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TR-8006-2

**COST IMPLICATIONS OF HARDWARE MANPOWER BALANCE:
PHASE II - UNIT SUSTAINMENT MANPOWER COST METHODOLOGY**

By

Rodney D. McConnell
Patricia A. Insley
William E. DePuy, Jr.
Jerome C. Ford
Clifton N. Horton

1 June 1981

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Prepared By:

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The application of the definition of high-cost/critical occupations, which is a refinement of the Phase I definition. A description of the unit sustainment manpower cost methodology, which includes a refinement of the initial unit methodology. The unit sustainment manpower cost data for selected weapon systems that refines the initial unit test data. A description and demonstration of the unit manpower life cycle cost methodology which includes initial unit and unit sustainment cost methodologies. The application of the analytical tools in the analysis of weapon system manpower requirements.

The definition and cost methodology are demonstrated using unit manpower for three major weapon systems: the Army M-1 tank, the Navy LAMPS Mk III helicopter system, and the Air Force ground launched cruise missile.

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PREFACE

Management Consulting & Research, Inc. (MCR) is currently under contract to the Office of the Assistant Secretary of Defense for Manpower, Reserve Affairs and Logistics (OASD (MRA&L)), Contract No. MDA 903-80-C-0553, Cost Implications of Hardware Manpower Balance. The scope of this study effort is divided into three phases:

- Phase I - Initial Unit Manpower Cost Methodology
- Phase II - Unit Sustainment Manpower Cost Methodology
- Phase III - Expand Weapon System Data Base and Develop Computer-Aided Capability

Phase I of this effort has been completed and documented in MCR's TR-8006-1, "Cost Implications of Hardware Manpower Balance: Phase I - Initial Unit Manpower Cost Methodology." The Phase II effort is documented in this technical report and supersedes the Phase I methodology. This report addresses the following major areas, each of which is described in a separate section:

- application of the definition of high-cost/critical occupations, which is a refinement of the Phase I definition;
- description of the preliminary unit sustainment manpower cost methodology, which includes a refinement of the initial unit methodology;
- unit sustainment manpower cost data for selected weapon systems, that refines the initial unit test data;
- a description and demonstration of the unit manpower life cycle cost methodology which includes initial unit and unit sustainment cost methodologies; and
- application of MCR-developed tools.

EXECUTIVE SUMMARY

The Office of the Under Secretary of Defense for Research and Engineering (OUSD (R&E)) has issued guidance that the impact on Service assets of weapon system manpower requirements will be considered in system design and acquisition.^{1/} Since then OASD (MRA&L) has worked with the Services on an overall effort, entitled "Hardware-Manpower Balance," to develop approaches to the problem of maintaining increasingly complex weapon systems with a diminishing supply of high-aptitude people.

Management Consulting & Research, Inc. (MCR) has been tasked to develop analytical tools to assist in evaluating weapon system manpower requirements. The "two-pronged" approach taken in this effort has been designed to consider the two key resource areas of weapon system manpower:

- requirements, which concern the quantity, by occupation, of manpower needed for the weapon system and the organizational units which operate and maintain the system; and
- costs, which concern the amount of money which must be budgeted to operate and maintain the system and its organizational units. This particularly applies to cost impacts relating to the specific composition of the required weapon system manpower.

MCR has developed analytical tools to use in examining the impacts of specific weapon system manpower requirements on these two separate, but related, resource areas. The two tools, described and demonstrated in this report, are:

- a definition for analyzing weapon system unit manpower requirements in terms of their high-cost/critical occupations; and

1/ DoDI 5000.2, "Major System Acquisition Procedures," March 19, 1980.

- a methodology for costing weapon system unit manpower which reveals occupation- and pay grade-specific cost relationships of the weapon system unit manpower requirements.

These two tools are interrelated and when used together produce a multidimensional portrait of weapon system unit manpower. The definition and cost methodology have been demonstrated on unit manpower data for three major weapon systems:

- the Army M-1 Tank,
- the Navy LAMPS Mk III, and
- the Air Force Ground Launched Cruise Missile (GLCM).

The definition and cost methodology are briefly described and the results of demonstrating these tools on the selected weapon systems are summarized below.

The definition of high-cost/critical occupations is used to analyze the characteristics of the weapon system unit occupation and pay grade requirements. The definition is composed of three elements:

- Mission Essentiality, determined on the basis of job titles of the positions within the organizational unit. We have used the rule that only operators and maintainers are mission essential. This characteristic is sufficient to qualify an occupation as high-cost/critical.
- High-Cost, determined on the basis of comparing combined occupation-specific costs (i.e., training costs, enlistment bonus cost, and selective reenlistment bonus (SRB) costs) to a selected baseline cost (for example, average training cost for the Service). The purpose of the comparison of total occupation-specific costs to a baseline cost is to indicate those occupations with higher than average costs. This characteristic is sufficient to qualify an occupation as high-cost/critical.
- Inventory Shortage, determined on the basis of examining authorizations and inventories for the required pay grades in each high-cost/critical occupation. A shortfall must be greater than some threshold. We have used the rule of 2.0% below authorized level as the basis for qualifying an occupation/pay grade combination as having an inventory shortage. The 2.0% threshold was used based on the pattern of the authorization

and inventory data analyzed. The 2% threshold is not significant in terms of readiness, but is used only as a reasonable value for analysis. This characteristic is not sufficient to qualify an occupation as high-cost/critical, but must be considered in conjunction with the other two characteristics.

Table 1 summarizes the results of applying this definition to unit manpower data for the three systems. Statistics are shown for the occupations (i.e., MOSs, ratings, and AFSCs), and the quantity of personnel required in those occupations.

This analysis of the occupational requirements of the selected weapon systems shows that all three of the systems are in potentially vulnerable positions due to the preponderance of unit personnel in high-cost/critical occupations. This vulnerability takes two forms:

- potential impacts because of the quantity of personnel in high-cost occupations, thus vulnerable to O&S budget reductions; and
- potential impacts because of the quantity of personnel in mission essential occupations, thus vulnerable to continued inventory shortages which could cause readiness and reliability degradation.

These problems may arise because of the following results:

- A tank battalion equipped with the M-1 has 82.6% of its 511 enlisted personnel in the 21 (of 32) high-cost/critical occupations.
- The LAMPS Mk III operational squadron has 73.7% of its 232 enlisted personnel in the 11 (of 23) high-cost/critical occupations.
- The GLCM flight has 94.7% of its 75 enlisted personnel in the 12 (of 15) high-cost/critical occupations.

Analysis of the data for the selected weapon systems has pointed out that examination of this level of detail is valuable in that it provides insight into the relationships and drivers of the manpower requirements for the unit. For example, it is not sufficient to look at the total authorizations and inventories for an occupation. The status of specific pay grades must be examined in order to determine real impacts. Quite often shortfalls in more senior pay grades are offset by large

Table 1. RESULTS OF HIGH-COST/CRITICAL OCCUPATION ANALYSIS

WEAPON SYSTEM	QUANTITY	HIGH-COST/CRITICAL		MISSION ESSENTIAL		HIGH-COST		INVENTORY SHORTFALL	
		QUANTITY	%	QUANTITY	%	QUANTITY	%	QUANTITY	%
M-1	MOSS	32	65.6	4	12.5	21	65.6	20	62.5
	Personnel	511	82.6	274	53.6	422	82.6	413	81.3
LAMPS Mk III*	Ratings	23	47.8	9	39.1	5	21.7	11	47.8
	Personnel	232	73.7	162	69.8	71	29.2	171	73.7
GLCM	AFSCs	15	80.0	8	53.3	8	53.3	12	80.0
	Personnel	75	94.7	25	33.3	61	81.3	71	94.7

*Data for an Operational Squadron only as distinct from a Fleet Readiness Squadron.

inventories in first term pay grades. Also, for examination of costs of manpower it is necessary to look at the details of these costs such as bonuses. Additional details of these analyses are contained in Section II of the report.

The initial unit manpower cost methodology, developed in Phase I of this study, is used to calculate the costs of initially acquiring unit manpower. This methodology uses occupation-specific data to develop manpower costs.

The unit sustainment manpower cost methodology uses occupation- and pay grade-specific data, to analyze unit manpower costs. This cost methodology is composed of two element structures:

- the manpower strength element structure, identifying four categories of personnel:
 - unit mission personnel,
 - intermediate maintenance personnel,
 - installation support personnel, and
 - indirect personnel support; and
- the manpower cost element structure, identifying two major types of costs:
 - recurring personnel acquisition costs, which are recurring costs associated with personnel attrition and replacement, and are calculated using annual personnel loss rates, called here unit sustainment factors; and
 - annual unit sustainment costs, which are annual costs related to all of the people in the unit and are based on the estimated manpower requirements of the unit.

These two types of costs are calculated for the level of manpower strength required (in this study, enlisted unit mission personnel only) and combined to produce an estimated annual unit sustainment, or operating and support, manpower cost. Table 2 lists the strength element structure. Table 3 lists the cost element structure.

Table 2. MANPOWER STRENGTH ELEMENT STRUCTURE

- Unit Mission Personnel
 - Crew/Operators
 - Organizational Maintenance
 - Other Unit Personnel

- Intermediate Maintenance Personnel

- Installation Support Personnel
 - Base Operating Support
 - Real Property Maintenance
 - Medical

- Indirect Personnel Support
 - Individuals
 - Transients
 - Holdees (Prisoners, Patients, etc.)

Table 3. UNIT SUSTAINMENT MANPOWER
COST ELEMENT STRUCTURE

<u>Recurring Acquisition Costs*</u>	<u>Annual Unit Sustainment Costs</u>
● GENERAL COSTS**	● GENERAL COSTS**
- Personnel Recruitment	- Permanent Change of Station (PCS)
● OCCUPATION-SPECIFIC COSTS	● PAY GRADE-SPECIFIC COSTS
- Enlistment Bonus	- Pay and Allowances
- Selective Reenlistment Bonus (SRB)	- Retirement
- Training	- Support
	- Incentive and Special Pay (ISP not included)

* Amortized costs calculated using unit sustainment (personnel loss rate) factors recurring at intervals dependent on loss rates.

** Non-occupation-specific or pay grade-specific costs.

In applying this methodology, unit mission personnel are identified by occupation and pay grade. Occupation-specific costs are calculated based on the quantities of personnel in each occupation. Pay grade-specific costs are calculated based on the quantity of personnel in each pay grade. The totals for these two cost groups, as well as those costs which are generally applied to all personnel (i.e., Recruitment and PCS), are totalled to produce the unit sustainment cost for the weapon system.

A more detailed explanation of the MCR unit sustainment manpower cost methodology, as well as a brief description of Service methodologies, is provided in Section III of the report.

The MCR-developed unit sustainment manpower cost methodology has been demonstrated on the three weapon systems selected to represent the Army, Navy and Air Force. In an effort to determine the impact of using this more detailed approach, the same data have been costed using a Service manpower cost methodology. The results of applying each of these methods to a single organizational unit are compared on Table 4.

Comparable MCR and Service manpower cost elements have been aligned on the table. MCR costs were calculated for the 511 enlisted personnel of an M-1 tank battalion and Army costs were calculated based on the allocated manpower per M-1 tank. The MCR costs were converted to a cost per tank in order to compare them with Army costs. The LAMPS Mk III comparison is for the 232 enlisted personnel of an operational squadron. The GLCM comparison is for the 75 enlisted personnel of a single flight.

There are two conclusions reached as a result of these analyses:

- There are two major reasons why weapon system unit manpower costs developed using the unit sustainment manpower cost methodology are higher than the costs developed with the Service methodologies:

Table 4. SUMMARY OF WEAPON SYSTEM UNIT SUSTAINMENT MANPOWER COST COMPARISON
(FY 80 Dollars in Thousands)

COST ELEMENT	M-1 (Costs Per Tank)		LAMPS Mk III (Costs Per Squadron)		GLCM (Costs Per Flight)	
	MCR	ARMY	MCR	NAVY	MCR	Air Force
Pay and Allowances	97.9	34.5	2,976.7	2,607.9	892.1	976.4
Support	10.6	15.1	440.1	175.9	139.4	87.3
Recruitment	3.2	19.7	126.2	34.2	10.2	21.5
Training	15.1		401.7	557.4	132.3	
PCS	5.4	6.4	104.7	111.6	51.2	51.2
Enlistment Bonus & SRB	--	--	60.5	Included in PCS	16.2	Included in PCS
TOTAL	133.2	134.8	4,010.1	3,453.7	1,251.2	1,116.5
Additional Costs Excluded by Services						
Retirement	24.4	--	721.1	--	219.3	--
Enlistment Bonus & SRB	1.2	--	--	--	--	--
TOTAL	163.1	134.8	4,731.2	3,453.7	1,470.5	1,116.5

- The use of occupation- and pay grade-specific costs rather than average costs; and
 - The inclusion of the accrued costs of future retirement annuities, which is the single largest reason for differences between costs developed with the MCR methodology and those developed using the Service methodologies.
- In those cases where the Service methodologies use occupation- and pay grade-specific data, the estimates for that element are close to MCR's calculations. However, the use of different factors or the inclusion of additional cost elements (e.g., Bonus and Retirement costs for the M-1 calculations) in the MCR methodology resulted in higher costs than Service estimates. Specifically:
 - The M-1 manpower costs, excluding bonus and retirement costs, were very close (within 1%). This is due to the Army derivation of precise occupation- and pay grade-specific costs for pay and allowances and personnel replacement (recruitment and training). However, the inclusion of retirement and bonus costs increased the total cost using the MCR methodology by 22%. Until DoD makes a decision to include the accrued cost of future retirement, it appears that Army weapon system costing is quite precise.
 - The LAMPS Mk III costs, excluding retirement, are 15% higher using the MCR methodology. This is due to the use of pay grade-specific, rather than average, pay and allowance and support data. The inclusion of retirement costs increased the estimate by 21%.
 - The GLCM manpower costs, excluding retirement, are 12% higher using the MCR methodology. This is due to the use of pay grade-specific, rather than average, support cost and pay and allowances as well as the use of occupation-specific, rather than Service-wide, loss rates to calculate annual training costs. The inclusion of retirement increased the estimate by 20%.

Details of the application of the MCR and Service manpower cost methodologies are provided in Section IV of the report.

The following conclusions have been reached based on the application of the high-cost/critical occupation definition and the cost methodology to actual weapon system data:

- Based on the limited sample analyzed (one weapon system for each Service), it is not possible to determine if the kinds of relationships identified in these analyses are exceptions or the norm, although we suspect they are the norm. However, application of the definition and cost methodology to a larger group of weapon systems would allow definitive conclusions to be made.
- It is necessary to examine the details of weapon system unit manpower requirements, since it is only through this process that the Services can identify exactly where potential problems exist. Evaluation of aggregated estimates makes this impossible and, frequently, obscures the fact that a problem exists.
- The utility of these tools is not only in the numbers they produce, but also in the examination of the detailed relationships among the various requirements and cost drivers.
- The analyses documented in this report indicate that each of the three weapon systems analyzed may experience substantial personnel problems (inventory shortage, readiness) due to the quantity of the high-cost/critical personnel they require. The true magnitude of these problems can only be determined following an analysis of total Service projected assets and demands.

MCR developed an initial unit manpower cost methodology in Phase I of the project. This is used to calculate the cost of initially acquiring unit manpower. When combined with the unit sustainment manpower cost methodology developed in this phase of the study a unit manpower life cycle cost may be calculated. A discussion of the unit manpower life cycle cost methodology and its demonstration on the LAMPS Mk III are provided in Section V of the report.

OASD (MRA&L) has developed the "Hardware-Manpower Balance" project in order to examine the relationship of hardware design, acquisition decisions, and manpower constraints. This is part of the overall expansion of the analysis of weapon system resource demands identified in DoDI 5000.2. The Integrated Program Summary (IPS), outlined in that instruction is an example

of this DoD-wide expansion of weapon system manpower and training analysis.

The tools developed by MCR during this project address two of the most critical resources of weapon system operations and support: manpower resources and dollar resources. Manpower for weapon systems must be acquired, trained and sustained. Weapon system manpower costs are directly influenced by the type of manpower required by the system. This has been clearly demonstrated by the high-cost/critical occupation definition and unit manpower cost methodologies developed and presented in this report.

The definition and cost methodology developed during this project have been tailored to provide a coordinated approach to analyzing the manpower impacts of system demands. As demonstrated in this report, much valuable information can be obtained by analyzing the detailed unit manpower requirements.

MCR recommends that the tools developed during the project be used by the ASD (MRA&L) to encourage the Services to identify and help resolve existing and potential manpower problems. Specifically, we recommend that OASD (MRA&L):

- Develop an approach which can be used to analyze weapon system manpower requirements as early as possible (DSARC I if strengths are available). These requirements, analyzed in terms of the definition of high-cost/critical occupations, should be examined in light of Service inventory projections, and problem areas should be identified. This analysis should examine first the unit mission personnel and then be expanded to include all requirements above the organizational level and below the depot level. This analysis would provide information on and insights into:
 - potential manpower problems such as:
 - excessive requirements for highly experienced senior personnel,
 - requirements for occupations which are already experiencing inventory shortages, and

- requirements in mid-level pay grades which are already experiencing inventory shortages;
 - system occupations with extremely specialized training requirements, but which have limited potential for utilization on other systems;
 - the requirement for occupations which require long training periods;
 - the requirement for occupations which are very expensive to develop;
 - the potential cost advantages of cross-training personnel experienced on similar systems; and
 - the broader impacts of the relationship of system design to occupation and pay grade requirements, and any alternatives to these approaches.
- The results of the analyses discussed above should be used to focus on alternative concepts for system manning. If the manning requirements cannot be changed (e.g., the occupation is mission essential), then a manpower acquisition strategy must be developed to ensure the availability of the required personnel.

Details of the application of the MCR-developed tools in the analysis of weapon system manpower requirements are provided in Section VI of the report.

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I. INTRODUCTION

This Technical Report presents the results of Phase II of MCR's project for OASD (MRA&L) on the "Cost Implications of Hardware Manpower Balance." In this phase of the project MCR has developed a methodology for estimating unit sustainment manpower costs for major weapon systems.

This section discusses the following topics:

- background of the analysis,
- purpose of the analysis,
- approach taken, and
- organization of this report.

A. BACKGROUND

The Under Secretary of Defense for Research and Engineering has issued policy guidance that manpower impacts will be considered in system design and acquisition. This is a new and expanded consideration of manpower. It requires both OSD and the Services to develop improved methods for evaluating manpower requirements (i.e., quantity and type of manpower) on Service resources.

Weapon systems currently being designed represent, for the most part, an ascending level of both sophistication and, in some cases, complexity. These technological advances have frequently resulted in the increased demand for more costly and skilled manpower specialties to operate and support these systems. The Services are currently experiencing manpower difficulties, in terms of retention of many skill areas, particularly in these costly and critical manpower specialties. In recognition of these difficulties, DoDI 5000.2, "Major System Acquisition Procedures," of 19 March 1980, delineates the manpower analyses the Services must perform in developing the

Decision Coordinating Papers (DCPs) and Integrated Program Summaries (IPSS) required for DSARC review. For DSARC Milestone II, the Services must:

- summarize projected requirements versus projected Service assets in critical career fields;
- identify new occupations which may be required;
- provide a summary by fiscal year and occupation of all formal training requirements for the proposed system, identifying numbers of personnel to be trained and training cost;
- identify the contractor support and depot workload requirements in terms of manhours per end item; and
- identify the net change in total force manpower associated with the proposed system in terms of active forces, reserve forces, and DoD civilians.

These estimates are to be refined by DSARC Milestone III in addition to the following analysis requirements:

- identify shortfalls in meeting requirements by occupation;
- assess the impact on system readiness of failure to obtain required personnel;
- identify new occupations not yet programmed into Service personnel and training systems; and
- summarize plans for attaining and maintaining the required proficiency of operating and support personnel.

These analyses require the Services to specifically address the potential impacts of total system requirements as well as detailed occupational requirements in terms of their projected resources (i.e., money, personnel, time). Therefore, system manpower requirements must be examined in detail from at least the following three aspects:

- The quantity and type of all manpower required directly or indirectly by the weapon system, or the unit in which it will be deployed, must be examined. This includes military, DoD civilian, and contractor personnel.

- The projected requirements for manpower versus projected inventories for manpower (particularly military personnel) must be examined.
- The potential sources of skilled and experienced manpower within the Service who may be available for cross-training or cross-utilization on the system must also be examined.

The primary purpose of these analyses is to call attention to critical occupations which seriously influence system readiness and which have serious projected resource demands or constraints. As part of this overall expansion of early analysis of weapon system manpower requirements, OASD (MRA&L) has tasked MCR to develop methods for evaluating two major aspects of manpower. These are:

- the identification and evaluation of high-cost/critical occupations required for weapon systems; and
- the impact on weapon system manpower costs of the required quantities of particular occupations and pay grades.

In Phase I of this effort a preliminary definition of high-cost/critical occupations and a preliminary initial unit manpower cost methodology were developed. The results of this effort were documented in the final report of Phase I.^{2/}

Phase II of this effort has concentrated on refining and quantifying the application of the definition of high-cost/critical occupations; and developing the unit sustainment manpower cost methodology. A high-cost/critical occupation is defined as one which is essential to accomplish the mission of the weapon system, and/or is costly (because of training or retention requirements). Inventory shortage is not sufficient, by itself, to qualify an occupation as high-cost/critical. This definition attempts to reflect the different applications of this term used by the respective Services.

2/ TR-8006-1, "Cost Implications of Hardware Manpower Balance: Phase I - Initial Unit Manpower Cost Methodology," R. McConnell et al., Management Consulting & Research, Inc., Falls Church Virginia, 30 November 1980.

In Phase I, two element structures were developed to categorize manpower requirements and manpower costs. The unit manpower requirements for a weapon system, identified by quantity in a given occupation/pay grade combination, were costed. This was accomplished by applying the occupation- and pay grade-specific costs, listed in the cost element structure, to the detailed unit manpower requirements.

In Phase II, the calculations using these element structures have been refined by including consideration of personnel loss and replacement. The costs calculated by this approach are related to sustaining the unit and are comparable to the manpower operating and support costs calculated by the Services. Unit sustainment factors, developed from Service personnel loss rates, are applied to the recurring manpower costs.

In originally developing the definition of high-cost/critical occupation and the unit manpower cost methodology, MCR considered application of these methods in terms of DSARC Milestone III or IIIA submissions. Further consideration has indicated that such analysis should be completed by DSARC Milestone II, when decisions can still be made which will affect the quantity and quality of manpower required by a new system. By DSARC Milestone II the Services have usually developed preliminary estimates of weapon system manpower requirements. Analysis of these preliminary estimates will permit identification of occupations which may present difficulties in the future. These difficulties may be due to systems requiring one or more of the following:

- extremely specialized training which severely restricts choices of assignments;
- occupations which currently have severe inventory shortfalls and are projected to have them in the foreseeable future;
- more expensive training in already expensive career fields; and
- disproportionately large numbers of high pay grade personnel, especially in occupations with inventory problems in certain pay grades.

The methods proposed for defining high-cost/critical occupations and costing unit manpower are designed to help address certain aspects of these problems.

B. PURPOSE

The purpose of this technical report is to document MCR's Phase II efforts concerning the "Cost Implications of Hardware Manpower Balance." This phase has involved six major areas of effort:

- refining the definition of high-cost/critical occupations;
- refining the initial unit test data and element structures;
- developing a unit sustainment manpower cost methodology;
- testing the methodology on selected weapon system unit manpower data;
- joining initial unit and sustainment costs into a manpower life cycle cost methodology for weapon systems; and
- identifying potential applications of these methods.

This phase has involved eight tasks collectively concerned with these areas.

C. APPROACH

The approach taken in this effort has involved building on the foundation of the methods developed in Phase I. In addition to refining the definition of high-cost/critical occupations, and the initial unit test data and element structures, the research into Service approaches has been expanded. The initial approach taken in this effort was to examine the methods used by the Army, Navy, and Air Force in considering critical occupation requirements and weapon system unit manpower costs. A major weapon system from each of the Services was selected to test the methods. The systems selected were:

- Army M-1,
- Navy LAMPS Mk III, and
- Air Force GLCM.

Each of these systems is approaching DSARC Milestone III or IIIA. In testing both the Phase I and Phase II methods, only organizational or unit mission manpower has been used. Intermediate Maintenance, Installation Support and Indirect Personnel have not been considered. The intent of this testing was twofold:

- to demonstrate the high-cost/critical occupation definition; and
- to compare results of using the MCR method of unit costing versus the Service methodologies.

Finally, the requirements of the Integrated Program Summaries are discussed. This is followed by suggested applicability of the two MCR methods (high-cost/critical occupation definition and unit manpower costs) to these requirements.

D. ORGANIZATION OF THIS REPORT

Following this Introduction are the five remaining sections:

- II. Application of the Definition of High-Cost/Critical Occupations
- III. Description of the Preliminary Unit Sustainment Manpower Cost Methodology
- IV. Unit Sustainment Manpower Cost Data for Selected Weapon Systems
- V. Discussion of the Unit Manpower Life Cycle Cost Methodology
- VI. Application of MCR-Developed Tools

Three appendices are also attached:

- Appendix A - Reference Sources
- Appendix B - Additional Navy Data
- Appendix C - Definitions of Service Manpower Cost Elements

II. APPLICATION OF THE DEFINITION OF HIGH-COST/CRITICAL OCCUPATIONS

This section continues the discussion of weapon system high-cost/critical occupation requirements, begun in Phase I of this project. Two topics are discussed:

- analysis of the high-cost/critical occupation definition; and
- results of applying the definition to specific weapon systems.

A. DEFINITIONAL ANALYSIS

MCR developed a definition of high-cost/critical occupations in Phase I of the current Hardware Manpower Balance project. This required identifying the characteristics of a high-cost/critical occupation. MCR researched the approaches used by the Army, Navy, and Air Force to evaluate critical occupations and determined that no universal definition existed. Rather, an occupation is classified as critical based on the context in which it is considered. Three basic characteristics consistently appeared to be part of these critical classifications:

- the essentiality of the occupation to accomplish the primary function of the weapon system or to achieve acceptable system readiness;
- the costs associated with training or maintaining adequate inventories of the occupation; and
- the inventory shortages in particular pay grades in the given occupation.

These three primary characteristics have been considered in the MCR definition of high-cost/critical occupations. This definition was applied to the three selected weapon systems used to test the manpower cost methodology presented in this report:

- the Army M-1,
- the Navy LAMPS Mk III, and
- the Air Force GLCM.

As part of the Phase II effort, MCR refined the Phase I definition by quantifying the methods for identifying the characteristics of high-cost/critical occupations. In refining the definition of these characteristics, the following changes have been made:

- Mission Essentiality - This is still the least quantifiable of the characteristics and is based on the impact an occupation has on system operational effectiveness or readiness. Initially, in Phase I, this characteristic was recognized on the basis of occupation code (e.g., Navy Rating AD-Aviation Machinist's Mate). It is now determined on the basis of job title (e.g., Power Plant Maintenceman) as given in the unit manpower document. This characteristic alone is sufficient to qualify an occupation as high-cost/critical.
- High-Cost - The criteria for classifying an occupation as high-cost is the comparison of the combined costs of enlistment bonus, selective reenlistment bonuses (SRBs) and occupational training to a baseline cost. The baseline costs used in these analyses are the Services' average training costs. Those occupations with occupation-specific costs totalling more than the Services' average training costs qualify as "high-cost." This approach has been used because it allows the recognition of all occupation-specific costs, rather than only selected ones (i.e., only training costs). Although the baseline used in this study may not be the "right" number, the purpose of the high cost analysis is only to indicate "above average" costs. Determination of a "high-cost" occupation is, therefore, dependent on the baseline used in the comparison. Using a higher baseline obviously would result in fewer occupations qualifying as high cost. High-cost should be analyzed in the light of the other two characteristics but is usually sufficient to qualify an occupation as high-cost/critical.
- Inventory Shortage - The basis for determining whether this characteristic contributed to an occupation being high-cost/critical has changed substantially. In Phase I it was determined solely on the basis of award of enlistment or selective reenlistment bonuses (SRBs); it

is now determined based on comparison of authorizations to inventories. SRBs were not found to be an accurate indicator of inventory shortages. Some occupations which have inventory shortages are not awarded SRBs since the shortage may be temporary or the occupation is easily substituted for or is not considered to be critical. Other occupations with relatively insignificant shortages receive SRBs. To remedy this problem, the authorizations and inventories for each pay grade were evaluated to determine if an inventory shortfall existed in required paygrades. An occupation is categorized as having inventory shortages if the authorizations in a required pay grade exceed the inventory by 2.0%. This margin minimizes the sensitivity to fluctuations in authorizations and inventory. The 2.0% threshold was used in this study because analysis of the authorizations and corresponding inventories showed that this was a common break-off point in the occupations and pay grades evaluated. The 2% threshold is not significant in terms of readiness, but is used only as a reasonable value for analysis. Inventory shortage by itself is not sufficient to qualify an occupation as high-cost/critical. It must be considered in light of the mission essentiality of the occupation.

