(2)

Guidelines for Planning the Cost Analysis of Active/Reserve Force Structure Change

Michael G. Shanley

6928

RAND | NATIONAL DEFENSE RESEARCH INSTITUTE

The research described in this report was sponsored by the Assistant Secretary of Defense (Program Analysis and Evaluation) and by the Assistant Secretary of Defense (Force Management and Personnel). The research was conducted in the National Defense Research Institute, RAND's federally funded research and development center supported by the Office of the Secretary of Defense and the Joint Staff, Contract No. MDA903-90-C-0004.

ISBN: 0-8330-1239-0

Published 1992 by RAND
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

R-4061-PA&E/FMP

Guidelines for Planning the Cost Analysis of Active/Reserve Force Structure Change

Michael G. Shanley

Prepared for the
Assistant Secretary of Defense
(Program Analysis and Evaluation)
Assistant Secretary of Defense
(Force Management and Personnel)

RAND

PREFACE

This report presents a set of guidelines for planning the cost analysis of force structure change. This research was sponsored by the Assistant Secretary of Defense (Program Analysis and Evaluation) and the Assistant Secretary of Defense (Force Management and Personnel). It should be of interest to analysts concerned with altering the mix of active and reserve units, and especially to cost analysts who must estimate the costs of such alterations.

The study was conducted by RAND's Defense Manpower Research Center as part of an ongoing program of defense costing research. This research addresses four aspects of costing: cost-study planning, costing methodology, data sources, and automated applications. Initial studies addressed these aspects primarily in the context of changes in the active/reserve force balance, whereas recent work has broadened that agenda to consider major changes in overall force size and structure, including changes in supporting organizations and activities.

This is the first report to focus specifically on cost-study planning. It reflects previous developments in costing methodology, including material in the following RAND reports:

- John F. Schank, Susan J. Bodilly, and Richard Y. Pei, *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology,* R-3210-RA, March 1986;
- John F. Schank, Susan J. Bodilly, and A. Allen Barbour, *Cost Analysis of Reserve Force Change: Nonrecurring Costs and Secondary Cost Effects,* R-3492-RA, May 1987;
- Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance,* R-3748-PA&E/FMP/JCS, September 1990;
- John F Schank, Susan J. Bodilly, and Michael G. Shanley, *Cost Element Handbook for Estimating Active and Reserve Costs,* R-3748/1-PA&E/FMP/JCS, September 1990;
- Michael Shanley, *Active/Reserve Cost Methodology: Case Studies,* R-3748/2-PA&E/FMP, 1991.

In the area of data sources, RAND is completing the "DoD Cost Factor Project," which provides a detailed view of cost measures in all the services. Currently completed reports from this project are:

- Adele R. Palmer, *Cost Factors in the Army: Vol. 1, The Decision-making Context,* R-4078/1-PA&E, forthcoming;
- Adele R. Palmer and Eric V. Larson, *Cost Factors in the Army: Vol. 2, Factors, Methods and Models*, R-4078/2-PA&E, forthcoming.

Automated models to aid analysts in conducting cost studies are under development in the Defense Manpower Research Center. An earlier study examined issues in automating an active/reserve costing methodology and developed initial prototypes. More recently, RAND has undertaken a project on "Force Structure Costing for Program Analysis and Evaluation" that will design and help implement a complete costing system, based on principles developed in the research reported here and the documents cited above, while also extending the previous work in terms of cost-study planning, methodology, data sources, and automation.

The Defense Manpower Research Center is a component of RAND's National Defense Research Institute, a federally funded research and development center supported by the Office of the Secretary of Defense and the Joint Staff.

SUMMARY

Cost analysts who prepare defense budgets are often called upon to evaluate the cost consequences of changes in force structure. Force structure changes can increase or decrease the number of units in the force or can alter the characteristics of existing units (e.g., through equipment modernization). In addition, because of recent reductions in defense budgets, proposals to transfer active missions to the Selected Reserve are often contemplated as a way of maintaining a force structure while reducing its cost.

However, as typically described, force structure proposals require additional specification for adequate cost analysis. Such proposals usually deal with the directly affected combat units, leaving to the analyst the task of identifying parts of the force indirectly affected by the change. Further, proposals are often vague about those characteristics of units that drive costs, like changes in manpower and equipment levels, and peacetime operating tempo (OPTEMPO). Finally, force structure proposals rarely consider methods of transition from one force structure to another. Because these aspects of a force structure change can critically affect cost, they require specific consideration in the analytic process.

This report fills a gap in the costing process by presenting a set of guidelines (see App. A) for fully defining force structure changes and for planning the execution of cost analyses involving force structure change. The guidelines are presented in the form of a "generic" question list, applicable to force structure proposals across services and components. The list of 15 first-level questions (most accompanied by a series of second-level questions) have been designed to extract the critical information missing from a vaguely worded force structure alternative. In addition to presenting the questions themselves, the report explains the rationale for each question, suggests procedures for determining answers, and provides examples to illustrate how those answers can affect cost.

The question list emerged from an extensive investigation into force structure cost analyses conducted by the services and the Office of the Secretary of Defense (especially the Office of the Assistant Secretary of Defense for Program Analysis and Evaluation) in the context of the federal budgeting process. That investigation included a series of case studies (published separately and briefly summarized in App. B) based on actual force structure change proposals that have recently

arisen in the programming cycle of the Planning, Programming, and Budgeting System (PPBS) process. The question list originated, then, from an environment in which force structure decisions are actually made.

The full question list is organized into three subject areas. First, a series of questions has been designed to extract the exact force structure change. To understand the force structure change, the analyst needs to identify all units affected, directly or indirectly, the type of change (e.g., activation, deactivation, modernization) units are expected to undergo, and any changes to the units' supporting infrastructure. The analyst also needs to establish a point of reference, or base case, from which to calibrate the change. Finally, because proposed changes in force structure are often part of a more comprehensive cost-cutting plan, analysts need to isolate the effects of force structure changes from the effects of other measures to reduce costs.

A second set of questions addresses the transition tasks associated with the implementation of a proposed change. To make the transition from old to new force structure, appropriate personnel may have to be acquired and trained, equipment may have to be procured and transported, base construction plans may have to be altered, and, for new types of units in the reserve, appropriate operation and maintenance plans may have to be designed. The analyst needs to inquire about such changes since they apply not only to the units directly affected by the force structure change, but also to indirectly affected units and the supporting infrastructure. In addition, because of the importance of transition costs for the determination of short-term savings, the analyst may have to inquire into the timing of transition events. Finally, because of the large variability in potential transition costs for similar types of force structure changes, the analyst must determine the extent to which initial requirements can be satisfied by existing facilities and resource inventories.

The third set of questions is intended to identify those changes in resource and activity levels that drive cost. To answer these questions, the analyst must inquire directly into the effect of the force structure change on manning type and quantity, equipment type and quantity, and on equipment operating tempo. The net effect of such changes does not necessarily follow directly from the nature of the force structure change. For example, unit deactivations are not always accompanied by decreases in service personnel endstrength. Finally, analysts need to determine the capability implications of a proposed force structure change, so that after the costs (or savings) of the

change are calculated, the analysis can specify what the dollars are buying.

With even qualitative answers to the questions contained in this report, the analyst is equipped to identify the full scope of a force structure change and the major cost-driving factors that are likely to influence the final results. With that information, the analyst can either plan the detailed work of a longer cost analysis or properly qualify (by the highlighting of critical assumptions) the results of an immediately required cost estimate.

CONTENTS

FIGURES

1. INTRODUCTION

During the programming and budgeting phases of the Planning, Programming, and Budgeting System (PPBS), Department of Defense (DoD) cost analysts are sometimes called on to evaluate the cost consequences of altering the mix of active and reserve units in the force structure (e.g., the transfer of an active unit to the reserve forces). The results of these evaluations, which are often required within days or even hours, must be accurate enough to allow decisionmakers to make informed choices among alternative force structures, and then make the appropriate adjustments in the budget.

At present, however, analysts often have difficulty calculating the costs of force structure changes. One reason is that appropriate cost factors and other data for evaluating active/reserve force structure problems are often difficult to obtain, especially on short notice. A second reason is that the services and the Office of the Secretary of Defense (OSD) lack an agreed-upon methodology for addressing force structure changes. These issues are addressed in other RAND research.[1]

Another reason analysts have difficulty assessing the cost of force structure changes is that proposals are often inadequately defined for costing purposes. To realistically calculate cost effects, analysts must specify the proposed alternatives in considerably more detail than they typically are. Thus, a major job of the cost analyst is to redefine active/reserve force structure decisions into terms appropriate for cost analysis.

The process of redefinition, however, is often impeded by the inherent complexities of force structure change. First, the effects of force structure change are rarely confined to the units directly targeted for change. Since the missions of various parts of the force are intercon-

[1]Cost factors are examined in the following publications: Adele R. Palmer, *Cost Factors in the Army: Vol. 1, The Decisionmaking Context*, R-4078/1-PA&E, forthcoming; and Adele R. Palmer and Eric V. Larson, *Cost Factors in the Army: Vol. 2, Factors, Methods, and Models*, R-4078/2-PA&E, forthcoming. For the outlines of a complete methodology for active and reserve unit costing, see Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance*, R-3748-PA&E/FMP/JCS; and John F. Schank, Susan J. Bodilly, and Michael G. Shanley, *Cost Handbook for Estimating Active and Reserve Costs*, R-3748/1-PA&E/FMP/JCS.

nected, changes specified for one part can indirectly affect other parts of the force, often in unanticipated ways.

Another complicating factor is that there can be major differences among units of the same generic type. Although most force structure changes are typically expressed in terms of a class of units (e.g., M-1 tank units, C-5 squadrons) units with the same label can vary significantly in terms of the characteristics that drive costs (i.e., resources used, activities undertaken, and missions supported). In effect, it is not the unit type alone that drives cost, but also other choices about levels of manpower, equipment, and operating tempo (OPTEMPO), which are important secondary drivers of cost.

A third complexity in force structure costing is transition costs, the expenses incurred during the change-over period from one force structure to another. These include the one-time, or nonrecurring, costs of acquiring the manpower, equipment, and facilities needed to support the new force structure. Under some circumstances, they can also include the Operating and Support (O&S) costs of operating units while undergoing the required change. Transition costs add complexity because they tend to be unique to particular problems and much less predictable than the elements of recurring cost. For example, the amount of transition costs can depend on resource surpluses or shortages (e.g., in equipment, basing, or manpower), factors that are unrelated to unit type or type of force structure change.

This report formulates a set of generic guidelines to assist cost analysts in addressing the issues of problem definition in the costing of force structure change. The guidelines, presented in the form of a question list, are applicable across all services and components. There are 15 first-level questions, and under those major questions is a series of second-level questions. Collectively, the list is designed as a tool for designing cost studies—a method for obtaining an overview of the force structure problem before becoming immersed in the details of cost calculations. For the inexperienced analyst, the questions will serve as a comprehensive guide; for the expert, they will serve as a simple checklist to ensure completeness of work. In either case, analysts will be better equipped to plan a detailed analysis of cost or to properly qualify the results of a quick estimate.

The guidelines derive from using "expenditures" as the underlying concept of cost as opposed to "opportunity" costs. To see the difference, suppose a unit is deactivated but endstrength remains constant. Under the expenditure approach, no change in personnel cost is registered because the same amount is expended on personnel before and after the change. In contrast, the opportunity cost approach would

register a dollar personnel savings, to account for the value of the added personnel available to the remaining units after the deactivation. Under the expenditures approach, the value of the freed personnel to other units is handled on the output side of the equation (as an increase in mission capability) separate from changes in dollar amounts.

Sections 2 through 4 of this report contain the basic set of guidelines for defining the problem. Section 2 focuses on uncovering the exact nature of the force structure change, including identifying all the units that are indirectly affected. Section 3 deals with how the changes will be implemented and the major elements of the cost of transition. Section 4 addresses the effects of the force structure change on DoD resources, operating tempos, and missions. In addition to presenting the questions themselves, the sections explain the rationale for each question, suggest procedures for determining answers, and provide examples to illustrate how those answers can affect cost. Many of the examples come from in-depth case studies prepared by RAND that are described in other reports.[2] Section 5 contains concluding remarks.

Finally, App. A contains the question list in summary form, and App. B summarizes three case studies often used to bring concrete meaning to the general principles embodied in the questions.

---

[2]A majority of the examples are drawn from RAND reports because few other published cost studies provide sufficient documentation to illustrate the points.

2. GUIDELINES FOR CAPTURING FORCE STRUCTURE CHANGE

The analyst's first task is to fully understand the nature and scope of the change to the force structure, since no realistic costs can be calculated without such an understanding. To accomplish this task, the analyst needs to identify all units affected, directly or indirectly, and any changes to the units' supporting infrastructure. The analyst also needs to determine the type and exact nature of the changes those units and other parts of the force are expected to undergo.

Below, the guidelines for capturing force structure change have been broken down into a series of seven questions, each addressing a different facet of the issue. Answers to these questions can often be usefully summarized in a table format that gives an overall snapshot of the change. For examples of such summaries, see the case studies in R-3748/2-PAE/FMP.

