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Cost Element Handbook for Estimating Active and Reserve Costs

John F. Schank, Susan J. Bodilly,
Michael G. Shanley

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Cost Element Handbook for Estimating Active and Reserve Costs

John F. Schank, Susan J. Bodilly,
Michael G. Shanley

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Prepared for the
Assistant Secretary of Defense
(Program Analysis and Evaluation)
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PREFACE

This report provides a reference handbook for cost analysts interested in estimating the various elements of costs associated with changes to the active and reserve force structure. It supports another report, *Estimating the Costs of Changes in the Active/Reserve Balance*, R-3748-FMP/PA&E/JCS, which provides a methodology for assessing the cost consequences of changes in the active/reserve force mix.

The research is part of a broader agenda of cost and resource analysis studies. In constructing the handbook, the authors built upon previously completed analyses of active and reserve unit costs. Results from the previous research are presented in *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, R-3210-RA, March 1986, and *Cost Analysis of Reserve Force Change: Non-Recurring Costs and Secondary Cost Effects*, R-3492-RA, May 1987. Three case-study applications of the methodology developed in R-3748-FMP/PA&E/JCS will be documented in a later report. A prototype system automating the methodology has been designed. Finally, the factors reported here may be improved upon as a result of a current RAND review of the methodologies used to develop all Department of Defense cost and resource factors.

The research was sponsored by the Assistant Secretary of Defense (Force Management and Personnel), the Assistant Secretary of Defense (Program Analysis and Evaluation), and the J-1 Directorate of the Joint Staff. The research was conducted by the Defense Manpower Research Center in RAND's National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense and the Joint Staff.



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SUMMARY

Cost analysts are dependent on the availability and accuracy of cost data to complete their work. This report provides a reference handbook of detailed information useful for estimating the various elements of cost associated with changes to the active and reserve force structure.¹ Its overall purpose is to help ensure that analysts consider all appropriate categories of cost in their work;² and that they use methods that are transparent, reproducible, and consistent across the Services and the active and reserve components.

Although the handbook contains a wealth of information useful for costing, it was not designed to exist by itself. Rather, this volume is intended to provide reference support for a separate methodology designed to properly set up and fully define active/reserve force structure problems. R-3748-FMP/PAE/JCS develops a structured, accounting approach to determining the resource implications of changes to the active/reserve mix. The cost guide presented here is aimed at completing the calculation of a full set of costs using that accounting structure.

The functions of the handbook presented are:

- First, to support the cost analyst in determining the resource consequences that accompany particular active/reserve decisions, once those decisions have been fully clarified using the methodology in the companion research document (R-3748-FMP/PAE/JCS).
- Second, to show how those resource changes can be mapped into individual elements of cost while ensuring that all appropriate elements of cost are included.
- Third, to support the analyst in calculating those individual elements of cost and in building the total cost of a decision from their aggregation.

¹The "costs" referred to are peacetime economic costs, regardless of how those costs are reflected in budgets. The "changes" referred to are assumed to be small in terms of the overall force structure—ones that do not significantly affect resource prices or the cost of overhead functions.

²Appropriate categories in the context of active/reserve decisionmaking fall in the areas of investment costs and operating and support costs. Inappropriate categories, not included in this report, are in the areas of research and development and the procurement of major weapon systems. Because such costs are typically not a factor in active/reserve force mix decisions, they are considered "sunk" (irrelevant) for purposes of the costing problem.

To fulfill its purposes, the handbook considers each of the various cost elements and resource factors on separate "data sheets." Each data sheet contains the following information:

- The **Title** places the data sheet in the larger context. It indicates whether the data sheet describes a "resource factor" or "cost element," refers to personnel- or equipment-related costs, and pertains to recurring or nonrecurring aspects of cost. The title also notes the Service(s) to which the description applies.
- Immediately below the title, the **Definition** section provides a clear and concise definition of the cost element or resource factor. Further, it differentiates the item from closely associated ones, referring the reader to other appropriate sections.
- The **Estimating equation(s)** shows how the different elements of cost can be calculated at varying **Levels of detail**, given the most commonly available **Data sources** and **References**. In most cases, the cost elements can be estimated by multiplying a "resource factor" (e.g., number of personnel, pieces of equipment, and peacetime activity levels) by a "cost factor" (i.e., cost per resource factor).
- The **Variations** section indicates situations in which multiple equations may be required, perhaps because of differences in cost factors by component or by type of personnel.

Taken together, the information embedded in the cost element data sheets describes a generic cost model for computing the changes in cost associated with a change in the active/reserve force structure.

Cost elements are separated into personnel-related costs and equipment-related costs. Nonrecurring (investment) and annual recurring (O&S) elements of cost are distinguished. In addition, selected resource factors are included, providing additional support for the calculation of cost elements. Finally, because of unique Service differences, the equipment cost element section is further subdivided into Air Force and Navy aviation units, Navy Ships, and Army sections.

In addition to the data sheets themselves, this handbook provides additional guidance and direction to the cost analyst. To provide an overview and context for the basic methodology, the underlying cost model that generated the detailed data sheets is separately presented and discussed, as is the mapping of resource changes into the cost element structure. Background texts on a variety of subjects provide guidance in specific cost areas, as, for example, on how the Services differ in their definition of "unit" and in their provision of equipment maintenance and support services to those units. Finally, more general

cost issues and principles are discussed, including the appropriateness of the average cost factors described in this handbook and methods that might be used in developing cost and resource factors under uncertainty. These discussions should prove especially appropriate for novice cost analysts.

As with any handbook, ensuring its continued usefulness requires keeping the information it contains current. The Services are continuously refining and updating the data collection and reporting systems relevant to active/reserve costing efforts. Therefore, cost analysts should update and annotate the following pages as new sources and data become available.

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I. INTRODUCTION

PURPOSE AND CONTEXT

Cost analysts are dependent on the availability and accuracy of cost data to complete their work. This report provides a handbook of detailed information useful for estimating the various elements of cost associated with changes to the active and reserve force structure.¹ Its primary purpose is to help ensure that analysts consider all appropriate categories of cost in their work; and that they use methods that are transparent, reproducible, and consistent across the Services and the active and reserve components.

Before using this reference, problems must be defined. At a minimum, cost analysts must have identified (1) one or more feasible solutions to a problem; (2) the units that would be affected, either directly or indirectly, by those alternatives; and (3) the implications of the proposed changes on each affected unit's personnel, equipment, and peacetime operations.

Assistance in fully defining problems is provided by a companion research report. R-3748-FMP/PAE/JCS develops and presents a structured, accounting approach to determining the resource implications of active/reserve force structure changes, and shows how those results can be mapped into the individual elements of cost presented in this volume.

APPROACH

The general approach of this handbook is to provide a well-defined, detailed, and complete list of individual elements of cost that can contribute to the total cost of force structure decisions. With this information, cost analysts can build the total cost of a decision from the aggregation of appropriate individual elements of cost.

¹Additional detail on elements of cost relating to active and civilian manpower is provided in Adele Palmer and David Osbaldeston, *Incremental Costs of Military and Civilian Manpower in the Military Services*, The RAND Corporation, N-2677-FMP, July 1988.

Scope

The design of this handbook and the definition of cost elements have been completed using the following assumptions:

Peacetime costs—The cost estimates of interest are assumed to be those incurred during peacetime operations.

Economic costs—The costs described in this manual refer to appropriate economic costs, regardless of how they may be funded or reflected in budgets. Thus, for example, even though all the procurement of major equipment and the operations of training schools are reflected in active budgets, an appropriate share of such costs must be allocated to reserve units when performing analyses involving the reserve forces.

Average cost factors—References in this manual are to average cost factors. In situations when average costs do not apply and when using them significantly distorts outcomes, other cost factors and data sources will have to be developed. This issue is discussed further later in this section.

A portion of life-cycle costs—In the context of the life cycle of major weapon systems, this manual describes operation and support (O&S) costs and some items of nonrecurring costs such as initial personnel acquisition and training costs and construction costs. Research and development costs and disposal costs are not covered in this report because they are not normally a significant factor in active/reserve force mix decisions. For the same reason, this report does not deal with the procurement cost of major weapon systems.²

Small force structure changes—This manual supports the costing of relatively small changes to the overall force structure, changes that do not significantly affect resource prices or the cost of overhead functions. Overhead functions include the overall administration of the force or component, the fixed, common use portions of base operating support (termed the base opening package), and the fixed costs of school training or higher level, centralized maintenance organizations, such as depots. Including the cost of these functions would require research outside the scope of this report.

Limited time dimension—This manual distinguishes between two types of costs: (1) nonrecurring investment costs that occur once, usually at the beginning of a change, and (2) recurring operating and support costs that occur annually after a change has been implemented. It does not deal with cost dynamics or other elements of time that can arise in cost analyses, such as the present value of future

²Cost sheets are included for procurement costs, but they do not list details, only general comments and sources of data.

costs, expected inflation factors, the expected life cycles of weapon systems, the timing of investment (nonrecurring cost) expenditures, or the pattern of recurring costs in the transition period to the steady state.

Cost Element Structure

Table 1.1 presents a highly aggregated version of the complete cost element structure presented in this volume. It distinguishes among five types of nonrecurring investment costs and eight types of recurring operating and support costs. Although the generic cost structure of Table 1.1 applies to all four Services, the more detailed versions that would typically be used in actual cost studies differ across the Services in the equipment area. Appendix B provides a more detailed list of cost elements, and shows how the structure varies by Service.

Table 1.1

GENERAL COST ELEMENT STRUCTURE

Nonrecurring costs
Personnel acquisition
Personnel training
Equipment procurement
Construction
Other ^a
Operating and Support costs
Personnel
Military pay and allowances
Civilian pay and allowances
Replacement acquisition and training costs
Support-related costs
Equipment
Consumables
Sustaining investment
Depot maintenance
Other

^aCan include the cost of overhead functions (although the calculation of those costs is not supported in this report). Examples might include the costs of opening a new base or closing an existing base, or requiring a major product line maintenance addition in a depot.

Data Sheets

In the third and fourth sections of this report, each of the various personnel and equipment cost elements and resource factors receives consideration on separate data sheets (composed of one or more pages). The separate data sheets for each element of cost are organized as summarized in Table 1.2.

Estimating Equations

An important part of the description of individual cost elements is an equation for computing cost elements in specific situations. Most of the cost elements can be estimated by associating "cost factors" with "resource factors." Expressed as a general equation,

$$\text{Cost element} = \text{cost factor} \times \text{resource factor} \quad (1)$$

the "resource factors" represent characteristics of a change that have the greatest effect on cost. Most often, they include the number and types of personnel, pieces of equipment, and peacetime activity levels of the equipment involved with a particular change. Whereas most military units have preprogrammed values for resources factors (e.g., as

Table 1.2

CONTENTS OF DATA SHEETS

Title—title of the resource factor or element of cost.

Definition—provides a clear and concise definition.

Variances—describes major dimensions by which the cost element can vary, including by Service and component.

Estimating equations—lists commonly used cost estimating equation(s) appropriate for the element of cost.^a

Level of detail—lists the minimum number of dimensions (variances) that should be considered in the costing of particular changes.^b

Data sources and offices—lists the offices, published documents, and data bases that supply information on the cost element, factor, or variable.

References—lists the references commonly used to develop costs.^b

^aEquations are generic and assume the cost analyst will supply parameters or calculate them using the data sources, offices, and references listed under other headings on the data sheet.

^bCompleted for personnel only.

in an Army Table of Organization and Equipment [TO&E]), the amount that is properly associated with a given force structure change often depends on the details of that problem, requiring input from the analyst. Support for determining appropriate values for resource factors is provided by the companion research report, R-3748-FMP/PAE/JCS.

"Cost factors" are dollar amounts for individual elements of cost, expressed in terms of resource factors; that is, they are average costs per person, per piece of equipment, or per operating measure of that equipment. Many cost factors are typically associated with any given cost element, reflecting a variety of personnel and equipment types that themselves have differing factors. However, in the context of force structure changes, cost factor values tend to be more generic than resource factor variables, in the sense that they do not often depend (as do resource factors) on the details of particular problems. Rather, they might be viewed as relatively fixed parameters in a cost model that computes the total cost of a given force structure change.³

The values of "cost factors" can often be derived from published data sources on total costs and resources. For instance, the "Budget Justifications" produced annually by each of the Services have figures on the total budgeted amounts for various types of personnel, and the numbers of personnel to which the figures apply. Dividing total costs by total resources yields average cost factors; for example, the average cost per Navy officer.

In a few cases, cost elements cannot be estimated using simple linear equations (of the form in Eq. (1) above), often because the correct amount is highly dependent on the specifics of unit basing. For example, the amount of nonrecurring equipment or construction costs involved in a decision is highly dependent on the specific type of change and the characteristics surrounding the change. As such, general cost estimating relationships are difficult to develop for those items.⁴ Support is provided here by listing the most likely sources of information and places of contact available to the analyst.

³However, the appropriateness of cost factor values for the problem at hand also has to be addressed. See discussion of "average cost factors" later in this section.

⁴This was one of the conclusions of J. Schank, S. J. Bodilly, and A. A. Barbour in *Cost Analysis of Reserve Force Change: Non-Recurring Costs and Secondary Cost Effects*, The RAND Corporation, R-3492-RA, May 1987.

CONTENTS

The remainder of this report provides a detailed description of the cost elements and resource factors that are relevant to active/reserve force mix problems in the Air Force, Army, and Navy. It is divided into three main sections, one devoted to the cost model and issues, a second to personnel-related cost elements and factors, and the third directed toward equipment-related cost elements and factors. The latter two sections begin with a discussion of general costing principles relevant to those areas, followed by separate sheets for each cost element and resource factor. Nonrecurring (investment) and annual recurring (O&S) elements of cost are distinguished in each section. In addition, because of unique Service differences, the equipment cost element section is further subdivided into Air Force, Army, and Navy sections. For convenience, a detailed index of the location of the data sheets for each of the factors and elements is provided in App. B.

Ensuring the usefulness of the handbook requires keeping the information it contains current. The Services are continuously refining and updating the data collection and reporting systems relevant to active/reserve costing efforts. Therefore, cost analysts should update and annotate the following pages as new sources and data become available.

II. COST MODEL AND COST ISSUES

Embedded in the cost element data sheets of this handbook is the outline of a generic cost model for computing changes in the active/reserve force structure. We next summarize that model to increase its visibility and usefulness to cost analysts.

THE COST MODEL

The model has been built on the premise that the resource implications of any given change will drive the cost of that change. Much of the description on the data sheets is devoted to detailing which resource factors are important to each element of cost. The important resource factors in active/reserve decisions can be grouped under six major headings called "cost driving factors." They are:

- Changes in manning quantity
- Changes in manning type
- Changes in equipment quantity
- Changes in equipment type
- Changes in unit basing
- Changes in unit operating tempo

"Manning type" can apply to a multitude of personnel characteristics, including component, skill, rank, grade, occupation, air and sea rating, and so forth. "Basing" can refer to any characteristic of unit location that affects cost. It can concern aspects of the land or the facilities it provides, local economic conditions, or the number of prior Service personnel available. The "unit operating tempo" can point to the usage rate of the equipment or to other peacetime operations of the unit.

The data sheets detail the importance of the cost drivers to particular cost elements in the following way: The "estimating equation" (when present) lists the resource factor that has the greatest influence on cost; thus, it represents the major cost driver for that element of cost. In addition, the "variances" section lists additional cost driving factors that may be important in particular situations.

For example, since the estimating equation under "composite military pay and allowances" (see data sheet in next section) uses the equation, "(Average pay/year) × (Number of personnel)," "manning

quantity" is the major cost driver. In addition, since the "variances" section states that pay can vary by component, rank, and possibly flight or sea rating, "manning type" is also a potentially important cost driver. Thus, to calculate the cost element "military pay and allowances," the analyst would have to divide personnel into the types appropriate to the problem at hand (e.g., perhaps officer vs. enlisted and reserve vs. active forces), develop an equation suited for each type, then sum over the types to obtain the total.

Table 2.1 shows the details of how the cost drivers (listed across the top) and cost elements (listed down the side) are interrelated. In each row the "X" refers to the major cost driver for the element, as indicated by the "estimating equation" of that element's data sheet. Resource implications in those areas must be fully spelled out before a cost figure for that element can be calculated. The "+" in the table refers to other important cost drivers listed under the "variances" or "level of detail" sections of the data sheet. It dictates the need, in some instances, for additional calculations to compute total cost.

To understand how the table is read, consider the first row under personnel O&S costs, "Military pay and allowances" (Table 2.1). An X appears under "Manning amount," because (as discussed above) that variable is used in the estimating equation. An X also appears under "Manning type,"¹ because proper costing would nearly always demand a distinction between officers and enlisted personnel, and between part-time and full-time personnel. In contrast, a + appears under "Operating tempo," because that variable is only occasionally important to the determination of pay. For example, a high operating tempo can sometimes involve additional special pays or additional drill days for reservists (see discussion in next section on the data sheet "special pay and bonuses"), or a greater proportion of full-time personnel in maintenance and support areas. Moreover, basing also receives a + because location can *sometimes* be an important factor in manning levels. For example, in Air Reserve units the number of support personnel can vary dramatically by base location.²

In practice, Table 2.1 can work as a planning tool for cost analysts when addressing problems. Having determined (even in a qualitative way) which of the cost driving (resource) factors are important in a

¹Occupation and grade may also be important in some problem definitions.

²In reading across a row, an entry (X or +) assumes the factor is directly, rather than only indirectly, important. For example, even though the cost element "military pay and allowances" does depend on the amount and type of equipment in the unit, the table does not acknowledge it because the relationship is only indirect. It is personnel factors that directly drive pay and allowances. The fact that the personnel factors are, in turn, driven by equipment factors is redundant for purposes of this table.

Table 2.1

MAPPING RESOURCE CHANGES INTO THE COST ELEMENT STRUCTURE

Cost Element	Cost Driving (Resource) Factors ^a					
	Operating Tempo	Manning		Equipment		Basing
		Amount	Type	Amount	Type	
Nonrecurring costs						
Personnel acquisition		X	X			X
Personnel training ^b		X	X			X
Equipment procurement ^b				X	X	+
Construction ^b		+	+	+	+	+
Operating and Support costs						
Personnel						
Military pay and allowances ^b	+	X	X			+
Civilian pay and allowances ^b	+	X	X			+
Replacement acquisition and training ^b		X	X			X
Support-related costs	+	X	+	+	+	+
Equipment costs						
Air Force and Navy aviation units						
Petroleum, oil, lubricants (POL)	X		+	X	X	
Training munitions		X	X	X	X	
Maintenance material	X			X	X	
Replenishment spares	X			X	X	
Depot maintenance	X			X	X	
Replacement support equipment				X	X	
Modifications				X	X	
Other		+	+	+	+	
Navy ship units						
Petroleum, oil, lubricants (POL)	X		+		X	
Training munitions					X	
Repair parts					X	
Supplies		X	X		X	
Intermediate level maintenance			X		X	
Depot maintenance					X	
Utilities	X		+		X	
Army units						
Petroleum, oil, lubricants (POL)	X			X	X	
Training munitions		X	X	X	X	
Maintenance material	+			X	X	
Replenishment spares	+			X	X	
Depot maintenance	+			X	X	
Higher level maintenance	+		+	X	X	
Other	+	+	+	+	+	+

SOURCE: Data sheets in Secs. III & IV of this report.

NOTES:

X: Major cost driver required for the estimation of the cost element.

+: Potentially important cost driver, required for the estimation of the cost element in some cases.

^aSee text for definition of terms.^bAlthough summarized here under a single cost element, the entry refers to multiple data sheets in the text.

given situation, the cost analyst can use the table to begin the design of a tailored cost model. The analyst begins by reading down the relevant columns,³ circling all Xs and those +s that potentially apply to the situation at hand.⁴ With that information, the analyst is prepared to determine the detailed resource implications of the problem, and to use the information on the appropriate cost element data sheets to tackle the details of the cost estimation process.

There are a number of costing issues and principles that arise in the context of active/reserve force mix analyses. They concern the determination of appropriate values for cost and resource factors, the differences between the Services and components, and fixed overhead costs. These and other issues are addressed in more detail in Secs. III and IV.

APPROPRIATENESS OF "AVERAGE" COST FACTORS

Average costing for typical, or notional, units is implicit in the description of the majority of the cost elements in this handbook. Average cost factors can be computed by dividing total costs by total resources—for example, total personnel costs divided by the total number of personnel.

Once average cost factors have been computed, they can be employed in the context of particular problems by applying them to appropriate resource factors (see Eq. (1)). For instance, an average cost per person for training may be used with the number of people requiring training, specific to the change under consideration. Similarly, average equipment-related costs can be used with specific types of units and pieces of equipment involved in a particular change.

The use of average cost factors is often satisfactory for costing changes to the active/reserve force mix—but not always. One context

³Reading down the columns helps explain the term "cost driving factor" as a resource factor with a far-reaching effect on cost. For example, in the third column, the table shows that the cost driver "manning amount" affects not only personnel cost elements, but also nonrecurring and equipment cost elements.

⁴The analyst may also add cost factors to address unique characteristics of a problem that cannot be captured in a generic cost model. For example, note that in the generic model the cost element "Replacement acquisition and training costs" is not affected by the operating tempo of the unit (see Table 2.1, first column). However, in some situations there might be a relationship. To cite one instance, the issue came up in a study of the possible effects of converting active C-141 units to the reserves (A. A. Barbour, *Cost Implications of Transferring Strategic Airlift C-141s to the Air Reserve Forces*, The RAND Corporation, N-2252-AF, February 1985). One possible effect of multiple conversions would be to increase the flying hour program of the remaining active units. A hypothesis of the study was that the substantially higher workload could affect retention rates in those active units. Thus, costing that situation would require recognizing a relationship between operating tempo and replacement acquisition and training costs.

in which average cost factors fail to suffice is when large modifications of the current force structure are contemplated. If the change being considered, by itself, can cause major changes in the existing cost structure, then the use of average or typical cost factors will no longer produce unbiased results. In those cases, additional analysis or modeling will be required to estimate appropriate marginal cost factors.

A second context in which average cost factors fail to provide reliable information is when incremental costs (those that would be paid for additional resources) are significantly different from the average. For example, the average cost of additional military personnel would include an amount for retirement benefits, based on the historical probabilities that personnel will remain in the force until retirement eligibility. However, some force mix alternatives could involve changes in personnel when those retirement probabilities do not apply. In those cases, the incremental cost for personnel would differ from the average cost.

A third reason for questioning the validity of simple average cost factors is the variance around that average. For example, some factors—like the price of petroleum products or the level of acquisition and training turnovers—may fluctuate considerably from year to year. In those cases, it may be advisable to use the average weighted over several years, rather than the simple one-year average. In that way, the large variance associated with the factor can be reduced or “smoothed” out.

Finally, average cost factors may be inadequate in cases when site-specific information critically affects outcomes. Average cost factors are often designed to apply force-wide, smoothing out the variances that can occur at specific locations or under specific conditions (POL costs per flying hour provide a good example). However, if location-specific cost factors are available, and are different enough from the average factors to affect the conclusions of the analysis, then the additional information should be incorporated.

In practice, average or planning cost factors are often readily available from published data. In those situations, the analyst is faced with the choice of using those numbers as is, or investing additional time and money into verification or the development of new, more appropriate, factors. In making that choice, analysts should be careful to weigh the expected benefits against the increased costs. Cost factors that appear substantially correct expressed as an average, or that play only a minor role in distinguishing between problem alternatives, do not merit extensive additional examination.

