Personnel Turbulence

The Policy Determinants of Permanent Change of Station Moves

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PREFACE

In 1994, the Army Deputy Chief of Staff for Personnel, the Commanding General of the Army's Forces Command, and the Deputy Chief of Staff for Operations and Plans expressed concern over the extent of personnel turbulence in the Active Component of the Army and asked the Arroyo Center to initiate research on the topic. An early set of results, focused on personnel moves among geographic locations (permanent change of station moves), was briefed to the three sponsors in 1995. This report provides an update to the earlier briefing and provides a more complete documentation of the results. It should be of interest to those involved in Army personnel issues, particularly personnel costs.

The research was conducted in the Manpower and Training Program of RAND's Arroyo Center, a federally funded research and development center sponsored by the United States Army.

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SUMMARY

The end of the Cold War was followed by a substantial reduction in both the size of the Army and the proportion of the Army stationed overseas. These events brought with them an expectation by some in the Army that the movement of soldiers—so-called personnel turbulence—would subside. As measured by the rate of permanent change of station moves, such a reduction has not occurred and is not expected for the foreseeable future.

The aggregate trends and projections for permanent change of station (PCS) moves, as well as the trends and projections within the individual classes of PCS moves, reveal that the absolute number of PCS moves has declined and is about to stabilize as the Army reaches postdrawdown stability. But the aggregate per-capita PCS-move rates will remain at about the Cold War level.

In particular, accession and separation moves—those moves that bring soldiers to their first duty station and return them to civilian life from their last duty station—will, in the out-years, remain roughly comparable to Cold War levels relative to force size. To reduce the numbers, the Army would have to increase the duration of soldiers' service.

Rotational moves—those moves of soldiers to and from overseas locations—are driven by overseas strengths and tour lengths. Rotational moves will decline in absolute terms, but will increase relative to overseas strengths because overseas cuts have come principally from long-tour (largely Europe-based) authorizations, rather than short-tour (largely Korea-based) authorizations. Ignoring extensions and curtailments, long-tour authorizations require only one re-

placement per authorization every three years, while short-tour authorizations require a replacement every year. Hence, the disproportionate return of long-tour authorizations raised the average number of replacements required per overseas authorization per year. Only reductions in authorizations or increases in tour length can reduce the numbers further.

The remaining three types of moves—training, operational, and unit,[1] which together constitute about 12 percent of moves—are driven by a number of factors. Operational moves result from the requirement to move soldiers out of CONUS assignments of fixed length or to balance shortages. Training moves result from professional development requirements. And unit moves result from unit restationings. Given officer end strengths and the high per-capita training move rate among officers, the greatest policy leverage to reduce training moves would come from changing policies that now cause officers to attend advanced courses and command and staff college on a PCS rather than TDY basis. Operational moves represent a more complicated situation; a number of demands generate such moves, in both the officer and the enlisted force. While operational moves represent a small fraction of the total, it may be worthwhile to investigate further the various drivers of such moves. No single policy change, however, is likely to have much power to reduce operational moves.

In terms of differences between officer and enlisted forces, Table S.1, which summarizes PCS-move rates, shows that in fiscal year 1997, when much of the drawdown turbulence has subsided, force losses (accession and separation) continue to create the most PCS-move turbulence for both types of forces. However, the second most important source of turbulence differs for the two forces. For the enlisted force, rotational moves to and from overseas assignments generate the most moves per thousand end strength. In contrast, for the officer force, other moves—principally training and operational—outrank rotational moves as the second most prevalent source per thousand end strength.

[1]Training moves send soldiers to or from training of 20 or more weeks duration; operational moves are those that occur within CONUS or within an overseas theater; unit moves are the moves of individuals who move when a unit is reassigned.

Table S.1

PCS Moves per 1,000 End Strength, FY97

	Officer	Enlisted
Accession and separation	162	436
Rotational	97	158
Other (training, operational, unit)	150	52
Total	409	646

Three types of moves—accession, separation, and rotational—constitute almost 90 percent of all Army PCS moves. Accession and separation moves can be reduced principally by increasing soldiers' average length of service. Because these loss-related moves are relatively inexpensive, it would take a substantial improvement in average length of service to save a significant amount of PCS-move money. More importantly, however, compensation incentives such as reenlistment bonuses would be required to achieve the longer career lengths. The cost of these incentives, together with the additional pay and retirement costs associated with a more senior force, would more than outweigh any PCS-move savings. On the other hand, longer service would mean fewer annual accessions and, therefore, smaller initial entry training costs. Although we have not analyzed the costs in detail, it is clear that PCS moves represent only a minor consideration in the cost changes associated with changing average lengths of service.

Rotational moves account for only about one-quarter of all PCS moves but more than half their total cost. Rotational moves can be reduced through two policy actions: reducing the number of soldiers stationed overseas or increasing the length of overseas tours. Neither of these policies lies wholly within the control of the Army, but the Army can influence both. The return of even half the overseas authorizations could save the Army more than $300 million a year. Lengthening tours in Europe from three to four years would save less, only about $100 million a year. The return of all overseas authorizations would save more than $600 million a year in PCS moves and would permit much larger savings in overseas infrastructure, off-

set initially by added infrastructure costs in the continental United States (CONUS).

In sum, the more than $1 billion the Army spends on PCS moves each year is largely driven by the length of soldiers' service and the tour lengths and strengths of its overseas force. Barring changes in these fundamental parameters, modest savings can be achieved through management options, but for the most part, the Army is likely to remain about as mobile as it was during the Cold War and is likely to continue to spend money on about its current number of PCS moves.

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ABBREVIATIONS

AC	Active Component
AIT	Advanced Individual Training
BRAC	Base Realignment and Closure
BT	Basic Training
CONUS	Continental United States
FY	Fiscal Year
IET	Initial Entry Training
NCOES	Noncommissioned Officer Education System
OCONUS	Outside the Continental United States
OSUT	One-Station Unit Training
PCS	Permanent Change of Station
PMAD	Personnel Management Authorizations Document
RC	Reserve Component
TDY	Temporary Duty
TDA	Table of Distribution and Allowances
TOE	Table of Organization and Equipment

Chapter One

INTRODUCTION

BACKGROUND

Personnel turbulence is a normal, long-term operating characteristic of the Army. Turbulence can take numerous forms, but its most visible manifestation is in "permanent change of station moves" (PCS moves), which take place when soldiers enter or leave the Army or when they are reassigned from one station to another individually or with a unit that is relocated.[1]

PCS-move turbulence clearly entails costs for the Army—both monetary and nonmonetary—as well as costs for soldiers and their families. On the monetary side, the moves themselves are expensive. The Army spends more than a billion dollars annually in PCS moves alone. On the nonmonetary side, turbulence disrupts stability and continuity of personnel assignments, and the Army has long recognized that declines in stability and continuity hinder readiness by reducing unit cohesion and increasing the number of soldiers at any given time who are either in training or learning their jobs. Further, frequent moves—or the expectation of them—cost soldiers and their families. Such moves may reduce a spouse's employment opportunities or earnings and may inhibit wealth-creating actions such as buying a home. Such uncompensated costs may shape soldiers' atti-

[1]Other sources of turbulence include local job changes, (e.g., when soldiers are promoted to higher positions) and temporary absences from home stations (e.g., when soldiers or units are temporarily moved for operational or training deployments). This report focuses on PCS moves, which are enormously costly to the Army and, in contrast to other types of turbulence, are fully described by existing Army data systems.

tudes toward the Army, which may, in turn, lead to greater attrition; increased attrition may lead to declines in unit cohesion and, in turn, to declines in readiness.

This research seeks to determine the extent and policy determinants of PCS moves, in the recent past and in the future, and to propose a range of alternative policies the Army could pursue to reduce instability and hold down costs, and by so doing, perhaps enhance cohesion and readiness.

APPROACH

To help assess policy options for dealing with the turbulence associated with PCS moves, this research relies upon a highly aggregated, spreadsheet-based model of the PCS process. The model estimates flows among the various locations (or venues) to which the Army assigns soldiers. More specifically, the model takes as input characteristics for each venue the following parameters: the venue's authorized strength, the tour length associated with the venue, and the time required to make the move from one venue to another. It provides the following outputs: the detailed assignment flows into and out of each venue and the tour length associated with CONUS TOE assignments.

Our simulation ignores training, unit, and certain classes of operational moves. Together, the omitted moves constitute about 10 percent of the actual totals.

ASSUMPTIONS

The research in this report is based on the following fundamental assumptions:

- The Army leadership desires to enhance assignment stability and reduce the deleterious effects of turbulence in ways consistent with its other imperatives.
- The Army will enter a postdrawdown phase in which its end strength will remain fairly constant at under 500,000 Active Component (AC) soldiers.

- For the near-to-mid term, the Army will continue to station a substantial fraction of its force overseas and will maintain for the foreseeable future the post–Base Realignment and Closure (BRAC) basing structure it now has planned.
- The Army's fundamental manpower policies pertaining to acquiring, training, and separating soldiers will remain intact.

In subsequent chapters we shall use the model to test how sensitive our findings are to changes in certain of these assumptions.

ORGANIZATION OF THIS DOCUMENT

Chapter Two examines the extent of the Army's recent (since 1987) and projected (through 2003) PCS-move experience in terms of number of moves by type and in terms of costs; it then explores the relationship between the extent of that turbulence and the policies and external conditions that drive it. Based on this understanding of what drives PCS moves, in Chapter Three we use the model described above to estimate the effects of policy changes on turbulence. Chapter Four offers conclusions.

Chapter Two

PERMANENT CHANGE OF STATION MOVES: TRENDS AND PROJECTIONS

The Army's PCS moves transfer personnel and their families, vehicles, personal effects, and household goods to a permanent duty station. But nothing is permanent about a permanent change of station move. At best a new assignment means two to four years of stability at a new duty station, then a subsequent "permanent" move. Soldiers may, on occasion, return to a particular installation for a second or even third tour, but they cannot count on a return when ordered to a new station. A PCS move generally carries with it no expectation of subsequent return to the old installation.

Soldiers expect periodic PCS moves as a condition of their service. This expectation is a defining characteristic of an Army career. There is little empirical basis for assessing the extent to which a change in the frequency of PCS moves affects either retention or morale.

This chapter describes the phenomenon of PCS moves, with the intent of examining the trends in the Army's experience with PCS moves since fiscal year 1987 and the projections for PCS moves through fiscal year 2003. Specifically, the section discusses

- The types or classes of PCS moves;
- The aggregate trends and projections for PCS moves;
- The trends and projections for each class of PCS move.

CLASSES OF PCS MOVES

As mentioned in Chapter One, the Army conducts PCS moves for several reasons: to bring soldiers to their first duty station when they

enter active duty, to return them to their homes of record when they leave active duty, to replace soldiers returning from fixed-length tours outside the CONUS, to send them to schools for longer than 20 weeks, to develop them professionally when needed experience cannot be gained at their current duty stations, to accommodate force and base realignments, to fill requirements that cannot be met with locally assigned personnel, to alleviate imbalances across installations, and to meet soldiers' personal needs for compassionate reasons.

In its financial accounting documents, the Army as well as the other services divide PCS moves into six classes: (1) accession moves; (2) separation moves; (3) rotational moves; (4) training moves; (5) operational moves; and (6) unit moves. Because in a force of a constant size separations drive accessions, we lump accession and separation moves into a single class. Figure 2.1 shows the fiscal year 1997 percentage breakdown of the five classes of moves. Each is discussed in more detail below.

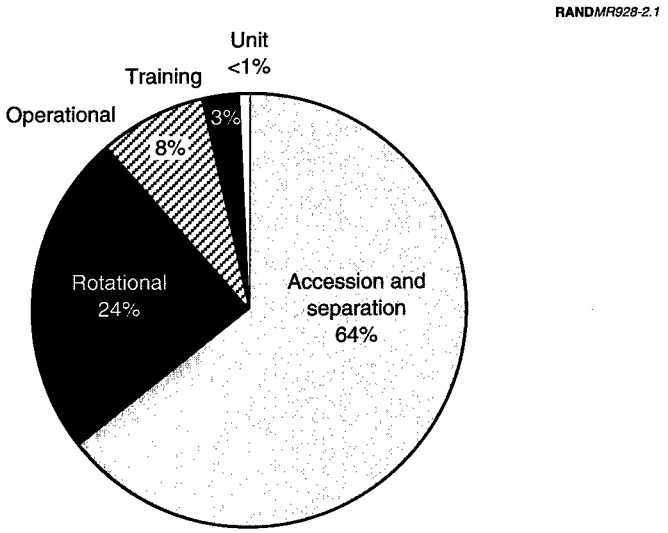


Figure 2.1—Percentage Breakout of Classes of PCS Moves, FY97

Accession and Separation Moves

These two types of moves—whose magnitude in a force of a given size is determined by losses from the force—today constitute 64 percent of PCS moves. Accession moves bring soldiers to their first duty stations; separation moves return soldiers to civilian life when they leave active duty. The number of losses from the force determines the number of separation moves, which, to maintain a constant force size, requires an equal number of accession moves. In a shrinking force, the number of accession moves is smaller than the number of separation moves. In a growing force, the converse is true. In all cases, the greater the average length of service, the fewer the losses and therefore the fewer the required accessions to maintain a constant force size. This leads directly to fewer accession and separation moves.

Rotational Moves

Rotational moves—moves of soldiers to and from outside continental United States (OCONUS) assignments—constitute a quarter of the Army's PCS moves. Two factors—the size of the force overseas and the length of overseas tours—drive the number of rotational moves.[1] Hence, the overall decline in overseas strengths would lead one to expect a decline in the absolute number of rotational moves. But the Army has reduced its troop strengths most significantly in Europe, where tours last three years, and to a lesser extent in other areas such as Korea, where tours last a year, causing the aggregate number of number of rotational moves to decline to a lesser extent than the total OCONUS end strength.

[1]The Army budgets and programs the initial moves of soldiers whose first duty assignment is overseas as accession rather than rotational moves. Historically, about one-third of accession moves have been to assignments overseas. Such moves are counted as accession moves since they move a soldier to his or her first duty assignment, but because the Army decides to have part of its force structure overseas, these initial moves could also properly be classed as rotational. Similarly, the final moves of soldiers whose last duty station is overseas are counted as separation rather than rotational moves. At any rate, the budgeted and programmed number of rotational moves understates the total number of moves to and from overseas theaters.

Training Moves

Training moves, which constitute only 3 percent of the PCS moves, bring soldiers to training courses of 20 weeks duration or greater and send them to their next duty assignments upon completion of their training. Soldiers attend courses shorter than 20 weeks on the basis of temporary duty (TDY) rather than PCS. Training moves are driven by the Army's skill and leader development requirements. They are largely devoted to moving the officer rather than the enlisted force. About 70 percent of the training moves and three-fourths of their costs are attributable to officer moves. This is due largely to the policy of sending all captains to their advanced courses and majors to command and staff colleges on a PCS rather than TDY basis. The enlisted force conducts most of its professional development training on a TDY basis.