1. What are the characteristics of the base case?

The base case of a force structure decision is defined as what would have happened if the change in force structure had not occurred. For example, if the proposed change is to move a mission into the Selected Reserve, the base case could well be to do nothing, to leave the mission in the active forces. However, because doing nothing is sometimes not an option (e.g., when the decision involves where to place new aircraft coming off the production line), the base case might become a "most favored alternative," or one with historical significance (e.g., the case represented in previous service Program Objectives Memoranda, or POMs). When no criteria exist for establishing a base case (e.g., when there are multiple alternatives proposed with no special individual distinction), analysts should ask a slightly different question: "What is common among all the alternatives?"

Because the goal of a force structure cost analysis is to calculate the *difference* between the cost of the new alternative and the base case, establishing the base case (or the common elements of a problem) is essential to the accurate determination of cost. For example, suppose a proposal was made to transfer a weapon system from an active unit to a reserve unit. Whether the transfer saves money or requires additional expenditures depends on how the base case is defined. If the base case was to keep the equipment in the active forces, the move

would show modest savings as determined by the difference in O&S costs by component. But if the base case was instead to retire the weapon system, the transfer alternative would save no money at all; in fact, it would *increase* costs by the amount of the O&S costs in the reserve unit. Considering one further example, if the transfer was an alternative to expanding the active basing structure (e.g., moving C-5s to the reserves as a way to make room for new C-17s at existing active bases), the move to the reserves would show not small savings in O&S costs, but rather large savings in facilities and land costs.

The establishment of a base case will often determine the cost drivers for a particular problem, ones that may be quite different from the drivers of total unit costs. For example, in the analysis of the proposed transition of C-5 aircraft to the reserves (see App. B for a fuller description of the proposal), personnel and flying-hour costs were shown to be responsible for 75 percent of total unit costs. However, the factor that drove the difference between making the transfer and leaving the aircraft in the active units (the base case) was "support-related costs"—the nonpersonnel costs of services provided by the installation as a whole, such as base rentals, utilities, communications, computer operations, and medical facilities (such costs are lower in reserve units because reserve personnel spend less time on the base). Although they were less than 10 percent of the total O&S costs of C-5 units, support-related costs represented over 90 percent of the difference between active and reserve operation of the aircraft.

Early identification of a base case can save valuable analysis resources and allow for quicker turnaround of cost studies. For example, in the AH-64 case (see App. B), the primary question was whether to modernize an AH-1 unit in the Army National Guard versus the base case of modernizing in the active forces. In both cases, the freed AH-1 equipment was moving elsewhere in the force, thus creating the typical domino effect on the force structure that often results from equipment modernization. However, the analysis did not have to consider these secondary effects because they were the same under both options.

Finally, the analyst must take care to define the base case as carefully as any proposed change, as both are equally important to the determination of cost. For example, when costing the transfer of a mission from the active forces to a new base in the reserves (versus the base case of not making the move), the analyst should specify not only the cost of new facilities at the reserve base, but also the savings from avoiding the facilities improvements planned at the old base in the event no move took place. Not to do so would overestimate the

cost of moving to the reserve base. (For further discussion of this issue see Question 15, which deals with basing.)

2. What military units are affected, directly or indirectly, by this alternative?

a. What are the named combat units involved in this force structure change?

b. What are the combat or deployable support units that are indirectly affected through a shared mission?

c. What units are affected indirectly through the transfer of resources, activities, or missions?

Normally, cost analysts receive descriptions of force structure changes in terms of the combat units directly affected by the change—X number of units activated or deactivated, transferred, or otherwise changed. What analysts must decide for themselves is whether units should be added to the problem scope because of indirect effects.

Combat units named in a proposed force structure change can affect other units in the force in two basic ways. First, they can be related through a shared mission, whereby changes specific to one unit perturb the peacetime activity levels or wartime responsibilities of other units. This is true, for example, for cargo squadrons in the Air Force. In the process of training unit personnel, cargo squadrons also provide airlift services to other parts of the military and for the maturing of rated officers who are programmed to occupy trainer and overhead staff positions in other units. If a force structure change reduces the number of cargo squadrons in the active forces or transfers more of the missions to the reserves, the remaining cargo units may be indirectly affected. In particular, to maintain the airlift and external training missions, the remaining active squadrons may have to fly more hours to make up for the shortfall created by the units that left the active forces. If so, those indirectly affected cargo units would properly become part of the problem scope.

The same scenario would apply in the case of Navy frigates and destroyers that serve as escorts for aircraft carriers with a peacetime forward-deployment mission. If some of those escorts move to the reserves and become unavailable for forward-deployment missions (because of the part-time nature of the reserves), the remaining escort ships would have to deploy more often (and steam more days) if the same mission were to be maintained. Once again, units not formally involved in a force structure change would have to be included in a study of that change.

Missions can also interconnect when one set of units supplies deployable support for another set of units. For example, in the Army, forward-support battalion (FSB) maintenance companies are designed to provide intermediate maintenance for weapon systems in tank, mechanized infantry, and artillery battalions within a division support command. If the peacetime capacity of a few of those companies is reduced because they are transferred to the reserves (the reservists work fewer hours), other FSB companies would have to make up the difference if the same output is required. Once again, units not formally involved in force structure change must be included to accurately evaluate cost effects.

A second way units can be indirectly affected in a force structure change is through the exchange of resources. If in the process of force structure change, the resources of primary units are added to or subtracted from the resources of other units, those indirectly affected units will have to be included as part of the problem scope. The clearest example is provided by a unit's major equipment. If the major equipment from a unit deactivation were to be used to modernize the equipment of another unit, both units should be included as part of the force structure change, even if the change was described as a deactivation and the modernized unit was not identified in the problem definition. Further, if the old equipment of the modernized unit goes to yet other units (instead of being scrapped or placed in idle capacity), those other units should also be included.

A less obvious example comes from the manning area. Suppose that a new unit is created without an increase in service endstrength. For example, one proposal in the transfer of FF-1052s to the Naval Reserve was to staff the new reserve units with reserve augmentees—reservists who were aligned with active ships. In that case, the active ships on which the augmentees originally trained would become a part of the problem scope and be included in an assessment of cost.

By excluding indirectly affected units from a cost analysis, large portions of the cost (or savings) of the force structure change can be left undetected. For example, consider the issue of transferring two C-141 squadrons from the active Air Force to the Air Reserve Forces.[1] When viewed as the deactivation of existing active C-141 squadrons and the establishment of new C-141 units in the reserves, the transfers were estimated to save $93 million per year in O&S costs. However, those savings were substantially less if the problem took into account the indirect effect on other units. In particular, if the

[1]For a detailed examination of this example, see R-3748-PA&E/FMP/JCS, Sec. II.

remaining active C-141 fleet were seen as replacing the external peacetime lift and rated officer training missions of the deactivating units, the savings were only $20 million per year, less than a quarter of the original amount.

Expanding a problem definition from one that includes only directly affected units into one that also includes all indirectly affected units can be approached systematically. Basically, the procedure calls for inquiring into the *source* of resources, activities, and missions in force structure changes when they are added; and into the *disposition* of resources, activities, and missions in force structure change when they are subtracted.

Figure 2.1 shows how the analyst would proceed for each force structure alternative. Starting with the given problem definition, the analyst selects one of the affected units and determines whether resources, activities, or missions are being added or subtracted (or both). The activation of a new unit or the addition of unit equipment (unit augmentation) would ordinarily involve "addition," whereas the deactivation of a unit or the reduction of unit equipment would ordinarily involve "subtraction." Equipment modernization would ordinarily involve both, because when a unit is modernized, resources are both added (the new equipment) and subtracted (the old equipment).

In cases of addition, the analyst would inquire into the source of the resource, activity, or mission; in cases of subtraction, the analyst would inquire into the disposition of those factors. The purpose of the inquiry is to determine if units need to be added to the problem scope. If any resource, mission, or activity has its source or disposition in another unit, the analyst must ask whether that other unit properly belongs within the scope of the problem at hand. The answer will depend on whether the changes in the other units can be considered predetermined and their costs sunk, or whether the changes are a logical cause or consequence of the force structure change under consideration.

If the inquiry for a selected unit does not imply the addition of more units to the problem scope, the analyst then selects another unit from the preliminary list and continues until all have been considered. However, if following the resources of any unit leads to the addition of more units to the problem scope, the analyst adds those newly identified units to the original list (see the feedback arrow in Fig. 2.1), and for each of those new units repeats the procedure to determine if yet more units should be properly added. Again, this procedure continues until closure in the problem definition has been reached—that is,

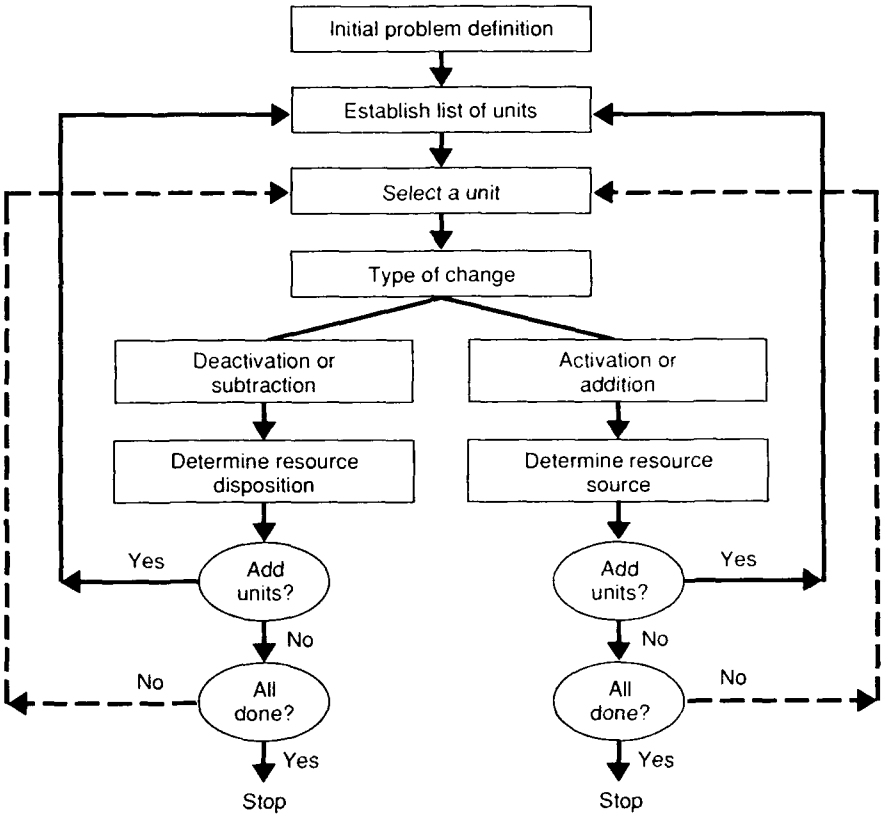

Fig. 2.1—Procedure to Determine the Units Affected by a Force Structure Change

until all indirectly affected units are included within the problem scope. In this way, the analyst can build up from a small number of directly affected units to a problem scope that includes all indirectly affected units.

The determination of whether units should be added to the scope of the problem can be portrayed as a decision tree that distinguishes the five basic types of unit change—changes in wartime mission, peacetime function, manning, equipment, and bases (see Figs. 2.2 and 2.3). Following the logic for each of the five categories, the analyst determines whether the decision arrows lead to or away from the addition of new units.

