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PREFACE

This research was performed in FY 2002 by the Institute for Defense Analyses for the Office of the Deputy Undersecretary of Defense (Program Integration) in fulfillment of the task entitled "Comparative Costs of Air Force Military and Civilian Science and Engineering Personnel." The paper compares the costs of increasing the number of Air Force scientists and engineers by awarding bonuses to officers in selected science and engineering career fields with the alternative of increasing the number of civil servants in similar fields.

The authors wish to thank Pam Bartlett of the Office of the Deputy Undersecretary of Defense (Program Integration) for her excellent guidance, James Bell and Stanley Horowitz at IDA for their comments on an earlier draft of this paper, and numerous Air Force personnel for supplying data and engaging in constructive discussions.

Colonel Lyndon S. Anderson participated in this research while a National Security Fellow at the Institute for Defense Analyses.

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SUMMARY

In the face of accession and retention shortfalls, the Air Force recently initiated a critical skills retention bonus (CSRB) for officers in the science and engineering (S&E) workforce. The bonus will be awarded to members with 4-13 years of commissioned service, at the rate of $10K per year for those who agree to four-year obligations. The Air Force Materiel Command also has suggested legislation that would offer commissioned officers a proficiency pay incentive for holders of graduate degrees in S&E disciplines who work in S&E positions. Monthly proficiency pay incentives would range from $100–$300, depending on experience. The targets of these awards are five career fields (designated "core groups" by the Air Force):

- Developmental Engineering (62E)
- Scientific/Research (61S)
- Acquisition Program Manager (63A)
- Communications-Information Systems (33S)
- Civil Engineer (32E).

There are alternatives to using bonuses and proficiency pay to fill all the available military S&E billets. Among them: the Air Force could use DoD civilian employees or private sector civilians to perform some portion of the work requiring S&E skills. The objective of our work was to assess the use of Air Force military and civilian science and engineering personnel in RDT&E positions by comparing the costs of using Air Force officers receiving bonuses with the alternative of using civil servants. A secondary objective was to define alternatives for later consideration.

Although we defined several alternatives, this paper concentrates on assessing only one: substituting civil servants for military officers. We divided the work into two major tasks:

- Projecting the evolving military officer workforce with and without the additional retention bonuses. Determining the cost of the military workforce with and without the CSRB. (We had no information on the likely effects of proficiency pay on retention. The dollar amounts of the proficiency payments would be substantially less than bonuses, so we excluded proficiency pay from our analysis.)

- Projecting the evolving Air Force civilian S&E workforce. Determining how much accessions must increase to substitute for military officers, and calculating the cost.

The Air Force Personnel Center provided the data necessary to describe the 2001 force for each of the five S&E specialties. By analyzing this information, we determined that the Air Force has officers who are not scientists or engineers but who are performing those duties, as well as S&E officers who are in non-S&E assignments. We examined the number and characteristics of non-S&E officers performing S&E duties to determine whether the Air Force is using less-qualified officers to fill those vacant positions. Fewer than 12 percent of the officers on S&E duty do not have S&E as a core group. Most of these are second lieutenants, and almost two-thirds have a primary AFSC in the S&E field; however, more than half have only a bachelor's degree, and many of their degrees are in general fields rather than technical ones. Junior officers may perform some S&E duties as a form of on-the-job training or to test their aptitude for obtaining a master's degree in an S&E field.

We also considered the extent to which S&E officers were assigned to perform non-S&E duties. If the number of such officers is large, the Air Force might be able to fill those positions without the bonus, simply by reassigning these officers to S&E duties. We found that 86 percent of S&E officers are performing S&E duties; the other 14 percent, more than 1600 officers, are performing a variety of duties, including instructor, student, and planning and programming. The Air Force encourages officers to broaden their careers, but these officers could be assigned to alleviate S&E shortages. However, the Air Force believes that part of the value of officer S&Es is the broader Air Force experience they bring to their duties.

Using the current force structure as a baseline, we projected the year of service and grade distribution of the present military force in the S&E specialties out to 2012. The Air Force Personnel Operating Agency provided retention rates with and without the bonus. These rates were repeatedly applied to each FY 2001 force to obtain projected military forces with and without the bonus.

For the military, we used cost information for basic pay, health care for active duty members and their families, and accrual costs for retirement and retiree health care. We also included costs for permanent changes of station (PCS), subsistence, family separation allowance, separation payments, the employer's share of social security tax, overseas station allowances, and death gratuities. We were not able to include additional costs for Air Force-funded full-time schooling for technical degrees. (Because military

S&Es may spend less time overseas than other Air Force officers, the Air Force-wide average family separation allowance, overseas station allowances, and PCS costs may be somewhat higher than actual costs.)

The Air Force also provided us with information on the structure of the civilian science and engineering work force. We had data on inventories, retention rates, and accessions by grade and age. For each of the five military S&E core groups, we found that almost all the corresponding civilian occupational series came from three major groups:

- 08—engineering
- 13—physics, chemistry, astronomy, and related sciences
- 15—mathematics, statistics, and operations research.

Retention rates were repeatedly applied to each occupational group to get projected strengths. Next, we determined how much civilian accessions (additions of new employees) had to increase to allow civilians to substitute for military officers.

Civilian costs included salaries, pension and health benefits, and employer's share of social security tax. The data for benefits were specific to civil service RDT&E personnel.

The average wage for civil service scientists and engineers during 2002 was about $70,000, whereas the average basic pay for the officers was a little less than $50,000. But accruals for retirement pay and post-retirement health care average $34,000 per year for officers, whereas the cost of all non-salary benefits for civilians averages about $18,000. Health care for military personnel and their dependents accounts for $7000 per officer. Allowances, initial skill training, PCS, CSRBs, and other miscellaneous costs also are sizeable components of total costs of officers.

Increasing the number of Air Force civilian S&Es is less expensive than increasing the number of military officers with the bonus option. Table S-1 presents the costs of increasing the number of officers in each of the five officer core groups and the costs of the alternative: increasing the number of Air Force civilians in each of the civilian occupational groups. The bottom line in the table displays the difference in total cost for each fiscal year from 2002 to 2012.

In all science and engineering disciplines, Air Force officers under a bonus scenario are more expensive than DoD civilians. On a per capita basis, only the cost per Communications-Information Systems (core group 33S) officer comes close to the cost per S&E civil servant. This is because this particular specialty has very low retention,

and thus proportionally more officers in lower pay grades and years of service than the other specialties. For example, in FY 2012, the cost per military officer ranged from $101,741 (33S) to $111,973 (civil engineer, core group 32E), including the bonus; the cost per civilian ranged from $89,180 to $92,837.

Table S-1. Total Costs Increases With Bonus (CSRB) vs. Substituting Civilians for Officers (FY 2002 Dollars, Millions)

Bonus	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Civil Engineer, 32E	13	16	19	21	24	26	29	31	34	36	38
Communications-Information Systems, 33S	30	39	48	57	65	73	80	88	96	104	111
Scientific/Research, 61S	10	12	14	16	18	20	23	25	27	29	31
Developmental Engineer, 62E	21	26	31	36	41	45	49	53	57	61	65
Acquisition Program Manager, 63A	17	21	25	30	35	40	44	49	55	60	65
Officer Total	91	115	137	160	182	204	226	247	268	290	310
Substitution											
Engineering, 08XX	12	23	34	45	57	68	78	90	101	112	122
Physics, chemistry, astronomy, and related sciences, 13XX	1	2	3	4	5	6	6	8	9	10	11
Mathematics, statistics, and operations research, 15XX	1	2	3	4	5	7	8	9	10	12	13
Civil Service Total	*14*	27	40	53	67	80	93	106	120	133	146
Difference	77	88	97	107	116	124	133	141	149	157	164

I. INTRODUCTION

The Office of the Deputy Under Secretary of Defense for Program Integration is responsible for overseeing Total Force manpower requirements determination, justification, apportionment, and execution. The same office is charged with ensuring the most effective use of Total Force structure and its allocation among DoD components. The military Services strive for a strong in-house science and engineering (S&E) capability to develop, test, field, maintain, and operate weapon systems. The Air Force believes that the value of officer S&Es is measured at least in part by the broader Air Force experience they bring to their S&E duties. However, maintaining this capability has been a challenge. Several Air Force officer S&E career fields have been under-accessing and not sustaining their force structures, and retention has been a persistent problem, given the attractive private sector opportunities available in these career fields.

To maintain the technical competence of the S&E workforce, the Air Force has requested a critical skills retention bonus (CSRB) for officers in this workforce. The bonus would be paid to members with 4-13 years of commissioned service at the rate of $10K per year for those persons who agree to four-year active duty Service obligations. Also, the Air Force Materiel Command has suggested legislation that would offer commissioned officers a proficiency pay incentive for holders of graduate degrees in S&E disciplines. Monthly proficiency pay incentives would range from $100–$300, depending on experience.

There are alternatives to using bonuses and proficiency pay. One is to use either DoD civilian employees or private sector civilians to perform some portion of the work requiring S&E skills. In 2000, a Defense Science Board task force on the technical capabilities of non-DoD providers recommended that the Department increase to 50 percent the portion of Service R&D management and laboratory staff provided by the private sector.[1]

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1 *Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers*, Office of the Undersecretary of Defense for Acquisition, Technology & Logistics, June 2000, p. 24.

The objective of our work was to assess the use of Air Force military and civilian science and engineering personnel in RDT&E and other science and engineering positions by comparing the costs of using Air Force officers receiving bonuses with the alternative of using increased numbers of civil service S&Es.

Our research plan comprised the following steps:

- Define alternatives (Chapter II). We documented the Air Force proposal for bonuses and proficiency pay and defined alternatives to it. Our analysis focused on the cost of the Air Force officers receiving CSRB payments relative to the use of civilian DoD employees. We also defined alternatives for later analysis.
- Define the baseline (Chapter III). We found comprehensive data on both existing positions ("spaces") and the individuals occupying those positions ("faces"). These databases are maintained by different offices, and we found that they could not be matched up to determine whether the Air Force has vacant positions in the S&E area, or is using civilians in positions that are designated as military. We were, however, able to use the "faces" data to develop a baseline number of military and civilian S&Es and their characteristics.
- Analyze the military baseline and bonus cases (Chapter IV). We used personnel force projection modeling to generate a baseline endstrength and grade distribution for military S&Es out to 2012. Next, we used Air Force estimates of retention rates under the bonus scenario to generate the alternative endstrengths and grade distributions.
- Analyze the civilian baseline and substitution case (Chapter V). In this case, we assumed that civilians will substitute for the marginal military S&Es retained as a result of the bonus. Using data on the market for civilian S&Es, we examined whether the Air Force can fill these additional positions with qualified civilian scientists and engineers, and whether the Air Force will have to raise pay to do so.
- Compare the costs to the Air Force under each system (Chapter VI). In this chapter, we drew together our analyses to determine the average costs of military and civilian S&Es.
- Discuss conclusions and possible extensions of the analysis (Chapter VII).

