80	15.78
1969	16.60	16.68
1970	15.90	16.02
1971	15.70	15.54
1972	15.40	15.09
1973	14.20	14.47

a. The numbers to the left of the variable refer to the listings in Tables 7 and 8.

Table 18. ALTERNATIVE HYPOTHESIZED FUNCTIONAL RELATIONSHIP FOR PE 71112

$$\left(\begin{array}{c}\overline{\text{PE 71112}} \\ \text{Directorate for} \\ \text{Materiel} \\ \text{Management}\end{array}\right) = f$$

1. Weapon System Inventory[a]
2. Weapon System Activity
4. Number of Systems Managed
5. Stock Fund Sales
7. Investment in Replenishment Spares and Modifications
8. Total Assets
9. Fleet Worth
11. OR, NORS, NORM Rates
G. Total Maintenance

REGRESSION EQUATION

$$\text{PE 71112 (\$ Million)} = 4.9218 \text{ Total Maintenance}^{0.21}$$

$$R^2 = .86$$

$$F = 19.21$$

Fiscal Year	Actual PE 71112 Dollars (Millions)	Estimated PE 71112 Dollars (Millions)
1968	15.80	15.44
1969	16.60	16.40
1970	15.90	16.32
1971	15.70	15.81
1972	15.40	15.16
1973	14.20	14.45

a. The numbers to the left of the variable refer to the listings in Tables 7 and 8.

b. Program Element 71113. The basic hypothesized functional relationship for PE 71113 is presented in Table 19. In AVSCOM, PE 71113 covers the Directorate for Procurement and Production. The primary functions of this directorate are: procurement operations; contract negotiation; and contract administration. The hypothesized functional relationship attempts to relate those variables that determine procurement actions requiring the supervision of the Directorate for Procurement and Production. The variation in two variables, total annual Contract Depot Maintenance Costs and Fleet Worth explained 99 percent of the variation in total PE 71113 annual expenses over the time period FY 1968-1973. The CER and a comparison of the actual PE 71113 expenses estimated by the equation are presented in Table 19.

As with PE 71112, if these variables are used to explain the variations in program element 71113 over time, it is impossible to estimate directly the program element requirements on the basis of force structure variables such as inventory and level of activity. Linking or secondary equations would be required.

c. Cost Estimating Relationship for UH-1 Helicopter Depot Maintenance Costs. As stated earlier, the UH-1, a utility/multipurpose helicopter, is the major consumer of AVSCOM-managed depot maintenance resources. See Table 20, which shows the distribution of UH-1 depot maintenance costs as a percent of total AVSCOM organic and contract depot maintenance costs.*

The UH-1 is the backbone of the Army aviation fleet. It was used extensively in the Vietnam conflict. As shown in Tables 21 and 22, the UH-1 inventory has represented about 40 to 45 percent of the total Army Aviation System inventory and 50 percent of the total rotary wing inventory.

---

*As used in this section, the term UH-1 will encompass the AH-1G. The AH-1G is designated the Cobra. It is basically a UH-1 design with a thinner fuselage and armament.

Table 19. HYPOTHESIZED FUNCTIONAL RELATIONSHIP FOR PE 71113

$$\begin{pmatrix} \text{PE 71113} \\ \text{Directorate for} \\ \text{Procurement and} \\ \text{Production} \end{pmatrix} = f$$

1. Weapon System Inventory[a]
2. Weapon System Activity
3. Depot Assets
4. Number of Systems Managed
5. Stock Fund Sales
7. Investment in Replenishment Spares and Modifications
9. Fleet Worth
E. Contract Maintenance

REGRESSION EQUATION

PE 71113 ($ Million) = 1.4389 + .0040 Contract Maintenance (.0010) + .0033 Fleet Worth (.0002)

$R^2 = .99$

$F = 296.08$

Fiscal Year	Actual PE 71113 Dollars (Millions)	Estimated PE 71113 Dollars (Millions)
1968	12.00	12.00
1969	13.60	13.56
1970	14.40	14.41
1971	13.80	13.87
1972	13.40	13.31
1973	12.80	12.86

a. The numbers to left of the variable refer to the listings in Tables 7 and 8.

Table 20. PERCENT DISTRIBUTION OF UH-1 DEPOT MAINTENANCE COST

Weapon System	Fiscal Year					
	1968	1969	1970	1971	1972	1973
UH-1 as Percent of Total Depot Maintenance Cost	50.2	59.1	62.6	63.1	60.0	51.3
UH-1 as Percent of Organic Depot Maintenance Cost	62.2	70.4	70.1	64.1	64.5	59.9
UH-1 as Percent of Contract Depot Maintenance Cost	33.9	49.0	58.0	62.5	55.0	41.2

The rationale used in deriving the depot maintenance cost estimating relationship for the UH-1 assumed that depot maintenance resource requirements are governed by the quantity of active equipment and the level of activity of this equipment. In other words, the critical variable is the intensity of operational employment of fielded equipment.* This rationale was applied in developing the cost estimating relationship presented in Table 23.

The combinational variable, UH-1 total annual Flying Hours times end year UH-1 Active Inventory, explained 90 percent of the variation in UH-1 total annual Depot Maintenance Costs over the time period FY 1968-1973. This can be interpreted to mean that depot maintenance costs are determined primarily by the

*This rationale is based on the depot maintenance criteria for Army Aviation Systems. These criteria, which deal primarily with the amount of operational hours, are presented in Table A-1 in Appendix A. These combat operations criteria are appropriate because, until FY 1973, about 70 percent of the total UH-1 flying hours were incurred in the Vietnam conflict.

Table 21. PERCENT DISTRIBUTION OF ALL ARMY AVIATION WEAPON SYSTEMS

Weapon System Series	Fiscal Year					
	1968	1969	1970	1971	1972	1973
Rotary Wing						
UH-1	39.8	40.2	41.9	41.5	46.2	47.8
OH	21.5	22.4	23.1	24.7	23.3	24.7
CH	8.1	7.6	7.0	6.8	6.4	5.4
TH	7.8	10.0	9.4	9.6	10.6	11.1
Fixed Wing						
O	7.7	6.0	5.3	4.3	1.2	.5
OV	2.0	2.0	2.2	2.3	2.4	2.6
U	9.1	8.2	7.6	7.3	6.2	4.8
RU	.8	.9	.8	.8	1.0	.9
OTHER	3.2	2.9	2.7	2.7	2.7	2.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Table 22. PERCENT DISTRIBUTION OF ROTARY WING WEAPON SYSTEMS

Weapon System Series	Fiscal Year					
	1968	1969	1970	1971	1972	1973
UH-1	51.4	50.1	51.4	50.2	53.3	53.6
OH	27.8	27.9	28.3	29.8	26.9	27.7
CH	10.5	9.5	8.6	8.2	7.4	6.1
TH	10.3	12.5	11.7	11.8	12.4	12.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Table 23. REGRESSION EQUATION FOR UH-1 DEPOT MAINTENANCE COST

$$\text{UH-1 Depot Maintenance Cost (\$ Million)} = 34.9543 + \underset{(.0021)}{.0122} \text{ Flying Hours } (10^3) \times \text{Inventory}$$

$$R^2 = .90$$

$$F = 32.69$$

NOTE: Flying hours times inventory represents intensity of usage of equipment, or intensity of operational employment.

Fiscal Year	Actual Depot Maintenance Dollars (Millions)	Estimated Depot Maintenance Dollars (Millions)
1968	130.5	152.8
1969	203.4	186.1
1970	208.6	217.3
1971	180.2	175.8
1972	140.8	126.9
1973	95.0	99.5

flying hour program of a given weapon system. The comparison of actual UH-1 total annual Depot Maintenance Costs and costs estimated by the equation is presented in Table 22.

F. INDEPENDENT VARIABLES AND FUNCTIONAL RELATIONSHIPS AT TACOM

Table 24 shows a list of activities or policy controllable variables, that may affect significantly the amount of Program 7 resources required at TACOM. It must be emphasized at this point that the type of equipment managed at TACOM is radically different from AVSCOM's equipment and the volume of items is much larger. TACOM manages 834 distinct systems, whereas AVSCOM manages only 66. The number of systems managed at TACOM will increase significantly on 1 July 1973 when it assumes end item and secondary item responsibility for Construction Equipment and Material Handling Equipment from TROSCOM (formerly MECOM).

Much of TACOM's workload involves secondary item management. About 98 percent of the requisitions processed are for stock fund secondary items.* In addition to managing the secondary items on systems, for which it has end item responsibility, TACOM, prior to 1 July 1972, was the secondary item manager for several ARMCOM (formerly WECOM) end items.** The priority accorded secondary item management is dictated by the Army's desire to keep its existing fleet of vehicles--combat, tactical, and self-propelled artillery--operational.†

The hypothesized functional relationships between the measures of resource expenditures for program elements in Program 7 and the independent variables are shown in Table 25.

---

*Conversations at TACOM 9 February 1973.

**A complete list of systems for which TACOM has secondary and end item responsibility was presented in the first section of this chapter.

†Conversations at TACOM 9 February 1973.

Table 24. THEORETICAL INDEPENDENT VARIABLES CONSIDERED AT TACOM

Code	Independent Variables	Dimension
1	Weapon System Inventory	Number
2	Weapon System Activity	Mileage
3	Number of Systems Managed	Number
4	Stock Fund Sales	Dollars
5	Investment in Replenishment Spares	Dollars
6	Investment in Initial Spares	Dollars
7	Total Strength of the Army (Numerical)	Number
8	Total Strength of the Army (Division Force Equivalent)	Number
9	Total Assets	Dollars
10	Intensity of Usage of Equipment (Mileage x Inventory)	Number

Table 25. THEORETICAL DETERMINANTS OF RESOURCE EXPENDITURES AT TACOM

Code	Dependent Variables	Dimensions	Hypothesized Functionally Related Variables[a]
A	PE 71112	Dollars Manpower	2, 3, 4, 5, 6, 7, 8, 9, D
B	PE 71113	Dollars Manpower	2, 3, 4, 5, 6, 7, 8, 9, D
C	PE 72896	Dollars Manpower	A, B, D, E
D	PE 72007	Dollars Manpower	1, 2, 10
E	PE 78017	Dollars Manpower	1, 2, 10, D

a. The numbers listed here refer to the variables in Table 24.

The independent variables used in the hypothesized relationships for TACOM are described as follows:

- Weapon System Inventory. The average total number of tactical and combat vehicles on hand. This does not include those deactivated and in storage.*
- Weapon System Activity. The mileage accumulated by the inventory of tactical and combat vehicles.**
- Number of Systems Managed. The number of tactical or combat vehicle systems managed by TACOM.†
- Stock Fund Sales. A measure of the workload within Program 7. Stock fund sales cover expense-type materials--those consumed in use.
- Investment in Replenishment Spares. TACOM has the major responsibility to determine the required investment in spares, processing of spares, procurement of spares, and the overall management of spare part programs for the Army tactical and combat vehicles and self-propelled artillery.
- Investment in Initial Spares. The funds spent during the initial provisioning of a system.
- Total Strength of the Army (Numerical). The number of military personnel on active duty.
- Total Strength of the Army (DFE). The strength of the Army in terms of division force equivalents.
- Total Assets. The dollar value of the assets controlled and stored by TACOM.
- Intensity of Usage of Equipment. A combinational variable--inventory multiplied by mileage. It measures the intensity of operational employment.

---

*TACOM does not maintain an historical file on its tactical and combat vehicle inventory. It is usually maintained for six months and disposed of. Individual analysts did maintain some historical summary data.

**The mileage historical data file is maintained at Lexington Blue-Grass Army Depot and published in the Fleet Management Report RCS/AMCMA-152. The mileage historical data file is maintained on an individual vehicle basis. This should provide a good historical data file on tactical and combat vehicle active inventory.

†To derive an effective measure, a weighting scheme must be derived to reflect the complexity of effectively managing a given system and the overall importance of a given system in the inventory.

1. The TACOM Data Base

Data used in this analysis for the program element expenses at TACOM and for the independent variables cover the five-year period FY 1969 through FY 1973. Table 26 contains some of the useful data sources at TACOM.

Overall, the research at TACOM was hindered by the lack of data. Army regulations require that historical data be disposed of after two years. In the case of inventory data, a historical data file of only six months is maintained. Fortunately, some historical summary-type data were available in the files of individual analysts.

The data sources have been separated into two catetories: prime and verification. The prime data have been used as the measures of the variables of interest. The verification data, although not always aggregated in the same manner as the prime data, were used as quality control checks and increased the credibility of the prime data.