DETERMINING VALUES FOR RESOURCE FACTORS

An important part of active/reserve cost analyses is the determination of values for resource factors (e.g., personnel and equipment levels) that fit the particular change being costed. For some types of changes, at least a part of this task will be straightforward. For example, when adding or subtracting standard military units (the unit may be an aircraft squadron or wing, a ship, or an Army company, battalion, or division), existing Service documents will define for the analyst the appropriate personnel and equipment composition associated with those units.

For most analyses, however, it is the determination of appropriate resource factors that constitutes the challenge of the costing effort. For example, even for problems when standardized Service documents apply, the analyst may have to choose among three measures of unit personnel and equipment—requirements, authorizations, and actual assignments. *Requirements* are the levels judged to be necessary to perform the stated missions and objectives of the unit. *Authorizations*, somewhat less than requirements, are the levels that the unit may possess in light of various personnel and equipment constraints (e.g., legislative personnel ceilings and budget limitations). *Assignments*, the actual number of personnel serving at the unit, can differ from authorizations for a variety of other reasons (e.g., localized budget limitations, recruiting shortfalls, or personnel skill deficiencies). In determining the resource factors to be used in the analysis, the analyst should adopt a consistent set of measures whenever possible, and carefully document any deviations from that rule.⁵

In addition, generic resource factors often do not apply when estimating the resource implications of a change. Unlike the cost factors (discussed above), the calculation of resource factors is usually specific to individual problems. In some cases, the analyst may have to complete considerable research to arrive at reasonable resource values.

One reason for the uniqueness of resource factors is that many force structure problems involve changes to existing units, rather than simply adding or subtracting units. The analyst must then be concerned with the differences in resource levels between the “old” and the “new” units, differences for which there are no programmed values and that can vary considerably on a case-by-case basis. For example, the modernization of an existing unit can necessitate a large number of case-specific questions regarding the sharing of equipment and the required training of personnel.

⁵In App. A, we give sources for both requirements and authorizations. Assignments or equipment usage may also be available, especially from specific units in the force.

Finally, appropriate values for resource factors can be difficult to determine because the analyst must look beyond the unit to gauge the full effect of a change on the total force. Often, changes in one unit can affect the functions and resources of others, requiring a careful look at the implications of a proposed change. In other cases, force-wide models (that address how units interact) may also be necessary to determine the total force impact on resources.⁶ In either case, supporting the documentation of the resource implications of an active/reserve force structure change is the subject of a companion research report, R-3748-FMP/PAE/JCS.

SERVICE AND COMPONENT DIFFERENCES

The military Services organize units and provide support functions in different ways. Of particular importance to force mix problems are the Service approaches to providing equipment maintenance and general base and unit support functions (e.g., mess, laundry, supply, transportation, and general personnel support and administration). Similarly, among the Services there are also policy differences between the active and reserve components, in, for example, unit organization and structure, maintenance and logistics support of equipment, and personnel acquisition and training.

To maintain consistency when comparing alternatives involving different Services or components, and to ensure the completeness of the cost estimates, it is necessary to understand the differences. Explanations are provided in this manual in two places. First, the next two sections give the different personnel and equipment organizational and support philosophies of the Services and components. Second, the "variances" section of the cost element data sheets address the same issues at the detailed level of the individual cost element. This information will help ensure that, in a decision analysis, the same types of costs will be measured on the same basis across all alternatives.

DEVELOPING COST AND RESOURCE FACTORS UNDER UNCERTAINTY

The various elements of cost are typically estimated by applying appropriate cost factors to variables describing the numbers and types of unit personnel and equipment. For policy decisions involving

⁶A. Barbour and A. Bonner, *The Air Reserve Forces in the Total Force, Appendix A, Derivation of the FORCE Cost Model Data Base*, The RAND Corporation, R-1977/3-AF, September 1977.

existing units or weapon systems, Service organizations or documents can often supply historical information on the average cost factors for cost elements. Occasionally, they can also supply information about the resource factors. A problem may arise, however, if the force structure change under examination involves a new type of unit or a new weapon system, or if the existing cost or resource factors are known not to apply.

When databases and cost documents cannot provide the necessary factors for new units and systems, alternative methods must be used to develop the necessary inputs for the cost-estimating equations. Besides the development of new models that can compute the estimates, there are at least four ways to approach timely resolution of uncertainty.

First, factors for new systems can often be based on analogies to existing systems for which cost factors are available. Subjective judgment plays a major role in the development of cost factors on an analogous basis, and this judgment should be supplemented with inputs from "experts" familiar with the new weapon system or the cost element of interest. The use of expert opinion is a second way to help resolve uncertainty. It should not be used by itself unless all quantitative means of estimating cost elements have proved impossible.

A third way to reduce the uncertainty in calculating costs is to use site-specific data. Sometimes general cost and resource factors do not exist because there are too few units of a particular type to develop them, as, for example, when a new type of unit is being introduced into the reserves. In this case, the best source of information may be to examine the experience of the few units that do exist.

Finally, analysts can use standard statistical techniques, such as sensitivity analysis. In this case, the analyst may undertake only to establish reasonable ranges for a resource or cost factor, then determine how critical that uncertainty is to the outcomes of the analysis. This was the approach in a recent study of Army units, in which equipment cost factors were difficult to establish. The study found that because personnel-related costs of most Army units greatly outweigh equipment operating costs, errors in estimating Army unit equipment costs did not adversely affect the unit cost estimates.⁷

DEALING WITH OVERHEAD COSTS

This manual is intended to support the costing of relatively small changes to the overall force structure, changes that typically do not

⁷See John Schank et al., *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, The RAND Corporation, R-3210-RA, March 1986, p. 41.

significantly affect the cost of overhead functions. Overhead costs include the overall administration of the force or component; the fixed, common-use portions of base operating support (termed the base opening package); and the fixed costs of school training or higher level, centralized maintenance organizations, such as depots. These costs are assumed to be relatively insensitive to small changes in personnel levels or the number of units in the force or the number of units located on a specific base. Calculation of these items is not supported by the manual's data sheets.

Some costing problems can involve a change in overhead functions without implying a substantial change in overall force structure. Examples might include the opening or closing of an existing base, or the addition of a major product line maintenance section in a depot. In those cases, the analyst should include the estimated cost of the relevant changes. The cost element structure leaves room for the inclusion of such costs, under the "other" category among the nonrecurring cost element categories in Table 1.1. That category could, of course, be made more specific to fit particular situations.

III. PERSONNEL COSTS

This section describes methods for estimating recurring and non-recurring personnel costs. Personnel costs, whether recurring or non-recurring, can be divided into three broad categories: pay and allowances, acquisition and training, and support. These categories contain cost elements that are estimated by multiplying a cost factor (cost per person) by a resource factor (number of personnel by type).

TYPES OF COST

Recurring Costs

Annual recurring costs are used when analyzing the costs associated with a static unit and force. The personnel cost elements include basic pay incentive and special pay, allowances, benefits, permanent change of station, social security, retirement, recruiting and processing, basic skill training, initial skill training, advanced skill training, and support. The cost of these elements is determined by considering the entire personnel count of the unit, including both direct unit personnel and support personnel. The unit personnel count by type of personnel is multiplied by the relevant cost factor for each type of personnel. The resulting amounts are summed over the entire unit, to arrive at total recurring costs for each element of cost.

Nonrecurring Costs

Nonrecurring costs are used when analyzing the one-time personnel cost changes due to some change in the force. The costs elements are similar to those for recurring costs, but, depending on the change, some elements will have zero costs. For instance, there are few pay and allowances to be considered in nonrecurring costs, unless the force change implementation requires some temporary non-unit personnel. Training costs, however, play a much larger role in nonrecurring costs because most force changes require a shifting of the force skill mix. Thus, the major difference between recurring and nonrecurring personnel costs lies in the number of personnel considered. The nonrecurring costs focus on the changes in unit personnel and the cost incurred to make the change. With nonrecurring costs, only the difference between the "old" and "new" unit personnel is included.

The following paragraphs describe standard methods for estimating recurring and nonrecurring unit personnel costs. First, we examine the types of personnel found in units and the measurement of the numbers of personnel, especially in the differences between Services and components. We then describe the structure of the cost factors and provide some insight into how to adapt existing cost models to the needs of the analyst. Finally, cost sheets cover each of the cost and resource factors used to determine unit costs.

TYPES OF PERSONNEL

The Services use five major types of personnel defined by their military component and status. They include:

- Military personnel
 - Full-time active
 - Part-time reservists
 - Full-time reservists
- Civilian personnel
 - Civilian
 - Technicians

Full-time reserve personnel fall into two categories. In the Army and the Air Force, reservists who are on full-time status are known as Active Guard/Reserves or AGRs. The equivalent in the Navy is TARS (Training and Administration of Reserves).

The Army and the Air Force have technicians who are full-time civilians on weekdays and part-time Selected Reservists on weekends. Technicians get paid for both civilian and reserve duty. They are also known as Air Technicians, Air Reserve Technicians, Army Technicians, and Army Reserve Technicians.

Personnel cost factors are driven by the characteristics of the personnel or job involved. For instance, pay and allowances are determined by grade level, job category, and years of experience. Standard rates are applied to the number of days of participation in a given category. Thus, although reservists receive the same daily rates of pay as active personnel, they earn less because they participate in fewer drill days per year. From a costing viewpoint, it is, therefore, important to distinguish the types of personnel in a unit so that the proper pay and allowances and training costs can be applied. These distinctions can include military/civilian status, active/reserve status, grade level, years of service, and job classification.

NUMBERS OF PERSONNEL

The relative strength of any type of personnel in a unit varies by Service, component policy, and unit type. In addition, the analyst must choose between using end strengths or average strengths. If the analyst desires a typical cost, average strength should be used. If a cost specific to a particular time is desired, the strength at that time should be used.

Full-Time and Part-Time Manning

Although one may assume that active units are composed of full-time active personnel and reserve units are composed of part-time reservists, this is not the case. The majority of active Air Force and Army units are composed of full-time, active personnel. Active Navy aviation and ship units, however, have both full-time USN personnel and part-time reserve augmentees.

The reserve units in all the military Services have both full-time and part-time members. The full-time members of reserve units provide the continuing equipment maintenance and administrative support needed for peacetime operations. The majority of the full-time personnel are in maintenance areas and their personnel requirement levels are a function of the peacetime activity levels of the unit equipment.

Unit Manning Level

The total number of people in a unit differs, of course, by unit mission. It also differs between active and reserve units depending on Service policy. In the Navy and the Army, similar units in the active reserve and Guard are defined to have the same numbers of personnel with the same occupational skill requirements. The difference in manning between similar active and reserve units in the Navy and Army is in the number of full-time versus part-time personnel.

The Air Force, however, uses a different manning procedure. Similar Air Force active, Air Reserve, and National Guard units may have very different numbers of people. In general, active units have the lowest number, Guard units somewhat higher, and Air Reserve units the highest. Air Guard units use technicians and AGRs, but have no pure civilians. They also have a fixed number of support personnel that does not vary by base location. Air Reserve units, however, use technicians and civilians, and the number of support personnel can vary dramatically by base location.

Unit Definition

The definition of unit personnel also varies by Service because of different Service policies regarding the definition of a "unit." However, to properly calculate the full costs of a decision, the analyst should seek to capture the full personnel implications of a change, regardless of whether those personnel are included in the primary unit manning document. All personnel directly performing or supporting the unit mission should be included in the costing. Personnel in the following functional areas should be considered:

- *Operators* are those directly involved in the mission performance such as infantrymen in an infantry unit and the flight crew in a flying unit.
- *Administrators* are those responsible for unit administration such as personnel management, pay, and training schedules.
- *Maintenance personnel* are those responsible for maintaining unit equipment at the unit or organizational level and at the intermediate level.
- *Support personnel* are those responsible for direct unit support such as security and weapons handling.

These classifications are usually straightforward and included in unit manning documents, except for maintenance and support functions. The Services differ in the inclusion of the two functions.

Maintenance. The maintenance function is usually divided into three stages:

- Organizational or unit level maintenance can easily be performed by unit personnel, such as minor upkeep of equipment and routine replacement of parts.
- Intermediate level maintenance requires more sophisticated diagnostics or more intensive work.
- Depot level maintenance requires the entire equipment item to be sent to a centralized facility (usually on a cyclic basis) or maintenance of equipment components that is beyond the capability of the intermediate level.

The costing of personnel in the first and third stages is well established and unambiguous; all the Services operate the same way. Each Service includes the organizational level maintenance personnel in the unit manning; thus, using standard procedure, their costs are automatically counted under "personnel costs." On the other hand, none of the Services includes depot level personnel in unit manning. Depots are totally separate organizations—large, permanent industrial facilities

employing mostly civilian personnel. The costs of depot maintenance, both labor and material, are lumped together under "equipment costs" (see the "depot maintenance" cost element in the next section). No attempt is made to separate the labor portion of depot costs and include them under "personnel costs."

The Services differ in how they provide intermediate level maintenance, and understanding those differences is critical to ensuring that cost analyses are complete and accurate. Below we explain how the Services differ and how we have decided to handle the costing for purposes of this handbook.

In the Air Force, intermediate level maintenance personnel are included in the unit personnel counts, just as are organizational level maintenance personnel. Thus, the two levels of personnel are costed in the same way: under personnel costs using standard unit manning documents.

Navy aviation units obtain intermediate level maintenance on a more centralized basis. Each installation (a base or aircraft carrier) receives support from an Aviation Intermediate Maintenance Department (AIMD) that handles the equipment from all the units on the base or on-board the carrier. The centralized function is composed of a permanent core of personnel assigned to the AIMD and a group of temporarily assigned augmentees from each client aviation unit. The Navy aviation unit manning document will include the augmentee group of intermediate maintenance personnel, but will not include the fixed, core group. For purposes of costing the aviation unit, we assume that a pro-rated share, or "slice," of this fixed AIMD group should be included in the personnel count of the unit. In this way, all the personnel costs of intermediate level maintenance will be included in one place—under the personnel section of costs.

Navy ship units receive intermediate maintenance from a centralized facility called Ship Intermediate Maintenance Activities (SIMA). However, unlike aviation units, this function is performed entirely by a permanent core group associated with the SIMA and is not counted in the unit personnel of the ship. Because all intermediate maintenance personnel are assigned to the SIMA, we treat those costs the same way we do depot maintenance costs: both labor and material costs are included under "intermediate maintenance" in the equipment section of costs.

In the Army, intermediate maintenance is performed entirely by separate combat service support units that (except for aviation units) are of two types: Direct Support and General Support. Again, because these units are totally separate, both their labor and material costs are included in the equipment section when calculating the costs of combat units.

Support. Support personnel are those persons who perform functions such as security, weapons handling, and facilities upkeep that directly support mission-oriented functions. Army and Navy units integrate a portion of the support personnel into the unit manning. Therefore, when unit personnel are costed, more of the personnel support costs are automatically included.

The Air Force, however, does not include support personnel in the unit (except for security and weapons handlers). Air Force units are supported by separate base organizations typically grouped under Base Operating Support (BOS). Therefore, the cost analysis of Air Force units should include a portion of the BOS personnel. Standard percentages are typically used to estimate the variable portion of the support personnel additive for Air Force aviation units.

PERSONNEL COST ELEMENTS

Each element of cost has a corresponding cost factor. The following discusses elements of costs and their related factors.

Personnel Pay and Allowance Cost Factors

The pay and allowance cost elements for military personnel include the following: basic pay, incentive pay, special pay, allowances, benefits, permanent change of station, social security, and retirement.

Each of these elements has associated cost factors that may vary by personnel characteristic or job category. The cost factors do not vary, at least on a daily rated basis, by Service or component. Characteristics that should be considered include: grade level, rating for flight duty, years of service, and occupation.

These cost factors can be determined at many levels of detail, but most important would be an officer and enlisted split and a rating split. As groups, officers make substantially more than enlisted personnel. Personnel receive additional pay (incentive and special pays) for flying time and for time at sea. Thus, a pilot may make substantially more than a maintenance officer because of flight-related pay.

Despite the standard daily rates for pay and allowances, the annual cost of each type of person by component can vary quite dramatically. For instance, a part-time reservist costs much less than a full-time active because the reservist works fewer days per year. Full-time reservists tend to cost more per year than full-time active personnel partly because the grade structure of full-time reservists is higher than that of the active personnel.

The pay and allowance cost elements for civilian personnel include the following: base pay, merit pay, distinguished executive awards, cash incentives, performance pay, overtime, holiday pay, overseas duty, and hazardous duty pay.

Civilian base pay varies by pay grade and years within pay grade. All Services and components pay at the same rates. Other pays are based on the civilian's performance and specific duties, but amounts of pay and eligibility are usually defined by regulation. Although the rates paid are statutory, the average civilian pay may vary by Service and component because of the different civilian grade structure in each Service and component.

Replacement Acquisition and Training Cost Elements

Replacement acquisition and training includes recruiting and processing costs, basic training costs, initial skill training costs, and advanced skill training costs. For both recurring and nonrecurring costs, the cost element is calculated for those personnel who left the unit during the study period and must be replaced. The cost element is based upon: (1) the average cost to acquire and train a person and (2) the number of people in a unit who must be replaced or acquired. For recurring cost, the number of people to be replaced is determined on an average annual basis. For nonrecurring cost, the number of people to be replaced or newly acquired is determined over the course of the change to the unit.

The cost elements include the pay, allowance, and travel of recruiters, trainers, and students, recruitment advertising, and the costs of materials used in training including ammunition.

The training cost factors vary by occupational category. Aircrews are more expensive to train than other occupations; therefore, the training costs are calculated, in aviation units, for pilots, other aircrew, and nonflight-rated personnel. However, within these categories the costs per person to train active and reserve personnel are assumed to be equal because all receive the same training at the same schools.

The number of replacements is a function of the turnover rate within a skill group and the proportion of the turnover that is filled with nonprior service personnel. Since the reserves recruit large numbers of personnel from the actives, some replacement personnel in reserve units will be acquired without recruiting or training costs. The turnover factors must also be modified by the percentage of personnel gains that are nonprior service. In the reserves this may substantially reduce the turnover rate, while in the actives there will probably be no effect.

Support-Related Costs

Besides the normal pay and allowances of support personnel, the unit incurs other support-related costs. These include some portion of base rentals, utilities, communications, computer operations, and medical support. The unit incurs only a portion of the variable costs of base operations; under normal circumstances fixed costs should not be included.

These types of costs remain difficult to track because Service accounting practices do not distinguish unit usage. Thus, several cautions must be stated about this type of cost. First, although the element should include only variable costs, it is often impossible to remove fixed costs from the estimate. Second, the cost element is usually estimated on an average officer and enlisted person basis; however, the cost may vary in other dimensions. As unit costing improves, respecification of this element will be necessary.

DETERMINING AN APPROPRIATE LEVEL OF DETAIL

Personnel costs can be estimated at a very detailed level, if the analyst finds it necessary. For instance, basic pay varies by grade and time in service. An analyst could attempt to cost personnel in a unit by their grade and average years in service. However, under many circumstances this level of detail will not add greatly to the accuracy of the personnel cost estimate. A less fine level of detail can be used if it can be assumed that the average unit grade structure is similar to the component grade structure. Under this assumption, only average officer and enlisted cost factors would be necessary.

In addition, often the Services have developed composite cost elements that consolidate many of the detailed pay and allowance costs elements into a single item for pay and allowances. These can be used if the unit in question does not have great numbers of personnel that would differ significantly from the average officer or enlisted personnel. The most important elements to include are basic pay, special and incentive pays, and additional drill days. These account for a large portion of costs.

The analyst should use judgment as to when more detail is needed. For instance, if the analyst is costing a medical unit, then it is inappropriate to use only officer and enlisted average pay factors, because the medical profession in the military earns much higher pay than other occupational specialties.

Training cost factors can be similarly consolidated and averages used. However, the differences in training cost factors by job category

can be dramatic. In particular, flight-related training must have cost factors separate from other training. However, nonflight-related training can often be consolidated into a single cost factor on an officer and enlisted basis without losing much accuracy.

OFFICES TO CONTACT FOR FURTHER INFORMATION

For questions concerning level of detail or the cost factors, the analyst should contact the offices listed in Tables 3.1, 3.2, and 3.3.

Table 3.1

ARMY OFFICES FOR PERSONNEL FACTORS

General/Active	Reserve	Guard
DAPE/DCS-Personnel and Budget	OCAR-Office of Chief of the Army Reserve	NGB-National Guard Bureau
DAPE/MBB-Program	DAAR/PE-Personnel	NGB/HR-Human Resources
DAPE/MBA-Manpower Management	DAAR/CO-Comptroller	NGB/ARA-Program Branch
DACA/BUZ-Budget	DAAR/PP-Plans and Programs	NGB/ARC-Comptroller
DACA/OMP-Program Budget	DAAR/TR-Training	NGB/ARM-Manpower
DAMO/TR-Training Directorate	DAMO/TRO-Reserve Component Training	NGB/ARP-Personnel
		NGB/ARO-Organization and Training
		DAMO/TRO-Reserve Component Training

Table 3.2

NAVY OFFICES FOR PERSONNEL FACTORS

General/Active	Reserve
NC-Comptroller of the Navy	NOP-095-Director, Naval Reserve
NCA-Naval Center for Cost Analysis	NOP-958-Planning and Programming
NOP-01-DCS Naval Operations-Manpower, Personnel, and Training	NOP-951-Manpower, Personnel, and Training
OP-01B3-Economic Analysis	
OP-13-Military Personnel Policy	

Table 3.3

AIR FORCE OFFICES FOR PERSONNEL FACTORS

General/Active	Reserve	Guard
SAF/AC-Comptroller of Air Force	AF/RE-Office of Air Force Reserve	NGB-National Guard Bureau
SAF-ACCC-Cost	AF/RE/REC-Comptroller	NGB/PR-Programs & Resources
DSC-Manpower	AF/RE/REPX-Personnel Plans	NGB/AC-Comptroller
AF/MPPB-Personnel Budget	AF/RE/REXP-Programs	NGB/MP-Manpower, Personnel
AF/DPX-Personnel Plans	AF/RE/REPP-Training	ANGSC/TE-Office of Training
AF/PRM-Manpower and Organization		
AF/DPP-Programs and Training		

PERSONNEL-RELATED DATA SHEETS

The pages following the tables provide individual data sheets for cost elements and resource factors dealing with personnel costs. Each data sheet has a header that fully describes the item. The name of the item appears at the top, followed by the following information:

- Item Type: whether the item is a "resource factor" or "cost element."
- Cost Type: whether the item refers to personnel- or equipment-related costs, and whether it pertains to nonrecurring or recurring aspects of cost.
- Services: In general, for personnel items, one data sheet covers all the Services; for equipment items, data sheets are Service-specific.

For an index to the factors and elements, see App. B.

COMPOSITE MILITARY PAY AND ALLOWANCES

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Military pay and allowances include basic pay, incentive and special pay, allowances, social security, benefits, permanent change of station, and retirement. The pay and allowances are earned at statutory rates for rank, year of service, and occupation. However, rather than estimating each factor separately, analysts often use a composite factor for all pay and allowances of large groups, such as active officers or reserve enlisted personnel. Prior to using these factors the analyst should ensure that the level of proposed aggregation is appropriate for the problem, and that the construction of the composite factor includes all important pay elements.

VARIANCES: The composite factors typically vary at least by Service, component, and rank, expressed in average officer and enlisted terms. In addition, it may vary by flight and sea ratings, or may require other adjustment to fit the particular situation (see the "variances" sections under the individual elements of pay).

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over categories of personnel:
(Average pay per year in category) * (Number of personnel in category)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Composite pay and allowances are usually estimated at the officer and enlisted level with separate factors for rated and nonrated personnel.