II. DEFINING THE ALTERNATIVES

A. THE AIR FORCE PROPOSAL

The Air Force proposed that some military officers in five science and engineering specialties be offered a critical skills retention bonus (CSRB). DoD is authorized to do this under a provision in Title 37 of the U.S. Code that was added in FY 2001. Under this provision:

- An active duty Service member in a skill area designated as critical by the Secretary of Defense may receive a bonus if the member reenlists, voluntarily extends, or agrees to remain on active duty for at least one year.
- The total payments to any individual may not exceed $200,000 during a career.
- The bonus takes effect 90 days after Congress is notified of the critical skill designation.

The Air Force requested that the following officer career fields be designated as critical:

Developmental Engineering (62E)
Scientific/Research (61S)
Acquisition Program Manager (63A)
Communications-Information Systems (33S)
Civil Engineer (32E).

The Secretary of Defense notified Congress on February 6, 2002, that he was designating the above five career fields as critical. The CSRB, $10,000 per year tied to a four-year service obligation, will be offered to members who have completed their initial active duty Service commitment and have 4–14 years of commissioned service (5–14 years for USAF Academy graduates), not to exceed 15 years of commissioned service. (Those in the 12th, 13th, and 14th years of service can apply for three, two, and one-year bonuses, respectively.) An officer may apply for and receive a subsequent CSRB after

completing his service obligation for a CSRB. The Air Force is now accepting applications for bonuses.[2]

We also learned of an Air Force Materiel Command proposal to provide proficiency pay of about $300 per month for experienced S&E officers. This proposal has not yet been examined Air Force-wide; we could find no retention estimates for a proficiency pay scenario and thus did not include it in our analysis.

B. ALTERNATIVES TO BONUSES AND PROFICIENCY PAY

There are several alternatives to offering bonuses and proficiency pay. We examine increasing the number of Air Force civilian S&Es rather than awarding bonuses to increase the number of officers (the use of civilian contractors also is possible and worthy of future examination).

The Air Force could endeavor to develop more military officers as qualified S&Es, which could be accomplished in a number of ways. One would be to establish accession bonuses to recruit more officers whom the Air Force can develop into scientists and engineers. However, in and of itself this would not deal with the problem of low retention rates.

Several alternatives relate to Air Force management of science and engineering career fields. For example, the Air Force could offer greater opportunities for officers to study for master's degrees in S&E areas and relatively fewer opportunities in other fields. Another alternative would be to change promotion policy. Air Force flag officers typically have their highest degrees in more general academic fields, such as national security policy or international relations. Air Force officers may not perceive the acquisition of a degree in S&E as a path to the top. If more S&Es were promoted, retention in these career fields might increase.

Another possibility is the use of lateral entry,[3] bringing in people who already have civilian training in S&E. The military Services traditionally have preferred to bring in junior people and train them internally. Advocates of lateral entry suggest that it can reduce the number of people whom the military has to train, and thus reduce the size of the active force. Lateral entry also gives the military a means to tailor the size and skill

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2 See http://afas.afpc.randolph.af.mil/csrb/default.htm

3 Karen W. Tyson and Stanley A. Horowitz, *Lateral Entry of Military Personnel,* Institute for Defense Analyses, IDA Paper P-2565, Alexandria, VA, March 1992.

mix of forces to their needs. In case of an immediate need, it might be possible to add people with the right technical skills quickly, without a wait of, at best, several months for them to complete training. Long commitments would no longer be needed to recoup investments in training. In addition to civilians with S&E training, the military could provide inducements for specialists with prior service to return.

III. DEFINING THE BASELINE

Our baseline had to reflect a situation of No Bonus (CSRB). In order to develop such a baseline, we needed a comprehensive picture of both military and civilian scientists and engineers in the Air Force.

We began by asking for information on positions in the Air Force requiring S&E specialties; they provided us with a database, which we sorted by position number. We also obtained data on the military officers and civilian employees occupying positions in science and engineering specialties from the Air Force Personnel Center (AFPC). Initially, our strategy was to match position numbers in the two databases, to see the extent to which existing positions were vacant, or occupied by under-qualified individuals. This proved infeasible. Our attempt to match positions ("spaces") with officers or employees ("faces") resulted in a very poor match rate. The Air Force told us that they had experienced the same problem.

Thus, we were unable to determine the number of vacant S&E billets in a systematic way, so we examined whether the Air Force was using a large number of non-S&Es in the S&E billets. We also examined the extent to which S&E officers were performing non-S&E duties.

A. BASELINE DATA—MILITARY OFFICERS

We used the AFPC data on officers performing S&E duties as the baseline. The following are descriptions of the five AFSCs regarded by the Air Force as science and engineering specialties and proposed for the bonus:

- 32E Civil Engineer: Develops and implements civil engineer (CE) force employment, and provides staff supervision and technical advice. Performs and manages CE functions and activities to provide facilities and infrastructure supporting the United States and allies. Activities include programming, budgeting, project management, drafting, surveying, planning, feasibility studies, construction management, utilities operations, energy and environmental programs, land management, real property accounting, fire protection, explosive ordnance disposal (EOD), disaster preparedness (DP) programs, family housing and dorm management, and mobilization programs at base level. Serves on response teams and related installation support

services. Advises commanders and government officials on effective use of CE resources.

- 33S Communications and Information: Supports Joint and Service communications and information (comm and info) requirements. Implements and conducts comm and info unit operations. Conducts defensive information operations. Manages communications-related plans, acquisitions, architectures, information resources, postal operations, comm and info engineering efforts, and Air Force visual information (VI) needs. Supports force employment planning, execution, and combat assessment. Conducts deployed communications operations. Plans, develops, engineers, and maintains comm and info architectures and standards. Develops programs to perform Air Force, Joint, and allied missions. Performs operations and maintenance of VI activities. Provides executive officer support.
- 61S Scientist/Research: Conducts or manages programs, projects, and activities to perform research. Research includes defining a problem, selecting methods of approach, performing experiments, accumulating and interpreting data, and publishing results. Research management includes formulating, planning, fiscal programming, monitoring, evaluating, coordinating, and administering programs, projects, and activities.
- 62E Developmental Engineer: Plans, organizes, manages, and implements systems engineering processes to assure required capability over the life cycle of Air Force systems. Included are accomplishing specialized engineering processes and sub-processes; formulating engineering policy and procedures; and coordinating and directing engineering and technical management activities and operations necessary for system conception, development, production, verification, deployment, sustainment, operations, support, training, and disposal. This includes technical management associated with the requirements definition, design, manufacturing and quality, test, support engineering and technologies, modifications, spares acquisition, technical orders, mission critical computer resources, support equipment, and specialized engineering.
- 63A Acquisition Manager: Manages defense acquisition programs covering every aspect of the acquisition process, including integrating engineering, program control, test and deployment, configuration management, production and manufacturing, quality assurance, and logistics support. Performs functions essential to acquisition programs involving major defense acquisition programs and other than major systems or subsystems. Performs acquisition support roles.

B. NON-S&E OFFICERS ASSIGNED TO S&E DUTIES

We were unable to estimate the number of military S&E vacancies in the Air Force because of the failure of the faces-spaces-matching exercise previously described. As some measure of the degree to which the Air Force is suffering these shortages, we assessed whether there were non-S&E officers assigned to S&E duties.

We found that 1291 officers (11.7 percent of the total on S&E duty) do not have an S&E core group (See Table III-1). Over 60 percent have core groups listed as "unknown/other." Of those who have a core group listed, typical specialties are operations, navigators, pilots, or rated (colonels).

Table III-1. Core Groups of Non-S&E Officers on S&E Duty

	S&E Duty Assignment					
Core Group Area	**32E**	**33S**	**61S**	**62E**	**63A**	**Total**
Unknown/Other	91	329	26	155	212	813
Operations	1	33	9	28	37	108
Navigator (LT-LTC)	1	2	2	10	74	89
Rated (COL)	5	7	6	7	43	68
Pilot (LT-LTC)	1	1	8	9	39	58
Logistics	1	13	7	4	21	46
Other Specialties*	2	26	7	4	6	45
36P Personnel	0	21	4	0	2	27
64P Contracting	0	5	2	0	12	19
65F Finance	0	6	1	1	10	18
Total non-S&Es on S&E Duty	102	443	72	218	456	1291
Total on S&E Duty, Regardless of Core Group	1357	4062	867	2239	2514	11039

* Such as Weather, Intelligence, and Manpower. No single core group had more than 13 officers.

The characteristics of non-S&E officers on S&E duty indicate that many of them are moving toward formal designations as S&Es. Sixty percent are grade O1, 2nd lieutenants. See Table III-2.

Table III-2. Grades of Non-S&Es in S&E Duty

Grade	Number of Officers	Percent
2nd Lieutenant	775	60
1st Lieutenant	38	3
Captain	144	11
Major	119	9
Lt Colonel	113	9
Colonel	102	8
Total	1291	100

However, almost two-thirds of these non-S&E officers on S&E duty have a primary AFSC in the S&E field. For more than half, their highest degree is a BA or BS. Over one-quarter have engineering degrees, but there are many with general degrees in management or liberal arts. Only 48 have degrees in chemistry or physics.

When we exclude officers with fewer than two years of service, there are 504 officers assigned to S&E duty without a core S&E designation. There are now only 36 officers with a core group listed as "unknown/other." The most prevalent core groups are operations (21 percent, including space and missile operations, air traffic control, air battle management, and combat control); navigators (18 percent); rated colonels (13 percent); and pilots (12 percent). Not counting the junior officers, 77 percent of these officers have a master's degree or better.

We conclude that the Air Force is using some S&E duty positions for on-the-job training for their junior officers. This is one way to alleviate a shortage of trained S&Es. In grades above 2nd lieutenant, officers serving in S&E positions generally have the required educational qualifications.

C. S&E OFFICERS ASSIGNED TO NON-S&E DUTIES

In order to have well-rounded officers, the Air Force rotates them through a variety of duties. We wanted to determine if the Air Force has a large group of S&E officers performing other duties; if so, then the Air Force could move these trained S&E officers into S&E duties rather than offering a bonus.

About 86 percent of Air Force officers with a core group in the S&E area are performing S&E duties. The duty AFSCs of these officers are shown in Table III-3.