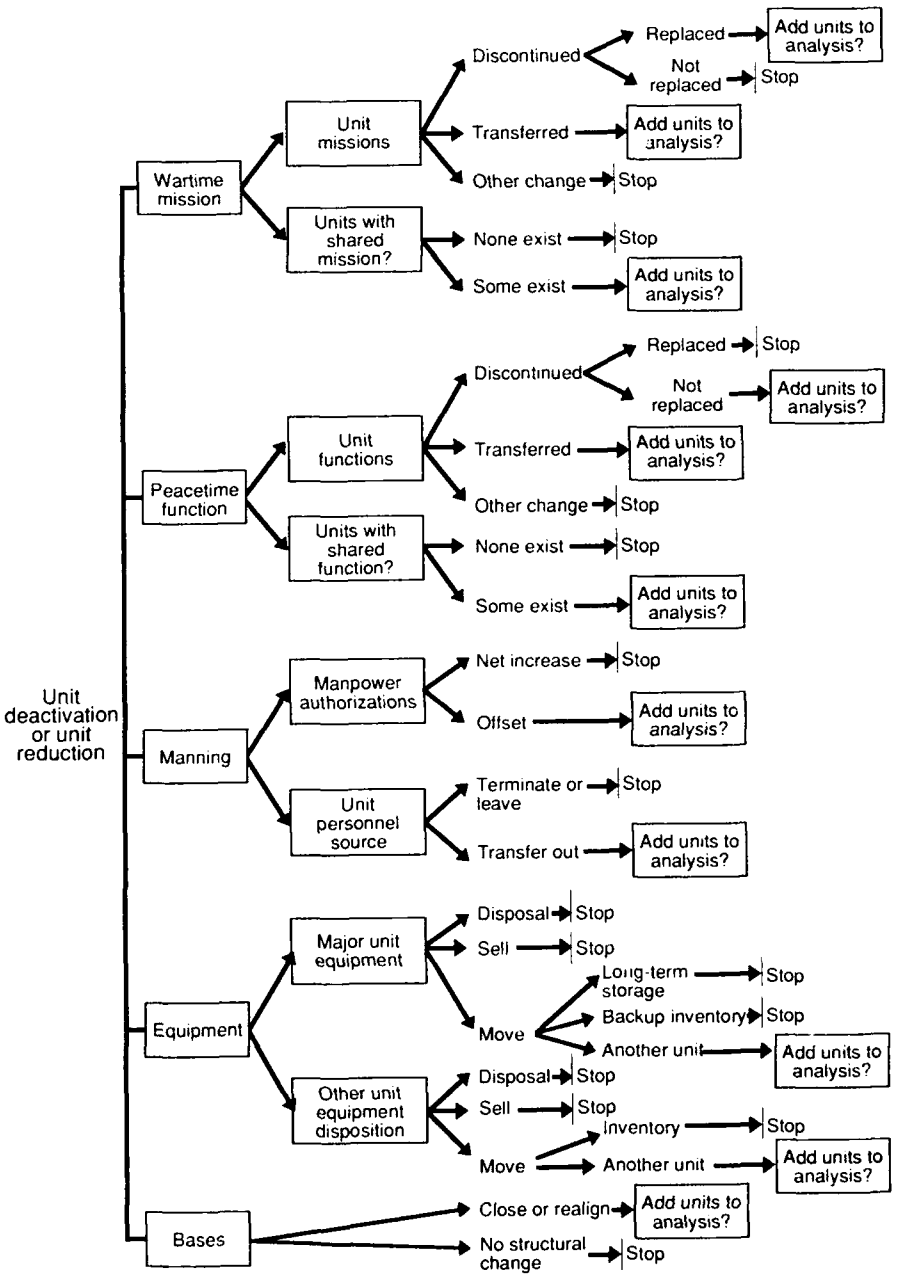

Fig. 2.2—Tracing the Effect of Unit Deactivation or Reduction on Problem Scope

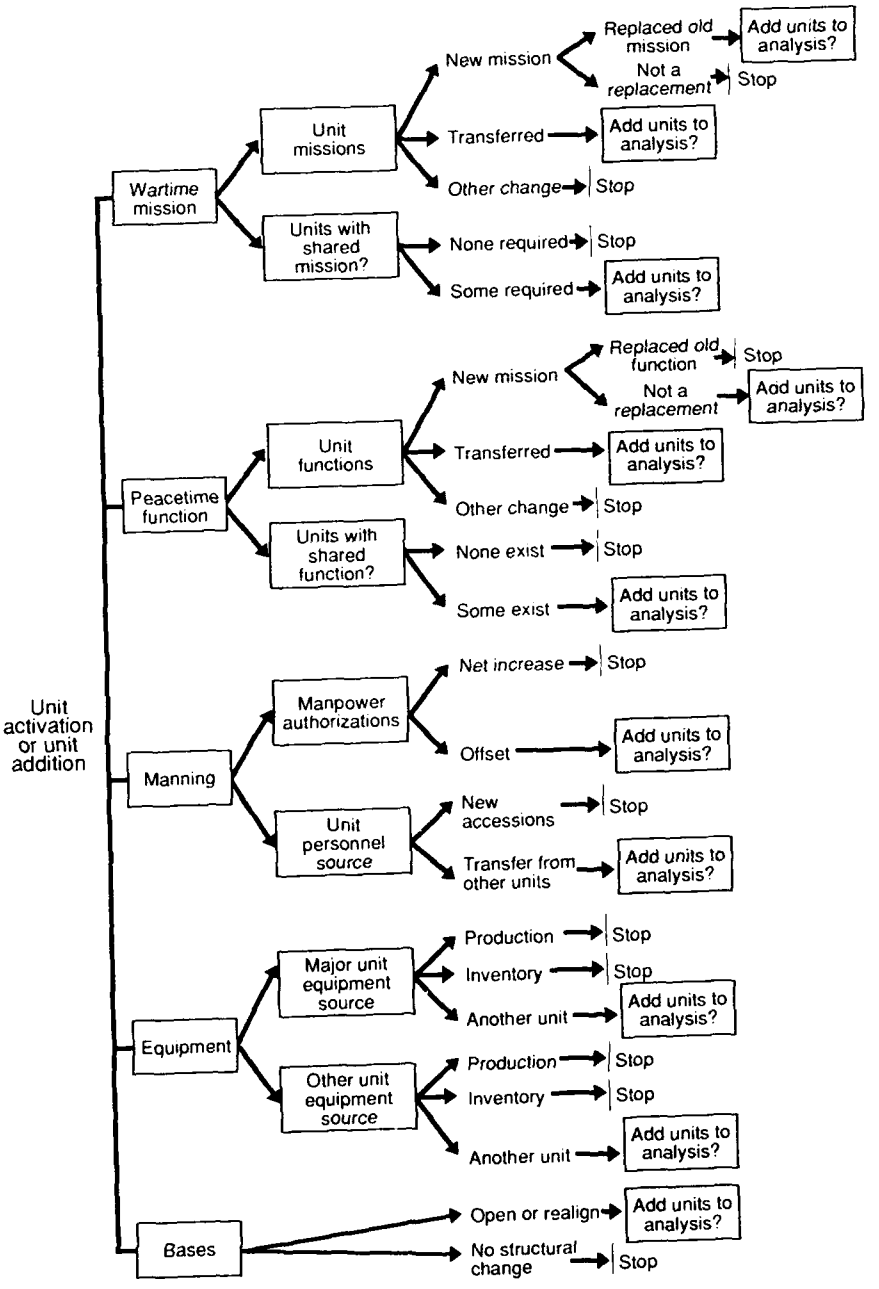

Fig. 2.3—Tracing the Effect of Unit Activation or Addition on Problem Scope

To see how the decision tree works, consider the ripple effect caused by the modernization of a unit's major equipment. If the unit's old weapon system is placed in inventory, disposed of, or sold, the resource trail would end with no other units involved. Following the decision tree along those options in Fig. 2.2 leads to the short vertical line, indicating an end to the inquiry about major equipment with no new units added. However, if the displaced weapon system was used to modernize other units with still older equipment, or if it was used to augment other units of the same type to a larger size, then the analyst needs to consider whether those units should also become a part of the problem definition and their costs included in the analysis. This is indicated in Fig. 2.2 by the "move" and "another unit" options, as well as by the shaded box that asks whether units should be added.

By taking one unit at a time, this method could develop an initially underdefined one- or two-unit problem and uncover its complete, complex nature. To consider a concrete example,[2] suppose the analyst were presented with a problem in which he or she knew only that the C-130 unit (16 primary authorized aircraft or PAA) at Kelly Air Force Base (AFB) was to be modernized with C-5As from the active forces. Initially, the problem would involve two units—the active units giving up the C-5s and the C-130 unit receiving them.

However, by using Figs. 2.2 and 2.3 to follow the resource trails, the analyst could determine that the full problem scope was much broader, including six units in total. First, inquiring about the disposition of the freed C-130Bs (using Fig. 2.2), the analyst would find that half the C-130Bs were to be sent to augment an existing C-130 unit at Peterson AFB from an eight to a full 16 PAA squadron, and that the other half were scheduled to replace six HC-130Hs at March AFB. Adding those two units to the problem scope would lead the analyst to determine (by using Fig. 2.2 again) that March's HC-130Hs would then be sent to establish an air rescue unit at Portland International Airport. Continuing through yet another cycle, the analyst would find that the aircraft of the air rescue unit would be joined by six CH-3Es. Inquiring into the source of the CH-3Es (using the "unit addition" from Fig. 2.3 this time), the analyst would find that they were displaced equipment from a different force structure change at Luke AFB, in which a unit was scheduled to be modernized with new F-16s. Adding the indirectly affected units to the problem scope (except the F-16 squadron, which involved a separate force

[2]The example is from R-3748/1-PA&E/FMP/JCS, p. 9.

structure change) expands the number of units involved from two to six.

The same principles found in the example using major equipment apply to support equipment, manpower, basing, wartime mission, and peacetime function. In each case, the analyst asks about source and disposition to determine whether units were indirectly affected. However, the types of "units" that are added to the analysis may include items other than those ordinarily defined as combat units. For example, in the case of a deactivation accompanied by a dispersal of the unit's manpower to a number of unidentified units, the "unit" added may be a hypothetical one, Unit X, which represents all those units together. In the costing process, the analyst would not only have to register that the personnel cost reduction in the deactivating unit was offset by gains in other units; he or she would also have to consider whether any new equipment costs in Unit X would also offset the decrease in those costs for the deactivated unit.

If the base on which a unit was located was logically part of the problem definition, the analyst may have to deal with support units in much the same way as combat units. For example, consider the example positing that Norton AFB would close (see Question 14). The analyst would find it necessary to add units called the Air Force Inspection and Safety Center, the Audit Agency, and the Audio Visual Service Center—missions that were located on the base alongside the combat squadrons. The analyst would then have to ask about the disposition of those missions and about their manpower, equipment, and activity level.

In summary, by following resource, activity, and mission trails, the analyst can proceed from a narrowly defined problem involving a few units to a fully defined problem involving a large number of units.

3. What is the type of each unit affected?

a. What is each unit's component (active, reserve, or guard)?

b. What is each unit's description (mission, design, series (MDS) or more specific)?

Instead of dealing with specific force units, proposed changes in force structure usually deal with specified "types" of units, defined at various levels of generality. (Specific units are often not identified until the implementation stage of a force structure change, long after the

decision to make the change has been made.) Typically, generic units are described in force structure problems according to component (i.e., active, reserve, or Guard), relative size in the organization (e.g., squadron or wing, battalion or brigade), mission (e.g., infantry, tank), and MDS of the weapon system of the unit. More refined classes of units are sometimes identified or pursued by the analyst, but analysts are often tasked with describing a typical or average unit among a large class of units.

Because specifying the unit type usually implies something about mission as well as resource and activity levels, such designations are often used to help estimate unit costs. Designation of a unit's component in the reserves, for example, typically means that the unit is less costly than a similar one in the active forces, because the reserves employ part-time manning and usually have a lower OPTEMPO than similar active units. A larger ALO (authorized level of organization) number for an Army unit with a particular TOE (table of organization and equipment) will typically mean lower O&S costs because of a lower manning requirement. In Air Force cost-factor handbooks, the specification of command and MDS implies specific estimates of a "typical" squadron's manning, major equipment, and OPTEMPO.

However, because of a significant variation in the resource and activity levels for units of the same type, a generic designation of unit "type" is often insufficient for estimating O&S costs. For example, in the C-5 case study, the standard number of aircraft per unit as reported in AFR 173-13 (18 or 24 PAA) was not relevant to the case because the actual unit sizes varied from eight to 22. In the Army AH-64 study, which showed manning in a Guard unit to be 125 percent of authorized level, generic information alone would have been misleading.

4. What type of change will the affected units undergo?

- **a. How many activations of new units?**
- **b. How many deactivations of existing units?**
- **c. How many existing units will undergo resource, activity, or mission changes?**

Besides knowing *which* units are affected by a force structure change, the analyst must determine *how* those units are affected. Force structure changes can affect the number of units (through the establishment of new units or disestablishment of existing ones) or the

characteristics of existing units. For example, units may undergo changes in:

- Size (amount of equipment or number of personnel)
- Personnel composition (e.g., crew ratio or the addition of reserve personnel to active units)
- Equipment composition (e.g., the modernization of unit equipment)
- Operating tempo
- Mission responsibilities (e.g., the deletion of the forward-deployment mission for Navy frigates).

Understanding the type of change units undergo is essential to the calculation of costs, since different types of changes have different resource, activity, and mission implications. For example, unit activations or augmentations (all else held equal) add to DoD resources and activities (and thus costs), whereas deactivations or unit equipment reductions typically decrease resources and activities. Modernizations of unit equipment do both—they add the resources and activities of the new unit, but they can also subtract some of the old unit. Further, additions or subtractions of whole units typically have a greater effect on cost than do changes to existing units, where the size of the cost effects depends on the difference in unit resources before and after the change. For this reason, knowing the type of changes that units are to undergo informs the analyst both about the type of resource and activity changes to look for and the likely magnitude of those changes.

A generally worded proposal for a change in force structure, such as "the transfer of X equipment from the active to reserve forces," does not indicate the types of changes to units that might result. On the active side, the transfer of equipment could mean deactivation of existing units, reductions in the size of active units with that equipment, or a simple reduction in equipment inventories. On the reserve side, the transfer could mean establishment of new units, augmentation of existing units, or modernization of existing units.

Problem statements that fail to specify the precise type(s) of change to the units affected run the risk of a gross miscalculation of the cost consequences. Consider the example of two C-141 squadrons transferring from the active Air Force to the Air Reserve Forces.[3] If it is assumed that the transferred equipment will be used in the reserves

[3]This example taken from R-3748-PA&E/FMP/JCS, Sec. II.

to modernize existing C-130 squadrons (with a retirement of the C-130s), the transfers can be estimated to save $151 million per year in the steady state. Alternatively, if the transfers are assumed to involve the establishment of new C-141 units in the reserves, the transfers would save more than a third less—about $93 million per year. The difference lies in the fact that in the second instance the reserve force structure expands as new units are added, while in the first instance the force structure remains constant as existing units are merely modernized.

5. Does the number of units increase, decrease, or stay the same?

Even if resource and activity levels remain constant, accurate costing requires identifying changes in the number of units. The number of units can change not only because of activations and deactivations, but also because of consolidations or splits. The C-5 case study (see App. B) gives an example of unit splits. Although the case involved no change in equipment levels of the total force (just a transfer of equipment from the active to the reserve forces), the unit splits would have increased the number of squadrons from 7 to 11 under one option, and from 7 to 9 under the other option.