The program element expenses at TACOM for the time period FY 1969-1973 are shown in Table 27. The source for PEs 71111, 71112, 71113, 72896, 72898 and 78017 for FY 1969-1972 was TACOM/CSFOR/78A Prior Year Report and for FY 1973 it was TACOM/AM109 Status of Funds Report. The source for total depot maintenance expenses, PE 72207, was the internal records of the Worldwide Depot Maintenance Conferences.

All of the expense data were normalized to FY 1973 functions and organizational structure. There were several significant financial changes as of 1 July 1972 in the composition of program element funding at TACOM. On 1 July 1972, 210 positions in the Directorate for Personnel, Training and Force Development, Comptroller Office, Legal Office and Selected Item Management Office were changed from PE 72896 to PE 72898 funding. In addition, 50 positions in Industrial Preparedness Operations (PE 78011) and Logistic Support Activities (PE 78012) were reprogrammed to Depot Maintenance Support Activities

Table 26. TACOM ACQUIRED DATA SOURCES

Data Level Source	Item	Parameters	Years	Program Element Applicability	Prime Data	Verification Data
Department of Army	Maroun Study	Dollars Manpower	1969-1971	71112, 71113	X	X
TACOM CS FOR78A	Prior Year Report	Manpower Dollars	1969-1973	71112, 71113	X	
TACOM AM 109	Status of Fund Report	Dollars	1969-1973	71112, 71113		X
TACOM AMP-I	Army Materiel Plan	Weapon System Inventory, Carriers	1969-1973	ALL	X	
WECOM	Density Data for Combat Vehicles	Weapon System Inventory, Tanks	1969-1973	ALL	X	
MIDA J-856	WECOM End of Year Program Status Report	Depot Maintenance Dollars, Tanks	1969-1972		X	
TACOM FORM-5395	Internal Record of Worldwide Depot Maintenance Conference	Prior Year Depot Maintenance Dollars	1969-1973	72207	X	

Table 27. TACOM PROGRAM ELEMENT EXPENSES[a]
(Dollars in Millions)

Program Element	Fiscal Year				
	1969	1970	1971	1972	1973
71111[b,f]	--	.1	.2	.2	.1
71112[b]	20.6	19.4	18.0	18.6	18.1
71113[b]	14.1	12.4	12.7	12.2	12.5
72896[b]	19.2	18.1	15.3	13.5	12.4
72898[b]	10.2	8.6	7.2	6.8	7.3
78017[b]	11.4	10.3	9.8	10.0	9.9
72007[c, d] (Combat)	28.7	24.7	27.4	39.9	45.5[h]
72007[c, d] (Tactical)	38.8	25.0	34.8	28.7	27.8
72007[c] (Total)	67.5	49.7	62.2	68.6	74.3[h]
72207[e]	2.5	2.8	8.3	11.3	11.3
TOTAL[g]	145.5	121.4	133.7	141.2	145.9

a. Expenses have been normalized to FY 1973 functions, organizational structure, and FY 1973 dollars.

b. The source for FY 1969-1972 was TACOM/CSFOR/78A Prior Year Report. For FY 1973 TACOM/AM109 Status of Fund Report.

c. These figures include expenses only for USAAMC. These expenses come under the Army Industrial Fund (AIF), PE 72007.

d. The Directorate for Maintenance at TACOM has the depot maintenance expenses for USAREUR and USARPAC. USAREUR and USARPAC expenses do not come under the AIF.

e. Since 1 July 1970, TACOM HQs has had the 72207 money for the repair parts program at the Taiwan Military Agency (TMA). TMA handles primarily tactical wheeled vehicles. However, TMA did handle a large volume of the overhaul work on M-48A3 tanks which were used in the Vietnam conflict. In addition, this includes expenses for Basic Issue Items (BII).

f. The depots, Anniston, Red River, and Letterkenny, which do work for TACOM are funded for their supply depot operations activities with AMC 71111 money through MIDA. The 71111 expenses shown here cover handling and packaging of MWO kits manufactured at the Directorate for RDT&E.

g. This total does not represent total Program 7 expenses at TACOM. It excludes PEs 78010, 78011, 78012 and 72897.

h. TACOM officially assumed end item responsibility for the M-41 series tank, M-48 series tank, M-60 series tank, M-88 and M-551 Recovery Vehicles on 1 July 1972 from ARMCOM, formerly WECOM. Prior to 1 July 1972 TACOM had only the secondary item responsibility for these systems. The depot maintenance expenses shown here reflect this change in responsibility. No personnel or manpower spaces were transferred.

(PE 78017). The M-60 tank program office funding also was assumed from WECOM. The assumption of the M-60 tank program office involved 87 positions and $1.9 million.* The normalization of PE expense data for all years incorporated all of the aforementioned changes in program element funding.

All of the program element expense data were normalized to an FY 1973 base. For PEs 71111, 71112, 71113, 72896, 72898 and 78017, the AMC civil service salary scale was used. For depot maintenance expenses, the AMC composite salary (graded salaries and wage board) indices were used. These normalization indices, a multiplication factor applied to the data of each year, were presented in Table 11.

2. TACOM Program Element Cost Estimating Relationships

a. Program Element 71112. The hypothesized functional relationship for PE 71112 is presented in Table 28. The CER for PE 71112 considers independent variables which contribute to the amount (volume) of resources that must be managed (indicator of workload at TACOM). The variation in one variable, total annual Stock Fund Sales, explained 90 percent of the variation in total PE 71112 annual expenses over the time period FY 1969-1973. The regression equation along with the comparison of the actual PE 71112 expenses and the expenses estimated by the equation are presented in Table 28.

The use of total annual Stock Fund Sales as the independent variable will prevent the direct estimation of PE 71112 resource requirements on the basis of force structure variables. A relationship linking Stock Fund Sales to a force structure variable is needed.

---

*52 positions--$1.1 million PE 72898, 26 positions--$.6 million PE 78012 and 9 positions--$.2 million PE 78017.

Table 28. HYPOTHESIZED FUNCTIONAL RELATIONSHIP FOR PE 71112

$$\begin{pmatrix} \text{PE 71112 Directorate for Materiel Management} \end{pmatrix} = f$$

2. Weapon System Activity[a]
3. Number of Systems Managed
4. Stock Fund Sales
5. Investment in Replenishment Spares
6. Investment in Initial Spares
7. Total Strength of the Army (Numerical)
8. Total Strength of the Army (DFE)
9. Total Assets

D. Total Maintenance

REGRESSION EQUATION

PE 73112 ($ Million) = 16.3824 + .0093 Stock Fund Sales
(.0018)

$R^2 = .90$

$F = 24.20$

Fiscal Year	Actual PE 71112 Dollars (Millions)	Estimated PE 71112 Dollars (Millions)
1969	20.60	20.37
1970	19.40	19.52
1971	18.00	18.56
1972	18.60	18.48
1973	18.10	17.75

a. The numbers to the left of the listed variables refer to the listings in Tables 24 and 25.

b. Program Element 71113. The hypothesized functional relationships for PE 71113 are presented in Tables 29 and 30. The hypothesized functional relationships try to identify those variables that determine procurement actions requiring the supervision of the Directorate for Procurement and Production. The variation in two variables, Investment in Replenishment Spares and Number of Systems Managed, explained 98 percent of the variation in total PE 71113 annual expenses over the time period FY 1969-1973.

In addition, a CER for PE 71113, which has one independent variable, Investment in Replenishment Spares, is presented in Table 30. This CER shows that the majority of the workload for the Directorate for Procurement and Production can be accounted for by Investment in Replenishment Spares. Eighty-nine percent of the variation in total PE 71113 annual expenses over the time period FY 1969-1973 can be explained by variations in Investment in Replenishment Spares. The number of systems managed does contribute to the amount of work within the Directorate for Procurement and Production, but only a small degree.

The CERs and a comparison of the actual PE 71113 expenses and the expenses estimated by the equations are presented in Tables 29 and 30, respectively.

Once again, the variables used to explain the variations in a program element over a time period will prevent direct estimation of the program element requirements on the basis of force structure variables. A relationship linking these variables to force structure variables, such as inventory, level of activity, and force mix, is needed.

c. Cost Estimating Relationship for M-60 Depot Maintenance Costs. The M-60 tank series includes the most important and sophisticated weapon systems within the Army's combat vehicle fleet. These weapon systems have been deployed primarily in

Table 29. HYPOTHESIZED FUNCTIONAL RELATIONSHIP FOR PE 71113-OPTION 1

$$\begin{pmatrix} \text{PE 71113} \\ \text{Directorate for} \\ \text{Procurement and} \\ \text{Production} \end{pmatrix} = f$$

2. Weapon System Activity[a]
3. Number of Systems Managed
4. Stock Fund Sales
5. Investment in Replenishment Spares
6. Investment in Initial Spares
7. Total Strength of the Army (Numerical)
8. Total Strength of the Army (DFE)
9. Total Assets

D. Total Maintenance

REGRESSION EQUATION

PE 71113 ($ Million) = 8.4059 + .0111 Investment in Replenishment Spares (.0010)

+ .0028 Number of Systems (.0007)

$R^2 = .98$

$F = 61.04$

Fiscal Year	Actual PE 71113 Dollars (Millions)	Estimated PE 71113 Dollars (Millions)
1969	14.10	14.10
1970	12.40	12.43
1971	12.70	12.54
1972	12.20	12.24
1973	12.50	12.59

a. The numbers to the left of the variables listed refer to the listings in Tables 24 and 25.

Table 30. HYPOTHESIZED FUNCTIONAL RELATIONSHIP FOR PE 71113-OPTION 2

$$\begin{pmatrix} \text{PE 71113} \\ \text{Directorate for} \\ \text{Procurement and} \\ \text{Production} \end{pmatrix} = f$$

2. Weapon System Activity[a]
3. Number of Systems Managed
4. Stock Fund Sales
5. Investment in Replenishment Spares
6. Investment in Initial Spares
7. Total Strength of the Army (Numerical)
8. Total Strength of the Army (DFE)
9. Total Assets

D. Total Maintenance

REGRESSION EQUATION

PE 71113 ($ Million) = 10.7535 + .0102 Investment in Replenishment Spares
(.0021)

$R^2 = .89$

$F = 22.86$

Fiscal Year	Actual PE 71113 Dollars (Millions)	Estimated PE 71113 Dollars (Millions)
1969	14.10	13.97
1970	12.40	12.85
1971	12.70	12.50
1972	12.20	12.13
1973	12.50	12.45

a. The numbers to the left of the variables listed refer to the listings in Tables 24 and 25.

Europe and CONUS. The M-60 tank series was not used in the Vietnam conflict; the M-48A3 tank was used exclusively in that area.

As stated earlier, the research at TACOM was hindered by lack of data. The analyst at TACOM, who recently assumed analytical responsibilities associated with the M-60 tank series, had some historical summary data;* however, the transfer of the ARMCOM (formerly WECOM) files to TACOM resulted in the loss or destruction of useful historical summary data on the M-60 tank series.

Based on the depot maintenance criteria for U.S. Army combat vehicles, it was assumed initially that the variable, Intensity of Operational Employment (inventory times the level of activity of the inventory), would be the best explainer of variations in depot maintenance expenses for the M-60 tank series.** The combat vehicle mileage data, however, were not readily available on an annual basis. Considerable time would have been required to obtain the data in the appropriate format. The data requirements for the follow-on study, shown in Appendix C, include the mileage data on an annual basis for combat and tactical vehicles. The use of Intensity of Operational Employment as an independent variable will be pursued in the follow-on study.

---

*As of 1 July 1972, TACOM assumed end-item in addition to secondary-item responsibility, which it already had, from ARMCOM (formerly WECOM) for the M-41, M-48, and M-60 series tanks, and the M-88 and M-551 combat vehicles.

**The same rationale was used in developing the depot maintenance CER for the UH-1. Appendix A contains a complete list of the criteria for depot maintenance of all U.S. Army weapon systems.

A depot maintenance cost-estimating relationship was developed for the M-60 tank series in which the variation in one variable, end year M-60 Active Inventory, explained 91 percent of the variation in depot maintenance expenses over the time period FY 1969-1973.* A careful study of the CER and the data used to derive it, however, revealed that severe reservations exist concerning the use of the CER in evaluating the impact of alternative M-60 inventory levels on depot maintenance costs. First, there is a large negative constant term. The equation is not usable below an M-60 active inventory level of 2,321. Second, the CER was derived from a set of actual inventory data with very limited range of values. The independent variable, Inventory, varied between 2,550 and 2,671--only 5 percent, whereas the dependent variable, Depot Maintenance Expenses, varied between $15.95 million and $23.79 million, or 50 percent. It is inadvisable to use a CER based on independent variable data of a very limited range if the regression equation has a large negative constant term. Third, it does not appear that inventory was the true driving force behind the variability in depot maintenance expenses for the M-60 tank series over the time period considered, FY 1969-1973. During the Vietnam conflict, the M-48A3 enjoyed a higher priority in terms of financing depot maintenance requirements. It appears that the depot maintenance expenses for the M-60 tank series were determined on a residual basis after the needs of the higher priority tank system were met. If depot maintenance expenses for the major Army tank systems, M-48A3, M-60, and M-60A1, were considered in the aggregate, a strong positive relationship between inventory or level of operational employment of the inventory and depot maintenance expenses should be found.