Table III-3. Duty AFSCs of Core S&Es on S&E Duty

Duty AFSC		Core Group					
		32E Civil Engineer	33S Comm-Computer Systems	61S Scientist	62E Dev. Engineer	63A Acq Manager	Total
32E	Civil Engineer	**1249**	*1*	*1*	*4*	*0*	1255
33S	Comm-Computer Systems	*7*	**3605**	*4*	*1*	*2*	3619
61S	Scientist	*2*	*6*	**738**	28	*21*	795
62E	Developmental Engineer	*3*	*5*	*15*	**1948**	*50*	2021
63A	Acquisition Manager	*3*	*3*	*55*	*407*	**1590**	2058
Duty AFSC Same as Core Group		**1249**	**3605**	**738**	**1948**	**1590**	**9130**
Outside Core Group but in Other S&E Duty AFSC		*15*	*15*	*75*	*440*	*73*	*618*
S&E Core Group and S&E Duty AFSC		1264	3620	813	2388	1663	9748

Of the S&E officers, 9130 have a duty AFSC that is the same as their core group. Another 618 are performing S&E duties outside their core group; more than 70 percent of these are S&E officers from core groups 32E, 33S, 61S, and especially 62E assigned as acquisition managers, which is consistent with Air Force policy that acquisition managers are developed from other specialties, and that one must perform acquisition management duties for a period of time before being assigned to that core group.

About 1600, or 14 percent, are performing other duties. Table III-4 shows the most prevalent duties for S&Es in other areas. Instructors and students account for 511 positions, 4.4 percent of its core S&E officer total. If the Air Force used lateral entry more often, it would be able to reduce the number of positions it devotes to students and instructors. Table III-5 shows the occupational families for the same group of officers.

Table III-4. Most Prevalent Duties for S&E Officers Not Currently on S&E Duty

Duty AFSC	Duty Title	32E Civil Engineer	33S Comm-Computer Systems	61S Scientist	62E Dev. Engineer	63A Acq. Manager	Total
81T0	Instructor	30	121	34	46	63	294
92S0	Student	32	73	14	46	52	217
16R	Planning and Programming	13	35	10	65	45	168
16G	AF Operations Staff Officer	5	25	14	29	16	89
21A	Aircraft Maintenance	0	2	6	33	40	81
16P	Int'l Politico – Military Affairs	7	12	4	25	29	77
30C	Support Commander	31	20	8	3	5	67
13S	Space and Missile Operations	1	4	4	36	17	62
97E0	Executive Officer above Wing Level	4	21	2	14	17	58
82A0	Special Duty	5	17	10	13	9	54
14N	Intelligence	0	5	12	21	11	49
91C0	Command	6	16	5	14	3	44
86P0	Special Duty	1	15	5	8	8	37
36P	Personnel	1	12	8	3	10	34
86M0	Special Duty	4	7	4	5	9	29
88P0	Special Duty	3	17	0	3	6	29
81C0	Special Duty	6	10	3	4	3	26
16F	Foreign Area	2	5	5	7	6	25
All others		19	46	22	28	62	177

Table III-5. Duty AFSC Family for Core S&Es Performing Non-S&E Duties

Core Group						
Duty AFSC Family	**32E Civil Engineer**	**33S Comm-Computer Systems**	**61S Scientist**	**62E Dev. Engineer**	**63A Acq. Manager**	**Total**
Special Duty (includes Instructors)	53	207	62	83	109	514
Operations	30	95	51	187	128	491
Reporting IDs (includes students)	47	112	24	77	76	336
Support	33	42	17	7	16	115
Logistics	3	4	8	39	53	107
Acquisition*	0	1	5	8	28	42
Unknown / Other	4	2	3	2	1	12
Total	170	463	170	403	411	1617

* Includes program director (20), finance (11), and contracting (11).

About 30 percent of the officers (491 of 1617) on non-S&E duty are in operational positions. This number represents 4.3 percent of the core S&E officers. The Air Force argues that many S&E positions need to be designated as military, because the military officers can obtain operational experience.

It appears that the Air Force could increase the number of officers filling S&E positions by changing its policies on accession (encouraging the accession of more experienced officers, thus saving instructor and student time) and rotation (requiring fewer career-broadening assignments).

D. BASELINE DATA—CIVIL SERVANTS

The civilian occupational series corresponding to AFSCs 61S and 62E were obtained from an Air Force briefing to the Science and Engineering Summit (Source: Lt Gen Plummer Intro Briefing to the Science and Engineering Summit, 11 Dec 00; http://www.safaq.hq.af.mil/aqre/summit_I/index.html)

To obtain comparable civilian Occupational Series for AFSCs 32E, 33S and 63A, we used AFMAN 36-2105 to highlight mandatory and desirable educational requirements. Using education as a basis, we referred to the Handbook of Occupational

Groups and Families, United States Office of Personnel Management, August 2001, to identify matching Occupational Series. For example, Mechanical Engineer is one of the undergraduate academic specializations mandatory for the 32E AFSC. The Handbook of Occupational Groups and Families identified GS-0830 as the Occupational Series for Mechanical Engineering.

An additional step was required for the 63A Acquisition Manager Air Force specialty. The Air Force desires that entry into the 63A AFSC be preceded by assignment in another utilization field, whenever possible (AFMAN 36-2105, Pg 237). The science and engineering career manager for AFSC 61S and 62E AFSCs reported that most disciplines which fall under the realm of science and engineering qualify to become acquisition managers; therefore, occupational series for this career field were adapted from those from the 61S and 62E AFSC, excluding life sciences and other specialized sciences that did not meet the criteria for acquisition managers.

We used DMDC data from the November 2001 DoD Occupational Conversion Index to identify additional occupational series and to validate already-identified occupational series. In addition, we consulted Air Force personnel specialists to determine the best matches. We were thus able to exclude medical and health sciences, social science, finance, and general management. For each of the five S&E AFSCs, we found that almost all the appropriate occupational series came from three major groups:

- 08—engineering
- 13—physics, chemistry, astronomy, and related sciences
- 15—mathematics, statistics, and operations research.

Table III-6 shows the crosswalk between the military AFSCs and the civilian occupational series. We requested data from AFPC on the current characteristics and salaries of Air Force civilian employees in occupations similar to the targeted AFSCs.

Table III-6. Crosswalk of Civilian Occupational Series with Military Science and Engineering AFSCs

Occupational Series	32E	33S	61S	62E	63A
0801 General Engineer	X	X		X	X
0804 Fire Prevention Engineering				X	
0806 Materials Engineering				X	X
0807 Landscape Engineer	X				

Table III-6. Crosswalk of Civilian Occupational Series with Military Science and Engineering AFSCs (Concluded)

Occupational Series	32E	33S	61S	62E	63A
0808 Architect	X				
0809 Construction Control	X				
0810 Civil Engineer	X				
0819 Environmental Engineering	X			X	X
0830 Mechanical Engineering	X			X	X
0840 Nuclear Engineering				X	X
0850 Electrical Engineering				X	X
0854 Computer Engineering		X		X	X
0855 Electronics Engineering	X	X		X	X
0856 Electronics Technician	X	X		X	X
0858 Biomedical Engineering				X	
0861 Aerospace Engineering				X	X
0881 Petroleum Engineering				X	X
0892 Ceramic Engineering				X	X
0893 Chemical Engineering				X	X
0896 Industrial Engineer		X		X	X
1301 General Physical Science			X		X
1310 Physics		X	X		X
1313 Geophysics			X		
1315 Hydrology			X		
1320 Chemistry			X		X
1321 Metallurgy			X		X
1330 Astronomy and Space Science			X		X
1340 Meteorology			X		
1350 Geology			X		X
1360 Oceanography			X		
1370 Cartography			X		
1372 Geodesy			X		
1386 Photographic Technology			X		
1510 Actuary			X		
1515 Operations Research			X		X
1520 Mathematics		X	X		X
1529 Mathematical Statistician			X		X
1530 Statistician			X		X
1540 Cryptography			X		
1550 Computer Science		X	X		X

The civilian population selected was Air Force civilians as of September 2001 who were in at least one of the listed occupations.

E. COMPARISON OF OFFICER AND CIVIL SERVICE PERSONNEL INVENTORIES

Air Force civilian S&E accessions are distributed across age groups, rather than being largely entry level. More than half the accessions in our data set were people age 35 or older (see Figure III-1). In contrast, the typical Air Force officer accession is 22 or 23 years old.

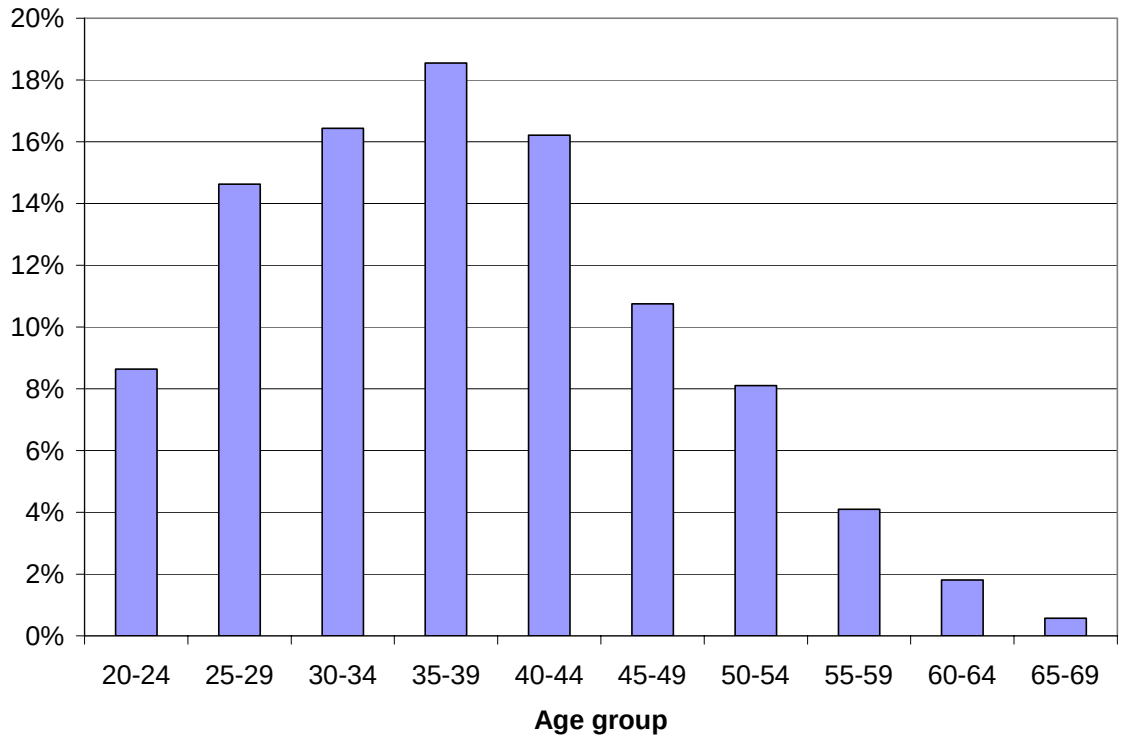

Figure III-1. FY 2001 Age Distribution of Air Force Civilian S&E Accessions

Consistent with the older average age of civilian S&E accessions, the average age of civil servants in the three science and engineering occupational fields was 45, 11 years older than the average age of the officer scientists and engineers. Only 13 percent of the civilians were younger than 35, compared to 54 percent of the officers; 46 percent of the civilians were 40 or older, compared to 20 percent of the officers. (See Figure III-2.)