The number of units is important to the calculation of cost because there may be economies of scale (or diseconomies of scale) associated with different force structure configurations. For example, a recent Program Analysis and Evaluation (PA&E) proposal called for consolidation of Air Force fighter aircraft into fewer squadrons at fewer bases so that economies of scale could be realized in the overhead costs of basing those aircraft.[4] If units can more effectively utilize equipment and facilities in larger squadrons, then larger unit sizes can reduce costs in military construction, procurement, and base operation.

Another example of the effect of unit size on cost involves the manpower required for squadron management. In the case of the C-5, two or three pilots must be trained for rated overhead positions for each squadron, regardless of size. In addition, new squadrons produce overhead requirements at the wing and higher organizational levels. With a fixed overhead cost (to train the rated pilots) associated with each squadron, smaller squadrons will have higher equipment operation costs on average.

---

[4]See *The Washington Post*, editorial page, Sunday, April 16, 1989.

6. Does the change affect the unit support structure?

- **a. Are there any changes to personnel establishments or personnel programs (e.g., acquisition, training, bonus levels)?**
- **b. Are there any changes to maintenance establishments (e.g., depots, intermediate maintenance) or other central logistics organizations?**
- **c. Are there any changes to basing establishments (e.g., base openings, closings, realignments)?**
- **d. Are there any changes to headquarters or administrative organizations?**

In their everyday functioning, military units make demands on such resources as manpower, equipment, munitions, and spare parts. Organizations or parts of the force that supply those resources constitute the support structure for the unit. They include the bases on which units reside and the facilities those bases provide, training and other personnel support systems, central logistics organizations that supply consumables (e.g., petroleum, oil and lubricants (POL), spares, support equipment, ammunition, and modification kits), intermediate- and depot-level maintenance organizations, and higher-level management organizations.[5]

When analysts consider the cost consequences of force structure change, they must take into account not only the direct effect of the change on the combat units themselves, but also the indirect effects on the supporting infrastructure. Those organizations also incur costs as the result of a change in their usage of manpower and equipment. For example, if a force structure change added major equipment to the DoD inventory, depots would have to expend additional resources to maintain those systems. If a force structure change led to decreased use of major equipment (perhaps because of a mission transfer to the reserves), buys of POL and spare parts would also decrease.

Some of the effect of force structure change on unit-supporting systems is already captured in existing force structure models. For example, in the *Cost Element Handbook for Estimating Active and Reserve Costs* created at RAND for estimating the costs of incremen-

[5]For further discussion of unit-supporting systems, see R-4078/2-PA&E, forthcoming.

tal force structure changes,[6] guidance is provided on calculating the variable costs incurred by support organizations that train the unit's personnel, that maintain its equipment, and that supply its resource demands related to equipment operation. In addition, the handbook contains a factor to calculate the nonpersonnel cost (variable portion) of the support provided by the service or installation as a whole, including that for base rentals, utilities, communications, and medical facilities. Thus, if (for example) tanks or aircraft are added to units in the force and operated at known rates, an analyst using the active/reserve cost model does not need to independently estimate (and must be careful not to double count) certain costs incurred by support units, because the appropriate cost factors have been built into the process.

However, because no existing force model adequately captures *all* support system costs for *every* force structure change, the analyst must still address the issue, adding costs or savings in support organization that are not captured by the relevant methodology. For example, the active/reserve cost model does not take into account changes in overhead costs, such as those for the overall administration of the force or component; the fixed, common-use portion of base-operating support (BOS); and the fixed costs of school training or higher-level, centralized maintenance organizations, such as depots. Other examples of costs not captured by most force structure models include those for:

- Opening or closing an existing base.
- Adding a major product-line maintenance section (with personnel and facilities costs) in a depot or intermediate maintenance facility.
- Adding a special budget (e.g., for advertising or bonuses) to attract personnel in a reserve location.
- Hiring a commercial carrier to transport Navy reserve personnel from their residences to their ship's homeport location.
- Introducing a major modification program as a consequence of a force structure change (e.g., a program to reengine aircraft before they are sent to the reserves).

Although it is difficult to predict when they will occur, added costs of changes to the infrastructure can make a critical difference in force structure decisions, even for relatively small changes in force struc-

[6]A complete description is given in R-3748/1-PA&E/FMP/JCS.

ture. Consider the FF-1052 study, which evaluated the cost of transferring 24 such ships from the active forces to create new reserve units (see App. B). If the costs of pier projects and SIMA (Ship Intermediate Maintenance Activities) facilities and SIMA support equipment were ignored or assumed to be zero, the payback period in the analysis was less than three years. In contrast, if historically based values were included for those costs, the time to break even increased to nearly ten years, making the alternative unattractive as a cost-saving change in the budgeting context.[7]

7. Are there other changes, unrelated to force structure, that are included in the problem definition?

Various types of cost-cutting measures can sometimes occur simultaneously within the same proposal. Thus, for example, a proposal to change the mix of active and reserve units can be accompanied by a proposed change to cut the resources, activities, or missions of the unit itself or of the supporting infrastructure. In such cases, it is important for the cost analyst to distinguish each of the strategies and, where possible, to calculate their independent impact on cost. By so doing, analysts define more precisely what the overall plan is accomplishing, place the different strategies into perspective, and give decisionmakers a better understanding of the role each strategy is playing. Decisionmakers then have a wider range of options from which to choose; for example, they can elect to implement only that portion of the overall plan that provides the main sources of savings.

Withholding unit resources is one method that can increase the savings impact of a force structure change. An example would be creating new units (a force structure change) but not increasing end-strength (a cut in average unit resources). That situation occurred in one of the alternatives considered in the FF-1052 case study (see App. B). The alternative called for staffing new reserve units with personnel who previously served in augment units on other active frigates.

A less obvious way of withholding resources is to underfund programs. For example, in the AH-64 case study (also in App. B), certain unanticipated, nonrecurring transition costs had to be funded from existing budgets. Such costs would not be treated as additional expenses under the active/reserve costing methodology because they do not represent a net additional expenditure of money. Rather, the costs of the transition represent a reduction in programs from which

[7]For further discussion of the effect of the supporting infrastructure on the cost of force structure change, see the questions relating to transition costs, basing, and equipment.

the funding was obtained. Just as it is inappropriate to count personnel savings when a unit deactivates but endstrength stays the same, it is also inappropriate to count costs that, in effect, do not change the level of total expenditures. Instead, what should be recorded is the decreased resources (and associated capabilities) of units hurt by the loss of dollars or manpower.

Underfunding decisions can also appear in the form of optimistic assumptions about the cost of implementing changes. For example, the FF-1052 transfers were programmed assuming that the transition costs would be zero, despite recent Navy experience with similar transfers that suggested at least some additional pier projects and SIMA facilities would be needed. If the optimistic assumptions turn out to be incorrect, implementing the change will require the additional appropriation of funds at a later date or the transfer of resources designated for other projects.

Another example of coupling resource reduction with force structure change is in maintenance practices. This arises again in the FF-1052 transfer case, where unit transfer decisions were tied to a decision to change maintenance practices in the reserves in a way that reduced maintenance cost. Although the program budget decision (PBD) evaluating the proposal was labeled a change in force structure (citing the transfer of frigates), the measure achieved significant savings only by coupling the force structure change with a decision to reduce funding for reserve ship depot maintenance—not just the ships undergoing transfer but other frigates in the reserve force as well. Over 90 percent of the savings estimated for the change could have been realized with no change in force structure at all.

Finally, force structure proposals might be combined with proposals to simply reduce mission capability or to reduce the peacetime services provided by military units. Units of the same generic type can train for different wartime mission assignments, can be scheduled to deploy at different points in a conflict, can provide differing amounts of peacetime services, and can be based in locations with differing strategic significance. If these or other unit characteristics are altered at the same time force structure is changed, they need to be included in the cost assessment so that the results can be placed in perspective.

The FF-1052s again serve as a good example. These frigates cost less in the reserves partly because they do not participate in the forward deployment mission of their active counterparts. The same is true in the case of cargo aircraft units, like C-5 and C-141 squadrons, in which the reserve units are unable to provide the same airlift services

as those of similar active units. In these cases, the entire savings from the transfer should not be attributed to the change in force structure, because some of the savings could have been realized by simply reducing the peacetime mission of the active units instead of making the force structure changes. To attribute the entire savings to the force structure change would obscure the source of the cost change which is due, at least in part, to the reduction in mission capability.

Analysts might use a variety of strategies to clarify savings that are attributable to a multifaceted proposal that includes both force structure changes and other measures. One method is simply to separate savings obtained from force structure changes from savings obtained from other cost-cutting measures.[8] Even if the exact resource implications cannot be identified, as when full funding is withheld, the analyst can identify the shortfall as unrelated to the change in force structure.

If cost effects of multiple decisions interact, a complete separation of effects may not be possible. For example, if the FF-1052s are sent to the reserves (a force structure decision) at the same time their peacetime forward deployment responsibilities are reduced (a decision about peacetime mission), then the savings from a reduced operating tempo cannot be assigned solely to either change. In those cases, the best that can be done is to specify the accompanying decisions taken in tandem with the force structure decision. In our example, costing the decision to move the FF-1052s to the reserves must be accompanied by a specification of whether peacetime mission would change or not.

Another approach to multifaceted proposals is to construct the base case in a way that clarifies the contribution of force structure change. For example, in the FF-1052 case described above, the analyst might have specified the base case as: no transfer of ships to the reserves *but reduced depot maintenance*. A similar strategy is to create additional alternatives or excursion cases (i.e., cases that change only one dimension of a major alternative) that clarify the role of force structure change in achieving savings. For example, if an analyst is required to cost out an alternative, making optimistic assumptions about cost, he or she might create another alternative with more middle-of-the-road assumptions. The difference in the cost consequences of the two options will isolate the portion of savings that can be attributed to factors other than force structure measures.

[8]Examples of this kind of presentation appear in R-3748/2-PA&E/FMP.

3. GUIDELINES FOR CAPTURING CHANGES DURING THE TRANSITION PERIOD

Case studies have shown that transition costs are often of sufficient magnitude to determine the outcome of an analysis. Yet transition costs may receive insufficient attention through being ignored or underestimated.[1] Those costs become even more important when a major goal of a force structure change is short-term budget savings—for example in cost-cutting drills in the programming and budgeting phases of the PPBS system.

After identifying the units to be affected and estimating the changes that will occur, the analyst can turn to the issue of the costs of implementing the change. To make the transition from old to new force structure, an implementation plan must be designed, appropriate personnel must be acquired and trained, equipment must be procured (including test and support equipment, initial training munitions, and initial spare parts) and transported to the appropriate location, and construction plans for bases and their facilities may have to be altered. In particular, facilities costs can involve many millions of dollars of military construction (MILCON) if the capacity does not already exist to accommodate a force structure change.

Although by definition transition costs are nonrecurring or one-time costs, they can also include costs that might ordinarily be designated as recurring O&S costs. For example, when, during a period of equipment modernization, reservists drill on the new equipment, the O&S costs may be considered as initial training costs, a component of the cost of transition. Or when, for example, during the period of a mission transfer from the active to reserve forces, the operations of the active and reserve units overlap, the excess O&S costs can be designated as nonrecurring transition costs.

Although transition costs can critically affect a force structure decision (they played an important role in all three of the case studies in R-3748/2-FMP/PA&E), they vary greatly, depending on the type of change in the total force and the characteristics surrounding the change. A 1987 RAND study[2] of the nonrecurring costs of force structure change showed totals as little as $1.3 million and as much

[1]See App. B; for a fuller description see R-3748/2-PA&E/FMP.

[2]See J. Schank, S. J. Bodilly, and A. A. Barbour, *Cost Analysis of Reserve Force Change: Nonrecurring Costs and Secondary Cost Effects*, R-3492-RA, May 1987.

as $127 million. The study concluded that nonrecurring costs tend to be higher when units and personnel are being added to the total force, when the basing location cannot provide existing facilities or a sharing of various logistic support assets, and when a high proportion of appropriate prior-service personnel cannot be obtained. However, as discussed below, even controlling for those influences, transition costs can vary widely.

The role of transition costs as a cost driver is enhanced by their occurrence at the beginning of the costing period. Because they are expended early in the life cycle of the new force structure, transition costs are less affected by discount rates than are the typical O&S savings of the new steady state, which are more evenly spread over the entire time period of a study. Moreover, as front-end expenditures, transition costs gain in importance the higher the discount rate; and when a major objective of a force structure change is short-term budget savings, exceedingly high discount rates are implied.

Despite their critical role in the costing of force structure changes, transition costs might be thought of as "hidden cost drivers" because they are difficult to estimate and are rarely available with the same timeliness as estimates of O&S savings. The difficulty occurs primarily because information on existing excess resources, which reduce the cost of unit requirements, is often not readily available and can require time-consuming research to uncover.

The absence of specific, quantitative, and timely information on transition costs tends to underrate their importance. For this reason, the analyst should address the issue at the earliest possible time in the analysis and should label as "incomplete" any analysis that does not consider transition issues.

The following three questions break down the transition cost question into three areas: nonrecurring cost elements and their importance, the role of excess capacity, and the role of timing in their determination.