---

*$$\begin{matrix}\text{M-60} \\ \text{Depot Maintenance} \\ \text{Costs (Millions of \$)}\end{matrix} = -162.494 + \underset{(.0123)}{.07001}\begin{pmatrix}\text{M-60} \\ \text{Active} \\ \text{Inventory}\end{pmatrix}$$

Until an aggregate CER for the major Army tank systems can be developed, the use of an average cost factor for the M-60 tank series is recommended. The average unit funded cyclical overhaul cost for an M-60/60A1, at the Mainz Army Depot is $48,281. At Anniston Army Depot it is $44,400.* The average annual depot maintenance expense for an M-60/60A1 tank, considering the total active inventory, is $7,595.**

G. SUMMARY COMMENTS

The exploratory quantitative analysis for this study was conducted at the AMC Commodity Command level. This was done to permit better identification of the independent Program 7 resource requirements and to permit the analyst to become familiar with data sources at the operational materiel management level. Furthermore, the task order requirement to prepare "first cut" CERs on the M-60 tank and the UH-1 helicopter dictated an analysis at this management level.

The work done at AVSCOM and TACOM yielded promising results in terms of potential for an Army Program 7 budget model. A reasonable depot maintenance CER was developed for the UH-1 helicopter, using an independent variable directly related to force structure. Good relationships were found between PE 71112

---

*This unit-funded cost is based on an exchange rate of $1 = 2.83 Deutsche marks. The source of this unit-funded cost was the comptroller at the government-owned, contractor-operated Mainz facility. The source for the unit-funded cost at Anniston Army Depot was a MIDA computerized listing of Direct Army Organic Requirements at each depot, which constituted 95 percent of the total funded costs at that depot (April 1973).

**This figure was derived by taking the total M-60/60A1 annual depot maintenance expense for FY 1973 presented in the Department of the Army OP-25 Report and dividing it by the M-60/60A1 active inventory for FY 1973.

and PE 71113 expenses and "micro" variables.* Further work will be necessary in these program elements to determine if suitable direct force structure variables can be identified or if "linking" variables will be required in the OSD model.

In the preliminary CAOMAF studies AMC has found that "linking" variables may permit the measurement of the impact of force structure changes on the management type program elements in Program 7. In the follow-on study** the possibility of relating supply depot operations (PE 71111) and the management type program elements to depot maintenance expenses will be investigated.† If successful, this should provide the linking variable that would permit measurement of the impact of force structure changes on these elements. Depot maintenance expenses are clearly related directly to varying amounts of equipment included in different force structures.

It is safe to assume that resource requirements in support type program elements†† must relate to the level of effort in depot maintenance, supply depot operations, and the management type program elements. These latter activities are the primary mission functions on the installations operated and maintained by organizations carried in the support type program elements.

---

*For purposes of this study a "micro" variable is one that cannot be directly related to force structure. Thus, Short Tons Moved is a workload independent variable that can explain resource requirements in PE 71111. Force structure data, however, do not show information on Short Tons Moved associated with different structures.

**Office of the Director of Defense Program Analysis and Evaluation Task Order PA&E-66, 8 May 1973 provides for further IDA research to develop an Army Program 7 budget model.

†Management type program elements include Inventory Control Points (71112), Procurement Operations (71113), and Maintenance Support Activities (78017).

††Support type program elements include Base Communications (Logistics) (72895), Base Operations (72896) and Command (72898).

In building the Army Program 7 budget model, therefore, studies will be conducted to determine if requirements in these primary mission program elements are suitable independent variables to use in cost estimating relationships for calculating support type program element resource requirements.

The CERs in this chapter, while rigorously derived, are merely illustrative of a methodology that should provide a useful analytical tool for evaluating quantitatively the effects on Program 7 resources of alternative force structures. Before the methodology can be used for this purpose, however, additional measurement data for the set of variables covering all of Army Program 7 must be acquired and arrayed. Then functional relationships between resource requirements in all Program 7 elements and the set of variables must be developed.

Appendix C contains a statement of data requirements deemed to be necessary to complete the analysis and develop an OSD budget model for Program 7 of the Army FYDP.

APPENDIX A

DEPOT MAINTENANCE CRITERIA

Table A-1. CRITERIA FOR DEPOT MAINTENANCE OF ARMY WEAPON SYSTEMS

Weapon System	Criteria
Aircraft (Combat Operations)	
UH-1B/C/M	2700 hours or 36 months/technical inspection[a]
UH-1D/H	3300 hours or 36 months/technical inspection[a]
AH-1G	3300 hours or 36 months/technical inspection[a]
CH-47/CH-54	2400 hours or 36 months/technical inspection[a]
OH-6/OH-58	2400 hours or 36 months/technical inspection[a]
OV-1	36 months/technical inspection[a]
U-21	48 months/technical inspection[a]
RU (All Models)	36 months/technical inspection[a]
Aircraft (Peacetime Operations)	
First Line Aircraft[b]	60 months/technical inspection[c] - As of January, 1973 an "On Condition Maintenance" Program was established to replace the peacetime criteria. An Aircraft Condition Evaluation (on every first line aircraft) is performed by field service teams. From these Aircraft Condition Evaluations, an Aircraft Condition Profile for each first line aircraft and first line aircraft system is established. Based on this Aircraft Condition Profile and a list of priorities among first line aircraft systems, the depot maintenance program will be developed given the amount of dollars allocated for depot maintenance.
Second Line Aircraft	Condition
Tactical Vehicles	Vehicles are chosen for overhaul on a selected basis in order to extend the operational life time of fleet. (Operational life time-mean 10-12 years, maximum 15 years).
Combat Vehicles	
Europe (All Equipment)	5000 miles; anytime before this if a technical inspection at the GSU level dictates depot level work is required.
CONUS (Generally)	5000 miles; technical inspection
Tanks	6000 miles; technical inspection
APC	7500 miles; technical inspection
Self Propelled Artillery (All Geographical Areas)	
M107 Artillery Gun	5000 miles; 10,000 rounds fired - gun tube and breech mechanism
M110 Howitzer	5000 miles; 45,000 rounds fired - gun tube and breech mechanism
M109 Howitzer	5000 miles; 30,000 rounds fired - gun tube and breech mechanism
M108 Howitzer	5000 miles; 50,000 rounds fired - gun tube and breech mechanism
XM163 Anti-Aircraft	7000 miles; 576,000 rounds fired - gun tube and breech mechanism
Towed Artillery (Vietnam,[d] Thailand and Korea)	
M102 (MOD) Howitzer	44,000 rounds fired
M101A1 Howitzer	52,000 rounds fired
M114A1 Howitzer	46,000 rounds fired
Towed Artillery (All Other Geographical Areas)	
M102 (MOD) Howitzer	44,250 rounds fired
M101A1 Howitzer	50,000 rounds fired
M114A1 Howitzer	46,500 rounds fired
Construction Equipment Material Handling Equipment Rail Equipment Ships	Overhaul selection is based on a technical inspection of a piece of equipment using the appropriate technical manual.
Electronics and Communication Equipment	Technical inspection; for planning purposes, 5 percent first year, 10 percent second year, 20 percent third year, 30 percent each year after third year (TB750-252, 5 February 1971).
Missile Systems	The overhaul criteria for missile systems are predicated on three factors: Shelf/service life, hours of usage and inspection or engineering factors as determined by previous maintenance experience for similar items. The shelf/service life of missiles containing explosive propellants and components is normally as follows: Hawk - 5 year shelf life for rounds in depot stocks and 3 years for rounds tactically deployed and technical inspection to extend to 5 years Shillelagh - 5 year shelf life/technical inspection Chaparral - 10 year shelf life/technical inspection Nike-Hercules - Missile body sections are overhauled as a result of technical inspection of electronic and hydraulic components. Propellants and explosive components are recorded depending on individual item shelf life which varies from 7 to 20 years. Tow - 5 years shelf life/technical inspection Redeye - 10 year shelf life/technical inspection Pershing - 10 year shelf life/technical inspection Sergeant - 10 year shelf life/technical inspection Honest John - 10 year shelf life/technical inspection The tactically deployed Hawk and Nike-Hercules ground guidance systems are scheduled for overhaul on a 5 to 8 year mean time between overhaul basis

a. An aircraft can be selected for overhaul before this time, if a technical inspection at the GSU level dictates depot level work is required.
b. First line aircraft are defined as all aircraft in production and out of production that are mission essential and deployable to a combat theatre. These aircraft receive top priority considerations for depot maintenance support.
c. The 60 months or technical inspection peacetime operations maintenance criteria was in effect until January 1973 when the "On Condition Maintenance" Program was initiated.
d. The maintenance criteria for equipment deployed in Vietnam is relevant to this study because the historical data base being used in this study will include weapon systems deployed in Vietnam.

SOURCE: The sources for this information were: AR 750-1, Army Materiel Maintenance Concepts and Policies, May 1972; DA Pamphlet 310-4, Military Publications, Index of Technical Manuals and Technical Bulletins, June 1972; TB 750-231 Self Propelled and Towed Artillery, June 1970 and TM 55-1500-328-25, Aeronautical Equipment Maintenance Management Policies and Procedures, July 1972.

APPENDIX B

THREE EXAMPLES OF STATISTICAL MODEL DEVELOPMENT IN AMC

APPENDIX B

THREE EXAMPLES OF STATISTICAL MODEL DEVELOPMENT IN AMC

B-1. AVSCOM's WORKLOAD AND RESOURCES MATHEMATICAL PREDICTION MODEL

This model was developed by the Systems Analysis Office of the Directorate for Plans and Analysis, AVSCOM. It is designed to predict the manpower requirements in certain key directorates--RDT&E, Procurement and Production, Materiel Management, Maintenance and Product Assurance, and at ARADMAC.

The model is not intended to be the sole predictor of manning requirements, rather, it is to be used for cross checking requirements submitted by the listed AVSCOM activities. These latter submissions are developed in accordance with formal guidance from AMC on workload variables. If there is a significant disparity between the manning requirements submitted by a directorate and those predicted by the model, an attempt is made to reconcile the two calculations and determine realistic but adequate manning figures. The coordinated manning requirements are then compared with manpower ceiling figures received from AMC. This comparison provides a basis for impact statements.

The data base for the AVSCOM model covers the period 1964-1972. The model considers 6 specific independent variables and 19 combinations of these 6 variables. The independent variables are: Total Flying Hour Program, Fleet Quantity (Inventory), Fleet Worth [Flyaway Unit Cost of an Aircraft System (Complexity Factor) times the Inventory of the System], Number of Line Items Managed, Value of Total Assets (Fleet Worth plus Depot Assets), and Number of Aircraft Systems.

In developing the model, correlation analysis was used to determine the best representative driver of a directorate's manpower requirements. A series of iterative operations is performed on the various independent variables. These variables are correlated separately with the dependent variable for each

directorate (man-years or man-hours). The iteration which provides the highest correlation with the dependent variable is interpreted as providing the best representative driver of the manpower requirements. Once the apparent driver of a directorate's manpower requirements has been determined, a least squares line of best fit is derived for prediction purposes. The representative drivers and the appropriate directorates are listed below.

Directorate	Representative Driver
RDT&E Personnel	Total Inventory x Total Flying Hours
Procurement and Production Personnel	Total Assets
Materiel Management Personnel	Total Inventory x Total Flying Hours x Fleet Worth
Maintenance Personnel	Total Inventory x Total Flying Hours
Product Assurance Personnel	$(\text{Total Inventory})^2$ x $(\text{Total Flying Hours})^2$ x Fleet Worth
ARADMAC Personnel	$\frac{\text{Total Assets x Total Inventory}}{\text{Total Flying Hours}}$
TOTAL AVSCOM Personnel	Fleet Worth

There is no evidence that cause-and-effect relationships are established before the iterations are conducted. The AVSCOM staff considers the model useful for limited application in accordance with its objective.

B-2. TACOM-COMPUTERIZED MANPOWER MODEL

This model, developed by the TACOM Cost Analysis Division, is used to predict manpower requirements in all TACOM directorates.

