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Interim Report

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Executive Summary

This paper presents a structured method for incorporating cost analysis into decisions involving the mix of Army active component (AC) and reserve component (RC) units of particular types. Determining the best mix of active and reserve units is an important element of defense planning and force sizing. Active units are generally able to deploy faster on short notice than reserve units and can be deployed more frequently than reserve units. Reserve units, on the other hand, are less expensive on a unit-for-unit basis, allowing the Army to have a larger force structure for a given level of expenditure.

The method permits comparison of several alternative force mixes with respect to cost, strategic capacity, and operational capacity. Our approach is to help decision makers find the least-cost active/reserve mix that can:

- Attain acceptable surge capacity, as measured by force size
- Attain acceptable steady state operational or presence levels, as measured by the number of units a force of a specified size and active/reserve mix can maintain on deployment on a continuing basis

A key element of this approach is to focus the analysis at the community level. By community we mean the set of units of a given type. We address questions like, "What is the most efficient mix of heavy brigade combat teams (HBCTs) to meet the surge and steady-state requirements for HBCTs?" Focusing on the cost of individual units or the cost of deploying a single unit from either the active or reserve components does not answer such community-level questions. An integrated analysis of multiple mixes of AC and RC units over multiple years gets to the heart of being able to answer such questions.

The model includes cost factors reflecting personnel costs, operating costs (both non-deployed and deployed), some infrastructure-related costs, procurement costs related to equipment replacement, and transportation costs related to deployment. One goal of our modeling effort is to include as many cost factors as possible, direct and indirect. The cost factors we use are taken from three Army models, as follows:

- The Force and Organization Cost Estimating System (FORCES) cost model provides annual unit-level factors for non-deployed units. This includes most personnel-related costs, including medical costs and retired pay accrual, as well as operating costs, such as fuel and maintenance. It also includes base operations and indirect support costs.

- The Army Military-Civilian Cost System (AMCOS) provides some additional personnel-related costs. These include estimates of annualized personnel accession costs and annualized education and training costs through initial skill training.
- The Army Contingency Operations Costing Model (ACM) was used to estimate deployment-related costs such as additional pay for RC personnel, the additional operating costs associated with deployment activity, and the cost of moving units to their deployment locations. It also captures reset costs. ACM bases some of its costs on the Contingency Operations Support Tool (COST) developed by the Institute for Defense Analyses (IDA).

User-specified inputs include:

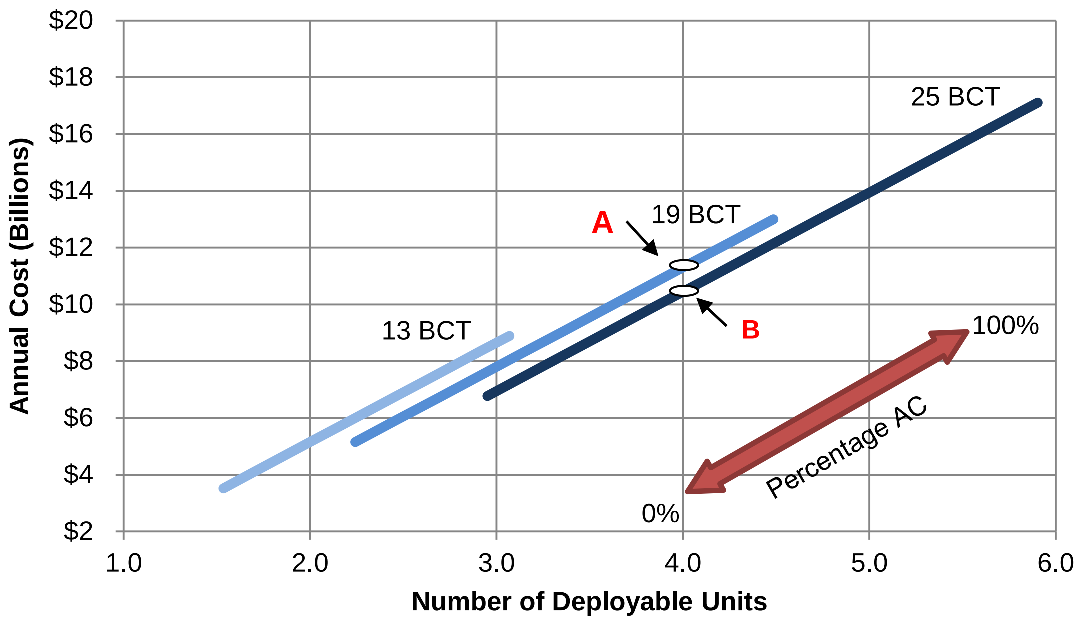
- Community or unit type (any of roughly 3,000 unit types are available) at the Standard Requirements Code (SRC) level
- Force levels by component
- Rotation assumptions
- Deployment duration
- Period-specific resource and activity levels
- Transit time and relief in place/transfer of authority (RIP/TOA)
- Pre-deployment training and post-deployment adjustment periods
- Pre-mobilization training days
- Need for deployment. The Army's force generation process, ARFORGEN, prepares units for deployment on a rotational basis, but they only deploy if there is a need for them. This input allows users to specify whether that need exists.
- Equipment replacement cost

For equal force structure sizes, there may well be little difference in equipment replacement costs for different AC/RC mixes, but since we are also looking at force structures of different sizes, the cost of replacing equipment that wears out may well vary in the long run. We allow users to choose the life of equipment and to incorporate replacement cost into their analyses of alternatives. The model provides three key outputs:

- The annual cost of operating the entire community. That includes the cost of both deployed and non-deployed units in all components.

- The surge capacity provided by the community. This is measured by the total number of units in the community, both active and reserve. This is really a throughput, since force size and mix are user-specified.
- The steady state level of operational capability, as measured by the number of units the community can maintain on deployment on a continuing basis.

The figure below illustrates how our model can illuminate the implications of a wide range of potential alternatives simultaneously.