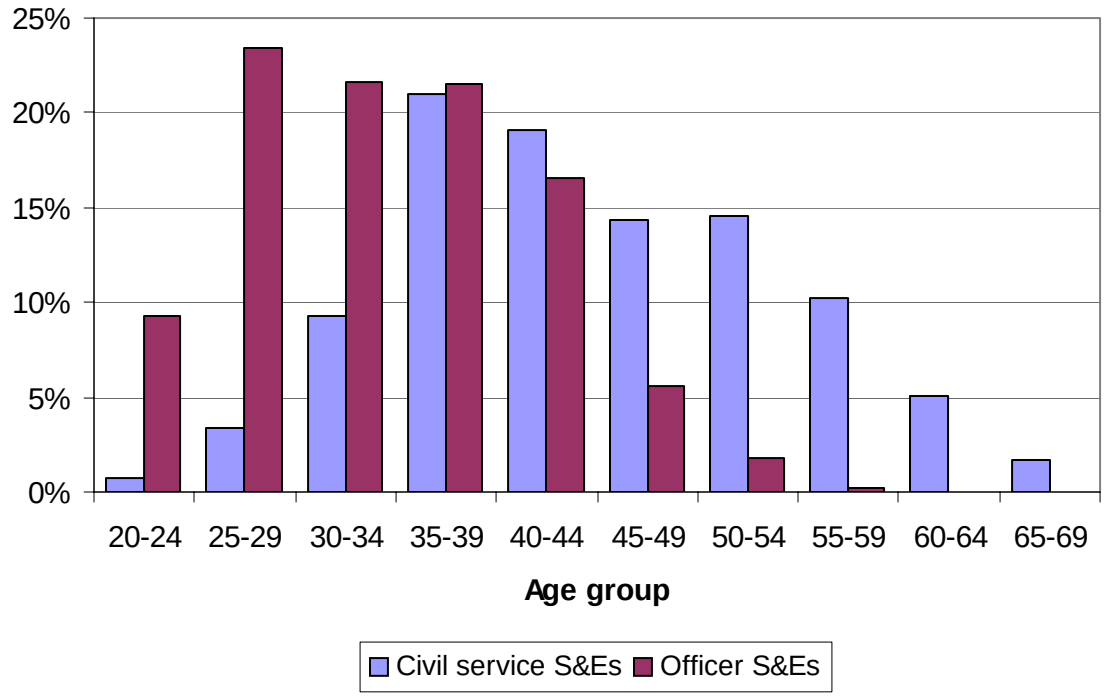

Figure III-2. FY 2001 Military and Civilian Age Distributions

A greater percentage of military S&Es in the higher grades have advanced degrees than do civilian S&Es. Overall, about 60 percent of these military officers have advanced degrees, about half being in technical fields, whereas 34 percent of the civilian S&Es have advanced degrees. Table III-7 shows that virtually all lieutenant colonels and colonels have post-graduate degrees; over 90 percent of majors do, as well. This contrasts with 71 percent of GM/GS-14s and 81 percent of GM/GS-15s. We do not know, however, what percentage of the advanced degrees held by Air Force civilians are in S&E fields.

Table III-7. Percentage of Officer and Civilian S&Es with Advanced Degrees

Military Grade	Percent	Civilian Grade	Percent
(02) 1 LT	12	GM/GS 7	12
(03) CPT	50	GM/GS 8	17
(04) MAJ	92	GM/GS 9	19
(05) LTC	100	GM/GS 10	22
(06) COL	100	GM/GS 11	25
		GM/GS 12	31
		GM/GS 13	51
		GM/GS 14	71
		GM/GS 15	81

IV. OFFICER BASELINE AND BONUS ANALYSIS

A. DETERMINING MILITARY ENDSTRENGTH

One way of accommodating the additional retention generated by the bonus (CSRB) is to increase officer endstrength (end of year personnel strength), allowing the number of Air Force officers to increase. We used this approach (despite the fact that the Secretary of Defense made clear that endstrength would not be allowed to increase) so we could get a clear idea of the cost difference between officer and civil service S&Es. If the Air Force were required to maintain constant endstrength under the CSRB pay option, it would have many different implementation choices—i.e., many ways of decreasing the number of officers in other specialties to accommodate the increase in S&Es. This analysis highlights the differences between a future force under a baseline no-bonus option and the CSRB option, and the simplest way to do that is to allow endstrength to increase.

We projected how each core group's personnel inventory—the number of officers in each year of service and grade—would evolve from FY 2002 through FY 2012 for a No-CSRB case and a CSRB case. The key data needed for this projection were the number of officers in each year of service and grade in FY 2001, the rates at which officers in the core groups are expected to join and leave the Air Force, and promotion rates.

The Air Force Personnel Center provided the necessary information to describe the FY 2001 personnel force inventory for each of the five core groups: 32E, 33S, 61S, 62E, and 63A. Because the number of officers in the first year of commissioned service seemed to be undercounted in the AFPC data, we obtained FY 2001 accessions numbers from documents provided by the Air Force Personnel Operating Agency to OASD (P&R).[4] We assumed that accession rates of officers in these core groups remained constant at their FY 2001 levels.

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[4] New officers may not be assigned to an S&E core group until they have some experience. It is also possible that many new officers' records were not updated for their core group until their second year of service.

AFPOA provided us with retention rates—the percentage of officers in each year of service who continue in the Air Force from one year to the next.[5] For each core group, AFPOA provided us with the two sets of retention rates it used to justify an Air Force request for paying a CSRB. One set is AFPOA's estimate of what retention rates would be in the absence of a CSRB, i.e., the baseline, or No-CSRB case. The other set is AFPOA's estimate of what retention rates would be if officers if the core groups were awarded CSRBs. We assumed these retention rates would not change throughout the projection period.

The AFPOA retention rates are solely by year of service and are not broken down by grade. Thus, for each core group we projected the number of officers in each year of service for each fiscal year from 2002 to 2012. That is, we calculated

$$n_y(t) = r_{y-1}\, n_{y-1}(t\text{-}1) \text{ for } y = 2, \ldots, 30, \text{ and } t = 2002, \ldots, 2012$$

$$n_1(t) = accessions(FY\ 2001)$$

where $n_y(t)$ is the number of officers in the y^{th} year of service at the end of fiscal year t and r_{y-1} is the retention rate—the fraction of officers in the $y\text{-}1^{st}$ year of service at the end of a fiscal year who remain until the end of the next fiscal year (and into the y^{th} year of service).

Instead of assuming that accessions will be at the FY 2001 level for each core group, we could have assumed that the Air Force would achieve its target accession levels for FY 2002 through FY 2004.[6] Had we used these target levels, which are higher than the actual FY 2001 accessions, we would have projected larger, but more junior, personnel inventories in each core group. The Air Force did not often meet its accession targets in these core groups during the years from FY 1997 through FY 2001, but two of the core groups exceeded them, so we were unsure about the realism of the Air Force targets. Fortunately, our cost comparisons are not especially sensitive to this assumption about accession rates.

To obtain the grade distribution, we assumed that within each year of service the future percentage of officers in each grade would be the same as it was in FY 2001, i.e., we assumed that the promotion rates of engineers and scientists are independent of their

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5 The numerator in the retention rate calculation includes all who stayed in the Air Force from one year to the next regardless of whether they were eligible to leave or not. The denominator includes all who stayed plus all who left.

6 We did not have target accession levels for years beyond FY 2004.

retention rates. Thus, if the fraction of officers in year of service y who were in grade g is p_{gy}, the number of officers in that grade and year of service in FY t is $p_{gy}n_y(t)$.

B. BASELINE MILITARY PERSONNEL PROJECTIONS

Table IV-1 presents each core group's projected officer personnel end of year strength for each year from FY 2002 through FY 2012. The personnel strengths of two core groups—32E and 62E—decline over the period, while the personnel strengths of the other core groups increase.[7] This increase-decrease is partly a result of our assumption of constant accessions at the FY 2001 level.

Table IV-1. Projected Personnel Endstrengths without Bonus (CSRB) Payments

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
32E	1488	1470	1453	1437	1424	1414	1403	1388	1375	1364	1359
33S	4485	4548	4606	4654	4692	4718	4744	4770	4802	4830	4858
61S	968	994	1017	1037	1052	1066	1081	1095	1111	1125	1138
62E	2755	2727	2692	2647	2603	2561	2527	2497	2469	2449	2434
63A	2349	2424	2490	2536	2571	2595	2613	2628	2647	2672	2699

The projected engineer and scientist forces become younger over time due to several factors: relatively low accessions in recent years compared to projected accessions, relatively large year groups reaching retirement eligibility, and low retention rates. Figures IV-1 through IV-5 display the projected numbers of officers by year of service for FY 2002 and FY 2012. Inspection of these figures shows the proportion of officers in the first 10 years of service is noticeably larger in FY 2012 than in FY 2002.

[7] We could not determine how many officers experience mid-career changes in their core specialties. These changes would cause us to under- or overestimate personnel strengths and percentages of officers in field grades, depending on whether a core group had a net inflow or outflow of officers due to mid-career changes.