The analysis performed in Phase I of the selected weapon system high-cost/critical occupations has been reevaluated. The three characteristics described above are considered in terms of the quantity of each occupation/pay grade combination. The Phase II evaluation has revealed the need for greater attention to pay grade requirements. This need can be readily understood when viewed in the context of the unit sustainment manpower cost methodology, discussed in Section III.

In reevaluating the occupation/pay grade requirements for each of the systems, in terms of the revised definition, analyses were performed in the following sequence:

- The mission essential occupations were identified based on data available from manpower documents which provide individual job titles.
- The occupation-specific costs (enlistment bonus, SRB, and training) were combined for each occupation required by the weapon system and compared to the applicable Service average training cost. Those occupations with combined costs greater than the

Service average training cost were classified as high-cost occupations. Occupations which are composed of only E-8 and E-9 positions were not included in these high-cost/critical calculations, since their training cost has been previously amortized and they do not receive bonuses or SRBs.

- The overall authorization and inventory for each occupation was determined.
- A matrix of the quantity of each occupation and pay grade combination was produced to display the distribution of requirements and to assist in the analysis of the three characteristics.
- For those occupations which have been classified as mission essential or high-cost, a more discrete evaluation of pay grade authorizations and inventories was conducted to identify specific shortfalls in required pay grades.
- Finally, the occupations were listed which qualified as either high-cost or mission essential, thus being identified as high-cost/critical.

The results of the analyses for the selected weapon systems are presented in the following subsection.

B. RESULTS OF ANALYSES

This section presents the results of MCR's reevaluation of the weapon system high-cost/critical occupation requirements originally performed in Phase I. These analyses represent the application of the revised definition of high-cost/critical occupations, just discussed, which allows a more quantifiable evaluation of system manpower requirements.

The weapon systems evaluated are the same ones examined in Phase I of this project. They each represent a new capability for the particular Service:

- the Army M-1 tank which is replacing the current M60 series;
- the Navy LAMPS Mk III ship weapon system which is augmenting the existing ASW capability provided by the LAMPS Mk I helicopter system; and

- the Air Force GLCM, a member of the cruise missile family, which will augment NATO defenses in Europe.

Because of the differences among these weapon systems, they have been evaluated and discussed individually. Each is considered in terms of the organizational unit in which it will be deployed. The M-1 has been examined in the context of a tank battalion. The GLCM is considered in terms of a flight. The LAMPS Mk III is considered in a somewhat different fashion due to the complexity of the units dedicated to it. Thus, data is provided for the 13 sea detachments included in a standard LAMPS Mk III operational squadron; the shore-based component of the squadron; and the Fleet Readiness Squadron (FRS), which is a totally dedicated training unit. It should be noted that the GLCM data is somewhat tentative as the specific pay grade requirements are still classified. For the purpose of this analysis the manpower was assumed to be distributed between E-4 and E-5 pay grades. This assumption was approved as adequate for analysis by the Air Force.

Each of the three evaluations are centered on the analyses of the organizational units described above. The manpower requirements data are displayed on the five main tables included in each discussion.

The demonstration of the application of this definition on the three systems has highlighted certain points which otherwise might not be exposed. These are summarized below:

- An occupation may be "high-cost" without having an enlistment bonus or SRBs awarded, and, conversely, an occupation may have an enlistment bonus and SRBs awarded and still not qualify as a high-cost occupation, due to low training costs.
- It is not sufficient to look at the total authorizations and inventories for an occupation. The status of specific pay grades must be examined in order to determine real impacts. Quite often shortfalls in more senior pay grades are offset by large inventories in first term pay grades.

- The award of an SRB does not necessarily indicate that an occupation is experiencing an inventory shortfall, and, conversely, the existence of an inventory shortfall does not necessarily mean an SRB is awarded to counteract it.

1. Army - M-1

The Army M-1 main battle tank is to be deployed throughout the world as a replacement for the M60 series of tanks. The primary organizational unit in which it will be deployed is a tank battalion consisting of 511 enlisted personnel. The primary manpower document for this battalion, the Table of Organization and Equipment (TOE), lists 32 occupations or MOSs spread over 13 Career Management Fields (CMFs). Personnel representing all pay grades between E-3 and E-9 are required, with the largest number in pay grade E-4.

Table II-1 lists the M-1 mission essential occupations. Of the 32 Military Occupational Specialties (MOSs) required, four are considered mission essential. These MOSs have been selected based on the job titles provided in the TOE. All are concerned with operating or maintaining the tank.

Table II-2 provides the detailed calculations of the high-cost evaluation of all of the occupations. As mentioned in the table footnotes, in some cases the MOSs represent aggregations of more than one occupation. The average training cost used was taken from the Army Force Planning Cost Handbook (AFPCH). The AFPCH establishes a value (in FY80 dollars) of \$6,654 as the average cost of initial training. For the purpose of the comparison to average training costs, only the skill digit ten (10) training costs have been used for each MOS. The skill digit is an MOS suffix which relates to pay grades. These costs most closely compare to the recruit and initial training costs averaged in AFPCH. Army costs of training were taken from the MOSB which provides training costs by occupation and skill level.

Table II-1. M-1 MISSION ESSENTIAL OCCUPATIONS

<u>JOB TITLE</u>	<u>OCCUPATION CODE</u>
M-1 Armored Crewman (Tank Commander/Loader/Gunner)	19K
M-1 Tank Driver	19L
M-1 Tank Turret Mechanic	45E
M-1 Tank System Mechanic	63E

Table II-2. M-1 OCCUPATION-SPECIFIC CALCULATIONS (FY80 \$) (Cont'd)

OCCUPATION TITLE	OCCUPATION CODE	TRAINING COST (\$)**	ENLISTMENT BONUS (\$)	SFB (Zone-level-\$)	HIGH-COST OCCUPATION	AUTHORIZATIONS ***	INVENTORY ***	SHORTFALL
Power Gen. (wheel & axle Mech.)	630	5,162	--	A-1 \$3,173 B-1 \$3,173	Yes	22,336	22,247	Yes ****
Mech. Tank (base Machgn)	638*	10,369	--	A-1 \$3,173 B-1 \$3,173	Yes	1,311 *****	3,525 *****	Yes *****
Mech. (wheeled vehicle Mechgn)	639	10,369	--	A-1 \$3,173 B-1 \$3,173	Yes	500	1,270	No
Trk. (w/tyr. Mechgn)	637	10,163	--	A-1 \$3,173 B-1 \$2,173	Yes	2,949	2,274	Yes
Mult. Transport Oper.	640	4,036	--	--	No	19,640	19,959	No
Legal Clerk	710	4,928	--	--	No	1,620	1,537	Yes
Administrative Oper.	711	5,423	--	--	No	21,319	20,840	Yes
Personnel Administra- tive Oper.	750	6,134	--	--	Yes	4,441	4,214	Yes
Shop	800	3,173	--	--	No	4,546	4,111	Yes *****
Eng. Supply & Parts Oper.	800	3,163	--	--	No	3,141	5,524	No
Vehicle Repair Oper.	810	3,173	--	--	No	3,417	3,111	No
Auto. Supply Oper.	811	3,173	--	--	No	19,411	16,417	No
Mech. (wheeled vehicle Mechgn)	812	5,118	--	A-1 \$3,173	Yes	17,034	16,571	Yes *****
Personnel Oper.	900	13,173	--	A-1 \$3,173 B-1 \$3,173	Yes	6,141	6,410	Yes
Trk. (w/tyr. Mechgn)	940	4,134	--	--	No	19,411	19,134	Yes

Twenty-nine of the MOSs are listed on this table. The three MOSs not included are 00Z (Command Sergeant Major), an E-4 position; 19Z (Armor Senior Sergeant), an E-8 position (E-8s and E-9s have been excluded from the analysis); and 79 (enlistment NCO), an MOS which begins at grade E-6. Eight MOSs receive enlistment bonuses. In addition, all but 120 (BIV and 91s of the occupations receiving SKBs receive them in both Lines A (21 months to six years of service) and B (six through ten years of service). Altogether, 15 of the MOSs are receiving SKBs. The third award level, the highest award level assigned, goes to 54E. The total number of occupations which qualified as high-cost was 21. This was based on the comparison of occupation-specific costs to the average training cost of \$6,654.

The second part of the analysis included in this table involves the authorizations and inventories for the occupation. Twenty-one occupations are listed as having inventory shortfalls. These shortfalls, indicated by a "yes" in the column marked "shortfall", may be for the overall occupational inventory (e.g., 11C) or in particular pay grades required by the M-1 (e.g., 05B). The latter case is indicated by a "yes" with four asterisks (****) underneath. Those MOSs which have been classified as mission essential or high-cost, and which have an overall or specific inventory shortfall, are listed on Table II-3. The MOSs with inventory shortfalls which do not meet the criteria and are, therefore, not listed on Table II-3 are 71D, 71L, and 94B. The required pay grades with the specific shortfalls are indicated by a ▲. Only pay grades through E-7 are shown. Pay grades E-8 and E-9 have not been included in this analysis because they are supervisors (not mission essential by the definition used for this study) and their training, bonus, and SRB costs have already been amortized. In order to facilitate this analysis the authorizations and inventories for some related MOSs have been aggregated (e.g., 19F, 19E, 19I, 19K and 19L have been combined).

Table II-4 provides an additional perspective of the M-1 battalion manpower requirements. This is a matrix of the distribution of personnel by occupation and pay grade combination. It shows the standard distribution of the majority of personnel in the E-3, -4, and -5 pay grades. The largest quantity of personnel is in CMF 19.

The data in the first four charts is summarized on Table II-5. An analysis of the M-1 tank battalion MOSs shows that 21 of the M-1 MOSs qualify as high-cost/critical (19K/L has been counted as two MOSs). Four (19K, 19L, 45E, 63E) are considered mission essential; all 21 have combined costs above the average and are therefore classified as high-cost; and all but one of the high-cost occupations (63S) have inventory shortfalls in required pay grades. This analysis demonstrates that for the M-1, 65.6% of the occupations qualify as high-cost/critical, or 422 of the 511 personnel (82.6% are in high-cost/critical occupations). Examination of manpower and occupations required in an M-1 tank battalion shows that over half of the personnel (53.6%) are required in the four mission essential occupations (19K, 19L, 45E and 63E).

It appears that the M-1 has a higher maintenance requirement than the M60 series of tank but at the organizational level there is an adequate number of mechanics to handle the workload. The Army position at DSARC III was that direct and general support (DS/GS) maintenance workload does not increase over current levels. For purposes of comparison, the MACRIT^{3/} criteria for the M60 series and the MSRS^{4/} criteria for the M-1 are shown in Table II-6. It should be noted that the

^{3/} Manpower Authorization Criteria, AR 570-2, "Organization and Equipment Authoriztaion Tables," 22 July 1969.

^{4/} "Material Systems Requirements and Specifications," Department of the Army, 10 October 1980.

Table II-5. M-1 ANALYSIS OF HIGH-COST/CRITICAL OCCUPATIONS

OCCUPATION CODE	MISSION ESSENTIAL	HIGH-COST	INVENTORY SHORTFALL	AVERAGE	CRITICAL
050	--	X	X	Training cost is above average (41.0% of bonus, shortfall in E-4).	Yes
05C	--	X	X	Training cost significant (41.0% of E-4 bonus).	Yes
11C	--	X	X	Bonus pay is shortfalls in E-3, E-4 and E-7.	Yes
12F	--	X	X	Training cost is above average (41.0% of bonus, shortfall in E-4).	Yes
16S	--	X	X	Training cost is above average shortfalls in E-4 and E-5.	Yes
190	--	X	X	Training cost not significantly above average (41.0% of bonus pay); shortfalls in grades E-4, E-5 and E-7.	Yes
19-L	X	X	X	Training cost above average (41.0% of bonus); shortfalls in E-5, E-6 and E-7.	Yes
21F	--	X	X	Combined cost (bonus and inventory) shortfalls in E-4, E-5.	Yes
40	--	X	X	Training cost above average (41.0% of bonus); shortfalls in E-4, E-5 and E-7.	Yes
40E	X	X	X	Training cost above average (41.0% of bonus); shortfalls in E-4, E-5 and E-7.	Yes
41F	--	X	X	Training cost above average (41.0% of bonus); shortfalls in E-4, E-5 and E-7.	Yes

Table II-5. M-1 ANALYSIS OF HIGH-COST/CRITICAL OCCUPATIONS (Cont'd)

OCCUPATION CODE	MISSION ESSENTIAL	HIGH-COST	INVENTORY SHORTFALL	REMARKS	HIGH-COST CRITICAL
64E	--	X	X	Training cost above average (+\$2.7) in SAs A and B paid; shortfall in E-5.	Yes
65B	--	X	X	Inventory shortfall in E-4, E-6 and E-7.	Yes
66E	X	X	X	Training cost above average (+\$5.8) in SAs A and B paid; shortfall in E-6 and E-7.	Yes
68S	--	X	--	Training cost above average (+\$5.9) in SAs A and B paid; no inventory shortfall.	Yes
69T	--	X	X	Training cost above average (+\$5.9) in SAs A and B paid; inventory shortfall in E-4, E-6 and E-7.	Yes
70S	--	X	X	Training cost above average (+\$6.1) in SAs A and B paid; inventory shortfall in E-4.	Yes
72T	--	X	X	Training cost above average (+\$6.1) in SAs A and B paid; inventory shortfall in E-4.	Yes
91B	--	X	X	SAs paid; shortfalls in E-4, E-6 and E-7.	Yes
91C	--	X	X	Training cost above average (+\$4.1) in SAs A and B paid; shortfall in E-6.	Yes

annual organizational maintenance manhours increase above the M60 for M-1, although no additional mechanics are provided. It appears, based on available manhours per mechanic, that the organizational maintenance personnel are adequate for peacetime requirements. The calculation shows that with a peacetime availability factor (annual available hours per mechanic) of 1,590^{5/} for a tank battalion of 54 tanks that

$$\left(\frac{954}{1,590} \times 54 = 32.4 \right)$$

33 mechanics are needed. The M-1 tank battalion has 11 45E and 37 63E for a total of 48 mechanics.

Table II-6. ANNUAL MAINTENANCE MANHOURS PER TANK (PEACETIME OPERATION)

	M-1	M60A1/A3	M60A2
ORG	954	399	569
DS/GS	1,405	1,016	843
TOTAL	2,359	1,415	1,412

The increase in DS/GS required manhours from 1,016 (M60A1/A3) to 1,405 for the M-1 will presumably create a 38% greater requirement for mechanics than are currently authorized. Most of this workload would fall on MOSs 45K and 63H since they do most of the maintenance at the DS/GS level for tanks. The current 45K and 63H authorized strength and inventory are as shown in Table II-7. Both of the MOSs are in short supply, particularly at the journeyman and senior level for 45K (E-4, E-5, E-6) and at the senior level (E-6, E-7) for the 63H. For an operating fleet of 3,763 tanks the increased number of mechanics could be as much as 920 as shown in the calculations below:

^{5/} TARCOM Report No. ECD-2-79, "Average Maintenance Labor Rates for Tactical and Combat Vehicles," February 1979.

Table II-7. DS/GS OCCUPATION/PAY GRADE-SPECIFIC AUTHORIZATIONS AND INVENTORIES*

OCCUPATION CODE	E-1 - E-3		E-4		E-5		E-6		E-7	
	AUTH.	INV.	AUTH.	INV.	AUTH.	INV.	AUTH.	INV.	AUTH.	INV.
45K	222	391	352	240	256	204	425	312	---	2
63H	1,667	1,381	1,321	1,025	747	770	840	793	834	714

*Data extracted from COP0-45 Report, MILPERCEN, November 1980.

$$\frac{1,016 \text{ (DS/GS annual maintenance manhours)}}{1,590 \text{ (availability factor)}} \times 3,763 \text{ tanks} = 2,405$$

$$\frac{1,405}{1,590} \times 3,763 = 3,325$$

$$3,325 - 2,405 = 920$$

The manpower impact of replacing the M60A1, -A2 and -A3 tank with the M-1 tank is relatively small. The overall number of enlisted personnel in each battalion does not change (511 total). The occupation mix changes to a limited degree, principally by the substitution of M-1-specific operators/maintainers for M60-specific personnel. The substitution initially is accomplished by either on-the-job training (OJT) or short transition courses. The occupations that are currently, or are projected to be, in short supply Army-wide remain the same. The M-1 does not exacerbate problems of occupation-shortages, but it does not alleviate these problems either. Apparently, the M-1 will continue to have the existing problems since the M-1 is a replacement system for the M60 series tank.

2. Navy - LAMPS Mk III

The LAMPS Mk III personnel requirements analyzed in this section represent two different types of organizational units:

- a LAMPS Mk III operational squadron (232 enlisted personnel), composed of:
 - 13 sea detachments, and
 - a shore-based component; and
- a Fleet Readiness Squadron (FRS) (248 enlisted personnel), a stand-alone training unit.

Both of these organizations are totally dedicated LAMPS Mk III units. Current planning calls for eight operational squadrons and two FRSSs. A third type of unit is also required by the

LAMPS Mk III, the Aviation Intermediate Maintenance Department (AIMD). Original plans called for five AIMDs to be stationed throughout the world, however, this number may be reduced to four. The AIMDs are discussed only briefly in this analysis for the following reasons:

- all of the occupations required in the AIMD are also required in the operational squadron; and
- they have relatively small numbers of personnel required (a total of 87 enlisted personnel).

Due to the various types of units required by the LAMPS Mk III, and the fact that some are considered mission essential and some support, there is apt to be confusion concerning how each unit is considered in these analyses. In order to minimize this confusion, certain rules have been applied:

- In determining mission essential occupations, only the mission essential units (sea-detachments and AIMDs) were examined. However, the mission essential occupations also occur in the "support" units: the shore-based component of the operational squadron and the FRS.
- In identifying the high-cost occupations, all ratings with occupation-specific costs were examined regardless of the type of unit in which they are required.
- In evaluating the pay grade inventories, the operational squadron and FRS requirements were used in determining if a shortfall existed in a required pay grade.

Table II-8 lists the mission essential occupations. The job titles listed are those in either the sea detachments or AIMD, which were the only units considered by MCR to be mission essential. The occupations also may be found fulfilling different jobs in the shore-based component or the FRS. The LAMPS Mk III requires a total of 23 occupations, with seven pay grades (E-3 through E-9). A total of nine of the occupations were considered mission essential.

Table II-9 presents the high-cost and inventory shortfall calculations, the data for the latter have been

Table II-8. LAMPS Mk III MISSION ESSENTIAL OCCUPATIONS*

<u>JOB TITLE</u>	<u>OCCUPATION CODE</u>
Maintenance/Material Control Coordinator/ Power Plant Maintenance	AD
Electrical Instrument Maintenance	AF
Air Frame Maintenance (Hydraulics)	AMH
Air Frame Maintenance (Structures)	AMS
Electronics Maintenance	AT
Aircrewman	AW
ASW Maintenance	AX
Armament Repair	AO
Aviators Equipment Repair	PK

*These job titles are for either the sea detachments or the AIMD, the only LAMPS Mk III units classified as Mission Essential. Individuals in these ratings also have other similar jobs in the shore-based component and FRS.

Table II-9. LAMPS Mk III OCCUPATION-SPECIFIC CALCULATIONS (FY80\$) (Cont'd)

OCCUPATION TITLE	OCCUPATION CODE	TRAINING COST**	ENLISTMENT BONUS	SRB (Zone-Level)-\$	HIGH-COST OCCUPATION	AUTHORIZATIONS ***	INVENTORY ***	SHORTFALL
Yeoman	YN	4,575	--	--	No	11,782	14,111	No
Airman/Seaman	AN/SN	3,294	--	--	No	N/A	N/A	

* Based on 1980 military occupational classification data.

** Training cost are an estimate for comparison to the \$1.6 million per man per year cost of the LAMPS Mk III program.

*** Authorizations and inventory are based on the 1980 data.

obtained from the FY80 FAST model calculations. Eighteen of the 23 occupations are listed on this table with information on training costs, enlistment and selected reenlistment bonuses, authorizations and inventories. The five occupations not included on this table are either positions not related to a specific occupation or rating (APO, PO), or are supervisory ratings which contain only E-8s and E-9s which are not included in this analysis (AF, AM, AV). The occupation-specific costs have been compared to the Navy average training costs (\$5,600 in FY80 dollars) supplied by the Training Resource Model (TRM). The training cost data, also acquired from TRM, represents recruit training and "A" school training only. As with all other Service calculations, bonus data (enlistment and SKB) was taken from current listings. The Navy awards very few enlistment bonuses, with the MS rating (Mess Management Specialist) receiving the only bonus of all the occupations considered. Four of the selected occupations (AT, AW, MS and PN) receive SKBs at varying award levels. Altogether five occupations, of the 18 listed on this table, qualify as high-cost. These are the AX, AT, AW, MS, and PN ratings. In examining the mission essential and high-cost occupations it was found that 11 of the occupations also have inventory shortfalls within required pay grades. The specific authorization and inventory data for these occupations are displayed on Table II-10. Examination of the authorizations and inventories in specific pay grades shows that the first term pay grades E-1 through E-3 have no shortfalls and frequently have large overages. However, almost half of the ratings listed have shortfalls in the E-4 grade and all of the ratings have shortfalls in pay grade E-5. Finally, pay grades E-6 and E-7 show shortfalls in seven of the ratings.

The detailed distribution of personnel by occupation and pay grade combination for an operational squadron and an FRS is contained in Table II-11. Detailed breakdowns of the personnel in the sea detachments, the shore-based component,

Table II-10. LAMPS Mk III OCCUPATION/PAY GRADE-SPECIFIC AUTHORIZATIONS AND INVENTORIES*

OCCUPATION GRADE	E-1 - E-3		E-4		E-5		E-6		Total
	Auth.	Inv.	Auth.	Inv.	Auth.	Inv.	Auth.	Inv.	
AD	1,316	6,067	2,600	2,851	2,915	2,539▲	2,539	2,488	13,500
AE	1,351	3,503	2,030	1,603▲	2,400	2,053▲	1,720	1,714	10,721
AM	1,023	3,051	1,315	1,442	1,496	1,293▲	1,063	1,681	7,505
AS	1,704	4,411	1,775	1,945	1,631	1,467▲	1,341	1,330	10,199
AC	1,365	2,434	1,552	1,706	1,451	1,252▲	1,271	1,266	7,411
AT	1,434	3,303	2,503	2,656▲	3,331	2,565▲	2,200	2,100	15,250
A4	576	917	601	564▲	925	724▲	601	664▲	3,473
B1	211	451	517	546	6	501▲	651	47	2,263
M3	3,000	6,000	4,301	4,077▲	4,225	3,639▲	3,341	3,330	21,574
F1	1,400	3,450	1,400	1,131▲	1,200	1,200	1,400	1,200	7,780
P2	4	501	487	511	487	514▲	488	511	2,002

and the AIMDs are contained in Appendix B. A comparison of the manpower required in the operational squadron and the FRS shows that the operational squadron requires all but one (A) of the ratings, while the FRS requires all but four of the ratings. The operational squadron requires over one half of its personnel, (162 personnel or 69.8%) in the nine mission essential occupations. This proportion is smaller (144 personnel or 58.0%) in the FRS.

In looking at the 13 sea detachments, as described in the draft Navy Training Plan, the pay grade composition for each detachment stays substantially the same. However, the distribution among occupations varies depending on the detachment. Thus, occupational representation may be more critical than pay grade level. The detachment responsibilities are restricted to operation of the helicopter and organizational maintenance. Table II-12 summarizes the preceding four tables on the LAMPS Mk III occupational and pay grade requirements. Eleven ratings were determined to qualify as high-cost/critical. Six of these ratings (AD, AE, AMH, AMS, AO and PR) qualified on the basis of mission essentiality alone. Two of the ratings (MS and PA) qualified on the basis of high-cost only. The remaining three ratings (AT, AW and AX) qualified on both mission essentiality and high-cost. These three ratings are the most expensive LAMPS Mk III ratings to train. Finally, all 11 of the high-cost/critical ratings have inventory shortfalls in required pay grades, with E-5 shortfalls appearing in each of the 11 ratings. The personnel distribution in the high-cost/critical occupations for the operational squadron and the FRS is the same as that discussed for Table II-11.

3. Air Force - GLCM

The GLCM is the land-based member of the cruise missile family, planned to be deployed in Europe as part of NATO defenses. The basic organizational unit is the flight.

Table II-12. LAMPS Mk III ANALYSIS OF HIGH-COST/CRITICAL OCCUPATIONS

OCCUPATION CODE	MISSION ESSENTIAL	HIGH-COST	INVENTORY SHORTFALL	REMARKS	PRIORITY CRITICAL
AC	X	--	X	Power Plant Maintenance; shortfalls in E-6, and E-7.	X
AE	X	--	X	Electrical Maintenance; shortfalls in E-4, E-5, and E-7.	X
AW	X	--	X	Hydraulics Maintenance; shortfalls in E-1, and E-7.	X
AWB	X	--	X	Structures Maintenance; shortfalls in E-3, and E-7.	X
AD	X	--	X	Aviation Ordnance; shortfalls in E-7.	X
AT	X	Y	X	Electronics Maintenance; expensive training (40000) and some shortfalls in E-4, E-5, and E-7.	X
AV	X	X	X	Armament; expensive S&W; shortfalls in E-1, E-2, E-3, and E-7.	X
AT	X	Y	X	Flow Maintenance; expensive training (40000) and some shortfalls in E-1, and E-2.	X
W	--	X	X	M - M - Special; expensive training (40000) and some shortfalls in E-4, E-5, and E-7.	X
BA	--	X	X	Training; expensive training (40000) and some shortfalls in E-1, E-2, E-3, and E-7.	X
BT	--	X	X	Structure; expensive training (40000) and some shortfalls in E-1, E-2, E-3, and E-7.	X

The exact composition of a GLCM flight in terms of occupation and pay grade distribution is still classified. For the purposes of the MCR analysis, personnel have been assigned to the average pay grades of E-4 and E-5. For this reason, some of the more detailed analyses of the GLCM must be considered as tentative.

The minimum direct personnel requirements for a GLCM flight calls for 75 enlisted, non-aircrew personnel. At this time 15 Air Force Specialty Codes (AFSCs) will have new shred-outs created: 316XOC (GLCM Missile System Analyst) and 443XOC (GLCM Missile Mechanic) representing new, GLCM-specific skills. Shredouts are alphabetical suffixes to AFSCs and indicate training or qualification on a specific weapon, specific equipment, model, or series. They are indicated by a sixth character appended to the basic five-character AFSC.