The data base for the model covers the period 1965-1972. For each directorate, except Maintenance, a simple linear equation is used with TACOM Net Demands (requisitioned line items less cancelled requisitioned line items) as the independent variable to explain manpower requirements. The equation for the Directorate for Maintenance has Equipment Improvement Requests (EIR) as the independent variable.

The model is very useful to the TACOM commander, because it uses the primary variable that appears to determine internal TACOM workload. However, the use of "micro" as opposed to "macro" independent variables precludes the direct evaluation of alternative force structures and their impact on Program 7 resource requirements.*

B-3. MIDA-LINEAR PROGRAMMING MODEL FOR PLANNING ORGANIC DEPOT WORKLOADS

This planning model, developed by the MIDA Operations Research Office, is designed to aid in determining a proper distribution of maintenance workload among the AMC depots. The critical variables are: Priority of the Items for Maintenance, Requirements by Commodity Command, Total Work Center Man-hours and Equipment Hours Available, by Depot. Using these variables, the model, through linear programming techniques, distributes the maintenance workload by depot, allocating workload first to prime depots and then to the secondary depots for the individual items.

---

*A typical micro independent variable would be Requisitioned Line Items, Equipment Improvement Requests, Short Tons Handled, and Line Items Managed. A typical macro independent variable would be Active Inventory of Weapon Systems, Weapon System Mix, and Level of Activity of Weapon Systems. A micro variable can be used in force structure analysis only through the use of some form of linking equation (see Chapter IV discussion of the Army CAOMAF program). On the other hand, a suitable macro variable may be used in a single equation to measure force structure impacts on Program 7 elements.

First, the following function is minimized for prime depots:

$$\text{Minimize} \left\{ \begin{array}{l} \text{Priority Value} \\ \text{of Prime Organic} \\ \text{Production} \end{array} + \begin{array}{l} \text{Priority Value} \\ \text{of Prime Production} \\ \text{Shortages} \end{array} \right\}$$

$$= \text{Minimize} \left\{ \begin{array}{l} \text{Priority Value} \\ \text{of Prime} \\ \text{Production} \end{array} \right\}$$

Subject to the following constraints,

I. $\left\{ \begin{array}{l} \text{Prime Depot} \\ \text{Production} \end{array} + \begin{array}{l} \text{Prime Production} \\ \text{Shortage} \end{array} \right\} = \begin{array}{l} \text{Customers Required} \\ \text{Quantity} \end{array}$

(for all customer program requirements)

II. $\left\{ \begin{array}{l} \text{Total Man-hours Utilized Per} \\ \text{Workcenter Per Depot} \end{array} \right\} \leq$ Total Workcenter Man-hours

(for each workcenter at each depot)

III. $\left\{ \begin{array}{l} \text{Total Equipment Hours Utilized} \\ \text{Per Equipment Per Depot} \end{array} \right\} \leq$ Total Equipment Hours

(for each piece of equipment at each depot)

IV. $\left\{ \begin{array}{l} \text{Total Spaces Utilized} \\ \text{Per Workcenter Per Depot} \end{array} \right\} \leq$ Total Workcenter Space

After the prime depot workload has been planned, the model distributes remaining workload beyond the capability of the prime depots to the secondary depots. The following function is minimized for secondary depot maintenance.

$$\text{Minimize} \left\{ \begin{array}{l} \text{Priority} \\ \text{Value of} \\ \text{Secondary} \\ \text{Production} \end{array} + \begin{array}{l} \text{Priority Value} \\ \text{of Secondary} \\ \text{Production} \\ \text{Shortages} \end{array} \right\} = \left\{ \begin{array}{l} \text{Priority} \\ \text{Value of} \\ \text{Secondary} \\ \text{Production} \end{array} \right\}$$

subject to the following constraints,

I. $\left\{ \begin{array}{l} \text{Secondary} \\ \text{Depot} \\ \text{Production} \end{array} + \begin{array}{l} \text{Secondary} \\ \text{Production} \\ \text{Shortages} \end{array} \right\} = \left\{ \begin{array}{l} \text{Prime} \\ \text{Production} \\ \text{Shortage} \end{array} \right\}$

II. $\left\{\begin{array}{l}\text{Total Man-hours Utilized} \\ \text{Per Workcenter Per Depot}\end{array}\right\} \leq$ Remaining Workcenter Man-hours
(for each workcenter at each depot)

III. $\left\{\begin{array}{l}\text{Total Equipment Utilized} \\ \text{Per Workcenter Per Depot}\end{array}\right\} \leq$ Remaining Equipment Hours
(for each piece of equipment at each depot)

IV. $\left\{\begin{array}{l}\text{Total Space Utilized} \\ \text{Per Workcenter Per Depot}\end{array}\right\} \leq$ Remaining Workcenter Space
(for each workcenter at each depot)

APPENDIX C

DATA REQUIREMENTS FOR FURTHER WORK ON AN ARMY PROGRAM 7 MODEL

APPENDIX C

DATA REQUIREMENTS FOR FURTHER WORK ON AN ARMY PROGRAM 7 MODEL

Research on the Army Logistics Support Study under OASD/SA Task Order SA-59, September 11, 1972, has made it possible to identify a tentative list of data required to develop a complete Army Program 7 budget model. Based on work on the current study it has been concluded that the categories of data discussed below are available in the Department of the Army.

Because an OSD model must be highly aggregated, the budget model, if possible, should be prepared on a total Program 7 basis. In other words, the model should not involve separate calculations for each AMC major subordinate command. It may be necessary to divide inputs into three categories: AMC, MTMTS, and Overseas. This should be manageable, however, at the OSD level.

It must be recognized that the following categories of data represent a "first cut" at a total data requirement based on research conducted to date. As model development work continues it may be discovered that additional data are required. For example, it may be necessary to show information by AMC major subordinate command and then have it aggregated by the IDA study team to secure the proper relationships.

Following are the categories of required data envisioned now for the follow-on study. Specific requirements are shown by program element in Sections C-1 through C-9. Table C-1 is a matrix that recapitulates on one format the data requirements described in Sections C-1 through C-9. Sections C-10 and C-11 contain other supplementary required information. Unless otherwise indicated, all cost and manpower data should be shown

by year FY 1968 through FY 1973 and normalized in all program elements to the FY 1974 organization, management, and accounting structures, as prescribed in AR 37-100-74. In the "All Other" category, show MTMTS data separately for those program elements that apply to MTMTS. Data should also be in FY 1973 constant dollars.

C-1. PROGRAM ELEMENTS 71111, 71112, 71113, 72896, AND 72898

Show separately by AMC and All Other (presumably only Overseas Commands) the following, by program element and fiscal year:

Military Personnel (All Categories)	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Utilities and Rent	Total Cost
Printing and Reproduction	Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
Other Supplies	Total Cost
Equipment	Total Cost
All Other OMA	Total Cost
Total Obligations for Year	Total
Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line aggregating to above total cost line	
Direct Obligations (Total less Reimbursements)	Total

In the above listing, a breakdown is requested of Other Purchased Services and Reimbursements. This is to permit the IDA analysts to understand not only sources and variability in these accounts but also interactions with AMC activities financed under the industrial fund concept. This takes on added significance in view of the further implementation of industrial funding at the depots effective 1 July 1973.

C-2. PROGRAM ELEMENTS 72003, 72005, 72007, and 72009

Additional information relating to PE 72007 for depot maintenance is set forth below.

Copies of final actual data in format of Statements A-2 and A-3, DA Forms 2266-R, 2268-R, and 2268-1-R for each fiscal year for the Munitions Command, Weapons Command, AMC Depot Maintenance Activities, and the Missile Command. Total annual data will suffice--no quarterly data required. Furthermore, on the A-3 format, only two columns are required for each year--orders received and billings revenue. It would be most useful if one A-2 and one A-3 could be submitted for each activity with a column for each fiscal year.

C-3. PROGRAM ELEMENT 72207

Show separately by AMC and All Other (presumably only Overseas Commands) the following by program element and by fiscal year:

Military Personnel (All Categories)	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Purchased Equipment Maintenance, Intra DoD	Total Cost
Major line item breakdown of Purchased Equipment Maintenance, Intra DoD	Cost, each line aggregating to above total cost line
Purchased Equipment Maintenance, Commercial	Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
Other Supplies	Total Cost
All Other OMA	Total Cost
Total Obligations for Year	Total

(Cont.)

Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-4. PROGRAM ELEMENT 72895

It is understood that resources carried in this program element will be transferred to FYDP Program 3 in FY 1974. If so, data need not be furnished for PE 72895, provided that the resources are deleted from the FY 1968-FY 1973 historical data base, regardless of where the resources were carried in previous years. Otherwise, data will have to be shown by year FY 1968--FY 1973 in following form.

Show separately by AMC and All Other (presumably only Overseas Commands) the following by fiscal year:

Military Personnel (All Categories)	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Communications	Total Cost
All Other OMA	Total Cost
Total Obligations for Year	Total
Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-5. PROGRAM ELEMENT 72897

Show separately by AMC and All Other (presumably only Overseas Commands) the following by fiscal year:

Military Personnel	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
All Other OMA	Total Cost
Total Obligations Per Year	Total
Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-6. PROGRAM ELEMENT 78010

Show following breakdown of total Program 7 costs by fiscal year:

Military Personnel	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Transportation of Things	Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
Other Supplies	Total Cost
All Other OMA	Total Cost
Total Obligations Per Year	Total
Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-7. PROGRAM ELEMENT 78011

Show following breakdown of total Program 7 costs by fiscal year:

Military Personnel	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Purchased Equipment Maintenance, Commercial	Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
All Other OMA	Total Cost
Total Obligations for Year	Total
Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-8. PROGRAM ELEMENT 78012

Show following breakdown of total Program 7 costs by fiscal year:

Military Personnel	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Travel of Personnel	Total Cost
Printing and Reproduction	Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
Other Supplies	Total Cost
All Other OMA	Total Cost
Total Obligations for Year	Total

(Cont.)

Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-9. PROGRAM ELEMENT 78017

Military Personnel	Man-Years, Total Cost
Civilian Personnel	Man-Years, Total Cost
Travel of Personnel	Total Cost
Printing and Reproduction	Total Cost
Other Purchased Services	Total Cost
Major line item breakdown of Other Purchased Services	Cost, each line aggregating to above total cost line
All Other OMA	Total Cost
Total Obligations for Year	Total
Reimbursements	Total Cost
Major line item breakdown of sources of reimbursements by cost for each line, aggregating to above total cost line	
Direct Obligations (Total Less Reimbursements)	Total

C-10. DEPOT MAINTENANCE - ADDITIONAL INFORMATION

- A copy of the OP-25 report for the Department of Army showing actual Depot Level Maintenance and Support Activities Obligations/Expenses for each fiscal year FY 1972 and FY 1973 and the program/budget for FY 1974.
- See Paragraph C-11.5 below.

C-11. MISCELLANEOUS INFORMATION - ALL DATA BY FISCAL YEARS 1968 - 1973, INCLUSIVE, UNLESS OTHERWISE INDICATED

1. Total Army Procurement Appropriations Direct Obligations in following categories. (Note--Data for FYs 1972 and 1973 need not be provided since they are available in Army FYDP of 2 February 1973.)

Aircraft Procurement

Missile Procurement

Procurement Weapons and Tracked Combat Vehicles

Procurement of Ammunition

Other Procurement

2. Army Stock Fund

   - A copy of statement 6 Army Stock Fund budget Form RCS CSGLD 1111 for each Materiel Category, for each Stock Fund Division for each fiscal year-actual. This includes "Reimbursable Issues" sheet and "Analysis of Customer Orders."

3. Worldwide mileage accumulated by the tactical and combat vehicle fleet by weapon system, by fiscal year, FY 1968 through FY 1973, and corresponding active inventory as of the end of each fiscal year. This information pertains only to direct Army operational employment. See Fleet Management Report RCS/AMCMA-152.

   The tactical vehicles of particular interest are:

   - 1/4 ton (ABT)
   - 1-1/4 ton (ABT)
   - 2-1/2 ton (ABT)
   - 5 ton (ABT)
   - 10 ton (ABT)

   The combat vehicles of particular interest are:

M-48 Series Tank	M163
M-60 Series Tank	M42A
M113A	M110
M106	M578
M106A	M728
M125A	M108
M132	M109
M132A	M88
M577	M551
M577A	M114
M548	M114A
M107	M113

4. Copies of Army annual statistical summary reports (for example, "The Gold Book" RCS-AMCMR-123) showing weapon and support system inventories and activity rates such as flying hours on aircraft. Reports should be as of the end of each fiscal year, FY 1968 through FY 1973.