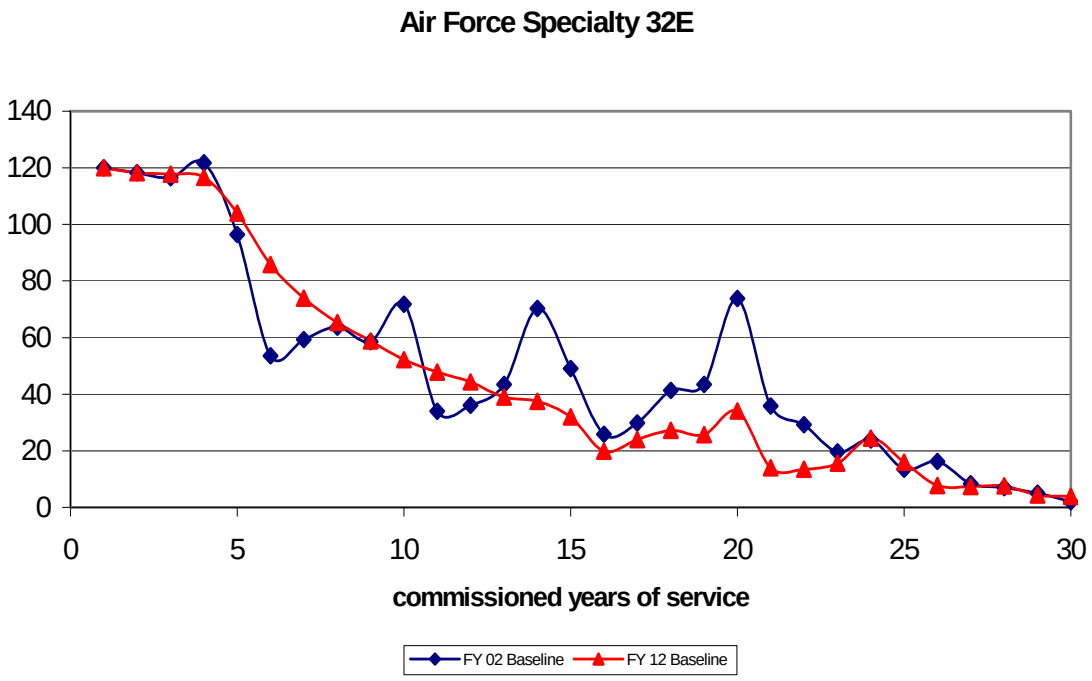

Figure IV-1. Baseline Personnel Inventories: Core group 32E

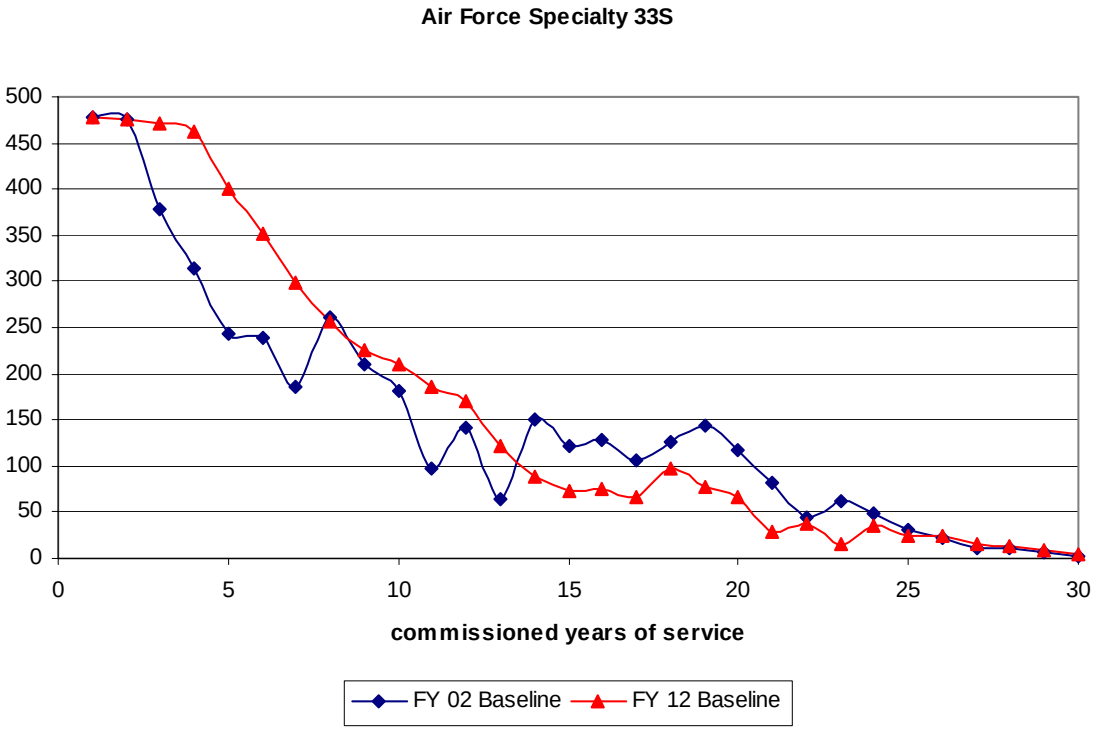

Figure IV-2. Baseline Personnel Inventories: Core group 33S

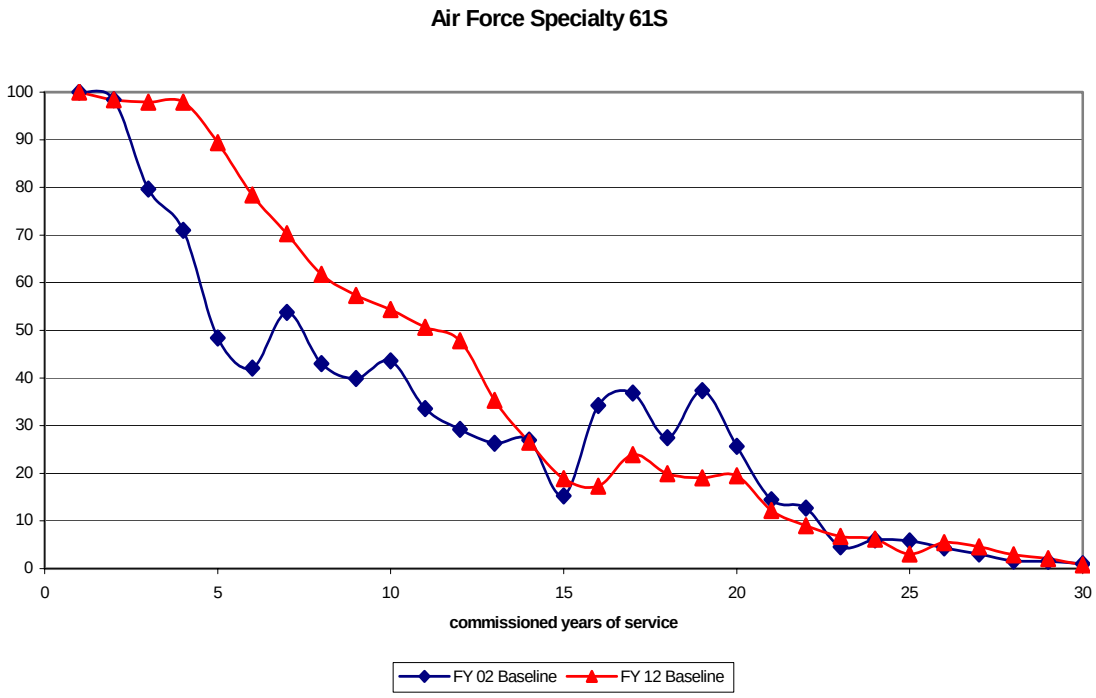

Figure IV-3 Baseline Personnel Inventories: Core Group 61S

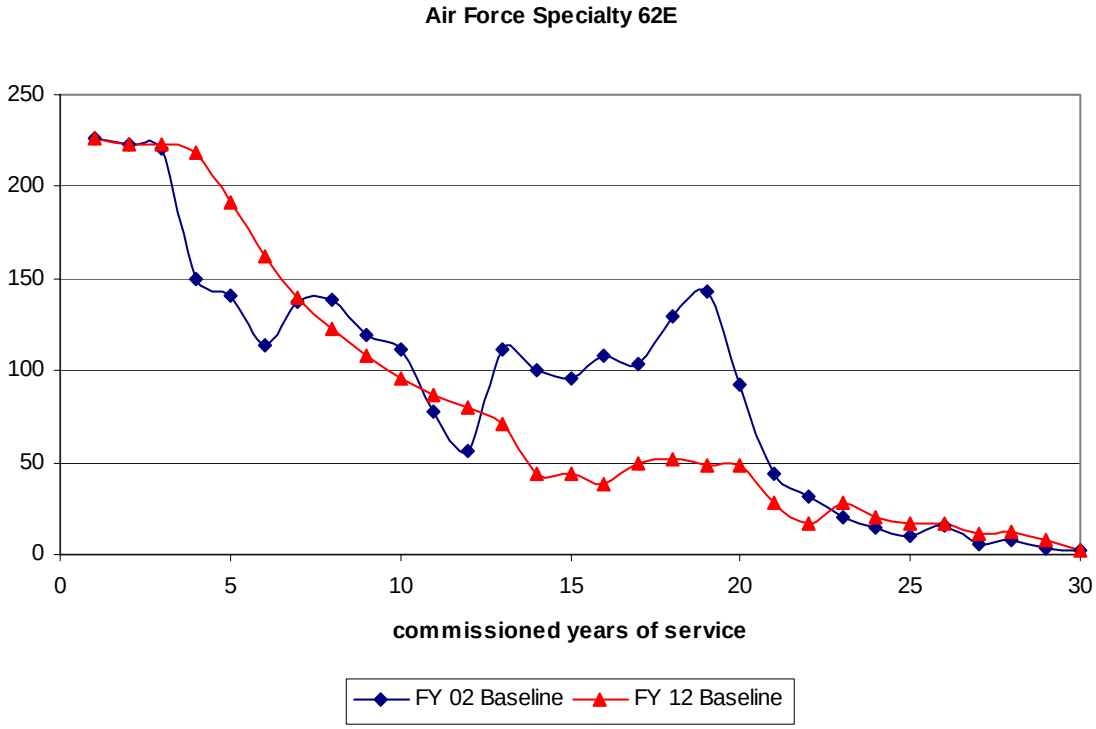

Figure IV-4. Baseline Personnel Inventories: Core Group 62E

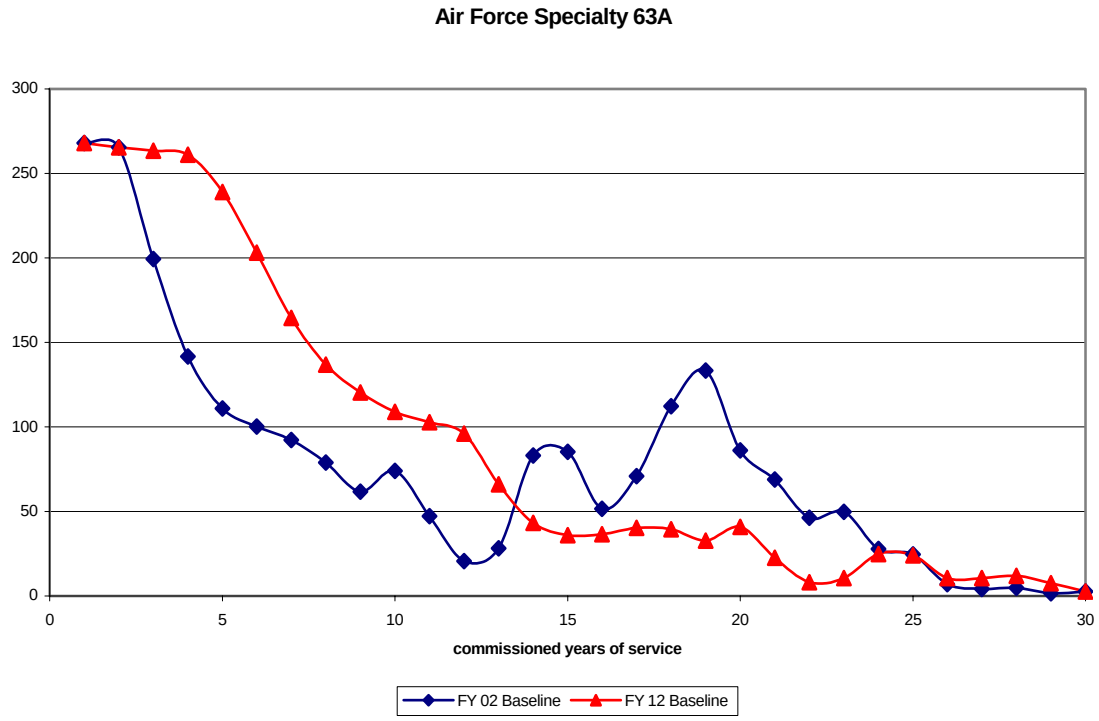

Figure IV-5. Baseline Personnel Inventories: Core Group 63A

Figure IV-6 displays the predicted cumulative retention rates of officers given completion of three years of service. Except for 61S, these cumulative retention rates, calculated from the AFPOA-supplied retention rates, are almost uniformly lower than the cumulative retention rates for all non-rated line officers. We calculated the cumulative retention rate, c_y, as

$$c_y = \prod_{i=4}^{y} r_i \, .$$

We calculated the retention rates for all non-rated line officers by comparing personnel inventories in FY 2001-FY 2002. For example, we calculated the retention rate for the 10th year of service by dividing the number of officers in the 11th year at the end of FY 2002 by the number of officers in the 10th year at the end of FY 2001. This way of calculating retention rates does not distinguish between losses to the Air Force and losses to the non-rated force due to completion of undergraduate flying training. To avoid misleading retention statistics for the non-rated force, we began the retention comparison with those who completed three years of service, because most pilots and navigators have completed their undergraduate flying training by this year of service. After obtaining these retention rates for all non-rated line officers, we calculated the cumulative retention rates in the manner described above.