Due to the fact that the GLCM will only be deployed in Europe and not in the continental United States (CONUS), it will present unusual personnel management and planning problems, as well as additional costs. Positions for GLCM-specific personnel will be limited to European assignments. In order to be assigned to other units, these personnel will have to undergo some level of retraining. Two of the AFSCs are constrained in this manner: 316XOC and 443XOC. In addition, two other AFSCs (304X0 and 461X0) require specialized training which also restricts their assignments to overseas, although not specifically to Europe.

Table II-13 lists the occupations which are considered mission essential for the GLCM. Of the 15 occupations currently under consideration for the GLCM, eight are considered as mission essential. These occupations fulfill jobs which are directly related to the operation, preparation, or maintenance of the system.

Table II-13. GLCM MISSION ESSENTIAL OCCUPATIONS

<u>JOB TITLE</u>	<u>OCCUPATION CODE</u>
Radio Relay Equipment Repairman	304X0
Missile Systems Analyst	316X0C
Avionic Communications Specialist	328X0
Aerospace Ground Equipment Mechanic	423X5
Missile Mechanic	443X0C
Munitions Systems Specialist	461X0
Nuclear Weapons Specialist	463X0
Refrigerator/Air Condition Specialist	545X0

Table II-14 gives detailed data on occupation-specific costs, authorizations and inventories for the 15 AFSCs. Based on this data, occupations are classified as being high-cost or having inventory shortfalls. The criteria for classifying an occupation as high-cost in this study is based on the sum of formal training costs and bonus awards compared to the Air Force training cost of \$6,786^{6/}. Those occupations whose costs exceed this baseline are categorized as high-cost. In the case of the GLCM, an occupation may receive an SRB (none receive an enlistment bonus), and still not qualify as high-cost, (e.g., 443X0C). Based on the comparison of combined occupation-specific costs to the Air Force average training cost, eight of the 15 GLCM AFSCs qualify as high-cost occupations. Four of these AFSCs (304X0, 427X4, 463X0, and 472X4) qualify due to the award of an SRB. The remaining four AFSCs (316X0C, 391X0, 461X0, and 811X0) qualify on the basis of their training costs.

Review of the composition of the proposed GLCM flight provides a better indication of the high-cost occupations. Six - one of the 75 personnel, or 81.3% of GLCM unit manpower, are in the eight high-cost occupations listed in Table II-14. The percentage is even higher for optimized versions of proposed GLCM manpower requirements.

More information about the 15 AFSCs is provided in an examination of the status of their authorizations and inventories. Fourteen of the AFSCs have inventory shortfalls in specific pay grades. Table II-15 provides additional detail on the status of specific pay grades in the mission essential or high-cost AFSCs. This table shows that for pay grades E-5, E-6 and E-7 there are shortfalls in seven of the 14 AFSCs listed. The

^{6/} \$6,786 is the enlisted non-aircrew training factor for FY80 used in the Cost Oriented Resource Estimating (CORE) model in AFP 173-13.

Table II-14. GLCM OCCUPATION-SPECIFIC CALCULATIONS (FY80 \$)

OCCUPATION TITLE	OCCUPATION CODE	TRAINING COST**	ENLISTMENT BOARDS	SPB (Zone-Level)-\$	HIGH-COST OCCUPATION	ADJ-HIGH/ADJ-LOW ***	INSTR-DUMY ***	SHORT-FALL
Radio Relay Equipment Repairer	304X0*	6,492	--	A-2 \$5,799 B-1 \$2,923	Yes	2,707	2,825	Yes ****
Missile Systems Analyst	316X0*	7,348	--	A-1 \$2,899	Yes	2,101	1,975	Yes
Airborne Com. Spec.	378X0*	5,069	--	--	No	2,150	1,816	Yes
Naval Analysis Spec.	391X0	7,022	--	--	Yes	811	756	Yes
Master Control Spec.	390X0	5,067	--	--	No	2,171	1,962	Yes
AGE Mechanic	423X5*	4,967	--	--	No	7,150	6,574	Yes
Naval Processing Specialist	427X4	4,993	--	A-1 \$2,899	Yes	575	667	Yes ****
Missile Mechanic (GLCM)	443X0*	3,012	--	A-1 \$2,899	No	1,923	1,813	Yes
Navigation Systems Specialist	461X0*	7,020	--	--	Yes	6,001	5,934	Yes
Naval Weapons Spec.	468X0*	3,420	--	A-1 \$2,899 B-1 \$1,923	Yes	1,391	1,150	Yes
Naval Weapons Specialist	462X0	5,267	--	A-2 \$5,799	Yes	405	304	Yes
Naval Weapons Specialist	465X0*	4,437	--	--	No	1,755	1,704	Yes
Naval Weapons Specialist	466X0	3,564	--	--	No	11,603	16,291	Yes
Naval Weapons Specialist	707X0	4,277	--	--	No	24,730	25,511	No
Naval Weapons Specialist	717X0	5,343	--	--	Yes	26,113	25,111	Yes

* Job titles are listed in the Job Title column of the Job Title List. ** Training cost is based on the cost of training for the job title. *** Shortfall is calculated as the difference between the total number of personnel required and the total number of personnel available. **** Job titles are listed in the Job Title List.

impact of these shortfalls can not be fully understood since the specific GLCM pay grade structure is classified.

Table II-16 shows the manpower distribution for the 15 AFSCs. Although the pay grade quantities may not be accurate, the occupation quantities are those actually planned. As shown in this table, AFSC 811X0 (Security Specialist) requires by far the largest number of personnel (57%) within the flight. It is also experiencing serious shortfalls in pay grade 4-6. The other occupations show a better situation primarily due to the relatively small numbers of personnel required. The largest demand will come from the 316X0 (Missile System Analyst) AFSC, which requires eight enlisted for a single flight. It is currently planned that the personnel who will fill this GLCM-specific shredout will be already experienced personnel from other systems. This is also planned for the other GLCM-specific shredout, 443X0 (Missile Mechanic).

Table II-17 summarizes the information in the preceding four tables. This table shows that 12 of the 15 GLCM AFSCs qualify as high-cost/critical occupations. Of the possible combinations of the three characteristics, only four (504X0, 316X0C, 461X0, and 463X0) qualify in all three categories. Eight of the 12 occupations are mission essential. However, all of these occupations also qualified in at least one of the other two characteristics. Eight of the 12 AFSCs are also high-cost, while all 12 of the AFSCs have inventory shortfalls. It is, of course, not known if these shortfalls are in required pay grades.

C. OBSERVATIONS

The following observations are made based on the analysis of the selected weapon system high-cost/critical occupations:

- The Services tend to consider occupations in terms of the separate characteristics of high-cost/critical (i.e., mission essentiality, cost, inventory

Table II-16. GLCM PERSONNEL BY OCCUPATION AND PAY GRADE

	374**	375*	381XG	423X5	427X4	443XG	461XG	463XG	472X4	545XG	645XG	702XG	811XG	TOTAL BY PAY GRADE
E-1														
E-2														
E-3														
E-4														
E-5		8	1	4	1	2	2	1	1	4	1	2	43	16
E-6	4													59
E-7														
Total by Occupation	4		1	4	1	2	2	1	1	4	1	2	43	75

* Average Grades are used. Actual grade/skill level information is classified.

** Error in column will be used but not both.

Table II-17. GLCM ANALYSIS OF HIGH-COST/CRITICAL OCCUPATIONS

OCCUPATION CODE	MISSION ESSENTIAL	HIGH-COST	INVENTORY SHORTFALL	REMARKS
3-410*	X	X	X	Communications Maintenance; serious inventory shortage in E-4, Zone A and B SRB paid.
31-400	X	X	X	Electronic Missile Maintenance; no inventory shortage in E-4 and E-5, but short at E-6 and E-7; SRB Zone A paid.
32-400*	X	--	X	Communications Maintenance; does not receive SRB although does have inventory shortage.
34-400	--	X	X	Production Control; slightly above baseline costs; inventory shortage for E-4, E-5 and E-7.
4-1-4B	X	--	X	Ground Equipment Maintenance; does not receive SRB although does have inventory shortage.
4-1-4	--	X	X	Metals & Surface Inspect; may not double with 4-1-4B. Just qualified as high-cost; shortage at E-4 and E-5.
41-400	X	--	X	Mechanical and Electrical Maintenance; E-4 inventory shortage; Zone A SRB paid but not qualified as high-cost.
4-1-4	X	X	X	Waders Preparation; expensive training.
4-1-4	X	X	X	Waders Preparation; expensive training; inventory shortage.
4-1-4	X	X	X	Waders Preparation; Zone A SRB paid; inventory shortage.
5-1-4	X	--	X	Waders Preparation; expensive training; inventory shortage.
5-1-4	X	X	X	Waders Preparation; expensive training; inventory shortage.

shortage) and, therefore, frequently do not obtain an overview of the impact of all three characteristics.

- The profile of high-cost/critical occupations within an organizational unit is influenced substantially by the mission essential occupations required for the particular weapon system. Table 11-18 shows the statistics for the M-1, LAMPS Mk III, and GLCM produced in this analysis. In the case of the M-1, over half of the battalion personnel are assigned to four M-1-specific mission essential occupations.
- The aspect of occupation-specific costs as another characteristic of weapon system manpower analysis has frequently been overlooked. Table 11-18 shows that in the M-1 battalion an extremely large proportion (82.6%) of the personnel are in occupations which are above average in cost. The GLCM flight shows a similar proportion (81.3%). In identifying high-cost occupations, the ultimate selection is dependent on the baseline used in the analysis. In this study the average training cost for each Service has been used as the basis for the comparison.
- The status of an occupation's inventory is frequently used by the Services as an indicator of criticality. However, an inventory shortfall is only of importance if a particular pay grade within an occupation is required by a weapon system. Thus, inventory analysis becomes meaningful only in the context of the requirements of a particular system or organizational unit. The true impact of inventory shortfalls can only be identified on a Service-wide basis for each occupation/pay grade combination.
- The three weapon systems examined have a preponderance of personnel in high-cost/critical occupations. This should not be taken to mean that all systems require large numbers of high-cost/critical personnel. It would be necessary to look at a high percentage of Service weapon systems before any analysis can be made of the impact of high-cost/critical occupations re-

The definition of high-cost/critical occupations can be used to develop a multidimensional analysis of weapon system manpower requirements. A profile for each occupation can be developed based on the three characteristics of the definition. Thus, an occupation would be described in terms of its mission

Table II-14. RESULTS OF HIGH-COST/CRITICAL OCCUPATION ANALYSIS

WORLD SYSTEM	QUANTITY	HIGH-COST/CRITICAL		MISSION ESSENTIAL		HIGH-COST		INVENTORY SHORTFALL	
		QUANTITY	%	QUANTITY	%	QUANTITY	%	QUANTITY	%
MARS	501	21	63.7	4	12.5	21	63.7	10	41.5
VENUS	501	427	85.6	274	54.6	427	85.6	414	82.8
JUPITER	100	11	47.9	9	30.1	5	11.7	11	41.8
SATURN	200	121	73.7	162	69.5	71	29.5	121	75.7
UPLINK	10	12	80.0	8	53.3	8	57.7	12	81.8
DOWNLINK	75	21	91.7	25	93.3	21	91.7	21	91.7

* Data for Operational Shortfall only.

essentiality, costs, and inventory status in relation to the number of people the weapon system requires in that occupation.

To illustrate the multidimensional aspects of the problem, a profile of the LAMPS Mk III system is provided in Table 11-11. As can be seen from the table, a LAMPS Mk III Operational Squadron requires 29 personnel in the mission essential AW (Aviation Anti-submarine Warfare Operator, rating), and 27 AAs in the FR. Based on current plans, which call for eight operational squadrons and two FRs, this translates into a total LAMPS Mk III requirement of 286 AAs (or 12.1% of the total 2,362 personnel required in these units).

In terms of the second element, high-cost, the AW rating has very large costs attached to it: a training cost of \$7,501, which is 35% over the Navy average training cost; and SAs awarded in Zone A (\$10,416) and Zone B (\$9,778). These costs, when examined in the context of the total unit, show that the AW-specific annual costs for the operational squadron account for \$114,082, or 24.7% of the total annual occupation-specific unit sustainment costs of \$462,504. Finally, the AW rating is experiencing inventory shortfalls in the four pay grades required in the LAMPS Mk III squadrons: E-4, E-5, E-6, and E-7. This multidimensional analysis allows the examination of the weapon system unit manpower requirements in terms of the characteristics which influence the sustainability of the system.

Table II-19. PROFILE OF THE AW RATING FOR
THE LAMPS MK III WEAPON SYSTEM

- Manpower Requirements by Squadron:

	<u>TOTAL</u>	<u>MISSION ESSENTIAL</u>	<u>AA</u>
Oper. Sqdn.	232	162	29
FRS	248	144	27

- Annual Costs by Squadron:

	<u>TOTAL COST</u>	<u>OCCUPATION- SPECIFIC</u>	<u>AA</u>
Oper. Sqdn.	\$4,731,156	\$462,504	\$114,382
FRS	4,940,169	425,630	85,420

- Authorizations and Inventory (E-4 through E-7)
for AW Rating:

<u>CURRENT AUTHORIZATIONS</u>	<u>CURRENT INVENTORY</u>	<u>REQUIREMENTS FOR LAMPS MK III AA</u>
2,545	2,012	286

III. DESCRIPTION OF THE PRELIMINARY UNIT SUSTAINMENT MANPOWER COST METHODOLOGY

This section presents:

- a general discussion of the initial unit manpower cost methodology and its relationship to the unit sustainment manpower cost methodology;
- a brief description of Service manpower life cycle cost methodologies; and
- a description of the preliminary unit sustainment manpower cost methodology.

A. GENERAL

As part of the effort in support of the OASD (M&A&L) Hardware Manpower Balance project, MCR has developed a manpower cost methodology. The methodology is intended to provide OSD with an independent means of calculating manpower cost for new weapon systems. The methodology calculates two types of manpower costs incurred over a weapon systems's life cycle: initial unit and unit sustaining costs. These costs are calculated in the context of the units in which the systems are, or will be, deployed. The unit is defined as the primary organizational entity (i.e., battalion, squadron, flight) to which manpower is assigned for a specific weapon system.

Initial manpower costs occur as a result of acquiring manpower for the system. Specifically, these are the costs of recruiting, bonuses, and training of personnel by the Services. In the context of the units in which the systems are deployed, MCR has identified these costs as initial unit manpower costs. These are the one-time costs for personnel prior to joining a unit. In fact, these costs can occur prior to a system being fielded. In effect, these are the costs of having personnel available to be assigned to the units. These same costs occur as a function of personnel attriting from the Services unit, therefore, are also part of the unit sustainment costs.

Sustaining costs of manpower occur over the operating life of the system. In the context of the units in which the systems are deployed, MCR has identified these costs as unit sustainment manpower costs. Specifically, these costs include the recurring costs of recruitment, bonuses, and training; pay and allowances; permanent change of station; personnel support; and retirement.

The initial and sustaining costs described above represent the total unit manpower costs of a weapon system over the life cycle. However, before manpower costs can be determined, manpower requirements (i.e., personnel to be costed) must be developed. Each of the Services approaches estimating weapon system manpower requirements differently. These approaches are based on the operational structure of the Service; characteristics of the generic type of weapon system being analyzed (e.g., aircraft, ship, tracked vehicle); and the DSARC phase of the system (e.g., full-scale development). As part of the Phase I effort to develop the initial unit manpower cost methodology, MCR developed a manpower strength element structure identifying types of manpower associated with weapon systems. The element structure is compatible with those used by the Services and the OASD. These manpower strength elements are used in both the initial unit and unit sustainment cost methodologies. The manpower strength element structure developed in Phase I of this effort has been modified based on comments received on the Phase I final report. Specifically, the "Training Support" element of the "Indirect Personnel Support" element has been deleted.

The MCR manpower cost element structure has also been revised based on review and analysis of the Phase I final report. The structure is now identified in terms of those costs associated with acquiring initial unit manpower and those associated with sustainment of unit manpower.

The unit sustainment cost methodology presented in this section is designed to be compatible with Service manpower cost methodologies, which are briefly reviewed in the next section. More detailed descriptions have been provided in the final report of the Phase I effort.

The MCR methodology allows for the calculation of occupation-specific and pay grade-specific manpower costs within the organizational unit. The methodology also allows for the calculation of other manpower costs outside the organizational unit (i.e.; intermediate maintenance, installation support, and indirect personnel support). In the interests of simplicity, since our purpose is only to demonstrate the use of the methodology, the cost data provided in Section IV of the report has been calculated only for enlisted personnel within the organizational unit.

B. SERVICE MANPOWER COST METHODOLOGIES

This section briefly describes the Service methodologies for calculating weapon system manpower costs in the following order:

- the Army methodology,
- the Navy methodology, and
- the Air Force methodology.

As part of the DSARC process the Services are required to develop two life cycle cost estimates:

- the Baseline Cost Estimate (BCE), and
- the Independent Parametric Cost Estimate (IPCE).

The latter is also sometimes called the Independent Cost Analysis (ICA). Development of the BCE is the responsibility of the Program Manager. The IPCE is developed by the Service staffs.

In costing weapon system manpower the Army, Navy, and Air Force each use similar approaches. All Services calculate a

cost per weapon system (i.e., cost per single item). The Navy and Air Force cost all manpower in the primary organizational entity or unit. The Army, since more than one weapon system can be found in a single organization or unit, allocates the manpower in the unit to the various weapon systems found therein. All Services develop a total number of unit mission officer and enlisted personnel. Annual pay factors are used to calculate pay and allowances costs. Usually, average annual training costs are calculated with the remaining annual costs determined using per capita cost factors. The total annual manpower costs for the weapon system are then multiplied by the number of years of the system's life cycle. Historically, the Services have not usually calculated costs using occupation- and pay grade-specific cost factors. Each Service cost methodology is summarized below.

1. Army Cost Methodology

The Army has several ways to estimate weapon system personnel operating and support costs.^{7/} These are briefly described below.

- Average numbers of crew, maintenance, and indirect personnel for each of the items of equipment are combined with the cost of an average crewman, maintenance specialist, or indirect person to determine the cost of operating one item for one year. The resultant cost is multiplied by the average annual operating quantity (the operating fleet) and the service life of the system to obtain the total life cycle personnel operating and support costs. This is currently the most common method of personnel costing and was used for the Baseline Cost Estimate for the M-1.
- Cost Estimating Relationships (CERs) are developed to estimate the personnel-related costs of the system.

^{7/} Report DCA-R-15 ARMY LIFE CYCLE COST MODEL Volume 11, "Users Guide to the Tactical Personnel Sub-Model." (dated supplement to the Army Life Cycle Cost Model Users Guide (14 May 1979), Department of the Army (DACA-CAS), Washington, D.C.

Accuracy of such relationships, however, depends upon the uncertainty surrounding the CER and the similarity of the CER data base to the system of interest.

- Using the Tables of Organization and Equipment (TOEs), or Tables of Distribution and Allowances (TDAs), the annual cost of personnel is computed by determining the number of personnel in each deployed TOE or TDA, aggregating the personnel by pay grade and MOS over all TOE/TDA in the system deployment plan, and applying costs by pay grade and MOS to determine annual operating and support personnel costs. Of the three alternatives, this is the most detailed, the most demanding in terms of knowledge about the personnel structure of the Army supporting the system, the most complete in terms of audit trail, the most closely related to the Army's way of force design, and the one most adaptable to sensitivity analysis. The personnel sub-model operated by the Cost Analysis Directorate follows this third approach. Using a series of input files, the model calculates and displays the number of personnel supporting the system by both pay grade and/or MOS to accumulate annual costs of pay and allowances, Permanent Change of Station (PCS), personnel replacement, the pro-rated share of the transient, patient, and prisoner assets, the pro-rated share of recurring (variable) Army supply support operations, recurring (variable) medical support, recurring (variable) quarters, maintenance and utilities, BASOPS support, recurring (variable) administrative support, recurring (variable) unit equipment, and recurring (variable) theater allowances.

The Army generates two major cost documents for the ASARC/DSARC process: the Baseline Cost Estimate (BCE) and the Independent Parametric Cost Estimate (IPCE). The Program Manager is responsible for developing the BCE, although other analytical groups may actually develop the estimate. The Office of the Comptroller of the Army (OCA), Cost Analysis Directorate, is the developer of the IPCE. Each of these organizations may use any of several possible models to develop these estimates. The particular methodology used to develop these cost estimates may require data not included in formal manpower, training, and logistics documents. When this occurs, the cost estimators

contact the various commands and activities, as necessary, for additional data. Manpower cost estimates, while dependent on manpower requirements estimates, are developed separately.

The BCE and the IPCE include manpower costs according to the specific cost categories of the Army cost breakdown structure shown in Table III-1. Definitions of the elements are provided in Appendix C. The entire cost breakdown structure, as well as detailed direction on developing life cycle costs, is provided in DA PAMPHLET 11-4, "Operating and Support Cost Guide for Army Materiel Systems," April 1976.

In costing manpower for weapon systems within the unit, the Army follows a procedure of assigning direct personnel (e.g., crew) and allocating direct maintenance personnel and indirect personnel to the weapon system. Thus, the Army does not cost the entire battalion but only those directly associated with the weapon system. The personnel procedure reflects crew, maintenance, and indirect personnel requirements, and costs are largely derived on the basis of cost factors from the Army Force Planning Cost Handbook (AFPCOH). In order to provide a total system cost, each military personnel cost element must also be multiplied by the total number of operational weapon systems and the total number of years in the life cycle. This procedure is normally used for all weapon system costing by the Army.

This data is combined with other data (e.g., Tentative Basis of Issue Plan) obtained from the commands and activities on an "as needed" basis. The cost data necessary to satisfy the Army cost breakdown structure elements is then calculated using:

- "in-house" Cost Estimating Relationships (CERs) and cost factors;
- estimates derived by analogy with other systems (e.g., the M60 and the M-1); and
- costs added as throughput.

Table III-1. COST BREAKDOWN STRUCTURE ELEMENTS
FOR ARMY MATERIEL SYSTEMS APPLICABLE
TO MANPOWER*

<u>Element Number</u>	<u>Cost Element</u>
3.0	Operating and Support
3.01	Military Personnel
3.011	Crew Pay and Allowances
3.012	Maintenance Pay and Allowances
3.013	Indirect Pay and Allowances
3.014	Permanent Change of Station (PCS)
3.03	Depot Maintenance
3.031	Labor
3.05	Other Direct Support Operations
3.051	Maintenance, Civilian Labor
3.06	Indirect Support Operations
3.061	Personnel Replacement
3.062	Transients, Patients and Prisoners (TPP)
3.063	Quarters, Maintenance and Utilities (QMU)
3.064	Medical Support
3.065	Other Indirect

* DA PAMPHLET 11-4, "Operating and Support Cost Guide for
Army Materiel Systems," Department of the Army, April 1976.

Various "ground rules" or costing assumptions are also noted. Relevant assumptions include:

- peacetime operation;
- planned milestone schedule;
- FY dollars used in calculations;
- O&S training (equipment) costs which are included in cost of replacement personnel training; and
- operating fleet theater deployment (e.g., CONUS and Europe for the M-1).

Although parametric methods are expressly required in producing the IPCE, they are not necessarily excluded from consideration in producing the BCE. A major difference, however, is that the IPCE uses a large integrated parametric model. Usually, the model is the Army Life Cycle Cost Model (ALCCM). For the M-1, the ALCCM was not used. An alternate model was used, one developed particularly for tracked combat vehicles. This alternate model proved very cumbersome and only a limited number of individuals had the expertise to use it. Because of these deficiencies, the model will not be used for costing the M-1 for DSARC Milestone IIIA.

The manpower and cost data for the M-1 DSARC Milestone III BCE and IPCE were obtained from the Materiel Systems Requirements Specifications (MSRS), the TOE Personnel Sub-model, and the AFPCH. The MSRS provides the basic system parameters including crew/operators, the TOE Personnel Sub-model provides data on the maintenance manpower and indirect manpower, and the AFPCH provides cost factors.

Another source of cost information that will be available for Army weapons system costing is the Operating and Support Cost Management Information System (O&SCMIS). This system is being developed by the Army to provide for centralization of all actual operating and support costs.

2. Navy Cost Methodology

In the Navy, manpower requirements identified in manpower and training documents are translated into manpower costs, under direction of the Program Manager (e.g., PMS/PMA 266 for the LAMPS Mk III). For the LAMPS Mk III, the Naval Air Systems Command (NAVAIR) is responsible for actually developing these costs; specifically, NAVAIR 04, the Logistics and Fleet Support Group. These costs are ultimately incorporated into the Decision Coordinating Paper (DCP) and Integrated Program Summary (IPS) presentations made at DSARC. The manpower requirements are also provided to OP-96D, the CNO Resource Analysis Group, which develops the Independent Cost Analysis (ICA) for the program. Both the baseline cost analysis, developed by the PM, and the ICA are presented in the format required by the Cost Analysis Improvement Group (CAIG) for CAIG review before being incorporated into the DCP/IPS.

The basic methodology used by NAVAIR 04 to develop LAMPS Mk III manpower operating and support costs is based on the Navy Resource Model (NARM) methodology. The NARM output is developed from cost factors derived from prior year budget data. OP-90 publishes the NARM methodology and factors annually in the "Navy Program Factors Manual." These factors are used in developing estimates for direct and indirect costs by appropriation: Military Personnel, Navy (MPN) and Operations and Maintenance, Navy (O&MN); for officers and enlisted; for ships and aircraft. The pay base used in the NARM calculations is the aggregated composite standard rate for officers and enlisted used in the FYDP.

For some costs of LAMPS Mk III, NAVAIR 04 modified or developed program-specific factors to be used in place of existing NARM factors. Part of the NARM calculations include the Officer and Enlisted Active Allowances. The allowances serve as the multiplier for calculating personnel costs per

aircraft based on the Navy Training Plan (NTP). A second multiplying factor used in the NARM methodology is a weighting factor developed for officers and enlisted by which the basic pay factors are multiplied. These weighting factors are developed by the Naval Military Personnel Command (NMPC) based on actual pay expenditures for each program element. However, the LAMPS Mk III manpower costs have not been calculated using the weighting factor supplied in the factors manual. Instead, the total pay factor has been used for officer and enlisted.

The basic cost elements and factors included in the NARM for costing aircraft manpower are listed in Table III-2. Definitions of the elements are provided in Appendix C.

Other factors used in the NARM calculations are the indirect officer and enlisted factors. These factors represent the calculated number of personnel required for indirect functions for each platform. These factors are developed by allocating variable support costs to ships and aircraft. The support costs which have been allocated are only those which are assumed to be affected by changes in the numbers of platforms. In other words, the support costs have been calculated based on identification of allocatable support activities. Generally, the following rules have been imposed:

- one third of base operations support costs have been allocated;
- two thirds of staffs and OMN for other selected support activities have been allocated; and
- all students, trainees, transients, patients, and prisoners have been allocated.

The final allocation for indirect costs is for those costs directly related to individual platform types. For each of the support activities, one force-related direct operating

Table III-2. NARM MANPOWER COST ELEMENTS*

Total Direct Operating Manpower (Aircraft)

- Annual Direct MPN
 - Total Officer Direct MPN
 - Officer Active Allowance
 - NARM Officer Pay Factor
 - Officer MPN Weight Factor
 - Total Enlisted Direct MPN
 - Enlisted Active Allowance
 - NARM Enlisted Pay Factor
 - Enlisted MPN Weight Factor
- Annual Direct OMN
 - Annual Air Temporary Additional Duty (TAD)
 - Air TAD Dollars/Person
 - Officer Active Allowance
 - Enlisted Active Allowance

Total Indirect Operating Manpower

- Operating Indirect MPN
 - Indirect Officer MPN
 - Indirect, Officers
 - Base Operations, Officers
 - Recruiting and Examining Activities, Officers
 - Health Activities, Officers
 - Transients, Officers
 - Training Officers
 - Personnel Holding Account, Officers
 - Indirect Officer MPN Factor

* "Navy Program Factors Manual," OPNAV 90P-020, 31 October 1979.