Operational Moves

Operational moves, which constitute 8 percent of PCS moves, transfer soldiers from one duty station to another within a given theater or within the CONUS. Such moves are driven by the need to correct grade or skill imbalances across geographic locations and to move soldiers who complete assignments of fixed duration (such as recruiting, drill sergeant, instructor, or Reserve Component (RC) support).

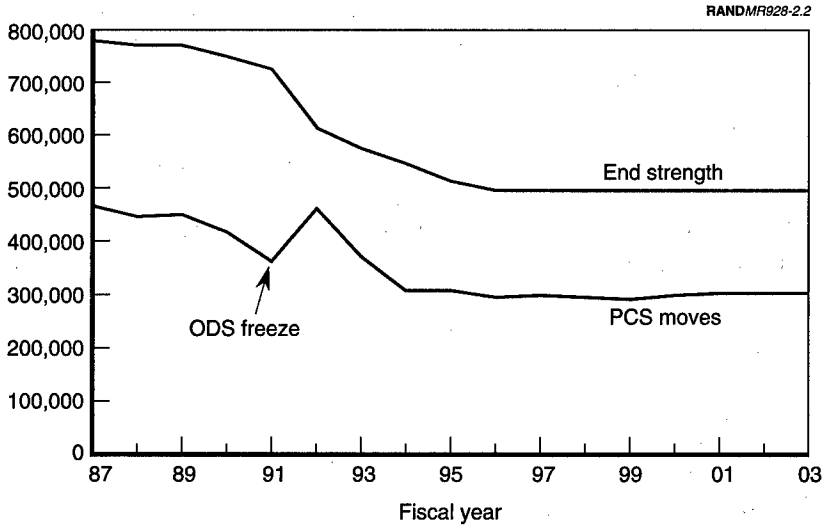
Unit Moves

Unit moves, which constitute less than 1 percent of PCS moves, occur when soldiers move as a part of the relocation of an entire unit. Most recently, such moves have been attendant principally to base realignments and closures.

Below we examine aggregate trends for all classes of PCS moves; then we examine the trends for the specific classes discussed above.

AGGREGATE TRENDS FOR PCS MOVES[2]

Since the end of the Cold War, the Army has reduced its active-duty force from almost 800,000 personnel to an anticipated steady state of just under 500,000 in fiscal year 1996.[3] As Figure 2.2 shows, the anticipated number of PCS moves has declined as well and roughly in proportion to the end-strength reductions. Specifically, the fiscal year 1997 end strength is expected to decline by 36.8 percent relative to fiscal year 1987, while the number of PCS moves will drop by 36.0



SOURCES: FY87–96 data from U.S. Department of the Army, *Budget Estimates, Military Personnel, Army,* "actual" columns; FY97–98 data from FY98/99 *Budget Estimates,* "estimate" columns; FY00–03 data from U.S. Department of the Army, *Program Objectives Memorandum,* FY98–03, Format F-7.

Figure 2.2—Active Army End Strengths and PCS Moves, FY87–03

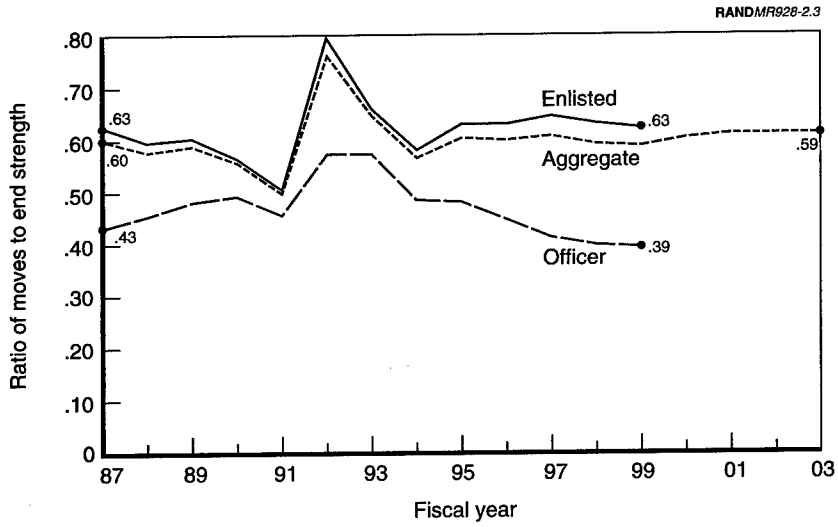
[2]This analysis excludes moves of U.S. Military Academy (USMA) cadets, which cost $486,000 in fiscal year 1994. Cadet moves, which are all accession- and separation-related, are fairly stable in number and cost and are unrelated to the policy issues this report addresses.

[3]Further reductions of about 15,000 in active component end strength are planned by the Defense Department but at the time of this writing have not been acted upon by the Congress.

percent. Some in the Army had anticipated a postdrawdown stabilization that would reflect a significantly larger reduction in moves and an associated increase in stability.

As shown in Figure 2.2, a freeze in personnel assignments and separations accompanied Operation Desert Storm (ODS) in fiscal year 1991, reducing the number of PCS moves that year. In 1992 the freeze was lifted, breaking the logjam and resulting in a spike of moves and a pronounced decline in end strength that year as soldiers who had been involuntarily extended on active duty or frozen in place in fiscal year 1991 either left the service or moved to their new duty stations. By fiscal year 1997, both end strength and the aggregate number of moves have nearly stabilized.

The ratio of PCS moves to end strength shown in Figure 2.3 reveals that the relatively stable force size in fiscal year 1997 and beyond will require about as many moves per end strength as it did during the Cold War. By fiscal year 1997, the enlisted force is expected to experience 0.63 moves per capita, exactly the fiscal year 1987 ratio. The



SOURCES: See Figure 2.2.

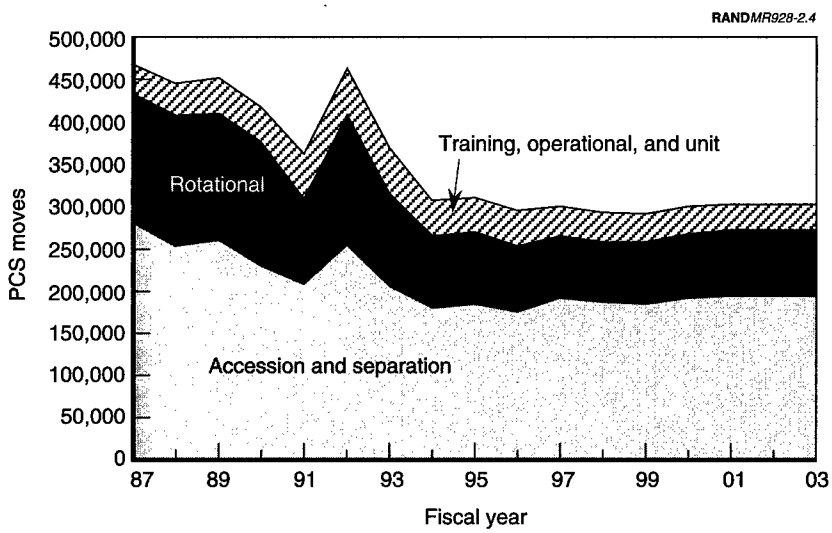
Figure 2.3—Ratio of Moves to End Strength: Officers, Enlisted, and Aggregate, FY87–03

officer force will continue to be less mobile than the enlisted force, reflecting officers' longer lengths of service and, therefore, fewer accession and separation moves per capita. For fiscal year 2000 and beyond, the Army Program Objectives Memorandum (POM) projects only aggregate figures; it does not separate enlisted and officer move projections. The aggregate POM projections are consistent with overall PCS-move rates at about the Cold War rate.

In the aggregate, the trend in PCS-move rates will be almost flat. The next section examines trends in the individual classes of PCS moves and the factors that determine those trends.

TRENDS BY CLASS OF MOVE

Figure 2.4 disaggregates the trend line from Figure 2.2 into the five classes of PCS moves. As the figure shows, accession and separation moves account for more than half the total. Such has been and will continue to be the case throughout the program period. As troop strengths overseas have declined, so have the number of rotational



SOURCES: See Figure 2.2.

Figure 2.4—Trends in Classes of PCS Moves, FY87–03

moves. Training, operational, and unit moves will continue to represent a small fraction of the total and will decline in absolute number until they stabilize in FY00.

Accession and Separation Moves

As Figure 2.4 reflects, the post–Cold War reduction in Army end strength substantially reduced the number of loss-driven moves. But as Table 2.1 shows, by fiscal year 1997, when the force stabilizes in size, the officer force requires slightly fewer loss-related moves and enlisted force slightly more relative to end strength than was the case in fiscal year 1987, before the drawdown began.

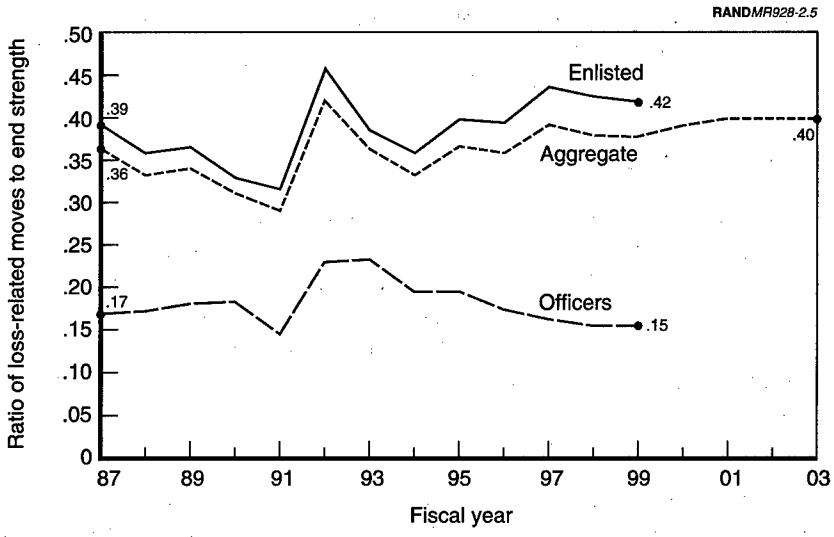
In fiscal year 1987, the 280,800 accession and separation moves shown above equaled about 17 percent and 39 percent of the active-duty officer and enlisted end strengths, respectively, or 36 percent for the force as a whole.[4] As Figure 2.5 shows, that percentage rose during the force drawdown of the early 1990s, indicating shorter average

Table 2.1

Changes in End Strengths and Loss-Related Moves (End strengths and moves in thousands)

	FY87	FY97	% Change
Officer			
End strength	108.0	80.3	–25.6
Loss-related moves	8.1	13.0	–28.2
Ratio of moves to end strength	.17	.16	
Enlisted			
End strength	668.0	410.7	–38.5
Loss-related moves	262.7	179.0	–31.9
Ratio of moves to end strength	.39	.44	
Aggregate			
End strength	776.0	491.0	–36.7
Loss-related moves	280.8	192.0	–31.6
Ratio of moves to end strength	.36	.39	

[4]Note that end strengths exclude cadets.



SOURCES: See Figure 2.2.

Figure 2.5—Ratio of Accession and Separation Moves to End Strength

durations of service as soldiers were either involuntarily separated or offered financial incentives to leave. In fiscal year 1994, the figure dropped to 33 percent and returned to about 40 percent by fiscal year 1996. This indicates a steady-state future only slightly more turbulent in terms of average length of service than the Cold War era, attributable entirely to marginally shorter expected tenures of the enlisted force.

Note the differences between the officer and enlisted rates.[5] Because officers serve from 2 to 2.5 times as long as enlisted personnel, the required replenishment percentage and corresponding proportion of accession and separation moves are substantially lower for officers. The trends of the two groups differ as well. While the enlisted percentages continue to climb through fiscal year 1997, indicating shorter average terms of service, the officer percentages decline slightly, indicating slightly longer terms of service.

[5]Note also in Table 2.1 that the officer force end strength drops by only 26 percent, while the enlisted force is reduced by 39 percent.

In sum, then, by fiscal year 1997, the aggregate number of loss-related moves will decline relative to fiscal year 1987 by less than the relative decline in end strength.

Rotational Moves

The principal determinants of rotational moves are the size of the force stationed OCONUS and the length of such tours of duty. Generally, in overseas locations such as Germany where soldiers may take their families—so-called accompanied tours—soldiers serve for three years. The relatively small number of soldiers who choose not to take their families to locations where dependents are allowed normally serve for two years. Tours in places where dependents are generally not permitted, such as South Korea, last one year.[6]

Table 2.2 shows that in fiscal year 1987, the Army had about 290,000 soldiers stationed OCONUS; by fiscal year 1997, that number drops to about 123,000, a decline of 58 percent. Most of the reduction results from cuts in the long-tour (principally European) structure, where the troop strength falls by 64 percent; the number of soldiers stationed in short-tour areas (principally Korea) drops by only 21 percent.

Every soldier serving in a short-tour area needs to be replaced every year, while only one-third of those serving in long-tour areas depart each year and therefore require replacement.[7] Hence, the large reduction in long-tour authorizations between fiscal year 1987 and fiscal year 1997 carries with it less than a proportional share of reductions in rotational moves.

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[6]Some accompanied tours are shorter than three years, while some unaccompanied tours are longer than one year. The numbers, however, are small. Accordingly, for the analysis at hand we make the simplifying assumption that all accompanied tours are three years and that all unaccompanied tours are one year.

[7]Assuming, of course, that all soldiers serve full tours and that no soldiers extend their tours. For the purposes of this policy-screening analysis we assume such to be the case.

Table 2.2

Changes in OCONUS Strengths and Rotational Moves (All figures in thousands)

	FY87	FY97	% Change
Long-tour structure	247.7	89.4	–64
Short-tour structure	42.2	33.4	–21
Total OCONUS structure	289.9	122.8	–58
Rotational Moves	151.7	73.0	–52

SOURCE: Structure figures—Personnel Management Authorizations Document (PMAD); move figures—budget estimates.

Other Moves: Operational, Training, and Unit

As shown in Figure 2.6, which breaks out the top band of Figure 2.4 into the three classes, each class of move is declining in number from its drawdown peak. Collectively, the three classes are expected to begin to stabilize in fiscal year 1997, reaching a steady state of about 30,000 moves in fiscal year 2000, about 90 percent of the Cold War level. Unit moves decline as drawdown restationing subsides. Training moves decline as the smaller Army requires proportionately less training. Operational moves rise slightly, for a somewhat complex reason. During the Cold War, large overseas strengths provided a large demand for replacements. This demand allowed personnel managers to move soldiers from CONUS assignments of fixed tour lengths (such as recruiting, RC, drill sergeant, or instructor duty) to overseas assignments under rotational moves. Now, as overseas demand has declined, managers must use operational moves rather than rotational moves to reassign many of these soldiers.

Training moves. As mentioned above, training moves take soldiers to and from training courses of 20 weeks or greater.[8] As shown in Table 2.3, the Army sends many more officers than enlisted personnel to these long courses. Specifically, officers require more than two-thirds of all training moves. An officer is more than ten times as

[8]Soldiers are sent to shorter courses of instruction on TDY rather than as a PCS.