5. The following information for each weapon system and other categories listed on Table C-2, by fiscal year, FY 1968 through FY 1973.

   a. Initial and Replenishment Spares Cost

   b. Modification Installation Costs

   c. Total Organic Depot Maintenance Cost and Direct Labor Hours*

   d. Average Organic Depot Maintenance Cost and Direct Labor Hours per Inventory Weapon System*

   e. Total Contract Depot Maintenance Cost and Direct Labor Hours*

   f. Average Contract Depot Maintenance Cost and Direct Labor Hours per Inventory Weapon System*

   g. A supply and maintenance history on each major weapon system on Table C-2 (those identified with an asterisk). These histories should include information on significant unprogrammed maintenance events which affected the amount of funds required to support each system over the FY 1968 - FY 1973 time period.

6. An identification of important approved program actions that will have a major impact on Army Central Supply and Maintenance during the period FY 1974 through FY 1976. This would include such actions as possible

---

*All depot maintenance costs should include a proration for peculiar and common components depot maintenance costs to the individual weapon system. Average depot maintenance costs need not be computed for the categories other than weapon systems. The total of data requested in paragraphs 5c and 5e should aggregate to the total direct Army OMA depot maintenance program for each year included in PE 72207.

programs to transfer major resources from the active Army to the Reserve forces, phase-down of depot maintenance operations overseas, and similar programs.

7. For each AMC and Overseas depot identify the major weapon system and federal stock numbers for which that depot is prime in terms of supply support or depot maintenance.

8. A matrix showing the interrelationship of weapon system responsibilities among commodity commands (those identified with an asterisk). The vertical columns of matrix should show the Army weapon systems (see Table C-2) and the commodity commands which have support responsibilities for these weapon systems.* The horizontal rows should identify commodity command responsibilities by weapon system. Show in the appropriate block the support system managed by commodity command for the listed weapon system. For example:

Weapon System	Support Systems					
	AVSCOM	TACOM	ARMCOM	MICOM	TROSCOM	ECOM
UH-1 AVSCOM	Major End Item					X Avionics
AH-1G AVSCOM	Major End Item		X Armament Ammo	X TOW Missile		X Avionics
M-60A1 TACOM		Major End Item	X Turret Gun Ammo			X Radio & Range Finder
M-107 ARMCOM		X Engine Transmission Final Drive	Major End Item			X Range Finder

*Only weapon systems from attached list.

Table C-1. SUMMARY OF OPERATING COST DATA REQUIREMENTS*

Type of Information	PROGRAM ELEMENTS											
	71111	71112	71113	72896	72897	72898	72207	72895	78010	78011	78012	78017
Military Personnel												
Man Years	X	X	X	X	X	X	X	X	X	X	X	X
Total Cost	X	X	X	X	X	X	X	X	X	X	X	X
Civilian Personnel												
Man Years	X	X	X	X	X	X	X	X	X	X	X	X
Total Cost	X	X	X	X	X	X	X	X	X	X	X	X
Communications - Total Cost								X				
Utilities & Rent - Total Cost	X	X	X	X		X						
Travel of Personnel - Total Cost											X	X
Printing & Reproduction - Total Cost	X	X	X	X		X					X	X
Transportation of Things - Total Cost									X			
Other Purchased Services - Total Cost	X	X	X	X	X	X	X		X	X	X	X
Major Line Item Breakdown of Other Purchased Services	X	X	X	X	X	X	X		X	X	X	X
_____	X	X	X	X	X	X	X		X	X	X	X
_____	X	X	X	X	X	X	X		X	X	X	X
_____	X	X	X	X	X	X	X		X	X	X	X
_____	X	X	X	X	X	X	X		X	X	X	X
Purchased Equipment Maintenance - Intra DOD - Total Cost							X					
Major Line Item Breakdown of Purchased Equipment Maintenance - Intra DOD							X					
_____							X					
_____							X					
_____							X					
_____							X					
Purchased Equipment Maintenance - Commercial - Total Cost							X			X		
Other Supplies - Total Cost	X	X	X	X		X	X		X		X	
Equipment - Total Cost	X	X	X	X		X						
All Other OMA - Total Cost	X	X	X	X	X	X	X	X	X	X	X	X
Total Obligations Per Year - Total	X	X	X	X	X	X	X	X	X	X	X	X
Reimbursements - Total Cost	X	X	X	X	X	X	X	X	X	X	X	X
Major Line Item Breakdown of Sources of Reimbursements	X	X	X	X	X	X	X	X	X	X	X	X
_____	X	X	X	X	X	X	X	X	X	X	X	X
_____	X	X	X	X	X	X	X	X	X	X	X	X
_____	X	X	X	X	X	X	X	X	X	X	X	X
_____	X	X	X	X	X	X	X	X	X	X	X	
Direct Obligations (Total Less Reimbursements)	X	X	X	X	X	X	X	X	X	X	X	

*SHOW INFORMATION BY FISCAL YEAR FOR FISCAL YEARS - FY 1968 THROUGH FY 1973

Separate Data Required for Applicable Program Elements: AMC, All Other, and WPMTS (for those program elements that apply to WPMTS).

Table C-2. DATA REQUIREMENTS WEAPON SYSTEMS LIST
(In accordance with AR 37-55)

Aircraft

*UH-1 Helicopter
*AH-1G Helicopter
*CH-47 Helicopter
CH-54 Helicopter
OH-6 Helicopter
OH-58 Helicopter
*OV-1 Fixed-Wing Aircraft
*U-21/RU-21 Fixed-Wing Aircraft
All Other Aircraft

Automotive Equipment

*1/4 Ton (ABT)
1-1/4 Ton (ABT)
*2-1/2 Ton (ABT)
5 Ton (ABT)
10 Ton (ABT)
All Other Tactical Vehicles

Support Vehicles
Administrative Vehicles

Combat Vehicles

*M-48A3 Tank (90MM)
*M-60 Tank (105MM)
*M-60A1 Tank (105MM)
Other Tanks
*M-106/A1 APC Mortar (107MM)
*M125A1 APC Mortar (81MM)
*M113/A1 APC F.T.
M114/A1 APC Command Post and Reconnaissance
*M577/A1 APC Command Post
*M548 Cargo Carrier (6 Ton)
*M551 Armored Reconnaissance Airborne Assault Vehicle
M578 Armored Recovery Vehicle
M88 Recovery Vehicle (Med.)
M728 Combat Engineering Vehicle
M107 Self-Propelled Field Artillery Gun (175MM)
*M108 Self-Propelled Howitzer (105MM)
*M109 Self-Propelled Howitzer (155MM)
*M110 Self-Propelled Howitzer 8"
Other Self-Propelled Artillery

Other Combat Vehicles

---

*See p. 197, 5g.

Table C-2. (Cont.)

Construction Vehicle

Scraper, Earth Moving, Hvy. 18 Cu. Yd.
Grader, Road Motorized, DSL, Dr. Vn., Hvy.
*20 Ton Crane Rough Terrain
Loader, Scoop Type, 2-1/2 Cu. Yd.
Tractor F.T. Medium and Heavy (Low Speed DSL)
Tractor WHL (DSL DRVN, MED W/BD HYD TILT-W/SCARIF)
Compressor, 250 CFM

Other Construction Equipment

Electronics and Communication Equipment

AN/GRC-26, /A/B/C/D, Radio Set
AN/GRC-46, Radio, TT, Set
AN/GRC-109, Radio Set
AN/PRC-25, Radio Set
AN/PPS-4/A, L/P Radar Set
AN/PPS-5/A, L/P Radar Set
AN/TVS-4, Night Vision, Sight
RT-662/GRC-106, Receiver Transmitter
RT-834/GRC-106, Receiver Transmitter
RT-505/PRC-25, Receiver Transmitter
RT-841/PRC-77, Receiver Transmitter
AM-3349/GRC-106, Amplifier

Other Electronics and Communications Equipment

Missile Systems

Sergeant
*Hawk
*Hercules
Honest John
Pershing
Other Missile Systems

Ships

Total Ships

Munitions Armament

Total Munitions

---

*See p.197 , 5g.

Table C-2. (Cont.)

Weapons Armament

*M101A1 Towed Howitzer (105MM)
M102 Towed Light Howitzer (105MM)
*M114/A1 Towed Medium Howitzer (155MM)
Gun Mach. (7.62MM)
Gun Mach. (50 Cal.)
Rifle, M16A1
Other Artillery and Guns
Small Arms
All Other Ordnance Items

Rail Equipment

Total Rail Equipment

General Equipment

Generator Set, 1.5 KW
Generator Set, 3 KW
Generator Set, 5 KW
All Other Generator Sets
Truck, Forklift, 4000 lb. Pt/SRT Gas
Truck, Forklift, 4000 lb. Elec.
Truck, Forklift, 6000 lb. PT/SRT Gas
Truck, Forklift, 6000 lb. Ded. Rt
All Other Truck, Forklifts
All Other General Equipment

Commodity Groups

Total

---

*See p. 197, 5g.

GLOSSARY

GLOSSARY

AMC LOGISTICS PROGRAM HARDCORE AUTOMATED SYSTEM (ALPHA):

This system provides a standardized method of reporting, processing, and analyzing depot maintenance requirements which are generally developed as a result of the supply control study processes.

APPROPRIATION:

A congressional authorization to spend from the Treasury for specified purposes: An "annual" appropriation must be spent or obligated for expenditure within the fiscal year for which it is made; a "continuing" or "no-year" appropriation is available until exhausted or until the purpose for which it has been provided has been fulfilled.

APPROPRIATION, MILITARY PERSONNEL (MPA):

An annual congressional authorization covering the cost of pay and allowances, permanent change of station travel, and other expenses associated with military personnel.

APPROPRIATION, OPERATIONS AND MAINTENANCE (OMA)

An annual congressional authorization covering the operating costs of the Army organizations, including those in Program 7. This is available for obligation for only one year and finances such costs as civilian personnel pay, personnel travel and transportation costs, rents, utilities, purchased equipment maintenance, supplies, and similar expenses.

APPROPRIATION, PROCUREMENT (PEMA):

A congressional authorization to acquire weapon systems, components, equipment, spare parts, and other hardware items necessary to equip and support military forces. (Procurement of Equipment and Missiles Army)

APPROPRIATION, RESEARCH AND DEVELOPMENT (RDT&E):

A congressional authorization covering the cost of research, development, engineering, design and test and evaluation activities by contractors and government installations, including procurement of equipment and materiel required for development, test, or evaluation of equipment or materiel under development.

ARMY INDUSTRIAL FUND (AIF):

A revolving fund established to finance service-type activities necessary to support military forces. It finances a continuing cycle of operations with receipts derived from such operations available in their entirety for use by the fund without further action by the Congress.

ARMY MATERIEL COMMAND (AMC):

AMC is the primary wholesale supplier for the Army. AMC consists of six commodity commands (TACOM, ARMCOM, AVSCOM, MICOM, ECOM, AND TROSCOM), one service command (TECOM), four research and development laboratories and centers (Materials and Mechanics Research Center, Harry Diamond Laboratories, Natick Laboratories, and the Biological Defense Research Center), and sixteen depots, which have the responsibility for development, test, cataloging, requirements determination, procurement, production, quality assurance, distribution, supply control, maintenance, and disposal of supplies and material.

ARMY MATERIEL PLAN (AMP-I/II):

This is the Army's primary instrument for analyzing end item management. It is a planning document used in the development and execution of the PEMA portion of the Army budget. The purpose of the AMP is to determine which PEMA-funded end items should be bought, in what quantities, and at what time. Part I integrates all elements of logistics planning directly affecting attainment of Army material objectives, namely: requirements, assets, losses, and production capabilities. It represents a target for equipment levels that should be attained on a time-phased basis in Army TOE and TOA units. Part II contains the Army's depot maintenance program requirements.

ARMY STOCK FUND (ASF):

A revolving fund administered by the Army and established to finance inventories of supplies and other stores. It is a management device used to procure, manage and issue expense type items. The fund utilizes its own working capital to purchase these items from private industry and from other government activities (primarily DoD). They are held in inventory until required by a customer, such as an Army depot maintenance activity, then they are sold to the customer. Funds received from the customer are used to replenish working capital so additional required items may be procured.

AUTHORIZED ACQUISITION OBJECTIVE (AAO):

The AAO represents the approved total Army equipment level. It includes material on hand or due in from depot maintenance, less forecasted losses plus production offsets, the items financed from available funds but not yet delivered from procurement sources, and authorized new-buy quantities.

AUTOMATED DATA PROCESSING (ADP):

Data processing/recording/manipulation performed by a system of electronic or electrical machines so interconnected and interacting as to reduce to a minimum the need for human assistance or intervention.