Table III-2. NARM MANPOWER COST ELEMENTS (Cont'd)

- Permanent Change of Station (PCS), ENL
 - Indirect Enlisted MPN
 - Indirect Enlisted
 - Base Operations, Enlisted
 - Recruiting and Examining Activities, Enlisted
 - Health Activities, Enlisted
 - Transients, Enlisted
 - Training, Enlisted
 - Personnel Holding Account, Enlisted
 - Indirect Enlisted MPN Factor
 - Permanent Change of Station (PCS), ENL
- Operating Indirect OMN
 - Logistics OMN
 - Base Operations OMN
 - Training OMN
 - Health Activities OMN
 - Recruiting and Examining Activities OMN

cost was chosen as a proxy for the support activity's workload. Support costs are allocated to each platform based on proportional share of the total proxy related to a particular platform type. In calculating manpower costs for the LAMPS Mk III, the PM has used the original formulas for calculating indirect costs assignable to platform types.

The current schedule calls for initiation of the development of an ICA in February 1981. Therefore, any discussion of the methodology used by OP-96D to develop the ICA is based on the standard procedures. OP-96D intends to use these procedures for the LAMPS Mk III DSARC III ICA. OP-96D uses the Naval Aircraft Operating and Support Cost Estimating Model to develop the independent parametric cost estimate. The model uses CERs, based on parametric relationships, and indirect factors in common with NARM. The cost element structure used for the ICA is shown in Table III-3; definitions are provided in Appendix C. The included elements are those related to manpower costs.

In addition to the two models discussed above, there are several other possible sources of manpower cost data. Currently these sources are not used in developing manpower cost data for DSARC submissions. These sources are briefly described below.

The Navy Training Resource Model (TRM) is a programming model operated by OP-120 to develop training requirements for the Program Objectives Memorandum and other program-related functions. The TRM provides an assessment of the total number of people to be trained within a rating in "A" school (initial skill training) by fiscal year. It also provides the resource impact for both direct mission manpower and indirect (base operations) manpower. The model multiplies manpower by average salary to give a dollar figure for each rating. The TRM model provides a reasonably accurate "A" school training cost for

Table III-3. NAVY COST ELEMENT STRUCTURE*

- Deployed Unit Operations
 1. Aircrew (Officers)
 2. Aircrew (Enlisted)
 3. Combat Command Staff
 5. Other Deployed Manpower
 6. Air TAD
- Below Depot Maintenance
 7. Aircraft Maintenance Manpower
- Installation Support
 10. Base Operating Support
- Depot Maintenance
 11. Component Rework
 12. Airframe Rework
 13. Engine Rework
- Depot Supply
 14. Depot Supply Operations
 15. Technical Support
- Personnel Support and Training
 17. Individual Training
 18. Health Care
 19. Personnel Activities

* Extracted from "Naval Aircraft Operating and Support Costs - Estimating Model FY77 Revision," Administrative Sciences Corporation, February 1977.

each Navy rating which is more precise than the average training cost provided by the NARM.

The Navy Billet Cost Model (BCM) provides an approach to manpower cost by occupation/pay grade combination. It was originally designed to be used in weapon system manpower life cycle costing. However, it is not suitable as data for the MCR-developer methodology since individual occupation- and pay grade-specific costs are not delineated. In addition, certain allocation procedures have been incorporated in the calculation of the cost elements which contribute to the single specified cost, which may not be appropriate for the MCR methodology (i.e., allocation of retirement and training costs).

The Visibility and Management of Operating and Support Costs (VAMOSOC) systems for ships and aircraft (VAMOSOC-ships and VAMOSOC-Air) provide operating and support (O&S) costs for weapon systems. The systems collect cost data on existing systems for both direct and indirect cost elements to include training costs. However, the training cost is only that unit-related training attributable to the system (e.g., for aircraft systems the cost of fleet readiness squadrons and certain "C" school maintenance courses). The cost of individual training is not included in the training support cost element. The military personnel cost element does not contain individual training costs either. This element only includes pay and allowances.

3. Air Force Cost Methodology

The Baseline Cost Estimate is prepared by the program Manager and the Independent Cost Estimate by the product division of the Air Force Systems Command for the Air Force Cost Analysis Improvement Group of the Air Staff.

The Air Force uses the OSI Cost Analysis Improvement Group (CAIG) cost element structure and definitions for aircraft costing for DSARC presentations. These include the

Table III-4. AIR FORCE OPERATING AND SUPPORT
COST ELEMENT STRUCTURE*

- UNIT MISSION PERSONNEL
 - Aircrew
 - Maintenance
 - Other Unit Personnel
 - Unit Staff
 - Security
 - Remaining Unit Personnel
- DEPOT LEVEL MAINTENANCE
 - Airframe Rework
 - Engine Rework
 - Component Repair
- INSTALLATION SUPPORT PERSONNEL
 - Base Operating Support
 - Real Property Maintenance
 - Medical
- INDIRECT PERSONNEL SUPPORT
 - Misc Operations and Maintenance
 - Medical O&M Non-Pay
 - Permanent Change of Station
- PERSONNEL ACQUISITION AND TRAINING
 - Acquisition
 - Individual Training

* "Aircraft Operating and Support Cost Development Guides,"
Office of the Secretary of Defense, Cost Analysis Improve-
ment Group, 15 April 1980.

Air Force cost structure. Those elements included in the total are the manpower costs. The definitions of the manpower cost categories are provided in Appendix C. The definitions are similar to those in the CAIG cost development guide for aircraft operating and support costs. It should be noted that when a missile system is addressed, aircraft/aircrew applies in this case to missile unit operators.

The general manpower cost methodology employed by the Air Force is a life cycle approach tailored to the specific program. Manpower costs are generalized by an average cost approach rather than by one oriented toward specific occupation and/or pay grades. For example, the projected GLCM requirements (officers and enlisted) are multiplied by the respective average officer and enlisted factors to arrive at unit mission personnel costs. The cost estimates derived by this methodology become part of the official cost estimate that is incorporated in the DCP. The manpower estimates for the support requirements are derived by applying factors to the unit mission personnel requirements. Personnel and training costs are developed based on a cost estimating methodology that has factors for acquisition, contractor-provided training, ATC residency, follow-on training, and replacement training. Once the user requirements are known, training costs for each AFSC are developed and fed into a computer model which calculates life cycle personnel acquisition and training costs.

Some other sources of cost information available for Air Force weapons costing are:

- AFP-173-13, "Cost Analysis, USAF Cost and Planning Factors," which has wide application in the estimation of manpower costs. Although it is primarily aircraft oriented, many general cost factors are available. Particularly useful are the costs for acquisition and training by Air Force Specialty Code.
- The Visibility and Management of Operating and Support Cost (VAMOSC II) system is being developed by

the Air Force to provide for the centralization of all operating and support cost analyses. One of the primary uses of the VAMOSC II data base will be to satisfy the operating and support cost requirements for DSARC presentations.

C. DESCRIPTION OF THE PRELIMINARY UNIT SUSTAINMENT MANPOWER COST METHODOLOGY

The MCR unit sustainment manpower cost methodology is designed to calculate manpower operating and support costs for weapon systems within an organizational unit. It is composed of two element structures:

- the manpower strength element structure, and
- the manpower cost element structure with a set of unit sustainment factors.

The manpower strength element structure is designed to identify the categories of direct and indirect personnel associated with a system. The four categories of manpower strength elements are:

- unit mission personnel,
- intermediate maintenance personnel,
- installation support personnel, and
- indirect personnel support.

Cost estimates can be developed for the operational unit, which corresponds to the unit mission personnel, or they can be expanded to include the other categories. No manpower strength element for depot maintenance personnel is included. This is because our primary interest is in military personnel costs with associated critical occupations. Very few military personnel are found in depot level maintenance since most personnel are civilians or contractors. Table III-5 lists the MCR manpower strength element structure.

The second element structure details unit sustainment manpower costs. There are two types of cost elements in this structure:

Table III-5. MCR MANPOWER STRENGTH ELEMENT STRUCTURE

- Unit Mission Personnel
 - Crew/Operators
 - Organizational Maintenance
 - Other Unit Personnel

- Intermediate Maintenance Personnel

- Installation Support Personnel
 - Base Operating Support
 - Real Property Maintenance
 - Medical

- Indirect Personnel Support
 - Individuals
 - Transients
 - Holdees (Prisoners, Patients, etc.)

- recurring acquisition costs, which are recurring costs associated with personnel attrition and replacement, and are calculated using annual personnel loss rates, called here unit sustainment factors; and
- annual unit sustainment costs, which are annual costs related to all of the people in the unit and are based on the estimated manpower requirements of the unit.

These two types of elements are used to calculate the total unit sustainment manpower costs. Table III-6 lists these elements.

The primary difference between the Service methodologies and the methodology proposed here is the use of occupation- and pay grade-specific data to calculate unit costs. The Services generally, but not always, use aggregates for the number of officer and enlisted personnel and the costs. In the MCK methodology the requirements and costs are developed taking into account occupation and pay grade cost impacts.

1. Description of Elements

Descriptions of the manpower strength elements and the manpower cost elements, as they are used in the unit sustainment manpower cost methodology, are presented below.

a. Manpower Strength Elements

- Unit Mission Personnel - these personnel are defined within the context of the primary force unit in which the weapon system is deployed (e.g., squadron, battalion, ship). In order to cost the unit precisely, personnel must be identified by occupation and pay grade. Force unit personnel are generally the crew/operators, maintenance, and all other unit personnel. The maintenance category includes organizational maintenance personnel within the unit.
 - Crew/Operators - full complement of crew/operators required to operate the weapon system of a discrete unit. This element is divided into officers and enlisted. The complete pay grade/occupation structure is used.
 - Organizational Maintenance - all organizational maintenance personnel in support of the weapon system. Maintenance Personnel may be allocated

Table III-6. UNIT SUSTAINMENT MANPOWER COST ELEMENT STRUCTURE

<u>Recurring Acquisition Costs</u>	<u>Annual Unit Sustainment Costs</u>
● General Costs	● General Costs
- Personnel Recruitment	- Permanent Change of Station (PCS)
● Occupation-Specific Costs	● Paygrade-Specific Costs
- Enlistment Bonus	- Pay and Allowances
- Selective Reenlistment Bonus (SRB)	- Retirement
- Training	- Support
	- Incentive and Special Pay

by the Services to individual weapon systems when shared by several weapon systems in a unit.

- Other Unit Personnel - remaining personnel assigned to the unit performing various operational roles (e.g., unit staff, security, administration).
- Intermediate Maintenance Personnel - maintenance personnel outside the unit performing on- and off-equipment maintenance. Officer/enlisted/civilian/contractor total is sufficient detail.
- Installation Support Personnel - personnel not directly assigned to the unit but required for the unit to operate in peacetime. Generally these people are assigned to the installation and would not be required if the unit were moved/deployed. Normally, these are allocated to supported units. Officer/enlisted/civilian/contractor total is sufficient detail.
 - Base Operating Support (BOS) - personnel supporting the operations of the installation and tenant organizations stationed there. Primarily these people provide such functions as communications, supply, services, security (excluding system security), transportation, and administration (e.g., finance, accounting, personnel).
 - Real Property Maintenance (RPM) - personnel assigned to maintenance and operation of real property facilities and related management and engineering support work and services.
 - Medical - medical personnel needed to support the unit at its peacetime location.
- Indirect Personnel Support - the proportionate share of the individuals accounts.
 - Individuals - transients and holdees (patients, prisoners, and personnel awaiting discharge); students and trainees are excluded as their cost is included in the student/trainee pay and allowance portion of training cost. Officer/enlisted total is sufficient detail.

b. Manpower Cost Elements

- Recurring Acquisition Costs - which are recurring costs associated with personnel attrition and replacement, and are calculated using annual personnel loss rates, called here unit sustainment factors; and

- General Costs:
 - Personnel Recruitment - the cost of enlisted recruitment and/or officer acquisition. This cost is derived from FY80 budget data from the Five Year Defense Plan data of October 1980. This is also a recurring cost of sustaining manpower and, in that case, is calculated using the unit sustainment recruitment factor which is based on Service personnel loss rate data.

- Occupation-Specific Costs:
 - Enlistment Bonus - this is the cost of enlistment bonuses awarded by the Services based on recruiting requirements. It is used as a recruiting inducement for certain occupations. This data is obtained from the Services. It is considered a recurring cost of sustaining unit manpower, dependent upon the rate at which personnel who are eligible to receive the bonus (new accessions) arrive in the unit. This cost is calculated using the unit sustainment enlistment bonus factor. MCR has applied the cost to E-3 authorizations since there are no E-2s authorized on manpower documents.
 - Selective Reenlistment bonus (SRB) - this is the cost of SRBs awarded by the Services based on internal retention requirements. It is used as an inducement to personnel to reenlist in certain occupations in order to retain a required level of experience. This data is obtained from the Services. It is considered a recurring cost of sustaining unit manpower. It depends upon the rate at which the personnel who might receive the SRB (E-4s through E-7s) must be replaced in the unit. This cost is calculated using the unit sustainment SRB factor.
 - Training - this is the cost related to recruit, initial skill and skill progression training. In the case of the Navy, initial skill training costs have been used as a surrogate for the skill progression training costs. These costs are obtained from the Services. It is also a recurring cost of sustaining unit manpower dependent upon

the rate at which new personnel in a given occupation are introduced into the unit. This cost is calculated using the unit sustainment training factor.

- Annual Unit Sustainment Costs - which are annual costs related to all of the people in the unit and are based on the estimated manpower requirements of the unit.
 - General Costs:
 - Permanent Change of Station (PCS) - this is the cost of Permanent Change of Station moves for unit personnel. It is an annual cost calculated by the Services. Service factors are used.
 - Pay Grade-Specific Costs:
 - Pay and Allowances - this cost is applied to each person in the manpower requirements document for the unit. The costs used in this methodology approximate the adjusted composite standard rate described in the OASD (C) publication "Average Cost of Military and Civilian Manpower in the Department of Defense," August 1980 ("Average Cost Handbook"). The standard rate averages all personnel within a pay grade and includes the total Service Military Personnel (MilPers) appropriation less PCS costs. The adjusted standard rate removes quarters (BAQ), and special allowances, incentive pays and other special pays not available to all the force. It includes base pay, rations (BAS), uniform, FICA, separation (excess leave), and bonuses. The bonus costs are removed from the standard rate and are instead used in the calculations of occupation-specific costs. Quarters (BAQ) may be added back in to include all pertinent pay/allowances.
 - Retirement - this cost is currently not included in any Service manpower cost methodology. The retirement rates cited in the "Average Cost Handbook" are the rates which have been used in this methodology. Retirement is considered an accrued liability for the ultimate retirement of the current force rather than a current liability in the "Average Cost Handbook." The cost of military retirement pay pays for personnel already retired. The services do not currently

separately for this and, therefore, they usually ignore this cost in their weapon system manpower costing. It is applied as an annual cost to the number of personnel required in each pay grade.

- Support - this is a cost that reflects the cost of providing medical (including CHAMPUS) and other support. MCR has used the costs in the "Average Cost Handbook." This cost is applied to all personnel in each pay grade.
- Incentive and Special Pay - this is an annual cost which may be paid to certain personnel based on Service decisions. Some types of incentive pays are: flight pay, submarine pay and other hazardous duty pays. Examples of special pays are sea pay, proficiency pay, medical pay, and nuclear officer pay. These costs are applied to all personnel who qualify, based on such factors as their occupation, geographical location, or work environment.

2. Definition of Unit Sustainment Factors

In order to use the initial unit manpower cost elements in the unit sustainment manpower cost methodology, factors must be applied. These unit sustainment factors allow for the calculation of the impact of personnel replacement in the costs. They represent the recurring costs related to personnel replacement.

The unit sustainment factors developed by MCR are detailed Service personnel loss rates for specific occupations and pay grades. As with the annual cost factors, the unit sustainment loss rate factors must be updated annually.

The unit sustainment factors are described below. The specific factors developed for the three Services are provided in Section IV.

a. Unit Sustainment Recruitment Factor

The recruitment cost is an average annual cost developed based on Service data. This cost is directly related to personnel loss rates. The factor used is based on the total Service loss rate. Consideration of mental categories and high school graduate status could be used for greater precision, i.e., higher mental categories and high school graduates are more costly to recruit.

b. Unit Sustainment Enlistment Bonus Factors

The enlistment bonuses are used by each of the Services to attract qualified personnel into occupations with large first term attrition. A person must meet three basic qualifications in order to be awarded an enlistment bonus for signing up for a particular occupation:

- have a high school diploma,
- score in the top three mental categories, and
- enlist for at least four years.

Not all of the enlisted personnel entering a qualifying occupation receive the enlistment bonus. Thus, a factor based on the percentage of actual awards (vs. those entering the qualifying occupation) must be calculated for each occupation. Where occupation-specific data is not available, Service-wide award data is used. In the case of the Navy and Air Force, where such data is not readily available, the Service-wide E-3 loss rate is used as a surrogate.

c. Unit Sustainment Selective Reenlistment Bonus Factors

Selective Reenlistment Bonuses (SRB) are awarded to various occupations. Awards are calculated on the basis of length of service of the reenlistee (correlating to Zone A, B, or C), award level and length of obligated service.

The current year SRB award list was used to identify the occupations receiving SRBs, the zone and award level. Costs were calculated in FY80 dollars for consistency with all other calculations in this study. The average pay grade and length of service was determined for each Service and each zone. The base pay for these averages was used as the pay factor and multiplied by the current award level and the average period of reenlistment for each Service. The average reenlistment period was used to determine the frequency of application. The SRB is applied only to the average grade for a particular zone in each Service (e.g., Army Zone A is E-4).

d. Unit Sustainment Training Factors

Training costs are one of the occupation-specific costs calculated as part of the MCR-recommended manpower cost methodology. All of the Services collect training cost data which contain, to varying degrees, the costs associated with training a person in a particular occupation. As discussed in Section II, these costs have been used as the basis for qualifying an occupation as a high-cost field.

In calculating life cycle manpower costs, the cost of providing occupational training to replacement personnel must be considered. Two major questions are raised in calculating these costs:

- How often should training costs be applied?
- What rate of loss should be used?

These two questions are related and are influenced by the data available in each Service. The Services collect and aggregate data differently. The Army has the widest scope of data, collecting training costs by occupation and skill level (which reflects pay grade) and personnel loss rates by occupation and years of service (which can also be related to pay grade). The Army training cost data is for

recruit training, initial skill training, and skill progression training. The Navy collects training costs with an occupation. Costs are for recruit training and initial skill, or "A" school, training. Skill progression training, or "C" school, costs are not adequately collected. Loss data for the Air Force is collected by occupation and pay grade combination. Training costs for an occupation reflect all costs associated with any training for the occupation. There is no individual cost for initial skill or skill progression training. Loss rates are calculated for each occupation but are not calculated by total pay grade population.

Because of differing levels of detail of training cost data available from the Services, occupation/pay grade-specific loss rates are applied where possible. In the absence of this detail, occupation-specific loss rates are used. The first instance is possible using Army data; the latter case applies to Navy and Air Force data.

3. Procedures for Using the Unit Sustainment Manpower Cost Methodology

Having defined the strength and cost elements, and the unit sustainment factors, the final part of the methodology is the procedure for calculating the costs. The unit sustainment manpower cost methodology simply multiplies cost elements by manpower strength elements to produce manpower costs. Some cost elements are applied in conjunction with loss rates (defined previously as unit sustainment factors). These rates take into account the movement of personnel through units in the normal course of enlistment, active duty, and their separation from the Service. This is a two-part process, described below. The first step is to:

- Organize manpower requirements data by occupation/pay grade combination and level requirement for each occupation and pay grade. Data are then arrayed by organizational unit (e.g., battalion, squadron, flight).

- Calculate manpower requirements beyond the organizational unit (e.g., intermediate maintenance, installation support and indirect personnel). Specifically, these personnel are identified as an aggregated total of officers and enlisted. MCK has not calculated these requirements since the Service methodology is the same as the MCK methodology.

Table II-4, in Section II, is an example of the unit mission personnel organization for the XM-1 tank battalion.

Once the unit manpower requirements have been organized by occupation and pay grade and the total number of personnel in each occupation and pay grade have been determined, the analyst can proceed to apply costs to the data. This second part of the process involves a sequence of steps:

- Calculate pay grade-specific costs.

This involves the application of the annual costs (C) which are pay grade-specific (PG) to the number of people in each grade (Q_{PG}). It translates into the following equation:

For PG:

$$(C_{P\&A} + C_{RET} + C_{SPT}) \times Q_{PG} = \text{Total Annual Cost (TC}_{PG}\text{)}$$

where:

- $C_{P\&A}$ = Annual Cost of Pay and Allowances for the specific pay grade;
- C_{RET} = Annual Cost of Retirement for the specific pay grade;
- C_{SPT} = Annual Cost of Support for the specific pay grade;
- Q_{PG} = Quantity of personnel in the specific pay grade.

After calculating the pay grade-specific costs, the next set of costs are determined.

- Calculate occupation-specific costs.

This involves the application of the costs (C) which are occupation (O)-specific to the number of people in each.

occupation (Q_0). In these calculations annual costs are calculated using the unit sustainment factors. This process translates into the following equation:

For O:

$$[(C_T \times F_{UST}) + (C_E \times F_{USE}) + (C_{SRB} \times F_{USSRB})] \times Q_0 \\ = \text{Total Annual Cost } (TC_O)$$

where:

- C_T = Cost of Training for the specific occupation;
- F_{UST} = Unit Sustainment Training Factor;
- C_E = Cost of Enlistment Bonus for the specific occupation;
- F_{USE} = Unit Sustainment Enlistment Bonus Factor;
- C_{SRB} = Cost of Selective Reenlistment Bonus for the specific occupation;
- F_{USSRB} = Unit Sustainment SRB Factor;
- Q_0 = Quantity of personnel in the specific occupation.

There are two costs which are not considered occupation- or pay grade-specific. These are Personnel Recruitment and Permanent Change of Station (PCS). The methodology uses an annual cost for each applied to all personnel. These costs are calculated using the following equations:

For Q:

$$(C_{RCT} \times F_{USR}) \times Q = \text{Total Annual Cost of Recruitment} \\ (TC_{RCT})$$

where:

- C_{RCT} = Annual Average Cost of Personnel Recruitment;
- F_{USR} = Unit Sustainment Factor Recruitment;
- Q = Total quantity of personnel.

and

$$C_{PCS} \times Q = \text{Total Annual Cost of PCS } (TC_{PCS})$$

where:

$$C_{PCS} = \text{Annual Average Cost of PCS.}$$

These two annual average costs can be calculated separately or with either the pay grade-specific or occupation-specific calculations. MCR has chosen to calculate both of these costs with the pay grade-specific costs in order to reduce the number of calculations.

There is another cost which can be either pay grade-specific or occupation-specific. This is incentive and special pay. This is an annual cost which only applies to specific positions. These costs are calculated as follows:

For Q:

$$C_{ISP} \times Q = \text{Total Annual Cost of Incentive and Special Pay (TC}_{ISP}\text{)}$$

where:

$$\begin{aligned} C_{ISP} &= \text{Annual Cost of Incentive and Special Pay;} \\ Q &= \text{Quantity of Personnel receiving Incentive and Special Pay.} \end{aligned}$$

MCR has chosen not to include these costs in Section IV since they are applicable only to a limited number of positions or are geographic-dependent (e.g., COLA).

Once all of the above calculations are made, each of the totals is summed producing the total annual manpower costs for the unit in which the system is, or will be, deployed.

The total annual manpower cost for an organization can be identified by the following equation:

$$TC_{PG} + TC_O + TC_{RCT} + TC_{PCS} + TC_{ISP} = TC$$

If TC is multiplied by the number of years of system life and also multiplied by the total number of units/organizations then a total weapon system unit manpower cost can be determined. As mentioned above, $TC_{ISP} = 0$ in the calculations in Section IV.

The next section presents the results of applying this methodology to selected systems and the comparison of these results with Service cost methodologies. Only the unit manpower costs have been calculated since these are the occupation-specific and pay grade-specific costs (or equal across occupations and grades). Manpower costs beyond the organizational unit would be calculated in the same manner as the Services currently do it. This is simply a matter of calculating the number of personnel in the other manpower strength elements and then multiplying by Service average cost factors.

IV. UNIT SUSTAINMENT MANPOWER COST DATA FOR SELECTED WEAPON SYSTEMS

This section presents:

- a description of the general approach used in applying the unit sustainment manpower cost methodology;
- the specific unit sustainment factors for each Service developed by MCR and used in the unit sustainment manpower cost calculations;
- a comparison of M-1 unit manpower costs per tank estimated using the MCR and Army methodologies;
- a comparison of the LAMPS Mk III unit manpower costs estimated using the MCR and Navy methodologies;
- a comparison of GLCM unit manpower costs estimated using the MCR and Air Force methodologies, and
- conclusions based on these comparisons.

A. GENERAL

This section documents the results of applying the MCR-developed unit sustainment manpower cost methodology to three weapon systems, (M-1, LAMPS Mk III, and GLCM). These three weapon systems are also costed using the methodologies currently used by the Army, Navy, and Air Force to develop weapon system manpower costs for DSARC Milestone III.

The objective of this analysis is to compare the results of the MCR and Service methodologies, particularly the impact of using occupation- and pay grade-specific costs. For the purposes of these cost comparisons, only Unit Mission Personnel have been costed. Within the unit, only enlisted personnel have been costed since they are the area of principal interest in demonstrating the methodology using occupation-specific data. As explained in Section III, the costs for the other three manpower strength categories (Intermediate Maintenance, Installation Support, and Indirect Personnel) have not been calculated. The reason for not calculating the two latter categories of personnel is that they are not calculated using occupation- and pay

grade-specific costs. In the case of intermediate maintenance personnel, it was decided that this was not necessary for the purpose of comparing results.

The manpower strength elements and manpower cost elements used in the MCR unit sustainment cost methodology (described in Section III) are shown in Tables III-5 and III-6. The unit sustainment factors, which are applied to the recurring manpower cost elements, have also been described in the preceding section. The specific unit sustainment factors used in the MCR calculations of M-1, LAMPS Mk III, and GLCM annual unit sustainment manpower costs are presented in the next subsection. The Service manpower cost elements, which are comparable to the cost elements in the unit sustainment methodology, are listed in Tables III-1 (Army), III-2 (Navy) and III-4 (Air Force).

The calculations using MCR's unit sustainment manpower cost methodology are organized by those costs which are occupation-specific and those that are pay grade-specific. The details of the weapon system manpower requirements are provided in Section II, in the discussion of high-cost/critical occupations.

In Section III, equations were provided that show how manpower costs are calculated using the MCR-developed methodology once manpower strength is determined. To demonstrate how these equations are used in the calculations in each Service subsection the equations are repeated here as they relate to the two tables provided for each Service. The two tables show pay grade-specific and occupation-specific cost calculations. An example from the M-1 calculations is given for one pay grade (E-7) and one occupation - Army MOS 12F20. The equations used and examples are shown below:

- Pay Grade-Specific Cost Calculations:

$$(C_{P\&A} + C_{RET} + C_{SPT}) \times Q_{PG} = TC_{PG}$$

$$\text{Example (E-7): } (\$17,928 + \$4,725 + \$1,588) \times 24 \\ = \$581,784$$

MCR has chosen to include two other costs on the pay grade-specific tables, these are Personnel Recruitment (C_{RCT}) and Permanent Change of Station (C_{PCS}). Thus, the tables display the following calculation for each pay grade listed (E-3 through E-9):

$$(C_{P\&A} + C_{RET} + C_{SPT} + C_{RCT} + C_{PCS}) \times Q_{PG} = TC_{PG}$$

$$\text{Example (E-7): } (\$17,928 + \$4,725 + 1,588 + \$391 + \$792) \\ \times 24 = \$610,176$$

producing a sum of the total annual cost for unit sustainment costs for each pay grade.