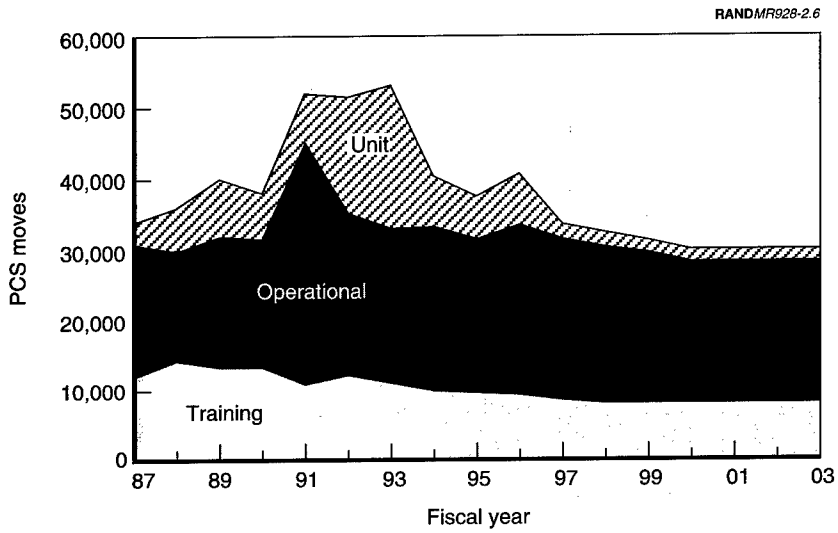

Figure 2.6—Training, Operational, and Unit Moves, FY87–03

likely as an enlisted soldier to move under a training move. A substantial fraction of these officer moves is required to send captains to their advanced courses and to send majors to command and staff colleges. The enlisted force, by contrast, does most of its noncommissioned officer education system (NCOES) training through TDY assignments rather than through PCS moves. While the POM does not show the officer and enlisted split of training moves for fiscal year 2000 and beyond, it projects an aggregate figure of 8,200 from fiscal year 2000–03, a number close to the fiscal year 1997 total (of 6,015 plus 2,700) shown in Table 2.3.

Two points can be made about training-move policy changes. First, training moves represent less than 3 percent of all PCS moves. Hence, reducing them will not save a lot of money. Second, because most of the training moves are associated with officer advanced and command and staff college courses, the greatest policy leverage over this class of moves would come from a policy change of conducting most of this training in a distributed mode and then sending officers to shorter phases of these two programs on TDY rather than in a PCS status. But if the Army chose to pursue this policy, increased TDY

Table 2.3

Training Moves, Percentages, and Rates for Selected Years

	FY87	FY89	FY91	FY93	FY95	FY97
Officer training moves	7,755	9,114	7,544	8,099	7,150	6,015
Enlisted training moves	4,372	4,315	3,501	3,000	2,800	2,700
Officer training moves as % of total	63.9	67.9	68.3	73.0	71.9	69.0
Enlisted training moves as % of total	36.1	32.1	31.7	27.0	28.1	31.0
Officer end strength (000)	108.0	106.9	106.3	87.8	82.3	80.3
Enlisted end strength (000)	668.4	658.3	614.8	480.4	423.7	410.7
Training moves per 1,000 officers	72	85	71	92	87	75
Training moves per 1,000 enlisted personnel	7	7	6	6	7	7

costs would offset PCS-move savings. Further, the readiness of units whose officers are absent on TDY would suffer.

Operational moves. As is the case with training moves, officers experience a disproportionate number of operational moves, but not to the same degree. Table 2.4 shows that in fiscal year 1997, officers will experience almost twice the per-capita operational move rate, 75 per 1,000, as will the enlisted force (41 per 1,000). Many officers move for professional development reasons, others move when their fixed tours, described above, end. The enlisted force has proportionately fewer such demands for moves.

Unit moves. As Figure 2.6 showed, the Army predicts that as the drawdown and base realignments subside, unit moves will cease to be a significant source of turbulence.

SUMMARY

The aggregate trends and projections for PCS moves, as well as the trends and projections within the individual classes of PCS moves, reveal that the absolute number of PCS moves has declined and is

Table 2.4

Operational Moves, Percentages, and Rates for Selected Years

	FY87	FY89	FY91	FY93	FY95	FY97
Officer operational moves	5,447	4,862	7,252	6,378	4,982	6,027
Enlisted operational moves	13,284	13,804	26,865	15,474	17,000	17,000
Officer operational moves as % of total	29.1	26.0	21.3	29.2	22.6	26.2
Enlisted operational moves as % of total	70.9	74.0	78.7	70.8	77.4	73.8
Operational moves per 1,000 officers	50	45	68	73	61	75
Operational moves per 1,000 enlisted personnel	20	21	44	32	40	41

about to stabilize as the Army reaches postdrawdown stability. But the aggregate per-capita PCS-move rates will remain at about the Cold War level. In particular, accession and separation moves relative to force size will, in the out-years, remain roughly comparable to Cold War levels. To reduce the numbers, the Army would have to increase the duration of soldiers' service. Although rotational moves, which are driven by overseas strengths and tour lengths, will decline in absolute terms, they will increase relative to overseas strengths, which is the result of disproportionate cuts in long-tour authorizations. Only reductions in authorizations or increases in tour length can reduce the numbers further. Training, operational, and unit moves, which together constitute less than 10 percent of moves, are driven by a number of factors. The most important single factor, however, is officer professional development requirements, principally the requirement to send officers via training moves to and from their advanced courses and command and staff college. Officer professional development needs also drive some operational moves. Given officer end strengths, the greatest policy leverage to reduce training, operational, or unit moves would come from changing policies that now cause officers to attend these courses on a PCS rather than TDY basis. Operational moves represent a more complicated situation; a number of demands generate such moves, both in the officer and the enlisted force. No single policy appears to domi-

nate. While operational moves represent a small fraction of the total, it may be worthwhile to investigate further the set of policies that drive such moves.

To assess differences between the officer and enlisted forces, Table 2.5 summarizes PCS-move rates for fiscal year 1997, in which much of the drawdown turbulence has subsided. Force losses (accession and separation) continue to create the most PCS-move turbulence for both officers and enlisted personnel. The second most important source of turbulence, however, differs for the two forces. For the enlisted force, rotational moves to and from overseas assignments generate the most moves per capita. For the officer force, other moves—principally training and operational—outrank rotational moves as the second most prevalent source per capita.

Table 2.5

PCS Moves per 1,000 End Strength, FY97

	Officer	Enlisted
Accession and separation	162	436
Rotational	97	158
Other (training, operational, unit)	150	52
Total	409	646

Chapter Three

HOW THE ARMY CAN REDUCE PCS-MOVE TURBULENCE

This chapter assesses the policy actions available to the Army to reduce the extent of PCS-move turbulence and the impact of those actions. It discusses the policy actions available, postulates measures of merit one might want those actions to influence, and estimates the effects of the policy actions in a postdrawdown steady state. Because most PCS moves pertain to the enlisted force, the chapter deals principally with enlisted moves. Nevertheless, a cost analysis of policy options, later in the chapter, does include the changes in PCS-move costs for both the officer and the enlisted forces.

POLICY ACTIONS TO REDUCE PCS-MOVE TURBULENCE

As illustrated in Chapter Two, several factors drive the various classes of PCS moves. Those factors, in turn, suggest policy actions that can be used to affect the rate of PCS moves and thus their cost. Table 3.1 summarizes the drivers discussed earlier and suggests the appropriate policy actions to deal with them, along with whether the actions are within the Army's control.

As discussed earlier, in a force of constant size, accession and separation moves are driven by losses from the force. The only policy tool available to reduce the number of accession and separation moves is to increase the average length of service to reduce losses. This policy is within the Army's control, but the savings are modest and carry substantial offsetting costs, as we shall discuss later.[1]

[1]The Army now enlists most soldiers for either three or four years. Some are attracted to two-year enlistments, and a small fraction enlist for more than four years. RAND colleague Bill Taylor suggests that options aimed at increasing the average length of

Table 3.1

Drivers and Policy Actions by PCS-Move Class

PCS-Move Class	Driver	Policy Action	Army Control?
Accession and separation	Size of force Duration of service	Increase duration of soldiers' service	Yes
Rotational	Overseas force strengths	Reduce overseas authorizations	No
	Overseas tour lengths	Increase overseas tour lengths	Partial
Training	Officer development requirements	Change training policy for officers: TDY rather than PCS	Yes
Operational	Professional development, TDA tour lengths, reenlistment options, strength imbalances	Revision of associated policy drivers	Yes
Unit	Base realignment	None needed at this time	Yes

Two factors determine the number of rotational moves: the number of soldiers stationed overseas and the length of tour. The number of rotational moves may be reduced either by reducing overseas authorizations or by increasing the length of overseas tours. While the Army may influence the number of soldiers stationed overseas, the policy is largely outside the Army's control. Overseas strengths are generally decided at higher levels, driven by broad national security and international political considerations. And even though overseas tour lengths too are largely set by the Department of Defense, the Army can influence the policy. Further, the Army can manipulate policies on extensions and curtailment of overseas tours, which can change actual rather than stated tour lengths.[2]

initial enlistments may have a payoff in reduced training costs as well as increased reenlistment rates. Enticing prospective recruits to accept longer terms of service would incur costs. Such analysis lies beyond the scope of this research.

[2]As stated earlier, in this analysis we assume that actual tour lengths equal those set by policy. In practice, some soldiers extend their tours, others return early. The simplifying assumption that these two factors offset one another serves the policy-screening purposes of this analysis.

Operational moves, driven in large part by the need to move soldiers out of and into professionally enhancing assignments as well as assignments of fixed duration, require significant and potentially difficult policy changes to influence.

Unit moves, for now at least, are a thing of the past and require no management attention.

Other policies within the Army's control, such as reducing transit time between moves or increasing tour lengths of certain CONUS assignments, are available but have minimal effect on aggregate turbulence.

Because most PCS moves and their costs pertain to the enlisted force rather than the officer force, this chapter's focus is on the most costly classes of enlisted moves—accession and separation and rotational moves—and on the policy actions appropriate to them. As mentioned earlier, training moves primarily affect officers rather than enlisted personnel and are not examined here. We omit all operational moves except those necessitated by CONUS assignments that carry with them fixed tour lengths.[3] Unit moves, small in number, do not merit policy attention.

MEASURES OF MERIT

This analysis relies on three measures of merit to determine the benefit of changing policies that affect the number of PCS moves: (1) CONUS stability index; (2) number of PCS moves; and (3) government cost of PCS moves. Each is discussed below in more detail.

CONUS Stability Index

Part of the CONUS force—recruiters, drill sergeants, those on RC duty, and others—serves in assignments of fixed duration. The CONUS stability index applies to the remainder of the CONUS force, whose tour lengths depend upon their own losses from the Army and the requirement to replace soldiers leaving tours of fixed duration

[3]The model does not capture operational moves made for reasons of professional development or skill imbalances.

both overseas and in CONUS. This stability index is computed as soldier strength (in the part of the CONUS force in question) per PCS departure per year.[4] This measure is mathematically equivalent to soldier-years per PCS departure, or tour length.

Because the measure aggregates first-termers and careerists, whose assignment durations are likely to differ, we prefer the more general term "CONUS stability index" to tour length. The measure serves as an aggregate index of CONUS stability rather than a prediction of tour lengths for specific sets of soldiers. As such, the measure serves well to estimate the extent to which policy changes enhance or diminish the stability of the CONUS force.

Number of PCS Moves

This metric is designed to show how the proposed policy changes affect the number of PCS moves in a given time period (in this case, one year), whether the policy increases or decreases them. This metric is inversely related to CONUS stability. The number of moves is important in that it is a principal determinant of the other two measures: the stability index and the aggregate cost of moves.[5] Hence, the number of moves may be thought of as more an intermediate than a final measure. Nevertheless, we present it as one of the three because of its centrality.

Government Cost of PCS Moves

In the aggregate, the Army has recently spent and plans to continue to spend more than a billion dollars a year on PCS moves. As Figure 3.1 shows, the cost of PCS moves continues to grow with predicted inflation as the number of moves remains constant.

Figure 3.2 shows for FY97 the distribution of number of moves by class and the fraction of total costs each of the six classes of PCS move represents. Rotational moves, which account for only 24 percent of all moves, generate more than half (52 percent of) the costs.

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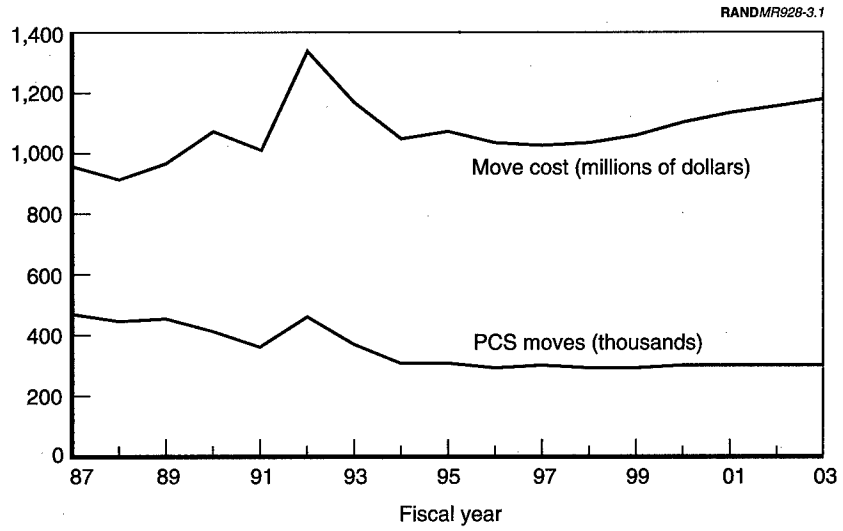
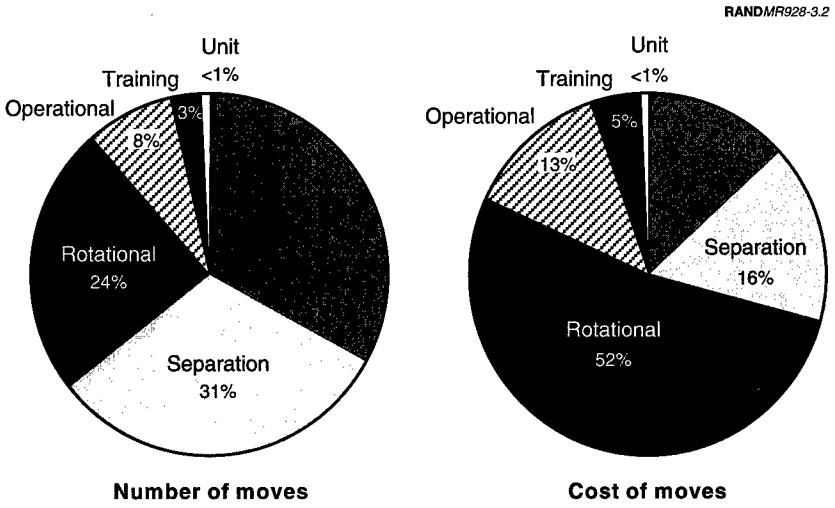
[4]Mathematically, the stability index is the reciprocal of the fraction of authorizations that must be filled each year.