8. What are the transition tasks and the associated nonrecurring costs or savings?

- **a. What are the administrative and planning tasks, and what will they cost?**
- **b. What are the personnel processing tasks, and what will they cost?**

c. What are the equipment processing tasks, and what will they cost?

d. What are the tasks associated with changes in facilities, and how much will they cost?

Although we have divided transition costs into four separate areas for discussion, we will discuss only the first two here. The other two—equipment costs and facilities costs—will be discussed with resource changes, under Questions 12 and 15 below.

Administrative and planning costs. The costs of force structure change include those for designing and overseeing implementation of the change and those for administering the change (e.g,. costs of environmental impact studies, coordination with states, or lawsuits that arise in connection with the change). Although often a minor component of cost, administration and planning costs can occasionally become significant, such as when a force structure change involves the introduction of a new type of unit into the reserves.

The importance of these costs can be illustrated with the example of the AH-64 attack helicopter, which deals specifically with the costs of design and oversight. In 1985, the Army decided to introduce the AH-64 attack helicopter into the Army National Guard as part of its equipment modernization program. The decision was unique not only because the Guard was receiving new equipment at the same time as the active Army, but also because the AH-64 was the Army's first high-technology aviation weapon system. As a result, the Guard was receiving a weapon system at a time when there were still many uncertainties about how the system should be manned and equipped.

Because the AH-64 unit was new to the Guard, and because the Guard unit was expected to maintain a C-1 readiness rating, there were substantial front-end costs associated with designing the fielding plan for the North Carolina unit. The front-end implementation costs were of two types: (1) the direct costs of designing the implementation program (e.g., designing a training program that both properly trains reservists on a complex weapon system while allowing them to fulfill their civilian job responsibilities), and (2) the indirect costs of learning from experience (e.g., the costs incurred by the North Carolina unit of retraining personnel whose skills deteriorated because the initial implementation plan did not ensure the timely arrival of aircraft[3]).

[3]In the North Carolina unit, the first of its kind, planners learned from experience to ensure that aircraft were delivered to the unit when required. The fielding plan was

A problem is that front-end design costs represent joint costs that apply to a large number of units, with no easy method of allocation. For example, while we studied the first of the AH-64 units, 15 others were scheduled for implementation in the coming years. The cost of designing an AH-64 implementation scenario should be partially allocated to these units. For that reason, we recommend that such costs be clearly marked as joint costs, presented separately from other decision costs.

Personnel costs. The nonrecurring personnel costs of force structure change include:

- The cost of acquiring and training (or retraining or cross-training) qualified personnel when additions are made to the force.
- The possible costs of personnel transfer, severance pay, and early retirement pay when subtractions are made.

The cost of acquiring and training qualified personnel includes recruiting expenses (including bonus and special promotion costs that may be required), pay and allowances of trainers and trainees, and the variable cost of training materials, equipment, and supplies. Personnel costs should be counted *both* for changes involving each of the individual units undergoing change *and* (discussed further in Question 6 above) for changes involving the supporting infrastructure (e.g., personnel expenses of intermediate- and depot-maintenance organizations or of opening or closing a base).

Nonrecurring personnel costs can be substantial, especially when the change involves the training of personnel for highly specialized skills. For example, the cost of recruiting and training a single Air Force fighter pilot can reach over $2 million. In contrast, training costs for reserve pilots and other aircrew can be substantially reduced when those units are able to recruit prior-service personnel who have already been trained in the active force. For this reason, the standard costs of recruiting and training requirements must be modified to reflect the percentage of prior-service personnel that are likely to be obtained.

Personnel transition costs for modernizations are more difficult to compute than are force structure changes that add or subtract whole

changed when aircraft for the North Carolina unit were unavailable for five months after pilots were ready to fly them. The result was a deterioration of flight skills, leading to nearly 800 extra flying hours (over $2 million worth) of retraining. These costs might properly be seen as a learning cost of the whole AH-64 Guard program, rather than as a cost attributable to the first unit of its kind.

units. When units are merely altered (and not established or disestablished), the costs of training can no longer be supported by referring to standard cost factor documents. Instead, personnel costs are primarily driven by the degree of similarity between the old and new weapon systems. For example, if a military unit (e.g., a fighter squadron or tank battalion) is being modernized with newer equipment, little additional training of personnel may be required. However, when units transition to substantially different functions (e.g., a fighter unit becomes a transport unit, or an infantry battalion becomes a combat engineer unit), substantial personnel training will be involved.

What makes the calculations even more difficult is the variability in the number of training courses that may be required and the varied methods of accomplishing the training. For example, when existing units undergo changes, a large portion of the new skill training may be accomplished with on-the-job training or with field-training detachments (with instructors on-site). These methods have much lower costs than does formal schooling, although the costs are largely undocumented. The 1987 RAND study referred to above suggested a method for gaining a first approximation of training costs when some of the specifics are missing.[4]

9. To what extent can costs be saved by making use of untapped resources or excess capacity?

a. What proportion of new personnel will have prior-service experience?

b. What proportion of support equipment and spares can be shared with an existing unit?

c. To what extent can units draw on excess capacity or alternative basing configurations to reduce facilities requirements?

Although the nonrecurring costs of military units are driven by well-defined requirements for types of personnel, equipment, and facilities, the size of nonrecurring costs in a force structure change is not just a function of what is required. Rather, those costs are a function of the *difference* between what is required and what is *available*. When the

[4]See R-3492-RA, p. 21. The method suggests appropriate assumptions given type of force structure change and type of occupation.

services are able to implement force structure changes by making use of existing resources and avoiding the purchase of new ones, we call it "making use of untapped resources or excess capacity." The use of untapped resources can occur in a variety of contexts. For example, a certain portion of unit facilities requirements can be satisfied by using excess capacity at existing bases or by designing a more efficient basing structure, thereby avoiding MILCON costs and reducing BOS costs. Similarly, if equipment is drawn from existing inventories, procurement costs are less than the requirement; and if reserve personnel can be recruited from the pool of prior-service personnel, training costs will be lower.

The cost implications of taking excess capacity into account can be large enough to alter a force-mix decision. This can be illustrated by the example of the Navy frigate (FFG-7). The FFG-7 unit in the Naval Reserve has been estimated to require nearly $2 million per year less for operation and support than an FFG-7 in the active Navy,[5] suggesting a savings from the transfer of such ships to the reserves. However, whether those savings could actually be realized depends entirely on the excess capacity of homeport locations. Basing new FFG-7 reserve units at Long Beach, a large active base with excess facilities, has been estimated to cost less than $2 million per ship,[6] a nonrecurring cost that could be recovered in less than one year of reserve operation. In contrast, basing new FFG-7 reserve units at Puget Sound, where no facilities currently exist, has been estimated to require $34 million per ship in construction costs alone, a nonrecurring cost that would require more than 17 years to recover from savings in O&S costs.

Other examples of the importance of excess capacity on force structure decisions are provided in Questions 11, 12, and 15, which deal with manpower, equipment, and basing issues, respectively.

Despite its potential importance, information on excess capacity can be difficult to obtain. To allow the maximum time for data collection, analysts should consider information needs relating to excess capacity early in the analysis process. If the required information is simply unavailable given the resources and time constraints, analysts should try to report the range of possible costs, or to qualify the cost study results.

---

[5]Department of the Navy, *A Report to the Congress on the Navy's Total Force*, February 1984, p. IV-4.

[6]See R-3492-RA, Table 1, p. 29.

10. What role does timing play in costs?

- **a. How much time will it take for each unit affected to transition to the new force structure?**
- **b. What are the year-by-year cost consequences of the change, and when do savings begin?**
- **c. When transitioning from old to new force structures, is there an overlap in the operations of units that are expanding with those that are contracting?**

The issue of timing in force structure changes can play an important role in the results of the cost analysis. In the general case, the analyst can account for the effects of time on cost by simply estimating the year-by-year costs of a force structure change, and by providing sufficient information for converting between current and constant-dollar values of those costs. To summarize the cost stream and to compare alternative changes, an analyst can, if necessary, provide present-value or internal rate-of-return measures.

However, additional issues sometimes arise in force structure costing. For example, the present value of savings may not be as important to decisionmakers as the short-term savings—those that can be accrued within the period covered by the budget or shortly thereafter. Thus, the length of the payback period can become an important supplementary measure of the cost consequences of a force structure change.

Analysts sometimes simplify the treatment of time by dividing all costs into one of two types: those that occur only in the transition period between the old and new force structure (i.e., nonrecurring costs), and those that recur continuously in the steady state (recurring O&S costs). Simplification is especially likely when budgeting is not so much the objective of the cost analysis as a decision among competing force structure alternatives. Although this characterization of costs sometimes works well, it may prove inadequate in a number of instances. First, in cases of lengthy transition periods (e.g., when the change calls for the growing of new units), the timing of nonrecurring costs may affect the eventual cost consequences. In those cases, a more sophisticated treatment of time may be desired.

Further, when competing alternatives require transition periods that vary in length, it would not be correct to simply compare total transition costs. An example might be the amount of time required to modernize an AH-1 unit with AH-64s in the active Army compared with the same change in the Army National Guard. In an active unit, the transition can take place in less than a year. In the Guard, it takes

more than twice as long—nearly two and a half years—to implement because the Guard must accommodate the part-time status of its personnel, maximizing the amount of transition training that can be accomplished within regular training periods.

The timing of costs can also be important in force structure change because the recurring costs of expanding and contracting units can overlap, creating a new type of transition cost: the cost of operating two units with the same mission at the same time. The overlap sometimes avoids a temporary loss of capability that would otherwise result during transition. If training a new unit takes longer than dismantling an old unit, maintaining a constant level of capability may require a delay in the transfer of personnel from the deactivating unit until the personnel in the new units have time to train-up to mission-ready status. The overlapping cost of operating the two units simultaneously generates a nonrecurring cost that could easily be overlooked when costs are simply divided into recurring and nonrecurring categories.

A study conducted at the Center for Naval Analyses showed the potential effect of the timing of mission transfer on the eventual costs. The study examined the transfer of an infantry battalion and a helicopter (CH-46E) mission to the Selected Marine Corps Reserve.[7] The author found that although annual O&S costs were $10 million less in the reserve infantry unit and $2.5 million less in the reserve helicopter unit, if the deactivation of the active units were delayed for three years after the start-up of the reserve units (to maintain a constant level of mission capability), the payback periods for transition costs would increase from two to seven years for the infantry unit, and from two to 15 years for the helicopter unit.

Finally, the amount of time allotted for achieving a force structure change can itself become a cost driver. For example, if a newly formed unit must be brought up to full strength within a short period of time, it may require advertising monies or enlistment bonuses that would otherwise not be required.

---

[7]P. F. Kostiuk, *Cost Analysis of Selected Units in the Marine Corps Active and Reserve Components*, Center for Naval Analyses, CRC 519, January 1984.

4. GUIDELINES FOR CAPTURING NET CHANGES IN DOD RESOURCES, ACTIVITIES, AND MISSIONS

Having identified the units that belong within the problem scope and the type of changes they are expected to undergo (e.g., deactivation or modernization), the cost analyst must proceed one step farther in the planning process to identify changes in resource and activity levels that drive cost. This section addresses such questions as: What is the effect of the change on manning type and quantity? On equipment type and quantity? What will be the effect of major equipment changes on the operating tempo? How will the change affect the basing structure? Analysts also need to determine the capability implications of the change so that cost implications can be placed into the context of changing output.

These questions should be asked not only for the units identified in the problem scope (see Question 2), but also for the supporting infrastructure of those units (see Question 6). However, the analyst should be careful not to double-count costs because many force structure models automatically measure some changes in the infrastructure. For example, the active/reserve force structure costing model estimates recurring cost changes of training establishments and depots for small force structure alterations. Therefore, for small changes in force structure the analyst needs to be concerned only with the nonrecurring transition cost changes that involve supporting organizations (e.g., for new equipment, facilities' modification, or the training of new personnel). Alternatively, if the alteration in force structure involves a large number of units, a full analysis of changes in support organizations would also be required.

In the implementation stage of a cost analysis, detailed resource analyses are required, because units with the same label and the same programmed factors can vary in personnel composition, equipment requirements, functional capabilities, and mission assignments. In the planning stage of the cost analysis, however, the purpose is not to make a precise calculation of changes on a unit-by-unit basis (because that is not a planning task), but rather to answer basic questions that will establish critical cost drivers for the problem at hand (e.g., by how much will endstrength increase?). An analysis of resources, activities, and missions can also establish the problem scope (as discussed in App. B).

In determining resource, activity, and mission changes, the analyst should consider only "net changes." Resource changes within a unit should not be counted when they do not represent net changes to DoD—that is, when new resources for a unit come from inventory or excess capacity or other units. For example, if a resource increase in a unit is required, but no funds are allocated for that purpose (a possible scenario in an era of tight budgets), then no net resource changes (or net increase in costs) can occur. Instead, resources can only be diverted from one purpose for the sake of another, leading to changes in cost only if driven by transition events.