- Occupation-Specific Cost Calculations:

$$[(C_T \times F_{UST}) + (C_E \times F_{USE}) + (C_{SRB} \times F_{USSRB})] \times Q_O = TC_O$$

$$\text{Example (12F20): } [(\$11,478 \times 0.13) + 0 + (\$3,760 \times 0.20)] \\ \times 1 = \$2,244$$

MCR has applied the unit sustainment factors for enlistment bonus (F_{USE}) and SRBs (F_{USSRB}) prior to putting the costs (C_E , C_{SRB}) on the tables. The tables display the data used to produce a total annual unit manpower cost (TC_O) for each occupation listed.

The sum of the costs from these two tables is the total annual unit sustainment manpower cost for the organizational unit. This cost is compared to a similar manpower cost developed using the specific Service methodology.

B. SERVICE UNIT SUSTAINMENT FACTORS

In this subsection brief descriptions of the unit sustainment factors, developed by MCR for use with the MCR methodology, are provided by Service.

1. Army - Unit Sustainment Factors

The Army uses a total Army enlisted loss rate in the calculation of personnel replacement costs. MCR has developed occupation-specific loss factors from Army data:

- Unit Sustainment Recruitment Factor - The Army total attrition factor for enlisted personnel was 24.7% for FY80.^{8/} This is applied to the recurring recruitment cost to derive the annual cost.
- Unit Sustainment Enlistment Bonus Factors. The Army enlistment bonus factor has been calculated in a different way than the Navy and Air Force factors due to the availability of more detailed data. The number of people who actually received bonuses in M-1 required occupations (3,187) has been divided by the number of E-3 authorizations in those MOSs, or the number of people who possibly could have qualified to receive these bonuses (8,054). This calculation produced a factor of 0.4.^{9/}
- Unit Sustainment Selective Reenlistment Bonus Factors - MILPERCEN calculates projected Selective Reenlistment Bonus costs using a five year average reenlistment period and average pay grades and years of Service for each zone.^{10/} In FY80, the average pay grades and years of Service were:
 - Zone A, E-4 with three years service;
 - Zone B, E-5 with eight years service; and
 - Zone C, E-6 with twelve years service.
 MCR has used these same data in the calculations.
- Unit Sustainment Training Factors - The Army collects training cost data by skill level for each MOS and documents this in the MOSB. In order to annualize these costs they must be multiplied by occupation- and skill level-specific annual loss rates. MCR obtained detailed FY80 continuation rates for each Army Career Management Field (CMF) from ODCSPER.^{11/} Continuation rates are the opposite of loss rates and are identified in terms of ranges of years of service (i.e., one to three years, four to six years, seven to ten years, and eleven to twenty years) within each CMF, rather than pay grade. MCR has correlated the average years of service for each pay grade to these data and selected the appropriate loss rate. Several CMFs were used

^{8/} Annual attrition factors for FY80 received from DACA-CAC, Mr. John Sincavage, taken from Army Force Cost Information System (which is the automated system for the AFPCH).

^{9/} Information received from MILPERCEN - Military Incentives Management Branch, Mrs. Kristine Farrendino.

^{10/} MILPERCEN, Monetary Incentives Branch, LTC L.K. Walker.

^{11/} DAPE-MPE, LTC K.M. Woodbury.

by MCR in costing the selected weapon system (M-1). The CMFs of greatest interest are those in which the largest population occurs within the system or those which are critical to the system, such as operators and maintainers. The two most important CMFs are 19 (armor crewmen) and 63 (maintenance) although several others are found in the M-1 battalion. The average years of service by pay grade used in these calculations are given below:^{12/}

<u>E-3</u>	<u>E-4</u>	<u>E-5</u>	<u>E-6</u>	<u>E-7</u>
1.5	3	5	10	16

Table IV-1 lists the continuation rates for the M-1 battalion CMFs. Loss rates, used in cost calculations, are the complement of these rates.

Table IV-1. ARMY FY80 CONTINUATION RATES FOR M-1 BATTALION CAREER MANAGEMENT FIELDS (BY PAY GRADE)

<u>CMF</u>	<u>E-3</u>	<u>E-4</u>	<u>E-5</u>	<u>E-6</u>	<u>E-7</u>
11	.79	.79	.61	.81	.91
12	.72	.72	.87	.90	.92
16	.78	.78	.82	.84	.91
19	.84	.84	.66	.79	.87
31	.78	.78	.77	.85	.92
54	.88	.88	1.00	1.00	1.00
63	.77	.77	.69	.85	.90
64	.77	.77	.85	.85	.91
71	.81	.81	.85	.88	.95
76	.78	.78	.91	.90	1.00
79	N/A	N/A	1.00	1.00	1.00
91	.82	.82	.82	.84	.95
94	.69	.69	.83	.87	.81

As shown in this table two CMFs, 54 and 79 have zero loss rates. This is possible for CMF 54 which indicates no annual losses. This is due to transfer of personnel from other CMFs in response to SRB inducements. CMF 79 (reenlistment NCO/recruiter) receives personnel only from transfers from other CMFs.

^{12/} Taken from DCSPER 411 report of November 1980. An alternate source of potentially more accurate data is the Defense Manpower Data Center (DMDC).

2. Navy - Unit Sustainment Factors

Historically, NAVAIR has not used manpower loss factors in calculating manpower life cycle costs. The MCR factors have been developed from Navy-provided data:

- Unit Sustainment Recruitment Factor - Recruitment costs are calculated using the overall FY80 Navy loss rate for enlisted personnel of 36.6%.
- Unit Sustainment Enlistment Bonus Factors - The enlistment bonus factor is based on the average loss rate for E-3s throughout the Navy. This rate is 31.0%. The only occupation required by the LAMPS Mk III squadron receiving an Enlistment Bonus is the Mess Management Specialist (MS). Specific award data is not readily available for this rating.
- Unit Sustainment Selective Reenlistment Bonus Factors - The SRB factor is calculated based on the average period of reenlistment in the Navy (four years), the current award level and zone, and the average pay grade and years of service in the given zone. For the Navy, the averages for each zone are:
 - Zone A - E-4 over four years,
 - Zone B - E-6 over eight years, and
 - Zone C - E-6 over ten years.^{13/}
- Unit Sustainment Training Factors - The sustainment factors for Navy training costs are based on loss rates by occupation. These loss rates are used as annual rates of personnel replacement for each occupation. Rates were developed by MCR based on FY80 data developed using the FAST model.^{14/} Table IV-2 lists the loss rates for each of the occupations required by the LAMPS Mk III. As can be seen in this table, all of the ratings involved have a loss rate of approximately 30%. The overall Navy enlisted loss rate is 36.6% annually. The LAMPS Mk III overall loss rate is 30%. This is consistent with the shortage of mid-level personnel (i.e., petty officers) currently being experienced by the Navy.

^{13/} Information obtained from OP-136D, LCDR Roger Hope.

^{14/} Information obtained from OP-135D, LT Paul Johnson.

Table IV-2. NAVY OCCUPATIONAL LOSS RATES
FOR LAMPS Mk III OCCUPATIONS

<u>OCCUPATION CODE</u>	<u>OCCUPATION TITLE</u>	<u>FY80 LOSS RATE</u>
AD	Aviation Machinist's Mate	.30
AE	Aviation Electrician's Mate	.32
AK	Aviation Storekeeper	.33
AME	Aviation Structural Mechanic (Safety Eqp.)	.27
AMH	Aviation Structural Mechanic (Hydraulics)	.29
AMS	Aviation Structural Mechanic (Structures)	.28
AO	Aviation Ordnanceman	.35
AT	Aviation Electronics Technician	.33
AW	Antisubmarine Warfare Operator	.31
AX	Antisubmarine Warfare Technician	.31
AZ	Aviation Maintenance Administrationman	.32
DK	Disbursing Clerk	.34
HM	Hospital Corpsman	.33
MS	Mess Management Specialist	.40
PN	Personnelman	.34
PR	Aircrew Survival Equipmentman	.32
YN	Yeoman	.37

3. Air Force - Unit Sustainment Factors

The Air Force uses a total enlisted turnover factor in the calculation of training and acquisition costs. MCR has developed specific occupation factors from Air Force-provided data:

- Unit Sustainment Recruitment Factor - Recruitment costs using the MCR unit sustainment methodology are calculated using the overall Air Force enlisted loss rate of 13.5% ^{15/} since this is not an occupation-specific cost.
- Unit Sustainment Enlistment Bonus Factors - Enlistment bonuses are not common in the Air Force and are only briefly mentioned here. None of the proposed GLCM AFSCs are currently being awarded enlistment bonuses.
- Unit Sustainment Selective Reenlistment Bonus Factors - The Air Force does not include SRB costs in its sustainment cost estimation process. MCR's methodology includes this cost category. Average amounts for SRBs were computed by deflating FY81 SRB budgeted amounts by 11.7% ^{16/} to arrive at FY80 amounts contained in the table. The budgeted amounts were based on average grade/years of service for each SRB zone as indicated below:
 - Zone A - E-4 over three years,
 - Zone B - E-5 over six years, and
 - Zone C - E-6 over ten years.
- Unit Sustainment Training Factors - Occupation-specific attrition factors for proposed GLCM occupations are presented in Table IV-3. The rates listed were calculated based on projected losses and projected authorizations for FY81 using data provided by the Airman Information Retrieval System (AIRS). The computations involved dividing projected losses by projected authorizations to arrive at a projected loss rate.

^{15/} Loss rate contained in Air Force Pamphlet (AFP) 173-13 and used with the Cost Oriented Resources Estimating (CORE) Model.

^{16/} 11.7% was used since that is the FY81 military pay increase.

Table IV-3. AIR FORCE OCCUPATIONAL LOSS RATES
FOR PROPOSED GLCM OCCUPATIONS

<u>OCCUPATION CODE</u>	<u>OCCUPATION TITLE</u>	<u>FY80 LOSS RATE</u>
304X0	Radio Relay Equipment Repairman	.200
316X0C*	Missile Systems Analyst	.200
328X0	Avionics Communications Specialist	.200
391X0	Maintenance Analysis Specialist	.132
392X0	Maintenance Management Specialist	.111
423X5	Aerospace Ground Equipment Mechanic	.171
427X4	Metals Processing Specialist	.153
443X0C**	Missile Mechanic	.224
461X0	Munitions Systems Specialist	.174
463X0	Nuclear Weapons Specialist	.190
472X4	Vehicle Maintenance Analysis Specialist	.062
545X0	Refrigeration/Air Conditioning Specialist	.166
645X0	Inventory Management Specialist	.157
702X0	Administrative Management Specialist	.189
811X0	Security Specialist	.259

* Loss rate for this new shredout is computed from the 316X0 data.

** Loss rate for this new shredout is computed from the 443X0 data.

In estimating training costs the Air Force applies an average attrition factor for each year of the life cycle cost estimate. The overall enlisted loss rate currently used by the Air Force is 13.5%. This value is a computed average rate for all enlisted personnel, spanning all grades and career fields. MCR used occupation-specific loss rates for Air Force training costs.

As can be seen in Table IV-3, 12 of the 15 AFSCs have an attrition rate higher than the average rate of 13.5% used in Air Force sustainment cost estimation. The average for these 15 AFSCs is 17.3%. This shows that a Service-wide average does not necessarily reflect system-specific attrition rates. Occupation-specific attrition rates should be used where possible to properly reflect the impact on specific systems.

C. M-1 MANPOWER COSTS

The M-1 has been costed using two procedures: the unit sustainment cost methodology (developed by MCR), and the standard Army methodology (described in DA PAM 11-4). The latter has been calculated using the factors developed for the IPCE. Both of these are described in Section III. The MCR costs were developed for the enlisted personnel in a single tank battalion (no officers were costed). The estimate of 511 enlisted is the current required strength for an M-1 tank battalion. M-1-specific MOS and pay grade adjustments to the basic TOE were based on guidance received from the Force Integration Staff Officer (FISO). The detailed matrix of pay grade and MOS combinations, shown in Table II-4, is the basis for the analysis using the unit sustainment methodology.

The calculations using the Army methodology follow the standard procedure of allocating military personnel per weapon system within the force unit. The Army does not cost the entire battalion but rather only those personnel directly identified with a given system. In an effort to make reasonable and

valid comparisons between the two methodologies, the final cost comparisons are made on the basis of an estimated manpower cost per tank rather than unit manpower costs. For the purposes of this research the factors and costs used in the March 1979 M-1 IPCE for DSARC Milestone III have been used. The costs have been updated to FY80 dollars and have incorporated the factors in the October 1979 version of the Army Force Planning Cost Handbook (AFPCH).

1. M-1 Manpower Costs Using the MCR-Developed Unit Sustainment Manpower Cost Methodology

These costs have been developed using the total required strength of an M-1 battalion of 511 enlisted personnel. The occupation- and pay grade-specific data and calculations are provided on two tables: "Annual M-1 Unit Sustainment Manpower Costs by Pay Grade," Table IV-4; and "Annual M-1 Unit Sustainment Costs by Occupation," Table IV-5.

a. Manpower Costs by Pay Grade

Table IV-4 arrays pay grade-specific costs. All costs are in FY80 dollars. For the M-1 tank battalion, the enlisted personnel include only pay grades E-3 through E-9. The cost categories listed on this table are explained below:

● Pay and Allowances:

- Adjusted Standard Rate (ASR) - The Composite Standard Rate (CSR) adjusted to exclude certain costs such as quarters. This is taken from the "Average Cost Handbook" and is pay grade-specific. The CSR includes basic pay, quarters, miscellaneous expenses (rations, FICA, clothing, bonuses, and several small costs), and incentive/special pay. The ASR excludes quarters and incentive/special pay.
- Enlistment and Selective Reenlistment Bonuses - These bonuses were included in the ASR as an average cost of equal value for all grades. They are deducted from the ASR to be used in precise occupation-specific cost calculations in Table IV-5.

Table IV-4. ANNUAL M-1 UNIT SUSTAINMENT MANPOWER COSTS BY PAY GRADE (FY80 \$)

PAY GRADE	PAY AND ALLOWANCES(\$)				RETIREMENT (\$)	SUPPORT (\$)	RECRUITMENT (\$)	PCS (\$)	TOTAL (\$)	QUANTITY BY PAY GRADE	TOTAL ANNUAL COST BY PAY GRADE (\$)
	ADJUSTED STANDARD RATE (+)	ENLISTMENT & REENLISTMENT CORUS-ES(-)*	QUARTERS (+)	SURTOTAL							
E-9	21,186	(197)	3,435	24,424	6,764	1,619	391	792	33,990	1	33,990
E-8	17,924	(197)	3,169	20,896	5,613	1,622	391	792	29,314	7	205,198
E-7	15,202	(197)	2,923	17,928	4,725	1,588	391	792	25,424	24	610,176
E-6	12,693	(197)	2,665	15,151	3,876	1,568	391	792	21,778	67	1,459,126
E-5	10,602	(197)	2,314	12,719	3,143	1,461	391	792	18,536	119	2,202,214
E-4	9,241	(197)	1,844	10,888	2,667	1,247	391	792	15,985	157	2,509,645
E-3	8,543	(396)	1,496	9,648	2,382	1,042	391	792	14,255	136	1,930,680
TOTAL**				6,151,190	1,535,935	667,491	199,801	404,712		511	29,950,029

*MCR deducted this average cost per pay grade for the purposes of this analysis. This occupation-specific cost is incorporated in the adjusted standard rate (ASR) and has been deducted here. It is included in the occupation-specific cost calculations.

**Column totals are derived by multiplying each pay grade-specific cost by the corresponding quantity by pay grade and summing the products.

- Quarters - The quarters costs by pay grade in the "Average Cost Handbook" are in error. The Handbook methodology requires the use of BAQ rates for Service members as a surrogate for operation and maintenance of government-provided quarters. The Army used the FY80 cost of BAQ payment, thereby excluding the cost of government-provided quarters in the Handbook data. As a substitute, the average of Quarters costs for the Navy and Air Force in the handbook are cited here.
- Subtotal - This is a subtotal of three costs: adjusted standard rate minus average bonuses plus quarters.
- Retirement - This is taken from the "Average Cost Handbook" and is pay grade-specific.
- Support - This is taken from the "Average Cost Handbook" and is pay grade-specific.
- Recruitment - This is calculated by dividing the total budgeted cost for FY80 of Recruiting and Advertising by the total number of non-prior Service (NPS) accessions. The cost of \$1,581 was multiplied by the unit sustainment recruitment factor (FY80 enlisted loss rate) of 0.247 to arrive at the annual cost per person of \$391.
- Permanent Change of Station (PCS) - The "Average annual PCS cost per man" for the Army cited in the March 1979 M-1 IPCE is used here. The \$501 FY72 cost is inflated to FY80 dollars by multiplying by 1.58, which yields an annual per capita cost of \$792.
- Total - This is the total of all costs by pay grade.
- Quantity - This is the projected quantity of enlisted personnel by pay grade for the M-1 tank battalion.
- Total Annual Cost by Pay Grade - This cost is calculated by multiplying the total cost for each pay grade by the quantity. These are the total pay grade-specific costs for the M-1 tank battalion. The total annual pay grade-specific costs for an M-1 tank battalion is \$8,959,029.

b. Manpower Costs by Occupation

Table IV-5 arrays occupation-specific costs. All costs are in FY80 dollars. The costs associated with the 32 MOSs required in an M-1 tank battalion are examined on this table. The cost categories listed on this table are explained below:

Table IV-5. ANNUAL M-1 UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION (FY80 \$)

Occupation Title	Occupation Code*	Pay Grade	Training Costs (\$)**	Loss Rate	Annual Training Cost (\$)	Annual Enlistment Bonus (\$)	Annual SRB (\$)	Individual Annual Costs (\$)	Quantity in Occupation	Total Annual Costs by Occupation (\$)
Command Sgt. Major	00Z (50)	E-9	---	---	---	---	---	---	1	---
Radio Operator	058 (10)	E-4	7,520	.22	1,654	---	---	1,654	2	3,308
	(10)	E-3	7,520	.22	1,654	600	---	2,254	1	2,254
Radio Teletype Operator	05C (20)	E-5	15,719	.18	2,829	---	---	2,829	2	5,658
	(10)	E-4	13,959	.22	3,071	---	---	3,071	2	6,142
	(10)	E-3	13,959	.22	3,071	1,000	---	4,071	2	8,142
Indirect Fire Infantryman	11C (40)	E-7	15,125	.09	1,361	---	---	1,361	1	1,361
	(30)	E-6	10,331	.19	1,963	---	---	1,963	1	1,963
	(20)	E-5	7,767	.39	3,029	---	752	3,781	6	22,686
	(10)	E-4	5,353	.21	1,124	---	618	1,742	9	15,678
	(10)	E-3	5,353	.21	1,124	1,600	---	2,724	9	24,516
Engineer Tracked Vehicle Crewman	12F (30)	E-6	13,000***	.10	1,300	---	---	1,300	1	1,300
	(20)	E-5	11,478	.13	1,492	---	752	2,244	1	2,244
	(10)	E-4	7,956	.28	2,228	---	618	2,846	2	5,692
Redeye/Stinger Man- portable Air Defense System Operator	16S (30)	E-6	11,082 (@ 16R)	.16	1,773	---	---	1,773	1	1,773
	(20)	E-5	8,815	.18	1,587	---	---	1,587	5	7,935
Cavalry Scout	19D (40)	E-4	6,698	.22	1,474	---	---	1,474	5	7,370
	(30)	E-7	16,223	.13	2,109	---	---	2,109	1	2,109
	(20)	E-6	14,260	.21	2,995	---	---	2,995	4	11,980
	(10)	E-5	10,589	.34	3,600	---	752	4,352	6	26,112
	(10)	E-4	7,067	.16	1,131	---	618	1,749	13	22,737
	(10)	E-3	7,067	.16	1,131	1,600	---	2,731	7	19,117
M-1 Armored Crewman	19K (40)	E-7	19,609 (@ 19J)	.13	2,549	---	---	2,549	11	28,039
	(30)	E-6	14,815	.21	3,111	---	---	3,111	36	111,996
	(20)	E-5	11,141	.34	3,754	---	752	4,541	35	158,935
	(10)	E-4	7,611	.19	1,435	---	618	1,834	37	68,006
	(10)	E-3	7,611	.19	1,435	1,600	---	2,830	53	149,460

*Specific training costs are developed by skill digit, which refers to pay grade.

**@ denotes instances where training costs for another similar MOS have been used because training costs for the given MOS are not available in the data source, the MOSB.

***No training cost for MOS 12F30 appears in the MOSB. This figure represents an estimated cost based on 12F20 training cost.

Table IV-5. ANNUAL M-1 UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION (FY80 \$) (Cont'd)

Occupation Title	Occupation Code*	Pay Grade	Training Costs (\$)**	Loss Rate	Annual Training Cost (\$)	Annual Enlistment Bonus (\$)	Annual SRB (\$)	Individual Annual Costs (\$)	Quantity in Occupation	Total Annual Costs by Occupation (\$)
M-1 Tank Driver	19L (20)	E-5	11,144 (@ 19J)	.34	3,789	---	752	4,541	19	86,279
	(10)	E-4	7,622	.16	1,220	---	618	1,838	19	34,922
	(10)	E-3	7,622	.16	1,220	1,600	---	2,820	16	45,120
Armor Senior Sgt.	19Z (40)	E-8	---	---	---	---	---	---	7	---
TAC Comm. Syst. Oper./Mechanic	31V (40)	E-7	11,169	.08	894	---	---	894	1	894
	(30)	E-6	8,658	.15	1,299	---	---	1,299	4	5,196
	(10)	E-4	5,257	.22	1,157	---	618	1,775	4	7,100
	(10)	E-3	5,257	.22	1,157	---	---	1,157	1	1,157
TAC Wire Opns. Specialist	36K (10)	E-4	3,493	.22	768	---	---	768	3	2,304
	(10)	E-3	3,493	.22	768	---	---	768	2	1,536
Metal Worker	44B (20)	E-5	10,162	.31	3,150	---	---	3,150	1	3,150
	(20)	E-4	8,402	.23	1,932	---	---	1,932	1	1,932
M-1 Tank Turret Mechanic	45E (20)	E-5	12,451 (@ 45K)	.31	3,860	---	752	4,612	3	13,836
	(10)	E-4	10,691	.23	2,459	---	1,223	3,682	4	14,728
	(10)	E-3	10,691	.23	2,459	---	---	2,459	4	9,836
IFV/CFV/ITV Turret Mechanic	45T (10)	E-4	10,691	.23	2,459	---	1,223	3,682	1	3,682
Chemical Opns. Specialist	54E (30)	E-6	11,391	.00	---	---	---	---	1	---
	(20)	E-5	11,319	.00	---	---	1,504	1,504	4	6,016
Power Sen/Wheel Vehicle Mechanic	63B (20)	E-5	7,381	.31	2,288	---	752	3,040	2	6,080
	(10)	E-4	5,621	.23	1,293	---	618	1,911	3	5,733
	(10)	E-3	5,621	.23	1,293	---	---	1,293	3	3,879
M-1 Tank System Mechanic	63E (40)	E-7	20,515	.10	2,052	---	---	2,052	4	8,208
	(30)	E-6	15,170	.15	2,276	---	---	2,276	5	11,380
	(20)	E-5	12,179	.31	3,760	---	752	4,512	6	27,072
	(10)	E-4	10,369	.23	2,385	---	618	3,003	11	33,033
	(10)	E-3	10,369	.23	2,385	---	---	2,385	11	26,235
Heavy Wheeled Vehicle Mechanic	63s (20)	E-5	12,129	.31	3,760	---	752	4,512	1	4,512
	(10)	E-4	10,369	.23	2,385	---	618	3,003	2	6,006

* Specific training costs are developed by skill digit, which relates to pay grade.
 ** @ denotes instances where training costs for another similar MOS have been used because training costs for the given MOS are not available in the data source, the MOSB.

Table IV-5. ANNUAL M-1 UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION (FY80 \$) (Cont'd)

Occupation Title	Occupation Code*	Pay Grade	Training Costs (\$)**	Loss Rate	Annual Training Cost (\$)	Annual Enlistment Bonus (\$)	Annual SRB (\$)	Individual Annual Costs (\$)	Quantity in Occupation	Total Annual Costs by Occupation (\$)
IFV/CFV/ITV Mechanic	63T (40) (20) (10)	E-7 E-5 E-4	15,170	.10	1,517	---	---	1,517	1	1,517
			12,129	.31	3,760	---	752	4,512	2	9,024
			10,369	.23	2,385	---	618	3,003	3	9,009
Motor Transport Operator	64C (40) (20) (10)	E-7 E-5 E-4	7,229	.09	651	---	---	651	1	651
			6,126	.15	919	---	---	919	1	919
			4,096	.23	942	---	---	942	9	8,478
Legal Clerk	71D (20) (10) (10)	E-5 E-4 E-3	4,096	.23	942	---	---	942	9	8,478
			6,688	.15	1,003	---	---	1,003	1	1,003
			5,224	.19	993	---	---	993	2	1,986
Personnel Admin. Specialist	75B (20) (10) (10)	E-5 E-4 E-3	9,894	.15	1,484	---	---	1,484	1	1,484
			8,134	.19	1,545	---	---	1,545	1	1,545
			8,134	.19	1,545	---	---	1,545	2	3,090
Personnel Senior Sgt.	75Z (40) (30) (10)	E-7 E-6 E-5	8,963	.05	449	---	---	449	1	449
			8,734	.12	1,048	---	---	1,048	1	1,048
			4,921	.15	738	---	---	738	5	3,690
Engr. Supply & Parts Specialist	76C (20) (10) (10)	E-5 E-4	3,161	.19	601	---	---	601	5	3,005
			7,661	.09	689	---	---	689	1	689
			5,901	.22	1,298	---	---	1,298	3	3,894
Petroleum Supply Specialist	76W (20) (10) (10)	E-5 E-4	8,124	.00	---	---	---	---	1	---
			8,040	.10	804	---	---	804	5	4,020
			6,432	.09	579	---	---	579	5	2,895
Unit Supply Specialist	76Y (40) (30) (20)	E-7 E-6 E-5	3,161	.22	695	---	---	695	2	1,390
			3,161	.22	695	---	---	695	3	2,085
			8,497	.00	---	---	---	---	1	---
Recruitment MCO	79D (30) (20) (10)	E-6 E-7 E-5	13,042	.05	652	---	---	652	1	652
			9,838	.16	1,574	---	---	1,574	1	1,574
			7,346	.18	1,322	---	---	1,322	7	9,254
Medical Specialist	91B (40) (30) (20)	E-5 E-4 E-3	5,586	.18	1,005	---	---	1,005	8	12,984
			5,586	.18	1,005	---	---	1,005	4	4,020
			5,586	.18	1,005	---	---	1,005	4	4,020

*Specific training costs are developed by skill digit, which relates to pay grade.
 **If several instances were training costs for another similar MOS have been used because training costs for the given MOS are not available in the data source, the MOS.

Table IV-5. ANNUAL M-1 UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION (FY80 \$) (Cont'd)

Occupation Title	Occupation Code*	Pay Grade	Training Costs (\$)**	Loss Rate	Annual Training Cost (\$)	Annual Enlistment Bonus (\$)	Annual SRB (\$)	Individual Annual Costs (\$)	Quantity in Occupation	Total Annual Costs by Occupation (\$)
Patient Care Specialist	91C (30)	E-6	28,175	.16	4,508	---	---	4,508	1	4,508
	(10)	E-3	14,161	.18	2,549	---	---	2,549	1	2,549
Food Service Specialist	94B (40)	E-7	11,093	.19	2,108	---	---	2,108	1	2,108
	(30)	E-6	8,627	.13	1,122	---	---	1,122	5	5,610
	(20)	E-5	6,119	.17	1,040	---	---	1,040	5	5,200
	(10)	E-4	4,359	.31	1,351	---	---	1,351	6	8,106
	(10)	E-3	4,359	.31	1,351	---	---	1,351	5	6,755
Total***					946,922	138,600	141,641		511	1,227,163

*Specific training costs are developed by skill digit, which relates to pay grade.