CENTRAL SUPPLY AND MAINTENANCE:

The segment of a military service which procures, distributes, and otherwise supports major materiel items required for operational support of service activities and performs or contracts for depot maintenance of service equipment.

CLOSED LOOP SUPPORT SYSTEM:

A totally integrated and controlled program in which DA-designated critical end items or components and assemblies are intensively managed through supply, retrograde, and overhaul to and from respective commands to provide and maintain positive control and prescribed levels of logistics readiness. The criteria that govern the selection of items for intensive management under a closed loop program are items whose high unit cost and/or complex nature limits normal logistical support, items essential to a particular mission, items in short supply that most severely affect operational readiness within a command and the criticality of which cannot be reduced to a satisfactory level through normal supply actions, and items which are in a critical worldwide asset position. (AR 110-1)

COEFFICIENT OF DETERMINATION:

A statistical term that describes the degree to which independent variables explain the variation in the dependent variable in an equation.

COMMAND ANALYSIS OF OMA FUNDING (CAOMAF):

This is an on-going activity that has evolved from Army efforts over the past four years to develop aggregative techniques for relating mission outputs to OMA and Military Personnel Appropriation (MPA) funding levels. The CAOMAF Program is based on a quasi "zero base" approach. It attempts to develop suitable equations based on past experience to permit the computation of total OMA and MPA requirements for a new budget without the need to identify the effects of individual program changes.

COMMODITY COMMAND:

A staff organization within the Army Materiel Command that exercises integrated commodity management of assigned materiel, including design and development; production and maintenance engineering; procurement, production, and industrial mobilization planning; cataloging and standardization; wholesale inventory management, stock control, and supply control; new equipment training, design of pertinent training devices, and technical assistance to users of equipment. In addition, a commodity command conducts and manages basic and applied research with respect to assigned materiel and such other research projects as may be assigned and executes assigned missions (aforementioned) in support of other AMC or DoD elements having project management or commodity management responsibility for specific weapon systems or items.

CONTRACT MAINTENANCE:

Depot level materiel maintenance performed in accordance with terms of contracts with commercial sources (i.e., private industry including both Government-Owned/Contractor-Operated and Contractor-Owned/Contractor-Operated).

COST-ESTIMATING RELATIONSHIP (CER):

A mathematical expression in which the cost of a system, item, or activity can be estimated by inserting value(s) of functionally related independent variable(s) into the expression and computing the resulting value of the dependent variable, cost.

CYCLICAL OVERHAUL:

To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards. The disassembly, test and inspection of the operating components and the basic structure to determine and accomplish the necessary rework, rebuild, replacement, and servicing required to obtain the desired performance.

DEFENSE PLANNING AND PROGRAMMING GUIDANCE (DPPG):

A comprehensive four-part document issued by OSD. It initiates the near-year force structure planning phase and establishes the necessary parameters for such planning, including financial ceilings and other constraints. The DPPG sets the stage for the total analytical effort which will culminate in the DoD program and budget. The four parts are DoD Policy Guidance on Strategy and Forces, Materiel Support Planning Guidance, Fiscal Guidance, and Guidance on Content of the Program Objectives Memorandums to be submitted by the Services.

DEPENDENT VARIABLE:

The value estimated by an equation that includes known values of a set of independent variables.

DEPOT LEVEL MAINTENANCE:

Maintenance that is the responsibility of and performed by designated maintenance activities to augment stocks of serviceable materiel, and to support organization and field maintenance activities by the use of more extensive shop facilities and equipment and personnel of higher technical skill than are normally made available at the lower levels of maintenance. Its phases normally consist of repairing, modifying, overhauling, reclaiming or rebuilding parts, assemblies, subassemblies, components, and end items; the emergency manufacturing of parts that are not available and providing technical assistance to using activities and intermediate maintenance organizations. (AR 37-55, AR 750-1, and AR 750-4)

DIRECT OBLIGATION:

This is the legal reservation of funds. An obligation is created when a contract is signed which states that the government will pay so much as consideration for goods or services received.

DIRECT SUPPLY SUPPORT (DSS):

This is a comprehensive supply program which is designed to improve the logistic support provided to user units overseas. It entails shipment of requisitioned materiel direct from CONUS depots to the user units overseas. Previously, the materiel was shipped from CONUS depots to overseas depots, then to the user unit. (DA Pamphlet 700-22)

DIRECT SUPPORT UNIT (DSU):

This unit provides direct field maintenance support to the using units or organizations. A DSU performs the following functions: exchange of serviceable for designated unserviceable end item/model or piece parts; repair on-site or for return to user of end items/modules which can be effectively and efficiently accomplished with easy-to-use tools and equipment and which will restore a high degree of reliability to the end item/module; distribution of organizational maintenance repair parts to supported units/organizations/activities; provision of technical assistance to include use of quick-reaction, highly mobile maintenance contact teams on a periodic or as required basis.

DIRECTORATE FOR MATERIEL MANAGEMENT:

The staff organization within the major subordinate command that is responsible for managing the MSC logistic support for commodities assigned to that MSC. Some of the functions are system support management, item management, provisioning of new systems, configuration control, determining organic contract maintenance mix, engineering services and cataloging, and standardization. The Directorate for Materiel Management is synonymous with Inventory Control Point.

DIRECTORATE FOR PROCUREMENT AND PRODUCTION:

The staff organization within the MSC which purchases materiel and services related to the assigned commodities; also has cognizance over specific Army contracts in terms of negotiation, administration, ans surveillance and quality assurance programs.

DIRECTORATE FOR MAINTENANCE:

The staff organization within the major subordinate command that is responsible for the centralized development, planning, and scheduling of depot maintenance activities with respect to assigned commodities.

EXPENDITURES:

In a governmental financial accounting sense, this represents the actual disbursement of funds that have previously been authorized to fulfill approved requirements. Thus, delivery of a government check to a contractor would result in the recording of an expenditure in government financial accounting records.

FEDERAL STOCK NUMBER (FSN):

An identifying number of an item of supply consisting of the four-digit Federal Supply Class (FSC) and the seven-digit Federal Item Identification Number (FIIN).

FISCAL GUIDANCE:

The Secretary of Defense's annual guidance on financial ceiling levels to be used in the planning, programming, and budgeting process by the services.

FIVE YEAR DEFENSE PROGRAM (FYDP):

The FYDP summarizes the official approved plans and programs of the Secretary of Defense for components within the Department of Defense.

FLEET WORTH:

The dollar value of the active systems managed by a major subordinate command. It is calculated by multiplying the active inventory figure for a particular system by its current average unit acquisition cost.

FORCE STRUCTURE:

The total operational and support forces authorized to a military service. Studies of force structure alternatives consider different configurations of forces in terms of total size and mix of the combat and support element.

FUNCTIONAL RELATIONSHIP:

This depicts a situation in which there is a cause-and-effect relationship. For instance, there is a functional relationship between the weapon system inventory, the level of operational employment of the inventory, and the amount of depot maintenance expenses for that inventory.

GENERAL SUPPORT UNIT (GSU):

The primary mission of a GSU is to provide logistic support to lower-category maintenance installations, DSU, and local area supply operations. A GSU performs the following functions: repair of unserviceable modules in support of the exchange service to lower-category maintenance activities; repair/modification of end items/modules for return to installation/command/local area supply stocks; support of the operational readiness float stocks of designated DSU's and other activities (repair and return-to-user programs); provide technical assistance, on-site maintenance, and contact team support to designated DSUs.

GENERATION RATE:

This represents the amount of serviceable assets that become unserviceable during the fiscal year and therefore require overhaul.

GOVERNMENT-FURNISHED MATERIEL (GFM):

Property in the possession of, or acquired directly by the Government and provided without charge to a contractor for incorporation in the end articles to be produced or otherwise consumed in the performance of the contract.

HEADQUARTERS AND INSTALLATION SUPPORT ACTIVITY (HISA):

This activity is responsible for the management and utilization of the physical plant, communications/electronics, audio-visual, and the logistical support services necessary for the operations and maintenance of the AMC installation, to include administrative services, community support activity, security equipment management, supply, transportation services, facilities engineering and safety.

INITIAL SPARES:

The spares and/or repair parts, assemblies, and components required to support and maintain an end item and/or article delivered under a contract during its initial phase of service. These spares are provided to permit necessary maintenance of end items pending the establishment of the pipeline of follow-on support.

INVENTORY CONTROL POINT (ICP):

An organizational unit or activity within a DoD supply system which is assigned the primary responsibility for the materiel management of a group of items. Materiel inventory management includes cataloging direction, requirements computation, procurement direction, distribution management, disposal direction, and, generally, rebuilding direction.

LEAST SQUARES REGRESSION ANALYSIS:

A technique which involves the fitting of a line to a scatter of data points. This produces a regression equation which describes the relationship between the independent and dependent variables.

LEVEL OF EFFORT:

This is a term used to identify an activity that receives a stable level of resource support over time. Generally, in such activities it is difficult to isolate specific workload factors that could be used to compute varying requirements for resource support in different time periods.

LIFE CYCLE MANAGEMENT:

This is the mission of an AMC major subordinate command with respect to assigned commodity categories. Life cycle management includes design and development; product, production, and maintenance engineering; procurement production provisioning and industrial mobilization planning; cataloging and standardization; wholesale inventory management, stock control, and supply control; new equipment training, and product disposal.

LOGISTIC SUPPORT:

The materiel and services required to ensure that operational and support forces have sufficient resources to perform their missions.

MACRO-INDEPENDENT VARIABLE:

Derived from the economic term macroeconomics. The term implies that the independent variable relates to higher levels of aggregation within an organization. For instance, in the evaluation of a force structure, the level of operational employment of the force structure is a Macro-Independent Variable as opposed to requisitioned line items of supplies processed in support of the force structure, which is a Micro-Independent Variable.

MAINTENANCE, DEPOT:

All maintenance above GSU and DSU level for overhaul, repair, and major modification of components or complete weapon systems.

MAINTENANCE, FIELD:

Maintenance performed by specialized field maintenance units. This consists of intermediate and major inspection of materiels and repair of unserviceable parts and components for which the unit has the required tools and personnel skills.

MAINTENANCE FLOAT:

Contains those end items or components of equipment authorized by the Department of the Army for stockage at installations or activities for replacement of unserviceable items of equipment when immediate repair of the unserviceable equipment cannot be accomplished by the support maintenance activity. The immediate exchange of serviceable for unserviceable equipment enables a using unit to perform its assigned mission without serious disruption. (AR 750-4)

MAJOR ITEM DATA AGENCY (MIDA):

The control point for most of the planning, programming, workloading, financing, and accounting that are important to integrate the various specialized management and operating activities of the Army Materiel Command.

MAJOR SUBORDINATE COMMAND (MSC):

See Commodity Command. All major subordinate commands within AMC are commodity commands except Test and Evaluation Command (TECOM). TECOM does not exercise any form of integrated commodity management of assigned materials. TECOM plans and conducts, or supervises for AMC, engineering tests (except those pertaining to aircraft performance, stability, and control) service tests, check tests, initial production tests, and preproduction tests of all Army materiel intended for general use by the Army in the field or for which the U.S. Army Forces Command (FORSCOM) represents the user.

MICRO-INDEPENDENT VARIABLE:

Derived from the term microeconomics. The term implies that the independent variable represents activities that can be approximated by the use of detailed data from the lower levels of an organization. For instance, requisitioned line items, short tons moved, and equipment improvement requests processed.

MILITARY ASSISTANCE PROGRAM (MAP):

This provides for the cost of supplies, equipment, logistical support, and other support and services for the armed forces of selected allied countries. This is financed by Program 10, Support of Other Nations, of the DoD Five Year Defense Program.

MILITARY TRAFFIC MANAGEMENT AND TERMINAL SERVICE (MTMTS):

The responsibilities of the agency include the management of Department of Defense traffic within the continental United States, the procurement and use of commercial transportation services required in the movement of DoD cargo and passengers within the continental United States and the movement and storage of personal property/ household goods both stateside and abroad.

NATIONAL INVENTORY CONTROL POINT (NICP):

See Directorate for Materiel Management and Inventory Control Point. An organizational segment within an AMC commodity command which has been delegated the responsibility for the integrated materiel management of a group of items.

NATIONAL MAINTENANCE POINT (NMP):

The organizational element within the major subordinate command that is responsible for the management of worldwide overhaul program, technical field assistance support, maintenance training, technical publications, maintenance engineering, configuration management, development and evaluation of proposed modification and support, and control of approved modification programs with respect to assigned commodities. (AR 750-3)

NORMALIZATION:

A statistical procedure to place all data on the same base for most accurate measurement of real differences caused by the factors under study. For example, to compensate for inflationary factors, FY 1965 data could be normalized for accurate comparison with FY 1970 data by applying an appropriate index adjustment to the FY 1965 values.