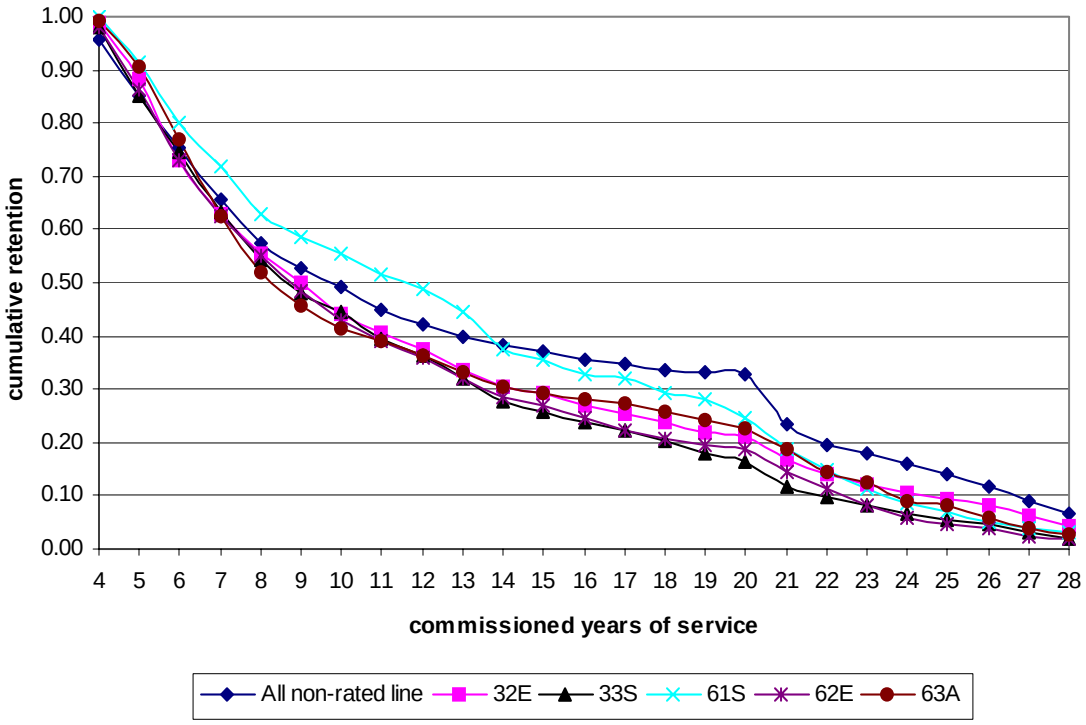

Figure IV-6. Cumulative Retention from Fourth Year of Service

C. MILITARY PERSONNEL PROJECTIONS WITH BONUSES

Table IV-2 compares total personnel strengths in the baseline (No Bonus) and bonus cases for each fiscal year from FY 2002 to FY 2012. The CSRBs are projected to increase personnel strengths in each of the five core groups.[8] By FY 2012, each core group's projected personnel strength is 14–16 percent greater than it would have been in the absence of CSRB payments.

Figures IV-7 through IV-11 display the differences in the FY 2012 projected personnel strengths by year of service for each core group. The bonuses are predicted to significantly increase the number of mid-career officers compared to the no-bonus baseline, and increase the total number of officers by 15 percent. The bonus would continue increasing the number of officers beyond 20 years of service if we had projected beyond FY 2012.

8 We double-checked our projections with AFPOA's. For the years our projections overlapped, FY 2002–FY 2007, we projected the same increases in personnel strengths.

TABLE IV-2. Projected Personnel Endstrengths without and with Bonus Payments

	2002	2003	2004	2005	2006	2007	2008	2009	201(	2011	2012
32E											
No Bonus	1488	1470	1453	1437	1424	1414	1403	1388	1375	1364	1359
Bonus	1512	1518	1523	1527	1534	1542	1548	1551	1555	1559	1567
Difference	*24*	*48*	*70*	*90*	*110*	*128*	*145*	*163*	*180*	*194*	*208*
33S											
No Bonus	4485	4548	4606	4654	4692	4718	4744	4770	4802	4830	4858
Bonus	4566	4702	4830	4948	5053	5142	5231	5319	5413	5500	5583
Difference	*81*	*153*	*225*	*294*	*361*	*424*	*486*	*549*	*610*	*670*	*725*
61S											
No Bonus	968	994	1017	1037	1052	1066	1081	1095	1111	1125	1138
Bonus	983	1024	1061	1097	1126	1155	1185	1214	1245	1275	1301
Difference	*15*	*30*	*44*	*59*	*74*	*89*	*103*	*119*	*134*	*149*	*163*
62E											
No Bonus	2755	2727	2692	2647	2603	2561	2527	2497	2469	2449	2434
Bonus	2802	2817	2824	2816	2807	2798	2794	2794	2794	2804	2814
Difference	*48*	*90*	*131*	*169*	*204*	*237*	*267*	*297*	*326*	*354*	*380*
63A											
No Bonus	2349	2424	2490	2536	2571	2595	2613	2628	2647	2672	2699
Bonus	2378	2481	2577	2654	2722	2781	2834	2884	2940	3003	3067
Difference	*29*	*57*	*86*	*118*	*151*	*186*	*220*	*256*	*293*	*331*	*368*