PUBLISHED DATA SOURCES: Some of the Services have cost factor documents that provide composite cost factors. Others do not publish documents, but have internal documents that can be used. Other levels of detail may be devised to fit the purposes of the analyst.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further details.

References

Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.

Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of Comptroller, Washington, D.C., November 1982.

MILITARY PAY AND ALLOWANCES: BASIC PAY

Item Type: **Cost Element**

Cost Type: **Personnel Related**

Annual Recurring Cost

Service(s): **Air Force, Army, Navy**

DEFINITION: Basic pay is the standard military compensation for time spent on military duty. It is earned at statutory rates set by the Congress. Reservists earn pay for their 14 active duty days, their 48 inactive duty drill days, and for any additional days they may drill. The additional drill days are usually the result of unit participation in mobilization and support exercises, unit conversions, and mission readiness drills. All types of drills must be included in the basic pay calculation.

VARIANCES: Basic pay rates vary by rank or grade and by year of service, but do not vary by Service or component. Thus, an E-1 with one year of experience in the military gets paid the same amount for a drill day whether he is in the Army or Navy or whether he is in the active service, reserve, or National Guard. Average rates of pay for reservists can be used if they take into account the additional unit drill days. Different types of units do receive more additional drill days than others, so the analyst may wish to distinguish additional drills by unit type.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all grades of military personnel:

(Average pay per year for grade) * (Number of personnel in grade)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Basic pay can be estimated at any level of detail appropriate to the analyst. Successive levels include average rate on an officer and enlisted basis within a component, average rate per grade within a component, average rate per grade, and years of service within a component. Reserve unit basic pay may be calculated based on average days across the component or additional drills may be calculated separately to account for unit type differences.

PUBLISHED DATA SOURCES: *The Uniformed Services Almanac* contains tables showing basic pay. Reserve *Almanacs* show estimated basic pay based on the minimum 48 drills and 14 active duty periods of reservists. The active budgets show basic pay by grade, averaged over years of service in grade, as well as average basic pay for officers and enlisted. The data are displayed for the current fiscal year and estimated for two out years. Reserve budgets show basic pay for active duty, inactive duty, and additional drill days. These amounts must be added together to arrive at total basic pay on an officer and enlisted basis. Basic pay by grade is not provided. Reserve *Almanacs* can be used for estimating at a finer level of detail.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further detail or for their own internal, unpublished sources.

References

See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justification, for personnel for the appropriate fiscal year.

MILITARY PAY AND ALLOWANCES: INCENTIVE PAY

Item Type: **Cost Element**

Cost Type: **Personnel Related**

Annual Recurring Cost

Service(s): **Air Force, Army, Navy**

DEFINITION: Military personnel receive additional pay at statutory rates for hazardous duty—aviation career incentive, flight, air weapons controller, parachute jumping, experimental stress, demolition, hazardous biological organisms, submarine duty, and aircraft carrier landing. The pay rate is standard per month and earned for every month of participation in hazardous duty, but each type of pay may have specific conditions for qualification. Incentive pay accounts for the large differences in pay between flight-rated and nonflight-rated personnel. Any incentive pay earned by reservists for additional drill days should be included.

VARIANCES: The rates of pay for the above duty are set by statute and do not vary by Service or component. Some incentive pays vary by years of service in that duty or by grade. The pay, however, is usually earned based on the time spent in the activity. Total amount earned by an individual may vary with the time spent in the activity.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all types of incentive pay:

(Pay per year for hazardous duty) * (Number of people in duty)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Pay can be estimated at any level of detail appropriate to the analyst. Successive levels of detail include yearly rate averaged over all types of duty, average officer and enlisted yearly rate averaged over all types of duty, average officer and enlisted rates for each type of duty, and average yearly rate for each grade for each type of duty.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* provides detail on the amount and conditions for earning each type of pay. In addition, the active budgets show on an annual basis the man-years involved in that duty, the statutory rate, and the total budget dollars allocated to that activity. The reserve budgets do not give this level of detail—most pay and allowances are aggregated into a single cost on an officer and enlisted basis. Reserve *Almanacs* can be used for estimating at finer levels of detail. The *Fifth Quadrennial Review of Military Compensation* can be used for a general overview of current Service practice.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further detail or their own internal, unpublished sources.

References

Office of the Secretary of Defense, *Fifth Quadrennial Review of Military Compensation*, Department of Defense, Washington, D.C., January 1987.

See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY PAY AND ALLOWANCES: SPECIAL PAY AND BONUSES

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Military personnel receive additional pay at statutory rates for special duty. The pay is to provide higher reimbursements for those specialties that are difficult to maintain in the Services and acts as a retention incentive for those specialties. The pay can be earned in two ways: as a bonus for enlistments or reenlistment in certain occupational categories or as a routine addition to basic pay without the need for contract extension. Special pay is given for physicians, board-certified medical officers, dental specialists, optometrists, veterinarians, military chiefs of staff, engineer and scientific specialists, pararescue diving, overseas duty extension, Navy nuclear plant duty, and sea duty. Occupational specialties eligible for enlistment and reenlistment bonuses vary by Service and only enlisted members are eligible. The pay can be in lump sums on a yearly basis or at a monthly rate for time spent in that activity. Pay rates are standard by statute, and may have specific conditions for eligibility. Any special pay earned by reservists for additional drill days must be accounted for.

VARIANCES: Special pay rates and bonuses do not vary across the Services or components, but the occupational categories eligible do. Also, each type may be earned in slightly different ways. For example, physicians earn variable special pay at an annual rate based on years of service, whereas optometrists earn a standard monthly amount with no variation by years of service. In addition, enlisted personnel are eligible for different types of pay than officers.

ESTIMATING EQUATION: Total annual special pay for a unit is calculated as: Summed over all types of specialties:

(Pay per year for specialty) * (Number of people in specialty)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

Total bonus cost is calculated as simply:

$$(\text{Number receiving bonus}) * (\text{Size of bonus})$$

If the size of the required bonus must be estimated, the cost analyst must have an estimate of the elasticity of (re)enlistments with respect to pay. This is the percentage change in (re)enlistments given a 1 percent change in pay. If the elasticity is denoted e , the formula for the required bonus is:

$$\text{Pay} * (\text{Percentage change in (re)enlistments}) * (1/e)$$

The measure of pay is typically the present value of pay for the term of enlistment.

LEVEL OF DETAIL: Special pays can be estimated at any level of detail appropriate to the analyst. Successive levels of detail are weighted average for all special pays across the component; weighted average for all special pays on an officer and enlisted basis; weighted average for specific category of special pay for component; and special pay per grade per category.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* contains detail on the types of special pay and the statutory rates and conditions of eligibility. In addition, the active budgets show, on an annual basis, the manyears involved in that duty, the statutory rate, and the total budget dollars allocated to that activity. The data are displayed for the current fiscal year and estimated for two out years. The reserve budgets do not have this level of detail—most pays and allowances are aggregated into a single amount on an average officer and enlisted basis. Reserve *Almanacs* can be used for estimating at a finer level of detail. The *Fifth Quadrennial Review of Military Compensation* can be used for a general overview of current Service practice.

Each Service has a bonus manager who maintains bonus improvement factors, for example, estimates of the increase in reenlistments due to the introduction of a bonus in an occupation. The effects of enlistment bonuses for the Army have been directly estimated by Polich et al. There are poor estimates of elasticities for the reserve forces. For the effects of a reserve reenlistment bonus experiment, see Grissmer et al.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further information or their own internal, unpublished sources.

References

- Grissmer, D. W., B. K. Burright, Z. D. Doering, J. Sachar, *The 1978 Selected Reserve Reenlistment Bonus Test: Executive Summary*, The RAND Corporation, R-2864-MRAL, April 1982.
- Polich, J. M., J. N. Dertouzos, S. J. Press, *The Enlistment Bonus Experiment*, The RAND Corporation, R-3353-FMP, April 1986.
- Office of the Secretary of Defense, *Fifth Quadrennial Review of Military Compensation*, Department of Defense, Washington, D.C., January 1987.
- See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY PAY AND ALLOWANCES: ALLOWANCES

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Military personnel are eligible for certain allowances, depending on their basing and housing circumstances. These allowances, provided at statutory rates, provide some reimbursement for the unique financial burdens of military duty. Allowances are provided for quarters, subsistence, duty overseas, uniforms, travel, housing, and family separation. The travel allowance is for travel to and from training sites, and is not the same as travel dollars associated with a permanent change of station. The allowances are given only when a member incurs that burden. Any allowances earned by reservists for additional duty days must be taken into account.

VARIANCES: Allowances do not vary across Service or component, however; each type of allowance is earned in slightly different ways. For example, the rate for a particular allowance may vary by grade. Also, because reservists usually live at home and do not have duty overseas, they are generally not eligible for housing, overseas stations, and family separation allowances.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all categories of allowances:

(Average allowance per year) * (Number of personnel eligible)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Allowances can be estimated at any level of detail appropriate to the analyst. Successive levels of detail include weighted average for all allowances across a component, weighted average for all types of allowances on an officer and enlisted basis, weighted average for a specific type of allowance, and rate for a particular allowance by grade.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* contains detail on the types of allowances and the statutory rates and conditions for eligibility. The active budgets show on an annual basis average allowances by grade, including manyears, statutory rate, and total budget amount. The data are displayed for the current fiscal year and two out years. The reserve budgets do not provide this level of detail—most pays and allowances are aggregated into a single amount on an officer and enlisted basis. Reserve *Almanacs* can be used for estimating at finer levels of detail.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further information or their own internal, unpublished sources.

References

See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY PAY AND ALLOWANCES: BENEFITS

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Military personnel receive additional benefits besides normal pay and allowances. These benefits include separation payments such as terminal leave and severance pays. In addition, payments are given for apprehension of deserters, death gratuities, and unemployment compensation. Pays are standard by statute, but have very specific conditions of eligibility.

VARIANCES: The different types of administrative payments are standard across Services; however, each type is earned in a slightly different way. For example, separation payments are based on years of service and accumulated leave time, whereas the unemployment compensation is estimated as 35 percent of base pay for a period of 13 weeks. Conditions of eligibility may preclude reservists from qualifying.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all grades of personnel:

(Average benefit per grade) * (Number of personnel in grade eligible)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Benefits can be estimated at any level of detail appropriate for the cost analyst. Successive levels of detail include yearly rates averaged over all types of pay and all grades, yearly rates averaged over all types of benefits on an officer and enlisted basis, yearly rates for all types of benefits for each grade, and rates for each type of benefit by grade.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* contains detail on the types of benefits and the statutory rates and conditions of eligibility. In addition, the active budgets show benefits on an average officer and enlisted basis or in more detail. Average rates and number of recipients are included. The data are displayed

for the current fiscal year and two out years. The reserve budgets do not provide this level of detail—most pay and allowances are aggregated into a single amount on an officer and enlisted basis. Reserve *Almanacs* can be used for estimating at finer levels of detail. The *Fifth Quadrennial Review of Military Compensation* can be used for a general overview of current Service practices.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for more information or for internal, unpublished sources.

References

Office of the Secretary of Defense, *Fifth Quadrennial Review of Military Compensation*, Department of Defense, Washington, D.C., January 1984.

See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

**MILITARY PAY AND ALLOWANCES:
PERMANENT CHANGE OF STATION (PCS)**

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Military personnel are reimbursed for some of the expenses incurred when ordered to a new station, including mileage, transportation by common carrier, per diem allowances, shipment of goods, and subsistence. Costs for both military personnel and their dependents are covered. Some reimbursement is at statutory rates, whereas other costs are fully covered. Any temporary duty travel incurred in connection with a permanent change of station is also included.

VARIANCES: The items covered and the rates at which they are reimbursed are standard throughout the Services. The amount received will vary by grade for those costs that are reimbursed based on grade, such as subsistence and travel pay and allowances. However, part-time reservists would not receive this type of reimbursement under most conditions because their moves are voluntary. Full-time Active Guard/Reserves might receive this pay if ordered to move.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all types of personnel:

(Average pay/year in category) * (Number of people in category)

LEVEL OF DETAIL: Payments can be estimated at any level of detail appropriate for the cost analyst. Successive levels of detail are average PCS by component, component average officer and enlisted PCS, and component average PCS by grade.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* contains detail on the types of PCS, rates of reimbursement, and conditions of eligibility. In addition, the active budgets show payments made on an average officer and enlisted basis. Number of recipients is included. The data are displayed for the current year and two out

years. The reserve budgets do not provide this level of detail—most pay and allowances are aggregated into a single number on an average officer and enlisted basis. Reserve *Almanacs* can be used for estimating at finer levels of detail.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further details or their own internal, unpublished sources.

References

Office of the Secretary of Defense, *Fifth Quadrennial Review of Military Compensation*, Department of Defense, Washington, D.C., January 1984.

See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY PAY AND ALLOWANCES: SOCIAL SECURITY CONTRIBUTION

Item Type: **Cost Element**

Cost Type: **Personnel Related**

Annual Recurring Cost

Service(s): **Air Force, Army, Navy**

DEFINITION: The Federal Insurance Contribution Act requires that the federal government contribute a social security tax for all federal employees, including the military, at statutory rates. This amount is not given to the employee that year, but is set aside for future payment. It is a cost to the government of employing a person.

VARIANCES: The tax rate does not vary across components or Services. Both active and reserves are taxed on their basic pay. Ceilings exist for taxable income; therefore, some variation exists according to basic pay grade structure and longevity.

ESTIMATING EQUATION: The total annual amount for a unit is calculated as: Summed over all pay grades:

(Average rate per grade) * (Number of personnel in grade)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Social security contributions can be expressed as a percentage of basic pay on a yearly basis. It can be estimated at any level of detail appropriate to the analyst. Successive levels include average per person within component, average officer and enlisted within component, average per pay grade within a component, average per pay grade, and longevity bracket within component.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* contains detail on the statutory rates of contribution. The active budgets show contributions on an annual average officer and enlisted basis. It is weighted for grade and longevity. The data are displayed for the current year and two out years. The reserve budgets do not give this level of detail—most pay and allowances are aggregated into a single amount on an officer and enlisted basis. *Reserve Almanacs* can be used for estimating at finer levels of detail.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further information or for internal, unpublished documents.

References

See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY PAY AND ALLOWANCES: RETIREMENT CONTRIBUTION

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: In addition to social security, the Services are required to set aside a contribution for each Service member's retirement. The Service member collects this retirement contribution only if he serves in the military for 20 years or more. The contribution is set aside by the government to fund future retirements; thus, it is a cost to the government for having a military employee. The contribution is set aside for each member every year that he is in the military whether or not he makes it to retirement age. The money is put into an actuarially sound fund that provides the retiree with his pension.

VARIANCES: The amount set aside per person is a percentage of basic pay determined using a normal cost percentage. The rate does not vary by Service, component, or grade. The rates are determined by an independent Board of Actuaries.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all grades of pay:

$$\frac{(\text{Percent contribution}) * (\text{Average basic pay}) *}{(\text{Number of people in grade})}$$

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: The contribution can be estimated at any level of detail appropriate to the analyst. Successive levels include average contribution across component, average officer or enlisted contribution within component, or average contribution by grade within component.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* contains detail on military retirement and the accrual system now in effect. The active budgets show retirement contribution rates for a

given year, man-years involved, total basic pay being given and total retirement set aside for officers and enlisted personnel. Average officer and enlisted costs can be computed by dividing the total set aside by the total number of officers or enlisted. The reserve budgets show retirement accruals for active duty days, inactive duty days, and training assemblies. Manpower strengths, average rates, and total budget amounts are provided. Reserve *Almanacs* can be used for estimating at finer levels of detail. The Office of the Actuary publishes yearly a document on the military retirement system.

OFFICES: The Office of the Actuary, Defense Manpower Data Center, should be contacted for the latest normal cost percentage or for any details on the military retirement system.

References

Office of the Actuary, *FY1985 DoD Statistical Report on the Military Retirement System*, Defense Manpower Data Center, March 1987. See App. B for references to each component's *Uniformed Services Almanac*, and each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

CIVILIAN PAY AND ALLOWANCES: DIRECT COMPENSATION

Item Type: Cost Element
Cost Type: Personnel Related
Annual Recurring Cost
Service(s): Air Force, Army, Navy

DEFINITION: Civilian personnel receive pay according to government pay scales at statutory rates. Total direct compensation may include base pay, merit pay, distinguished executive awards, cash incentives, performance pay, overtime, holiday pay, and overseas duty and hazardous pays.

VARIANCES: Civilian base pay varies by pay grade and years within pay grade. All Services and components pay at the same rates. Other pays are based on the civilian's performance and specific duties, but amounts of pay and eligibility are usually defined by regulation. Although the rates paid are statutory, the average civilian pay may vary by Service and component because of the different civilian grade structure in each Service and component.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all civilian pay grades:

(Average pay per grade per year) * (Number of unit civilians in grade)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Compensation can be estimated at any level of detail appropriate to the analyst. Successive levels include average pay per civilian within a component and average pay per civilian within grade within a component.

PUBLISHED DATA SOURCES: The *Uniformed Services Almanac* or the *Federal Personnel Guide* provides the tables for figuring civilian base pay. In addition, the active and reserve budgets show civilian pay for the Service and component by average within component and within grade. The pay shown in the budgets, however, aggregates direct compensation, benefits, and contributions into a single amount.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further information.

References

Federal Personnel Publications, *Federal Personnel Guide, Employment and Benefits*, Washington, D.C., 1987.

See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for operation and maintenance for the appropriate fiscal year.

CIVILIAN PAY AND ALLOWANCES: BENEFITS AND CONTRIBUTIONS

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: In addition to direct compensation, civilians receive indirect benefits in the form of government contributions to employees' health, life, and disability insurance. As with military personnel, the government makes contributions to employees' social security and to the Civil Service Retirement and Disability Fund. All these contributions are a cost to the government of civilian employment.

VARIANCES: Benefits and contribution rates are the same across all Services and components, but the relative number and grade structure of the Services causes the average civilian benefit for each Service and component to differ.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all personnel:

(Average cost per grade per year) * (Number of civilians in grade)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Benefits can be estimated at any level of detail appropriate to the analyst. Successive levels include average cost per civilian within a component and average cost per civilian within a grade within a component.

PUBLISHED DATA SOURCES: See discussion of Civilian Direct Compensation.

OFFICES: See discussion of Civilian Direct Compensation.

References

Federal Personnel Publications, *Federal Personnel Guide*, Washington, D.C., 1987.

See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for operation and maintenance for the appropriate fiscal year.

CIVILIAN PAY AND ALLOWANCES: CIVILIAN TRAVEL

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Civilians are reimbursed for travel expenses, including government-directed moves. Reimbursement can be at regulated rates, for instance, for per diem. Or reimbursement can cover expenses, for instance, for moving family belongings. All civilian travel expenses are included in this category.

VARIANCES: Rates and conditions of reimbursement do not vary across Services or components. However, the average travel cost for each Service and component may vary due to grade structure or amount of travel initiated.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as:

(Average travel cost) * (Number of civilians)

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: Details on travel are difficult to establish; thus, an average for all civilians within a component is appropriate.

PUBLISHED DATA SOURCES: The active and reserve budgets provide average civilian travel costs within a component.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further details.

References

Federal Personnel Publications, *Federal Personnel Guide*, Washington, D.C., 1987.

See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for operation and maintenance for the appropriate fiscal year.

MILITARY ACQUISITION OF REPLACEMENT PERSONNEL: RECRUITING AND PROCESSING

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Annual recurring costs include those for replacing unit personnel who normally turn over during a year. The costs of recruiting and processing new soldiers and reenlistments into the military are among these costs, which include advertising expenses; pay, allowances, and travel of recruiters; travel of recruits; costs of processing recruits into the military; and initial clothing and equipment.

VARIANCES: Recruiting and processing costs per recruit vary by Service and component, and are significantly different for officers and enlisted. However, the costs do not vary by occupational specialty. Although some recruits may get special enlistment bonuses or pay because of the occupational category they choose, it is included in their pay and allowances and is not a part of recruiting and processing.

In addition, the total cost will vary based on how unit personnel are defined and on their turnover rate within the unit. See the data sheets, "Personnel Strength: Unit Level" and "Military Acquisition: Acquisition Turnover" for information about the variances of those variables.

ESTIMATING EQUATION: To estimate annual recruiting and processing costs, use the following equations:

$$\begin{aligned} &(\text{Number of officers}) * (\text{Acquisition cost/officer}) * \\ &(\text{Officer acquisition turnover}) \text{ and} \\ &(\text{Number of enlisted}) * (\text{Acquisition cost/enlisted}) * \\ &(\text{Enlisted acquisition turnover}) \end{aligned}$$

For further information on the number of personnel and turnover rates, see the data sheets, "Personnel Strength: Unit Level" and "Military Acquisition: Acquisition Turnover."

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. The minimum level should be by

component with an average officer and enlisted breakdown. Further breakdowns will be by subelement, but not by grade.

PUBLISHED DATA SOURCES: These costs are not routinely tracked in the form desirable, but can be roughly estimated from the following sources. Service cost models have some detail on average officer and enlisted recruiting costs. The Service military personnel budgets contain information on pay and allowances of military recruiters and the cost of initial clothing. Information is provided on an average officer and enlisted basis. The Service operation and maintenance budgets also contain information on the operating costs of recruiting and advertising. The total budget for these activities is shown. It is not on a per capita or on an officer and enlisted basis.

OFFICES: To arrive at more detailed costs than those offered in published documents, it is necessary to contact the offices listed in Tables 3.1, 3.2, and 3.3.

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.
- See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel and operation and maintenance for the appropriate fiscal year.

MILITARY ACQUISITION OF REPLACEMENT PERSONNEL: BASIC TRAINING

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Annual recurring costs include those for replacing unit personnel who normally turn over during a year. The costs of sending a recruit through basic training are among those costs. Costs include pay, allowances, travel expenses, and subsistence of students; pay, allowances, travel expenses, and subsistence of instructors; costs of materials including ammunition used during the course; cost of any variable support during training including utilities, support personnel, and so forth. If appropriate to the problem, the costs associated with the Service academies, ROTC, Officer Training School (OTS), and the enlisted commissioning programs are also included, although they apply only to officers. This cost element should not include any force overhead cost, but only costs that vary by the student load. Further, cost should be based on the number of graduates, taking into account the cost of recruits who drop out prior to completing the course work.

VARIANCES: The costs per soldier for basic training vary by Service, but not component, as all components within a Service use the same schools. Costs also do not vary by occupation, but do vary on an average officer and enlisted basis because the courses for officers and enlisted differ.

In addition, the total cost will vary based on how unit personnel are defined and on their turnover rate within the unit. See the data sheets, "Personnel Strength: Unit Level" and "Military Acquisition: Acquisition Turnover" for information about the variances of those variables.

ESTIMATING EQUATION: Basic training costs are expressed on an officer and enlisted basis within a component. To estimate annual recurring costs use the following equations:

(Number of officers) * (Acquisition cost/officer) *
(Officer acquisition turnover) and

(Number of enlisted) * (Acquisition cost/enlisted) *
(Enlisted acquisition turnover)

For further information on the number of personnel and turnover rates, see the data sheets, "Personnel Strength: Unit Level" and "Military Acquisition: Acquisition Turnover."

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. The minimum level should be by Service with an officer and enlisted breakdown. Further breakdowns will be by subelement, not by grade or skill.

PUBLISHED DATA SOURCES: These costs are not routinely tracked in the form desirable, but can be roughly estimated from the following sources. Service cost models have some detail on average officer and enlisted basic skill acquisition costs. The Service military personnel budgets contain information on the total training operations budget, but does not provide the breakdown needed.