**@ denotes instances where training costs for another similar MOS have been used because training costs for the given MOS are not available in the data source, the MUSB.

***Column totals are derived by multiplying each occupation-specific cost by the corresponding quantity in occupation and summing the products.

- Occupation Title - Most MOS titles for the M-1 tank battalion were obtained from the MOS Handbook (MOSB). Titles of new MOSSs, especially those which are system specific to the M-1 tank, were obtained from the M-1 FISO.
- Occupation Code - Occupations are specified by MOS code. The MOS code consists of five characters. The first three characters (two numbers followed by a letter) identify the basic skill. The last two characters further specify relative skill levels and special qualifications required for a given position.
- Pay Grade - This is taken from the list prepared by the FISO in the M-1 BOIP Analysis or from TOE 17-035 H010, and corresponds to the skill digit.
- Training Costs - The total weighted variable cost for the MOS corresponding to skill digit or pay grade is taken from the MOSB for the exact MOS (identified by the full five-character MOS code). In the case of new MOSSs specific to the M-1, the total weighted variable cost for a comparable MOS has been used. All training costs are taken from the September 1980 update of the MOSB Volume I, (enlisted) and are in FY80 dollars. No training cost is applied to E-8 and E-9 positions.
- Loss Rate - This is the unit sustainment training factor. These factors are derived from Army FY80 continuation rates for career management fields by pay grade. Table IV-1 lists all the rates used as unit sustainment training factors in this calculation.
- Annual Training Cost - The training cost times the loss rate provides the annual cost for each MOS listed.
- Annual Enlistment Bonus - The enlistment bonus for those MOSSs authorized them has been multiplied by the unit sustainment enlistment bonus factor of 0.40 to derive an annual enlistment bonus cost. For example, MOS 19D is eligible for a \$4,000 enlistment bonus. The 0.40 factor adjusts for the actual number of personnel who receive the bonus. This calculation is only applied to E-3s.
- Annual SRB - The selective reenlistment bonus (SRB) costs for eligible MOSSs (shown previously on Table II-2) have been annualized using a Unit Sustainment SRB factor of 0.20 based on the average Army reenlistment period of five years. Zone A bonuses have been applied to E-4 positions and Zone B bonuses to E-5 positions. The unit sustainment SRB factor has been used to develop an annual SRB cost.

- Individual Annual Costs - This is the total of the annual costs of training, enlistment bonuses, and SRBs. E-8 and E-9 personnel were not costed.
- Quantity in Occupation - MOS quantity for the M-1 tank battalion is determined from the FISO's BOIP Analysis as of September 1980 combined with the current TOE. This is used as the multiplier of the Individual Annual Costs for each MOS.
- Total Annual Cost by Occupation - These are the total occupation-specific costs for the M-1 battalion and is the product of the individual annual cost for each MOS times the quantity of personnel in each MOS. The total M-1 battalion occupation-specific cost is \$1,227,163.

2. M-1 Manpower Costs Using the Army Methodology

The Army methodology used for the Independent Parametric Cost Estimate (IPCE) and explained in DA PAM 11-4 has been used in these calculations. The personnel allocation and cost factors for military personnel have been taken from the March 1979 M-1 IPCE. The Army used FY72 base year costs adjusted to FY79 dollars. MCR has adjusted the FY72 dollars to FY80 dollars. The MCR adjustment factor of 1.7205 was derived by multiplying the Army factor of 1.6079 used in the IPCE (used to convert FY72 dollars to FY79 dollars) by 1.07 to compensate for to FY80 pay raise.

The calculation for each Army cost element shown on Table IV-6 is explained below. These are annual costs per M-1 tank:

- Crew Pay and Allowances - 4 persons per tank crew times annual pay and allowances of \$6,719 (FY72 \$) adjusted to FY80 \$ (1.7205 adjustment factor) is \$46,240.
- Maintenance Pay and Allowances - 1.5 persons per tank times annual pay and allowances of \$5,738 (FY72 \$) adjusted to FY80 \$ (1.7205 adjustment factor) is \$14,808.
- Indirect Pay and Allowances - 2.63 indirect personnel per tank times annual pay and allowances of \$7,392 (FY72 \$) adjusted to FY80 \$ (1.7205 adjusted factor) is \$33,448.

Table IV-6. ANNUAL M-1 OPERATING AND SUPPORT COSTS - ARMY METHODOLOGY (FY80 \$)

COST ELEMENT	COST FACTOR (\$)	MANPOWER FACTOR	COST (\$)
MILITARY PERSONNEL COSTS:	--	--	(100,935)
● Pay and Allowances:	--	--	(94,496)
- Crew	11,560	4	46,240
- Maintenance	9,872	1.5	14,808
- Indirect	12,718	2.63	33,448
● Permanent Change of Station	792	8.13	6,439
INDIRECT SUPPORT OPERATIONS:	--	--	(33,854)
● Personnel Replacement	2,305	8.13	18,740
● Quarters, Maintenance, and Utilities	675	8.13	5,488
● Medical Support	337	8.13	2,740
● Other Indirect (Base Operations)	847	8.13	6,886
TOTAL	--	--	134,789

- Permanent Change of Station (PCS) - The IPCE annual PCS cost per person inflated to FY80 dollars is \$792. This is multiplied by the number of personnel allocated per tank of 8.13 (crew 4, maintenance 1.5 and indirect 2.63) producing a cost of \$6,439.
- Personnel Replacement - The IPCE annual personnel replacement cost of \$1,340 (FY72 \$) times an adjustment factor of 1.7205 and times 8.13 persons per tank is \$18,740. This includes the cost of recruitment, accession, separation and training.
- Quarters, Maintenance, and Utilities (QMU) - The AFPCH FY80 annual average cost of \$581 for CONUS and \$768 for Europe is averaged to \$675. Multiplied by 8.13 personnel per tank the cost is \$5,488.
- Medical Support - The AFPCH FY80 annual average cost of \$317 for CONUS and \$356 for Europe is averaged to \$337. Multiplied by 8.13 personnel per tank the cost is \$2,740.
- Other Indirect (Base Operations Cost) - The cost of base operations is included in the "Other Indirect" cost element of the Army cost breakdown structure. It is calculated and listed here in order to approximate the costs covered by the "Support" costs listed in the "Average Cost Handbook." Base Operations per capita costs are available from AFPCH (p. I-11) for CONUS and Europe as follows:

CONUS:	\$1,311
Europe:	\$1,733
Average:	\$1,522 per capita annual Base Operations Cost

Quarters, maintenance, and utilities are also included in this cost (44.3% of total). In order to avoid counting QMU twice, it is deducted from base operations to yield an annual average cost of \$847. Multiplied by 8.13 personnel per tank the cost is \$6,886.

- Total - The total cost for one M-1 tank using approximately the same manpower cost categories as the unit sustainment manpower cost methodology is \$134,789. The Army does not include enlistment or reenlistment bonus costs in their cost methodology.

3. Comparison of Manpower Costs

It is necessary to compare the manpower costs on an equitable basis since the MCR unit sustainment costing was for

an entire tank battalion and the Army manpower costing is based on allocation of personnel per tank. The manpower requirement of 511 personnel used by MCR equates to 9.46 personnel per tank. The Army allocation factor is 8.13 personnel per tank. Using the proportion of $\frac{8.13}{9.46}$ or .8594, multiplied by the MCR unit sustainment costs and then dividing the result by 54 (the number of tanks in a battalion) gives a cost per tank of \$162,111.

Each comparable MCR and Army manpower cost element has been aligned on Table IV-7. The primary cost difference between the two methods is the addition of retirement and bonuses to the MCR costs. These costs are not included in the Army costs. The Army costs are shown on Table IV-6. The MCR costs are shown on Tables IV-4 and IV-5. The MCR unit costs had to be factored so they would be comparable to Army costs per tank. The MCR factoring calculation consisted of multiplying the cost for each element by 0.8594 and then dividing by the number of tanks in the battalion (54).

- Pay and Allowances - Both methodologies developed pay grade-specific costs based on the grade structure within a tank battalion. The slight difference in cost is principally due to the treatment of quarters costs. MCR used a quarters cost for all quarters maintenance and utilities in pay and allowances, whereas the Army identifies this as a support cost.

$$\text{Sample calculation: } \frac{(\$6,151,190 \times .8594)}{54} = \$97,895$$

- Support - The medical and base operation costs equate to the MCR support cost. When pay and allowances and support costs are added, the MCR and Army methodologies are quite close (within 1%).
- Recruitment and Training - Both the Army and MCR use occupation-specific training costs. The Army includes recruitment as part of the personnel replacement cost. Both methodologies provide similar costs (within 3%).
- Permanent Change of Station (PCS) - This cost is the same for both methodologies since the Army cost factor was used in both calculations.

Table IV-7. COMPARISON OF ANNUAL M-1 MANPOWER COSTS (FY80 \$)

Manpower Costs for One M-1 Tank

<u>MCR METHODOLOGY</u>		<u>ARMY METHODOLOGY</u>		<u>REMARKS</u>
<u>COST ELEMENT</u>	<u>COST (\$)</u>	<u>COST ELEMENT</u>	<u>COST (\$)</u>	
Pay & Allowances	97,895	Pay & Allowances	94,496	Military Pay & Allowances are pay grade-specific.
Support	10,623	QMU	5,488	MCR has considered Quarters Maintenance as part of Quarters.
---	---	Medical	2,740	Medical and Base Operations have been considered comparable to Support.
---	---	Base Operations	6,886	
Subtotal	10,623	Subtotal	15,114	
Replacement	3,150	Personnel Replacement	18,740	
Training	15,076	---	---	
Subtotal	18,226	Subtotal	18,740	Army calculated occupation-specific training costs. MCR also has calculated training based on occupation-specific data.
Pay	6,461	PCS	6,439	
TOTAL	133,299	TOTAL	134,780	
Personnel**	24,230			
Equipment*	4,430			
Support	16,111			

*Costs for equipment elements. Personnel costs not included in the Army cost calculations. **For the purpose of this report, PCS are not used separately in the MCR calculations.

- Total - The MCR and Army methodologies both provide approximately the same cost per tank since both methods use pay grade-specific and occupation-specific costs (within 1%). However, the addition of bonus costs and retirement cost in the MCR methodology adds 22%.

4. Observations

The Army is fairly precise in the derivation of pay grade- and occupation-specific costs for pay and allowances and personnel replacement (training costs). The same precise approach by MCR yielded very similar results: \$133,209 per tank versus \$134,789 per tank using the Army methodology. The addition of bonus cost, which seems reasonable since that is included in other Services' pay and allowance costs, still does not make a significant difference (4%). Only retirement cost causes a large difference in costs (18%). However, until DoD makes a decision to include retirement costs, it appears that Army weapon system manpower costing is quite precise in terms of including occupation- and pay grade-specific costs.

D. LAMPS MK III MANPOWER COSTS

The LAMPS Mk III has been costed using two procedures: the MCR unit sustainment cost methodology and the Navy Resource Model (NARM) factors. Only the enlisted unit manpower in an operational squadron has been costed for the LAMPS Mk III. No officers have been costed. The operational squadron contains two components: the 13 sea detachments and the shorebased component. A standard LAMPS Mk III operational squadron is projected to require 232 enlisted personnel. A detailed breakdown of LAMPS Mk III enlisted personnel is shown on Table II-11.

A second type of squadron is also required for the LAMPS Mk III, a Fleet Readiness Squadron (FRS). The FRS is a totally

dedicated training squadron. Although it is currently planned to have the same number of aircraft as an operational squadron (13) it has a slightly larger quantity of enlisted personnel (248). A detailed breakdown of FRS personnel is also shown on Table II-11. The FRS is usually not included as a separate unit in Navy calculations of manpower costs since the standard approach is to calculate manpower costs by aircraft. The FRS manpower costs have been calculated separately and are discussed in the cost part of this subsection. The FRS manpower costs have been examined in terms of the cost differences with the operational squadron. The manpower data for both of these squadrons has been obtained from the Draft LAMPS Mk III Navy Training Plan of August 1980.

1. LAMPS Mk III Manpower Costs Using the MCR-Developed Unit Sustainment Manpower Cost Methodology

These costs have been developed using the estimate of 232 enlisted personnel required for a LAMPS Mk III operational squadron. The occupation- and pay grade-specific data and calculations are provided on two tables: Table IV-8, "Annual LAMPS Mk III Unit Sustainment Manpower Costs by Pay Grade," and Table IV-9, "Annual LAMPS Mk III Unit Sustainment Manpower Cost by Occupation."

- a. Manpower Costs by Pay Grade

Table IV-8 arrays the pay grade-specific costs. All costs are in FY80 dollars. The LAMPS Mk III operational squadron requires personnel in pay grades E-3 through E-9. The cost categories on this table are discussed below:

- Pay and Allowances:

- Adjusted Standard Rate (ASR) - The Composite Standard Rate adjusted to exclude certain costs such as quarters. This is taken from the "Average Cost Handbook," and is pay grade-specific.

Table IV-8. ANNUAL LAMPS Mk III UNIT SUSTAINMENT MANPOWER COSTS BY PAY GRADE (FY80 \$)

LAMPS Mk III Operational Squadron

PAY GRADE	PAY AND ALLOWANCES (\$)					RETIEMENT (\$)	SUPPORT (\$)	RECRUITMENT (\$)	PCS (\$)	TOTAL (\$)	QUANTITY BY PAY GRADE	TOTAL ANNUAL COST BY PAY GRADE (\$)
	ADJUSTED STANDARD RATE (+)	ENLISTMENT & REENLISTMENT BONUS ES(-)*	QUARTERS (+)	SUBTOTAL								
E-9	21,282	(357)	3,423	24,348	6,539	2,865	544	451	34,747	2	69,494	
E-8	18,011	(357)	3,155	20,815	5,480	2,850	544	451	30,140	4	120,560	
E-7	15,431	(357)	2,899	17,973	4,672	2,743	544	451	26,383	14	369,362	
E-6	12,939	(357)	2,607	15,189	3,861	2,459	544	451	22,504	31	697,024	
E-5	10,587	(357)	2,217	12,447	3,060	1,886	544	451	18,408	70	1,288,560	
E-4	9,311	(357)	1,766	10,720	2,654	1,638	544	451	16,007	76	1,216,532	
E-3	8,491	(357)	1,474	9,608	2,389	1,480	544	451	14,472	35	506,450	
TOTAL										232	\$4,268,452	

*Average enlistment and reenlistment bonus cost is incorporated in the Adjusted Standard Rate (A.S.R.). This occupation-specific cost is deducted from the ASR and used in the occupation-specific cost calculations.

Table IV-9. ANNUAL LAMPS Mk III UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION*
Lamps Mk III Operational Squadron

Occupation Title	Occupation Code	Training Costs (\$)**	Loss Rate	Annual Training Costs (\$)	Quantity In Occupation	Total Annual Training Costs (\$)	Annual Bonus & SRB (\$)***	Total Annual Costs by Occupation (\$)
Aviation Machinist's Mate	AD	3,476	.30	1,043	31	32,333	---	32,333
Aviation Electrician's Mate	AE	4,779	.32	1,529	30	45,870	---	45,870
Aviation Storekeeper	AK	4,425	.33	1,460	8	11,680	---	11,680
Aviation Structural Mechanic (Safety Equipment)	AME	5,503	.27	1,486	1	1,486	---	1,486
Aviation Structural Mechanic (Hydraulics)	AMH	4,599	.29	1,334	15	20,010	---	20,010
Aviation Structural Mechanic (Structures)	AMS	5,190	.28	1,453	17	24,701	---	24,701
Aviation Ordnanceman	AO	5,129	.35	1,795	3	5,385	---	5,385
Aviation Electronics Technician	AT	12,106	.33	3,995	16	63,920	11,718	75,638
Aviation Anti-Submarine Warfare Operator	AW	7,563	.31	2,345	29	68,005	46,077	114,082
Aviation Anti-Submarine Warfare Technician	AX	12,633	.31	3,916	16	62,656	---	62,656
Aviation Maint. Administration-man	AZ	3,601	.32	1,152	8	9,216	---	9,216
Disbursing Clerk	DK	4,529	.34	1,540	1	1,540	---	1,540
Hospital Corpsman	HM	5,343	.33	1,763	1	1,763	---	1,763
Mess Management Specialist	MS	4,110	.40	1,644	4	6,576	2,328	8,904
Personnelman	PA	4,149	.34	1,411	5	7,055	651	7,706
Aircrew Survival Equipmentman	PP	5,512	.32	1,764	2	3,528	---	3,528
Yeoman	YN	4,575	.37	1,693	8	13,544	---	13,544
Airman/Seaman	AH/SY****	3,294	.31	1,021	22	22,462	---	22,462
Aviation Petty Off.	APG				7			
Petty Off.	PO				2			
TOTAL					226	491,740	60,774	462,514

*These calculations do not include E-8 and E-9 personnel.
**Training costs obtained from FY80 Training Resource Model data.
***Details of these calculations are in Appendix B.
****Airman/Seaman are non-rated positions. The loss rate for E-1 through E-3 has been used in these calculations.

- Enlistment and Reenlistment Bonuses - These bonuses were put in the ASR as the same amount for each pay grade. They are deducted from the ASR to be used in precise occupation-specific cost calculations in Table IV-9.
- Quarters - This is taken from the "Average Cost Handbook," and is pay grade-specific.
- Subtotal - This is the subtotal of three costs: ASR minus average bonuses plus quarters.
- Retirement - This is taken from the "Average Cost Handbook" and is pay grade-specific.
- Support - This is taken from the "Average Cost Handbook" and is pay grade-specific.
- Recruitment - An amount of \$1,486 is the calculated Navy recruitment cost which is derived by dividing total budgeted cost for FY80 Recruiting and Advertising by the total number of Non-Prior Service (NPS) accessions. A unit sustainment recruitment factor of 0.366, the overall Navy loss rate, is applied to the recruitment amount of \$1,486 and yields an annual recruitment cost of \$544 per person.
- Permanent Change of Station (PCS) - The PCS cost contained in the NARM was used. This is the same cost used in the Navy methodology.
- Total - This is the total of all costs by pay grade.
- Quantity by Pay Grade - This is the quantity by pay grade for one LAMPS Mk III operational squadron.
- Total Annual Cost by Pay Grade - These are the total pay grade-specific costs for a LAMPS Mk III operational squadron. This cost is calculated by multiplying the total individual cost for each pay grade by the quantity in that pay grade. The total annual pay grade-specific costs for a LAMPS Mk III operational squadron is \$4,268,652.

b. Manpower Costs by Occupation

Table IV-9 arrays occupation-specific costs. All costs are in FY80 dollars. The LAMPS Mk III operational squadron requires 17 different ratings, which have occupation-specific costs associated with them. In addition there are three other non-rated positions which have personnel assigned (AN/SN, APO and

PO). Of these, only the AN/SN apprentice positions have specific costs identified for training. The training costs given for each rating represent the costs of recruit training and "A" school or initial skill training. Some individuals will receive additional training; however, these costs are currently not available. In order to account for these costs, a surrogate has been used, the training costs for recruit and "A" school training. The cost categories on this table are provided below:

- Occupation Title - These are the standard titles and codes for Navy ratings (occupations).
- Occupation Code - This is an alphabetic code usually representing the key words in the rating title. It is generally composed of three or four letters, with the last character representing the rate of the individual. The rate is comparable to the pay grade.
- Training Costs - These are the occupation-specific costs obtained from the Training Resource Model (TRM), furnished by OP-122.
- Loss Rate - This is the unit sustainment training factor based on the personnel loss rate in each rating. Table IV-2 lists the unit sustainment training factors used in these calculations.
- Annual Training Costs - This is the product of multiplying the rating training cost by the annual rating loss rate.
- Quantity in Occupation - This is the number of people in the operational squadron who are projected to receive occupation-specific training. E-8 and E-9 personnel have not been included in these calculations.
- Total Annual Training Costs - The product of multiplying the annual training costs by the quantity in the occupation.
- Annual Bonus and SRB - This is the sum of separate calculations of the annual bonus costs and the annual SRB costs. These costs have been calculated by multiplying the estimated bonus and SRB amounts (discussed in Section II) by the unit sustainment factors and the number of personnel receiving the payment. Details of these calculations are in Appendix B.

- Total Annual Costs by Occupation - This is the sum of the total annual training costs and the total annual bonus and SRB costs. The total occupation-specific unit manpower cost for the LAMPS Mk III is \$462,504, based on calculations for 226 of the 232 enlisted personnel.

2. LAMPS Mk III Manpower Costs Using the Navy Methodology

The LAMPS Mk III operational squadron was costed using the Navy methodology used for the BCE, using the Navy Resource Model (NARM) factors. The NARM factors are contained in the "Navy Program Factors Manual." The factors are: total manpower cost and total manpower per LAMPS Mk III aircraft. MCR has converted this to a per capita cost and then multiplied by the number of personnel in the operational squadron. The cost calculations appear in Table IV-10.

The following explanation addresses the definition and calculation of the cost elements shown on Table IV-10. Additional detail on the NARM factors is provided in Section III and Appendix C.

- Unit Mission Personnel Cost - This pay and allowance cost is calculated by multiplying the NARM FY80 pay factor of \$11,341 times 232 enlisted personnel (number of enlisted personnel in one LAMPS Mk III Squadron) producing a total of \$2,631,112. The NARM pay and allowance factor contains all military personnel appropriation costs except PCS.
- Indirect Personnel Support
 - Miscellaneous Operating and Support (O&M) - This is the NARM Base Operating Support O&M cost. It is derived by dividing the NARM factor for the LAMPS Mk III (\$25,000) by the NARM Manpower factor (48.9 enlisted) which yields a per capita enlisted cost of \$512. When multiplied by 232 enlisted the total cost is \$118,784.
 - Medical O&M - This cost is calculated by taking the NARM cost factor for the LAMPS Mk III (\$12,000), and dividing that by the NARM Manpower factor (48.79 enlisted) which yields a per capita cost of \$246. When multiplied by 232 enlisted the total cost is \$57,072.

Table IV-10. LAMPS Mk III OPERATIONAL SQUADRON ANNUAL OPERATING AND SUPPORT MANPOWER COSTS - NAVY METHODOLOGY (FY80 \$)

COST ELEMENT	COST FACTOR (\$)	MANPOWER FACTOR	COST (\$)
UNIT MISSION PERSONNEL:	--	--	--
• Pay and Allowances	11,341	232	2,631,112
INDIRECT PERSONNEL SUPPORT:	--	--	--
• Miscellaneous O&M	512	232	118,784
• Medical O&M	246	232	57,072
• Permanent Change of Station	451	232	104,632
PERSONNEL ACQUISITION AND TRAINING:	--	--	--
• Acquisition	(68.44 + 82)	232	34,901
• Training	(2238 + 164)	232	557,352
TOTAL	--	--	3,503,853

- Permanent Change of Station (PCS) - The NARM per capita factor of \$451 was multiplied by 232 enlisted to yield a total cost of \$104,632.
- Personnel Acquisition and Training
 - Acquisition - The NARM cost of recruiting and examining consists of a manpower factor (0.30 per LAMPS Mk III) and an O&M cost factor (\$4,000 per LAMPS Mk III). The total manpower cost was derived by dividing 0.30 by the NARM manpower factor for the LAMPS Mk III (48.79) and multiplying this by 232 enlisted which yields 1.4 personnel. When multiplied by the personnel cost factor of \$11,341 the total is \$15,877. The O&M cost is derived by dividing \$4,000 by 48.79 enlisted which gives a per capita cost of \$82. \$82 x 232 enlisted personnel is \$19,024. Thus, the sum total cost is \$34,901.
 - Individual Training - The NARM cost of training consists of a manpower factor (9.63 trainers per LAMPS Mk III) and an O&M factor of \$8,000 per LAMPS Mk III). The manpower cost is derived by dividing 9.63 by 48.79 (NARM factor for LAMPS Mk III) and multiplying by 232 enlisted which yields 45.79 trainers. When multiplied by \$11,341 the total is \$519,304. The O&M cost is derived by dividing \$8,000 by 48.79 enlisted which gives a per capita cost of \$164. When multiplied by 232 enlisted this yields \$38,048.
- Total Cost - The total cost using the Navy methodology is \$3,503,853 for a LAMPS Mk III operational squadron.

3. Comparison of Manpower Costs

Table IV-11 summarizes the comparison of the costs for each of cost elements of the MCR unit sustainment cost methodology and the Navy NARM methodology. Equivalent cost elements are compared from the two methodologies. Since the Navy does not include retirement costs in their methodology, it is added separately.

The comparative analysis of the two methodologies, as depicted in Table IV-11, follows:

- Adjusted Standard Rate (less bonus plus quarters) - This is approximately the same element as the pay

Table IV-11. COMPARISON OF ANNUAL LAMPS Mk III MANPOWER COSTS

Manpower Costs for One Operational Squadron

MCR METHODOLOGY		NAVY METHODOLOGY	
COST ELEMENT	COST (\$)	COST ELEMENT	COST (\$)
Adjusted Standard Rate (less bonuses)	2,314,862	Unit Mission Personnel	2,607,912
Quarters	481,863	---	---
Subtotal (Pay & Allowances)	2,876,727	Subtotal (Pay & Allowances)	2,607,912
Support	440,069	Miscellaneous O&M	118,784
---	---	Medical O&M	57,072
Subtotal	440,069	Subtotal	175,856
Recruitment	126,260	Acquisition	34,901
Training	401,336	Individual Training	337,959
Support	507,336	Subtotal	542,253
PCS	104,632	PCS	104,632
Enlistment Bonus & SRB	60,774	---	---
TOTAL	4,010,140	TOTAL	3,480,653
RETIREMENT*	721,611		
TOTAL	4,731,751		

The Navy does not calculate pay grade-specific pay and allowances. MCR has used pay grade-specific adjusted standard rates.

MCR has used a Navy average cost for the support cost.

The Navy does not use occupation-specific training costs. MCR has calculated occupation-specific training costs.

*MCR has used a Navy average cost for the support cost, but is in line with the MCR methodology. For the purposes of allowing a comparison between the two methodologies, Retirement has been included in the MCR calculation.

and allowances cost element (Navy methodology). However, it is computed by pay grade for the LAMPS Mk III organization. Hence, it would be expected to furnish a different, more precise, cost than the NARM average enlisted cost factor.

- Support - This cost equates to the miscellaneous O&M (Base Operating Support) and Medical O&M in the Navy methodology. The difference in cost is difficult to analyze as all the components are not apparent. It appears that the main cause of the difference is the NARM factors which are LAMPS-specific and based on expenditures whereas the MCR cost is based on a Navy average.
- Recruitment and Training (MCR methodology) - This compares with Acquisition and Individual Training (Navy methodology) and produces similar costs.
- Permanent Change of Station (PCS) - This cost is the same for both methodologies as the NARM cost has been used in both calculations.
- Enlistment Bonus and SRB - These costs are based on the bonuses awarded to specific ratings. The Navy methodology incorporates this in the unit mission personnel (pay and allowance) cost element.
- Total - Unit sustainment cost using MCR's methodology yields a cost for one operational squadron that is \$506,287 or 15% higher than that calculated using the Navy methodology. When retirement is included in MCR's methodology, the increase is \$1,227,303 or an additional 21% above the Navy costs.