The Cost and Capability of Alternative AC/RC Mixes for the HBCT Community at Rotation Patterns of 1:3 for the AC and 1:5 for the RC without Equipment Replacement

The figure uses HBCTs as an example. For each of three different sizes of the HBCT community (13, 19, and 25 BCTs), it shows how annual cost and the number of deployable units varies as one moves from a set of HBCTs that is all AC (on the upper right of each community-size line) to one that is all RC (on the lower left of each community-size line). The more RC units are substituted for AC units, the less the cost of a given number of HBCTs and the fewer deployable units that can be generated on a rotational basis.

The figure allows one to better understand the cost and AC/RC mix implications of meeting stated levels of requirements for both surge capability and rotational deployment capability. Suppose requirements are for a force size of 19 HBCTs with a steady state deployment capability of four units. Point A allows these requirements to be met with a community size of 19 HBCTs that is about 70 percent AC at a cost of roughly $11.2

billion a year. At first glance that appears to be the best alternative. However, Point B identifies an additional consideration; it increases the number of HBCTs to 25 and provides the same number of deployable units with a force that is about 30 percent AC at a cost of roughly $10.2 billion. In this example, it is possible to meet deployment requirements, increase force structure, and save money with a relatively more RC-intensive force. This could be particularly important if there is significant uncertainty about the surge capacity requirement. More surge capacity could be bought—in this case 25 HBCTs—with less funding to mitigate surge capacity risk.

The methodology for comparing active/reserve force mix alternatives that we have described and illustrated gives insights into the costs and capabilities associated with alternatives, but it is incomplete. Its results should be considered with the following caveats in mind:

- Transition (unit conversion) costs are not considered. In many circumstances, changes in the mix of active and reserve units would take time and entail costs.
- The rate at which surge forces can be generated is not yet addressed.
- Some cost factors that we take to be constants may not be, for substantial shifts in active/reserve mixes. Training costs are an example.
- Possible differences in effectiveness between active and reserve component units are not addressed.

Our current modeling structure does provide a better-informed starting point for analyses of AC/RC force structure alternatives by identifying the active/reserve mix that can least expensively meet both surge and steady-state operational requirements.

In addition to improving the treatment of infrastructure costs, we are extending the work to capture the ability of alternatives to meet the kinds of surge demands that may materialize in the future. This will give the Department of Defense leadership the ability to better understand the risks and rewards associated with alternative force structures. Its value will go beyond improving analysis of active/reserve force mix decisions to strengthening the basis for a wide range of programmatic decisions.

Contents

1. Introduction

A. Objective and General Approach

The purpose of this paper is to present a structured method for incorporating cost analysis into decisions involving the mix of Army active component (AC) and reserve component (RC) units of particular types. Determining the best mix of active and reserve units is an important element of defense planning and force sizing. Active units are generally better able to deploy on short notice than reserve units, and can be deployed more frequently. Reserve units, on the other hand, are less expensive on a unit-for-unit basis, allowing a larger force structure to be maintained for a given level of expenditure. We are developing computer-based models to facilitate comparison of alternative AC/RC force mixes for all of the Services. This model will provide a quick capability to assess a wide range of AC/RC force mix alternatives for impacts on cost, surge capacity, and operational capacity. In this paper, we focus on the prototype model developed for analysis of alternative AC/RC force mixes for the Army and present results drawn from Army examples.

Our approach is to find the active/reserve mix that can least expensively:

- Attain acceptable surge capacity, as measured by the number of units (although we do not address how quickly they could deploy); and
- Attain acceptable steady state operational or presence levels, as measured by the number of units that can be maintained on deployment on a continuing basis.

A key element of this approach is to focus the analysis at the community level. By community, we mean the set of units of a given type, such as all heavy brigade combat teams (HBCTs) in the Army. The point of AC/RC force mix analysis is to understand the cost and effectiveness of a mix of forces of in a given community. We address questions like, "What is the most efficient mix of HBCTs to meet the surge and steady-state requirements for HBCTs?" We hope to facilitate a more complete examination of sets of alternative force mixes. We seek to capture both direct and indirect costs, clarify the relationship between cost and both the strategic and operational capacities of the force, and measure both the cost and effectiveness implications of adding or subtracting one more marginal AC or RC unit. Focusing on the cost of individual units or the cost of deploying a single unit from either the active or reserve components does not answer such community-level questions.

B. Background

In a recent analysis, Jennifer Buck has pointed out, "Differences in the cost of the active and reserve components relate primarily to three factors. First, the guard and reserve have lower operating and training tempo. Second, they receive part-time pay and benefits. Third, the guard and reserve incur smaller infrastructure costs."[1]

Ms. Buck says that the biggest issue in active-reserve force mix costing is not comparing the cost of individual personnel or units. It is comparing the cost of getting equivalent amounts of capability into theater. She notes that the cost of a non-deployed reserve component brigade combat team (BCT) is only 28 percent the cost of an active BCT.[2] She goes on to emphasize, however, that the cost of maintaining one unit deployed on a rotational basis is similar for a force of active units as for a force of reserve units; the active force may even be cheaper.[3] This is because reserve units can be deployed less frequently in a situation short of major war, so a larger force structure is required to maintain one reserve unit deployed than to maintain one active unit deployed. That analysis did not explore the value to the additional force structure.

Similarly, analysis by Jacob Klerman of RAND finds that, "For wars fought with rotation, much—but not all—the RC's cost advantage disappears," and that in some cases, "The RC is actually more expensive." In this analysis the crucial question for costing is: What is the ratio of RC units in the force to AC units in the force needed to maintain one unit continuously deployed.[4]

This perspective is valid for calculating the cost of rotationally deployed presence, but such presence and its associated operational capability, while quite important, are not the only reasons for having military force structure. The reserve component can serve two purposes. The first is the traditional one of providing strategic surge capability in national emergency and all-out war. The second, as demonstrated over the last decade, is meeting a need for rotational deployed presence for stability operations or smaller scale war. In the event of a major war the United States is likely to want more forces than it is able to routinely deploy on a rotational basis. For such an event the larger force structure required to deploy a reserve unit is not a by-product of rotational policy; it is a major advantage. The papers cited above give little credit to this advantage. They do not directly capture a dimension of capability that should be an integral part of active/reserve force mix decision making.