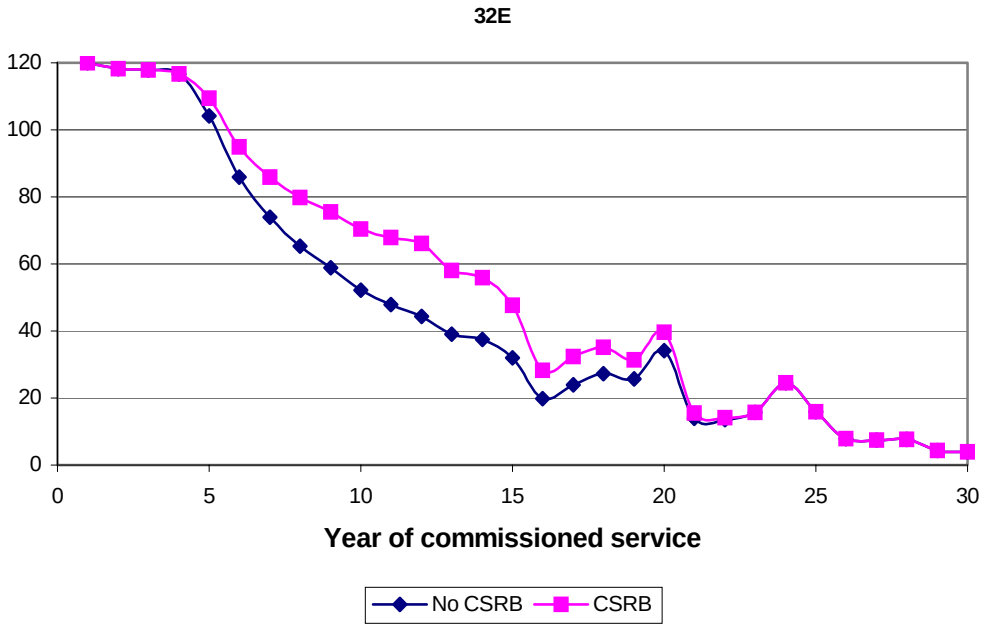

Figure IV-7. FY 2012 Personnel Inventories: Core Group 32E

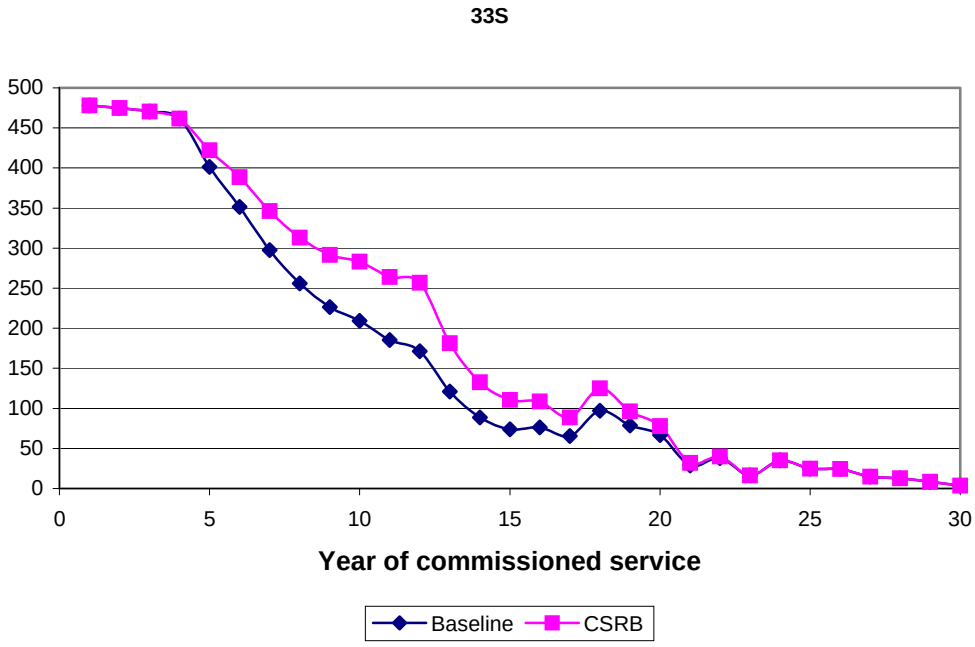

Figure IV-8. FY 2012 Personnel Inventories: Core Group 33S

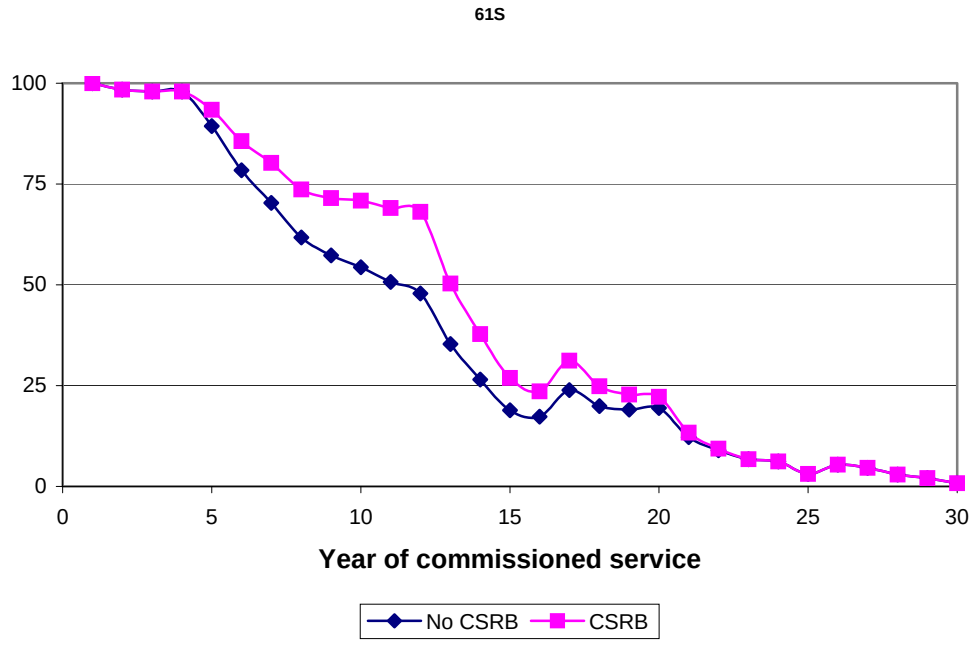

Figure IV-9. FY 2012 Personnel Inventories: Core Group 61S

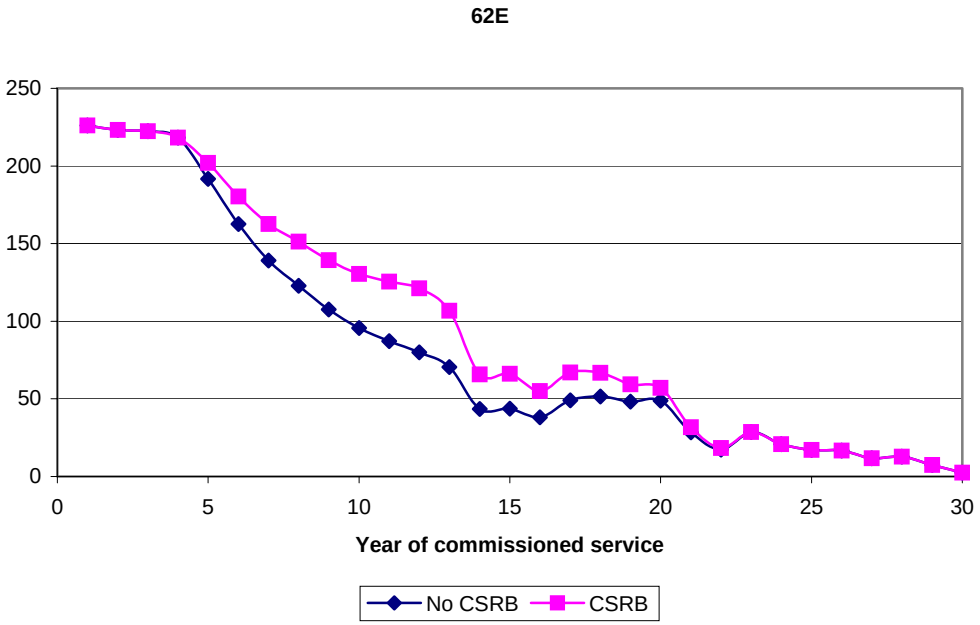

Figure IV-10. FY 2012 Personnel Inventories: Core Group 62E

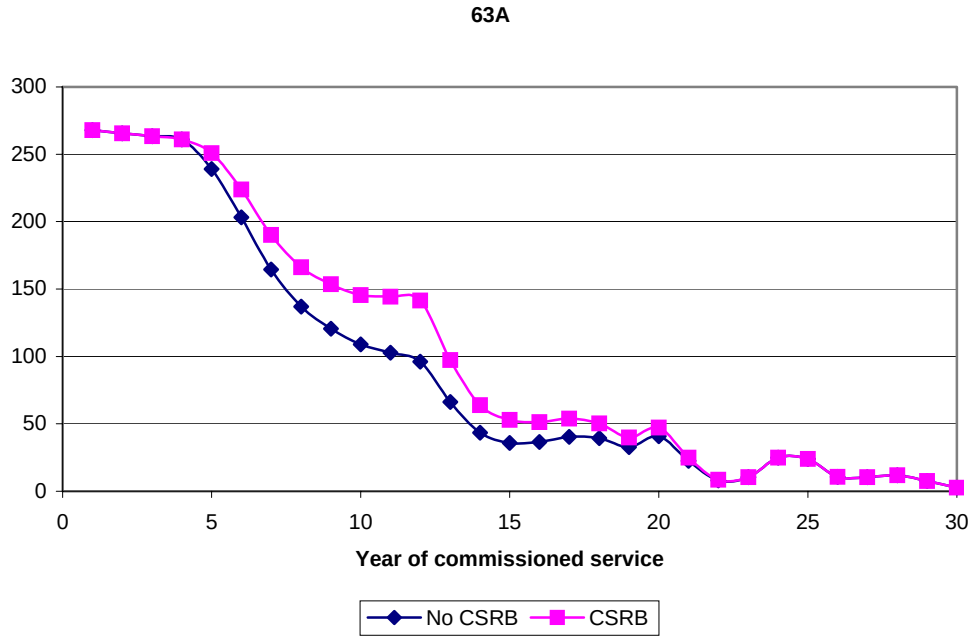

Figure IV-11. FY 2012 Personnel Inventories: Core Group 63A

The increases in projected personnel strengths are substantial and are attributable to AFPOA's predictions of the effects of CSRB payments. The Air Force predicts that CSRB payments will increase retention rates sufficiently to generate 26–29 percent increases in the total commissioned years of service per accession, depending on the core group. This substantial increase in retention is evident in Figure IV-12, which displays the differences between the baseline (No Bonus) cumulative retention rates and the CSRB-influenced retention rates, given completion of three years of service for core group 32E. The graphs for the other four S&E core groups look much the same, so we omitted them for brevity's sake.

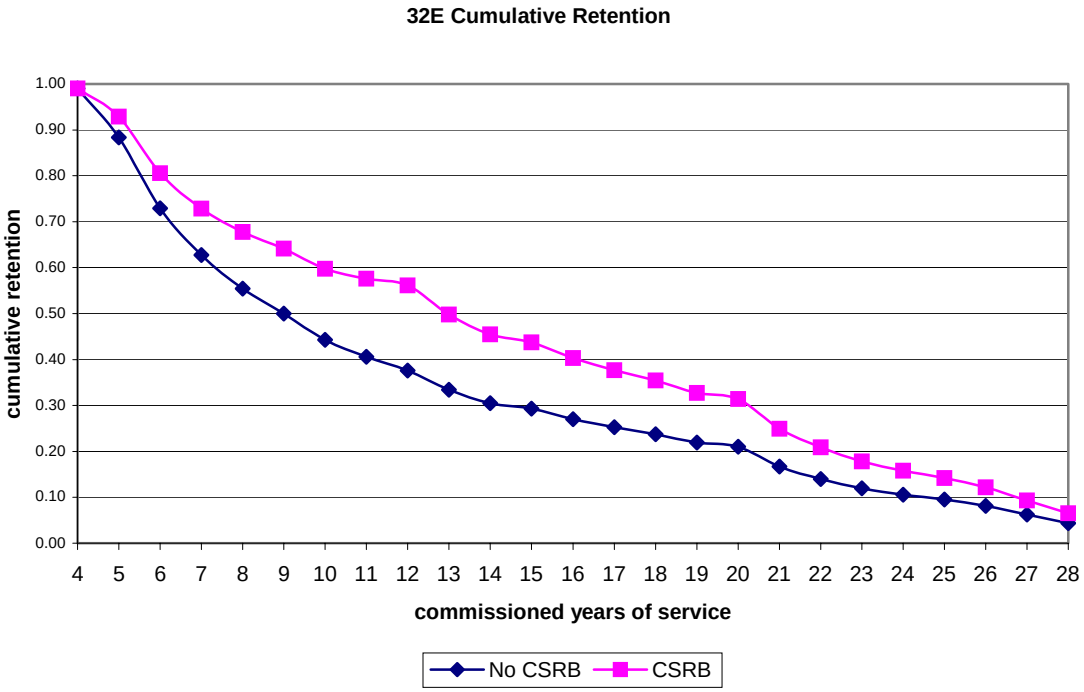

Figure IV-12. Cumulative Retention: Core Group 32E

We evaluated Air Force assumptions about retention increases due to the CSRB and found them reasonable. We found two pieces of evidence supporting Air Force estimates of the retention effects of CSRB payments, and no evidence that they are unreasonable. First, AFPOA based its predictions on recent Air Force experience with paying a similar bonus to JAG (judge advocate general) officers, a specialty that has suffered retention problems. The second piece of evidence came from simulations by a RAND Corporation researcher, Michael Mattock, who has preliminary estimates for an

officer retention model.[9] Mattock simulated the effects of an annual bonus on retention and found that retention rates increased by roughly the same amount as AFPOA's predictions. The RAND results are for Air Force officers in mission support, a collection of non-rated line career fields that include scientists and engineers.

[9] Mattock's model is an updated version of the model presented in Glenn A. Gotz and John J. McCall, *A Dynamic Retention Model for Air Force Officers: Theory and Estimates*, RAND Corporation, R-3028-AF, December 1984.

V. SUBSTITUTION OF CIVIL SERVANTS FOR OFFICERS

A. DETERMINING THE NUMBER OF CIVILIANS REQUIRED TO SUBSTITUTE FOR MILITARY OFFICERS

The number of civilians required to substitute for military officers was taken from the results of the military force projection modeling. We aged the civilian S&E labor force to determine the age-grade distribution in the future under baseline conditions.

We had two data files. The first, which we will call the AFPC File, provided information on individuals by salary, age, grade, education, etc., for the year 2001 (see Table V-1). The second, the Progress File, provided data on accessions, promotions, and retention for S&Es of various ages, grades, years of government service, and by the two federal retirement plans, FERS and CSRS, but no salary data (See Table V-2). Non-US citizens were removed from the data file.