11. How does personnel endstrength change?

- **a. How many personnel positions are affected, including those not defined in unit manning documents but connected with the unit mission?**
- **b. Will total endstrength increase, decrease, or stay the same?**
- **c. Will the personnel composition (e.g., grade distribution) of the force change in ways that will significantly affect cost?**

"Personnel" refers to the number and type of personnel in units taking part in a force structure change. For costing purposes, personnel are grouped into "types" according to their cost. At a minimum, groupings should distinguish between active and reserve, full-time and part-time, military and civilian, and officer and enlisted personnel.[1] "Endstrength" refers to the total number of military personnel positions authorized for each service and component. Final endstrength levels are a congressional decision, but proposals to change a force structure can include suggested changes in "working" endstrength limits.

Changes in force structure can increase, decrease, or change the composition of personnel in the units directly affected. However, whether those changes translate into net changes in DoD personnel depends, in part, on whether the changes are also reflected in endstrength limits and service budgets, a separate decision from the change in force structure. Because units can be activated or deactivated with no change in proposed endstrength (and therefore no change in cost), the analyst should concentrate on changes to the number of military per-

[1]Other distinctions that could significantly affect costs include job classification, grade level, and years of service.

sonnel at the service and component level, not at the level of individual units.

Counting the number of personnel affected by a force structure change requires that the analyst make some choices. For example, the number of personnel can refer to one of several items: manpower requirements, actual assignments, or authorizations. Whereas the choice will depend somewhat on the purpose of the analysis, counting authorizations is more typical and appropriate when endstrength changes are involved because they refer to positions budgeted. Especially with civilian personnel (not governed by strict endstrength limits), the analyst should ensure that *all* personnel positions connected with the unit mission are considered, including all those that are part of the command/base staff, maintenance, weapon system security, or base operating support.[2] The extent to which such personnel are included in unit manning documents varies by service. The *Cost Element Handbook for Estimating Active and Reserve Costs*, R-3748-PA&E/FMP/JCS, contains a full explanation of those differences.

Personnel costs are typically a large portion of total unit O&S costs. Personnel-related costs include not only pay and allowances but also the cost of replacement training to account for personnel turnover within the unit. Together, such costs can amount to over 90 percent of total unit costs in manpower-intensive units (e.g., infantry battalions), and usually amount to at least 40 percent, even in equipment-intensive units (e.g., ship units).[3]

Since personnel are a major cost driver of total unit costs, personnel changes can potentially play a large role in determining the recurring cost implications of force structure change. (The role of changes in personnel in the determination of *nonrecurring* cost is discussed in Question 8.) Changes in personnel should be recorded on a forcewide basis. For example, if personnel endstrength is not reduced when a unit is deactivated, personnel savings will not occur. Instead, costs will stay the same but other units, those whose manning increases

[2]In counting personnel, the analyst should be careful not to double count. Some personnel costs are included in cost factors relating the effect of force structure change on the support infrastructure (see Question 6).

[3]The number of personnel can also drive other components of unit costs, such as the cost of supplies on ships and a part of base support (including a portion of base rentals, utilities, communications, computer operations, and medical support).

because of the redistribution of authorized positions, will undergo increases in mission capability (see Question 14).

The decision of whether to decrease endstrength as a result of unit deactivation (or increase it to create new units) will often play a major role in the analysis of that force structure change. For example, in evaluating a proposed transfer of two C-141 squadrons to the reserves, the decision about whether to decrease active endstrength (after deactivating two active units in the process of the transfer) meant the difference between a change with a $20-million-per-year net savings and one with a $40-million-per-year net cost.[4]

Even if a force structure change does not alter endstrength levels, a change in personnel composition can have important cost implications. For example, a unit deactivation may be accompanied by a decrease in accessions rather than a decrease in personnel of the type in the deactivating unit. Since new accessions are much less costly than experienced soldiers, that change would have a significant effect on the total personnel costs of the change.

Issues of both personnel endstrength and composition arise when a force structure change involves the choice between apparently similar active and reserve units. Personnel costs for units in the Selected Reserve are typically less than costs for similar units in the active forces because of the part-time nature of many reserve personnel and because of the opportunity of the reserve forces to recruit personnel who have already been trained in the active forces. However, the analyst should be aware that the personnel cost differences between active and reserve units can be wide or narrow depending on:

- The total number of personnel in the reserve unit as compared with the number in the active unit (e.g., in the Air Force, a larger number of personnel can be authorized for reserve units than for active units; in the Army National Guard, units are sometimes allowed to go overstrength).
- The percentage of full-time personnel in reserve units (that percentage can exceed 50 percent if the weapon system is complex).
- The number of part-time personnel in the active units (all the services have programs that allow part-time reservists to train and serve with active units).

---

[4]See R-3748-PA&E/FMP/JCS, Sec. II.

- The extent to which prior-service personnel can be recruited into reserve positions (especially those positions with high training costs).[5]

In summary, the analyst should carefully consider the personnel implications of a force structure change, focusing on changes at the service and component level rather than at the level of individual units. In particular, the analyst should determine the effect of the force structure change on endstrength limits, which do not necessarily have to change in the way implied by the change in force structure.

12. How does equipment change?

a. Does the number of major end-items of equipment increase, decrease, or stay the same?

b. Does the type of major equipment change?

c. What are the net changes in requirements for mission-specific equipment and munitions (e.g., missiles, war reserve materiel (WRM), spares, support equipment)?

d. What costs for mission-specific equipment and munitions can be avoided as a result of the force structure change?

e. What modifications are required to major end-items of equipment as a consequence of the force structure change?

Unit equipment refers to a unit's major weapon system(s), ground support equipment (aviation units only), maintenance support and test equipment, training equipment, other major end-items of equipment (e.g., trucks), the initial stock of spares both for the pipeline in peacetime and for wartime reserves, and the initial munition requirements. Force structure changes can involve the procurement of new equipment,[6] the retirement of old equipment, the modification of existing equipment, and equipment transportation.

In addition to affecting unit equipment, changes in force structure can also affect equipment in the supporting infrastructure. For example, the transfer of four FF-1052s from the active forces to reserve

[5]In addition, in the event of a major shift of the total force toward units in the reserve forces, prior-service personnel may become less available as the active force shrinks, both in absolute terms and relative to the size of the reserve force.

[6]Procurement costs of major unit equipment are typically not included because that decision rarely hinges on active/reserve force structure issues.

units based in San Francisco required procurement of about $7 million in new support equipment for the SIMA, the intermediate maintenance support organization. Similarly, the introduction of the AH-64 into the Army National Guard required about an $8 million investment in additional electronic support equipment at a higher-level maintenance facility.

In the context of a force structure change, equipment requirements generate both recurring and nonrecurring costs. The portion of the recurring costs (e.g., costs for consumables, like POL and maintenance supplies) that are most closely related to the operating rate (OPTEMPO) of unit equipment will be considered under the peacetime activities change (Question 13). However, some annually recurring costs do not vary directly with OPTEMPO, but rather depend largely on the change in the amount and type of major unit equipment that follows from the change in force structure. Examples include the costs for repair parts for Navy ships, the cost of replacement support equipment for Navy and Air Force aircraft, and the cost for storage when equipment is mothballed or placed in the back-up inventory.

The nonrecurring costs of force structure change include procurement costs of unit equipment and the cost of transporting unit equipment (which can sometimes be substantial). In addition, it can occasionally include the cost of altering unit equipment when it is required as part of the force structure change. For example, a recent proposal to transfer KC-135s from the active Air Force to the reserve forces required reengining KC-135As to KC-135Es because that was the type of aircraft the reserves were equipped to operate and maintain. Engine modification was also required for OH-58A scout helicopters in the AH-64 modernization in the Army National Guard because the required equipment for the unit, OH-58Cs, were unavailable at the time of the unit upgrade.

Equipment-related changes can result in savings as well as costs, as when unneeded equipment is sold or equipment costs are avoided. For example, suppose an A-10 unit in the Air Force had been scheduled for upgrading with a new inertial navigation system before a force structure decision was made to send the aircraft to the reserves. If the Air Force decided that the upgrade was no longer needed given its current deployment to a reserve unit, then the avoided cost of the upgrade would be considered a savings from the force structure change.

The costs (or savings) of equipment-related changes resulting from force structure change can be substantial. For example, the cost of

equipment requirements for fighter aircraft units can be particularly large. The incremental equipment cost of modernizing two F-4 squadrons to F-14s at Dallas Naval Air Station was $30 million. Just the reengining costs in the KC-135 case mentioned above were $84 million for 14 aircraft, an amount 20 times more than the estimated annual savings in O&S costs from transferring the unit to the reserves.

Although requirements for unit equipment are well defined in service documents (e.g., TO&E in the Army), equipment costs associated with force structure change can vary widely. One reason is that some of the costs mentioned above (e.g., altering unit equipment or procuring equipment for support units) occur rarely in small force structure changes; however, they can have a large impact when they do occur. A second reason for the variance is that many force structure changes do not involve simple addition or subtraction of whole units and their equipment. In modernizations, for example, one would want to know the "delta" (added amount) of equipment required to go from the old type of unit to the new type. Such figures are typically not as available as are total unit requirements; they depend on the actual equipment possessed by the existing unit. If the unit had been operating with equipment shortfalls, then the cost of modernizing it with new equipment would likely be greater.

Basing arrangements add to the variance in equipment costs related to force structure change. If units can collocate on bases with units of the same type, they may be able (depending on unit deployment requirements) to share various logistics assets used in the operation and maintenance of those units. To see the effect that sharing can have on transition costs, consider the F-4 to F-14 modernization. If the two squadrons were based at Oceana Naval Air Station (NAS), which already has an F-14 repair capability, the nonrecurring equipment cost would be only one-third the amount ($10 million instead of $30 million) than if they were based at Dallas, which lacks that capability. The same principle holds true for an A-7B to A-7E modernization. If the new unit is based at Cecil NAS, the equipment procurement cost would be only about one tenth ($1 million instead of $10 million) the amount of basing at Atlanta NAS.[7]

In addition, more centralized basing can lead to other economies of scale. For example, if one piece of test equipment for an aviation unit is required for every 36 aircraft, two pieces will be needed for an active wing of 72 aircraft on a single base, but three pieces will be re-

[7]See R-3492-RA.

quired for reserve component units with 24 aircraft on each of three bases.

Finally, nonrecurring equipment costs vary widely for similar force structure changes because it is the *net* addition of equipment that requires costing, an amount that often differs from *total* unit equipment requirements.[8] New production is only one possible source of that equipment. Besides being able to share equipment, units are often able to cut down on the purchase of new equipment by obtaining equipment from inventory or from other existing units and avoid adding to the cost of the change. For example, if a force structure decision involving the transfer of aircraft or ships from the active to reserve components, the existing equipment that supports the active unit may (or may not) also be moved to the reserve unit, reducing the need for additional equipment. Further, when in addition the number of units of a weapon system is being reduced in the total force, and other units are being transferred to the reserve components (as is likely in the current drawdown period), a surplus of equipment will be created for the remaining active units, and this situation will reduce the amount of new equipment needed for the new reserve units.

In summary, force structure change can involve the purchase, retirement, transportation, or modification of unit equipment (or the equipment of the supporting infrastructure). The net equipment costs of a force structure change depend on the type of force structure change, unit equipment requirements, existing equipment inventories, basing arrangements, and the particular requirements of individual cases. Cost analysts can obtain an upper bound of these estimated costs based on unit equipment requirements alone. Short of the development of new cost factors that consider the other drivers of cost, the analyst might obtain lower estimates based on previous studies or, if available, on the examination of particular units, bases, and inventories affected by a change.

13. How do peacetime activities change?

a. Does the level of peacetime activity (in most cases measured by OPTEMPO) increase, decrease, or stay the same?

[8]This issue is discussed under Question 8, which deals with the effect that excess capacity has on cost.

b. Does the distribution of peacetime activity across weapon systems and other types of equipment change in ways that significantly affect cost?

Changes in peacetime activity often accompany changes in the active/reserve force structure. Peacetime activities include both unit functions performed exclusively for the benefit of the unit itself, such as training, and external unit functions that serve, at least in part, larger missions or other parts of the force (e.g., providing airlift services by cargo aircraft as a by-product of unit training). In either case, peacetime activity is most often measured in terms of operating tempo of the equipment; OPTEMPO is generally expressed as flying hours, steaming days, vehicle miles, or rounds of ammunition expended per year (or other period).

Equipment costs related to peacetime activity or OPTEMPO are often a large component of total annual O&S costs for a unit, sometimes amounting to more than 50 percent. Equipment-related costs include those for consumables, such as POL, maintenance supplies, and training ordnance; those for sustaining investment, such as costs for replacement support equipment, replenishment spares, and modifications; those for higher-level maintenance, such as depot-level maintenance; and those for miscellaneous items, such as contractor unit-level support.

Since OPTEMPO can be a major cost driver of total unit costs, it can also potentially play a large role in determining the recurring cost implications of force structure change. As with other changes, however, the potential can be realized only if the changes to the directly affected units are not offset in the operation of other units, so that they represent net changes to the DoD. (This point is discussed further below.)

In the context of a force structure change, the recurring costs of peacetime activity can change for two reasons. First, they can change because of a change in the level of peacetime activity (the amount of equipment or the frequency of its use changes). Second, recurring costs of peacetime activity can change because of a change in the type of activity. For example, modernizing a unit with new equipment will typically change the cost of equipment operation, even if the OPTEMPO remains the same. Moreover, if the operations of activating and deactivating units overlap in the transfer of equipment to the reserves, the cost of equipment operation can become a nonrecurring transition cost (see discussion under Question 10, which discusses timing issues).