1 Jennifer C. Buck, "The Cost of the Reserves," in *The New Guard and Reserve*, ed. John D. Winkler and Barbara A. Bicksler, (San Ramon, CA: Falcon Books, 2008), 175.

2 Ibid., 182.

3 Ibid., 183.

4 Jacob Alex Klerman, "Rethinking the Reserves" (Santa Monica, CA: RAND Corporation, 2008), 22–23.

C. Outline

The next chapter of the paper presents the analytic structure we have used in our modeling: the inputs, outputs and sources of data. This is followed by an analysis of alternative force mixes for the set of BCTs in the Army force structure. All three types of BCTs are considered: HBCTs, Stryker BCTS (SBCTs), and infantry BCTs (IBCTs). The last chapter provides final observations.

2. Analytic Structure

A. Introduction

This chapter presents information on the modeling structure and data sources used in our computerized tool for analyzing AC/RC force mix alternatives for Army communities. Over 3,000 kinds of Army units are covered.

B. Scope of Analysis

Our modeling structure is meant to provide a better informed starting point for analyses of AC/RC force structure alternatives. While it cannot provide conclusive evaluations, it does provide a consistent methodology for analyzing alternative AC/RC mixes for a wide range of unit types. It puts the focus on critical factors such as total community-level cost, strategic capacity, and operational capacity. It captures most aspects of costs, and the characteristics of rotational use of both active and reserve units, including the level of resources available to units at various points in the rotational cycle. More details are provided in the next section.

It does not address:

- Possible differences in the effectiveness of deployed units from different components
- Transition (unit conversion) costs. In many circumstances, changes in the mix of active and reserve units would take time and entail costs that are not considered.
- The rate of force generation in surge. The number of units in force structure is used as the measure of surge capability. The ability to have that capability available within some specified period is not yet considered.
- Variation in infrastructure cost factors as a function of AC/RC mix. For example, largely reserve-intensive communities cannot benefit as much from training costs borne to support active units. We are not yet able to allow these factors to vary.

C. Inputs

1. Pre-specified Costs

The cost factors used in our calculations are all taken from Army models. We are very grateful for the outstanding support we have received from the Army costing community. While analytic perspectives will differ, we hope that the use of common costing assumptions will facilitate discussion of the pros and cons of force-mix alternatives.[5] Table 1 summarizes the cost elements captured by the model.

Table 1. Summary of Cost Elements

Direct Equipment Parts & Fuel Cost
Post Production Software Support
Indirect Support Cost
Personnel
Personnel Accession
Replacement Personnel Training
Basic Pay and Allowances
Retired Pay Accrual
Housing Allowances
Cost of Living Allowance (COLA)
Special Incentive/Hazardous Duty Pay
Permanent Change of Station (PCS) Travel: Military & Dependents
GI Bill and Other Education
Defense Health Program
Base Operations
Cost of Deployments
Additional Pay for Reservists
Increased Operating Tempo Cost
Transportation Costs
Additional C4I (Command, Control, Communications, Computers, & Intelligence), contractor support, etc.

Both equipment operating costs and personnel costs capture the additional training costs involved in preparing both active and reserve units for deployment.

Base operations costs include infrastructure support, housing, security, soldier and family support, and several other items. Indirect support costs include contractual services, mission travel, transportation of things, civilian labor, and several other items.

5 LTC Rick Morrison, Mr. Tony Boyda, and Mr. Joe Gordon of the Army G-8 office have provided invaluable assistance.

Individual training beyond initial Military Occupational Specialty (MOS) is not included. Unit training costs are captured under the cost elements that reflect unit activity.

The costs are available by type of unit or organization. The Army's taxonomy for identifying unit types is the Standard Requirements Code (SRC). The SRC structure allows us to capture units at various levels of aggregation. For example, a brigade-level organization has an SRC and is composed of smaller units, each having its own SRC. For every SRC, separate cost factors are provided by component.

Three sources of cost factors are drawn upon. The Force and Organization Cost Estimating System (FORCES) cost model provides annual unit-level factors for non-deployed units. This includes most personnel-related costs, including medical costs and retired pay accrual, as well as operating costs, such as fuel and maintenance. It also includes base operations and indirect support costs.

The Army Military-Civilian Cost System (AMCOS) provides some additional personnel-related costs. This includes estimates of annualized personnel accession costs and annualized education and training costs through initial skill training.

The Army Contingency Operations Costing Model (ACM) was used to estimate deployment-related costs such as additional pay for RC personnel, the additional operating costs associated with deployment activity, and the cost of moving units to their deployment locations. It also captures reset costs. ACM bases some of its costs on the Contingency Operations Support Tool (COST) developed by IDA.

2. User-specified Inputs

An important feature of the model is that by altering inputs iteratively, users can quickly perform sensitivity analysis along many dimensions, seeing the implications for both the cost and operational capacity of alternative choices.

a. Community or Unit Type

Selection of the community, or type of unit, to be analyzed is the first step in examining a force mix alternative. A pull-down menu of SRCs is provided for the purpose of selection.

b. Force Levels by Component

The essence of defining an analytic alternative is specifying the AC/RC mix in the community to be addressed. The number of units in each Army component—active, U.S. Army Reserve (USAR) and Army National Guard (ARNG)—must be entered. In addition to analyzing the specified force structure, the model addresses all possible force mixes for a community of the same size as well as larger and smaller communities. The amount larger and smaller is chosen as an input.

c. Rotation Assumptions

As was discussed in the introduction, the frequency with which units are deployed is an important factor driving the relative cost of active and reserve forces. Both active and reserve component units move through the force generation, or ARFORGEN, cycle. Typically, availability for deployment is followed by a reset period and then by several periods of increasing training and readiness before the next availability period.