[5]A changing force size would also affect the stability index.



SOURCES: See Figure 2.2.

Figure 3.1—Trends in Number and Cost of PCS Moves, FY87–03



SOURCE: U.S. Department of the Army, *FY 1998/1999 Biennial Budget Estimates, Military Personnel, Army*, Submitted to Congress, February 1997, pp. 126–147.

Figure 3.2—Number and Costs of Moves by Type, FY97

Accession and separation moves, which together constitute 64 percent of PCS moves, are proportionally much less expensive, representing only 13 and 16 percent of the costs, respectively. Training, operational, and unit moves account for less than 12 percent of the moves but more than 18 percent of the total costs. Hence, this section concentrates principally on those moves that make up the greatest aggregate costs: accession, separation, and rotational.

Table 3.2 shows the highly differing unit costs that create the disparities between the number and cost of moves of each class. It compares for fiscal year 1997 the rates per move for each type move for both the officer and enlisted forces. Types are listed in descending order of cost for the enlisted force.

Within type of move, a rotational move costs the most by far, while an accession move costs the least. A rotational move entails the movement of a soldier and his or her family and household goods to overseas locations, an expensive proposition. An officer move of any category costs substantially more than a comparable enlisted move because the officer force tends to have larger numbers of married personnel and because officer entitlements exceed those of enlisted personnel. An officer accession move costs more than three times as much as a comparable enlisted move. Officer moves of other classes cost roughly twice those of comparable enlisted moves.

Clearly, in terms of cost to the government, policies that affect a given number of rotational or operational moves will have a much

Table 3.2

Costs per Move by Type, Officer, and Enlisted, FY97

	Enlisted	Officer
Rotational	$6,709	$12,846
Operational	4,756	8,409
Training	3,867	6,143
Unit	3,425	6,578
Separation	1,635	3,980
Accession	1,196	3,983

SOURCE: U.S. Department of the Army, *FY 1998/1999 Biennial Budget Estimates, Military Personnel, Army,* Submitted to Congress, February 1997, pp. 126–147. Costs exclude nontemporary storage and temporary lodging expense.

greater dollar impact than those that affect the same number of separation and accession moves.

In terms of total dollars associated with each class of moves, the enlisted force requires slightly more than three-fourths of the more than $1 billion spent on PCS moves each year. And as Table 3.3 shows, most of the enlisted money is tied up in accession and separation ($252 million) and rotational ($437 million) moves. The third largest cost component is officer rotational moves ($101 million).

CAPTURING THE EFFECTS OF POLICY CHANGES

This section describes the spreadsheet-based model used to estimate the effects of policy changes. We concentrate here on the enlisted force because it requires more than three-fourths of the total PCS-move cost. The model is based on a highly stylized model of the enlisted force, discussed below. At the end of this section we do include the results of a variant of the model tailored to the officer force. For brevity we have omitted the details of the officer analysis.

A Highly Stylized Model of the Enlisted Force

For this analysis, which deals with steady-state conditions rather than transitional turbulence, we think of the enlisted force in a highly stylized way, as shown in Figure 3.3.

Table 3.3

Aggregate PCS Move Costs by Type for Officer and Enlisted Forces, FY97 ($M)

	Millions of Dollars		
	Officer	Enlisted	Total
Accession and separation	52	252	304
Rotational	101	437	537
Training	37	10	47
Operational	51	81	132
Unit	1	6	7
Total	241	787	1,028

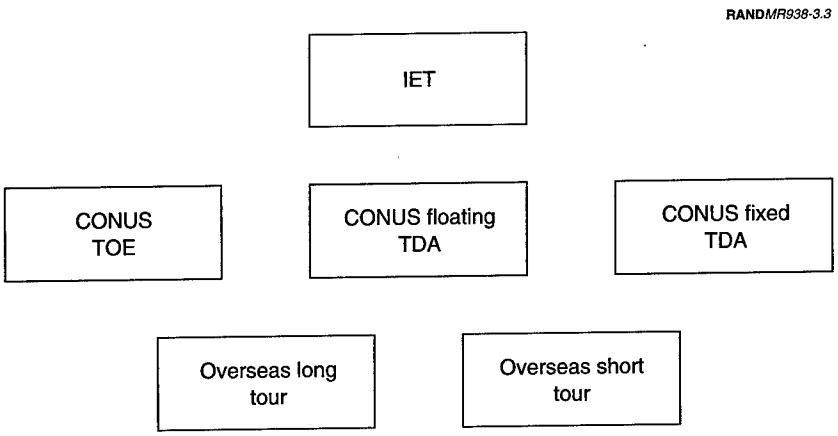


Figure 3.3—Stylized Representation of the Army

In this representation, soldiers are assigned to one of the six classes of assignments, or venues, shown in Figure 3.3. After initial entry training (IET), where they spend a specified period of time, soldiers move on to one of the following five remaining classes of assignment:

- **CONUS TOE:** The set of authorizations in CONUS classed as TOE organizations. CONUS TOE tour lengths are not set by policy but are derived from the need to replace soldiers leaving fixed-tour venues (the two overseas venues and TDA assignments in CONUS that carry fixed-length assignments) for other assignments and to replace soldiers leaving the force from all venues.
- **CONUS floating TDA:** The set of authorizations classed as TDA organizations but for which there are no fixed tour lengths. As in CONUS TOE units, tour lengths in CONUS floating TDA organizations are derived from losses from other venues where tour lengths are fixed. Because the Army may wish to limit the time soldiers spend in TDA units, we examine the effects of constraining tour lengths in TDA units rather than allowing them to float.
- **CONUS fixed TDA:** The set of authorizations classed as TDA organizations but for which there are fixed tour lengths. These authorizations include recruiters, drill sergeants, instructors, and those assigned to fixed-tour RC duties.

- **Overseas long tour:** The set of authorizations in which soldiers are authorized to serve with their dependents, usually for three years.
- **Overseas short tour:** The set of authorizations in which soldiers serve without their families. These are mostly one-year tours.

Three of the five post-IET venues—both the overseas venues and CONUS fixed TDA—carry prescribed tour lengths that generate soldier moves out of these organizations and a corresponding replacement move. Soldiers also leave the Army from each venue, requiring further moves. Tour lengths in the CONUS TOE and floating TDA venues vary with the flow requirements generated by flows out of the three fixed-tour venues as well as separations from the Army.

The analysis that follows shows how changes in the policies and conditions described earlier (in Table 3.1) affect the flows among the venues. This analysis assumes no unit or training moves and no operational moves for reasons of professional development or skill imbalances. Hence, the analysis understates the actual number of moves that the enlisted force would experience under the assumed policies, but the understatement is small, owing to the relatively small numbers of such unaccounted-for moves in the enlisted force. Appendix B offers a detailed documentation of the model.

Estimating Enlisted Moves Under Current Policies

For the analysis reported in this section, the base-case data and assumptions reflected in Table 3.4 have been imposed. Additionally, we have assumed that the transit time needed to complete a PCS move is 20 days, a value that we vary later. For each soldier who undergoes a PCS move, the man-year equivalent of 20 days is removed from CONUS TOE end strength, in effect causing CONUS TOE to take all the operating strength deviation (the extent to which the given end strength is unable to fill the set force structure).[6]

[6]A soldier in transit between duty stations remains on the books of the losing unit until picked up by the gaining unit. Hence, the transit time we compute here reflects a loss of soldiers present for duty rather than a decrement in the unit's assigned strength. We have chosen to account for this transit time explicitly to reflect the readiness loss associated with transit time. As shown below, the effect of varying transit time is negligible.

Table 3.4

Base Case Enlisted Input Parameters

Venue	Average Strength	Tour Length (years)	Can Flow To
IET	30,053	0.37	All other venues
CONUS TOE	×	×	CONUS fixed TDA CONUS floating TDA OCONUS long tour OCONUS short tour
CONUS fixed TDA (e.g., drill sergeants)	15,000 (est.)	2.67 (2/3 @ 3 yrs; 1/3 @ 2 yrs)	CONUS TOE OCONUS long tour OCONUS short tour
CONUS floating TDA	60,953	×	CONUS TOE OCONUS long tour OCONUS short tour
Overseas accompanied tour	77,336	3.00	CONUS TOE CONUS fixed TDA CONUS floating TDA
Overseas unaccompanied tour	28,693	1.00	CONUS TOE CONUS fixed TDA CONUS floating TDA
Total force	410,700	—	—

NOTE: Cells containing an "×" indicate values determined within the model. Authorized strengths listed come from the fiscal year 1997 PMAD. Enlisted end strength number of 410,700 comes from the President's Fiscal Year 1997 Budget, based on a total force size of 495,000. IET strength and tour lengths are derived from ELIM model results for fiscal year 1998–2000.

The base set of assumptions in Table 3.4 reflects postdrawdown end strengths, tour lengths, and accession behavior. The fiscal year 1997 Personnel Management Authorizations Document (PMAD) was used for end-strength figures because it reasonably reflects the post-drawdown enlisted force.[7] The accession requirement (91,370),

[7]Since this analysis was conducted, the Department of Defense has decided to reduce Army programmed end strength from 495,000 to 480,000. The next POM should reflect this reduction, which will have some effect on the results reported here. The extent cannot be clear until the Army decides how and where the reductions might be taken. For example, it makes a difference whether the reductions come from overseas or CONUS and from TOE or TDA units.

average number of soldiers in IET (30,053), and tour-length figures are derived from fiscal years 1998–2000 ELIM model results.[8] Those are postdrawdown years where accessions into the enlisted force are expected to reflect fairly stable postdrawdown accession behavior. The Army's planned fiscal year 1997 accession figures are inappropriate for the steady-state representation here, because they are substantially higher than what the steady-state force will require. Instead, we used as an estimate of the steady-state accession requirement a figure of 91,370, computed as the average of the Army's planned figures for fiscal years 1998–2000.

Losses from the force are assumed to be the same as accessions into the force.[9] Based upon training attrition rates and an average IET training length of 0.37 years, the average strength in IET equals 30,053. Of the total accessions each year, 81,997 flow into the force.[10]

The table also indicates the permitted assignment flows among the various venues. For simplicity, some flows are not permitted. In particular, soldiers may not move between the two CONUS TDA venues; soldiers completing TDA assignments must go either overseas or to a TOE assignment. Nor are flows permitted between the two OCONUS venues. The real-life flows among these venues are so small as to not detract from model results. Further, these constraints are easily relaxed.

Values for Measures of Merit Under Current Policies

As mentioned earlier, three measures of merit were determined to measure the impact of policy actions: (1) CONUS stability index; (2) number of PCS moves; and (3) government cost of moves. The

[8]The specific ELIM V model alternative is E941151P, 20 JAN 1995, provided by Office of the Deputy Chief of Staff for Personnel, Military Strength Programs Division (DAPE-PRS).

[9]We use net accessions (i.e., those that flow into the force after IET attrition) rather than gross accessions of 91,370. The net accession number of 81,997 is derived by applying basic training (BT), advanced individual training (AIT), and one-station unit training (OSUT) attrition rates to gross accessions.

[10]The IET tour length of 0.37 years is derived from averaging the training times of prior-service and non-prior-service accessions, recognizing the proportions of the latter who undergo BT/AIT and OSUT.

base case values for those measures are determined from the base case data in Table 3.4 and are discussed below.

CONUS stability index. When the model was run through the base case parameters shown in Table 3.4, we derived the base case stability index number of 2.57.

Number of PCS moves. In the base case, the number of PCS moves is determined to be 239,700. The number is derived by totaling the various classes of accession, separation, rotational, and operational moves, as shown in Table 3.5.

Government cost of moves. In the base case, the cost of PCS moves is determined to be $712.4 million. The number is computed as the sum of the products of the unit cost and number of moves of each type (see Table 3.6). Here, we use the unit cost figures shown in Table 3.2 for operational and rotational moves; unit cost figures for accession and separation moves are derived from the numbers in Table 3.2 and adjusted to reflect the split between CONUS and OCONUS.[11]

Since most moves are related to losses (accession and separation moves) or to overseas stationing (rotational moves), the policies and external conditions that determine losses and overseas stationing have the greatest power to affect PCS-move turbulence. For loss-related policies, we use an aggregate, surrogate measure: average length of active service. We examine three specific policies related to overseas stationing: tour length, size of the force overseas, and disposition of reduced overseas strengths. In addition to these two principal classes of policies, for completeness we look at others,

[11]The fiscal year 1998/1999 President's Budget estimates for total accession and separation costs per move—$1,196 and $1,635, respectively—do not distinguish between CONUS and OCONUS cost differences. To break these two numbers into their component CONUS and OCONUS parts, we assume that the ratios of CONUS to OCONUS accession and separation costs per move in fiscal year 1997 would be the same as they were in FY95—0.799 for accession moves and 0.547 for separation moves. These ratios were provided by the Office of the Assistant Secretary of the Army (Financial Management).

which together offer less promise for reducing turbulence. Finally, we examine the effects of limiting tours in TDA units to no more than three years.

Table 3.5

Base Case Value for Number of Enlisted PCS Moves, FY97

Type of PCS Move	Number of PCS Moves
CONUS accession	57,900
OCONUS accession	24,100
CONUS separation	58,600
OCONUS separation	23,400
Rotational	61,500
Operational	14,300
Total	239,700

NOTE: Numbers do not add up to the total, due to rounding.

Table 3.6

Base Case Value for Government Cost of Enlisted Moves, FY97

Type of PCS Move	Number of PCS Moves	PCS Move Cost ($/move)	Total Cost of PCS Moves ($ millions)
CONUS accession	57,900	1,114	64.5
OCONUS accession	24,100	1,394	33.6
CONUS separation	58,600	1,323	77.5
OCONUS separation	23,400	2,418	56.5
Rotational	61,500	6,709	412.4
Operational	14,300	4,756	67.9
Total	239,700		712.4

NOTE: Columns may not add to total, due to rounding.

POLICY ANALYSIS: CHANGING THE POLICY DRIVERS OF ENLISTED MOVES

Here we demonstrate and evaluate the outcomes of changing the principal policy drivers of enlisted moves: length of service, overseas tour lengths, overseas strengths, and other policies of lesser importance.

Increasing Enlisted Lengths of Service: An Aggregate Measure of Loss-Related Policies

This analysis varies the average period of service parametrically. The specific policies that would cause such changes are implicit rather than specified. And since various specific policies could have somewhat different effects on aggregate turbulence, the effects shown in this section should be considered approximate. The purpose here is to obtain first-order approximations of the magnitude of the effects of policy changes.

Several specific policies, among them the distribution of lengths of initial enlistment and reenlistment policies, affect the average length of service of the enlisted force. The length of time soldiers serve determines the number who leave the Army each year and, therefore, the number who must be brought in to replace those who leave. The Army now replaces about 20 percent of its enlisted strength with new accessions each year. This implies that each new accession serves about five years.