4. Observations

Sustainment costs based on occupation- and pay grade-specific cost and loss factors yield higher cost estimates than those which omit these specific cost factors. A LAMPS Mk III Fleet Readiness Squadron (FRS) was also costed, in similar fashion to the operational squadron, using both methodologies. The MCR methodology (Tables IV-12 and IV-13) yielded a total cost of \$4,940,169, while the Navy methodology (Table IV-14) showed a cost of \$3,745,844, a difference of \$1,194,325. The manpower cost per aircraft for the operational squadron (15 aircraft) is \$363,935 using the MCR unit sustainment methodology and \$267,743 using the Navy methodology. The manpower

Table IV-12. ANNUAL LAMPS Mk III UNIT SUSTAINMENT MANPOWER COSTS BY PAY GRADE (FY80 \$)

Fleet Readiness Squadron

PAY GRADE	PAY AND ALLOWANCES(\$)				RETIEMENT (\$)	SUPPORT (\$)	RECRUITMENT (\$)	PCS (\$)	TOTAL (\$)	QUANTITY BY PAY GRADE**	TOTAL ANNUAL COST BY PAY GRADE (\$)
	ADJUSTED STANDARD RATE (+)	ENLISTMENT & REENLISTMENT BONUS ES(-)*	QUARTERS (+)	SUBTOTAL							
E-9	21,282	(357)	3,423	24,348	6,539	2,865	544	451	34,747	3	104,241
E-8	18,017	(357)	3,155	20,815	5,480	2,850	544	451	30,140	6	180,840
E-7	15,431	(357)	2,899	17,973	4,672	2,743	544	451	26,383	14	369,362
E-6	12,939	(357)	2,607	15,189	3,861	2,459	544	451	22,504	45	1,012,680
E-5	10,587	(357)	2,217	12,447	3,080	1,886	544	451	18,408	46	846,768
E-4	9,311	(357)	1,766	10,720	2,654	1,638	544	451	16,017	40	640,280
E-3	8,431	(357)	1,474	9,608	2,389	1,490	544	451	14,472	34	1,360,368
TOTAL										246	4,514,534

*An average enlistment and reenlistment bonus cost is incorporated in the Adjusted Standard Rate (ASR). This occupation-specific cost is deducted from the ASR and used in the occupation-specific cost calculations.

Table IV-13. ANNUAL LAMPS MK III UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION (FY80 \$)*
Fleet Readiness Squadron

Occupation Title	Occupation Code	Training Costs (\$)**	Loss Rate	Annual Training Costs (\$)	Quantity in Occupation	Total Annual Training Costs (\$)	Annual Bonus & SPI (\$)***	Total Annual Costs by Occupation (\$)
Aviation Machinist's Mate	AD	3,476	.30	1,043	25	26,075	---	26,075
Aviation Electrician's Mate	AE	4,779	.32	1,529	16	24,464	---	24,464
Aviation Storekeeper	AK	4,425	.33	1,460	5	7,300	---	7,300
Aviation Structural Mechanic (Safety Equipment)	AME	5,503	.27	1,486	2	2,972	---	2,972
Aviation Structural Mechanic (Hydraulics)	AMH	4,599	.29	1,334	14	18,676	---	18,676
Aviation Structural Mechanic (Structures)	AMS	5,190	.28	1,453	24	34,872	---	34,872
Aviation Ordnanceman	AO	5,129	.35	1,795	2	3,590	---	3,590
Aviation Electronics Technician	AT	12,106	.33	3,995	14	55,930	5,859	61,789
Aviation Anti-Submarine Warfare Operator	AW	7,563	.31	2,345	26	60,970	24,450	85,420
Aviation Anti-Submarine Warfare Technician	AX	12,633	.31	3,916	15	58,740	---	58,740
Aviation Maint. Administration- man	AZ	3,601	.32	1,152	12	13,824	---	13,824
Dispensing Clerk	DK	4,529	.34	1,540	---	---	---	---
Hospital Cook	HM	5,343	.32	1,763	---	---	---	---
Med. Management Specialist	MC	4,116	.40	1,644	---	---	---	---
Personnel Sgt.	PA	4,145	.34	1,411	7	9,807	1,367	11,174
Aviation Structural Electrician	ER	5,512	.32	1,764	4	7,060	---	7,060
Yeoman	Y	4,576	.37	1,693	11	18,603	---	18,603
Aviation Support Technician	AK/AT****	3,294	.31	1,021	50	51,050	---	51,050
Petty Officer	PO	---	---	---	3	---	---	---
					294	314,294	31,654	345,948

*Total annual costs by occupation include costs for training, maintenance, and other personnel.
 **Training costs are based on FY80 Training Resource Model data.
 ***Loss rates are based on FY80 Training Resource Model data.
 ****Occupation codes are indicated in parentheses. The loss rate for E-1 through E-3 has been used in these calculations.

Table IV-14. FLEET READINESS SQUADRON ANNUAL OPERATING AND SUPPORT
MANPOWER COSTS - NAVY METHODOLOGY (FY80 \$)

COST ELEMENT	COST FACTOR (\$)	MANPOWER FACTOR	COST (\$)
UNIT MISSION PERSONNEL	--	--	--
• Pay and Allowances	11,341	248	2,812,568
INDIRECT PERSONNEL SUPPORT:	--	--	--
• Miscellaneous O&M	512	248	126,976
• Medical O&M	246	248	61,008
• Permanent Change of Station	451	248	111,848
PERSONNEL ACQUISITION AND TRAINING	--	--	--
• Acquisition	(68.44 + 82)	248	37,630
• Training	(2238 + 164)	248	595,814
TOTAL	--	--	3,745,844

cost per aircraft for the FRS (also 13 aircraft) using the MCR unit sustainment methodology is \$380,013 and \$288,142 using the Navy methodology. The difference in per aircraft costs between the FRS and the operational squadron is mainly due to the FRS having 248 personnel - 12 more than an operational squadron. It should be noted that the Navy does not use separate factors for the FRS but assumes the same cost per aircraft. However, since there are only two FRS squadrons versus eight operational squadrons, the increased manpower cost is fairly small. The increase per aircraft overall is \$3,723 annually or about 1% of manpower cost per aircraft.

E. GLCM MANPOWER COSTS

The GLCM manpower cost has been estimated using two procedures: the MCR unit sustainment methodology and the assumed Air Force methodology. In both instances the GLCM was costed using manpower strength estimates developed by the Tactical Air Command (TAC) for a minimum manning of 75 enlisted personnel per GLCM flight. Table II-16 provides a computed average quantity and average pay grade level for each proposed GLCM AFSC based on the minimum manning of 75 personnel per flight. No officers have been costed.

The quantity value which has been used is computed for the average pay grades of E-4 and E-5 for a flight. Although only pay grades E-4 and E-5 are actually costed, MCR included data for enlisted pay grades E-3 through E-9. This data can be used to calculate costs for the projected actual pay grades if and when the actual grade/AFSC structure is unclassified. This average approach is only used to avoid classifying this report. Average quantities have been computed by distributing the squadron requirements for each AFSC equally among the flights that will compose the squadron. For example, if four 427X4s were assigned to a squadron consisting of four

flights, it is assumed that one 427X4 would be assigned to each flight.

1. GLCM Manpower Costs Using the MCR-Developed Unit Sustainment Manpower Cost Methodology

This cost has been developed using an anticipated GLCM flight of 75 enlisted personnel. The occupation- and pay grade-specific data and calculations are provided in two tables: "Annual GLCM Unit Sustainment Manpower Costs by Pay Grade," Table IV-15; and "Annual GLCM Unit Sustainment Manpower Costs by Occupation," Table IV-16.

a. Manpower Costs by Pay Grade

Table IV-15 arrays costs by pay grade. All costs are in FY80 dollars. For the GLCM flight currently planned only average grades are available, E-4 and E-5, although pay grades E-3 through E-9 are shown with appropriate cost entries. The cost categories listed on this table are explained below:

- Pay and Allowances:
 - Adjusted Standard Rate (ASR) - The Composite Standard Rate is adjusted to exclude certain costs such as quarters. This is taken from the "Average Cost Handbook."
 - Enlistment and Reenlistment Bonuses - These bonuses were included in the ASR as an average cost of equal value for all pay grades. They are deducted from the ASR so as to be used in precise occupation-specific cost calculated in Table IV-15.
 - Quarters - This is taken from the "Average Cost Handbook."
 - Subtotal - This is a subtotal of three costs: ASR minus average bonuses plus quarters.
- Retirement - This is taken from the "Average Cost Handbook" and is pay grade-specific.
- Support - This is taken from the "Average Cost Handbook" and is pay grade-specific

Table IV-15. ANNUAL GLCM UNIT SUSTAINMENT MANPOWER COSTS BY PAY GRADE (FY80 \$)

PAY GRADE	PAY AND ALLOWANCES(\$)				RETIREMENT (\$)	SUPPORT (\$)	RECRUITMENT (\$)	PCS (\$)	TOTAL (\$)	QUANTITY BY PAY GRADE**	TOTAL ANNUAL COST BY PAY GRADE (\$)
	ADJUSTED STAFFING RATE(+)	ENLISTMENT & REENLISTMENT COSTS-EE(-)	QUARTERS (+)	SUBTOTAL							
E-1	21,820	(88)	3,447	25,179	6,899	2,940	136	817	35,971	--	--
E-2	18,292	(88)	3,182	21,386	5,714	3,099	136	817	31,152	--	--
E-3	15,650	(88)	2,946	18,545	4,830	3,044	136	817	27,373	--	--
E-4	13,113	(88)	2,763	15,920	4,057	2,846	136	817	23,629	--	--
E-5	11,285	(88)	2,411	13,406	3,303	2,315	136	817	19,997	17	333,609
E-6	8,814	(88)	1,922	1,452	2,412	1,725	136	817	16,642	55	962,626
E-7	6,410	(88)	1,517	9,741	2,291	1,295	136	817	14,382	--	--
***										20	\$1,322,245

*M-15. The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table. The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table. The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table.

**The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table. The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table.

***The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table. The data are based on the 1979 data for the pay grade of the population. The actual personnel file data is provided in the table.

Table IV-16. ANNUAL GLCM UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION (FY80 \$)

Occupation Title	Occupation Code	Training Costs (\$)	Loss Rate	Annual Training Costs (\$)	Annual Enlistment Bonus (\$)	Annual SRB (\$)	Individual Annual Costs (\$)	Quantity in Occupation	Total Annual Costs by Occupation (\$)
Radio Relay Equipment Repairman	304X0	6,492	.200	1,298	---	1,450	2,748	4	10,932
Missile Systems Analyst	316X0	7,348	.200	1,470	---	725	2,195	8	17,560
Maintenance Analyst Specialist	391X0	7,022	.132	927	---	---	927	1	927
Maintenance Management Specialist	352X0	5,087	.111	565	---	---	565	1	565
Aerospace Ground Equipment Mechanic	423X5	4,967	.171	849	---	---	849	4	3,396
Metals Processing Specialist	427X4	4,993	.153	764	---	725	1,459	1	1,459
Mobile Electronic	443X0	3,812	.224	675	---	725	1,400	2	2,800
Munitions Systems Specialist	461X0	7,020	.174	1,221	---	---	1,221	2	2,442
Nuclear Weapons Specialist	463X0	3,404	.197	647	---	1,450	2,197	1	2,197
Vehicle Maintenance Analyst Specialist	472X4	5,267	.062	323	---	1,450	1,773	1	1,773
Refrigerant and Air Conditioning Specialist	545X0	4,427	.166	747	---	---	747	4	2,988
Inventory Management Specialist	645X0	3,849	.157	604	---	---	604	1	604
Administrative Management Specialist	702X0	4,277	.189	808	---	---	808	2	1,616
Security Specialist	811X0	9,265	.257	2,367	---	---	2,367	43	9,266
TOTAL								75	145,235

*SRB or SRB0 will be used but not both. MCP chose to use SRB0 as it is the higher cost AFSC.

- Recruitment - This is calculated by dividing the total cost for FY80 of Recruiting and Advertising by the total number of non-prior service (NPS) accessions. The cost of \$1,006 was multiplied by the unit sustainment recruitment factor (overall enlisted loss rate) of 0.135 to arrive at the annual cost per person of \$136.
- Permanent Change of Station (PCS) - The FY80 PCS cost per manyear provided in the Military Personnel, Air Force FY82 POM Average Manyear Costs has been used. This is the same as the cost used in the Air Force methodology.
- Total - This is the total of all costs by pay grade.
- Quantity by Pay Grade - This is the total of enlisted personnel for the GLCM projected minimum flight. The average pay grades were derived from preliminary AFSC/grade requirements aggregated on a squadron basis. The conversion process consisted of two steps. The first step involved determining an average quantity for each AFSC on a flight basis. The second step involved determining an average grade level for each AFSC. For instance, if the four 427X4s consisted of two E-6s and two E-4s, an average grade level of E-5 would then be designated for that AFSC. The per flight average quantity for AFSCs with average grade levels were summed resulting in an average quantity of 17 E-4s and 58 E-5s in a flight.
- Total Annual Cost by Pay Grade - These are the total pay grade-specific costs for a GLCM flight. Since an average grade structure of only E-4 and E-5 is used, there are no values for the other grade levels. The total manpower costs by pay grade for a GLCM flight is \$1,322,245.

b. Manpower Costs by Occupation

Table IV-16 arrays occupation-specific costs.

All costs are in FY80 dollars. The cost categories listed on this table are explained below:

- Occupation Title - AFSC titles are taken from AFP 173-13.
- Occupation Code - Occupation is specified by AFSC. The first three characters specify career field; the fourth is skill level (shown by an "X" as these are all for journeyman-level personnel who have finished

technical training); the fifth character is for the precise occupation within a career field.

- Training Costs - This is the variable cost of training a specific AFSC to the journeyman level. All training costs are taken from the June 1980 update to AFP 173-13 and are in FY80 dollars. The cost of recruitment, travel, and clothing (\$1,486) was deducted to avoid double counting.
- Loss Rate - The loss rates or unit sustainment training factors are occupation-specific and were computed based on projected losses in each occupation for FY81. The projected losses span the entire career field and are not pay grade-specific. The unit sustainment factors used in this cost calculation are listed on Table IV-3.
- Annual Training Cost - This cost is calculated by multiplying the annual loss rate for each occupation by its total training cost.
- Annual Enlistment Bonus - No enlistment bonuses are paid to the AFSCs listed.
- Annual SRB - The selective reenlistment bonus (SRB) costs for eligible AFSCs is computed by multiplying the unit sustainment SRB factor by the average SRB cost for a specific zone and multiple level. The unit sustainment SRB factor of 0.25 was used based on the average Air Force reenlistment period of four years.
- Individual Annual Costs - This is the total of the training and SRB annual costs.
- Quantity in Occupation - This is the quantity by AFSC for one GLCM flight based on TAC estimates for a minimum flight received from AF/MPP in October 1980.
- Total Annual Cost by Occupation - These are the total occupation-specific costs for a GLCM flight and are the product of the individual annual cost of each AFSC times the quantity of personnel in each AFSC. The total GLCM occupation-specific cost is \$148,235.

2. GLCM Manpower Costs Using the Air Force Methodology

The GLCM weapon system was costed using an assumed Air Force methodology. Cost elements pertinent to manpower are provided in Table III-4 (taken from AFP 173-13).

The following explanation addresses the cost categories on Table IV-17 and relates them to the Air Force Cost Element Structure. Sources of data are provided for each entry description. The Air Force methodology is an average cost approach and the values for each AFSC are identical except for specialty training.

- AFSC - These are the AFSCs found in the GLCM flight.
- Unit Mission Personnel Cost - A pay factor of \$11,685 is used for all AFSCs. This amount represents the pay and allowances for one enlisted manyear for FY80. This value represents a per capita share of the entire Air Force Military Personnel appropriation less PCS costs. This data has been provided by AF/ACB.
- Indirect Personnel Support:
 - Miscellaneous Operations and Maintenance (Misc. O&M) - The value is the FY80 miscellaneous O&M rate per manyear. This cost was provided by the Air Force Cost Analysis Division (AF/ACMC) as the one used in costing weapon systems. This is the Base Operations non-pay factor from AFP 173-13 for FY80.
 - Medical O&M Non-Pay - This cost is the FY80 O&M rate per manyear and was also provided by AF/ACMC. This is the medical non-pay factor from AFP 173-13 for FY80.
 - PCS - This value is the FY80 PCS cost per man-year and was provided by AF/ACB.
- Personnel Acquisition and Training:
 - Training Costs - This value is provided in AFP 173-13 as the variable cost per individual Air Force specialty. This amount includes acquisition cost, cost of formal training, and leave costs. The acquisition portion of this cost element includes Recruitment, Initial Clothing Issue, Accession, Travel and Recruit Training (including trainee pay and allowances). The formal training portion is composed of the cost per graduate from each formal training course which an individual attends in becoming qualified at the basic skill level for each AFSC.
 - Loss Rate - This is the average enlisted turnover factor (.135) used by the Air Force in the estimation of costs and is provided in AFP 173-13.

Table IV-17. GLCM ANNUAL OPERATING AND SUPPORT MANPOWER COSTS - AIR FORCE METHODOLOGY (FY80 \$)

AFSC	UNIT MISSION PERSONNEL COST(\$)	INDIRECT PERSONNEL SUPPORT			PERSONNEL ACQUISITION & TRAINING			SUB TOTAL	QUANTITY	TOTAL
		MISCELLAN- EOUS CBM(\$)	MEDICAL NON-PAY(\$)	PCS(\$)	TRAINING COSTS	LOSS RATE	COST (\$)			
304X0	11,685	963	201	817	7,978	.135	1,077	14,743	4	56,372
316X0	11,685	963	201	817	8,834	.135	1,193	14,859	8	118,872
391X0	11,685	963	201	817	8,508	.135	1,149	14,815	1	14,815
392X0	11,685	963	201	817	6,573	.135	887	14,553	1	14,553
423X5	11,685	963	201	817	6,453	.135	871	14,537	4	58,148
427X4	11,685	963	201	817	6,479	.135	875	14,541	1	14,541
443X0	11,685	963	201	817	4,498	.135	607	14,273	2	28,548
461X0	11,685	963	201	817	8,506	.135	1,148	14,814	2	29,629
463X0	11,685	963	201	817	4,990	.135	660	14,326	1	14,326
472X4	11,685	963	201	817	6,673	.135	904	14,570	1	14,570
545X0	11,685	963	201	817	5,423	.135	808	14,474	4	57,756
611X0	11,685	963	201	817	5,535	.135	747	14,413	1	14,413
612X0	11,685	963	201	817	5,741	.135	778	14,411	2	28,822
613X0	11,685	963	201	817	10,452	.135	1,410	15,076	48	118,140
TOTAL									75	1,116,436

- Cost - This is the product of the acquisition and training cost and the annual loss rate.
- Subtotal - This is the sum of the Unit Mission Personnel Cost, Indirect Personnel Support Costs, and Personnel Acquisition and Training Costs.
- Quantity - This is the quantity of each AFSC in a GLCM flight.
- Total - Each AFSC total cost represents the subtotal cost for each AFSC times the quantity for that AFSC. The overall total for the 75 enlisted personnel in a GLCM flight is \$1,110,432.

3. Comparison of Manpower Costs

Table IV-18 presents a comparison of the annual cost of a minimum GLCM flight of 75 enlisted personnel. The comparison is between the MCR-developed methodology and the Air Force methodology.

The cost elements used in both methods are essentially the same except that MCR's methodology includes costs for retirement and SRBs. In order to make a valid comparison, retirement cost and SRB cost are added separately.

The following paragraphs describe the entries on a cost category basis beginning at the top of Table IV-18:

- Pay and Allowances - MCR used E-4 and E-5 pay and allowance factors. The Air Force uses an overall enlisted pay and allowance factor.
- Support - This is an O&M cost; it is directly related to Miscellaneous O&M (which is base operating support) and Medical O&M.
- Recruitment and Training (MCR Methodology) - This compares with Acquisition and Specialty Training (Air Force methodology) which is approximately the same. The Air Force Recruitment cost includes initial clothing cost which may be included in the Unit Mission Personnel cost as well. The Air Force calculates Specialty Training costs by occupation; hence we used the AFP 173-13 costs. This includes the cost of Recruit Training, Initial Skill Training, and Skill Progression Training.

- Permanent Change of Station (PCS) - This cost is the same for both methodologies, since the Air Force cost was used for both.
- SRB - This cost is based on the Air Force's awarded specific SRBs. The Air Force methodology incorporates this in pay and allowances.
- Total - The MCR methodology shows an annual manpower cost for one GLCM flight that is \$134,797 higher than the costs computed using the Air Force methodology. When retirement costs are included, this difference is increased to \$354,044. This is primarily due to higher support and training costs using the MCR cost factors. The MCR SRB cost is included in the Air Force Unit Mission Personnel factor for pay and allowance cost. The Retirement cost is not included in Air Force costs.

4. Observations

The Air Force cost factors and precise approach to costing the GLCM currently have not been determined. The standard cost element structure will be followed. It appears that using the costs in AFP 173-13 with occupation-specific loss factors provides improved estimates. The Air Force average turnover factor of 13.5% is much lower than the factors for most GLCM occupations. The manpower costs produced using the MCR methodology were 11% higher than the manpower costs produced using the Air Force methodology. MCR used pay grade-specific costs whereas the Air Force used an average pay grade cost. The inclusion of retirement cost adds another 21%.

F. CONCLUSIONS

The following are the key conclusions reached as a result of comparing the unit sustainment costs to the results produced using the various Service methodologies:

- There are two major reasons why weapon system unit manpower costs developed using the unit sustainment manpower cost methodology are higher than the costs developed with the Service methodologies:
 - The use of occupation- and pay grade-specific costs rather than average costs; and
 - The inclusion of retirement costs, which is the single largest reason for differences between costs developed with the MCR methodology and those developed using the Service methodologies.
- In those cases where the Service methodologies use occupation- and pay grade-specific data, the estimates for that element are close to MCR's. However, the use of different factors or the inclusion of additional cost elements (e.g., bonus and retirement costs for the M-1 calculations) in the MCR methodology resulted in higher costs than Service estimates. Specifically:
 - The M-1 manpower costs, excluding bonus and retirement costs, were very close (within 1%). This is due to the Army derivation of precise occupation- and pay grade-specific costs for pay and allowances and personnel replacement (recruitment and training). However, the inclusion of retirement and bonus costs increased the total cost using the MCR methodology by 22%.
 - The LAMPS Mk III costs, excluding retirement, are 15% higher using the MCR methodology. This is due to the use of pay grade-specific, rather than average, pay and allowance and support data. The inclusion of retirement costs increased the estimate by 21%.
 - The GLCM manpower costs, excluding retirement, are 12% higher using the MCR methodology. This is due to the use of pay grade-specific, rather than average, support cost and pay and allowances as well as the use of occupation-specific, rather than Service-wide, loss rates to calculate annual training costs. The inclusion of retirement increased the estimate by 20%.

V. DISCUSSION OF THE UNIT MANPOWER LIFE CYCLE COST METHODOLOGY

This section presents:

- a description of the unit manpower life cycle cost methodology; and
- a demonstration of this methodology using LAMPS Mk III manpower requirements data.

A. DESCRIPTION OF THE UNIT MANPOWER LIFE CYCLE COST METHODOLOGY

The overall purpose of this study effort has been to develop a unit manpower life cycle cost methodology. As discussed briefly in Section III, this methodology is composed of two parts:

- The initial unit manpower cost methodology, developed in Phase I of this study, which is used to calculate the costs of initially acquiring the unit manpower; and
- The unit sustainment manpower cost methodology, developed in Phase II of this study, which is used to calculate the annual costs of the manpower required to operate and maintain the system in the unit. This methodology has been described in detail in Section III and demonstrated in Section IV.

In this section the relationship of these two methodologies is described and demonstrated using the manpower data for one LAMPS Mk III operational squadron.

The initial unit manpower cost methodology uses element structures similar to those used in the unit sustainment cost methodology. The primary difference is the cost element structure. The initial unit manpower cost elements contain only those elements identified with manpower acquisition costs. In calculating these one-time manpower costs, lump-sum, rather than amortized costs, are used for the four cost elements. Table V-1 shows the relationship of the cost elements for the two methodologies. The following is a brief definition of the cost elements for initial unit manpower.

Table V-1. UNIT MANPOWER LIFE CYCLE COST METHODOLOGY

INITIAL UNIT MANPOWER COST ELEMENTS (Manpower Acquisition Phase)		UNIT SUSTAINMENT MANPOWER COST ELEMENTS (Operating and Support Phase)	
		Recurring Acquisition Costs*	Annual Unit Sustainment Costs
● General Costs**		● General Costs**	● General Costs**
- Recruitment		- Recruitment	- Permanent Change of Station (PCS)
● Occupation-Specific Costs		● Occupation-Specific Costs	● Pay Grade-Specific Costs
- Enlistment Bonus		- Enlistment Bonus	- Pay and Allowances
- Selective Reenlistment Bonus (SRB)		- Selective Reenlistment Bonus (SRB)	- Retirement
- Training		- Training	- Support
			- Incentive and Special Pay (ISP - not included in demonstration)

* Amortized costs calculated using unit sustainment (personnel loss rate) factors.

These recur at intervals dependent on loss rates.

** Non-occupation or pay grade-specific costs.

Initial Unit Manpower Cost Elements:

- General Costs - a cost that is not occupation- or pay grade-specific. The one cost item is:
 - Personnel Recruitment - the cost of enlisted recruitment and/or officer acquisition. This cost is derived from FY80 budget data from the Five Year Defense Plan data of October 1980.
- Occupation-Specific Costs which include:
 - Enlistment Bonus - this is the cost of awarding enlistment bonuses to personnel enlisting in specific occupations experiencing recruiting problems. This is also a pay grade specific cost since only personnel in lower pay grades can qualify to receive enlistment bonuses. Bonuses are used as an inducement to personnel to enlist in particular occupations. Enlistment bonus data is obtained from the Services.
 - Selective Reenlistment Bonus (SRB) - this is the cost of awarding SRBs to personnel reenlisting in specific occupations experiencing personnel retention problems. This is also a pay grade-specific cost since only personnel in higher pay grades can qualify to receive SRBs. SRBs are used as an inducement to personnel to reenlist in certain occupations in order to retain a required level of experience. SRB data is obtained from the Services.
 - Training - this is the cost related to recruit, initial skill and skill progression training. In the case of the Navy, initial skill training costs have been used as a surrogate for the skill progression training costs. These costs are obtained from the Services.

B. DEMONSTRATION OF THE UNIT MANPOWER LIFE CYCLE COST METHODOLOGY

This demonstration combines Phase I and Phase II into a life cycle methodology. Calculation of unit manpower life cycle costs involves the use of both of these methodologies, applied to unit manpower requirements data. The initial unit manpower cost is a one-time cost, based on applying the lump-sum costs to all of the members of the unit. The unit sustainment cost is

developed for one year and must be multiplied by the number of years in the system's projected operating cycle in order to obtain the unit's total manpower operating and support (or unit sustainment) costs in constant dollars. This total is then added to the previously calculated initial unit manpower cost to produce the unit manpower life cycle cost (LCC) in constant dollars.

In order to demonstrate the LCC methodology, calculations have been made using data for one LAMPS Mk III operational squadron. Table V-2 shows the data used in calculating the initial unit manpower costs. Tables V-3 and V-4 (duplicates of those found in Section IV) show the unit sustainment cost calculations.

Based on these calculations, the projected life cycle cost for one LAMPS Mk III operational squadron is as follows:

	CONSTANT FY80 <u>\$ (000s)</u>
Annual Unit Sustainment Manpower Cost	
Pay Grade-Specific Costs (Table V-3)	4,268.7
Occupation-Specific Costs (Table V-4)	+ 462.5
	<u>\$ 4,731.2</u>
	x 20 (years)
Total Unit Sustainment Manpower Cost	<u>\$94,624.0</u>
Initial Unit Manpower Cost (Table V-2)	+ 2,407.4
LIFE CYCLE COST	<u>\$97,031.4</u>

The initial unit costs are minor compared to unit sustainment costs.