Issues of peacetime activity levels typically arise when a force structure change involves the choice between apparently similar active and reserve units. The level and cost of peacetime activity are typically less for units in the Selected Reserve than for similar units in the active forces. However, the analyst should be aware that the differences do not automatically exist (e.g., a recent study found that active and reserve KC-135 aircrews had identical flying hour requirements), or may be less than expected (e.g., some active units already include reserve personnel who use equipment less frequently). Further, OPTEMPO may be an insufficient measure of peacetime activity if differences in maintenance practices exist between the components. For example, the use of more expensive labor for intermediate maintenance of reserve ships makes that function more expensive than it is in the active forces. To cite another example, in the late 1980s, FF-1052 frigates in the active forces were maintained at a much lower level than the same ship in the reserve forces. When comparing the peacetime activity of active and reserve units, therefore, the analyst must look beyond differences in OPTEMPO.

Whatever the difference in peacetime activities between similar active and reserve units, proper costing requires that analysts consider the reason for the difference so they can distinguish the savings resulting from the force structure change from the savings due to other changes. If activity levels following an active unit's transfer to the reserves are lower because the more experienced reserve personnel need to train less, the savings can be attributed to the change in force structure. However, if the activity is less because of a decline in mission capability (e.g., a later deployment schedule), the OPTEMPO-related savings cannot be solely attributed to the change in force structure because that same savings could have been accomplished without a force structure change—by simply reducing the mission of the active unit. (Further discussion of this issue is contained in Question 7, which deals with distinguishing resource and activity changes that can be attributed to force structure changes from those that can be attributed to other types of decisions. Also, changes in capability are analyzed in Question 14.)

Whatever the reason for a difference in the activity level of similar active and reserve units, those savings can be captured in the context of a force structure change only if they represent a *net* difference in peacetime activity for the entire force. When units are interconnected by external missions, gross differences in units directly affected by force structure change may be offset by changes in other units that share the same mission. For example, even though cargo squadrons in the active forces fly more than their reserve counterparts, the full

savings from a movement of units to the reserves can occur only if there are no compensating hours flown by other units in the active forces to maintain external missions of providing peacetime airlift and rated officer training.

In summary, changes in the level of peacetime activity can have large effects on force structure decisions. However, the analyst must ensure that the effects are properly measured. Measures of peacetime activity should adequately reflect cost and should represent the *net* effects of the change to the DoD. In addition, the extent to which changes in peacetime activity can be correctly attributed to the change in force structure should be assessed.

14. How does mission capability change?

- **a. Does the force structure expand, contract, undergo modernization, shift toward one component or the other, or otherwise change?**
- **b. Is there a change in unit resourcing or maintenance practices?**
- **c. Do unit mission statements change?**
- **d. Is there a change in readiness ratings, deployment schedules, crew ratios, or other descriptors of unit output or performance?**

Mission capability refers to the set of wartime activities that units are expected to conduct and to the units' ability to perform those missions. Information about capability is important in the cost analysis of force structure change because decisionmakers are often presented with unequal alternatives. Capturing differences in capability among force structure alternatives provides a context for the results of the cost analysis and a way of associating an output with a price tag. Although directly measuring units' wartime mission capability is beyond the scope of this report, we offer indicators that help describe changes in that capability.

Changes in mission capability can be indicated in a number of ways. First, a simple description of the exact nature of the force structure change can tell much about capability (see Questions 1 through 5). For example, suppose the reserve forces receive new equipment. If under one alternative that equipment is used to create a new reserve unit, capability in the reserves has been increased by the value of that unit. In contrast, if under another alternative the transferred equipment is used to modernize an existing reserve unit (and the ex-

isting equipment of the reserve unit is retired), capability in the reserves has increased less—by the difference between the value of the old unit and the value of the new unit. By acknowledging the difference in capability, one would be able to place the cost consequences of the two alternatives in the proper context. The question becomes not just one of which alternative has the greater cost, but rather one of whether the added capability is worth the higher price.

A second way in which changes in capability can be noted is simply in the complete mission statements of the units involved, since force structure changes may be accompanied by changes in mission statements. Reserve units, for example, often do not have the full range of operational requirements that their active counterparts have. For instance, the Navy's reserve tactical air squadrons do not train for the nuclear mission taken on by their active counterparts. Changes in mission should accompany any comparisons of cost to clarify the output that a particular alternative is buying.

Changes in how units are manned and equipped is a third way changes in mission capability are indicated. In general, the closer units are to their full resource requirements, the greater their capability. Thus, alternatives that involve more complete resourcing of units imply greater capability than alternatives with less complete resourcing. In the context of force structure change, differences in resourcing may be quite obvious, as when Army units are described according to their authorized level of organization (the ALO specifies manpower and equipment authorization). Other differences in resourcing may be more subtle, as when units are added and subtracted without adjustments in endstrength levels (see Question 11 for examples), or when resourcing is required but funds are not budgeted (see Question 7 for examples). During budget cost-cutting drills, the analyst should be aware that changes in unit resources often accompany changes in force structure in a multifaceted attempt to reduce budget outlays. Reports of the cost consequences of such proposals should be accompanied by a description of all changes in output, and in particular should distinguish the relative contribution of force structure changes and resource changes to the final cost results.

Finally, changes in force structure capability can be indicated by changes in unit characteristics that measure or relate to unit performance. Examples of appropriate unit characteristics include readiness ratings, crew ratios, and deployment schedules. For example, in the AH-64 study, the main difference between the AH-1 to AH-64 modernization in the active forces and in the Army National Guard was the readiness ratings of the old AH-1 units: C-1 in the active

case and C-3 in the guard case. The distinction was important because the major difference in costs between the two options could be explained in terms of that difference in capability. The guard modernization cost more, but it was buying a greater increase in capability.

In summary, a description of changes in mission capability furnishes a context for the evaluation of results expressed in dollar figures and helps clarify what is being saved or bought. Changes in mission capability can be indicated by changes in force structure, mission statements, resource levels, or unit characteristics.

15. How will the change affect basing structure?

- **a. Will facilities or land at the base increase, decrease, or otherwise change?**
- **b. What facility costs are avoided because of the force structure change?**
- **c. Are bases opened, closed, or realigned as a consequence of the force structure change?**

The basing structure refers to the land on which a unit is located and the facilities that it includes, as well as the land and facilities of the unit's supporting infrastructure. Force structure changes can include the sale or purchase of land and the construction or rehabilitation of facilities. Facilities can be those used in connection with unit equipment, such as hangars, runways, docks, maintenance buildings, supply facilities, and POL storage facilities; those used to support the unit's personnel, such as dining halls, commissaries, and barracks; and those used for overall administration of the base.

Facilities on a base used entirely for other unit missions—those not connected with a force structure change—are generally ignored for purposes of costing that change. For example, proposing an alteration to the airlift squadrons on Norton Air Force Base would not usually involve the Air Force Inspection and Safety Center, the Audit Agency, or the Audio Visual Service Center, which are also located at Norton.

However, when a force structure change includes base openings, base closings, or base reorganizations, all activities on the base can potentially become a part of the force structure problem. In such cases, the analyst may have to include seemingly unrelated missions as "units" affected by the alterations in force structure, and inquire into changes in their activities and resource levels. For example, the en-

tire base would share in the cost consequences of a proposal that would both increase the size of Air Force fighter squadrons (a force structure change) and at the same time consolidate those squadrons on fewer bases (a base reorganization).[9]

In the context of force structure change, changes in basing can generate both recurring and nonrecurring costs. Recurring costs can change because some basing costs are a function of the number and type of unit personnel (e.g., cost for base rentals, utilities, communications, computer operations, and medical facilities), or unit facilities and equipment (e.g., facilities upkeep). When force structure changes also include base closure, other recurring costs can be involved as well; examples are CHAMPUS medical cost, caretaker costs at deactivated bases, and housing costs for military personnel.

The nonrecurring basing costs of force structure change typically include the cost of constructing or rehabilitating military facilities, and can occasionally involve the purchase of land. Further, in the case of base closure or reorganization, nonrecurring basing costs can include those for toxic cleanups or other environmental restorations, costs of base shutdowns, and costs of contract termination.[10]

Savings from base closures are also possible—from the sale of land and facilities and from the avoidance of facility rehabilitation planned in advance of the closure. The Base Closure Commission, for example, recommended numerous sales of military-owned land and cited savings from the avoidance of planned construction for rehabilitation at eight bases, with an average of over $30 million saved per base.[11]

The nonrecurring basing cost of force structure change can play a critical role in decisionmaking. For example, a new C-5 ANG unit with 12 PAA (to be located at Memphis NAS) was estimated to require $142 million in MILCON, for runways, operational and logistics facilities, and aircraft hangars.[12] That amount was more than ten times the estimated O&S cost savings that could be achieved from the transfer of the aircraft from the active forces.

---

[9]See description of PA&E proposal in "The Part-Time Military," *National Journal*, March 4, 1989, p. 519.

[10]The Base Closure Commission showed that the costs of closure or realignment of bases can be quite high. Those costs averaged $42 million per base at 16 Army bases proposed for closure or realignment, $65 million at two Navy bases, and $165 million at five Air Force bases. (Statistics compiled by the author based on information supplied by the Base Closure Commission.)

[11]Average computed by the author based on information supplied by the Base Closure Commission.

[12]See R-3492-RA.

Although requirements for facilities on bases are well defined in service documents, basing costs associated with force structure change can vary widely. One reason for difficulty in prediction is that costs not associated with facilities (e.g., toxic cleanup required when a force structure change results in a base closure) are rare (at least in small force structure changes), yet they have a large effect when they do occur. A second reason is that many force structure changes do not involve simple addition or subtraction of whole units, but rather reorganizations or other changes to existing units. For changes to existing units, requirements are less well defined.

Basing costs for *changes* in units are typically less than those for additions of entire units, but even costs for changes in units can be high if the new unit is substantially different from the old one. For example, facility costs at Luke AFB for the F-16 modernization were $16 million in large part because the F-16s were replacing a very different type of aircraft—CH/HH-3E helicopters.

A major reason that nonrecurring basing costs of force structure change vary widely is that they depend on the existing capacities of specific bases, information that may not be readily available to cost analysts who are examining generic force structure alternatives. For example, in the C-5 case (see App. B), the cost of creating a new ANG unit to accommodate the C-5As coming from the active forces was substantial—$142 million for a beddown at Memphis. However, that cost could be reduced to $20 million (and would make a critical difference in the force structure decision) if the transferred aircraft were all located on large active bases that already supported other C-5 units and that could accommodate additional C-5 aircraft. Although the basing information was available in the C-5 case, in many cases it might be too time-consuming to obtain within the required time frame of the cost analysis (for example, in the FF-1052 case in App. B), leaving the accuracy of the cost conclusions extremely uncertain. (For a fuller discussion of this issue, see Question 8.)

Once computed, basing costs can be difficult to allocate to the units in the force structure change. For example, a joint cost problem can arise in associating construction costs with force structure changes. Major construction projects required for force structure changes are sometimes combined with minor construction and renovation projects required because of deterioration to facilities over time. Alternatively, some of the work may be completed in anticipation of future plans, which may be unrelated to the force structure change under consideration. For these reasons, the analyst should try to separate costs where possible (i.e., compute total construction cost with and

without the force structure change) and clearly mark as "joint" those costs that cannot be separated.

In summary, force structure change can involve the sale or purchase of land and the construction or rehabilitation of facilities at force structure units or at the location of the unit's supporting infrastructure. The basing-related costs of a force structure change depend on unit facility requirements, the type of force structure change, excess capacity in existing facilities, whether a new base is being opened or an existing one closed, and the particular requirements of individual cases. Absent base closure, cost analysts can often obtain an upper-bound estimate of costs based on information about facilities requirements. Short of the development of new cost factors that consider additional drivers of cost, other estimates would have to be obtained from case studies of previous changes of a similar kind.

5. CONCLUDING REMARKS

The guidelines in this report are intended to support cost analysts in the task of translating generally worded force structure alternatives into scenarios that are sufficiently detailed to permit cost analyses. The idea behind this guide is to allow the cost analyst to gain a larger perspective—to obtain an overall view of the problem before immersion in the details.

Answering the 15 basic questions posed in this report will allow cost analysts to establish a fully defined problem for the costing of proposed changes in military force structure, especially those changes involving both active and reserve units. Answering the questions will also assist the analyst in focusing on those aspects of a force structure change that will drive its costs. Finally, the questions and their answers should aid in analysis documentation, allowing later review of the cost calculations and their use in evaluating similar future proposals. Using less rigorous approaches, analysts run the risk of conducting improperly defined, incomplete, or less efficient analyses of proposals designed to alter the force structure.

Because time constraints and information gaps may make it impossible to fully answer each question in the context of specific proposals for force structure change, analysts will sometimes have to proceed without having all the information they need. At those times, the question list can establish a prioritized task list that will guide the detailed aspects of the cost analysis. For example, if attempting to follow the guidance leads to the conclusion that little is known about the transition costs of a force structure change, analysis resources can be focused on the transition period at the earliest possible stage, allowing the maximum time frame for the often time-consuming investigation of the appropriate training, equipment, and basing issues.