Within a reasonable range of changes, longer lengths of service will enhance CONUS stability and reduce the number of PCS moves only modestly. For example, Figure 3.4 reveals that a 25 percent increase in average length of service—a very substantial change—would improve the CONUS stability index from the base case value of 2.57 to 2.97 years (a 16 percent improvement) and reduce the total number of moves to 212,400, 27,400 fewer than the base case of 239,700 (about an 11 percent reduction). A more realistic 5 percent increase in average length of service (about three months longer than the current five years) would improve stability by only about a month (3.4 percent) and save about 6,500 moves (2.7 percent).

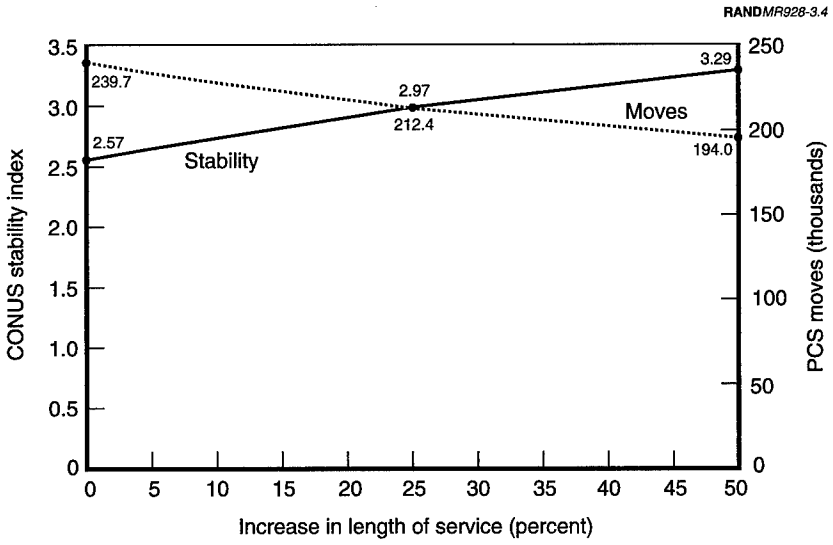


Figure 3.4—Stability and PCS Moves as a Function of Increases in Length of Service of the Enlisted Force

Table 3.7 shows how the changes above translate into dollar-cost savings to the government. While the substantial 25 percent increase in duration of service would add five months to CONUS stability and save about 27,000 moves, it would save virtually no money. Such is the case because longer service reduces the number of accession and separation moves—which, as we saw earlier, are inexpensive relative to, in particular, rotational moves. The more senior force that results from longer service in effect substitutes these more expensive moves for the cheaper ones. When service is lengthened, the same number of soldiers go to and return from overseas, but more of them are already in the force and are more likely to be married than are new accessions. Hence, longer service saves moves and enhances stability, but it does not save much PCS-move money.

Considerations other than PCS-move costs dominate the decision to lengthen durations of service. Longer service would reduce accessions and therefore save the associated costs of initial entry training,

Table 3.7

Stability Improvements and Cost Savings from Longer Enlisted Service

	CONUS Stability (Base = 2.57 years)		Cost of Moves (Base = $712 million)	
Increase in Duration of Service	Index (years)	Increase (months)	Cost ($ millions)	Change ($ millions)
5%	2.66	1	710	–2
10%	2.74	2	709	–3
25%	2.97	5	705	–7

NOTE: Dollar costs and savings are computed using the number of moves derived from the simulation times the FY97 cost of each type of enlisted move from the FY97 column of the Army's FY96/97 biennial budget estimates submitted to Congress in February 1995. Figures exclude nontemporary storage and temporary lodging allowance, about $43 million per year.

savings that per capita far exceed those of PCS moves. Further, we have ignored here the significantly higher pay and benefits a more senior force would require as well as the added cost of incentives necessary to achieve the longer service. Finally, a more senior force would be more likely to retire and therefore raise retirement accrual costs.[12] Such a force would, however, be more experienced and, therefore, perhaps more ready. In sum, PCS-move costs represent only a minor consideration in any decision to lengthen durations of service.

Lengthening Overseas Tours

The longer the overseas tour length, the fewer replacements are required to sustain the overseas force each year. The long-tour length is of interest not just for the potential gains from increasing it, but also because from time to time, proposals arise to convert three-year accompanied tours into one-year unaccompanied tours. Although it seems unlikely that the Army would substantially lengthen unac-

[12]The Army would not, however, pay the full added accrual cost. Service accrual rates are based upon the average likelihood of retirement of all the services, not on service-specific likelihoods. Hence, the cost of an increase in Army likelihood of retirement would be shared by all the services.

companied tours, and to shorten them would not allow soldiers a sufficiently long productive period in theater, we have examined the effects on stability from lengthening so-called short tours.

Long tours. The long, or accompanied, tour consists primarily of those assignments associated with Western Europe, although lesser numbers of authorizations in other locations are also included. Long-tour authorizations are expected to constitute just under 19 percent of the postdrawdown enlisted strength, or just over 77,000 authorizations in fiscal year 1997 (as shown in Table 3.4). We demonstrate the effects on force turbulence, the number of PCS moves, and their costs if the Army were to keep soldiers in long-tour assignments for four years instead of the current three, or if the Army chose, instead, to reduce long-tour lengths to one-year unaccompanied tours.

Figure 3.5 illustrates how varying the long-tour length affects CONUS stability and the total number of PCS moves. Under current policies and a steady-state force equal in size and disposition to that projected for fiscal year 1997, the current three-year overseas tour length

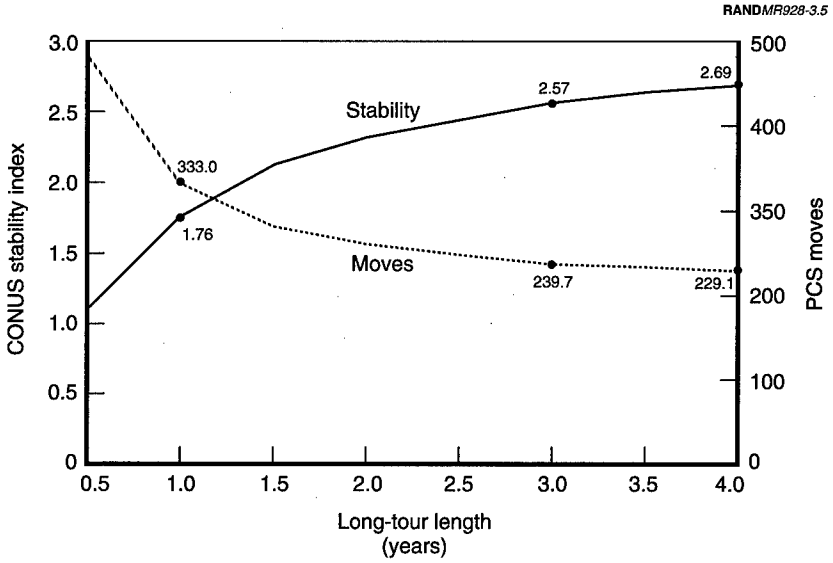


Figure 3.5—Enlisted Stability and PCS Moves as a Function of Long-Tour Length

would allow enlisted soldiers in CONUS units to remain in place on average about 2.57 years. Increasing the long-tour length to four years would lengthen the resulting CONUS stability by less than two months (from 2.57 to 2.69 years). Decreasing it to two years would reduce CONUS stability by three months. Similarly, a six-month change within the two- to four-year range would change the CONUS stability index by half the above amounts. Lengthening long tours beyond the current three years yields only modest savings in moves and enhancements to CONUS stability; the current three-year policy lies on the flat part of the curve. For tours shorter than two years, the effects become distinctly nonlinear.

As Figure 3.5 shows, shortening the long-tour length to one year, a policy change consistent with converting accompanied tours to unaccompanied tours, would dramatically reduce the stability of the CONUS-based force from 2.57 to 1.76 years, a 31 percent reduction, and increase the number of PCS moves by more than 93,000, a 39 percent increase.

As Table 3.8 shows, increasing long-tour length to four years appears to neither reduce turbulence much (stability increases by only one month) nor save many PCS-move dollars (costs fall by $71 million, or about 10 percent). With tour lengths beyond three years, CONUS stability is constrained by retention policies, not tour lengths.

The conversion of three-year tours to one-year short tours would reduce CONUS stability by 10 months, to about 1-3/4 years. The policy

Table 3.8

Enlisted Stability and Cost Changes Resulting from Changes in Long-Tour Length

	CONUS Stability (Base = 2.57 years)		Cost of Moves (Base = $712 million)	
Long-Tour Length	Index (years)	Change (months)	Cost ($ millions)	Change ($ millions)
Four years	2.69	+1	641	–71
One year	1.76	–10	No estimate	No estimate

change presents a more formidable cost-estimation task, and one for which insufficient data are available to make reasonable estimates. In effect, the conversion to one-year unaccompanied tours would substitute unaccompanied for accompanied moves. Existing cost data do not distinguish between the two, instead reflecting only the average cost of a rotational move. Further, the analysis requires an estimate of the proportion of soldiers' families who would remain at the members' CONUS duty station while the member is unaccompanied and the proportion who would move to another CONUS location at government expense.

The conversion from long to short tours would triple the number of PCS moves required to support a given current long-tour population and would therefore increase the turbulence of the force. Such moves, however, would be significantly less expensive than the current accompanied moves because no dependents or household goods would be sent overseas.

Changes in PCS-move costs that would result from conversion to unaccompanied tours would likely be outweighed by the net changes in other categories of costs and savings. In particular, the following additional costs would accrue: basic allowance for quarters and variable housing allowance for soldiers and families restationed in the United States, and impact aid to U.S school districts. These costs would be offset by the following savings: family housing and dependent support facilities overseas, including DoD dependent schools. Policymakers would need to weigh the net of these factors against the concomitant increase in turbulence.

Short tours. Figure 3.6 demonstrates the relationships among short-tour lengths, stability, and the number of PCS moves. A lengthening of short tours from one to three years—in effect converting short tours to long—would save about 32,000 moves annually and enhance the stability index of the CONUS force from 2.57 to 2.97 years, an increase of about five months. But this CONUS stability index fails to capture the tripling in the stability of the 27,000 enlisted soldiers serving in the short-tour areas, a significant stabilization. As was the case in the long-tour analysis above, a lack of data leaves us unable to estimate the PCS-move cost savings associated with this policy change.

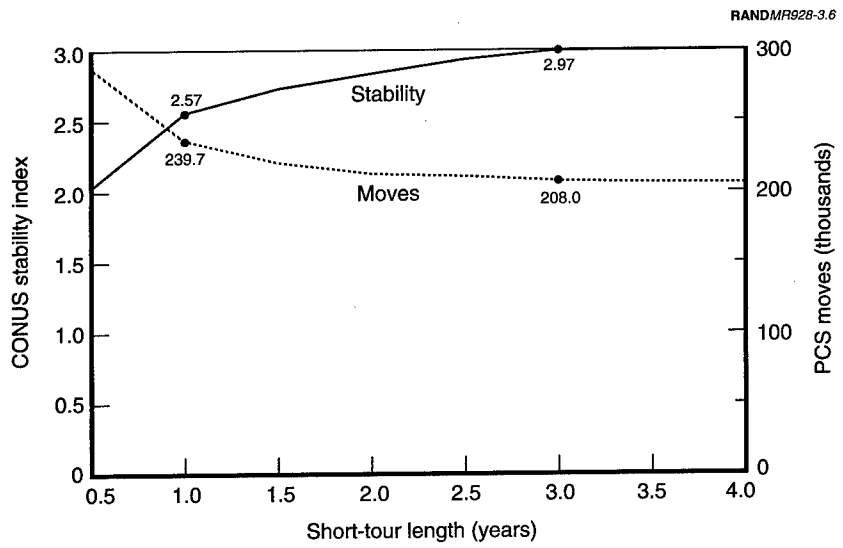


Figure 3.6—Enlisted Stability and PCS Moves as a Function of Short-Tour Length

We show this short- to long-tour option for illustrative purposes only. Not only would the conversion of Korean tours from unaccompanied to accompanied require substantial political negotiations, there would have to be considerations of readiness and issues surrounding the ability to promptly evacuate dependents should a war begin. Further, the construction requirements for family support facilities would overwhelm any PCS-move savings. Suffice it to say that if conditions permitted, the lengthening of short tours to long tours would save about 30,000 moves a year and enhance the stability of the CONUS force as well as the short-tour force.

Returning Overseas Force Structure to CONUS: Bringing Troops Home

Because soldiers serve overseas for tours of fixed lengths, the number of soldiers so deployed determines the number of new soldiers and CONUS-based troops that need to be sent overseas as replacements each year. While this policy lies outside its direct control, the Army

may from time to time have an opportunity to influence, if not control, the outcome of policy debates on the size of the force overseas. Accordingly, the Army needs to understand the extent to which reducing overseas stationing can reduce turbulence and save money.

Since overseas strengths now call for about three times as many long-tour as short-tour authorizations (77,000 versus 29,000, as shown in Table 3.4), and since the tour-length ratios are three to one, reducing equal percentages of either long- or short-tour authorizations has roughly the same effect on CONUS stability and the aggregate number of PCS moves. The costs, however, are different. Moves to overseas accompanied areas cost more than those to unaccompanied areas. Even though dependents of short-tour-bound soldiers may move with their household goods to another CONUS location, such moves cost substantially less than overseas moves (see Table 3.2).

As Figure 3.7 and Table 3.9 show, the effects on CONUS stability and number of moves of returning overseas authorizations to CONUS are fairly linear. The return of half the overseas authorizations would save about 31,000 moves and enhance CONUS stability by about eight months (from 2.57 to 3.27 years). A complete return of all overseas troops would roughly double the extent of the effects. Under a complete return, stability would increase to 3.97 years and the number of moves would fall to 178,400.

As Table 3.9 shows, the net effect of returning all overseas authorizations to CONUS would increase the CONUS stability index by about 17 months and save $444 million a year, more than half the entire enlisted PCS-move budget.

Again, since the effects are fairly linear, bringing home half instead of all the troops would save about half as much money ($226 million versus $444 million) and enhance stability by half as much (8 months versus 17 months).

Overseas stationing, while substantially reduced from Cold War levels, still substantially inhibits stability and costs a significant amount of PCS-move money—over half the PCS-move budget for such rotational moves, as was demonstrated in Figure 3.2.