For active forces, the standard rotation metric is the ratio between the amount of time a unit is deployed (called *boots-on-the-ground time*, or BOG) and the amount of time it is at home in the non-deployed part of the training cycle (called *dwell*). The metric is called the BOG:dwell ratio. This ratio is relevant because there is policy guidance to not exceed a specified level of BOG:dwell for active forces.

For reserve forces, the standard rotation metric is the ratio between the amount of time a unit is mobilized (called *MOB*) and dwell. This is called the MOB:dwell ratio. It is relevant because there is policy guidance to not exceed a specified level of MOB:dwell for reserve forces. For reserve units, MOB may differ from BOG because of the need to provide additional training for units before deployment and to allow for adjustment time after the return from deployment. Active units also undergo pre-deployment training, but this training is not a constraint on the percent of time they can be deployed. For the AC, deployments are limited by the fraction of time units are deployed. For the RC, they are limited by the fraction of time units are mobilized.

In addition to influencing costs, rotation assumptions strongly affect the amount of steady-state operational presence that can be generated by a community of a given size and force mix.

In our model, several rotation assumption choices are offered. On the active side, users can choose BOG:dwell ratios of 1:2 or 1:3. The former reflects the practice during most of the period of operations in Iraq and Afghanistan. The latter reflects the Army's goal. Similarly, on the reserve side, users can choose MOB:dwell ratios of 1:4 or 1:5, with the former reflecting recent practice and the latter reflecting the Army's goal.

d. Deployment Duration

For any given set of rotation assumptions, longer duration deployments mean fewer deployments and lower deployment costs. As you increase deployment duration for either component, you reduce the cost of providing any given amount of rotational presence. We allow users to input their choice for deployment duration in months separately by component.

e. Period-specific Resource and Activity Levels

The Army's modeling of periods in the force generation cycle for both active and reserve forces breaks the time down into a deployment period, a reset period, and several additional training/readiness, or TR, periods. For each period, so-called *aim points* can be specified that reflect the amount of equipment on-hand, training readiness, and number of personnel present during every period. This affects the cost of units during the complete force generation cycle. In our analyses, we use the Army's standard aim points, which differ by unit type. The model is flexible in that users may replace these if they choose, and will immediately see the impact of the change. Our model also accepts entries on deployment operating tempo relative to fully-resourced peacetime activity.

f. Transit Time and Relief in Place/Transfer of Authority (RIP/TOA)

If units spend more time in transit to their deployment locations or if they are in place along with the units they are replacing for some period of time, a given force structure will allow fewer deployment locations to be covered at any one time. Since the level of steady state operational presence is an important output of our analysis, users are given the opportunity to enter their assumptions regarding the sum of transit time and RIP/TOA (overlap) time.

g. Pre-deployment Training and Post-deployment Adjustment Periods

Typically reserve component units spend some of their mobilization period training for deployment and adjusting after deployment. Since the MOB:dwell ratio is a constraint on the operational use of the RC, longer training and adjustment periods imply less time actually deployed. The model provides default levels of pre-deployment training and post-deployment activity depending on the type of unit; however, users are permitted to adjust these values.

h. Pre-mobilization Training Days

In order to limit the requirement for additional training during mobilization and to ensure the readiness of deploying RC units, it may be desirable to provide additional training days for the RC in the periods prior to mobilization. Our model provides for the provision of such training. This affects the cost of using the RC rotationally.

i. Need for Deployment

The model assumes that all units go through the rotational cycle, but gives the user the ability to determine whether it is necessary to deploy, and for RC units whether it is necessary to mobilize. When deployments and mobilizations are not needed, the RC becomes relatively cheaper.

j. Equipment Replacement Cost

For equal force sizes, there may well be little difference in equipment replacement costs for different AC/RC mixes, but since we are also looking at forces of different sizes, the cost of replacing equipment that wears out may well vary in the long run. We allow users to choose the life of equipment and to incorporate replacement cost into their analyses of alternatives. Equipment replacement costs are attributed to a unit only when the equipment is held by the unit. The fraction of authorized equipment on hand varies over the ARFORGEN cycle. The fact that equipment on hand may be used less intensively by reserve units than by active units is not taken into account. Because it is impossible to know how replacement equipment may differ from current equipment, we assume that the cost of replacement equipment is the same as that of the equipment being replaced.

D. Outputs

The model provides three key outputs:

- The annual cost of operating the entire community for a given force mix and other selected input choices. That includes the cost of both deployed and non-deployed units in all components.
- The surge capacity provided by the community. This is measured by the total number of units in the community, active plus reserve. This is really a throughput, since force size and mix are user-specified.
- The steady state level of operational capability, as measured by the number of units the community can maintain on deployment on a continuing basis.

Additional outputs, such as cost per available month, are also calculated.

3. Illustrative Analyses of Brigade Combat Team Communities

A. Defining Alternatives

The Army currently has 73 BCTs: 40 Infantry BCTs, 9 Stryker BCTs, and 24 Heavy BCTs. In the current budget environment, both reductions in the total number of BCTs and shifts from the active to reserve component (all RC BCTs are now in the ARNG) are likely to be considered. We compare force structures that differ in both size and force mix, both of which are likely to be considered in the current budget environment. Table 2 shows the alternative force structures we have selected for our illustrative analysis. For each kind of BCT, overall force size and the AC/RC split are displayed. A complete description of the individual units composing each BCT is available in Appendix A.