OFFICES: To arrive at more detailed estimates, it is necessary to contact the offices listed in Tables 3.1, 3.2, and 3.3.

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.
- See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY TRAINING: INITIAL SKILL

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Annual recurring costs include those for replacing unit personnel who normally turn over during a year. The costs of initial skill training are among those costs. After basic training, each officer and enlisted person attends courses to qualify him or her for a general military occupational category. This is known as initial skill training. Prior service personnel replacing unit personnel are assumed to be already fully trained, and thus no training costs are calculated. (If this assumption is incorrect for a particular problem, additional training costs can be included for prior service personnel.) However, for nonprior service personnel replacing unit personnel, the costs of initial skill training include pay, allowances, travel expenses, and subsistence of students while attending courses; pay, allowances, travel expenses, and subsistence of instructors; materials used during instruction including ammunition; and costs of any variable support used during instruction including utilities and support personnel. Force overhead costs are not included. Cost should be based on the number of graduates, taking into account the cost of personnel who drop out prior to the completion of course work.

VARIANCES: Initial skill training costs per person vary by Service and by officer and enlisted. They do not vary by component within a Service, as all personnel take the same courses. However, costs will vary significantly by skill area; at a minimum, flying skills must be distinguished as they are much more expensive to train than others. As a consequence, different types of units will likely have different average skill training costs, because different units require different mixes of skills.

Finally, the total cost will vary based on how unit personnel are defined and their turnover rate within the unit. See the data sheets "Personnel Strength: Unit Level" and "Military Training: Initial Skill Turnover" for information on the variance of those variables.

ESTIMATING EQUATION: Initial skill training costs are used to estimate annual recurring costs as: Summed over major skill areas:

$$\begin{aligned} & (\text{Number of officers in skill area}) * (\text{Cost/officer in skill area}) * \\ & \quad (\text{Initial skill area turnover}) \text{ and} \\ & (\text{Number of enlisted in skill area}) * (\text{Cost/enlisted in skill area}) * \\ & \quad (\text{Initial skill area turnover}) \end{aligned}$$

For further information on the number of personnel and turnover rates, see the data sheets, "Personnel Strength: Unit Level" and "Military Training: Initial Skill Turnover."

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. The minimum level is by average officer and enlisted within a Service with a flying/nonflying skill breakdown. Further breakdowns will be by subelement and by skill area.

PUBLISHED DATA SOURCES: These costs are not routinely tracked in the form desirable, but can be roughly estimated from the following sources. Flying-related costs are much more accurately tracked than others. Service cost models have some detail on average officer and enlisted initial skill training. *U.S. Air Force Cost and Planning Factors* gives skill area breakouts for enlisted personnel, but combines them with basic skill acquisition costs. The Army cost models have average officer and enlisted costs, but no skill breakdowns. Also, the costs are aggregated with advanced training. In addition, the Services have unpublished databases that can be used to track these costs on a skill-by-skill basis. Using these databases is a labor intensive process.

OFFICES: To arrive at more detailed estimates than those possible with published documents, the offices in Tables 3.1, 3.2, and 3.3 should be contacted.

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSOC)*, Washington, D.C., various years.

MILITARY TRAINING OF REPLACEMENT PERSONNEL: ADVANCED SKILL

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Annual recurring costs include those for replacing unit personnel who normally turn over during a year. The costs of advanced skill training are among these costs. After initial skill training, each officer and enlisted person attends further courses to qualify him or her for a specific skill area. For instance, a pilot may have obtained general fighter training in initial skill classes. In advanced skill classes, he will train on a particular fighter aircraft. Prior service personnel replacing unit personnel are assumed to be already fully trained, and thus no training costs are calculated. (If this assumption is incorrect for a particular problem, additional training costs can be included for prior service personnel.) However, for nonprior service personnel replacing unit personnel, the costs of advanced skill training include the same components as for initial skill: pay, allowances, travel expenses, and subsistence of students while attending courses; pay, allowances, travel expenses, and subsistence of instructors; materials used during instruction including ammunition; and the costs of any variable support used during instruction including utilities and support personnel. Force overhead costs are not included. Cost should be based on the number of graduates, taking into account the cost of personnel who drop out prior to completion of course work.

VARIANCES: Advanced skill training costs per person vary by Service and by officer and enlisted. They do not vary by component within a Service, as all personnel take the same courses. However, costs will vary significantly by skill area; at a minimum, flying skills must be distinguished as they are much more expensive to train than others. As a consequence, different types of units will likely have different average skill training costs, because different units require different mixes of skills.

Finally, the total cost will vary based on how unit personnel are defined and their turnover rate within the unit. See the data sheets, "Personnel Strength: Unit Level" and "Military Training: Advanced Skill Turnover" for information on the variance of those variables.

ESTIMATING EQUATION: Advanced skill training costs are used to estimate annual recurring costs as: Summed over major skill areas:

$$\begin{aligned} & (\text{Number of officers in skill area}) * (\text{Cost/officer in skill area}) * \\ & \quad (\text{Advanced skill area turnover}) \text{ and} \\ & (\text{Number of enlisted in skill area}) * (\text{Cost/enlisted in skill area}) * \\ & \quad (\text{Advanced skill turnover}) \end{aligned}$$

For further information on the number of personnel and turnover rates, see the data sheets, "Personnel Strength: Unit Level" and "Military Training: Advanced Skill Turnover."

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. The minimum level is by average officer and enlisted within a Service with a flying/nonflying skill breakdown. Further breakdowns will be by subelement or by skill area.

PUBLISHED DATA SOURCES: These costs are not routinely tracked in the form desirable, but can be roughly estimated from the following sources. Flying-related skill costs are much more accurately tracked and generally available. Service cost models have some detail on average officer and enlisted costs. *U.S. Air Force Cost and Planning Factors* gives skill area breakdowns for flying-related skills, especially variances by type of aircraft. Army cost models have average officer and enlisted costs, but no skill breakdowns. The costs are aggregated with initial skill training. In addition, the Services have unpublished databases that can be used to track some of these costs on a skill-by-skill, or course-by-course basis. Using these databases is a labor intensive process.

OFFICES: To arrive at more detailed estimates than those possible with published documents, the offices in Tables 3.1, 3.2, and 3.3 should be contacted.

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.

U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.

Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSOC)*, Washington, D.C., various years.

SUPPORT RELATED

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Each unit annually uses some of the support provided by the Service or installation as a whole, including base rentals, utilities, communications, computer operations, and medical facilities. The support is in part fixed by the size and needs of the Service as a whole and is not attributable to a specific unit. However, some part of support is directly attributable to a unit at a specific location and varies by the size of the unit. The variable portion of support costs should be included in the O&M costs of a unit. It has been estimated on a per person basis because much of the support is "people" related.

However, these types of costs remain difficult to track because Service accounting practices do not distinguish unit usage. Thus, two cautions must be stated. First, although the element should include only variable costs, it is often impossible to remove fixed costs from the estimate. Second, although the cost element is usually estimated on a per person basis, the cost may vary in other dimensions. As unit costing improves, the respecification of this element will be necessary.

VARIANCES: As currently estimated, this cost varies by Service and component on a per person basis. Unit officers, enlisted, civilians, and support personnel incur this cost at the same annual rate. However, the cost may vary in other dimensions.

ESTIMATING EQUATION: Total annual amount for a unit is calculated as: Summed over all unit and unit support personnel:

$$(\text{Average cost/person}) * (\text{Number of people})$$

For further information on the number of personnel, see the data sheet, "Personnel Strength: Unit Level."

LEVEL OF DETAIL: The analyst will usually confine this factor to a low level of detail—that is, on a per person basis with no distinctions by type of person. However, as better techniques are developed, it may prove possible to distinguish this support-related factor by type of unit.

PUBLISHED DATA SOURCES: Only the Air Force publishes a support-related factor (AF Regulation 173-13). Support can be estimated for the other Services by using support costs from the operation and maintenance budget and dividing by total personnel. If possible, those support costs determined as fixed should be eliminated from the calculation. A RAND document (R-3210-RA) shows one approach to the calculation.

OFFICES: Tables 3.1, 3.2, and 3.3 provide offices that can be contacted for further information.

References

Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.

Schank, J., S. J. Bodilly, R. Y. Pei, *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, The RAND Corporation, R-3210-RA, March 1986.

See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel and operation and maintenance for the appropriate fiscal year.

PERSONNEL STRENGTH: UNIT LEVEL

Item Type: **Resource Factor**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: Most cost calculations require multiplying a cost factor by the number of personnel to which it applies. When referring to the operation of a unit, all mission-related functions should be included in the unit strength, including operators, administrators, maintenance, and support. Special calculations of unit strength may have to be made because the Services have no standard approach as to the definition of a unit, especially to the extent maintenance and support personnel are included in the unit definition. (Support personnel are discussed further on the next data sheet.) In addition, a decision must be made as to what measure of unit personnel will be used: requirements, authorizations, or assignments. For further discussion of those levels of measurement, see Sec. II.

In addition, costing models often require that unit personnel strengths be disaggregated to identify different types of personnel, perhaps numbers of officers and enlisted, number within grade, number within occupational specialty, numbers of types of full-time and part-time members, and numbers of military versus civilian members.

For further information on the number and types of unit personnel, see "Types of Personnel" and "Numbers of Personnel" earlier in Sec. III.

VARIANCES: Personnel strengths vary by type of unit—some are very labor intensive. Types of units vary by Service and component; thus, it is necessary to use unit-specific personnel strengths. Moreover, personnel strengths vary by how they are measured. Typical strengths for a type unit may be used, although location- and time-specific strengths are also often available. Also, see the discussion of requirements, authorizations, and assignments in Sec. II.

Finally, some Services man similar type units at different levels depending on when the unit deploys. In the Army this is called an

authorized level of organization (ALO). The differences in ALOs must be explicitly recognized in the cost analysis.

ESTIMATING EQUATION: The unit personnel strengths are used in many calculations, including those for pay and allowances, contributions, benefits, social security, retirements, training, and recruiting. The specific formula will vary for each, but in general the strengths are used as follows: Summed over each type of personnel:

(Personnel strength in the category) * (Costs/person in that category)

LEVEL OF DETAIL: At a minimum, it is necessary to identify a consistent measure of personnel strength and to distinguish the ALO level of a given type of unit. Further, it will also be necessary to distinguish personnel on the basis of officer and enlisted, full-time or part-time, military or civilian, and broad categories of occupational specialties as they affect pay or costs. For instance, flight-rated personnel should always be identified. The analyst can use greater level of detail as needed, including identifying strengths by pay grade and occupational specialty code.

PUBLISHED DATA SOURCES: Both active and reserve unit personnel strengths can be obtained from unit manning documents, tables of organization and equipment, and tables of organization and allowances that are available from each Service. Service cost models also show typical unit strengths, but usually not with the detail needed.

OFFICES: Tables 3.1, 3.2, and 3.3 show offices that can be contacted for further information and for internal, unpublished sources.

References

- Department of the Air Force, Extended Unit Manpower documents.
- Department of the Army, Table of Organization and Equipment.
- Department of the Navy, Manpower Authorization Form (1000/2).
- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.

PERSONNEL STRENGTH: UNIT LEVEL SUPPORT

Item Type: **Resource Factor**

Cost Type: **Personnel Related**
Annual Recurring Cost

Service(s): **Air Force, Army, Navy**

DEFINITION: Unit support on a base is provided by personnel not necessarily associated with the unit. Full costing of a unit's activity requires that some part of supporting personnel pay be attributed to the unit. Unit configuration may or may not include these personnel, but in either case, they must be costed. For instance, in Army units many of the "support" people, like cooks and police, are included in the unit. The same is true for Navy ship units. Units in the Air Force, however, may not include the supporting personnel. Thus, the analyst must determine if support personnel are included in the unit manning. If not, some portion of base support personnel must be costed to the unit's support. Support personnel are usually full-time military or civilians, but further breakdown by type of personnel as described under unit personnel may be necessary for a full costing.

VARIANCES: Like unit strengths, personnel support will vary by type of unit in each Service and component; therefore, unit-specific support strengths must be used. In addition, the number of support personnel can vary by base location. For example, in the Air Force, a unit that is colocated with others will have a different number of support personnel than a unit on a base by itself. Further, for Air Reserve units, the number of support personnel can vary dramatically by base location.

ESTIMATING EQUATION: Unit support personnel must be costed with unit personnel to produce the full annual operating and support cost of a unit. Support personnel receive the same pay and allowances of other military or civilian personnel. The strengths are used as follows: Summed over each type of personnel:

(Personnel strength in category) * (Cost/person in category)

LEVEL OF DETAIL: See discussion for unit personnel strengths.

PUBLISHED DATA SOURCES: See discussion for unit personnel strength. If support personnel are not included in manning documents, it may be necessary to estimate support personnel by allocating some portion of base support personnel to the specific unit. RAND report R-3210-RA shows alternative methods for doing this.

OFFICES: See discussion for unit personnel strengths.

References

- Department of the Air Force, Extended Unit Manpower documents.
Department of the Army, Table of Organization and Equipment.
Department of the Navy, Manpower Authorization Form (1000/2).
Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.
Schank, J. F., S. J. Bodilly, R. Y. Pei, *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, The RAND Corporation, R-3210-RA, March 1986.

MILITARY ACQUISITION: ACQUISITION TURNOVER

Item Type: **Resource Factor**

Cost Type: **Personnel Related**

Annual Recurring Cost

Service(s): **Air Force, Army, Navy**

DEFINITION: To compute the cost of replacing unit personnel who normally turn over during a year, acquisition cost elements (see the data sheets, "Military Acquisition for Replacement: Recruiting and Processing" and "Military Acquisition: Recruiting and Basic Training") are multiplied by an acquisition turnover factor. This factor represents the percentage of unit personnel who are expected to be replaced or turned over in a year. The number or percentage of replacements to be acquired is a function of the turnover rate within a component and the proportion of that turnover that is filled by non-prior service personnel. If filled by qualified prior service personnel, then the turnover factor is assumed to be zero with no training costs resulting. Turnover factors should be based on losses from the Service to reflect replacement rather than gains that reflect growth.

VARIANCES: Acquisition turnover varies by Service and by component. Since the reserve force recruits large numbers of prior service individuals who were trained during an active career, some replacement personnel in reserve units will not require training. The prior service gains by the reserve force along with higher retention rates help reduce turnover rates. Turnover rates also vary significantly by officer and enlisted personnel. Therefore, turnover rates should vary, at a minimum, by Service, component, and officer and enlisted. Skill area variances are not appropriate for acquisition turnover.

In addition, turnovers may fluctuate from year to year due to economic factors, recruiting efforts, and the national situation. If typical factors not specific to any year are desired, the turnover factor should be developed using several years of data to minimize yearly fluctuations.

ESTIMATING EQUATIONS: Acquisition turnover is estimated specific to each component and on an officer and enlisted basis as:

$$\begin{aligned} & (\text{Losses/average personnel strength}) * \\ & (\text{Nonprior service gains/average gains}) \end{aligned}$$

Acquisition turnover factors are used to estimate annual recurring personnel costs for each component as:

$$\begin{aligned} & (\text{Number of officers}) * (\text{Acquisition cost/officer}) * \\ & (\text{Officer acquisition turnover}) \text{ and} \\ & (\text{Number of enlisted}) * (\text{Acquisition cost/enlisted}) * \\ & (\text{Enlisted acquisition turnover}) \end{aligned}$$

LEVEL OF DETAIL: It is usually appropriate to estimate this cost on a component officer, and enlisted basis; however, if the analyst has factors appropriate to a unit, then they should be used.

PUBLISHED DATA SOURCES: The *Military Manpower Training Report* provides student loads for acquisition under the categories of recruit training and officer acquisition training. These can be divided by average strengths to develop turnover factors. The numbers would not need to be multiplied by a nonprior service ratio, as it is taken into account by using student loads. Each component's budget also contains information on number of personnel recruited, average strengths, and number of nonprior service gains. These numbers can be used to develop the factors. Since several years' worth of data are available, the numbers can be used to smooth out yearly fluctuations.

OFFICES: The offices in Tables 3.1, 3.2, and 3.3 can be contacted for further information pipelines of people in the components.

References

Department of Defense, *Military Manpower Training Report for FYxx*, Office of the Assistant Secretary of Defense (Force Management and Personnel), FYxx.

See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY TRAINING: INITIAL SKILL TURNOVER

Item Type: **Resource Factor**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: To compute the cost of replacing unit personnel who normally turn over during a year, the initial skill cost element (see the data sheet, "Military Training for Replacement: Initial Skill") is multiplied by an initial skill turnover factor. This factor represents the percentage of unit personnel who are expected to need replacement training in that skill area. The number or percentage of replacements to be acquired is a function of the turnover rate within a skill area and the percentage of that turnover that is filled with nonprior service personnel. If filled by qualified, prior service personnel, the turnover factor is assumed to be zero with no training costs resulting. Turnover factors should be based on losses to reflect replacement rather than gains that reflect growth.

VARIANCES: The initial skill turnover varies by Service and component. Since the reserve force recruits large numbers of prior service personnel who were trained during an active career, some replacement personnel will not require initial skill training. The prior service gains by the reserve force, along with higher retention rates, help to reduce reserve turnover factors. Turnover rates also vary significantly by officer and enlisted personnel and by skill area. It is especially important to distinguish between flying and nonflying skills.

In addition, turnovers may fluctuate from year to year due to economic factors, recruiting efforts, and the national situation. If typical factors are desired, turnover factors should be developed using several years of data to minimize yearly fluctuations.

ESTIMATING EQUATION: Initial skill turnover can be developed using officer and enlisted training pipeline flows specific to a component and by dividing the number of students in a skill area pipeline by the average number of personnel in that skill area. If the actual

pipeline numbers are not available, turnover can be estimated on a component, officer, and enlisted basis for each major skill area as:

$$\begin{aligned} & (\text{Losses/average personnel strengths}) * \\ & (\text{Nonprior service gains/average gains}) \end{aligned}$$

Initial skill turnover factors are used to estimate annual recurring personnel costs for each skill area as:

$$\begin{aligned} & (\text{Number of officers in skill area}) * (\text{Cost/officer in skill area}) * \\ & (\text{Officer initial skill turnover for skill area}) \text{ and} \\ & (\text{Number of enlisted in skill area}) * (\text{Cost/officer in skill area}) * \\ & (\text{Enlisted initial skill turnover}) \end{aligned}$$

LEVEL OF DETAIL: This factor can be estimated at any level of detail appropriate to the analyst. A minimum is by Service component, on an officer and enlisted basis. If further information is available, skill area-specific factors should be used. If information is available on turnover in a particular unit, and the analysis applied only to that unit, then unit-specific turnovers might be adopted.

PUBLISHED DATA SOURCES: These factors are not always available at the level of detail that may be desired. The *Military Manpower Training Report* provides numbers of student loads for initial skill training. These can be divided by average personnel strengths to develop turnover factors. The numbers would not need to be multiplied by a nonprior service ratio, as it is taken into account in the numbers. This reference does not contain major skill area breakdowns.

Each component's budget also contains information on number of personnel recruited, average strengths, and number of nonprior service gains. They can be used for very general factors. No skill area breakdowns are provided and the numbers are not specific to the initial skill training stage.

Each Service cost model contains factors that could be appropriately used, although they may not be specific to the initial skill training stage or contain skill area breakdowns.

OFFICES: The offices in Tables 3.1, 3.2, and 3.3 can be contacted for further information.

References

Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.

Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.

Department of Defense, *Military Manpower Training Report for FYxx*, Office of the Assistant Secretary of Defense (Force Management and Personnel), FYxx.

Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.

U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.

See App. B for references to each Service's and component's Justification of Estimates, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY TRAINING: ADVANCED SKILL TURNOVER

Item Type: **Resource Factor**
Cost Type: **Personnel Related**
Annual Recurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: To compute the cost of replacing unit personnel who normally turn over during a year, the advanced skill cost element (see the data sheet, "Military Training for Replacement: Advanced Skill") is multiplied by an advanced skill turnover factor. This factor represents the percentage of unit personnel who are expected to need replacement training in that skill area. The number or percentage of replacements to be acquired is a function of the turnover rate within a skill area and the percentage of that turnover that is filled with non-prior service personnel. If filled by qualified, prior service personnel, then the turnover factor is assumed to be zero with no training costs resulting. Turnover factors should be based on losses to reflect replacement rather than gains that reflect growth.

VARIANCES: The advanced skill turnover varies by Service and component. Since the reserve force recruits large numbers of prior service personnel who were trained during an active career, some replacement personnel will not require advanced skill training. The prior service gains by the reserve force, along with higher retention rates, help to reduce reserve turnover factors. Turnover rates also vary significantly by officer and enlisted personnel and by skill area. It is especially important to distinguish between flying and nonflying skills.

ESTIMATING EQUATION: Advanced skill turnover can be developed using officer and enlisted training pipeline flows specific to a component and skill. The number of students in a skill area is divided by the average number of personnel in the skill area. If actual student loads are not available, turnover can be estimated on a component and officer and enlisted basis for major skill areas in a component as:

$$\frac{(\text{Losses/average strength}) *}{(\text{Nonprior service gains/average strengths})}$$

Advanced training turnover factors are used to estimate annual recurring costs for each skill area as:

$$\begin{aligned} & (\text{Number of officers in skill area}) * \\ & (\text{Advanced training costs/officer in skill area}) * \\ & (\text{Officer advanced training turnover in skill area}) \text{ and} \\ & (\text{Number of enlisted in skill area}) * \\ & (\text{Advanced training cost/enlisted in skill area}) * \\ & (\text{Enlisted advanced training turnover in skill area}) \end{aligned}$$

LEVEL OF DETAIL: Level of detail for this factor is the same as that for initial skill turnover.

PUBLISHED DATA SOURCES: Published sources are the same as for the initial skill factor, except that in the *Military Manpower Training Report* the student pipeline for this factor is found under the specialized skill training, skill progression training category.

OFFICES: Tables 3.1, 3.2, and 3.3 show the offices that can be contacted for further information.

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.
- See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.
- Department of Defense, *Military Manpower Training Report for FYxx*, Office of the Assistant Secretary of Defense (Force Management and Personnel), FYxx.

MILITARY ACQUISITION: RECRUITING AND BASIC TRAINING

Item Type: **Cost Element**

Cost Type: **Personnel Related
Nonrecurring Cost**

Service(s): **Air Force, Army, Navy**

DEFINITION: The costs of a force structure change may include nonrecurring costs for the acquisition of new personnel, including those for recruiting and basic training. New acquisitions that are nonprior service personnel must be recruited and processed and attend basic training before going to a unit. The costs include advertising expenses; pay, allowances, and travel of recruiters; costs of processing recruits; initial clothing and equipment; pay, allowances, travel, and subsistence for students and instructors; costs of materials during instruction; and any variable support provided during acquisition and basic training. If appropriate to the problem, the costs associated with the Service academies, ROTC, OTS, and the enlisted commissioning programs are also included, although these apply only to officers. This cost element should not include any force overhead cost, but only costs that vary by the student load. Further, the cost should be based on the number of graduates, taking into account the cost of recruits who drop out prior to completing the course work.

VARIANCES: Recruiting and processing costs per recruit vary by Service and component, and are significantly different for officers and enlisted personnel. The cost to send a recruit through basic training varies by Service, but not component, as all recruits have the same training. Basic training costs vary by officer and enlisted. Neither recruiting nor basic training costs vary by skill area. Finally, the cost of recruitment and basic training will depend on the number of non-prior service personnel that are obtained. See the data sheet, "Military Acquisition: Acquisition Change" for further information.