OFFICE OF THE DIRECTOR OF DEFENSE PROGRAM ANALYSIS AND EVALUATION (ODDPA&E):

Staff organization within the Office of the Secretary of Defense which directs/conducts resource allocation studies.

ORGANIC MAINTENANCE:

Maintenance performed in Army facilities (AIF and Non-AIF) by Department of Army personnel (military and civilian, and including direct hire non-U.S. citizens and personnel hired under master labor contracts with most governments).

POLICY CONTROLLABLE VARIABLE:

Factors in a program or an activity that can be determined by establishment of or changes in a policy. For example, the overhaul interval of an aircraft engine may be determined by issuance of a policy from the appropriate authority.

PROGRAM DECISION MEMORANDUMS (PDM):

Directives issued by the Secretary of Defense to the services covering forces and programs. PDMs provide final and firm guidance on force structures and other issues necessary for preparation of the DoD budget.

PROGRAM ELEMENT:

A grouping of forces, manpower, and costs associated with an organization, or a group of similar organizations, a function, or a project. Each program element is identified with a planned mission or output that is to be attained.

PROGRAM OBJECTIVES MEMORANDUM (POM):

Issued by each of the services, POMs contain the programs that the service wishes to implement within the guidance provided by the DPPG. It is a very lengthy and detailed document showing in program-element detail the service's program for the next five years.

PRESIDENT'S BUDGET:

The budget presented to the Congress by the President in January of each year at the opening of that year's congressional session. It covers financial requirements of the U.S. Government for the fiscal year which commences on 1 July following the presentation to the Congress.

PRIME DEPOT:

This is a hard-core installation whose mission is to provide the necessary maintenance support to assigned weapon systems. The fact that a depot has a maintenance support mission implies that it has qualified personnel, tools, equipment, and physical facilities. For instance, Anniston Army Depot is the prime depot for all Army tanks and ARADMAC is the prime depot for all Army aircraft.

PROVISIONING:

The process of determining the range of quantity of items (i.e., spares and repair parts, special tools, test equipment, and support equipment) required to support and maintain an end item of materiel for an initial period of service.

REGRESSION ANALYSIS:

A quantitative technique which involves fitting a line to a scatter of data points. This produces a regression equation which describes the relationships between the independent and dependent variables.

REIMBURSEMENTS:

Amounts received or to be received by an agency or activity for the cost of materiel, work or services furnished or to be furnished to others for credit to an appropriation or other fund account.

REPARABLE GENERATIONS:

The number of reparable items which become unserviceable in the field and are returned to the depot for repair over a given period of time.

REPLENISHMENT SPARES:

Reparable and consumable items required to replenish stocks for use in the maintenance, overhaul, and repair of equipment. These spares meet the regular, recurring requirements for maintenance support of equipment.

SELECTED ANALYSES:

Current list of impact analysis subject areas, issued by OSD to the various services, that are of interest to the Secretary of Defense in formulating the fiscal guidance for the various services.

SERVICEABLES:

This is an item of equipment which is either in condition for operational use or support or economically reparable to a condition suitable for operational use or support.

SYSTEM-WIDE PROJECT FOR ELECTRONIC EQUIPMENT AT DEPOTS, EXTENDED (SPEEDEX):

SPEEDEX is an assemblage of standard computers, remote input and output devices, and standardized functional procedures and computer programs designed to assist in accomplishing the AMC depot missions of receiving, storing, issuing, and overhauling materiel and providing related support functions on a centralized computer programming and centralized computer program maintenance basis.

STRUCTURE AND COMPOSITION SYSTEM ARMY (SACS FILE):

The SACS file is the core element in the Army logistic requirements computation process. This system is literally a series of computer programs that tie together selected ACSFOR management information systems and computer-maintained files. Five major files are used in the Structure and Composition System File: Force Accounting System (FAS), The Army Authorization Document System (TAADS), Tables of Organization and Equipment (TOE), Bases of Issue Plans (BOIP), and Shorthand Note Control System (SHNCS).

TABLE OF DISTRIBUTION AND ALLOWANCES (TDA):

These tables cover authorizations for nondeployable general support and all other categories of Army organizations except those with TOEs. They are tailored to each specific noncombat mission since the units are essentially unique.

TABLE OF ORGANIZATION AND EQUIPMENT (TOE):

TOEs include prototype organizational structures displaying wartime minimum essential personnel and equipment required for prescribed missions of each type of Army combat, combat support, and service support unit.

THE ARMY AUTHORIZATION DOCUMENTS SYSTEM (TAADS):

TAADS includes all Army unit documents reflecting tailored authorized quantities of personnel and equipment. This file provides the authority for requisitioning and distributing resources to all active Army and Reserve Component units. It contains the Modification Tables of Organization and Equipment (MTOE) and Tables of Distribution and Allowances (TDA) for all Army organizations. MTOEs are the standard TOEs for combat, combat support, and service support units of the Army in the Field as modified, if necessary, for each individual unit, based on unique operational requirements, constraints, or environment.

"WASH" ACCOUNT:

An accounting term to identify an account in which receipts and expenses should be equal, so at the end of an accounting period the net balance is zero. A "wash" account would identify a process that takes place and is important to management but, in itself, cannot be categorized as asset, liability, capital, receipt, or expense.

WEAPON SYSTEM:

A weapon and those components required for its operation. It is a composite of equipments, skills, and techniques that form an instrument of combat.

WORKING CAPITAL FUND:

A revolving fund established to finance inventories of supplies and other stores or to provide working capital for industrial fund activities.

ZERO BASE BUDGETING:

A process of estimating financial requirements for a future time period by analyzing each element of expense in terms of total workload to be accomplished; this is opposed to the incremental budgeting approach that is limited to an analysis of increases and decreases in workload elements from year to year with the current year expenses considered as a baseline for the future year estimates.

BIBLIOGRAPHY

BIBLIOGRAPHY

Reports

Adjutant General's Office (Army), Lessons Learned, Headquarters, United States Army Depot, Long Binh, (Washington, D.C., May 1970), UNCLASSIFIED.

Adjutant General's Office, Operational Report - Lessons Learned, Headquarters, U.S. Army Depot, Cam Ranh Bay, Period Ending 30 April 1971, AD 892 001L, (Washington, D.C., 15 February 1972), UNCLASSIFIED.

Alvey, E.L. (Lt Col), Analysis of Operating Costs of Selected Missile Units CONUS FY 69, U.S. Army Field Operating Cost Agency, OF-106-70, (June 1970), UNCLASSIFIED.

Archer, Bruce F., Dean P. Westerman, A Method for the Determination of Intra-Theater Logistic Support Funding (U), Methodology and Cost Effectiveness Office, (Aberdeen Proving Ground, Maryland, March 1970), SECRET.

Army Materiel Command, Maroun Study: Command Analysis of OMA Funding, AMCCP-BP, (Washington, D.C., April 1972), UNCLASSIFIED.

_____, Responsibilities and Relationships of AMC in the Army Logistics System, Project AMCB 2-68, (Washington, D.C., December 1968), UNCLASSIFIED.

Baker, Richard J., Analytical Techniques for Logistics Management, Army Advanced Materiel Concepts Agency, AD 714 367, (Alexandria, Virginia, October 1970), UNCLASSIFIED.

Berger, Doris C., et al, Selected Uniform Cost Factors: A Manual for the Army Materiel Command, Research Analysis Corporation, RAC-TP-451, (McLean, Virginia, June 1972), UNCLASSIFIED.

Bertrand, H., et al, Operating and Maintenance Cost Estimating Relationships for Army Aircraft, Planning Research Corporation, PRC-R-869, (Santa Barbara, California, August 1966), UNCLASSIFIED.

Binkin, Martin, Support Costs in the Defense Budget, The Submerged One-Third, The Brookings Institution, (Washington, D.C., 1972) UNCLASSIFIED.

Bossenga, John R., et al, An Evaluation of the Results of Using TAERS Data as Input to a Repair-Parts Forecasting Methodology, Research Analysis Corporation, RAC-TP-367, (McLean, Virginia, October 1969), UNCLASSIFIED.

Buffay, Jerry L., et al, Reconciliation of the Pacific Theater's Stock Records with the Army Master Data File, Research Analysis Corporation, RAC-TP-403, (McLean, Virginia, August 1970), FOR OFFICIAL USE ONLY.

Byers, Andy J., Centralization versus Decentralization of NICP Depot Relationships within the Army Supply System, Defense Supply Agency, (Washington, D.C., 1967), UNCLASSIFIED.

Caldarone, R.P., et al, Development of Logistics Planning Factors in South Vietnam, Planning Research Corporation, P-186.10, (Washington, D.C., 22 September 1967), SECRET.

Chakour, Frederick M., Automated Life Cycle Cost Models for Army Weapon Systems, National Technical Information Service, AD688-599 (Springfield, Virginia, May 1969), UNCLASSIFIED.

Christensen, L., et al, Development of Logistics Planning Factors in South Vietnam (LOG PLAN-V), Volumes I through III, Prepared for Office of the Secretary of Defense, Advanced Research Projects Agency, Planning Research Corporation, PRC R-1240, (Los Angeles and Washington, D.C., MARCH 1969). Volume I, FOR OFFICIAL USE ONLY; VOLUMES II and III, SECRET.

Clarke, Ray M., et al, Comparison of US Army and US Air Force Secondary Items and Repair-Parts Supply Support Systems (U), Research Analysis Corporation, RAC-R-95, (McLean, Virginia, June 1970), FOR OFFICIAL USE ONLY.

Comptroller General's Report to the Congress, Army Inventories--Inaccuracies, Effects, and Ways to Improve, U.S. General Accounting Office, B-146828, (February 26, 1971), UNCLASSIFIED.

_____, Improvements Needed in Army Supply Management and Stock Fund Activities in Korea, U.S. General Accounting Office, B-166312, (June 30, 1969), UNCLASSIFIED.

_____, Logistic Aspects of Vietnamization - 1969-1972, U.S. General Accounting Office, B-159451, (Washington, D.C., January 1973), UNCLASSIFIED.

Davies, Alan D. (Task Coordinator), et al, Executive Management Requirements Analysis for the Integrated Facilities System, Prepared for Department of the Army, Deputy Chief of Staff for Logistics, Director of Installations, Planning Research Corporation, PRC R-1209, Volume X, (Los Angeles, California, Washington, D.C., May 1970), UNCLASSIFIED.

Dee, Robert F., et al, Accrued Costs of Depot Overhaul, Wear-Out, and Total-Loss Accidents of Army Equipment, Research Analysis Corporation, RAC-TP-384, (McLean, Virginia, November 1969), UNCLASSIFIED.

Department of the Army, Assistant Vice Chief of Staff Office, The Army Management Information System Master Plan, System-wide Project for Electronic Equipment at Depots--Extended (SPEEDEX), Management Information Systems Directorate Office, (Washington, D.C., June 1972), UNCLASSIFIED.

_____, Office of the Deputy Chief of Staff for Logistics, DA Program for Selected Item Management System (SIMS) General Concept Outline, Revised February 1970, U.S. Army Logistics Doctrine, Systems and Readiness Agency, (New Cumberland, Pennsylvania, 1971), UNCLASSIFIED.

_____, Depot Maintenance Budgeting Systems Edition II, (Washington, D.C., November 1972), UNCLASSIFIED.

_____, General System Description (GSD) for Standard Expanded Direct Exchange (DX), U.S. Army Logistics Doctrine, Systems and Readiness Agency, AD892024L, (New Cumberland, Pennsylvania, November 1971), UNCLASSIFIED.

_____, The SIGMALOG System, U.S. Army Logistics Doctrine, Systems and Readiness Agency, (New Cumberland, Pennsylvania, April 1972), UNCLASSIFIED.

Doran, Reginald F., et al, An Analysis of the Army Repair-Parts Supply System, Research Analysis Corporation, RAC-R-41, (McLean, Virginia, August 1968), UNCLASSIFIED.

Eastman, Samuel Ewer, et al, The Development and Application of a Procedure for Estimating the Economic Life of Weapon Systems, Economic Sciences Corporation, AD711115, (Washington, D.C., 17 August 1970), UNCLASSIFIED.

Faust, Robert J., et al, Major Item Management Information System, Research Analysis Corporation, RAC-TP-409, (McLean, Virginia, October 1970), UNCLASSIFIED.

Ferrara, Thomas F., Richard D. Goodfriend, and Joel Morris, Methodology for an Economic Analysis to Improve Justification for Retention of Mobilization Production Capability, Research Analysis Corporation, RAC-TP-443, (McLean, Virginia, February 1972), UNCLASSIFIED.