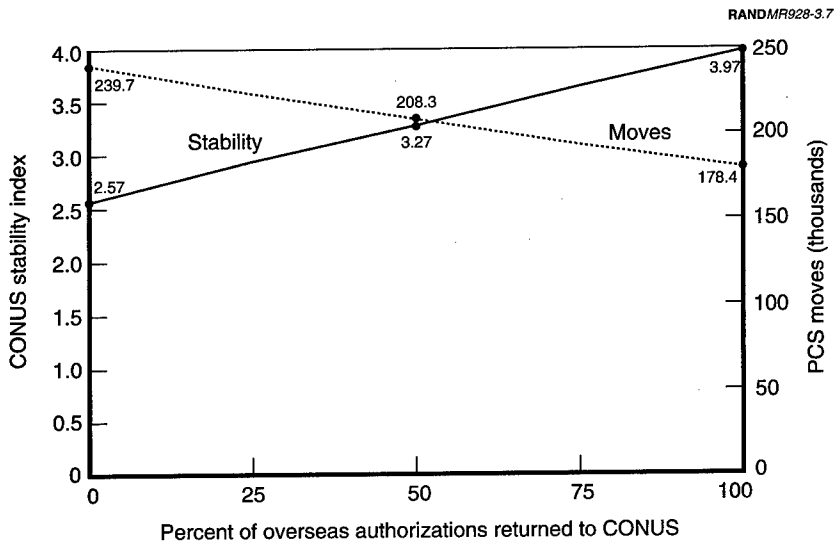


Figure 3.7—Enlisted Stability and PCS Moves as a Function of the Proportion of Overseas Authorizations Returned to CONUS

Table 3.9

Enlisted Stability and Cost Changes Resulting from Returning Overseas Authorizations to CONUS

	CONUS Stability (Base = 2.57 years)		Cost of Moves (Base = $712 million)	
Overseas Authorizations Returned	Index (years)	Change (months)	Cost ($ millions)	Change ($ millions)
50%	3.27	+8	486	–226
100%	3.97	+17	268	–444

Removing Overseas Structure from the Force: Cutting End Strength

If reduced overseas authorizations are taken out of the end strength rather than added to the CONUS force, the effects on stability and

moves are diminished, but savings increase. Table 3.10, which repeats the 100 percent figures from Table 3.9, shows that while shifting all overseas authorizations to the CONUS force would (as shown earlier) enhance CONUS stability by 17 months and reduce move costs by $444 million, eliminating those authorizations enhances CONUS stability by only 14 months (to 3.7 years instead of 3.97 when the authorizations remain in the CONUS force) but reduces move costs by $488 million. The decrease in stability improvement occurs because adding returned spaces to the CONUS structure rather than taking them out of the force provides a larger pool from which to take replacements, thus allowing soldiers in the larger pool to remain in place longer. The greater savings in the costs of PCS moves occurs because there is a smaller force, which requires fewer accession and separation moves to sustain itself.

Clearly, the option of reducing overall end strength is a fundamentally important decision, and one that transcends the less important measures of PCS-move cost and CONUS stability at hand. Nevertheless, the comparison of these measures under both planned and reduced end strengths provides useful insights.

Increasing Length of Service While Lengthening Tours

As was demonstrated earlier, neither longer service nor increased accompanied-tour lengths alone offer much promise for enhanced stability or dollar savings. There appears to be little synergistic effect from changing the two policies in concert. As we saw earlier, in-

Table 3.10

Changes in Enlisted Stability and Move Cost Resulting from 100% CONUS Basing

	CONUS Stability (Base = 2.57 years)		Cost of Moves (Base = $712 million)	
Disposition of Reduced Overseas Strength	Index (years)	Change (months)	Cost ($ millions)	Change ($ millions)
Added to CONUS strength	3.97	+17	287	–444
Removed from force	3.70	+14	224	–488

creasing service duration by 25 percent would add about five months to CONUS stability. Similarly, lengthening long tours to four years would alone add about one month. When implemented together, as Table 3.11 shows, the two policy changes would increase the index by seven months and save about $82 million—roughly the sum of the savings from the two policy changes implemented alone.

Increasing Enlisted Lengths of Service While Bringing Troops Home

Combining increased lengths of service with reduced overseas strengths offers dramatic improvements in stability and reductions in the number and costs of PCS moves. These results are displayed in Figure 3.8 and Table 3.12.

Figure 3.8 shows the effects on stability when various proportions of the current overseas-stationed force are returned to CONUS. Each of the four curves represents a different service-length increase, from no increase to a 50 percent increase. As shown in the bottom curve, in the absence of any increased service length, if all the troops are brought home there is a linear improvement in the stability index, which increases from 2.57 to 3.97 (the results shown above in Figure 3.6).

The top curve in the figure reveals that even with a 50 percent increase in service length, if no troops are returned, the index is limited to 3.29 years. This improvement, while substantial, is still limited by

Table 3.11

Changes in Enlisted Stability and Move Cost Resulting from Service and Tour-Length Increases

	CONUS Stability (Base = 2.57 years)		Cost of Moves (Base = $712 million)	
Policy	Index (years)	Change (months)	Cost ($ millions)	Change ($ millions)
25% increase in service length	2.97	5	705	–7
Long-tour length: four years	2.69	1	641	–71
Both policies changed	3.15	7	630	–82

the high turnover rate of the force as a whole. When, however, length of service increases by 25 percent—the second curve from the top—and half the troops are returned, the stability index increases to 3.97, equal to that when all overseas troops are returned with no increase in length of service. And when length of service increases by 25 percent or more and most of the overseas troops are returned to CONUS, we see stability indexes above five years.

Table 3.12 shows selected stability changes from the above figure and the associated costs; substantial changes in both policies result in sizable cost savings.

The table reveals the large savings that result from reducing overseas strengths. As shown in Table 3.2, a rotational move costs about 50 percent more than an operational move (a move within CONUS or within a theater) and about five times as much as an accession move. Hence, the return of troops from overseas—a reduction in expensive rotational moves—generates substantial cost savings relative to longer service, which reduces the less costly accession and separation moves.

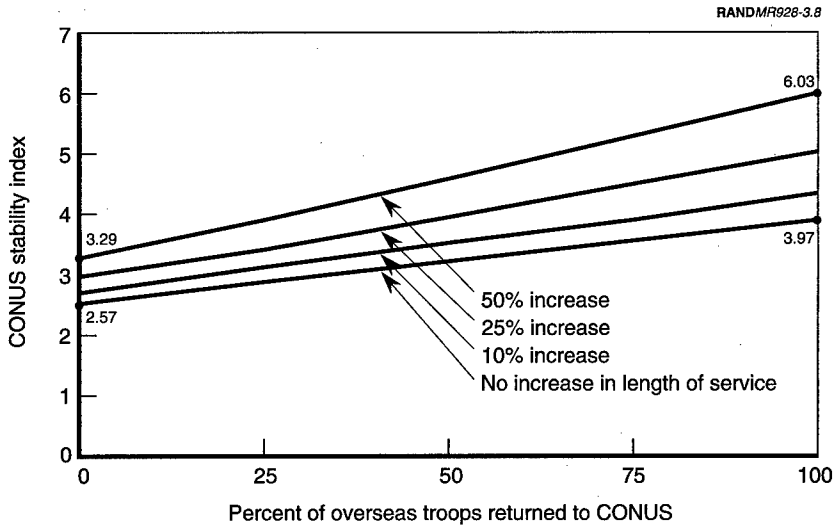


Figure 3.8—Enlisted Stability as a Function of Service Length and the Proportion of Overseas Authorizations Returned to CONUS

Table 3.12

Changes in Enlisted Stability and Move Cost Resulting from Longer Service and Return of Troops from Overseas

Policy Changes		CONUS Stability (Base = 2.57 years)		Cost of Moves (Base = $712 million)	
Longer Service	Return of Troops	Index (years)	Change (months)	Cost ($ millions)	Change ($ millions)
No change	50%	3.27	+8	486	–226
No change	100%	3.97	+17	268	–444
25%	No change	2.97	+5	705	–7
25%	50%	3.97	+17	457	–255
25%	100%	5.01	+29	223	–489

Limiting CONUS TDA Assignments to No More Than Three Years

The Army has been concerned that if reduced overseas strengths reduced the requirement to move soldiers, those assigned to TDA units in CONUS might, without increased funding for operational moves, remain in TDA units for four or five years—long enough for soldiers' tactical and field proficiency to erode. Because this aggregate analysis has lumped all soldiers—first-termers and careerists—into a single category from which we have derived the CONUS stability index, we cannot separate out with any precision just how long careerists might remain in place. Our aggregate index represents a composite of first-term and career tour lengths. Nevertheless, the analysis does allow for rough estimates of the effects on the number of moves should the Army decide to constrain TDA tours. For this analysis, we have selected three years as the constraint.

Table 3.13 demonstrates, for two selected cases in which the CONUS stability index exceeds three years, the resulting number of increased moves associated with the decision to constrain TDA tours to three years.

In the first case in Table 3.13, the Army takes actions that cause soldiers to remain on active duty 50 percent longer than is the case to-

Table 3.13

Effects on the Enlisted Force of Constraining TDA Tours to Three Years

	Base		3-Year TDA Tour		Difference	
	Index	Moves (000)	Index (TOE)	Moves (000)	Index	Moves (000)
+50% longer service	3.29	194.5	3.26	196.7	–0.03	+2.2
75% troops home	3.62	193.2	3.54	198.3	–0.08	+5.1
Both	5.30	138.9	4.90	151.9	–0.40	+13.0

day. The actions allow soldiers to remain in place 3.29 years. If the Army decided to limit TDA tours to 3 years instead of 3.29, it would add 2,200 moves each year, reflecting the more rapid movement of soldiers out of TDA units. The cost of the financial incentives required to induce soldiers to remain on active duty longer and the cost of the more senior force would dwarf the small additional cost of the added 2,200 PCS moves.

In the case shown in Table 3.13 where 75 percent of the overseas troops are returned home, the resulting CONUS stability index would be 3.62 years in both TDA and TOE units. If the TDA tours were limited to three years, the resulting TOE tour length would drop by less than one-tenth of a year (to 3.54), reflecting the greater movement of soldiers out of TOE units to replace the faster-moving TDA soldiers and costing the Army about 5,100 additional operational moves, about $23 million at fiscal year 1997 rates. But the return of 75 percent of overseas soldiers would save several hundred million a year in the very expensive rotational moves.

Policies with Small Effects on Turbulence

We also tested some additional policy actions—changing the size of the force in fixed-length tours in CONUS, changing the lengths of fixed-length tours in CONUS, and changing the transit time between assignments—but none of these actions had much of an effect on turbulence.

Because recruiters, drill sergeants, instructors, and other CONUS-based soldiers fill TDA authorizations of fixed tour lengths, changing the size of the force in such tours in CONUS will have an effect on the stability of the remaining CONUS force. Like soldiers overseas, these personnel must be replaced. Because these authorizations represent a small fraction of the total CONUS authorizations, even doubling their size would have little effect on aggregate turbulence.

Changing the lengths of fixed-length tours in CONUS has a similar effect to changing overseas tour lengths, but again the change applies to a relatively small number of authorizations. Hence, changes in tour length will have little aggregate effect.

Finally, increased transit time increases the end strength required to support a given force structure. We have assumed a transit time of 20 days. Adding or subtracting 5 days from that figure would change the CONUS stability index by a tiny amount (0.04 years) and cost or save only about one hundred moves. Hence, it is not a policy worthy of further consideration. Transit time does, however, affect readiness, but to an extent we have not measured.

Officer Analysis

While we omit the detailed analysis of these policy changes as they pertain to officers, we do provide in Table 3.14 a summary of the cost and stability effects of the key policy options discussed above for the officer as well as the enlisted force.

Note the proportionately greater stability increases to officer compared with enlisted stability when long-tour lengths are changed and when troops are returned from overseas. This phenomenon reflects the important downward pull on stability resulting from the comparatively shorter lengths of service of the enlisted force. This difference is reinforced by observing the relatively greater increase in stability of the enlisted force when career lengths are increased.

Table 3.14

Summary of the Effects of Policy Changes for the Officer and the Enlisted Forces

Policy Change	Stability Change (Months)		Off+Enl PCS Cost Change ($ millions)	Other Factors
	Enlisted	Officer		
Career length				
+5%	+1	—	–3	Costs: retention incentives, higher pay and retirement.
+25+	+5	+1	–11	Savings: training costs.
Long-tour length				
4 yr	+1	+2	–103	Costs: BAQ and VHA, impact aid.
1 yr	–10	–14	Added cost not estimated	Savings: infrastructure, COLA, DoDDS.
Overseas return				
50%	+8	+25	–369	Costs: BAQ and VHA, impact aid, FSA and subsistence, soldier transportation.
100%	+17	+48	–683	Savings: infrastructure, COLA, DoDDS.

SUMMARY

Three types of moves—accession, separation, and rotational—constitute almost 90 percent of all Army PCS moves. Accession and separation moves can be reduced principally by increasing soldiers' average length of service. Because these loss-related moves are relatively inexpensive, it would take a substantial improvement in average length of service to save a significant amount of PCS-move money. More importantly, however, compensation incentives such

as reenlistment bonuses would be required to achieve the longer career lengths. The cost of these incentives would more than outweigh any PCS-move savings. The small PCS-move savings would be further offset by the higher pay of a more senior force. While we have not done a detailed cost analysis, it is clear that a policy of increasing average lengths of service would cost rather than save the Army money.

Rotational moves account for only about one-quarter of all PCS moves but more than half their total cost. Rotational moves can be reduced through two policy actions: reducing the number of soldiers stationed overseas or increasing the length of overseas tours. Neither of these policies lies wholly within the control of the Army, but the Army can influence both. The return of even half the overseas authorizations could save the Army more than $300 million a year. Lengthening tours in Europe from three to four years would save less, only about $100 million a year. The return of all overseas authorizations would save more than $600 million a year in PCS moves and would permit much larger savings in overseas infrastructure, offset to some extent by added infrastructure costs in CONUS.

Chapter Four

CONCLUDING OBSERVATIONS

Despite the return of a large fraction of the Army's overseas strength, the rate of PCS moves within the smaller Army of the 1990s will approximate the rate in existence during the Cold War.

Most of the Army's PCS moves are required to bring new soldiers to their first duty stations and to return departing soldiers to civilian life from their final duty stations. The rate of such movement in a force of a given size can be reduced only by increasing the length of time soldiers spend on active duty. Unfortunately, to increase the average length of service the Army would have to invest in significant expenditures for compensation incentives such as reenlistment bonuses, higher pay, and retirement costs. The cost of these incentives would more than offset any PCS-move savings. Further, the increase in average length of service would raise the average seniority of the force, again raising the cost. On the other hand, the more senior force would require fewer new accessions each year, saving training costs and perhaps making the force more ready. Hence, we conclude that the Army should decide its desired experience distribution on the basis of considerations other than stability and PCS-move costs. Other considerations dominate the calculus.

While smaller in number, rotational moves generate the bulk of the Army's PCS-move costs. These overseas moves are the most expensive per capita and in the aggregate. The number of such moves is directly related to overseas strengths and tour lengths. The Army's dramatic reduction in its long-tour strengths, the three-year tours principally in Europe, and much more modest reduction in its short-

tour strengths, the one-year tours principally in Korea, served to raise the average number of moves required per overseas authorization.

One-year short tours are unlikely to be lengthened due to the long family separation already involved, but such a lengthening could have a significant effect on stability. Lengthening long tours from three to four years would help stability somewhat and save a modest amount of PCS-move costs. The most dramatic effect, however, could come from a reduction in the remaining overseas authorizations. A return of all overseas troops would save more than $660 million a year in PCS-move costs. However, PCS costs would probably be a peripheral consideration in such a change; equally or more important would be international political considerations, potential savings in dependent support facilities overseas, and incremental costs for new facilities in the United States.