Unresolved questions may also lead to the establishment of new alternatives or excursions (minor variations on existing alternatives) that will help to further define the problem. For example, if the manpower implications of a reduction in force structure remain unclear, the analyst may wish to set up a presentation that looks at a variety of possible outcomes. One possible outcome might assume that endstrength will be reduced according to the specification of manpower authorizations in the affected units, whereas other outcomes might assume a partial reduction in endstrength, a reduction of new accessions only, or no change in endstrength.

Even in extremely short costing exercises, when time does not permit the exploration of a variety of possible scenarios, the question list in this report will guide the analyst in identifying the assumptions and in qualifying the results of a more limited analysis. For without some consideration of the full problem scope, the outcomes of cost calculations can have little meaning.

Appendix A
SUMMARY OF GUIDELINES FOR COST ANALYSES

For easy reference, the full question list appears below, organized into three subject areas—the change in force structure, changes during the transition period, and net changes in DoD resources, activities, and missions. The questions apply to each alternative considered in a force structure decision. In the text of this report, the question list is supplemented with additional information. The rationale for each question is explained, the procedure analysts should follow is provided, and examples[1] are given to help illustrate how various considerations can affect cost.

THE CHANGE IN FORCE STRUCTURE

The first group of questions addresses the nature of the change and the units affected.

1. What are the characteristics of the base case?
2. What military units are affected, directly or indirectly, by this alternative?
   a. What are the named combat units involved in this force structure change?
   b. What are the combat or deployable support units that are indirectly affected through a shared mission?
   c. What units are affected indirectly through the transfer of resources, activities, or missions?
3. What is the type of each unit affected?
   a. What is each unit's component (active, reserve, or Guard)?
   b. What is each unit's description (MDS or more specific)?
4. What type of change will the affected units undergo?
   a. How many activations of new units?

[1]Many of the examples are taken from other RAND force structure costing work, from examples that were used in the formulation of the question list itself. The principal references are R-3748/2-PA&E/FMP, 1991, and R-3492-RA, 1987.

   b. How many deactivations of existing units?
   c. How many existing units will undergo resource, activity, or mission changes?
5. Does the number of units increase, decrease, or stay the same?
6. Does the change affect the unit support structure?
   a. Are there any changes to personnel establishments or personnel programs (e.g., acquisition, training, bonus levels)?
   b. Are there any changes to maintenance establishments (e.g., depots, intermediate maintenance) or other central logistics organizations?
   c. Are there any changes to basing establishments (e.g., base openings, closings, realignments)?
   d. Are there any changes to headquarters or administrative organizations?
7. Are there other changes, unrelated to force structure, that are included in the problem definition?

CHANGES DURING THE TRANSITION PERIOD

The next set of questions addresses the nonrecurring costs associated with the proposed change—facility costs, personnel recruitment, training, equipment procurement, spare parts, transportation, administrative overhead, and construction. Because these one-time costs (which are difficult to estimate because they vary from case to case) can be quite large, they can play a central role in the decisionmaking process.

8. What are the transition tasks and the associated nonrecurring costs or savings?
   a. What are the administrative and planning tasks, and what will they cost?
   b. What are the personnel processing tasks, and what will they cost?
   c. What are the equipment processing tasks, and what will they cost?
   d. What are the tasks associated with changes in facilities, and how much will they cost?
9. To what extent can transition costs be saved by making use of untapped resources or excess capacity?

a. What proportion of new personnel will have prior-service experience?

b. What proportion of support equipment and spares can be shared with an existing unit?

c. To what extent can units draw on excess capacity or alternative basing configurations to reduce facilities requirements?

10. What role does timing play in costs?

a. How much time will it take for each unit affected to transition to the new force structure?

b. What are the year-by-year cost consequences of the change, and when do savings begin?

c. When transitioning from old to new force structures, is there an overlap in the operations of units that are expanding with those that are contracting?

NET CHANGE IN DOD RESOURCES, ACTIVITIES, AND MISSIONS

The third set of questions is intended to identify changes in resource and activity levels that drive cost. The questions address the net effects of the change on manning, equipment, operating tempo of major equipment, and basing structure. In addition, indications of changes in military capability are addressed.

11. How does personnel endstrength change?

a. How many personnel positions are affected, including those not defined in unit manning documents but nonetheless connected with the unit mission?

b. Will total endstrength increase, decrease, or stay the same?

c. Will the personnel composition (e.g., grade distribution) of the force change in ways that will significantly affect cost?

12. How does equipment change?

a. Does the number of major end-items of equipment increase, decrease, or stay the same?

b. Does the type of major equipment change?

c. What are the net changes in requirements for mission-specific equipment and munitions (e.g., missiles, war reserve materiel (WRM), spares, support equipment)?

d. What costs for mission-specific equipment and munitions can be avoided as a result of the force structure change?

e. What modifications are required to major end-items of equipment as a result of the force structure change?

13. How do peacetime activities change?

a. Does the level of peacetime activity (in most cases measured by OPTEMPO) increase, decrease, or stay the same?

b. Does the distribution of peacetime activity across weapon systems and other types of equipment change in ways that significantly affect cost?

14. How does mission capability change?

a. Does the force structure expand, contract, undergo modernization, shift toward one component or the other, or otherwise change?

b. Is there a change in unit resourcing or maintenance practices?

c. Do unit mission statements change?

d. Is there a change in readiness ratings, deployment schedules, crew ratios, or other descriptors of unit output or performance?

15. How will the change affect basing structure?

a. Will facilities or land at the base increase, decrease, or otherwise change?

b. What facilities costs are avoided because of the force structure change?

c. Are bases opened, closed, or realigned as a consequence of the force structure change?

Appendix B

CASE STUDIES OF CHANGES IN THE MIX OF ACTIVE AND RESERVE UNITS

The guidelines in this report emerged from an extensive investigation into force structure cost analyses as conducted by the services and OSD in the context of the federal budgeting process. That investigation included a series of case studies that involved an in-depth examination of three force structure change proposals, two of which recently arose in the programming cycle of the PPBS process. Although published separately (see R-3748/2-PA&E/FMP), the case studies are briefly summarized here to provide additional context to many of the examples used throughout this report.

C-5 CASE IN THE AIR FORCE

During development of the FY88–92 budget, the Air Force offered the transfer of 26 C-5A cargo aircraft to the reserve forces as a cost reduction measure. Although a straightforward transfer of major equipment, the proposed force structure changes were complex. The two options considered in detail would have affected force structure at five bases, and involved the creation of new units in the Air National Guard and Air Force Reserves, the reduction in size of existing C-5 active units, and the increase in size of existing C-5 reserve units. Although equipment in the total force would have remained constant, the net effect would have been to increase the total number of C-5 squadrons but decrease their average size.

A detailed analysis of the potential O&S savings that could result from the transfers showed little difference between either of the proposed new force structures and the base case (of leaving the aircraft in the active forces). Although the reserve C-5 units would use more part-time manning than would the active units, the difference was not large and was partially offset by the increase in the total number of personnel under the two transfer options. The decrease in OPTEMPO under the proposed changes was also relatively small, and it, too, was offset by other factors, including the need to hire commercial aircraft to augment the C-5s' airlift mission. In fact, total equipment operation costs (including the cost of the commercial lift) were higher under both transfer options than they were in the base case.

Relative to recurring cost differences, transition costs under both the transfer options would have been high. Option 1 would have involved $136 million in transition costs (primarily for training), and Option 2, $317 million. The particularly high cost of Option 2 resulted from the proposed basing arrangements; whereas Option 1 would have accomplished all the changes on existing C-5 bases, Option 2 called for the establishment of a new C-5 base, requiring high-cost facilities.

In the end, a study group formed by the then Deputy Secretary of Defense concluded that significant savings from a transfer were doubtful, and that any savings would be possible only after recouping the significant transition costs of making the transfer. Under Option 1, some ten years would pass before recurring cost savings would exceed transition cost. Under Option 2, the period was more than five times longer. Consequently, the idea of a transfer was abandoned.

FF-1052 CASE IN THE NAVY

During a review of the FY90–91 budget under the new Bush Administration, changing the mix of active and reserve units became a major budget issue for the Navy. One of the formally considered proposals called for the transfer of 24 Navy frigates to the reserve forces between fiscal years 1990 and 1993.

Although we were unable to obtain official documentation of the PBD (Program Budget Decision), we gathered enough information and data[1] to design a similar study, which considered a great many more options. The major option (to the base case of not transferring the ships) for the RAND study was constructed by choosing the simplest and most realistic assumptions concerning implementation of the transfers. Under that case, the newly acquired reserve ships would be assigned to ports and areas where the demographics suggest that sufficient personnel could be recruited to staff the unit. Home ports with available pier space would be sought, but it would be expected (consistent with recent experience) that some construction costs for pier projects would be necessary. Further, the new reserve personnel required to man the ship would represent net additions to the force. To realize the potential savings of a reserve conversion, active end-strength would decrease, the OPTEMPO of the ships under reserve control would decline according to standard factors, and the forward

[1]The information we used was compiled from interviews within the multiple offices of OSD and the Navy that produced or participated in an analysis of the proposal.

peacetime deployment mission of the units, no longer possible with part-time personnel, would be dropped.

The other options considered in the RAND study are:

Option 2: Assumes that the forward deployment mission of the frigates would be maintained, requiring the remaining active frigates to deploy more often and for longer periods.

Option 3: Assumes that, to avoid construction costs in new home ports, ships would be left in their existing home ports (we call this a "transfer in place"). Reserve personnel would have to be recruited in inland areas, requiring the airlifting of personnel to ships on training weekends and for active duty tours.

Option 4: Assumes a transfer in place combined with the funding of a major reserve recruitment effort in the local areas.

Option 5: Assumes a transfer in place with inland recruiting, combined with a decision to leave total reserve endstrength unchanged.

Option 6: Assumes the existence of sufficient excess capacity such that the ships could be transferred with little or no transition cost. In this case, we tried to approximate the assumptions used in the creation of the PBD.

Option 7: Assumes that instead of transferring the ships to the reserves, they were mothballed or placed on inactive reserve status.

Initially, OSD analysts estimated that transferring the ships would save $550 million between fiscal years 1990 and 1994, and suggested a savings of about $6 million per ship, per year, in the steady state. However, subsequent analysis, as reported in the final PBD, drastically reduced that estimate to less than $10 million during the transition period, and less than $1 million per ship in the steady state. The RAND analysis concluded that even those savings were unlikely, given that past experience suggested sizable transition costs that were assumed to be zero in the PBD. The RAND analysis concluded that significant savings were possible from taking the frigates out of the active Navy only if the ships were retired or were placed in the Naval Reserve without increasing reserve endstrength.

AH-64 CASE IN THE ARMY

In 1985, the Army made the decision to introduce the AH-64 attack helicopter into the Army National Guard as part of its equipment modernization program. This was unprecedented not only because the Guard was receiving new equipment at the same time as the ac-

tive Army, but also because the AH-64 was the Army's first high-technology aviation weapon system. We chose to compare the modernization of the first Guard unit receiving the equipment (an AH-1 unit in North Carolina) with the modernization of a similar AH-1 active unit.[2]

Results of the cost analysis suggested little difference in cost between modernizing the attack helicopter battalion in the active Army and modernizing a similar unit in the Army National Guard. The increase in O&S costs in the Guard case was estimated at $6.4 million, slightly less than the increase on the active Army side (where the difference was $7 million), despite the lower readiness rating of the AH-1 unit in the Guard. One reason for this result is the Guard practice of fully manning underequipped units and using that equipment more intensively to train all personnel. This practice tended to lessen the effect of mission-readiness levels on recurring costs.

Although recurring costs appeared somewhat less in the Guard case, the nonrecurring transition costs appeared somewhat larger. This was true because the Guard had to purchase additional electronic support equipment already available in the active Army, had to upgrade the scout helicopters for the new unit, and had to design a fielding plan for the AH-64s that ensured that the Guard personnel could be properly trained without compromising their civilian job responsibilities.

---

[2]Information about the modernization in the Guard came from the Aviation Division, Army National Guard Bureau, and the 1st Battalion, 130 Aviation Regiment in North Carolina.

REFERENCES

Department of the Navy, *A Report to the Congress on the Navy's Total Force,* February 1984, p. IV-4.

Gotz, Glenn A., Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance,* RAND, R-3748-PA&E/FMP/JCS, Sec. II.

Kostiuk, P. F., *Cost Analysis of Selected Units in the Marine Corps Active and Reserve Components,* Center for Naval Analyses, CRC 519, January 1984.

Palmer, Adele R., *Cost Factors in the Army: Vol. 1, The Decision Making Context,* RAND, R-4078/1-PA&E, forthcoming.

Palmer, Adele R., and E. V. Larson, *Cost Factors in the Army: Vol. 2, Factors, Methods, and Models,* RAND, R-4078/2-PA&E, forthcoming.

Schank, John F., Susan J. Bodilly, and A. Allen Barbour, *Cost Analysis of Reserve Force Change: Nonrecurring Costs and Secondary Cost Effects,* RAND, R-3492-RA, 1987.

Schank, John F., Susan J. Bodilly, and Michael G. Shanley, *Cost Element Handbook for Estimating Active and Reserve Costs,* RAND, R-3748/1-PA&E/FMP/JCS, September 1990.

Shanley, Michael G., *Active/Reserve Cost Methodology: Case Studies,* RAND, R-3748/2-PA&E/FMP, 1991.

"The Part-Time Military," *National Journal,* March 4, 1989, p. 519.

The Washington Post, editorial page, Sunday, April 6, 1989.