_____, Richard G. Huver and Paul S. Sonder, Jr., AMIS and MIMS: The Interaction of the Army Management Information Systems with the Current Major Item Management System, Research Analysis Corporation, RAC-CR-60, (McLean, Virginia, November 1972), UNCLASSIFIED.

Finan, William F., Inventory Control of Army Non-Combat Essential Items, Logistics Management Institute, AD 709-414, (Washington, D.C., May 1970), UNCLASSIFIED.

Fisher, Gene H., Cost Considerations in Systems Analysis, Rand Corporation, R-490-ASD, (Santa Monica, California, December 1970), UNCLASSIFIED.

_____, Derivation of Estimating Relationships: An Illustrative Example, Rand Corporation, RM-3366-PR, (Santa Monica, California, November 1962), UNCLASSIFIED.

Fishman, George S., Improved Forecasting Methods for Item Management and Maintenance Manpower Requirements, Rand Corporation, RM-6010-PR, (Santa Monica, California, June 1969), UNCLASSIFIED.

Fitzpatrick, George R. and Robert W. Bluehdorn, An Effort to Identify Improved Management Indicators for the Total Maintenance Support Activities Account, Research Analysis Corporation, RAC-CR-48, (McLean, Virginia, January 1972), UNCLASSIFIED.

Fitzpatrick, George R., et al, An Evaluation of Project CAVAMP, Research Analysis Corporation, RAC-TP-415, (McLean, Virginia, February 1971), UNCLASSIFIED.

Geisinger, Kenneth E., The Army Reparable Item Control System, Research Analysis Corporation, RAC-TP-416, (McLean, Virginia, April 1971), UNCLASSIFIED.

Geisler, Murray A., Relationships Between Weapons and Logistics Expenditures, Rand Corporation, RM-1786, (Santa Monica, California, August 1956), UNCLASSIFIED.

Gilbert, David H., William A. Michael and Michael A. Chernick, An Introduction to the Use of Weighted Historical Data to Forecast Depot Supply Work Loads, Army Materiel Systems Analysis Agency, RDT&E Project No. 1P765801MM11, (Aberdeen Proving Grounds, Maryland, September 1971), UNCLASSIFIED.

Hafner, Ralph A., et al, European Theater Transportation System (U), Volumes 1 and 2, Main Report, Research Analysis Corporation, (McLean, Virginia, November 1969), SECRET.

Hickey, James E., Logistics Lessons from the Vietnamese Era, Rand Corporation, R-478-PR, (Santa Monica, California, February 1970), FOR OFFICIAL USE ONLY.

Holaday, Duncan A., An Analysis of Operating Costs of Armored and Infantry (M) Divisions (USAREUR FY 1968, U.S. Army Field Operating Cost Agency, OF-102-70, (Washington, D.C., February 1970), FOR OFFICIAL USE ONLY.

Horowitz, Joel L., An Efficiency-Effectiveness Indicator System for Depots, Research Analysis Corporation, (McLean, Virginia, June 1968), UNCLASSIFIED.

Inventory Management Pilot Task Group, AMC Inventory Management Standard System, U.S. Army Materiel Command, (Washington, D.C., December 1967), UNCLASSIFIED.

Joint Army-NSIA Conference, New Developments in Logistics within the Army, (Washington, D.C., 21 September 1971), UNCLASSIFIED.

Karadbil, Leon N., et al, An Evaluation of Project OASIS in USAREUR and Three NICPs, Research Analysis Corporation, RAC-D1-TP, (McLean, Virginia, June 1970), UNCLASSIFIED.

Kim, K.H., et al, Planning Guides for the Commodity Commands of the U.S. Army Materiel Command, Battelle Columbus Laboratories, Defense Systems and Technology Office, (Washington, D.C., May 1, 1969), FOR OFFICIAL USE ONLY.

Knapp, Mark I., et al, Relating U.S. Air Force Mission Forces and Central Supply and Maintenance Resources, Institute for Defense Analyses, S-374, (Arlington, Virginia, November 1970), UNCLASSIFIED.

Large, J.P., Concepts and Procedures of Cost Analysis, Rand Corporation, RM-3589-PR, (Santa Monica, California, June 1963), UNCLASSIFIED.

Lewis, Donald E., and Thomas T. Tierney, Meeting Tomorrow's Logistic Challenges with "NOW" Research, Rand Corporation, R-686-PR, (Santa Monica, California, March 1971), UNCLASSIFIED.

Lynch, Cornelius J., and Paul E. Palatt, Army Operating Information System, Research Analysis Corporation, RAC-CR-46, (McLean, Virginia, January 1972), UNCLASSIFIED.

Mader, Donald W., Development of Equipment Operating Cost Factors Based on TAERS and AMDF Data, Research Analysis Corporation, RAC-TP-413, (McLean, Virginia, November 1970), UNCLASSIFIED.

Markham, Howard A., and Lt. Col. Norman C. Blahuta, Costs of Repair-Parts Supply Operations in a Combat Division, Research Analysis Corporation, RAC-TP-356, (McLean Virginia, August 1969), UNCLASSIFIED.

Minckler, R. D. and J. Holdahl, Planning Guides for the Headquarters and Class II Activities of the U.S. Army Materiel Command, Battelle Columbus Laboratories, Defense Systems and Technology Office (Washington, D.C., August 15, 1969), FOR OFFICIAL USE ONLY.

Morgan, John D., PPBS and Maintenance Cost Analysis, Headquarters AFLC (Wright-Patterson Air Force Base, Ohio, April 1968), UNCLASSIFIED.

_____, and Dominick J. DeMarco, A Sizing Methodology for U.S. Air Force Central Supply and Maintenance Resources, Institute for Defense Analyses, P-813, (Arlington, Virginia, January 1973), UNCLASSIFIED.

Nicholas, Michael J. (1Lt.), An Analysis of Operating Costs of Selected Missile Units USAREUR, FY 1968, U.S. Army Field Operating Cost Agency, (Washington, D.C., August 1969), UNCLASSIFIED.

O'Flaherty, John, Data System for Weapon System Cost Analysis in the Army Materiel Command, Research Analysis Corporation, RAC-TP-398, (McLean, Virginia, June 1970), UNCLASSIFIED.

_____, Fundamentals of the AMC Cost Data Base, Research Analysis Corporation, RAC-CR-2, (McLean, Virginia, May 1971), UNCLASSIFIED.

_____, Weapon System Cost Model Objectives, Research Analysis Corporation, RAC-CR-28, (McLean, Virginia, April 1971), UNCLASSIFIED.

Patterson, Michael L., Integrated Logistic Support Costs, Research Analysis Corporation, RAC-CR-3, (McLean, Virginia, February 1971), UNCLASSIFIED.

Paulson, R.M., et al, Using Logistics Models in Systems Design and Early Support Planning, Rand Corporation, R-550-PR, (Santa Monica, California, February 1971), UNCLASSIFIED.

Perry, B.E., et al, Planning Guides for U.S. Army Materiel Command Depots in CONUS Base, Battelle Memorial Institute, (Washington Office, March 18, 1968), FOR OFFICIAL USE ONLY.

Petruschell, R.L., Some Curve-Fitting Fundamentals, Rand Corporation, RM-5766-SA, (Santa Monica, California, December 1968), UNCLASSIFIED.

Phillips, John G., Cost of Operation and Maintenance Activities (Army): Techniques for Analysis and Estimation, Research Analysis Corporation, RAC-TP-242, (McLean, Virginia, April 1967), UNCLASSIFIED.

Pope, Kenneth R., et al, Operations and Maintenance Cost Methodology, Planning Research Corporation, DDC-AD-854-370, (Washington, D.C., May 1969), UNCLASSIFIED.

Roelofs, Thomas B., et al, Simulation and Gaming Methods for Analysis of Logistics (SIGMALOG): Theater Materiel Model, Research Analysis Corporation, RAC-TP-400, (McLean, Virginia, September 1970), UNCLASSIFIED.

Rostker, Bernard, Logistics--Its Planning, Programming and Budgeting in the Office of the Secretary of Defense 1968-1970, Rand Corporation, P-4881, (Santa Monica, California, August 1972), UNCLASSIFIED.

Seely, Jarvis S., et al, System for Estimating Materiel Wartime Attrition and Replacement Requirements (SYMWAR), Volume II, Operational Systems and Data Bases, Research Analysis Corporation, RAC-TP-404, (McLean, Virginia, January 1971), UNCLASSIFIED.

Sherbrooke, Craig C., Resource Allocation Techniques for Logistics Management, Rand Corporation, P-4139, (Santa Monica, California, July 1969), UNCLASSIFIED.

Stament, Alfred D., and Carl R. Wilbourn, Cost Estimating Relationships: A Manual for the Army Materiel Command, Research Analysis Corporation, RAC-TP-449, (McLean, Virginia, May 1972), UNCLASSIFIED.

Tholen, Albert D., et al, A Forecast of Logistics Requirements, Application of the Delphi Method to the Study of the Peacetime Army Logistic Base, Research Analysis Corporation, RAC-TP-427, (McLean, Virginia, June 1971), UNCLASSIFIED.

_____, Systems for Estimating Materiel Wartime Attrition and Replacement Requirements (SYMWAR), Volume I, Problem Background, Original Loss Rate Tables, and System Concept, Research Analysis Corporation, RAC-TP-404, (McLean, Virginia, September 1970), UNCLASSIFIED.

Turek, Joan, and Irving Heymont, A Method for Estimating Distribution Costs of Army Equipment, Research Analysis Corporation, RAC-009-304, (McLean, Virginia, November 1969), UNCLASSIFIED.

U.S. Army Logistics Management Center, Second Quarterly Supplement to the 1972 Annual Department of Defense Bibliography of Logistics Studies and Related Documents, Defense Logistics Studies Information Exchange, (Fort Lee, Virginia, 1 July 1972), UNCLASSIFIED.

U.S. Army Strategy and Tactics Analysis Group, Assistant Chief of Staff for Force Development, U.S. Army Force Planning Guide, Europe (U), Volume I of III Volumes, Department of the Army, (Washington, D.C., 1970), SECRET.

Magazines

Army Logistician, Volume 3, Number 1, January-February 1971.

Army Logistician, Volume 3, Number 2, March-April 1971.

Army Logistician, Volume 3, Number 3, May-June 1971.

Army Logistician, Volume 3, Number 4, July-August 1971.

Army Logistician, Volume 3, Number 5, September-October 1971.

Army Logistician, Volume 3, Number 6, November-December 1971.

Army Logistician, Volume 4, Number 2, March-April 1972.

Army Logistician, Volume 4, Number 3, May-June 1972.

Army Logistician, Volume 5, Number 2, March-April 1973.

Articles

Bennewitz, Eckhard, "Improvements Planned - Work Measurement Essential to Resource Management," Defense Management Journal, Volume 8, No. 3, October 1972), pp. 30-35.

McCall, John J., "Defense Management," Management, Stephen Enke (editor), (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1967), pp. 164-185.

Theses

Gamino, J.M., The Unified Logistics Command Concept, A Critical Analysis, National Technical Information Service, (Springfield, Virginia, 1971), UNCLASSIFIED. A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements of the degree Master of Military Art and Science.

Henry, J., Charles W. (Major) and Major Garry A. Scharberg (USA), An Analysis of Maintenance Support Planning for Selected United States Army Combat Vehicles, School of Systems and Logistics, Air Force Institute of Technology, SLSR-41-69, (Wright-Patterson AFB, Ohio, August 1969), UNCLASSIFIED.

Jenson, William C. (Lt Col), and Major Nicholas J. Craddock, An Analysis of the Organizational Structure of the Depots in the Army Materiel Command, School of Systems and Logistics, Air Force Institute of Technology, SLSR-15-68, (Wright-Patterson AFB, Ohio, August 1968), UNCLASSIFIED.

Munnelly, John E. (Lt Col), and Major Rolf S. Scovell, An Analysis of Depot Maintenance Requirements and the Development of a Model to Estimate Fixed Base Depot Workload Generated by UH-1 and CH-47 Helicopters in Vietnam, School of Systems and Logistics, Air Force Institute of Technology, SLSR-28-66, (Wright-Patterson AFB, Ohio, August 1966), UNCLASSIFIED.

Rider, Graham W., An Exploration of the Concept of Logistics, A Constitutive Approach, National Technical Information Service, AD-708-743, (Springfield, Virginia, June 1970), UNCLASSIFIED. A doctoral thesis presented to the Faculty of the Arizona State University in partial fulfillment of the requirements of the degree Doctorate of Business Administration.