Table 2. Alternative BCT Force Structures

Total BCT Quantity (AC/RC)	73 (45/28)	65 (37/28)	60 (30/30)	60 (24/36)
Infantry BCT	40 (21/19)	35 (16/19)	32 (13/19)	32 (11/21)
Stryker BCT	9 (8/1)	9 (7/2)	9 (6/3)	9 (4/5)
Heavy BCT	24 (16/8)	21 (14/7)	19 (11/8)	19 (9/10)

The left-most alternative is the current situation. Moving right, the next alternative reduces the active force structure by eight BCTs, leaving the number of ARNG BCTs unchanged but converting one Guard Heavy BCT to a Stryker BCT. The next alternative reduces the total force structure by five more BCTs to a total of 60 with an equal number in the AC and ARNG. The final alternative keeps the number of BCTs at 60 and moves six additional BCTs into the Guard.

We analyze two sets of rotation alternatives. The first reflects recent practice: a 1:2 BOG:dwell ratio for the AC and a 1:4 MOB:dwell ratio for the ARNG. The second reflects the Army's preference: a 1:3 BOG:dwell ratio for the AC and a 1:5 MOB:dwell ratio for the ARNG. We assume that deployments actually take place.

Deployment durations of nine months are assumed for both AC and RC units. The analysis incorporates transit time or RIP of one week at each end of the deployment cycle. The sum of pre-deployment training and post-deployment adjustment time is assumed to be three months for the Guard units. The default levels of dwell-period resources (aim points) associated with a “deployed expeditionary force” are assumed in all cases.

B. Results for Alternatives

Our results are reported for a total of eight cases: the four force structure alternatives under the two sets of rotation alternatives. Table 3 shows costs without equipment replacement, while Table 4 includes the same costs with equipment replacement added. In both tables, the community cost is reported both including the costs of deployment and, alternatively, with those deployment costs removed. The latter case pertains when units reach the available phase of the ARFORGEN cycle but are not needed in a deployed location. These two costs function as the effective maximum and minimum cost bounds for any given community. More detailed versions of these tables, with information on each of the three kinds of BCTs, are presented in Appendix B.

Table 3. Results of Illustrative Analyses without Equipment Replacement

	1:2 AC/1:4 RC				1:3 AC/1:5 RC			
Case number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total BCT Quantity (AC/RC)	73 (45/28)	65 (37/28)	60 (30/30)	60 (24/36)	73 (45/28)	65 (37/28)	60 (30/30)	60 (24/36)
Rotational Deployability	18.1	15.6	13.7	12.7	13.9	12.0	10.6	9.9
Annual Community Cost (Deployment)	$36.4B	$31.4B	$27.4B	$25.0B	$33.0B	$28.5B	$24.9B	$22.7B
Annual Community Cost (No Deployment)	$23.3B	$20.0B	$17.3B	$15.6B	$22.9B	$19.6B	$17.0B	$15.3B

Under our assumptions, the current set of 73 BCTs can provide about 18 units of operational presence at the higher rotation rates shown for Case Number 1, on the left side of the table. We estimate the annual community cost to be $36 billion. The lower rotation rates in Case Number 5 can provide almost 14 BCTs of operational capability at an annual cost of $33 billion.

The right side of the table shows the savings and the output losses associated with the alternative force structures under less strenuous rotation assumptions. For example, comparing Cases 7 and 8 shows that at a constant level of 60 BCTs, replacing six active BCTs with ARNG BCTs reduces potential operational capability by almost one BCT to about 10 BCTs in the steady state and saves about $2 billion a year.

Table 4 shows the same content as Table 3, but with equipment replacement costs included. Our analysis assumes a 30-year default replacement schedule for unit equipment across both the active and reserve components. This replacement requirement is reduced according to the amount of equipment on-hand (less than 100 percent) at any given time during the ARFORGEN cycle. This assumption mirrors Army costing practice.

Table 4. Results of Illustrative Analyses with Equipment Replacement

	1:2 AC/1:4 RC				1:3 AC/1:5 RC			
Case number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total BCT Quantity (AC/RC)	73 (45/28)	65 (37/28)	60 (30/30)	60 (24/36)	73 (45/28)	65 (37/28)	60 (30/30)	60 (24/36)
Rotational Deployability	18.1	15.6	13.7	12.7	13.9	12.0	10.6	9.9
Annual Community Cost (Deployment)	$38.4B	$33.3B	$29.0B	$26.7B	$35.0B	$30.3B	$26.5B	$24.4B
Annual Community Cost (No Deployment)	$25.3B	$21.8B	$19.0B	$17.2B	$24.9B	$21.4B	$18.6B	$16.9B

Table 4 shows the same levels of rotational deployability for the alternatives, but the costs are higher. We estimate that the 73-BCT community costs more than $38 billion annually at the higher rotation rates. At lower rotation rates, in Case 5, the same size and mix community costs $35 billion annually. Comparing Table 3 and Table 4 indicates that equipment replacement costs range from $1.6 billion to $2.0 billion, depending on force size and mix.

Comparing the last two rows of Table 3 and Table 4 shows that when force structure is not deployed, the differences in costs associated with alternative rotation tempos decrease significantly. Additionally, more reserve-intensive force mixes, given a specific strategic capability, achieve greater relative cost savings when deployments are not required (compare Case 4 with Case 5 and Case 7 with Case 8).

Several caveats should be kept in mind. In particular, our analysis has ignored transition costs. Moving to Case 8, for example, would require the disestablishment of a substantial number of active units and the establishment of eight new ARNG units—with associated costs and delays. In addition the analysis implicitly assumes that RC units would be as able as AC units to meet surge requirements. The risk involved in possible surge scenarios deserves more careful examination. Possible differences in the effectiveness of deployed AC and RC units are also not considered.

C. Depiction of a Wide Range of Alternatives

Table 3 indicates that more RC-intensive mixes of BCTs can maintain force structure at lower cost and still provide substantial rotational presence. It does not, however, provide a holistic evaluation of all the possible alternatives for the community. Figure 1 illustrates how our model can illuminate the implications of a wide range of potential alternatives simultaneously.