Modest but perhaps worthwhile savings can be achieved through policies to reduce training moves. While training moves account for only $70 million of the more than $1 billion a year in PCS moves, most of that $70 million is associated with the sending of officers to their advanced courses and to command and staff colleges. A policy of sending officers to such courses on a TDY rather than PCS basis could stabilize officers and save money. Such a policy change might be accompanied by a substitution of distance learning for in-house instruction, thereby shortening course attendance. There would, of course, be offsetting costs associated with the distance learning. We have not estimated such costs.

In sum, while there are measures the Army can take to tighten its PCS budget and stabilize soldiers in the process, the important policy tools that would allow significant savings and substantially slow the rate of turbulence either lie outside the Army's authority to decide or carry with them significant offsetting costs.

Appendix A

NUMBERS OF PCS MOVES AND THEIR COSTS

Table A.1, following, provides the number of PCS moves and their then-year costs for the years FY87–03. The figures, as cited in the table, come from Army budget and programming documents.

Table A.1

Historical and Projected Numbers and Costs of PCS Moves

	FY1987		FY1988		FY1989	
Officers	Moves	Costs	Moves	Costs	Moves	Costs
Accession	8312	18378	8598	19234	9552	26935
Training	7775	41547	9393	52966	9114	54016
Operational	5447	26145	4278	21599	4862	25787
Rotational	15002	134008	16496	152675	17056	166121
Separation	9831	21859	9599	21922	9638	22971
Unit	293	1956	536	3507	1249	7852
TOTAL OFF	46660	243893	48900	271903	51471	303682
Enlisted						
Accession	135108	116064	116139	83859	121421	93418
Training	4372	6211	4906	7264	4315	6652
Operational	13284	51561	11496	23017	13804	29022
Rotational	136715	402160	135922	408254	133244	416589
Separation	127599	130756	120307	102344	119336	107445
Unit	2655	7083	5156	10038	6636	10673
TOTAL ENL	419733	713835	393926	634776	398756	663799
Total						
Accession	143420	134442	124737	103093	130973	120353
Training	12147	47758	14299	60230	13429	60668
Operational	18731	77706	15774	44616	18666	54809
Rotational	151717	536168	152418	560929	150300	582710
Separation	137430	152615	129906	124266	128974	130416
Unit	2948	9039	5692	13545	7885	18525
TOTAL	466393	957728	442826	906679	450227	967481

NOTE: "Moves" columns reflect the number of moves; "Costs" columns show then-year costs in thousands of dollars.

All figures include reimbursibles. Costs exclude nontemporary storage and temporary lodging expense.

SOURCES: (1) FY87-96 data: U.S. Department of the Army, *Budget Estimates, Military Personnel, Army,* "actual" columns; (2) FY97 and 98 data from FY98/99 Budget Estimates, "estimate" columns; (3) FY00-03 data are from POM 98-03, less cadet moves.

	FY1990		FY1991		FY1992	
Officers	Moves	Costs	Moves	Costs	Moves	Costs
Accession	8335	27171	7218	25617	6553	21720
Training	9098	68242	7544	58821	8456	50883
Operational	5562	37267	7252	56842	5902	47898
Rotational	17110	184027	17286	218023	17109	200924
Separation	10712	31233	8170	26451	15052	46616
Unit	762	6296	820	6715	1736	13634
TOTAL OFF	51579	354236	48290	392469	54808	381675
Enlisted						
Accession	90264	79630	78149	75662	77730	66907
Training	4300	7997	3501	6790	4002	7994
Operational	12754	33252	26865	72906	16841	47931
Rotational	129435	461140	80866	321642	138091	606138
Separation	121730	125022	115648	131393	155861	186545
Unit	5532	11278	5879	11551	14355	38962
TOTAL ENL	364015	718319	310908	619944	406880	954477
Total						
Accession	98599	106801	85367	101279	84283	88627
Training	13398	76239	11045	65611	12458	58877
Operational	18316	70519	34117	129748	22743	95829
Rotational	146545	645167	98152	539665	155200	807062
Separation	132442	156255	123818	157844	170913	233161
Unit	6294	17574	6699	18266	16091	52596
TOTAL	415594	1072555	359198	1012413	461688	1336152

Table A.1—continued

	FY1993		FY1994		FY1995	
Officers	Moves	Costs	Moves	Costs	Moves	Costs
Accession	6531	24092	6748	24584	6764	25472
Training	8099	51030	7200	40061	7150	41342
Operational	6378	54793	5830	40581	5100	36913
Rotational	13181	170994	10880	127745	10800	131058
Separation	13887	48887	9786	32195	9271	32383
Unit	2314	17879	716	5169	750	5641
TOTAL OFF	50390	367675	41160	270335	39835	272809
Enlisted						
Accession	77876	79589	68276	77762	71124	82475
Training	3000	8063	2929	10269	2800	10162
Operational	15474	50381	17310	70282	16500	69388
Rotational	95355	470400	74646	461580	73414	467909
Separation	107261	141423	94386	139163	97914	151118
Unit	17850	52935	6310	19326	5287	16775
TOTAL ENL	316816	802791	263857	778382	267039	797827
Total						
Accession	84407	103681	75024	102346	77888	107947
Training	11099	59093	10129	50330	9950	51504
Operational	21852	105174	23140	110863	21600	106301
Rotational	108536	641394	85526	589325	84214	598967
Separation	121148	190310	104172	171358	107185	183501
Unit	20164	70814	7026	24495	6037	22416
TOTAL	367206	1170466	305017	1048717	306874	1070636

	FY1996		FY1997		FY1998	
Officers	Moves	Costs	Moves	Costs	Moves	Costs
Accession	6081	23149	6352	25299	6196	25317
Training	6850	39919	6015	36952	5770	36469
Operational	6455	51739	6027	50683	5868	50702
Rotational	8015	98373	7825	100522	7650	100996
Separation	7992	31108	6680	26585	6196	25143
Unit	1025	6361	185	1217	175	1187
TOTAL OFF	36418	250649	33084	241258	31855	239814
Enlisted						
Accession	73951	86515	92281	110344	87956	106605
Training	2800	10148	2700	10440	2300	9060
Operational	17500	78862	17000	80852	16500	80691
Rotational	70538	450728	65125	436898	65125	447849
Separation	87287	139438	86697	141767	85835	142755
Unit	6000	19314	1824	6248	1970	6952
TOTAL ENL	258076	785005	265627	786549	259686	793912
Total						
Accession	80032	109664	98633	135643	94152	131922
Training	9650	50067	8715	47392	8070	45529
Operational	23955	130601	23027	131535	22368	131393
Rotational	78553	549101	72950	537420	72775	548845
Separation	95279	170546	93377	168352	92031	167898
Unit	7025	25675	2009	7465	2145	8139
TOTAL	294494	1035654	298711	1027807	291541	1033726

Table A.1—continued

	FY1999		FY2000		FY2001	
Officers	Moves	Costs	Moves	Costs	Moves	Costs
Accession	6220	26173				
Training	5770	37187				
Operational	5668	49946				
Rotational	7646	104579				
Separation	6220	25933				
Unit	185	1280				
TOTAL OFF	31709	245098				
Enlisted						
Accession	87104	107792				
Training	2300	9321				
Operational	16000	79722				
Rotational	65125	465282				
Separation	85026	144967				
Unit	1461	5257				
TOTAL ENL	257016	812341				
Total						
Accession	93324	133965	97200	145900	99200	151000
Training	8070	46508	8200	48600	8200	50000
Operational	21668	129668	20000	114300	20000	117500
Rotational	72771	569861	76200	615000	76200	627500
Separation	91246	170900	94200	173100	96000	180000
Unit	1646	6537	1900	7700	1900	7900
TOTAL	288725	1057439	297700	1104600	301500	1133900

	FY2002		FY2003	
Officers	Moves	Costs	Moves	Costs
Accession				
Training				
Operational				
Rotational				
Separation				
Unit				
TOTAL OFF				
Enlisted				
Accession				
Training				
Operational				
Rotational				
Separation				
Unit				
TOTAL ENL				
Total				
Accession	99200	153100	99200	155600
Training	8200	51100	8200	52500
Operational	20000	120000	20000	123200
Rotational	76200	639500	76200	652300
Separation	96100	183100	96100	186900
Unit	1900	8100	1900	8300
TOTAL	301600	1154900	301600	1178800

Appendix B

STEADY-STATE PCS MODEL DESCRIPTION

The aggregate PCS model is a steady-state model that estimates flows among the various locations to which the Army assigns soldiers. For the analysis reported in Chapter Three, the model considers the following assignment venues:

- CONUS TOE.
- CONUS "fixed" TDA: those CONUS TDA assignments whose tour lengths are determined based on Army policy, e.g., drill sergeants, instructors. Such assignments are of two to three years duration.
- CONUS "floating" TDA: those CONUS TDA assignments whose tour lengths are determined based on Army needs of the moment, usually related to filling other vacancies.
- Initial entry training (IET): the venue by which soldiers enter the enlisted force.
- OCONUS accompanied or "long" tour: the overseas venue that permits the soldier's family to accompany the soldier on his overseas assignment—the tour length is usually three years. Assignments in Western Europe are examples of the long tour.
- OCONUS unaccompanied or "short" tour: the overseas venue that does not permit the soldier's family to accompany him overseas; the tour length is usually one year. Assignments in the Republic of Korea are examples of the short tour.

MODEL INPUTS

The analyst must specify certain assignment venue characteristics—the characteristics associated with Chapter Three's analysis are presented in Table B.1. The model then determines the detailed flows among the venues and the assignment stability index, i.e., the tour length associated with CONUS TOE assignments (the first venue).

The analyst must provide the following data for all assignment venues:

- Each venue's authorized end strength.
- Except for the CONUS TOE venue, the tour length. The CONUS TOE tour length (assignment stability index) is determined by the model. It is possible to constrain the "CONUS floating TDA" tour length to equal the assignment stability index, which was done in most of Chapter Three's analysis (several cases constrained CONUS floating TDA tour length to three years—see Table 3.12).
- The transit time from one venue to another, i.e., the length of time required to make a PCS move to a new assignment venue from the current assignment. This is assumed to be 20 days for Chapter Three's analysis. For each soldier who undergoes a PCS move, the man-year equivalent of 20 days is removed from CONUS TOE end strength.
- The permitted flows from one assignment venue to another.
- For the enlisted force as a whole, the force's authorized end strength.

With this data, the model determines the CONUS TOE end strength, the detailed assignment flows into and out of each venue, and the assignment stability index, i.e., the tour length associated with CONUS TOE assignments.

The data in Table B.1 reflect the analysis base case. They are intended to reflect postdrawdown end strengths, tour lengths, and accession behavior. The 1997 PMAD was used for assignment venue end strength figures because it reasonably reflects the postdrawdown enlisted force. IET end strength and tour length figures are derived

from 1998–2000 ELIM model results[1] because 1998–2000 are postdrawdown years in which accessions into the enlisted force are expected to reflect stable postdrawdown accession behavior. Total end strength comes from the FY97 president's budget, minus 4,000 U.S. Military Academy cadets.

Losses from the force are assumed to be the same as accessions into the force. Those accessions are determined directly from the IET end

Table B.1

Base Case Input Parameters

Venue	Authorized End Strength	Tour Length (years)	Can Flow To:
CONUS TOE	×	×	CONUS fixed TDA CONUS floating TDA OCONUS long tour OCONUS short tour
CONUS floating TDA	60,953	×	CONUS TOE OCONUS long tour OCONUS short tour
IET	30,053	0.37	All other venues
CONUS fixed TDA (e.g., drill sergeants)	15,000	2.67	CONUS TOE OCONUS long tour OCONUS short tour
OCONUS long tour (accompanied tour)	77,336	3.00	CONUS TOE CONUS fixed TDA CONUS floating TDA
OCONUS short tour (unaccompanied tour)	28,693	1.00	CONUS TOE CONUS fixed TDA CONUS floating TDA
Total force	410,700	—	—

NOTE: Cells containing an "×" indicate values determined within the model. Authorized end strengths for each assignment venue come from the FY97 PMAD. IET end strength and tour length are derived from ELIM model results for 1998–2000. Total force end strength comes from the president's FY97 budget, based on a force size of 495,000.

[1]The specific ELIM V model alternative is E941151P, 20 JAN 1995, provided by DAPE-PRS.

strength and tour length to be about 82,000 annually.[2] These are *net* accessions, after IET attrition, but also including prior-service accessions that do not need initial training.

The table also indicates the permitted assignment flows among the various venues. In particular, assignment flows are not permitted between the two CONUS TDA venues. Nor are assignment flows permitted between the two OCONUS venues. We recognize that these are restrictive assumptions but believe that the real-life flows are so small as to not detract from model results.

MODEL LOGIC

The model's computations proceed in a series of steps, iteratively executed until the model converges on a CONUS TOE tour length solution. For purposes of this discussion, we assume that CONUS floating TDA tour length is specified by the analyst. Later we relax this assumption when we address model convergence issues. The steps are listed below:

- For all but the first assignment venue, determine the total flows into and out of the venue.
- Determine the annual separations from each venue.
- Determine the detailed from-to flows into all but the first venue.
- Determine the detailed flows into the first venue from the other venues.
- Estimate the first venue's end strength (removing the man-year implications of the PCS-move transit times).

These steps are repeated iteratively until the model converges. Convergence means that the assignment stability index, i.e., first venue's tour length, remains invariant from one iteration to the next. This effectively means that the man-year implications of PCS-move transit time remain invariant from one iteration to the next.

[2]Annual accessions are determined by dividing IET end strength by the IET tour length. Other annual flows are determined in the same manner, by dividing an assignment venue's end strength by its analyst-specified tour length.

Determine Total Flows and Separations

For all but the first venue, the authorized end strength and tour length are specified by the analyst. From these we can determine the total annual flows into and out of the venue. This is accomplished with a simple calculation:

annual flows = authorized end strength / tour length.

Separations from a venue are assumed to be proportional to the venue's authorized end strength. Total separations are further assumed to equal the flows into IET—in the steady state, the flows into a system must equal the flows out of that system. Thus, total annual separations are calculated as follows:

total annual separations = IET end strength / IET tour length.

Each assignment venue's annual separations are then determined in proportion to end strength.

These results are illustrated graphically in Figure B.1. In this figure the annual separations from all venues and the total flows out of all but the first venue are shown in the rightmost two columns. Similarly, the total flows into the venues are shown in the bottom row. The bottom IET cell is blank because there are no flows from the other venues into IET.

Determine Detailed Flows into the Venues

We have calculated the total flows into and out of all but the first assignment venue. The next step is to determine the venues from which these flows come. For example, we know the total flows into the CONUS fixed TDA venue (15,000/2.67 = 5,618). How should these flows be allocated to the other venues?