Table V-3. ANNUAL LAMPS MK III UNIT SUSTAINMENT MANPOWER COSTS BY PAY GRADE (FY80 \$)

LAMPS MK III Operational Squadron

PAY GRADE	PAY AND ALLOWANCES(\$)					RETIEMENT (\$)	SUPPORT (\$)	RECRUITMENT (\$)	PCS (\$)	TOTAL (\$)	QUANTITY BY PAY GRADE	TOTAL ANNUAL COST BY PAY GRADE (\$)
	ADJUSTED STANDARD RATE(+)	ENLISTMENT & REENLISTMENT COSTS(-)*	QUARTERS (+)	SUBTOTAL								
E-9	21,282	(357)	3,423	24,348	6,533	2,965	544	451	34,747	2	69,494	
E-8	18,017	(357)	3,155	20,815	5,493	2,950	544	451	30,343	4	12,156	
E-7	15,431	(357)	2,839	17,913	4,672	2,743	544	451	26,325	14	367,161	
E-6	12,339	(357)	2,537	15,119	3,961	2,459	544	451	21,534	31	647,604	
E-5	10,627	(357)	2,217	13,487	3,250	1,996	544	451	17,728	9	1,575,391	
E-4	9,311	(357)	1,766	10,720	2,654	1,638	544	451	16,013	76	1,217,305	
E-3	6,423	(357)	1,471	7,537	2,304	1,448	544	451	14,284	31	1,107,197	
TOTAL										215	5,522,145	

*Average enlistment and reenlistment rates are incorporated in the Adjusted Standard Rate (ASR). This is multiplied by the cost rate derived from the ASR and used in the calculation of initial cost rates shown.

Table V-4. ANNUAL LAMPS Mk III UNIT SUSTAINMENT MANPOWER COSTS BY OCCUPATION*
Lamps Mk III Operational Squadron

Occupation Title	Occupation Code	Training Costs (\$)**	Loss Rate	Annual Training Costs (\$)	Quantity in Occupation	Total Annual Training Costs (\$)	Annual Bonus & SRB (\$)***	Total Annual Costs by Occupation (\$)
Aviation Mechanist's Mate	AD	3,476	.30	1,043	31	32,333	---	32,333
Aviation Electrician's Mate	AE	4,779	.32	1,529	30	45,870	---	45,870
Aviation Storekeeper	AK	4,425	.33	1,460	8	11,680	---	11,680
Aviation Structural Mechanic (Safety Equipment)	AME	5,503	.27	1,486	1	1,486	---	1,486
Aviation Structural Mechanic (Hydraulics)	AMH	4,599	.29	1,334	15	20,010	---	20,010
Aviation Structural Mechanic (Structures)	AMS	5,190	.28	1,453	17	24,701	---	24,701
Aviation Ordnanceman	AO	5,129	.35	1,795	3	5,385	---	5,385
Aviation Electronics Technician	AT	12,106	.33	3,995	16	63,920	11,719	75,639
Aviation Anti-Submarine Warfare Operator	AW	7,563	.31	2,345	29	68,005	46,077	114,082
Aviation Anti-Submarine Warfare Technician	AX	12,633	.31	3,916	16	62,656	---	62,656
Aviation Maint. Administration-Mem	AZ	3,601	.32	1,152	8	9,216	---	9,216
Disarming Clerk	DE	4,502	.34	1,540	1	1,540	---	1,540
Hostilities Specialist	HM	5,343	.33	1,763	1	1,763	---	1,763
Miss Management Specialist	MO	4,110	.40	1,644	4	6,576	---	6,576
Personnel Clerk	PE	4,143	.34	1,411	5	7,055	651	7,706
Aviation Survival Equipmentman	SE	5,512	.32	1,764	2	3,528	---	3,528
Yeoman	YE	4,575	.37	1,692	8	13,536	---	13,536
Aviation Battery Operator	AGDA****	3,234	.31	1,011	??	22,400	---	22,400
Petty Officer	APG		---		7			
	PG		---		2			
					??	4,273		56,133

*...
 **...
 ***...
 ****...
 *****...
 The loss rate for E-1 through E-3 has been used in these calculations.

VI. APPLICATION OF MCR-DEVELOPED TOOLS

The recent direction in DoD management philosophy to decentralize policy execution and to shorten the acquisition process requires improved methods for DoD-wide performance evaluation and monitoring. Currently, the DSARC Milestone documentation in DoDI 5000.2 (dated 19 March 1980) requires submission of a document entitled the Integrated Program Summary (IPS). The IPS accompanies the Decision Coordinating Paper (DCP) and is used to explain weapon system resources (cost), manpower, and logistics requirements. Although the IPS requirements may change in the future, the necessity for assessing the impact of new weapon systems on Service manpower resources will remain.

This section presents a discussion of:

- DSARC manpower requirements
- Application of MCR methods
- Conclusions
- Recommendations

A. DSARC MANPOWER REQUIREMENTS

The specific requirements of each DSARC milestone, as currently defined in the IPS instructions, are summarized below.

At DSARC Milestone I:

- identify alternative manpower employment concepts for the weapon system and summarize manpower sensitivities to these alternative employment concepts; and
- identify parameters and innovative concepts to be analyzed and then presented at DSARC Milestone II.

At DSARC Milestone II:

- summarize projected requirements versus projected Service assets in critical career fields;
- identify new occupations which may be required;

- provide a summary by fiscal year and occupation of all formal training requirements for the proposed system, identifying numbers of personnel to be trained and training cost;
- identify the contractor support and depot workload requirements in terms of manhours per end item; and
- identify the net change in total force manpower associated with the proposed system in terms of active forces, reserve forces, and DoD civilians.

These DSARC Milestone II estimates are to be refined by DSARC Milestone III, and in addition, the following analyses are required:

- identify shortfalls in meeting requirements by occupation;
- assess the impact on system readiness of failure to obtain required personnel;
- identify new occupations not yet programmed into Service personnel and training systems; and
- summarize plans for attaining and maintaining the required proficiency of operating and support personnel.

The intention of the IPS analyses is to allow decision-makers the opportunity to evaluate the impact of new system requirements on projected resources and force structures. From the perspective of manpower requirements and costs, DSARC Milestone I is clearly an appropriate point to begin analysis and documentation of detailed manpower requirements and costs.

The impending changes in the acquisition process are intended to shorten the cycle and reduce costs. The improved DSARC review may streamline documentation as currently prescribed for the IPS; however, the need to address the crucial manpower impacts will remain.

B. APPLICATION OF MCR METHODS

OASD (MRA&L) developed the "Hardware-Manpower Balance" project in order to examine the relationship of hardware design, acquisition decisions, and manpower constraints. The tools developed by MCR during this project address two critical resources of weapon system acquisition: manpower and dollars. Manpower for weapon systems must be acquired, trained and sustained. Weapon system manpower costs are directly influenced by the type of manpower required by the system. This has been demonstrated by the high-cost/critical occupation definition and the unit manpower cost methodology developed and presented in this report.

The definition and cost methodology developed during this project have been tailored to provide a coordinated approach to analyzing the manpower impacts of system demands. As demonstrated in this report, much valuable information can be obtained by analyzing the detailed unit manpower requirements. The high-cost/critical occupation definition allows for the evaluation of occupation and pay grade requirements in terms of three primary characteristics:

- system mission essentiality,
- costs, and
- inventory status.

The unit manpower cost methodology permits the detailed analysis of occupation- and pay grade-specific costs for weapon systems in the context of the units in which they are deployed.

Benefits which would be derived from applying the occupation- and pay grade-specific definition and methodology are summarized below.

- Insights can be gained about potential manpower problems such as:
 - excessive requirements for highly experienced senior personnel

- requirements for occupations which are already experiencing inventory shortages; and
- requirements in mid-level pay grades which are already experiencing inventory shortages.
- System occupations with extremely specialized training requirements, and having limited potential for utilization on other systems, can be identified and examined.
- The requirement for occupations which require long training periods or are very expensive to develop, can be evaluated.
- The potential cost advantages of cross-training personnel experienced on similar systems can be examined.
- The broader impacts of the relationship of system design to occupation and pay grade requirements, and any alternative to these approaches can be analyzed.

C. CONCLUSIONS

The following conclusions have been reached based on the application of the high-cost/critical occupation definition and the unit manpower cost methodology to actual weapon system data.

- Based on the limited sample analyzed (one weapon system for each Service), it is not possible to determine if the kinds of relationships identified in these analyses are exceptions or the norm. Although we suspect they are the norm, however, application of the definition and cost methodology to a larger group of weapon systems would allow definitive conclusions to be made.
- It is necessary to examine the details of weapon system unit manpower requirements, since it is only through this process that the Services and OSD can identify exactly where potential problems exist. Evaluation of aggregated estimates makes this impossible and, frequently, obscures the fact that a problem exists.
- The utility of these tools is not only in the numbers they produce, but also in the examination of the detailed relationships among the various requirements and cost drivers.
- The analyses documented in this report indicate that each of the three weapon systems analyzed, by experience substantial personnel problems (inventory shortage,

readiness) due to the quantity and quality of high-cost/critical personnel they require. The true magnitude of these problems can only be determined following an analysis of total Service projected assets and demands.

D. RECOMMENDATIONS

In Sections II and IV of this report, the application of the high-cost/critical occupation definition and unit manpower cost methodology has been demonstrated using the data for one major weapon system from each Service. The next phase of analysis should expand the application of the definition and methodology to the broader context of projected Service manpower resources and force structures.

MCR recommends that the tools developed during the project be used by the ASD(MRA&L) to encourage the success of Service efforts in achieving hardware manpower balance. Specifically, we recommend that OASD(MRA&L) develop an approach which can be used to analyze weapon system manpower requirements as early as possible (DSARC I if strengths are available). The weapon system manpower requirements, analyzed in terms of the definition of high-cost/critical occupations, should be examined in light of Service inventory projections and problem areas identified. This analysis should examine first the unit mission personnel and then be expanded to include requirements above mission unit and below depot level. The use of this approach should achieve the benefits detailed in Subsection VI.B above. The results of analyses should be used to focus on alternative concepts for system manning. If the manning requirements cannot be changed (e.g., the occupation is mission essential), then a manpower acquisition strategy must be developed to ensure the availability of the required personnel. The approach will support analyses leading to decisions on manpower costs, hardware/manpower trade-offs or alternative manning concepts and manpower acquisition strategies.

APPENDIX A

REFERENCE SOURCES

APPENDIX A

Part 1. Interviews

<u>INDIVIDUAL</u>	<u>ORGANIZATION</u>	<u>ADDRESS</u>	<u>PHONE</u>
<u>OSD</u>			
MAJ Thomas May	PA&E (CA)	PNT 2D278	697-4311
<u>ARMY</u>			
MAJ Charles Calloway	DAPE-MPR	PNT 2B729	695-1463
Mr. Wayne Knox	DACA-CAW	PNT 2B685	697-3568
MAJ W.J. Marm	DAPE-MPR	PNT 2B725	695-7485
Mr. John Sincavage	DACA-CAC	PNT 2A680	695-6718
LTC K.R. Stuhlmuller	DAMO-RQR	PNT 2B543	697-5442
LTC Lanny Walker	MILPERCEN	HOFF I: 232	325-9770
LTC K.M. Woodbury	DAPE-MPE	PNT 2B745	695-4615
<u>NAVY</u>			
LCDR Richard DeJaegher	OP-112D	AA 1841	694-4974
LCDR Roger Hope	OP-136D	AA 2840	694-5512
Mr. Robert Houts	AIR-4105A	JP-2 448	692-7360
LT Paul Johnson	OP-135D	AA 2825	694-5445
Mr. James McCune	OP-136D	AA 1409	694-2035
LCDR J.J. Richardson	OP-135D	AA 2825	694-5445
<u>AIR FORCE</u>			
MAJ Richard Ely	AF/MP	PNT 5C469	695-4518
MAJ David Gallagher	AF/RDQB	PNT 5D327	694-3816
Ms. Arlene Gribben	AF/MPPPN	PNT 4E161	695-4066
CMS A.J. Kelly	HQS TAC		AV 432-2423
MAJ Jack Leonhardt	AF/MPPPN	PNT 4E161	697-6649
LTC Robert Owens	AF/ACM	PNT 4D212	697-0722
Mr. John Reece	AF/MPPPN	PNT 4E161	695-3434
MAJ Donald Sutton	AF/ACM	PNT 4D212	697-0791

APPENDIX A

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APPENDIX B

ADDITIONAL NAVY DATA

Table B-1. LAMPS Mk III ENLISTMENT BONUS AND SRB CALCULATIONS (FY80 \$)

OCCUPATION CODE	PAY GRADE	ENLISTMENT BONUS	ANNUAL ENLISTMENT BONUS	SELECTIVE REENLISTMENT BONUS		ANNUAL SRB	QUANTITY IN PAY GRADE	TOTAL ANNUAL BONUS AND SRB
				AWARD LEV. & ZONE	SRB			
AT	E-4	--	--	A-3	7,812	1,953	6	11,718
AW	E-4	--	--	A-4	10,416	2,604	13	33,852
	E-6	--	--	B-3	9,778	2,445	5	12,225
MS	E-4	1500	375	A-3	7,812	1,953	1	2,328
	E-6	--	--	B-2	6,518	1,630	--	--
DN	E-4	--	--	A-1	2,604	651	1	651
TOTAL								60,774

* Total Enlistment Bonus and SRB values have been divided by the Navy average reenlistment period of four years to obtain the annual cost.

Table B-2. LAMPS Mk III ENLISTMENT BONUS AND SRB CALCULATIONS (FY80 \$)

OCCUPATION CODE	PAY GRADE	ENLISTMENT BONUS	ANNUAL ENLISTMENT BONUS	SELECTIVE REENLISTMENT BONUS		ANNUAL SRB	QUANTITY IN PAY GRADE	TOTAL ANNUAL BONUS AND SRB
				AWARD LEV. & ZONE	SRB			
AT	E-4	--	--	A-3	7,812	1,953	3	5,859
AW	E-4	--	--	A-4	10,416	2,604	--	--
	E-6	--	--	B-3	9,778	2,445	10	24,450
MS	E-4	1500	375	A-3	7,812	1,953	--	--
	E-6	--	--	B-2	6,518	1,630	--	--
DN	E-4	--	--	A-1	2,604	651	2	1,302
TOTAL								31,611

*Total Enlistment Bonus and SRB values have been divided by the Navy average reenlistment period of four years to obtain the annual cost.

APPENDIX C

DEFINITIONS OF SERVICE
MANPOWER COST ELEMENTS

A. DEFINITIONS OF ARMY MANPOWER COST ELEMENTS:

3.011 Military Crew Pay and Allowances (P&A)

Includes basic pay, BAQ, BAS, theater pay, special pay; excludes P&A for operators of other equipment in the force unit such as trucks and switchboards. Employs average annual basic P&A per crewman and average annual theater cost per crewman. For the XM-1 no special pay was recognized. Enlistment bonuses are not included in calculating this cost. SRB (Selected Reenlistment Bonuses) are also not included.

3.012 Military Maintenance Pay and Allowances

The same inclusions/exclusions are applied as noted above for the crew. The same average factors are used except as they apply specifically to maintenance personnel.

3.013 Military Indirect Pay and Allowances

Same inclusions/exclusions as for crew. Personnel are charged in the ratio of direct personnel for the system to all direct personnel for all systems in the force.

3.014 Permanent Change of Station (PCS)

Includes PCS travel paid to and from overseas theater and within CONUS from MPA appropriation -- costs of all chargeable personnel in the force; excludes costs of personnel allocated to other systems in the force structure.

3.031 Depot Maintenance Labor

Includes military and civilian labor for vehicle and component overhauls and repairs -- direct and indirect labor costs; excludes materiel and transportation. A CBK per depot labor costs per overhaul is applied which is based on theater labor rates.

3.061 Personnel Replacement

Includes MPA, OMA, and other procurement costs for MOS training costs, accession costs, separation costs; excludes

enlistment/reenlistment bonuses, cost of replacing depot maintenance and medical support personnel, RTTC and SMA costs. Applies an average annual replacement cost per man factor to the total crew/maintenance/indirect military personnel per tank times an annual attrition rate.

3.062 Transients, Patients, Prisoners (TPP)

Includes TPP costs for crew, maintenance, and indirect personnel dedicated to the tank; excludes indirect personnel within a tracked vehicle battalion and DS/GS maintenance personnel for common support equipment. The AFPCO TPP factor is applied to cost of crew, maintenance, and indirect P&A.

3.063 Quarters, Maintenance and Utilities (QMU)

Includes cost for personnel living in government-owned quarters or annual OMA cost of installation operations in support of force units; excludes fixed installation costs. Applies average annual QMU cost per man for Europe and COMUS to total number of dedicated personnel per weapon.

3.064 Medical Support

Includes OMA variable cost for medical/dental for force unit (battalion); excludes cadets, retirees, medical overhead, non-recurring Army medical costs. Applies average annual per capita theater cost factor.

3.065 Other Indirect

Includes cost of Project Management Office, Product Improvement Office; theater costs for operation of schools for dependents; special transportation costs and costs of general supplies to force units which exist solely because of the system being costed, per capita costs of supply system, Army administration, Army personnel management, individual weapon (training) qualification, and recurring unit operations and recurring other procurements. Excludes non-recurring costs. An annual theater cost factor is used.

B. DEFINITIONS OF NAVY MANPOWER COST ELEMENTS.

1. Definitions of the NARM manpower cost elements are as follows:

- Direct Operating Manpower:
 - Officers Active Allowance - the average number of officers per aircraft in a squadron.
 - Enlisted Active Allowance - the average number of enlisted personnel per aircraft in a squadron.
 - NARM Officer Pay Factor - the aggregated composite standard pay rates for officers.
 - NARM Enlisted Pay Factor - the aggregated composite standard pay rates for enlisted personnel.
 - Officer MPN Weight Factor - the factor used to percentage the average pay up or down based on actual past MPN expenditures for officers within each program element.
 - Enlisted MPN Weight Factor - the factor used to percentage the average pay up or down based on actual past MPN expenditures for enlisted personnel within each program element.
 - Annual Air TAD - the total travel and daily expenses of all squadron personnel assigned to an aircraft in a particular series who perform temporary additional duty.

- Indirect Operating Manpower:
 - Base Operations Officers and Enlisted - the total number of officers and enlisted personnel to operate and maintain bases.
 - Recruiting and Examining Activities, Officers and Enlisted - the total annual number of officers and enlisted who serve in positions related to either recruiting or examining prospective Navy enlisted entrants who will operate a particular type of ship or aircraft.
 - Health Activities, Officers and Enlisted - the number of officer and enlisted medical staff members allocated for each ship or aircraft type. Includes the program elements labeled "Care in Defense Facilities" and "Other Health Activities."
 - Transients, Officer and Enlisted - the annual total man-years that personnel are assigned.

staff or support positions on board aircraft of a particular type, or from one station to another. Types of moves include the following:

- Accession moves
- Separation moves
- Training moves
- Operational moves
- Rotational moves
- Organized Unit moves

- Training, Officers and Enlisted - the number of man-years spent in training students who later serve as replacements for those separating from the Navy during the year. This factor also includes the number of staff who provide their training. Several types of training are involved as defined below.

- Readiness Training - an interim training period where personnel already in the Navy are given short refresher courses to familiarize them with an aircraft before being reassigned to one of the same type.
- Recruit Training - the period when all enlisted receive their initial training in boot camp.
- Officer Candidate Schools - provide training to potential Naval officers who are not Naval Academy or NROTC graduates.
- Professional Military Education - provides college-level instruction to officers on advance military topics.
- General Skill Training - a period of technical training undergone by officers and enlisted in a wide range of topics such as data processing, photography, and nuclear power.
- Other Professional Education - provides college-level instruction in non-military professional fields such as engineering.
- Education and Training, In-Service - covers all types of nonmilitary training for officers and enlisted either on board or at the Navy in Service facilities, or provided by the Navy in civilian institutions. This excludes those personnel involved in scholarship and subsidy programs.

- Other health support activities include training of officers and enlisted personnel in health training at various levels, including Service-sponsored health and dental training programs. These programs are designed to attract people to the service and to provide
- Fleet Support activities include training period when personnel from the Army and Navy are assigned to various courses and courses to train personnel in various fields on ships to which they have been assigned.
- Training Support activities include assistance to units in the form of training equipment. This includes training of flight training teams and maintenance extension courses.

- Personnel holding various grades of commission - the annual total number of personnel holding various grades of commission assigned to various types of aircraft type are in a "flight status" status.
- PCS - the total number of personnel assigned to staff of various types of ship or aircraft of various types.

- Operating Indirect O&M:

- Logistics, O&M - the total number of these Budget Activity 7 O&M activities that can be allocated back to particular ship or aircraft types.
- Base Operations support activities include for maintaining base operations of various ships or aircraft types.
- Training, O&M - the number of personnel and maintain training activities of various personnel to operate various types of ship or aircraft.
- Health Activities, O&M - the number of personnel to operate medical facilities of various types and enlisted assigned to various types of ship or aircraft.
- Recruiting activities include the annual cost to operate various types of recruit or examine groups of various types of entrants who were assigned to various types of aircraft type.

2. Definitions (by number) of the elements and items related to manpower costs are provided below.

● Deployed Unit Operations

1. Aircrew (Officer) - This element represents officer personnel who operate the squadron aircraft. Although all pilots are in the squadron, such as those in flight division or squadron staff positions, their primary duty is to be that of a pilot and their full cost is shown in this element.
2. Aircrew (Enlisted) - This element covers all paying enlisted personnel who perform as crewmembers for the aircraft.
3. Combat Command Staff - This element represents the pay of manpower necessary for management and supervision of squadron operations. Included in this element are:
 - the Air Wing Commander and his staff, allocated equally to each of the wing aircraft deployed on the carrier,
 - the squadron Administration department,
 - the squadron Operations department,
 - the squadron Executive and Executive Assistance Department,
 - the squadron Safety department,
 - the squadron Photo department, if any, and
 - any other personnel whose primary function places them in this element.
5. Other Deployed Manpower - This is the cost of all squadron personnel who are in support of administrative nature. It is essentially the remainder of the squadron personnel who are not costed in Elements 1. Aircrew (Officers), 2. Aircrew (Enlisted), 3. Combat Command Staff, or 7. Aircraft Maintenance Manpower.
6. Air Temporary Additional Manpower - This is the cost of travel, lodging, and incidental expenses incurred so that personnel can attend and receive training (usually maintenance-related).

- Below Depot Maintenance:

7. Aircraft Maintenance Manpower - This element consists of the cost of the manpower necessary to support the total preventive and corrective maintenance actions performed on the aircraft and its installed systems and equipment. This includes the squadron personnel who are assigned TAB to the Aircraft Maintenance Department.

- Installation Support:

10. Base Operating Support - This is the cost of base manpower and the operating supplies necessary to provide the base services which support the squadron.

- Depot Supply:

14. Depot Supply Operations - This is the cost of manpower and material necessary to buy, store, package, manage and control spares, spares and repair parts used in operations and maintaining aircraft, aircraft components and support equipment. When a new spare is introduced into the force, spare parts are procured to sustain operations. Spare parts are introduced into the supply system and resources are expended to manage, store, distribute, package and crate both the spares inventory and other common supply items which support aircraft system personnel.

15. Technical Support - This is the cost of a number of programs (usually managed centrally), which support aircraft operations. A partial list of these programs is given below:

- Contractor Engineering Technical Services (CETS)
- Navy Engineering Technical Service Unit
- Depot Rework of Aircraft Support Equipment (GSE)
- Installation and Distribution of Spare Parts
- Depot Rework of Aircraft Landing Gear
- Technical Publications Support
- NAVAIRSYSOM Repairable Control

- Personnel Support and Training

17. Individual Training - This is the cost of training personnel in training who will replace unit personnel, the training staff and training staff for recruit training in both combat and support units and navigator training, as well as the operation and maintenance of trainers and simulators by the Fleet Aviation Specialist Operational Training Detachments (FASOTRAs) and the Fleet Air Maintenance Training Detachments (FAMTDs). This element does not include any aspect of readiness training, which is costed as a separate squadron.
18. Health Care - Health care is the cost of medical personnel and materials needed to provide medical support to aircraft unit personnel and to base personnel who provide direct support to the aircraft.
19. Personnel Support - Personnel support is comprised of two parts. The first part consists of the costs incident to the permanent maintenance of station (PCS) of squadron and base support personnel, either individually or as an organized unit. The second portion is the cost of recruiting and examining activities, the cost of transient personnel, and the cost of prisoners.

C. DEFINITIONS OF AIR FORCE MANPOWER COST ELEMENTS

The definitions of the manpower cost categories are provided below. These are similar to those in the OASD cost development guide for aircraft operating and support. Note that when aircraft/aircrew is stated the term also applies to missile unit operators.

- Unit Mission Personnel - Consists of aircrew operators, maintenance, and other unit personnel. The Air Force uses an average cost for officers and for enlisted pay and allowances. The cost factors include most Military Personnel Costs other than PCS costs.
- Aircrew/operators - The cost of pay and allowances, for the full complement of crew members required to operate the aircraft, equipment of a discrete unit.

- Maintenance - The pay and allowances for personnel performing organizational maintenance, intermediate maintenance, or other maintenance on aircraft, ordnance or munitions. Does not include depot maintenance.
- Other Unit Personnel.
 - Unit Staff - The pay and allowances for personnel required for unit command, flying supervision, operations control, planning, scheduling, flight safety, aircrew quality control, and unit administration.
 - Security - The pay and allowances for system security personnel, including security forces and related administrative personnel. Duties performed include entry control, close and distant boundary support, and security alert teams.
 - Remaining Unit Personnel - The pay and allowances for other personnel assigned to deployed units. It includes unit (squadron) logistic, ground safety, and special mission personnel (e.g., photo developing and interpreting personnel for reconnaissance units).
- Installation Support Personnel - The personnel elements consist of those personnel not directly assigned to the unit, but are required for the unit to perform its mission in peacetime. Normally these people are assigned to the host organization at the installation and would not be required if the unit were moved elsewhere. The Air Force uses the same average cost factors as used for unit mission personnel costs. The number of support personnel is calculated as a percentage of unit mission personnel. The factors range from 15% to 18% of mission manpower depending on the command. The factor used for the Tactical Air Command is approximately 17%.
- Base Operating Support - The cost of personnel supporting the operation of the installation and the tenant organizations stationed there. These personnel are primarily involved in the functioning of command and control, services, security police (excluding flight security), and transportation. It also includes a portion of flight support personnel.

charged to mission elements, such as maintenance, finance, or personnel. Higher management, commander and operations staff are excluded.

- Real Property Maintenance (RPM) - The cost of personnel assigned to the maintenance and operation of real property facilities and related management and engineering support work and services.
- Medical - The cost of medical personnel needed to support the unit at its peacetime location.

- Indirect Personnel Support

- Miscellaneous Operations and Maintenance - Miscellaneous unit and personnel costs not accounted for by other cost elements. These costs are funded under the O&M appropriation. Included are the costs for TDY travel, utilities, purchased services, miscellaneous supplies and equipment. Also included is the cost of miscellaneous medical supply support for all personnel.
- Permanent Change of Station - The cost of permanent change of station moves.

- Personnel Acquisition and Training - The Air Force uses cost factors for acquisition and training:

- Acquisition cost factors include cost of recruitment and basic military training.
- Training costs are developed by the Air Training Command (ATC). ATC, in coordination with the production contractor, attempts to reduce the manpower loading factor based on life cycle in the determination of high skill training requirements. For GLCN, ATC will develop special training standards based on such factors as the user requirements, equipment to be used, length of courses, and the number of students to be trained.

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