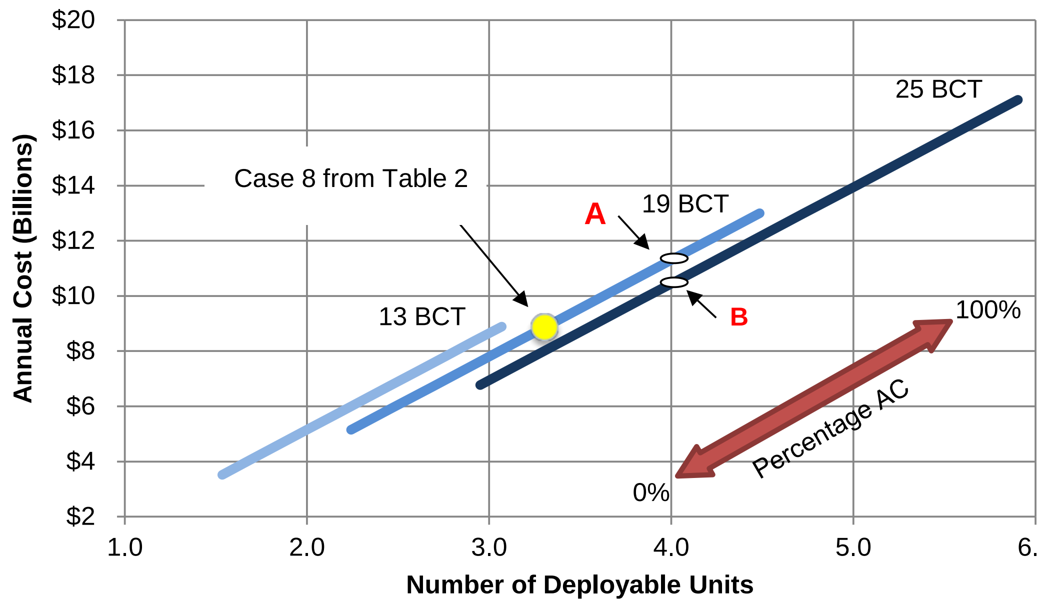


Figure 1. The Cost and Capability of Alternative AC/RC Mixes for the HBCT Community at Rotation Patterns of 1:3 for the AC and 1:5 for the RC without Equipment Replacement

The figure uses HBCTs as an example. For each of three different sizes of the HBCT community (13, 19, and 25 BCTs, representing different levels of strategic capacity), it shows how the annual cost and the number of deployable HBCTs vary as one moves from a mix that is all AC (on the upper right of each community-size line) to one that is all RC (on the lower left of each community-size line). The yellow dot depicts the HBCT portion of Case 8 in Table 3 (with deployments). The more RC HBCTs are substituted for AC HBCTs, the less a community of a given size costs and the fewer deployable units it can generate on a rotational basis. The number of deployable units represents the potential level of operational capacity.

Figure 1 allows one to better understand the cost and AC/RC mix implications of meeting stated levels of requirements for both surge capability and rotational deployment capability. Suppose the requirement is for a force size of 19 HBCTs with a steady state deployment capability of four units. At Point A, that requirement is met with a community size of 19 HBCTs that is about 70 percent active, at a cost of roughly $11.2

billion a year. At first glance that appears to be the best alternative, since both criteria are satisfied. However, Point B may also deserve consideration. It increases the community size to 25 HBCTs and provides the same number of deployable units with a force that is about 30 percent active at a cost of roughly $10.2 billion. In this example it is possible to meet deployment requirements, increase force structure, and save money with a relatively more reserve-intensive mix. In other words, Point B represents a community with greater strategic capacity that produces the same operational capacity for less cost than the community represented by Point A.

The community depicted at Point B may appear cheaper than the one depicted at Point A because we did not include expenditures for equipment replacement in the analysis. A set of 25 HBCTs clearly costs more to equip than a set of 19 HBCTs. On the other hand, if we already have enough equipment for 25 BCTs, that number could be maintained for quite some time without replacing all of the equipment.

Figure 2 demonstrates the importance of equipment replacement costs. It presents the results for Case 8 in Table 4 with deployments including equipment replacement. The costs for all alternatives increase, and the relative savings with more reserve-intensive force mixes are smaller than in the analysis excluding equipment replacement. Points A and B have nearly merged. It is still possible for a larger, more reserve-intensive mix to provide a given level of rotational capability at no additional cost. Analysis of communities that are more equipment-intensive than HBCTs, like aviation, indicates in some cases the curves will flip, with rotational capability provided by reserve units costing more than the same rotational capability provided by active units. In those cases the larger surge capability provided by the more reserve-intensive mix comes at a price.

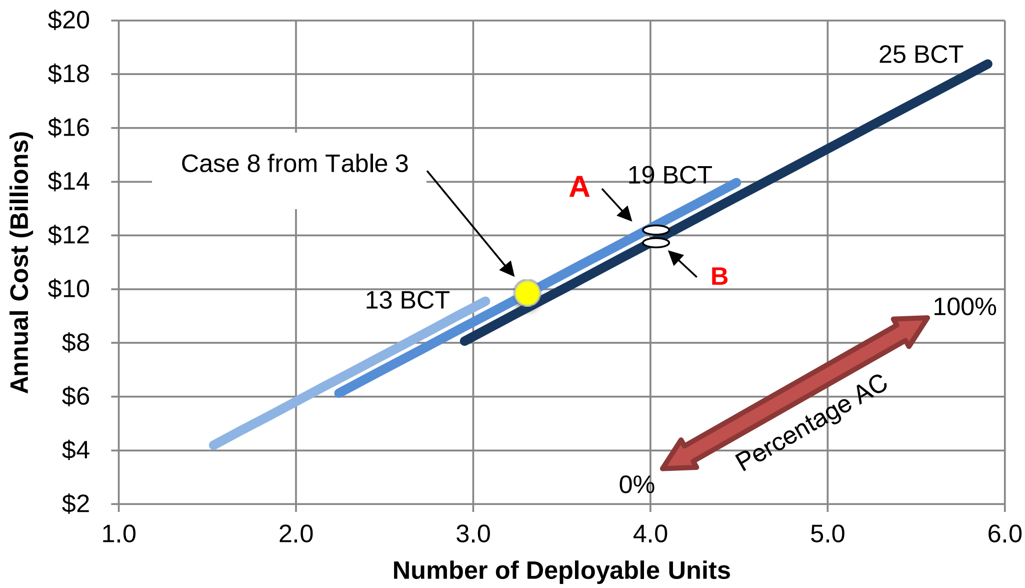


Figure 2. The Cost and Capability of Alternative AC/RC Mixes for the HBCT Community at Rotation Patterns of 1:3 for the AC and 1:5 for the RC with Equipment Replacement