ESTIMATING EQUATION: Recruiting and basic training costs are added together to obtain acquisition costs, which are expressed on

an officer and enlisted basis within a component. Nonrecurring costs associated with a force change are estimated as:

$$\begin{aligned} & (\text{Number of nonprior service officers acquired}) * \\ & \quad (\text{Acquisition cost/officer}) \text{ and} \\ & (\text{Number of nonprior service enlisted acquired}) * \\ & \quad (\text{Acquisition cost/enlisted}) \end{aligned}$$

For additional information on the number of personnel acquired, see the data sheet, "Military Acquisition: Acquisition Change."

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. The minimum level should be by Service and component with an officer and enlisted breakdown. Further breakdowns will be by subelement, not by grade or skill.

PUBLISHED DATA SOURCES: These costs are not routinely tracked in the form desirable, but can be roughly estimated. See discussion in (refer to index in App. B) Annual Recurring Cost Section I.A. under Military Acquisition of Replacement Personnel: Recruiting and Processing; and Military Acquisition of Replacement Personnel: Basic Training. The elements are the same.

OFFICES: See discussion under Annual Recurring Cost Model; Personnel Cost Element: Acquisition: Recruiting and Processing and Basic Skill Acquisition (refer to App. B).

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.
- See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY TRAINING: INITIAL SKILL

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Nonrecurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: The costs of a force structure change may include nonrecurring costs for the training of personnel, including initial skill training. After basic training, each recruit attends initial skill training courses to qualify for a general military occupational category. In addition, some prior service personnel or existing unit personnel may require cross-training to fit the changed unit's skill needs. The costs of initial skill training include pay, allowances, travel, and subsistence of students while attending training; pay, allowances, travel, and subsistence of instructors; course materials; and any variable support costs incurred during training. Force overhead costs are not included. Costs should be based on the number of graduates, taking into account the cost of personnel who drop out prior to the completion of course work.

VARIANCES: Initial skill training costs per soldier vary by Service and by skill area. Costs do not vary by component within a Service as all personnel take the same courses. Costs vary significantly by officer and enlisted and by skill area. Flying skills are especially expensive to train.

Finally, initial skill training costs depend on the number of personnel that will require that training, as opposed to the number of new people required. The number of new people required must be adjusted by the number of prior service people that can be obtained and the number of other attendees requiring cross-training. See the data sheet, "Military Training: Initial Skill Change" for further information.

ESTIMATING EQUATION: Initial skill training costs are used in nonrecurring cost calculations and should be applied to all people from the unit receiving training, including those receiving cross-training in a new skill area. Summed over major skill areas:

(Number of nonprior service officers in acquired skill area
+ number of other officers attending) *

(Initial skill cost/officer in skill area) and
 (Number of nonprior service enlisted acquired in skill area
 + number of other enlisted attending) *
 (Initial skill cost/enlisted in skill area)

For additional information on the number of people requiring training, see the the data sheet, "Military Training: Initial Skill Change."

LEVEL OF DETAIL: Costs can be estimated at any level appropriate to the analyst. The minimum level is on an average officer and enlisted basis within a Service with a flying/nonflying skill breakdown. Further breakdowns will be by subelement or skill area.

PUBLISHED DATA SOURCES: These costs are not routinely tracked in the form desirable, but can be roughly estimated. As the costs included are the same, see discussion in (refer to App. B) Annual Recurring Cost Section I.A. under Military Training: Initial Skill.

OFFICES: See offices listed in Tables 3.1, 3.2, and 3.3.

References

- Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.
- Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.
- U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.
- Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C., various years.

MILITARY TRAINING: ADVANCED SKILL

Item Type: **Cost Element**
Cost Type: **Personnel Related**
Nonrecurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: The costs of a force structure change may include nonrecurring costs for the training of personnel, including advanced skill training. Advanced skill training qualifies a person for a specific skill area. For instance, a pilot may have obtained general fighter training in initial skill. In advanced skill he will train on a particular fighter aircraft. The costs of advanced skill training include pay, allowances, travel, and subsistence of students and instructors; materials used during instruction, including ammunition; and variable support for instruction, including utilities and support personnel. Force overhead costs are not included. Costs should be based on the number of graduates, taking into account the costs of personnel who drop out prior to completion of course work.

The force change being considered may require that advanced training be given to newly acquired nonprior service personnel, prior service personnel acquired from other units, and existing unit personnel not qualified in the occupational categories now needed in the unit. Advanced training for nonprior service personnel takes place in formal schools. Advanced training for prior service personnel may be accomplished by formal school, field training days, or on-the-job training.

VARIANCES: Advanced skill training costs per soldier vary by Service and by skill area. Costs do not vary by component within a Service as all personnel take the same courses. Costs vary significantly by officer and enlisted and by skill area. Flying skills are especially expensive to train.

Further, initial skill training costs depend on the number of personnel that will require that training, as opposed to the number of new people required. The number of new people required must be adjusted by the number of prior service people that can be obtained and the number of other attendees requiring cross-training. See the data sheet, "Military Training: Advanced Skill Change" for further information.

Finally, advanced skill training costs vary by the manner in which they are provided:

- Formal school training—The student attends formal school and there is no variance between components, but average costs vary by skill area.
- Field training days—An instruction team is temporarily sent to a unit to provide the instruction needed. Costs will vary on a case-by-case basis depending on the number of instructors sent, costs to send them, time spent at the unit, whether unit personnel receive additional training drill days to accomplish the training, and the materials used by the course.
- On-the-job training—Already trained unit personnel provide instruction to untrained personnel while performing the unit mission. There are no costs associated with this manner of training.

ESTIMATING EQUATION: The uniqueness of every change will affect the cost-estimating relationship. In general, each category of cost element is multiplied by the number of personnel who fit into that category, including newly acquired personnel and existing unit personnel who are receiving cross-training in a new skill.

Formal school, by skill area:

(Number of nonprior service officers acquired + others attending) *
(Costs/officer in skill area) and
(Number of nonprior service enlisted acquired + others attending) *
(Cost/enlisted in skill area)

Field training days, by skill area:

(Number of officers attending) * (Average cost/officer in skill area) and
(Number of enlisted attending) * (Average cost/enlisted in skill area)

On-the-job training: No costs.

For additional information on the number of people requiring training, see the the data sheet, "Military Training: Advanced Skill Change."

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. At a minimum, costs should be specified on an officer and enlisted basis, by skill area, and by the manner of training. Further detail will be by skill area or subelement.

PUBLISHED DATA SOURCES: For formal school training costs, see discussion in Annual Recurring Cost Section I.A. under Military Training of Replacement Personnel: Advanced. The costs associated

with field training days are not currently known, and are not available in any published document.

OFFICES: Information can be obtained by contacting the offices shown in Tables 3.1, 3.2, and 3.3.

References

Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C., February 1986.

Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.

U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C., December 1984.

Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSOC)*, Washington, D.C., various years.

MILITARY ACQUISITION: ACQUISITION CHANGE

Item Type: **Resource Factor**
Cost Type: **Personnel Related**
Nonrecurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: The force change being considered may require the acquisition of personnel to fill out the changed unit to manning requirements. To compute the costs of military acquisition (see the data sheet, "Military Acquisition: Recruiting and Basic Training"), the cost per person must be multiplied by the number of nonprior service personnel who will join the unit as a result of the change. Prior service personnel are assumed to have already been acquired and not to have associated acquisition costs. The acquisition change should include unit and support strength increases or decreases.

VARIANCE: The number of people to be acquired will vary for each change considered. Therefore, strengths should be unit, location, and time specific.

ESTIMATING EQUATION: If actual changes are not available, unit manning documents can be used with component-specific nonprior service turnovers to determine the acquisition changes. The following calculations are necessary.

(Number of officers in old unit – number of officers in new unit) *
(Nonprior service officer gains/average officer gains)
(Number of enlisted in old unit – number of enlisted in new unit) *
(Nonprior service enlisted gains/average enlisted gains)

The acquisition change in personnel is used in the nonrecurring cost calculation as follows. On an officer and enlisted basis:

(Number of nonprior service officers acquired) *
(Acquisition cost/officer) and
(Number of nonprior service enlisted acquired) *
(Acquisition cost/enlisted)

LEVEL OF DETAIL: Since acquisition costs vary by component and on an officer and enlisted basis, the personnel acquisition change should also be specified at this level.

PUBLISHED DATA SOURCES: The unit and support personnel change can be determined using unit manning documents when the change is programmed or involves existing units. These documents provide typical unit manning figures and do not reflect the slow buildup or drawdown of personnel over several years associated with most changes. Component gains for determining a nonprior service turnover can be found in any of the Service budgets.

OFFICES: For location- and time-specific information, it is necessary to contact the offices in Tables 3.1, 3.2, and 3.3. They can also provide information for those changes that are new to the force and for which typical strengths plans have not yet been developed.

References

Department of the Air Force, Extended Unit Manpower documents.
Department of the Army, Table of Organization and Equipment.
Department of the Navy, Manpower Authorization Form (1000/2).
See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY TRAINING: INITIAL SKILL CHANGE

Item Type: **Resource Factor**

Cost Type: **Personnel Related
Nonrecurring Cost**

Service(s): **Air Force, Army, Navy**

DEFINITION: The force change being considered may require the acquisition and training of personnel to fill out the changed unit to new manning requirements. Each nonprior service person acquired by the unit will participate in initial skill training after recruitment and basic training. In addition, some existing unit personnel may require cross-training in a new specialty. To account for the costs of initial skill training (see the data sheet, "Military Training: Initial Skill"), the costs per person must be multiplied by the number of nonprior service personnel acquired and the number of additional persons requiring training. Both unit and unit support personnel should be included in the calculation.

VARIANCE: The change in personnel strengths must be specific to the force change.

ESTIMATING EQUATIONS: If actual changes are not available, unit manning documents can be used with component-specific non-prior service turnovers to determine initial skill training changes. The calculations by skill area are:

$$\begin{aligned} & (\text{Number of officers in old unit} - \text{number of officers in new unit}) * \\ & \quad (\text{Nonprior service officer gains/average officer gains}) \\ & (\text{Number of enlisted in old unit} - \text{number of enlisted in new unit}) * \\ & \quad (\text{Nonprior service enlisted gains/average enlisted gains}) \end{aligned}$$

The initial skill change in personnel is used in the nonrecurring cost calculations as follows. Summed over each major skill area:

$$\begin{aligned} & (\text{Number nonprior service officers acquired in skill area}) * \\ & \quad (\text{Initial skill cost/officer in skill area}) \text{ and} \\ & (\text{Number nonprior service enlisted acquired in skill area}) * \\ & \quad (\text{Initial skill cost/enlisted in skill area}) \end{aligned}$$

LEVEL OF DETAIL: Since initial skill training varies at a minimum on an officer and enlisted basis by major skill areas, the initial skill change should also be specified at this level. Further breakdowns would be by detailed occupational categories or by subelement. The changes must be specific to a particular change, location, and time.

PUBLISHED DATA SOURCES: The unit and support personnel change can be determined using the unit manning documents when the change is programmed or involves existing units. These documents provide typical unit manning figures and do not reflect the slow build-up or draw-down of personnel over time typical of most changes. In addition, the documents are not location-specific. Location- and time-specific information can be obtained from the offices in Tables 3.1, 3.2, and 3.3, and are preferable sources. Component gains for determining a nonprior service turnover are estimated using the Service budgets.

OFFICES: For location- and time-specific information, the offices in Tables 3.1, 3.2, and 3.3 should be contacted. They can also provide information on changes new to the force and for which typical strength plans have not yet been developed.

References

Department of the Air Force, Extended Unit Manpower documents.
Department of the Army, Table of Organization and Equipment.
Department of the Navy, Manpower Authorization Form (1000/2).
See App. B for references to each Service's and component's *Justification of Estimates*, also known as Budget Justifications, for personnel for the appropriate fiscal year.

MILITARY TRAINING: ADVANCED SKILL CHANGE

Item Type: **Resource Factor**
Cost Type: **Personnel Related**
Nonrecurring Cost
Service(s): **Air Force, Army, Navy**

DEFINITION: The force change being considered may require the training of personnel in the unit to be qualified for a new occupation or weapon system (cross-training) or, if the person is newly acquired, to initially qualify for an occupation. To compute the costs of advanced military training (see the data sheet "Military Training: Advanced Skill"), the cost per person must be multiplied by the number of people who must receive skill training as a result of the change. Both unit and unit support personnel should be included in the change.

VARIANCES: The number of personnel receiving training will be unique to the unit change. In general, however, the Services rely heavily on formal school and field training days for full-time personnel and on-the-job training for part-time personnel. Further, all non-prior service acquisitions will receive formal school advanced skill training.

ESTIMATING EQUATION: The training change in personnel, summed over all skill areas and types of personnel, is used in the non-recurring cost calculation as:

Formal school, by skill area:

(Number of nonprior service officers acquired + others attending) *
(Costs/officer in skill area) and
(Number of nonprior service enlisted acquired + others attending) *
(Costs/enlisted in skill area)

Field training days, by skill area:

(Number of officers attending) * (Average cost/officer in skill area) and
(Number of enlisted attending) * (Average cost/enlisted in skill area)

LEVEL OF DETAIL: Costs can be estimated at any level of detail appropriate to the analyst. At a minimum, changes should be

expressed for officers and enlisted, by major skill area, and manner of training. The changes must be specific to a particular change, location, and time.

PUBLISHED DATA SOURCES: There are no published data sources for this factor. Each unit change requires the preparation of a "Unit Training Plan" that specifies the number of personnel training, the manner of training, and the courses necessary. The training plan can be used to construct the necessary factors. Plans are available from the offices listed in Tables 3.1, 3.2, and 3.3.

OFFICES: For further information, contact the offices in Tables 3.1, 3.2, and 3.3.

IV. EQUIPMENT COSTS

This section describes the estimation of nonrecurring and annual recurring unit equipment costs. Also included in this category are the nonrecurring costs of facilities construction. The appropriate equipment cost elements and the estimating techniques depend on the specific military Service. Because of the differences between the Services in organization structure and in providing maintenance support, and the differences in available models and data sources, there are three subsections on equipment cost estimating—one each for the Air Force, Army, and Navy. Furthermore, the Navy section is composed of separate subsections for aviation units and ships.

TYPES OF COST

Nonrecurring Costs

The nonrecurring costs in this section include two broad categories—the procurement cost of the necessary unit equipment, spare parts, and training ordnance; and the costs of constructing or modifying any facilities necessary for unit personnel or equipment operations and maintenance. The unit equipment of interest includes the major weapon system(s),¹ support equipment, test equipment, and training equipment and devices. Facilities include hangars, runways, maintenance buildings and shops, administration buildings, and personnel-related buildings such as barracks, dining halls, commissaries, and the like.

The first step in estimating the nonrecurring costs is to determine the numbers and types of equipment that must be procured and the numbers and types of buildings that must be built or modified. The answers to these questions are greatly dependent on the circumstances of a specific decision. For example, if the decision involves a comparison of active and reserve units with the same type and quantity of equipment, then the cost of that equipment need not be considered in the decision analysis. If, however, the decision involves comparisons of alternatives where different quantities of equipment will be required, the procurement cost of that equipment should be included in the cost estimate.

¹Note, however, that the procurement cost of major weapon systems is rarely a factor in active/reserve force mix decisions.

Other factors that must be considered when determining the numbers of unit equipment and facilities include whether resources may be available from existing inventories (especially when there is a transfer from the active to the reserve forces), and whether the dispersed peacetime basing of reserve units causes diseconomies of scale in equipment requirements.

Annual Recurring Costs

Annual recurring equipment costs include a number of elements, such as the following:

Consumables

- Petroleum, oil, lubricants
- Maintenance supplies
- Training ordnance

Sustaining investment

- Replacement support equipment
- Modifications
- Replenishment spares

Depot level maintenance

- Overhaul
- Component repair
- Engine repair

Contractor unit level support

The total equipment operations and maintenance cost includes both fixed costs, depending only on the numbers and types of equipment, and variable costs that are a function of the peacetime activity level of the equipment. For example, scheduled depot level maintenance for aircraft and ship overhauls is programmed on a calendar basis, independent of the operating levels between maintenance actions. These elements of cost are fixed. In contrast, fuel consumption depends on how often the equipment is used. Therefore, fuel represents a variable element of annual equipment operating cost.

Usually, the fixed equipment costs are the same for similar equipment in active and reserve units; that is, the scheduled actions must be performed regardless of which component is using the equipment. In contrast, the variable elements of equipment cost usually differ for similar active and reserve units, because peacetime activity levels usually vary between the two components. In addition, the cost per operating measure may not be equal for active and reserve operations.

For example, the fuel cost per flying hour for a given type of aircraft may differ for active and reserve operations.²

The methodology for estimating the annual recurring cost of equipment involves combining fixed or variable cost factors with resource factors like equipment levels or programmed peacetime usage rates. Therefore, at a minimum, the cost analyst must have established a set of appropriate cost factors, and have a knowledge of the numbers and types of unit equipment and the activity levels of that equipment in peacetime. Other variables that can affect certain elements of annual equipment cost include the number of crews and the number of personnel in the unit.

SERVICE DIFFERENCES

The military Services organize units and provide equipment maintenance in different ways. To maintain consistency when comparing alternatives involving different Services and to ensure the completeness of the cost estimates, it is necessary to understand these differences in maintenance philosophies.

Levels of Maintenance

Equipment maintenance is typically segregated into three levels—organizational, intermediate, and depot. Organizational maintenance is provided by unit personnel and involves minor corrective and preventive maintenance procedures plus the removal and replacement of broken subsystems. When the maintenance action is beyond the capability of the organizational level, the failed component is sent to a higher level for repair. Intermediate level maintenance performs the repair functions that cannot be accomplished at the unit level. Therefore, a maintenance action may involve the removal of a failed subsystem by unit (organizational) personnel, who then send the component to the intermediate level for repair (and presumably replace the bad component with a good one drawn from supply).

Those repair actions that are beyond the capability of the intermediate level are sent to the depot for repair. The depot (which may be a contractor facility) possesses the highest degree of repair capability and typically can repair or rebuild any subsystem in the major weapon system. Depots are large, permanent industrial facilities employing mostly civilian personnel.

²However, before concluding that a cost factor differs between the components, care should be taken to ensure that apparent differences are not the result of differing accounting or funding procedures.

All the Services have organizational maintenance personnel within the unit structure. The depots for all the Services are beyond the unit and depot personnel are not "counted" toward the unit. For cost purposes, depot maintenance costs are estimated on a repair cost basis and not by separately costing depot personnel and repair parts. That is, depot maintenance costs are based on average fixed cost factors per major item of equipment or on variable cost factors per operating measure.

The differences between the Services in the maintenance area involve how intermediate level maintenance is provided. Below we explain those differences and the implications they have for the calculation of equipment cost elements.

Air Force Intermediate Level Maintenance

In the Air Force, intermediate level maintenance personnel are organized at the wing level and allocated to the individual squadrons that comprise the wing. Therefore, an Air Force unit (squadron) will include both organizational and intermediate maintenance personnel. When estimating equipment operating and support cost in the Air Force, no additives are required for intermediate level maintenance beyond the cost of repair parts.

Navy Intermediate Level Maintenance

The Navy provides intermediate level maintenance on an installation (a base or aircraft carrier) basis. Naval aviation units rely on a centralized Aviation Intermediate Maintenance Department (AIMD) for intermediate level repairs. The Naval Air Station or carrier AIMD supports all flying units stationed at the base or on board the carrier. The AIMD is composed of a permanent cadre of personnel who provide administrative and support equipment maintenance functions in addition to maintaining the repair facility. The permanent AIMD personnel may also provide some minor repair functions for the squadrons they support.

The permanent AIMD cadre is supplemented by unit personnel assigned on temporary duty to the AIMD. These TAD (temporary assigned duty) personnel are theoretically in the AIMD to perform the intermediate level repair of their squadron's components. In reality, they will repair components from any squadron.

Navy aviation squadrons, therefore, contain both organizational level personnel and personnel for the variable portion of intermediate level maintenance. What is missing from the squadron organization is

a share of the fixed AIMD cadre, which, as discussed in Sec. III, is handled under the "personnel" section of O&S costs. As for equipment O&S costs, Navy aviation units are like those in the Air Force—no additions are required for intermediate level maintenance, except the cost of repair parts.

Intermediate maintenance is provided to Navy ships on a centralized basis by Ship Intermediate Maintenance Activities (SIMAs). The difference between ships and aviation units is that the ship has no intermediate maintenance personnel; all intermediate maintenance personnel are assigned to the SIMA. When developing cost estimates for Navy ships, an appropriate SIMA "slice" must be included that covers both labor and material costs. Such an estimation is typically made on the basis of the average SIMA workload required for different classes of ships. The annual workload in man-hours is converted to numbers of people who are then costed using per capita factors.

Army Intermediate Level Maintenance

Like the Air Force and Navy, Army combat units contain organizational maintenance personnel. Intermediate level maintenance is provided by separate combat service support (CSS) units to all combat units in their area of responsibility. Direct Support (DS) units provide intermediate level maintenance on a division basis; General Support (GS) units provide intermediate level maintenance at echelons above the corps level. GS units typically are fixed installations in the far rear of the theater that possess the highest degree of intermediate level capability. DS units are semifixed facilities that move with the division.

The cost analysis of Army units must include an appropriate portion of DS and GS unit costs. Again, the "slice" must cover both labor and material costs. Such an allocation is often difficult because of the wide range of units and equipment supported by DS and GS units, and because data systems typically do not track DS and GS repair actions back to specific units or even to specific types of equipment. Analogies, rules of thumb, and subjective judgment often are used to estimate the unit maintenance for Army combat units.

COMPONENT DIFFERENCES

In addition to the differences in organizational structure and logistics support between the military Services, there are also differences between the active and reserve components.

Activity Levels

Similar active and reserve units will often differ in their peacetime equipment activity levels. Usually, reserve components will operate their equipment less frequently in peacetime than their active counterparts. For example, the authorized annual flying hours per aircraft (or per crew) for reserve component units will be less than the annual flying hours for active units.

Part of the difference in peacetime activity is due to the deployment schedules of the units. Active units are normally scheduled to deploy during the initial outbreak of hostilities and, therefore, must be fully trained and combat ready. Reserve units may follow later deployment schedules, allowing for additional training between activation and deployment.

Another factor contributing to the differences in equipment operating rates (and, therefore, equipment costs) is the experience levels of the crew members. Many reserve crew members are prior service personnel who have received extensive training during their active military careers. These more experienced operators require less training in peacetime than the relatively "new" crew members in active units. The lower equipment operating levels of reserve units result in lower annual recurring equipment operating costs compared with the costs of similar active units.³

Costs Per Activity Hour

Reserve units may have lower cost per operating measure than similar active units. For example, the POL cost per flying hour for a given type of aircraft can be less for reserve operations than for active operations, because of the experience of the reserve operators. A prime example is the reserve crew members of Air Force transport aircraft. Often these reservists not only have a significant amount of prior service experience but also are pilots for commercial airlines. Their long history of military and commercial experience helps them to operate the aircraft more efficiently than active aircrew members.

Unfortunately, few data collection and reporting systems differentiate between active and reserve equipment. Therefore, only average cost factors are normally available. The standard assumption adopted for cost analyses is that the fixed cost per item of equipment and the variable costs per operating measure are the same for similar active

³There are exceptions, however. Some types of reserve units, especially those with peacetime missions such as air defense and strategic aerial tankers, have the same (or higher) activity levels as their active counterparts.

and reserve units. If, however, separate factors are available, they should be incorporated into the cost analysis.