The model assumes that the detailed from/to flows into a venue are proportional to the total flows out of the giving venues, i.e., the number of soldiers eligible to flow from those venues. In this manner we can determine the detailed flows into each venue. Figure B.2 shows the results of these computations. The shaded figures are those quantities calculated in the previous step. Performing this set of cal-

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	Total flows into and out of each venue							
	CONUS TOE	CONUS floating TDA	IET	CONUS fixed TDA	Long tour	Short tour	Annual separations	Total flows out
CONUS TOE							41,884	
CONUS floating TDA							13,435	23,714
IET								81,997
CONUS fixed TDA							3,306	5,618
Long tour							17,046	25,779
Short tour							6,324	28,693
Total flows in		23,714		5,618	25,779	28,693	81,997	

Figure B.1—Total Flows and Annual Separations

culations is equivalent to distributing each column's "total flows in" (which appears at the bottom of the venue's column) upward across the giving venues.[3]

Total flows into and out of the first venue, CONUS TOE, are included in this computation. These flows can be determined because all of the flows out of the first assignment venue are known after the detailed from/to flows for the other venues are determined (the flows out of the first venue are simply the sum of the flows in the first row).

[3]We use the "total flows out" (the rightmost column) as the proportionality template for allocating the detailed flows into each venue. Since moves are not permitted between certain venues, the proportionality template for each column must take this into consideration. For example, since flows are not permitted between the short tour and the long tour, the short tour's proportionality template should exclude 25,779, the number of flows out of the long tour, and the long tour's proportionality template should exclude 28,693, the number of flows out of the short tour.

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	Detailed flows into the venues							
	CONUS TOE	CONUS floating TDA	IET	CONUS fixed TDA	Long tour	Short tour	Annual separations	Total flows out
CONUS TOE		8,332		1,974	10,287	11,450	41,884	73,928
CONUS floating TDA					3,330	3,673	13,435	23,714
IET		9,242		2,189	11,410	12,700		81,997
CONUS fixed TDA					782	870	3,306	5,618
Long tour		2,906		688			17,046	25,779
Short tour		3,234		766			6,324	28,693
Total flows in	73,928	23,714		5,618	25,779	28,693	81,997	239,728

Figure B.2—Detailed Flows In

Prior to model convergence these values vary from iteration to iteration, and we will discuss this further when we address model convergence issues.

Total flows within the enlisted force (239,728) can also be determined at this point because we now know the total flows associated with each venue. Further, inspection of Figure B.2 indicates that the total flows out of each venue exactly equal the total flows into the venue, with flows out of IET being balanced by annual separations.

Determine First Venue Detailed Flows

By examining Figure B.2 we see that we have sufficient information to determine the detailed flows into the first venue, i.e., we can fill in the first column. These flows are computed as *residual* flows—the difference between the total flows out of the venues and the detailed

flows out of the venues. For example, looking across any but the first row of Figure B.2, we can determine the flows into CONUS TOE from that venue by simply subtracting from the venue's total flows the detailed flows out of that venue. Focusing on CONUS fixed TDA, we see that the flow into CONUS TOE is

$$660 = 5{,}618 - 782 - 870 - 3{,}306.$$

Figure B.3 shows the results of these computations. Previously determined values are shaded in this figure.

Figure B.3 also demonstrates other characteristics concerning flows among venues. First, no flows are permitted from other venues into IET, as illustrated by the absence of a "total flows in" value at the bottom of the IET column. Second, the two TDA assignment venues show no cross flows, as illustrated by the lack of detailed flows between the two TDA venues. Third, and similar to the TDA venues, no

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	All from/to flows							
	CONUS TOE	CONUS floating TDA	IET	CONUS fixed TDA	Long tour	Short tour	Annual separations	Total flows out
CONUS TOE		8,332		1,974	10,287	11,450	41,884	73,928
CONUS floating TDA	3,306				3,330	3,673	13,435	23,714
IET	46,456	9,242		2,189	11,410	12,700		81,997
CONUS fixed TDA	660				782	870	3,306	5,618
Long tour	5,139	2,906		688			17,046	25,779
Short tour	18,368	3,234		766			6,324	28,693
Total flows in	73,928	23,714		5,618	25,779	28,693	81,997	239,728

Figure B.3—All From/to Flows

flows are permitted between the two OCONUS venues, i.e., the "long tour" and "short tour" venues. All flows between assignment venues are governed by analyst-supplied inputs that indicate the flows that are permitted.

Fourth, no annual separations occur from IET. IET separations are treated outside the model because those losses are significantly different than the model's estimate for them would have been. The model's estimate is based on inventory proportionality, i.e., the losses associated with an assignment venue are proportional to the inventory in that venue. With the exception of the IET venue, this is a reasonable assumption, hence the decision to treat IET losses outside the model and use net accessions. Fifth, the model does not permit flows from a venue to itself.

Estimate the First Venue's End Strength and Tour Length

The next step in the process determines the man-year implications of the length of time it takes to move soldiers from one assignment venue to another. Figure B.4 illustrates the results of this computation. The number of in-transit man-years associated with each from/to flow is shown in this figure, as are the total in-transit man-years (8,643). Those man-years are taken from the first assignment venue, CONUS TOE. In fact, in the model CONUS TOE authorized end strength is defined to be the total authorized end strength (410,700) minus the authorized end strengths associated with the other assignment venues and also minus the in-transit man-years.[4]

Given the first venue's authorized end strength and the total flows into the first venue, we can then determine the associated tour length (the assignment stability index). This is done using the following relationship:

tour length = authorized end strength / flows in (or out).

[4]In Figure B.4, cells in the "Total to" (bottom) row do not equal corresponding cells in the "Total from" column because we do not count as part of end strength the time it takes soldiers to undergo the separation PCS move. Considering such flows would essentially add another column to the figure, representing the detailed man-year equivalents of the separation moves.

RAND*MR928-B.4*

	In-transit man-years							
	CONUS TOE	CONUS floating TDA	IET	CONUS fixed TDA	Long tour	Short tour	Total from	Total inventory
CONUS TOE		457		108	564	627	1,756	190,022
CONUS floating TDA	181				181	201	563	60,953
IET	2,546	506		120	625	696	4,493	30,053
CONUS fixed TDA	36				43	48	127	15,000
Long tour	282	159		38			478	77,336
Short tour	1,006	177		42			1,226	28,693
Total to	4,051	1,299		308	1,413	1,572	*8,643*	8,643
								410,700

Figure B.4—In-Transit Calculations

Figure B.5 shows the tour length results. The figure presents the analyst-provided tour lengths as well as the tour lengths computed based on the above relationship. The CONUS floating TDA input tour length is shaded because, in most of the analysis presented in Chapter Three, the model constrains this tour length to be the CONUS TOE tour length. The other venues' analyst-provided tour lengths are exactly equal to their computed tour lengths. Were they not, the model would be in error.[5]

[5]The model contains numerous diagnostic tests to determine whether it is operating properly, including a test to ensure that input and computed tour lengths are equal. Warning messages are displayed to warn the user when the model detects improper conditions.

RANDMR928-B.5

	Tour lengths	
	Input	Computed
CONUS TOE		2.57
CONUS floating TDA	2.57	2.57
IET	0.37	0.37
CONUS fixed TDA	2.67	2.67
Long tour	3.00	3.00
Short tour	1.00	1.00

Figure B.5—Tour Lengths

Circular Variable Definitions and Model Convergence

The model arrives at its solution iteratively through a convergence process. This is because some of the model's variables are defined in a circular fashion, i.e., in terms of other variables whose values are not known prior to computation. For example, the first assignment venue's authorized end strength depends in part on the in-transit man-years associated with PCS moves. These man-years in turn depend on the detailed flows among the venues, which depend on each venue's tour length and authorized end strength. However, the first venue's tour length depends on the detailed flows into the venue and its authorized end strength, which in tern depend on in-transit man-years. Figure B.6 illustrates the circularity of these relationships as well as the mechanism for constraining the "CONUS floating TDA" tour length to equal the assignment stability index. The values at the heads of the arrows depend on the values at the tails of the arrows.

Figure B.6 (and all the other figures in this appendix) is an excerpt from the spreadsheet model itself. In order to use cyclic variable

RAND*MR928-B.6*

	Inventory and tour length inputs	
	Authorized end strength	Tour
CONUS TOE	190,022	2.57
CONUS floating TDA	***60,953***	2.57
IET	***30,053***	***0.37***
CONUS fixed TDA	***15,000***	***2.67***
Long tour	***77,336***	***3.00***
Short tour	***28,693***	***1.00***
Total inventory	**410,700**	

	Computed	
	Inventory	Tour lengths
CONUS TOE	190,022	2.57
CONUS floating TDA	***60,953***	2.57
IET	***30,053***	***0.37***
CONUS fixed TDA	***15,000***	***2.67***
Long tour	***77,336***	***3.00***
Short tour	***28,693***	***1.00***
In-transit man-years	8,643	

Figure B.6—Cyclic Variable Definitions

definition, we must first estimate the values of the computed variables. Otherwise, there would be no starting point for those "input" variables that depend on the computed variables. These estimates are made by running the model without the cyclic definitions. This is done by taking three actions in the spreadsheet itself. First, the CONUS TOE inventory is defined only in terms of the total inventory and the inventories of the other assignment venues, ignoring in-transit man-years. Second, the CONUS floating TDA tour length is set equal to a number (say three years) rather than being defined as equal to the assignment stability index. Finally, and only for purposes of distributing flows into the venues in proportion to the flows available from the giving venues, a representative CONUS TOE tour length is provided as an input.

The resulting model run has three characteristics. First, the model-computed inventory exceeds the total inventory by the number of in-transit man-years. Further, the CONUS floating TDA tour length will

probably not equal the CONUS TOE tour length, even though the analyst setting up the initial model run may have specified the two tour lengths to be equal. Third, the CONUS TOE tour length computed by the model will probably not be equal to the analyst-specified tour length.

Once this initial model run is made, the cyclic variable definitions must be imposed. This means that the CONUS TOE inventory cell in the input section must be defined in terms of the authorized end strengths and the in-transit man-years. It further means that the CONUS floating TDA tour length cell in the input section must be defined to equal the CONUS TOE tour length cell from the computation section. Finally, the CONUS TOE tour length cell in the input section must be defined to equal the corresponding cell from the computation section.

There is no guarantee that the model will converge. Convergence depends on how well the analyst selects the initial estimates of variable values for the initial model run. Care must be taken in doing so.

Dealing with Negative Residual States

As discussed above, the flows into the first assignment venue are calculated as *residual* flows. It is possible, therefore, for these flows to be negative. Figure B.7 illustrates how this might occur and illustrates how the condition can be corrected.

In Figure B.7 the residual flow from long tour to CONUS TOE is negative. This has come about because the long tour length is 4.5 years rather than the base case's three years—the figure's rightmost column displays tour length. This results in a reduction in the total flows into and out of long tour. Because the detailed flows into assignment venues are determined based on their total flows, changing the long tour length has a minimal effect on the flows into other nonresidual venues. Thus, while total long tour flows decrease, other nonresidual detailed flows remain about the same, thus resulting in the negative residual flow from long tour to CONUS TOE.[6]

[6]This can be seen by comparing the columns associated with CONUS floating TDA, CONUS fixed TDA, and short tour in Figure B.3 with those in Figure B.7.

RAND*MR928-B.7*

All from/to flows									
From/to	CONUS TOE	CONUS floating TDA	IET	CONUS fixed TDA	Long tour	Short tour	Losses	Flows out	Tour length
CONUS TOE		7,830		1,979	6,664	11,126	41,970	69,570	2.74
CONUS floating TDA	3,134				2,129	3,554	13,407	22,223	2.74
IET	49,466	9,229		2,333	7,855	13,114		81,997	0.37
CONUS fixed TDA	882				538	898	3,299	5,618	2.67
Long tour	**–2,248**	**1,934**		**489**			**17,010**	**17,186**	4.50
Short tour	18,336	3,230		816			6,311	28,693	1.00
Flows in	69,570	22,223		5,618	17,186	28,693	81,997	225,287	

Figure B.7—Negative Residual Flow Example

In this example four elements combine to yield the negative flow, shown in boldface type in the figure (five elements including the negative flow itself). The first, the rightmost element, is the total flows into and out of long tour (17,186), being defined as the ratio of its authorized end strength and its tour length. The second is the venue's losses (17,010), which represent the venue's proportional share of total losses. The third and fourth are the flows from long tour into CONUS floating TDA and CONUS fixed TDA (1,934 and 489). Each of these two flows is the proportional allocation of all the flows into the associated venue, the proportionality assumption being based on the number of soldiers eligible to flow, i.e., the flows out of the giving venues. The –2,248 obtains from the following:

$$-2{,}248 = 17{,}186 - 17{,}010 - (\,1{,}934 + 489\,).$$

To remove the negative flow we must alter the proportionality assumption and change the flows from long tour into CONUS floating TDA and CONUS fixed TDA, the italicized numbers in the above equation. We have to reduce the sum of these flows (1,934 + 489 = 2,423) by 2,248 in order to remove the negative residual flow.[7] We can think of this graphically as redistributing the flows associated with each of the two columns in the figure representing the flows into CONUS floating TDA and CONUS fixed TDA (to fix a row we have to change some columns). Figure B.8 illustrates the computations involved, which are performed by the spreadsheet after the model is executed.

RAND*MR938-B.8*

Eliminate 'long tour' negatives	Negative "flows"	CONUS floating TDA	IET	CONUS fixed TDA
Proportionality values		1,934	0	489
Allocate negative flow	–2,249	–1,795		–454
Redistribute flow				
CONUS TOE		8,523		2,155
CONUS floating TDA				
IET		10,046		2,539
CONUS fixed TDA				
Long tour		139		35
Short tour		3,515		889
		22,223		**5,618**
Normalize				
CONUS TOE		0.384		0.384
CONUS floating TDA				
IET		0.452		0.452
CONUS fixed TDA				
Long tour		0.006		0.006
Short tour		0.158		0.158
		1.000		**1.000**

Figure B.8—Reducing Negative Residual Flows

[7]Were the sum of these flows insufficient to compensate for the negative residual, we would be faced with an infeasible solution.

The 2,248 reduction is proportionally distributed over the two venues, shown in the bottom row of the figure's top segment—we redistribute 2,249 flows rather than 2,248. The allocations for each venue are 1,795 and 454 respectively (the proportionality values are simply the flows from Figure B.7). The long tour to CONUS floating TDA flow must be reduced by 1,795, and the long tour to CONUS fixed TDA flow must be reduced by 454.

The figure's middle segment illustrates the redistributed flows for each venue. The two long tour flows have been reduced (from 1,934 and 489 respectively to 139 and 35), with the difference proportionally redistributed to other valid venues in each column, thereby ensuring that the total flows associated with CONUS fixed TDA and CONUS floating TDA are preserved. The third segment converts these flows to distributions that can be applied on the next execution of the model.[8]

In some instances redistribution of negative flows does not relieve the situation. This will occur when the negative residual flow is greater than the sum of the other available flows for the venue. When this occurs there is no way to remove the residual flow, i.e., the inputs lead to infeasible results.

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[8]The model actually begins its computations by constructing flow distributions based on the proportionality assumption. These distributions are applied unless the analyst chooses to override them. Negative residual flows can be eliminated by overriding these distributions with those shown in Figure B.8.

The model has several buttons (macros) that the analyst can push when negative residual flows occur. Each button superimposes the appropriate negative-removing distribution on the model computations—the bottom segment's distributions—thereby eliminating a specific negative residual flow. The analyst can push these buttons directly or can choose a governing button that automatically pushes the detailed buttons until all negative states are removed or the analyst intervenes.

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