D. Caveats

This section reiterates some of the qualifications noted in describing the scope of our analysis. The methodology for comparing active/reserve force mix alternatives that we have described and illustrated gives insights into the costs and capabilities associated with alternatives, but it is incomplete. Its results should be considered with the following caveats in mind:

- Transition (unit conversion) costs are not considered. Inactivating some units and activating others is costly and time consuming. Our methodology can identify promising alternatives, but implementation issues must be analyzed separately.
- The rate at which surge forces can be generated is not yet addressed. Community size is an indicator of how much strategic capability a part of the force structure can ultimately provide, but force planning requires an understanding of whether the capability can be fielded soon enough to address scenarios of interest. Our methodology can tell us how many units are at various points in the ARFORGEN cycle, which could be related to how long it would take to get them ready for deployment. This relationship has not yet been incorporated into our modeling.
- Unit readiness is not the only determinant of time to deployment. Limitations to strategic lift capacity and the availability of training facilities are also factors. There is a case for placing capability in the RC if lift will not be available before reserve units can be ready.
- Some cost factors that we take to be constants are very likely to be sensitive to large shifts in active/reserve mixes. Training costs are an example. Currently many reserve component personnel have substantial prior active duty service. This means that much of their training was provided while they were on active duty and that the reserve components do not have to pay for initial entry of advanced skill training. If more of the force structure were in the reserve components, there would be fewer prior service accessions and more training costs would have to be borne by the RC. In such circumstances, our RC training factors should be increased. On the other hand, if more personnel leaving the AC can be encouraged to join the RC, RC training cost factors could be decreased. The possibility of making adjustments for such changes has not yet been incorporated into our modeling.
- In general, though, it is unlikely that RC training costs will often be larger than AC training costs. The same is true for base operating costs.

4. Final Observations

We have been able to draw on the Army's extensive unit-level cost models and databases to build an automated community-level active/reserve force mix analysis model. It allows us to quickly estimate the cost and capabilities associated with alternative AC/RC mixes within communities chosen by the user.

Our modeling calculates the average annual cost of supporting and using the units, both active and reserve, in a community on a rotating basis. Personnel costs, operating costs, some overhead costs, equipment replacement costs, and deployment costs are included. Equipment replacement costs can also be captured. In addition to cost, it focuses on two dimensions of capability:

- Surge capability, roughly captured by the number of units in the community
- Steady state operational presence levels, as measured by the number of units a community of a specified size and active/reserve mix can maintain on deployment on a continuing rotational basis

In this paper, we analyzed AC/RC force mix alternatives for brigade combat teams. In many cases we find that, to the extent that an RC-intensive force structure is consistent with meeting rotational capability requirements, the more we rely on the RC, the more force structure we can afford.

Many cost analyses of AC/RC force mix have concentrated on the relative cost of individual personnel or units, not explicitly considering that a reserve component unit cannot routinely be deployed as frequently and therefore provides less operational capability on a rotational basis. More recent analyses have emphasized the cost of maintaining one deployed unit rotationally, which takes more RC units than AC units. These have not explicitly considered the additional surge capability that is a by-product of having more forces.

Analyzing AC/RC force mix at the community level facilitates thinking about both the size of the community and its ability to generate rotationally deployed forces. This is a step toward a more complete analysis of alternative force mixes.

Appendix A.
Unit Composition of BCTs

Table A-1. IBCT

Unit Number	SRC	Title
1	06125G301	FIRES BN 105T (IBCT) (M119A1)
2	07215G001	INFANTRY BN (IBCT) (M41)
3	07215G001	INFANTRY BN (IBCT) (M41)
4	17215G001	RECON SQUADRON (IBCT) (M41)
5	63335G401	BDE SUPPORT BN W/FSC (INF BCT)
6	77302G201	HQS INFANTRY BRIGADE CBT TM
7	77405G001	BDE SPECIAL TROOPS BN (IBCT)

Table A-2. SBCT

Unit Number	SRC	Title
1	05063F301	ENGINEER CO (SBCT)
2	06385F601	FIRES BN 155T (SBCT) (M777)
3	07093F301	ANTIARMOR COMPANY (SBCT) (M1134)
4	07095F501	INFANTRY BN (SBCT)
5	07095F501	INFANTRY BN (SBCT)
6	11307G801	BRIGADE SIGNAL CO (HBCT/IBCT)
7	17095F501	RECONNAISSANCE SQUADRON (SBCT)
8	34143F301	MI CO (SBCT)
9	47102F501	HHC STRYKER BCT (SBCT)
10	63106F601	HHC BRIGADE SUPPORT BN (SBCT)
11	07095F501	INFANTRY BN (SBCT)

Table A-3. HBCT

Unit Number	SRC	Title
1	06385G001	FIRES BN 155SP (HBCT) (M109A6)
2	07205G101	COMBINED ARMS BN (M2A3/M3A3/M1A2)
3	07205G102	COMBINED ARMS BN (M2A2/M3A2/M1A1)
4	17205G102	RECON SQUADRON (HBCT) (M3A2)
5	63325G601	BRIGADE SUPPORT BN (HBCT)
6	87302G101	HHC HEAVY BDE CBT TEAM (HBCT)
7	87305G301	BDE SPECIAL TROOP BN (HBCT)