DATA SOURCES AND CONTACTS

Analysts can typically obtain data from a variety of sources, although each of those sources has disadvantages. Some Services publish documents or planning guides containing various cost factors on a per item of equipment and per operating measure basis. These planning guides are useful when the time frame for the cost exercise is short or if no other sources of data exist. Other, potentially more useful, sources of cost factor data include the various cost collection systems used by the specific Services. A disadvantage of using these collection systems is the requirement for multiple years worth of data to smooth out year-to-year fluctuations. Also, substantial effort may be required to assemble and analyze the raw data in order to develop the necessary aggregate factors.

Below, we discuss data sources and contacts in each of the Services.

Air Force

The Directorate of Cost and Management Analysis (AF/ACC) is a major focal point for cost analysis in the Air Force. The Cost Programs Division (ACCC) maintains a number of cost databases and annually publishes Air Force Regulation (AFR) 173-13, *U.S. Air Force Cost and Planning Factors*. AFR 173-13 contains information on unit compositions, personnel cost factors, and equipment activity levels and costs and is the single best source of compiled cost information in the Air Force.

AFR 173-13 also describes the Cost Oriented Resource Estimating (CORE) model. CORE, which serves as the basis for most of the cost sheets that follow, is a model for estimating the annual operating and support costs of active units. CORE is computerized and the personnel of ACCC can provide information on using the computer model.

The SABLE model is a time-phased version of CORE that is used in budget work. It also contains data on Air Reserve and National Guard aircraft that are not available in CORE.

AFR 173-13 contains separate tables of cost factors for budget year costs and for life-cycle costs. The budget year costs are specific to the previous budget period; the life-cycle costs are averages over the service life of the weapon system. Usually, the life-cycle costs are used for cost analysis purposes because they smooth out year-to-year

fluctuations. However, budget year cost factors may be appropriate if the analyst believes the previous year's cost will more accurately reflect the decision of interest.

The data in AFR 173-13 are planning factors based on aggregations of historical expenditures in various budget categories. The Visibility and Management of Operating and Support Costs (VAMOSOC) data system collects actual expenditures for the various aircraft in the Air Force inventory.⁴ The VAMOSOC system in the Air Force is broken into two subsystems—the Weapon System Support Cost System (WSSCS) and the Component Support Cost System (CSCS). The WSSCS currently has six years of data on aircraft. The CSCS is relatively new and expenditure data are just now being accumulated.

There are annual VAMOSOC WSSCS reports on the various aircraft families in the Air Force inventory. These reports show total flying hours and expenditures for all aircraft of a given Mission-Design-Series. The data are reported in two formats—one entitled USAF Detail and the other the CAIG (Cost Analysis Improvement Group) Format. Both personnel and equipment costs are reported. The equipment cost element structure for the CAIG Format is:

CAIG Format

- Consumables
 - POL
 - Maintenance material
 - Training ordnance
- Depot level maintenance
 - Aircraft overhaul
 - Engine overhaul
 - Engine accessories
 - Aircraft accessories
 - Avionics instrumentation
 - Avionics communications
 - Avionics navigation
 - Armament
 - Support equipment
- Class IV mod installation
- Interim contractor support
- Contractor logistics support

⁴VAMOSOC data may contain year-to-year inconsistencies, and some data are calculated using factors from AFR 173-13.

Sustaining investments
Reparable spares
Replacement support equipment
Modification kits

The Air Force VAMOSC system is described in AFR 400-31. The system is maintained by Headquarters Air Force Logistics Command (HQ AFLC/ACCV) and personnel in that office can provide current or historical VAMOSC reports. The major disadvantage of the VAMOSC data is that only costs for active aircraft assigned to "relevant" commands (e.g., Alaskan Air Command, Air Force in Europe, Air Training Command, Military Airlift Command, Pacific Air Forces, Strategic Air Command, Tactical Air Command) are reported. There are no cost expenditures for Air Reserve or National Guard aircraft.

VAMOSC provides total expenditures for a fleet along with the number of aircraft in the fleet and the total flying hours for those aircraft. These data could be used to estimate appropriate cost factors per aircraft or per flying hour. The per flying hour factors should be adequate measures, but the per aircraft factors may be underestimated because not all of the aircraft in the fleet will be operational during the course of the year. Since aircraft must cycle through the depot overhaul process on a calendar basis, some portion of the fleet is always in the depot or in the depot pipeline. There are also "extra" aircraft that are used as fillers or as replacements for peacetime losses. Therefore, the total operational fleet is always less than the number of possessed aircraft shown in the VAMOSC reports.⁵

The factors in AFR 173-13 should be used for "quick reaction" studies when planning factors would be appropriate. VAMOSC data should be used if there is more time to prepare the cost estimate and if specific aircraft types or specific cost elements are of interest. A thorough cost analysis will use both sources in developing the "best" cost factors. As mentioned above, VAMOSC contains data for only active aircraft. Certain cost factors will be the same for active and reserve aircraft; however, there are cost elements where the cost factors will differ for the active and reserve.

Each of the major commands (e.g., SAC, TAC, MAC, ATC) also has cost groups that can provide cost data specific to their equipment and functions. These organizations should be contacted for detailed information on specific units and operations. The Air Training Command

⁵The definition of VAMOSC's "possessed" aircraft is not clear. When comparing the Primary Authorized Aircraft (PAA) with the number of "possessed" aircraft in VAMOSC, the PAA values are almost always greater. This discrepancy would tend to overestimate the per aircraft factors.

is especially useful for obtaining training costs of aircrew members and other Air Force skills.

Navy

The availability of cost information is fragmented in the Navy. Numerous organizations maintain control and visibility over various aspects of cost and budgetary inputs. Two important groups within the Office of the Secretary of the Navy and the Office of the Chief of Naval Operations are:

Naval Center for Cost Analysis Branch (NCA)
Director of Naval Reserves, Planning and
Programming Division (NOP-958)

The various offices of the Assistant and Deputy Chiefs of Naval Operations also have cost budget groups. Two of the most knowledgeable for the cost analysis of ship and aviation units are:

Surface Warfare Programs and Budget Division (NOP-30)
Aviation Plans and Requirements Division (NOP-50)

There are other cost groups within the Naval Air Systems Command and the Naval Sea Systems Command. Cost information for reserve units may be available from the Commander, Naval Reserve Forces, New Orleans.

The primary data source for developing cost factors in the Navy is the Visibility and Management of Operating and Support Costs data collection and reporting system. There are really two VAMOSC systems, one for aviation units (VAMOSC-AIR) and one for ships (VAMOSC-SHIPS). The VAMOSC-SHIPS system is more developed than VAMOSC-AIR and can usually provide complete data for cost analysis purposes. Reports can be requested that provide average or total costs for a class of ships over a specified time period. One source of VAMOSC-SHIPS reports is:

Assistant Chief of Naval Operations (Surface Warfare),
Ship Maintenance Policy and Programming
Section (NOP-325D)

The overall responsibility for VAMOSC-AIR reports resides with Navy Aviation Logistics Command Management Information System (NALCOMIS, PMA 270). Administrative and technical responsibility is controlled by the Naval Aviation Logistics Center (NAVAVNLOGCEN) within the Logistics System Development Directorate (Code 04). Questions and requests for standard reports or special requests can be made to:

NALCOMIS-O&S/(VAMOSC-AIR) Program Manager, NAVA
VNLOGCEN 04 Directorate (Code 422)

The cost analysis of Navy active and reserve aviation and ship units involves obtaining various data and factors from the offices listed above, the VAMOSC data systems, and other cost organizations as required by the scope of the analysis.

Army

The analysis of annual recurring operating and support costs for Army equipment is more difficult than similar analysis in the other military Services, primarily because of the wide range of equipment found in Army units and the lack of suitable cost data collection systems. Aircraft and ships are highly visible and separate weapon systems and their associated costs are identifiable and closely monitored. An Army unit, however, may have tanks, trucks, radios, power generators, and numerous other types of equipment. Furthermore, there are typically no programmed activity levels for Army equipment, except for helicopters. Because of these problems, few cost factors for Army equipment operating costs are available.

The Army cost analysis community is in a state of transition. The U.S. Army Cost and Economic Analysis Center (FM-CACC-ZA), once the centralized organization for Army cost analyses, published the *Army Force Planning Cost Handbook* (AFPCH) and maintained the Force Cost Information System (FCIS). The AFPCH was derived from the FCIS and was a source of models and factors for estimating the nonrecurring and annual recurring costs of active units. Now the Army has decided to replace the AFPCH and FCIS with new, contractor-built cost data collection systems and cost reporting models. The office of Resource Management under the Assistant Secretary of the Army for Program Analysis and Evaluation (DACS/DPP) has assumed much of the responsibility for developing the cost collection systems and cost model development.

One recently developed system is the Operating and Support Cost Management Information System (OSCMIS), which has replaced the FCIS and is the Army's counterpart to VAMOSC. Annual OSCMIS reports are published by the Director of Resource Management Systems. OCMIS presents annual operating and support cost factors for many major items of equipment in the Army inventory. The cost factors represent actual expenditures for spare parts and a number of other cost elements. The system is constantly being updated and refined, and should represent a useful method of estimating equipment operating costs.

Steps are also under way to develop a measure of peacetime activity for Army equipment and units. The Battalion Level Training Model (BLTM) will produce matrices of equipment operating measures (hours, miles, rounds fired) that are required to attain specific readiness levels for Army equipment and units. The combination of OSCMIS and the BLTM will allow cost analysts to develop estimates of annual costs for active and reserve Army units.

The best source of operating cost data often can be found at individual unit locations. Each installation has a cost tracking system to monitor expenses and to prepare budget estimates for subsequent time periods. These cost tracking systems are often unique to the base (or the state in terms of National Guard units) and, therefore, can not be used for comparative exercises except with full understanding of the definitions and assumptions built into the systems.

The major weapon system program offices and the major commands (e.g., Tank and Automotive Command, Armament, Chemical, and Munitions Command, Aviation Systems Command) have cost data on specific weapon systems or on families of vehicles. These organizations should be contacted to ascertain data availability.

Many elements of equipment operating cost will be estimated based on the procurement cost of the equipment. In some cases, this procedure will yield suitable results; in other instances, using a procurement cost measure as the basis for annual operating cost will provide only a rough order of magnitude estimate. The cost analysis of Army equipment will require formulating estimates and gathering data from various sources and then combining the multiple values into a reasonable cost measure.

EQUIPMENT-RELATED DATA SHEETS

The following pages are individual data sheets for cost elements and resource factors dealing with equipment costs. Each data sheet has a header that fully describes the item. The name of the item appears at the top, followed by the following information:

- Item Type:** whether the item is a "resource factor" or "cost element."
- Cost Type:** whether the item refers to personnel or equipment related costs, and whether it pertains to nonrecurring or recurring aspects of cost.

Services: In general, for personnel items, one data sheet covers all the Services; for equipment items, data sheets are Service-specific.

For an index to the factors and elements, see App. B.

UNIT EQUIPMENT LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: Unit equipment levels are types and quantity of major end items of equipment authorized for the unit. The number of aircraft for flying squadrons is defined as the Primary Aircraft Authorization (PAA). For a given Mission-Design-Series of aircraft, there are usually one or more specific PAA values. For example, active Air Force fighter squadrons have PAA levels of 18 or 24. Unit equipment levels are used directly in the calculation of all recurring equipment cost elements, except "other costs."

VARIANCES: Reserve squadrons often have fewer aircraft than similar active squadrons. For example, fighter squadrons in the Air Reserve and National Guard may have 18 aircraft, whereas similar fighter squadrons in the active force will have 24 aircraft.

DATA SOURCES: Typical PAA factors are provided in AFR 173-13:

Table 4-4 Aircraft and Missile Program Factors - Active Forces

Table 4-5 Aircraft Program Factors - ANG

Table 4-6 Aircraft Program Factors - AFRES

PAA values and basing locations for Air Force squadrons can also be obtained from:

Deputy Chief of Staff, Programs and Resources,
Directorate of Programs and Evaluation (AF/PRP)

PEACETIME EQUIPMENT ACTIVITY LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: For flying units, the authorized levels of unit equipment usage in peacetime are usually expressed in flying hours per aircraft per year (FH). Peacetime equipment activity levels are used in the calculation of many equipment cost elements: see data sheets "POL," "Maintenance Material," "Replenishment Spares," and "Depot Maintenance."

VARIANCES: There are normally different equipment activity levels for similar active and reserve force units. Typically, reserve units will use their equipment less frequently in peacetime than active units.

DATA SOURCES: Typical annual flying hours per aircraft can be obtained from AFR 173-13:

Table 4-4 Aircraft and Missile Program Factors - Active Forces

Table 4-5 Aircraft Program Factors - ANG

Table 4-6 Aircraft Program Factors - AFRES

Authorized flying hour programs for specific squadrons can be obtained from:

DSC/Programs and Resources, Director of Programs and
Evaluation, Data Base Management Division (AF/PPRB)

Total annual flying hours for all aircraft of a given Mission-Design-Series are also contained (along with the appropriate number of aircraft) in the VAMOS reports. An annual per aircraft flying hour figure obtained from these data will probably understate the programmed flying programs for unit aircraft since a portion of the total fleet will be in pipeline or nonoperational status during the year.

CREW RATIO AND COMPOSITION

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: The crew ratio (CR) is the number of crews authorized per aircraft. The composition of the crew indicates the number and type of the various positions in a crew. The crew ratio is used in the calculation of the cost element "Training Munitions."

VARIANCES: For similar aircraft and missions, active and reserve forces may have different crew ratios. For a given aircraft and mission, active and reserve crews will have the same crew composition.

DATA SOURCES: Typical crew ratios for various aircraft units are contained in AFR 173-13:

Table 4-7 Selected Typical Aircraft Squadron Strengths

Specific crew ratios for various active, Air Reserve, and National Guard squadrons are contained in AFR 173-13:

Table 4-4 Aircraft and Missile Program Factors - Active Forces

Table 4-5 Aircraft Program Factors - ANG

Table 4-6 Aircraft Program Factors - AFRES

Aircrew compositions are contained in AFR 173-13:

Table 4-1 Authorized Aircrew Composition - Active Forces

Table 4-2 Authorized Aircrew Composition - ANG

Table 4-3 Authorized Aircrew Composition - AFRES

Note that the crew composition values in AFR 173-13 include positions related to the aircraft operations. Positions for which the aircraft is merely a working platform may be excluded.

PETROLEUM, OIL, AND LUBRICANTS (POL)

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This cost covers the petroleum, oil, and lubricants consumed by unit equipment during annual operations.

VARIANCES: The POL consumed per flying hour for a specific type of aircraft may differ for active and reserve operations because of different operating characteristics and experience levels of the aircrews. Total POL cost may also vary by component due to differing unit equipment levels or peacetime activity levels.

ESTIMATING EQUATIONS:

$$(\text{FH per aircraft per year}) * (\text{PAA}) * (\text{POL cost per FH})$$

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: Average POL costs per operating hour for various Mission-Design-Series of aircraft are contained in AFR 173-13:

Table 2-1 Logistics Cost Factors (Budget Year)

Table 2-4 Logistics Cost Factors (Life Cycle)

Component-specific factors can be developed from data in AFR 173-13:

Table 2-9 MAJCOM Fuel Consumption Factors

The total cost of aviation fuel consumed by a given Mission-Design-Series of active aircraft is contained in the annual VAMOSC reports along with the total number of flying hours. A POL cost per flying hour for active aircraft can be obtained from these data. Recent experience suggests that reserve operations will result in a lower POL cost factor than active operations.

TRAINING MUNITIONS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This cost covers the ammunition, bombs, missiles, and other ordnance expended during annual training exercises.

VARIANCES: Training munition requirements are usually the same for similar active and reserve units with the same wartime missions. However, the costs for similar units may differ by component if crew ratios or unit equipment levels differ.

ESTIMATING EQUATIONS:

(Munitions cost per crew) * (Crew ratio) * (PAA)

See data sheets "Crew Ratio and Composition" and "Unit Equipment Levels" for further information.

DATA SOURCES: Annual munitions cost for various types of aircraft are contained in AFR 173-13:

Table 2-8 Munitions Training Cost

AFR 173-13 also contains the cost of various munitions:

Table 2-7 Munitions Acquisition Cost

Annual VAMOSC reports contain the total training munitions expenditures for a given Mission-Design-Series of active aircraft along with the number of aircraft in the fleet. An average based on these data will probably understate actual training munitions cost per aircraft because of the pipeline aircraft in the fleet and the different missions of various units. The VAMOSC cost factor can provide an actual expenditure measure to compare with the planned factors in AFR 173-13.

MAINTENANCE MATERIAL

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This cost covers the consumable items used during equipment maintenance at either the organizational or intermediate levels of maintenance. (See the first part of Sec. IV for a discussion of the organization of maintenance activity in the Services.) It includes such items as gaskets, seals, and filters needed for preventive or corrective maintenance plus the bit and piece parts used to repair higher level component assemblies.

VARIANCES: The cost of maintenance material is a function of equipment levels and equipment operating levels. The cost of maintenance material per operating measure of a given aircraft is the same for active and reserve force units.

ESTIMATING EQUATIONS: The cost of maintenance material is a function of the activity level of the aircraft:

$$(\text{Base maintenance supplies per FH}) * (\text{FH}) * (\text{PAA})$$

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: The cost per flying hour for base maintenance supplies is contained in AFR 173-13:

Table 2-1 Logistics Cost Factors (Budget Year)

Table 2-4 Logistics Cost Factors (Life Cycle)

Budget year factors in Table 2-1 differentiate between systems supplies and general supplies. They should be combined to estimate the total cost of maintenance material.

Total maintenance material expenditures for a given Mission-Design-Series of active aircraft are contained in the annual VAMOSC reports along with the total number of flying hours for the fleet. A cost factor can be calculated from these data.

REPLENISHMENT SPARES

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This cost covers the subsystem components or major assemblies that must be replaced because of wear or condemnation.

VARIANCES: The replenishment spares cost per operating measure of a given aircraft is usually the same for active and reserve equipment operations. However, the total cost may vary by component due to differing unit equipment levels or peacetime activity levels.

ESTIMATING EQUATIONS: Replenishment spares cost is a function of activity level.

$$(\text{Replenishment spares cost per FH}) * (\text{FH}) * (\text{PAA})$$

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: AFR 173-13 contains replenishment spares cost per flying hour for various aircraft:

Table 2-1 Logistics Cost Factors (Budget Year)

Table 2-4 Logistics Cost Factors (Life Cycle)

The annual VAMOSOC reports contain total reparable spares cost for active aircraft along with the flying hours. A cost factor can be developed from these data.

DEPOT MAINTENANCE

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This cost covers the labor and material expended during depot maintenance or overhaul of unit equipment.

VARIANCES: Certain weapon systems or subsystems on the weapon system are scheduled for depot maintenance on a calendar basis. An example is aircraft airframes. This portion of depot maintenance is considered fixed or purely a function of the equipment levels in the unit. The fixed portion of depot maintenance cost is typically the same for active and reserve units. Some weapon systems or subsystems are sent to the depot because the level of repair is beyond the capability of the organizational or intermediate maintenance levels. Examples are aircraft engines and avionic components. This portion of depot maintenance is unscheduled, and therefore variable. The variable portion of depot maintenance cost is a function of equipment usage in peacetime. Since activity levels in peacetime are often different for active and reserve units, the variable portion of depot maintenance cost is also different for active and reserve units. The cost per activity measure, however, is usually the same for the active and reserve forces.

ESTIMATING EQUATIONS:

$$\begin{aligned} & (\text{Depot maintenance cost per aircraft}) * (\text{PAA}) + \\ & (\text{Depot maintenance cost per FH}) * (\text{FH}) * (\text{PAA}) \end{aligned}$$

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: Typical depot maintenance costs per flying hour and per aircraft for various Mission-Design-Series of aircraft are contained in AFR 173-13:

- Table 2-1 Logistics Cost Factors (Budget Year)
- Table 2-2 Depot Maintenance Factors
- Table 2-4 Logistics Cost Factors (Life Cycle)

Note that the depot cost factors in AFR 173-13 also contain the appropriate costs for contractor support for both depot and field actions.

Actual depot expenditures for active aircraft are contained in the annual VAMOSC reports. These expenditures are segregated into various subelements of cost. The VAMOSC data can be used to develop cost factors for active aircraft, but care must be exercised because of the difference in actual operational aircraft and the number of possessed aircraft shown in the VAMOSC reports. Those subelements of depot cost that are purely a function of flying hours can adequately be estimated from the VAMOSC data. However, if the VAMOSC data are used, the elements of depot cost that are estimated on a per aircraft basis may be understated because of the pipeline aircraft.

REPLACEMENT SUPPORT EQUIPMENT

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: Costs are for the unit support equipment that must be replaced because of wear or condemnation and the replenishment spares required to repair support equipment at either the organizational or intermediate levels of repair.

VARIANCES: The cost per aircraft for replacement support equipment and spare parts is usually the same for active and reserve equipment regardless of equipment activity levels. The total cost could vary by component if unit equipment levels differ.

ESTIMATING EQUATIONS:

(Replacement support equipment cost per aircraft) * (PAA)

See data sheet "Unit Equipment Levels" for further information.

DATA SOURCES: Replacement support equipment cost factors for various types of aircraft are contained in AFR 173-13:

Table 2-1 Logistics Cost Factors (Budget Year)

Table 2-4 Logistics Cost Factors (Life Cycle)

Total annual replacement support equipment cost for a given Mission-Design-Series of active aircraft is reported in VAMOSC. A per aircraft figure based on these data may understate actual aircraft expenditure because of the difference between operational and possessed aircraft.

MODIFICATIONS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This cost covers modification kits and modification initial spares for aircraft, support equipment, and training equipment. The modifications included are those needed to achieve acceptable levels of safety, overcome mission capability deficiencies, improve reliability, or reduce maintenance costs. Excluded from this cost element are modifications that are undertaken to provide operational capability not called for in the original design or performance specifications.

VARIANCES: The modification cost per aircraft is usually the same for active and reserve equipment. Total cost will differ only if unit equipment levels differ.

ESTIMATING EQUATIONS:

$$(PAA) * (\text{Constant}) * (\text{Flyaway cost in millions})^{.9343}$$

The current constant in FY 1984 dollars is 4203. The constant factor is provided in the description of the CORE model in AFR 173-13.

See data sheet "Unit Equipment Levels" for further information.

DATA SOURCES: Flyaway costs for various aircraft are contained in AFR 173-13: Table 2-6 Unit Flyaway Costs.

Labor costs for modifications installed at the depot are reflected in AFR 173-13: Table 2-2 Depot Maintenance Factors.

The total annual cost for modification kits and their installation for a given Mission-Design-Series of active aircraft is reported in the VAMOSC system. Per aircraft cost factors based on these data may understate actual expenditures because of the difference between possessed and operational aircraft.

OTHER COSTS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Air Force**

DEFINITION: This category covers costs of any recurring investments not included in the previous categories. If VAMOSOC rather than AFR 173-13 data were used to develop the depot maintenance costs, the cost of contractor support should be included here (contractor support costs are included in the AFR 173-13 depot maintenance cost factors, and also in Table 2-5, Contractor Logistics Support Life Cycle Cost Factors). Also, any costs for software maintenance should be added in this cost element (software maintenance cost is usually personnel related and there are no associated equipment costs).

ESTIMATING EQUATIONS: Input value.

DATA SOURCES: If contractor support costs are to be included, the appropriate costs may be obtained from the annual VAMOSOC reports. Note that contractor support usually decreases over time as the Air Force institutes organic support capability. Therefore, a cost based on actual expenditures in the previous year should be modified by information from the appropriate weapon system program, manager, or office.

Information on other types of cost not accounted for in the previous cost elements can be obtained by consulting the weapon system program manager.

EQUIPMENT PROCUREMENT

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Air Force**

DEFINITION: The initial procurement cost of the unit equipment includes the cost of the major weapon system, ground support equipment (typically termed "yellow gear"), maintenance support and test equipment, training equipment, initial spare parts, and the initial unit munition requirements. For most costing exercises, the procurement cost of the major weapon system will not be included because the equipment is already in the inventory or because the same number of units of equipment will be required by both active and reserve units.

VARIANCES: The items of equipment to be included in the cost analysis depend on the policy decision under consideration. If a new unit is being activated, all equipment will be required. If an existing unit is being modified, then only the additional equipment required for the new unit configuration must be obtained. Not all of the required equipment will have to be procured in all cases. For certain decisions, equipment may be available from existing inventories. For example, if an active unit is being modernized with a new weapon system and the weapon system being replaced will be used to modernize an existing reserve unit, there may be support equipment and other resources available from the active unit that can also be transferred to the reserve unit.

At times, the reserve units suffer from diseconomies of scale in terms of support equipment requirements. The dispersed basing of reserve units may result in a total support equipment requirement greater than the requirement for consolidated active units. For example, if one piece of equipment is required for every 36 aircraft, the three dispersed 24-aircraft squadrons of the reserve force will need three pieces of the equipment. The consolidated active wing of 72 aircraft will require only two pieces of the equipment.

ESTIMATING EQUATIONS: This cost element is greatly dependent on the circumstances surrounding the policy decision. Therefore, there is no convenient cost estimating relationship. Information must be obtained from the appropriate offices plus the cost analyst must ascertain what, if any, equipment is available in the existing inventory.

DATA SOURCES: Each weapon system has a Table of Allowances specifying the numbers and types of equipment required for various numbers of unit aircraft. Equipment procurement costs and levels may be available from:

Office of the Air Force Reserve, Programs and Resources
Division, Programs Branch
National Guard Bureau, Director of Air National Guard,
Plans and Operations Division
United States Air Force, Deputy Chief of Staff, Logistics and
Engineering, Weapon System Program Division or Aircraft
System Division

MILITARY CONSTRUCTION

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Air Force**

DEFINITION: The costs of constructing or modifying the buildings and facilities used by a unit in performing its mission and functions include hangers, runways, maintenance facilities, and administrative buildings. Also included should be the cost of constructing or modifying any base support facilities for unit personnel or equipment, such as supply facilities, POL storage facilities, mess halls, and commissaries. If appropriate, the costs to facilities in a caretaker status must also be considered.

VARIANCES: Different types of weapon systems and unit configurations will require different types and numbers of facilities. Reserve units usually do not require the same numbers and types of personnel-support facilities as are required by active units because the reserve units are composed of large numbers of part-time reservists who do not place a burden on facilities such as base housing, mess halls, and commissaries.

ESTIMATING EQUATIONS: The military construction costs for a specific policy decision will be a function of the facility requirements of the unit and the facilities that are available at the basing location. The magnitude of this cost is greatly dependent on the specific weapon system requirements and the specific basing location. Therefore, it is difficult to estimate this cost without detailed information about the particulars of the policy decision.

DATA SOURCES: Each component has an office responsible for military construction and the resulting budget submissions:

Office of the Air Force Reserve, Programs and Resources
Division, Programs Branch
National Guard Bureau, Director of Air National Guard,
Engineering and Services Division
Deputy Chief of Staff Logistics and Engineering,
Directorate of Engineering and Services (AF/LEE)

The Budget Justifications for Military Construction contain cost estimates for various construction projects. The estimates include a description of the facility along with a breakout of cost.

Each Air Force base annually submits a Form 920, Utilization of Facilities, that identifies the units and numbers of personnel on the base, their facility requirements, the facilities that exist on the base, and any facility shortfalls or excesses. They can be used to determine if there are excess facilities at a base of interest. The following document also defines various facility requirements:

"Standard Facility Requirements," AFM 86-2, Department
of the Air Force

UNIT EQUIPMENT LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The category includes the types and quantity of major end items of equipment authorized for the unit. In Navy aviation units, there are usually standard squadron sizes in terms of numbers of aircraft. For example, the normal number of aircraft in a Navy fighter squadron is 12. Unit equipment levels are directly used in the calculation of all equipment cost elements except "other costs."

VARIANCES: Reserve squadrons typically have the same number of aircraft as similar active squadrons.

DATA SOURCES: The number of aircraft and the basing location for Navy squadrons can be obtained from:

Aviation Support Systems Branch, Assistant Chief of Naval
Operations (Air Warfare), NOP-505 and
Statistical Analysis Branch, Assistant Chief
of Naval Operations (Air Warfare), NOP-508F

PEACETIME EQUIPMENT ACTIVITY LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: This category covers the authorized levels of unit equipment usage in peacetime. For aircraft, activity levels are expressed in flying hours per aircraft per year (FH). The peacetime flying hour programs for U.S. Naval Reserve (USNR) aircraft may include the flight training hours for the Selected Reserve aircrew members that augment active squadrons. These hours should be subtracted from the USNR squadron flying programs to accurately measure the peacetime activity rates for reserve squadrons. Likewise, these hours should be added to the active squadron flying programs to estimate active annual operating and support costs. Peacetime equipment activity levels are used in the calculation of many equipment cost elements: see data sheets "POL," "Maintenance Material," "Replenishment Spares," and "Depot Maintenance."

VARIANCES: There are normally different equipment activity levels for similar active and reserve force units. Typically, reserve units will use their equipment less frequently in peacetime than active units.

DATA SOURCES: Annual authorized flying hour programs for Navy aircraft can be obtained from:

Assistant for Flying Hour Programs, Assistant Chief of Naval Operations (Air Warfare), NOP-05E

The VAMOSC-AIR reports contain the total annual flying hours for regular units and the Fleet Readiness Squadrons for the active and reserve forces by Type-Model-Series of aircraft. The data are supplied to the VAMOSC system by NOP-05.

The reserve O&M Budget Justifications contain average and total flying programs for various types of aircraft under:

Program Package: Reserve Air Forces
Budget Activity: 1 Mission Forces

CREW RATIO AND COMPOSITION

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The crew ratio (CR) is the number of aircrews authorized per aircraft. The composition of the crew indicates the number and type of the various positions in a crew. The crew ratio is used in the calculation of the cost element "Training Munitions."

VARIANCES: For similar aircraft and missions, active and reserve forces may have different crew ratios. For a given aircraft and mission, active and reserve crews will have the same composition.

DATA SOURCES: Crew ratios and compositions can be obtained from:

Aviation Support Systems Branch, Assistant Chief of Naval
Operations (Air Warfare), NOP-505
Statistical Analysis Branch, Assistant Chief of Naval
Operations (Air Warfare), NOP-508F

PETROLEUM, OIL, AND LUBRICANTS (POL)

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: These costs cover the petroleum, oil, and lubricants consumed by unit equipment during annual operations.

VARIANCES: The POL consumed per flying hour may differ for active and reserve aircraft operations because of different operating characteristics and experience levels of the aircrew. Total POL may also vary by component because of differing peacetime activity levels.

ESTIMATING EQUATIONS:

$$(\text{POL cost per FH}) * (\text{FH}) * (\text{Number of aircraft})$$

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: POL costs per flying hour for Navy active and reserve aircraft can be obtained from:

"Flying Hour Cost Reporting System," Naval Aviation
Maintenance Program Division, Assistant Chief of Naval
Operations (Air Warfare), NOP-51 or
"Flying Hour Projection System," Navy Aviation Logistics
Center

VAMOSC-AIR reports also contain total POL costs for various types of aircraft. The data are supplied to VAMOSC by NOP-51.

TRAINING MUNITIONS

Item Type: **Cost Element**

Cost Type: **Equipment Related**

Annual Recurring Cost

Service(s): **Navy Aviation Units**

DEFINITION: The costs cover ammunition, bombs, missiles, and other ordnance expended during annual training exercises.

VARIANCES: Training munition requirements may vary for similar active and reserve aviation units. One source of variation may come from different crew ratios.

ESTIMATING EQUATIONS:

(Munitions cost per crew) * (Crew ratio) * (Number of aircraft)

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: The following office can provide data on munition allowances for different types of units or different aircraft:

Deputy Chief of Naval Operations (Naval Warfare), Tactical Readiness Division, NOP-73.

The following office can provide cost data for various munitions:

Deputy Chief of Naval Operations (Navy Program Planning), General Planning and Programming Division, NOP-80.

Training munition cost data are also contained in the VAMOSC reports. The type commanders (AIRLANT and AIRPAC) can provide information on actual munition usage for their aircraft.

MAINTENANCE MATERIAL

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The costs cover consumable items used during equipment maintenance at either the organizational or intermediate levels of maintenance. (See the first part of Sec. IV for a discussion of the organization of maintenance activity in the Services.) Costs include such items as gaskets, seals, and filters needed for preventive or corrective maintenance plus the bit and piece parts used to repair higher level component assemblies.

VARIANCES: The cost of maintenance material is a function of equipment operating levels. The cost per operating measure is usually the same for similar active and reserve aviation units.

ESTIMATING EQUATIONS:

(Maintenance material cost per FH) * (FH) * (Number of aircraft)

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: Maintenance material costs per flying hour for various active and reserve aircraft can be obtained from:

"Flying Hour Cost Reporting System," Naval Aviation
Maintenance Division, Assistant Chief of Naval
Operations (Air Warfare), NOP-51 or
"Flying Hour Projection System," Navy Aviation Logistics
Center

VAMOSC-AIR reports may contain the costs of organizational maintenance supplies for different commands by type of aircraft. The data are supplied to VAMOSC by NOP-51.

REPLENISHMENT SPARES

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The costs cover subsystem components or major assemblies that must be replaced because of condemnation.

VARIANCES: The replenishment spares cost per operating measure of a given aircraft is usually the same for active and reserve equipment operations. However, the total cost may vary by component because of differing peacetime activity levels.

ESTIMATING EQUATIONS:

(Replenishment spares cost per FH) * (FH) * (Number of aircraft)

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: Information on replenishment spares cost can be found in annual VAMOSC reports. VAMOSC data should be averaged over a period of several years to smooth out year-to-year variances. Dividing the total replenishment spares cost by the total flying hours will yield a cost per flying hour measure for each year. Data are supplied to VAMOSC by the Naval Aviation Logistics Center (code 422D).

The Aviation Supply Office (Philadelphia) monitors the spare part requirements and costs for aircraft.

DEPOT MAINTENANCE

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The cost covers material and labor expended during depot maintenance or overhaul of unit equipment.

VARIANCES: Certain weapon systems or subsystems on the weapon system are scheduled for depot maintenance on a calendar basis; an example is aircraft airframes. This portion of depot maintenance is considered fixed or purely a function of the equipment levels in the unit. The fixed portion of depot maintenance cost is typically the same for active and reserve units.

Some weapon systems or subsystems are sent to the depot because the level of repair is beyond the capability of the organizational or intermediate maintenance levels. Examples are aircraft engines and avionic components. This portion of depot maintenance is unscheduled, and therefore variable. The variable portion of depot maintenance cost is a function of equipment usage in peacetime. Since activity levels in peacetime are often different for active and reserve units, the variable portion of depot maintenance cost is also different for active and reserve units. The cost per activity measure, however, is usually the same for active and reserve.

ESTIMATING EQUATIONS:

$$\begin{aligned} & (\text{Depot maintenance cost per aircraft}) * (\text{Number of aircraft}) + \\ & (\text{Depot maintenance cost per FH}) * (\text{FH}) * (\text{Number of aircraft}) \end{aligned}$$

See data sheets "Unit Equipment Levels" and "Peacetime Equipment Activity Levels" for further information.

The fixed cost per aircraft is attributable to Scheduled Depot Level Maintenance (SDLM), which is primarily for the scheduled rework of aircraft airframes. SDLM intervals are set for each Type-Model-Series of aircraft but may change (usually lengthened) during the service life of the aircraft. The annual cost of SDLM (and, therefore, the fixed

depot cost per aircraft) can be estimated from the total cost of SDLM, the time between SDLM (interval), and the time it takes to perform SDLM.

Annual fixed depot cost per aircraft can be estimated as:

$$[(12 \text{ months}) / (\text{SDLM interval} + \text{SDLM duration})] * (\text{SDLM cost})$$

DATA SOURCES: SDLM costs, intervals, and durations, plus the annual depot cost per flying hour for avionic and engine repairs can be obtained from:

Plans, Policy, and Fleet Maintenance Support Branch, Assistant
Chief of Naval Operations (Air Warfare), NOP-514

The Navy Aviation Logistics Center (NALC), the command in charge of the Navy Air Rework Facilities (NARFs), can provide data on depot maintenance costs. The Aviation Supply Office (Philadelphia) may have data on the depot maintenance cost of avionic components.

REPLACEMENT SUPPORT EQUIPMENT

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The cost is for unit support equipment that must be replaced because of wear or condemnation.

VARIANCES: The cost per aircraft for replacement support equipment and spare parts (regardless of unit activity levels) is usually the same for active and reserve equipment. The total cost could vary by component if unit equipment levels differ.

ESTIMATING EQUATIONS:

(Replacement support equipment cost per aircraft) *
(Number of aircraft)

See data sheet "Unit Equipment Levels" for further information.

DATA SOURCES: Cost data for replacement support equipment are not contained in the VAMOSC reports. Information on this cost should be obtained from NOP-514 or from AIRLANT or AIRPAC.

MODIFICATIONS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The cost is for modification kits and modification initial spares for aircraft, support equipment, and training equipment. The modifications included are those needed to achieve acceptable levels of safety, overcome mission capability deficiencies, improve reliability, or reduce maintenance costs. Excluded from this cost element are modifications that are undertaken to provide operational capability not called for in the original design or performance specifications.

VARIANCES: The modifications cost per aircraft is usually the same for active and reserve equipment.

ESTIMATING EQUATIONS:

(Modifications cost per aircraft) * (Number of aircraft)

See data sheet "Unit Equipment Levels" for further information.

DATA SOURCES: VAMOS reports contain annual modifications costs for various Type-Model-Series of aircraft. Modification costs should be averaged over several years to smooth out year-to-year variances.

OTHER COSTS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The cost is for any recurring investments not included in the above categories. Two items of cost that may be included in this category are contractor support and software maintenance.

ESTIMATING EQUATIONS: Input

DATA SOURCES: Data on this element of cost may be obtained from the unit or command. Software maintenance cost is usually personnel related and should be accounted for by including software maintenance personnel in the unit personnel allowances. There may be software maintenance costs associated with contractor support.

Contractors often provide interim support in the field and at the depot while the Service is developing its own organic support capability. Usually, contractor support is heaviest during the initial years of a weapon system's life cycle and decreases as the system ages in the force. For aviation units, there may always be some level of contractor support, especially for deployed units onboard carriers. Cost data on contractor support should be obtained from the weapon system program office.

EQUIPMENT PROCUREMENT

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The initial procurement cost of the unit equipment includes the cost of the major weapon system, ground support equipment (typically termed "yellow gear"), maintenance support and test equipment, training equipment, initial spare parts, and the initial unit munition requirements. The procurement cost of the weapon system is not normally included in the analysis, either because the equipment is already in the inventory or because the same numbers and types of equipment are required for both active and reserve units.

VARIANCES: The items of equipment to be included in the cost analysis depend on the policy decision under consideration. If a new unit is being activated, all equipment will be required. If an existing unit is being modified in some manner, only the additional equipment required for the new unit configuration must be obtained. Not all of the required equipment will have to be procured in all cases. For certain decisions, equipment may be available from existing inventories. For example, if an active unit is being modernized with a new weapon system and the weapon system being replaced will be used to modernize an existing reserve unit, there may be support equipment and other resources available from the active unit that can also be transferred to the reserve unit.

ESTIMATING EQUATIONS: Because this element of cost is greatly dependent on the circumstances surrounding the policy decision, there is no convenient cost estimating relationship. Information must be obtained from the appropriate offices plus the cost analyst must ascertain what, if any, equipment is available in the existing inventory.

DATA SOURCES: Each weapon system has an Individual Material Readiness List (IMRL) specifying the numbers and types of equipment required for various numbers of unit aircraft. Equipment procurement costs and levels can be obtained from:

Director, Aircraft Material (Code 57), Commander, Naval Air
Reserve Forces, New Orleans

or from the appropriate weapon system program office.

MILITARY CONSTRUCTION

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Navy Aviation Units**

DEFINITION: The cost of constructing or modifying the buildings and facilities used by the unit in performing its mission and functions includes hangars, runways, maintenance facilities, and administrative buildings. Also included should be the cost of constructing or modifying any base support facilities for unit personnel or equipment such as supply facilities, POL storage facilities, mess halls, and commissaries and the cost associated with placing facilities in a caretaker status if appropriate.

VARIANCES: Different types of weapon systems and unit configurations will require different types and numbers of facilities. Reserve units usually do not require the same numbers and types of personnel-support facilities as are required by active units because the reserve units are composed of large numbers of part-time reservists who do not place a burden on base housing, mess halls, and commissaries.

ESTIMATING EQUATIONS: The military construction costs for a specific policy decision will be a function of the facility requirements of the unit and the facilities that are available at the basing location. The magnitude of the cost is greatly dependent on the specific weapon system requirements and the specific basing location. Therefore, it is difficult to estimate this cost without detailed information about the particulars of the policy decision.

DATA SOURCES: Each component has an office responsible for military construction and the resulting budget submissions. These are:

Director, Aircraft Material (Code 57), Commander,
Naval Air Reserve Forces, New Orleans
CV and Air Station Programs Division, Assistant Chief of Naval
Operations, Air Warfare (NOP-55)

The Budget Justifications for Military Construction contain cost estimates for various construction projects and describe the facility along with a breakout of cost.

PEACETIME EQUIPMENT ACTIVITY LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: This cost covers the authorized levels of unit equipment usage in peacetime. For ships, the programmed activity level is in steaming days underway per year—times when the ship's engines are fired and the ship is steaming in open waters. However, ships do not steam a full 24 hours each steaming day. Therefore, the steaming day measure must be converted to a steaming hour measure for cost estimating purposes. The actual steaming hours per day vary between activities in home waters and deployment.

In addition to steaming hours underway, ships operate in two other modes: steaming days not underway (ship's engines are fired but the ship is in port) and "in cold iron" (ship's engines are not operating and the ship relies on dock facilities). POL and Utilities are the two elements of cost that are a function of steaming hours underway and not underway.

VARIANCES: There are normally different equipment activity levels for similar active and reserve force units. Typically, reserve units will use their equipment less frequently in peacetime than active units.

LEVEL OF DETAIL: To estimate the annual equipment cost of Navy ships, two activity measures are needed—steaming hours underway and steaming hours not underway. These measures can be developed from the programmed steaming days underway in home waters and deployed.

The following conversion factors were developed in a previous study.

Active:	Steaming hours per programmed steaming day underway	20.6 deployed
		19.0 home waters
		19.4 average

	Steaming hours per programmed steaming day not underway	8.36
Reserve:	Steaming hours per programmed steaming day underway	18.90
	Steaming hours per programmed steaming day not underway	15.96

The above factors should be checked using data from the offices listed under Data Sources.

DATA SOURCES: For ships, programmed steaming days underway and not underway may be obtained from:

Active	Surface Warfare Programs and Budget Division, Assistant Chief of Naval Operations (Surface Warfare), NOP-30
Reserve	Surface Program Management Division, Director of Naval Reserve, Office of the Chief of Naval Operations, NOP-953, or Surface Warfare, Naval Reserve Program Coordinator, Assistant Chief of Naval Operations (Surface Warfare), NOP-03R

Actual steaming hours and days can be obtained from:

Active	"Fleet Consumption Report," Petroleum Management Branch, Material Division, Deputy Chief of Naval Operations (Logistics), NOP-413
Reserve	Actual steaming hours per programmed steaming day can be obtained from NOP-953 (see above).

PETROLEUM, OIL, AND LUBRICANTS (POL)

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: The cost covers the petroleum, oil, and lubricants consumed by unit equipment during annual operations.

VARIANCES: The POL consumed per operating measure may differ for active and reserve operations. In addition, POL cost will vary by component due to differing programmed activity levels. Finally, note that for Navy ships, fuel consumption factors differ for hours underway and hours not underway.

ESTIMATING EQUATIONS:

$$(A) * (B) * (C) * (D) + (G) * (E) * (F) * (D)$$

where

- A = Programmed steaming days underway
- B = Steaming hours per steaming day underway
- C = Barrels of fuel per hour underway
- D = Cost per barrel of fuel
- E = Steaming hours per steaming day not underway
- F = Barrels of fuel per hour not underway
- G = Programmed steaming days not underway

See data sheet "Peacetime Equipment Activity Levels" for further information.

DATA SOURCES: Fuel consumption in barrels per hour underway and not underway for various active and reserve ships and the cost per barrel can be obtained from:

Petroleum Management Branch, Material Division,
Deputy Chief of Naval Operations (Logistics), NOP-413

VAMOSC-SHIPS reports may also contain the barrels of fuel consumed per steaming hour. The data are supplied to VAMOSC by the Navy Maintenance Support Office (NAMSO).

TRAINING MUNITIONS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: The cost is for ammunition, bombs, missiles, and other ordnance expended during annual training exercises.

VARIANCES: Training munition requirements are usually the same for similar active and reserve ships.

ESTIMATING EQUATIONS: Annual munitions cost per ship

DATA SOURCES: For ships, training munition cost data are contained in VAMOSC reports. Cost data should be averaged for several years over a given class of ships. These data are supplied to VAMOSC by:

Navy Ships Parts Control Center—Conventional Ammunition
Integrated Management System (SPCC-CAIMS)

REPAIR PARTS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: The cost covers repair parts and components procured by the ship for use in organizational level maintenance of the ship and installed equipment.

VARIANCES: Repair parts cost is assumed to be fixed within the range of a ship's peacetime operating level and, therefore, the cost for active and reserve ships is assumed to be the same.

ESTIMATING EQUATIONS: Annual repair parts cost per ship

DATA SOURCES: VAMOSC displays repair parts cost, component repair costs, and component replacement costs under several different categories:

- Repair Parts (element number 1.2.2)
- Organizational Exchanges (element number 4.1.1)
- Organizational Issues (element number 4.2.1)

The data are supplied to VAMOSC by:

- Navy Accounting and Finance Center (NAFC), Navy Cost Information System/Operations subsystem (NCIS/OPS) and Navy Ships Parts Control Center (SPCC)

Cost data should be averaged over several years for a class of ships.

SUPPLIES

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: Cost of nonmaintenance material and supplies used by the ship and the ship's crew includes items relating to the health, safety, and welfare of the crew, such as medical and dental supplies, radiation badges, fire protection suits, janitorial supplies, paper, and other administrative supplies.

VARIANCES: This element of cost is estimated based on the number of ship's full-time personnel for different classes of ships. Since many of a reserve ship's crew are part-time reservists, the full-time equivalents (FTE) are lower for a reserve ship as compared to a similar active ship. The cost per FTE is assumed to be the same for active and reserve ships.

ESTIMATING EQUATIONS:

$$(\text{Supplies cost per FTE}) * (\text{FTE})$$

DATA SOURCES: Total cost of supplies for different classes of ships is contained in VAMOSC reports under:

Supplies (element number 1.2.3)

The annual cost of supplies for active ships should be averaged over several years for a given class of ship. The average annual supplies cost per ship can be divided by the total personnel strength of an active ship to yield the average supplies cost per FTE. This average cost factor, in conjunction with the FTE for a reserve ship, can be used to estimate total annual recurring supplies cost for a given class of reserve ship. FTE for Naval Reserve ships can be calculated as the number of full-time (active duty and TAR) personnel plus .20 times the number of Selected Reservists.