Appendix B.
Results of Illustrative Analyses in Detail

Table B-1. IBCT with and without Equipment

	1:2 AC/1:4 RC				1:3 AC/1:5 RC			
Case number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total BCT Quantity (AC/RC)	40 (21/19)	35 (16/19)	32 (13/19)	32 (11/21)	40 (21/19)	35 (16/19)	32 (13/19)	32 (11/21)
Rotational Deployability	9.3	7.7	6.8	6.4	7.2	6.0	5.3	5.1
Annual Community Cost without Equipment Replacement								
Annual Community Cost (Deployment)	$15.8B	$13.0B	$11.4B	$10.7B	$14.5B	$12.0B	$10.4B	$9.8B
Annual Community Cost (No Deployment)	$10.6B	$8.7B	$7.5B	$7.0B	$10.4B	$8.5B	$7.4B	$6.8B
Annual Community Cost with Equipment Replacement								
Annual Community Cost (Deployment)	$16.3B	$13.4B	$11.8B	$11.1B	$14.9B	$12.3B	$10.8B	$10.2B
Annual Community Cost (No Deployment)	$11.1B	$9.1B	$7.9B	$7.3B	$10.9B	$8.9B	$7.7B	$7.2B

Table B-2. SBCT with and without Equipment

	1:2 AC/1:4 RC				1:3 AC/1:5 RC			
Case number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total BCT Quantity (AC/RC)	9 (8/1)	9 (7/2)	9 (6/3)	9 (4/5)	9 (8/1)	9 (7/2)	9 (6/3)	9 (4/5)
Rotational Deployability	2.7	2.5	2.3	2.0	2.0	1.9	1.8	1.5
Annual Community Cost without Equipment Replacement								
Annual Community Cost (Deployment)	$6.0B	$5.6B	$5.2B	$4.4B	$5.4B	$5.1B	$4.7B	$4.0B
Annual Community Cost (No Deployment)	$4.0B	$3.7B	$3.4B	$2.9B	$3.9B	$3.6B	$3.4B	$2.8B
Annual Community Cost with Equipment Replacement								
Annual Community Cost (Deployment)	$6.3B	$5.9B	$5.5B	$4.7B	$5.7B	$5.4B	$5.0B	$4.3B
Annual Community Cost (No Deployment)	$4.3B	$4.0B	$3.7B	$3.2B	$4.2B	$4.0B	$3.7B	$3.1B

Table B-3. HBCT with and without Equipment

	1:2 AC/1:4 RC				1:3 AC/1:5 RC			
Case number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total BCT Quantity (AC/RC)	24 (16/8)	21 (14/7)	19 (11/8)	19 (9/10)	24 (16/8)	21 (14/7)	19 (11/8)	19 (9/10)
Rotational Deployability	6.2	5.4	4.6	4.3	4.7	4.1	3.5	3.3
Annual Community Cost without Equipment Replacement								
Annual Community Cost (Deployment)	$14.7B	$12.8B	$10.8B	$9.9B	$13.1B	$11.5B	$9.7B	$8.9B
Annual Community Cost (No Deployment)	$8.7B	$7.6B	$6.4B	$5.7B	$8.6B	$7.5B	$6.3B	$5.6B
Annual Community Cost with Equipment Replacement								
Annual Community Cost (Deployment)	$15.9B	$13.9B	$11.8B	$10.9B	$14.3B	$12.6B	$10.7B	$9.8B
Annual Community Cost (No Deployment)	$10.0B	$8.7B	$7.4B	$6.7B	$9.8B	$8.6B	$7.2B	$6.6B

Illustrations

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References

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Abbreviations

AC	Active Component
ACM	Army Contingency Operations Costing Model
AMCOS	Army Military-Civilian Cost System
ARFORGEN	Army Force Generation
ARNG	Army National Guard
BCT	Brigade Combat Team
BOG	Boots-on-the-Ground
C4I	Command, Control, Communications, Computers, & Intelligence
COLA	Cost of Living Allowance
COST	Contingency Operations Support Tool
FORCES	Force and Organization Cost Estimating System
HBCT	Heavy Brigade Combat Team
IBCT	Infantry BCT
IDA	Institute for Defense Analyses
MOB	Mobilized
MOS	Military Occupational Specialty
PCS	Permanent Change of Station
RC	Reserve Component
RIP/TOA	Relief in Place/Transfer of Authority
SBCT	Stryker Brigade Combat Team
SRC	Standard Requirements Code
TR	Training/Readiness
U.S.	United States
USAR	U.S. Army Reserve

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

We drew on the Army's extensive unit-level cost models and databases to build an automated active/reserve force mix analysis model that allows us to quickly estimate the cost and capabilities associated with alternative active component/reserve component (AC/RC) mixes for a community chosen by the user. By community we mean the set of units of a given type. Our modeling calculates the average annual cost of supporting and using the units, both active and reserve, in a community on a rotating basis. Personnel costs, operating costs, some overhead costs, equipment replacement costs, and deployment costs are included. Equipment replacement costs can also be captured. In addition to cost, it focuses on two dimensions of capability:

- Surge capability
- Steady state operational presence levels

In this paper, we illustrate the use of our model by analyzing AC/RC force mix alternatives for various kinds of brigade combat teams.
At this time, the model does not capture all the elements that pertain to active/reserve force mix decisions; such as unit effectiveness, the transition costs of establishing units in one component and disestablishing them in another, responsiveness under surge conditions, or possible variability in some infrastructure cost factors.
Our current modeling provides a better-informed starting point for analyses of AC/RC force structure alternatives. Extensions of this work are incorporating flexibility in the specification of infrastructure costs factors and are addressing how well a given force structure can respond to potential surge requirements.
The work will go beyond active-reserve mix questions to give the Department of Defense a tool for evaluating alternative force structures in the context of demand and programmatic costs.

15. SUBJECT TERMS

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