INTERMEDIATE LEVEL MAINTENANCE

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: The cost is for labor and materials expended for the intermediate level maintenance of the ship. Intermediate maintenance may be provided by Ship Intermediate Maintenance Activities (SIMAs) or by repair tenders and ships. This category does not include regularly scheduled ship overhauls and maintenance performed at the depot level. The first portion of Sec. IV discusses the organization of maintenance activity in the Services.

VARIANCES: The annual intermediate maintenance cost for reserve ships is typically higher than for active ships. On active ships, the full-time personnel complement can perform all required organizational level maintenance. The reduced full-time manning of reserve ships, however, cannot perform all organizational level repairs, and intermediate level maintenance personnel thus have to perform some organizational level work. Intermediate level maintenance is assumed not to vary by peacetime operating levels.

ESTIMATING EQUATIONS:

$$\begin{aligned} & (\text{I-level workload in man-years}) * (\text{Productivity factor}) * \\ & (\text{Cost per man-year}) + (\text{Annual I-level material cost per ship}) \text{ or} \\ & (\text{Annual I-level cost per ship}) \end{aligned}$$

The first equation estimates intermediate maintenance cost based on a labor and material component. The I-level workload may be expressed in terms of direct productive hours. If so, the productivity factor is applied to account for indirect workloads and the unavailability of personnel. The application of the productivity factor should convert direct workload into personnel requirements. For example, if a function requires four hours of productive labor, and a maintenance worker can devote only 50 percent of his time to productive work, then a full eight-hour workday is necessary to accomplish the four-hour task.

If the I-level workload already includes unproductive or indirect times, then the productivity factor is equal to 1.

The development of the factors for reserve ships from some sources (see Data Sources below) has assumed a one-to-six ratio of active-to-reserve manhours. That is, the intermediate workload for reserve ships is assumed to be approximately six times the workload for a similar active ship. Unpublished analysis by the Center for Naval Analyses (CNA) suggests this factor is too high.

Both the Atlantic and Pacific fleets currently assume IMA-level maintenance personnel are productive only 45 percent of the time. Therefore, the productivity factor would be 2.22 (1/.45). The cost per I-level manyear can be estimated by using the average pay and allowances factor developed under personnel costs.

DATA SOURCES: Annual intermediate level maintenance manhour requirements are published for both the Atlantic and Pacific fleets:

- "POM-87 Requirements for Development of Intermediate Maintenance Activities (IMA),"
Commander-in-Chief, U.S. Atlantic Fleet
- "POM-87 Requirements for Development of Intermediate Maintenance Activities (IMA),"
Commander-in-Chief, U.S. Pacific Fleet

Both CNA and the Ship Maintenance Division of NOP-04 should be consulted to obtain information on the proper intermediate level workload for reserve ships.

Annual intermediate maintenance workloads and material costs for different classes of ships are also contained in VAMOSC reports:

- Direct Intermediate Maintenance (element number 2.0)
 - Ashore Maintenance Labor (element number 2.1)
 - Afloat Maintenance Labor (element number 2.2)
 - Material (element number 2.3)

DEPOT MAINTENANCE

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: This category of cost includes the labor and material expended during the scheduled and unscheduled maintenance of ships and ship components performed above the intermediate level of maintenance. It includes regular scheduled overhauls, restricted availability overhauls, technical availability overhauls, selected restricted availabilities, and other depot level repairs and overhauls.

VARIANCES: Regular overhaul is scheduled major repair with the ship in drydock. Restricted availability overhauls involve specific items on the ship; the ship is unavailable for duty. Technical availability overhauls involve specific items on the ship, but the ship is available for full-duty performance. Neither restricted nor technical availability overhauls are prescheduled. Selected restricted availability overhaul is prescheduled restricted or technical availability. Ships typically have an overhaul cycle; that is, a given class of ship is scheduled for the various types of overhauls and depot repairs over a span of so many years. For example, there is a six-year maintenance cycle for FF1052 class frigates. Since depot maintenance does not vary by the ship's activity level, the total depot and other overhaul workload is usually the same for similar active and reserve ships.

ESTIMATING EQUATIONS:

Annual depot maintenance cost per ship

The total depot maintenance cost for a class of ships should be summed over the span of the maintenance cycle and then averaged to get an annual depot cost per ship.

DATA SOURCES: VAMOSOC reports contain overhaul and depot maintenance costs for various classes of ships:

Direct Depot Maintenance (element number 3.0)
Scheduled Overhaul (3.1)

Regular Overhaul (3.1.1)
Selected Restricted Availabilities (3.1.2)
Nonscheduled Ship Repair (3.2)
Restricted Availability (3.2.1)
Technical Availability (3.2.2)
Modernization Program (3.3)
Other Depot (3.4)

UTILITIES

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Navy Ships**

DEFINITION: The cost covers electricity, gas, sewage disposal, and other support utilities provided to a ship from shore facilities when the ship is at the dock.

VARIANCES: The cost of utilities is a function of the number of personnel onboard the ship and the amount of time the ship spends at the dock. The difference between the annual utilities cost for active and reserve ships results from two factors. First, a reserve ship deploys less frequently than an active ship, suggesting that the utilities cost for reserve ships should be greater than for active ships. However, there are fewer full-time personnel onboard a reserve ship because of the part-time nature of the reservists' peacetime mission, suggesting that the daily utilities cost for reserve ships should be less than that of active ships.

ESTIMATING EQUATIONS: The following equation assumes that the daily utilities cost does not vary with the number of full-time personnel onboard the ship. (This assumption is not totally unreasonable. A light turned on for five people costs the same as a light turned on for one. Also, a large portion of the utilities cost is for ship equipment.)

(Utilities cost per day) * (Number of days in port)

The number of days in port should include both days in "cold iron" and the steaming days in port not underway. The number of days in port equals steaming hours underway subtracted from 8760 hours in a year and divided by 24 hours in a day (see the data sheet "Peacetime Equipment Activity Levels" for procedures to estimate steaming hours underway).

DATA SOURCES: VAMOSOC reports contain the annual cost for purchased services while a ship is at dock. This factor can be used in place of the above equation or can be used to develop a daily utility

cost if the analysis suggests that the ship will have a deployment pattern different from the pattern for the data reported in VAMOSC.

MILITARY CONSTRUCTION

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Navy Ships**

DEFINITION: The cost of constructing or modifying the buildings and facilities used by the unit in performing its mission and functions includes docks, piers, maintenance facilities, and administrative buildings. Also included should be the cost of constructing or modifying any base support facilities for unit personnel or equipment such as supply facilities, POL storage facilities, mess halls, and commissaries and the cost associated with placing facilities in a caretaker status, if appropriate.

VARIANCES: Different types of ships will require different types and numbers of facilities. Reserve units usually do not require the same numbers and types of personnel-support facilities as are required by active units. Reserve units are composed of large numbers of part-time reservists who do not place a burden on base housing, mess halls, and commissaries.

ESTIMATING EQUATIONS: The military construction costs for a specific policy decision will be a function of the facility requirements of the unit and the facilities that are available at the basing location. Because the magnitude of this cost is greatly dependent on the specific weapon system requirements and the specific basing location, it is difficult to estimate without detailed information about the particulars of the policy decision.

DATA SOURCES: Each component has an office responsible for military construction and the resulting budget submissions:

Director, Construction Force Programs, Commander,
Naval Air Reserve Forces, New Orleans
Naval Facilities Engineering Command (NFEC)

The Budget Justifications for Military Construction contain cost estimates for various construction projects and describe the facility along with a breakout of cost.

UNIT EQUIPMENT LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: Unit equipment levels are the types and quantity of major end items of equipment authorized for the unit. Authorized equipment levels are defined for various Authorized Levels of Organization (ALOs), which indicate a unit's deployment schedule. Unit equipment levels are used to calculate all equipment cost elements.

VARIANCES: Similar active and reserve units at the same ALO will have identical equipment authorization levels. However, when reserve units often have a different ALO level than their active counterpart, equipment levels are also likely to differ.

DATA SOURCES: The types and quantities of Army unit equipment are defined in the unit's Table of Organization and Equipment (TOE). Equipment levels for major end items are specified for each of the three ALOs. Cost factors are typically not available, or cost data collected, for the minor items of unit equipment. However, for most cost analysis efforts, the major items of unit equipment will account for the majority of the annual unit equipment operating costs. Therefore, it is usually not necessary for costing purposes to determine the quantities of all equipment within a unit, but only the major items. Unit TOEs can be obtained from:

Pentagon Library or
Organization Documents Directorate, Army Training
and Doctrine Command (TRADOC)

For aircraft, inventory status information is contained in:
Army Aircraft Inventory Status and Flying Time Report,
RCS:DRCRE-304

PEACETIME EQUIPMENT ACTIVITY LEVELS

Item Type: **Resource Factor**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: The authorized levels of unit equipment usage in peacetime may be expressed in miles, hours, or rounds fired. Except for aircraft, there are no programmed operating rates for Army equipment. Peacetime equipment activity levels can be important in the determination of all equipment cost elements.

VARIANCES: There are normally different equipment activity levels for similar active and reserve force units. Typically, reserve units will use their equipment less frequently in peacetime than active units.

DATA SOURCES: There are currently no programmed operating rates for Army equipment. This situation will change when the Battalion Level Training Model is fully developed. Actual hours, miles, and rounds fired are collected for a number of major weapon systems. For example, peacetime usage data for the M1 tank is collected under the Sample Data Collection program and published periodically by the U.S. Army Tank Automotive Command, Warren, Michigan. Actual peacetime operating data may be obtained from:

Fleet Management Data: Tactical Vehicle Usage and Age,
U.S. DARCOM Material Readiness Support Activity,
Lexington, KY or
The Army Maintenance Management System—Equipment Data
Base (TAMMS-EDB)

Specific units may also collect usage data on their equipment. Aircraft flying hours are contained in either:

Army Aircraft Inventory and Flying Time Report,
RCS:DRCRE-304, or
Army Regulation 570-2, Organization and Equipment
Authorization
Tables—Personnel, Department of the Army, or from

Deputy Chief of Staff, Operations and Plans,
Training Directorate (DAMO-TR)

PETROLEUM, OIL, AND LUBRICANTS (POL)

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: The cost is for the petroleum, oil, and lubricants consumed by unit equipment during annual operations.

VARIANCES: The cost of fuel per operating measure is usually the same for active and reserve units. However, the total cost can vary by component because of differing unit equipment levels or peacetime activity levels.

ESTIMATING EQUATIONS: Sum over all major end items of unit equipment:

(Fuel cost per operating measure) * (Peacetime activity level)
* (Quantity of unit equipment) or
(Fuel cost per year) * (Quantity of unit equipment)

DATA SOURCES: Estimates of fuel usage and cost for different types of equipment are contained in:

FORSCOM Cost Factor Handbook (available from FORSCOM Headquarters, Fort MacPherson, GA)

Aircraft fuel costs may be obtained from DACA-CACC-FD:

U.S. Army OMA&PA Cost Factors, Vol. 2: Appendixes Annual POL costs for both active and reserve equipment are also contained in the OSCMIS reports.

TRAINING MUNITIONS

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: The cost is for ammunition, bombs, missiles, and other ordnance expended during annual training exercises. Annual ammunition expenditures usually differ for similar units organized at different ALOs.

VARIANCES: Reserve and National Guard units typically expended less training munitions per year than active units. However, the readiness/deployment status of the unit will largely determine the peacetime training munition consumption levels.

ESTIMATING EQUATIONS:

(Munitions cost per person) * (Number of people) or
(Munitions cost per crew) * (Crew ratio) * (Quantity of unit equipment)

LEVEL OF DETAIL: Detail on the cost per person or the cost per crew may not be available; an aggregate training munitions cost per unit may be available and should be used in such instances. The Army can provide detailed information on the number and cost of various types of munitions authorized for specific unit training. These values may not accurately reflect actual usage since Army ammunition expended during annual training is constrained by the budget.

DATA SOURCES: The cost of the ammunition expended by specific units is tracked in the Training Ammunition Management Information System (TAMIS). TAMIS is administered by:

Deputy Chief of Staff, Operations and Plans, Training
Directorate (DAMO-TR)

Annual ammunition expenditures for active and reserve equipment are also contained in the OSCMIS reports.

MAINTENANCE MATERIAL

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: The cost is for consumable items used during equipment maintenance at either the organizational or intermediate levels of maintenance. (See the first part of Sec. IV for a discussion of the organization of maintenance activity in the Services.) It includes such items as gaskets, seals, and filters needed for preventive or corrective maintenance plus the bit and piece parts used to repair higher level component *assemblies*.

VARIANCES: The cost per operating measure is the same for active and reserve force units. However, because cost of maintenance material is a function of unit equipment operating levels, the total cost for active and reserve units may differ.

ESTIMATING EQUATIONS: Often data are not available that would allow estimation of the cost as a function of equipment operating levels. Thus we sum over all major items of unit equipment:

(Annual maintenance material cost per item) * (Quantity)

DATA SOURCES: The annual ASCMIS reports contain replacement repair parts costs for active and reserve equipment. Also, the FORSCOM *Cost Factor Handbook* contains repair parts cost factors for various items of equipment.

REPLENISHMENT SPARES

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: The cost covers subsystem components or major assemblies that must be replaced because of wear or condemnation.

VARIANCES: The replenishment spares cost per operating measure is usually the same for active and reserve equipment operations. However, the total cost may vary by component because of differing unit equipment levels or peacetime activity levels.

ESTIMATING EQUATIONS: Often data are not available that would allow estimation of the cost as a function of equipment operating levels. Thus we sum over all major items of unit equipment:

(Annual replenishment spares cost per item) * (Quantity)

DATA SOURCES: The annual OSCMIS reports contain some data on this element of cost. Further work is under way to refine the cost factors for replenishment spares cost within the OSCMIS system.

DEPOT MAINTENANCE

Item Type: **Cost Element**

Cost Type: **Equipment Related**

Annual Recurring Cost

Service(s): **Army**

DEFINITION: The cost is for material and labor expended during depot maintenance or overhaul of unit equipment.

VARIANCES: Certain weapon systems or subsystems on the weapon system are scheduled for depot maintenance on a calendar basis. An example is aircraft airframes. This portion of depot maintenance is considered fixed or purely a function of the equipment levels in the unit. The fixed portion of depot maintenance cost is typically the same for active and reserve units. Some weapon systems or subsystems are sent to the depot because the level of repair is beyond the capability of the organizational or intermediate maintenance levels. Examples are aircraft engines and avionic components. This portion of depot maintenance is unscheduled, and therefore variable. The variable portion of depot maintenance cost is a function of equipment usage in peacetime. Since activity levels in peacetime are often different for active and reserve units, the variable portion of depot maintenance cost is also different for active and reserve units. The cost per activity measure, however, is usually the same for active and reserve.

ESTIMATING EQUATIONS: Often data are not available that would allow estimation of the cost as a function of equipment operating levels. Thus we sum over all major items of unit equipment:

(Annual depot maintenance cost per item) * (Quantity)

DATA SOURCES: The annual OSCMIS reports contain depot maintenance cost factors for secondary items removed from the major end items. The ODCSLOG(DALO-RM) may also be able to provide scheduled overhaul cycles and overhaul costs for major end items of equipment.

HIGHER LEVEL MAINTENANCE

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Annual Recurring Cost
Service(s): **Army**

DEFINITION: The cost of labor and material expended for the repair of unit equipment at levels above the unit but below the depot includes, for Army equipment, repairs performed at the Direct Support (DS) and General Support (GS) levels. Intermediate level maintenance is assumed not to vary by peacetime operating levels.

VARIANCES: This element of cost may be different for active and reserve equipment because of the differences in annual equipment activity levels and the differences in maintenance support practices in peacetime.

ESTIMATING EQUATIONS: Often data are not available that would allow estimation of the cost as a function of equipment operating levels. Thus we might use the following procedure: The labor hours for DS and GS maintenance can be converted to personnel requirements with the resulting personnel costed as described in Sec. III of this report. Repair parts costs for DS and GS maintenance are included in the replacement parts costs of the OSCMIS reports and in the FORSCOM *Cost Factor Handbook*.

DATA SOURCES: There is no current source for annual DS and GS labor hours for Army equipment. Program offices, contractor reports, or the major commands may be able to supply these data.

OTHER COSTS

Item Type: **Cost Element**

Cost Type: **Equipment Related**

Annual Recurring Cost

Service(s): **Army**

DEFINITION: The annual equipment related costs not covered in the above categories may include support equipment related costs, modification costs, contractor unit level support costs, and transportation costs.

VARIANCES: This element of cost may be different for similar active and reserve units because of differences in operating environments, activity levels, and ALO levels.

ESTIMATING EQUATION: Input

DATA SOURCE: This element of cost will be unique to items of equipment or to units; data should be obtained from individual units or from the major commands.

EQUIPMENT PROCUREMENT

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Army**

DEFINITION: The initial procurement cost of the unit equipment includes the cost of the major weapon system, maintenance support and test equipment, training equipment, initial spare parts, and the initial unit munition requirements. For most costing exercises, the procurement cost of the major weapon system will not be included since the equipment will already be in the inventory or because the same number of units of equipment will be required by both active and reserve units.

VARIANCES: The items of equipment to be included in the cost analysis depends on the policy decision under consideration. If a new unit is being activated, all equipment will be required. If an existing unit is being modified in some manner, only the additional equipment required for the new unit must be obtained. Not all of the required equipment will have to be procured in all cases. For certain decisions, equipment may be available from existing inventories. For example, if an active unit is being modernized with a new weapon system and the weapon system being replaced will be used to modernize an existing reserve unit, there may be support equipment and other resources available from the active unit that can also be transferred to the reserve unit.

At times, the reserve units suffer from diseconomies of scale in terms of support equipment requirements. The dispersed basing of reserve units may result in a total support equipment requirement greater than the requirement for consolidated active units.

ESTIMATING EQUATIONS: Because this element of cost is greatly dependent on the circumstances surrounding the policy decision, there is no convenient cost estimating relationship. Information must be obtained from the appropriate offices plus the cost analyst must understand what, if any, equipment is available in the inventory.

DATA SOURCES: Equipment procurement costs and levels may be available from:

Army Material Command or
The major subordinate commands (TACOM, AVSCOM, etc.)

MILITARY CONSTRUCTION

Item Type: **Cost Element**
Cost Type: **Equipment Related**
Nonrecurring Cost
Service(s): **Army**

DEFINITION: The cost of constructing or modifying the buildings and facilities used by the unit in performing its mission and functions includes hangars, runways, maintenance facilities, and administrative buildings. Also included should be the cost of constructing or modifying any base support facilities for unit personnel or equipment such as supply facilities, POL storage facilities, mess halls, and commissaries. If appropriate, the costs to facilities in a caretaker status must also be considered.

VARIANCES: Different types of weapon systems and unit configurations will require different types and numbers of facilities. Reserve units usually do not require the same numbers and types of personnel-support facilities as are required by active units. Reserve units are composed of large numbers of part-time reservists who do not place a burden on base housing, mess halls, and commissaries.

ESTIMATING EQUATIONS: The military construction costs for a specific policy decision will be a function of the facility requirements of the unit and the facilities that are available at the basing location. Because the magnitude of this cost is greatly dependent on the specific weapon system requirements and the specific basing location, it is difficult to estimate the cost without detailed information about the particulars of the policy decision.

DATA SOURCES: Each component has an office responsible for military construction and the resulting budget submissions:

Office of the Chief of the Army Reserve, Construction
Management (DAAR-CM)
National Guard Bureau, Director of Army National Guard,
Installations Division (NGB-ARI)
Chief of Engineers, Construction Program
Division (DAEN-ZCP)

The Budget Justifications for Military Construction contain cost estimates for various construction projects and describe the facility along with a breakout of cost.

Appendix A

REFERENCES FOR PERSONNEL COST AND RESOURCE FACTORS

Cost elements and resource factors for personnel come mainly from two types of documents: Services' Budget Justifications or the *Uniformed Services Almanac*. Other sources may also be useful such as the *U.S. Air Force Cost and Planning Factors* or the *Army Force Planning Cost Handbook*. The latter is dated, not having been reissued since 1982; however, if it is ever updated or reissued, it would be valuable. The following is a list of references for personnel cost and resource factors.

UNIFORMED SERVICES ALMANACS:

Uniformed Services Almanac, Lee Sharff, Publisher, Uniformed Services Almanac, Inc., Washington, D.C.

Reserve Forces Almanac, Lee Sharff, Publisher, Uniformed Services Almanac, Inc., Washington, D.C.

National Guard Almanac, Lee Sharff, Publisher, Uniformed Services Almanac, Inc., Washington, D.C.

BUDGET JUSTIFICATIONS, PERSONNEL:

Department of the Air Force, *Justification of Estimates for FYxx*, Military Personnel, Air Force.

Department of the Air Force, *Justification of Estimates for FY19xx*, Reserve Personnel, Air Force.

Department of the Air Force, *Justification of Estimates for FY19xx*, National Guard Personnel, Air Force.

Department of the Army, *Justification of Estimates for FY19xx*, Military Personnel, Army.

Department of the Army, *Justification of Estimates for FY19xx*, National Guard Personnel, Army.

Department of the Army, *Justification of Estimates for FY19xx*,
Reserve Personnel, Army.

Department of the Navy, *Justification of Estimates for FY19xx*,
Military Personnel, Marine Corps.

Department of the Navy, *Justification of Estimates for FY19xx*,
Reserve Personnel, Marine Corps.

Department of the Navy, *Justification of Estimates for FY19xx*,
Military Personnel, Navy.

Department of the Navy, *Justification of Estimates for FY19xx*,
Reserve Personnel, Navy.

**BUDGET JUSTIFICATIONS, OPERATION
AND MAINTENANCE:**

Department of the Air Force, *Justification of Estimates for
FY19xx*, Operation and Maintenance, Air Force.

Department of the Air Force, *Justification of Estimates for
FY19xx*, Operation and Maintenance, Air Force Reserve.

Department of the Air Force, *Justification of Estimates for
FY19xx*, Operation and Maintenance, Air National Guard.

Department of the Army, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Army.

Department of the Army, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Army Reserve.

Department of the Army, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Army National Guard.

Department of the Navy, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Marine Corps.

Department of the Navy, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Marine Corps Reserve.

Department of the Navy, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Navy.

Department of the Navy, *Justification of Estimates for FY19xx*,
Operation and Maintenance, Navy Reserve.

COST FACTORS GUIDES:

Headquarters U.S. Air Force, *U.S. Air Force Cost and Planning Factors*, AF Regulation 173-13, Department of the Air Force, Washington, D.C.

Department of the Army, *Force Planning Cost Handbook (AFPCH)*, Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.

U.S. Army Cost and Economic Analysis Center, *U.S. Army OMA & MPA Cost Factors Handbook*, Vols. I and II, Office of the Comptroller of the Army, Washington, D.C.

Department of the Navy, *Visibility and Management of Operating and Support Costs (VAMOSC)*, Washington, D.C.

UNIT MANNING DOCUMENTS:

Department of the Air Force, Extended Unit Manpower documents.

Department of the Army, Table of Organization and Equipment.

Department of the Navy, Manpower Authorization Form (1000/2).

OTHER REFERENCES:

Federal Personnel Publications, *Federal Personnel Guide, Employment and Benefits*, Washington, D.C., 1987.

Office of the Secretary of Defense, *Fifth Quadrennial Review of Military Compensation*, Department of Defense, Washington, D.C., January 1987.

Schank, J. F., Susan J. Bodilly, Richard Y. Pei, *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, The RAND Corporation, R-3210-RA, March 1986.

Appendix B

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