Table V-1. Major Data Elements in AFPC File

Date of birth	Retirement plan (mostly FERS and FICA or CSRS)
Acquisition certification, yes/no and level	Locality pay area
Pay plan	Recruitment bonus
Veterans status	Occupational series
Date entered or departed current agency	Career program position ID and description
Education level	Functional class ID and description
Subject to military recall?	Organizational function ID and description
Total salary	Highest instructional program description (e.g., major)
Year completed highest degree	Occupational certification
Civilian grade of position	Academic institution, highest degree
Current occupational series	Position title
AF demonstration pay plan and description	

Table V-2. Data Elements in Progress File

Person Number	Demonstration Plan (if applicable)
Age	Demonstration Grade (if applicable)
Years until Retirement Eligibility	Educational Level
Is person in a pay demonstration project?	Organizational Function
Disposition at end of fiscal year (retained, normal loss, or programmed loss)	Appointment Type
Fiscal year (1998, 1999, 2000, or 2001)	Prior Military Service
Functional Classification [??]	Retirement Plan
Career Family	Years of Service
Pay Plan (GS or GM)	Accession this year (Yes/No)
Career Series	Effective accession date (if applicable)
Grade	

To forecast the civilian workforce, we needed to combine information about accessions and loss rates from the Progress File with salary and demographic information from the AFPC File. As we discussed above, we limited our examination to the following occupational series:

- Engineers (career series 08XX). FY 2001 personnel strength: 9978, about 85 percent of our civilian S&E population.
- Physical scientists (career series13XX). FY 2001 personnel strength: 855, about 7 percent.
- Mathematicians (career series 15XX). FY 2001 personnel strength: 855, about 7 percent.[10]

We excluded employees who were not US citizens and thus would have difficulty qualifying for security clearances. We also excluded programmed losses (235, or less than 0.5 percent of the civilian database), defined as losses for administrative reasons such as expiration of a temporary appointment, on the advice of the Air Force.

B. AIR FORCE CIVILIAN S&Es IN PAY DEMONSTRATION PROJECTS

During the time of our analysis, there were two major pay demonstration projects under way that affected Air Force civilian S&Es: the Air Force laboratory personnel demonstration and the acquisition demonstration. The pay demonstrations did not raise the overall level of pay, but it did increase its dispersion. In other words, an outstanding

[10] The personnel strengths of 13xx and 15xx in our data were identical in FY 2001. They were not the same in our FY 1998-2000 data.

performer could receive a larger raise than a mediocre performer, but the size of the total raise pool remained constant. The Air Force told us that there was no evidence that retention rates differed between those in pay demonstrations and those not. We had no information on the retention of outstanding performers in pay demonstrations. Our cost estimates below do not distinguish between the two groups.

C. ANALYZING THE MARKET FOR CIVILIAN S&Es

We needed to determine at what price the Air Force could hire the necessary civilians. If the number of civilians required is large relative to the total market, it is possible that the Air Force would have to raise its offering salaries to attract enough S&E civilians.

To examine this issue, we consulted a number of sources. The most detailed was a compilation of science and engineering salaries by the Commission on Professionals in Science and Technology (2001),[11] which provided information on the numbers of practicing scientists and engineers in the United States, by type of degree, along with salary information on S&Es in various industries.

The number of civilian accessions required under the substitution scenario peaks at 803 per year. The number of 1997–98 graduates in science and engineering fields (the latest years for which data were available) is in Table V-3, and the number employed in the Federal government in 2000 is in Table V-4. The additional civilian scientists and engineers that the Air Force would have to recruit appear to be a relatively small portion of the number available in the Federal workforce alone.

[11] Commission on Professionals in Science and Technology, *Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys*, 19th edition, Washington, D.C., June 2001.

Table V-3. Number of New Graduates in Science and Engineering Fields, by Degree Level

Field	Bachelor's Graduates	Master's Graduates
Computer and Information Science	46000	19,900
Math and Related Sciences	23700	7300
Physics, Chemistry, and Related Sciences	36600	9000
Aerospace Engineering and Related Fields	2400	1500
Chemical Engineering	12400	45000
Civil and Architectural Engineering	20200	6600
Electrical, Electronic, Computer and Communications Engineering	34200	16300
Industrial Engineering	6000	3600
Mechanical Engineering	26300	6800
Total S&E Graduates	207800	116,000

Source: Salaries of Scientists, Engineers, and Technicians, op. cit., Tables 47 and 48.

Table V-4. Number of Civilian Scientists and Engineers in the Federal Workforce, September 30, 2000 (excludes Life, Health, and Social Sciences)

Occupation	Number
Physics	2787
Chemistry	2679
Other Physical Sciences	18060
Mathematics	1357
Statistics	2903
Mathematical Statistics	1280
Computer Science	3571
Computer Specialist	57148
Operations Research	3246
General Engineering	18158
Aerospace Engineering	7640
Chemical Engineering	1063
Civil and Architectural Engineering	12858
Electrical, Electronic, and Computer Engineering	26944
Industrial Engineering	1157
Mechanical Engineering	9130
Other Engineering (excluding Biomedical)	12393
Total	182374

Source: Salaries of Scientists, Engineers, and Technicians, op. cit., Table 262.

AFPC data indicate that Air Force civilian accessions include not just new graduates but also experienced S&Es from other employers, both inside and outside the Federal civil service. While DoD uses the same civil service pay scale as do other Federal agencies, it is believed that DoD has more people in high grades than do other agencies. Thus, the Department may be a more attractive place for S&Es to work.[12]

In the Air Force civilian S&E workforce, we found that retention rates remained high even after workers became retirement-eligible under FERS, the newer of the two Federal retirement plans. (Everyone currently hired into the Federal government is required to be in FERS.) This suggests that it would be relatively easy to retain experienced S&Es once recruited.

We compared the salaries for Air Force civilian S&Es with data on salaries in US industry. Much of the Commission's data were on starting salaries, but some Federal occupational groups had no or very few workers who had started recently. Our comparison is summarized in Table V-5. While there are several missing cells, it appears that Air Force starting pay may be lower than that in industry, but Air Force pay for experienced workers is roughly comparable. This comparison does not include fringe benefits, but we found no evidence that industry fringe benefits are significantly better than those offered by the Federal government.[13] Considering the available evidence, we saw nothing to indicate that the Air Force would have to increase pay significantly to attract the required number of civilian S&Es.

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12 There are anecdotal accounts of both civilian and military S&E positions being difficult to fill. One obstacle is low grading of positions when they are changed from military to civilian. The Air Force indicates that civilian locality pay, at least in the Washington, DC area, is less adequate than the military differential.

13 Intangibles such as career challenge, job security, and advancement opportunities also were not included in our analysis. Some of these can work to the advantage of either the Air Force or industry, depending on the individual job candidate.

Table V-5. Comparison of Air Force Civilian Pay for Starting and Experienced Workers with Industry Pay, by Degree Level

BA/BS Degrees		
Occupation	**Air Force Starting Pay**	**Air Force Pay for Experienced Workers**
Aerospace Engineering	Lower than industry: AF: $39K, I: $42K	
Chemical Engineering	Lower than industry AF: $47K, I: $50K	Lower overall AF:$61K, I:$68K
Chemists	Same as industry	Higher overall AF:$56K, I:$54K
Computer engineering	Lower than industry	
Computer Science	Starting salary is only 75% of industry	Comparable to industry
Electrical Engineering	Starting: AF:$56K I:$41	
Environmental Engineering	Starting higher AF:$43K (ages 25–29) I:$32K	
General Biological Science	No data	Overall comparable AF:$56K I:$58K
General Engineering	Starting comparable AF:$44K I:$45K	
Industrial Engineering		Overall Comparable AF:$61K I:$56K
Materials Engineering	Starting lower AF:$35K I:$39K	Higher overall
Mathematics		Overall comparable AF:$69K I:$69K
Mechanical Engineering	Comparable to industry	Comparable to industry
Physics	About 90% of industry starting pay	
Telecommunications	Higher than industry	Comparable to industry

MA/MS and Higher Degrees		
Occupation	**Air Force Starting Pay**	**Air Force Pay for Experienced Workers**
Aerospace Engineering	Starting salaries slightly less AF: $49K I: $51K	94% of industry pay for PhD
Chemical Engineering	Starting salaries slightly higher (MS)AF: $51 I: $48K	(MS) lower Overall AF:$69K I:$78K (PhD) lower overall AF:$76K I:$89K
Chemists		Civil service data are sparse, but salaries appear roughly comparable, AF pay higher among those with experience. (MS) AF:$70K I:$63K (PhD) AF:$75K I:$80K
Computer Engineering		Roughly 90% of industry
Computer Science		105% of industry overall

Table V-5. Comparison of Air Force Civilian Pay for Starting and Experienced Workers with Industry Pay, by Degree Level (Concluded)

Electrical Engineering	82% of industry	((BA-PhD) Comparable overall AF:$62K I:$62K
Electronics Engineering		(BA-PhD) Overall AF:$67K I:$62K (Same Industry data as above)
Environmental Engineering		Overall less AF:$63K I:$71K
General Biological Science		Overall comparable AF:$56K I:$58K
General Engineering		Overall Comparable (MS) AF:$77K I:$75K
General Physical Science		Overall much higher (PhD) AF:$94K I:$65K
Industrial Engineering		Lower (MA) AF:$66K I:$69K Higher (PhD) AF:$90K I:$76K
Mathematics		Overall comparable AF:$69K I:$69K
Meteorology		89% of industry overall (BA-PhD)
Physics		90% of industry after 10–14 yrs since degree, 83% of industry after 20-24 years since degree

Sources: AFPC data for Air Force, Salaries of Scientists, Engineers, and Technicians for Industry.

D. PROJECTING THE CIVIL SERVICE S&E PERSONNEL FORCE

For each of the three civil service S&E occupational groups, we projected how the number of people at each age and grade would evolve from FY 2002 through FY 2012 for a baseline case and for a substitution case. The baseline case maintains personnel strengths for the three occupations at FY 2001 levels. The substitution case increases civilian endstrengths to substitute for the increase in officers that would be achieved when CSRBs are paid. Thus, the civilian projections were structured so that the total personnel strength for each fiscal year—officer plus civilian—in the baseline case would be exactly the same as in the CSRB case, but the CSRB case would have more officers and fewer civilians than the substitution case.

We assumed that if the Air Force began paying CSRBs, there would be no need for the number of Air Force civil service S&Es to grow. Thus, our civilian baseline case accessed just enough new civilian S&Es to replace personnel losses in each projection year. On the other hand, the substitution case assumed that the Air Force did not pay

CSRBs and the civil service workforce would need to increase to make up for the shortage. Table IV-2 in the preceding section shows CSRB payments increased the projected number of officers by 197 in FY 2002, trending up to 1845 by FY 2012. Thus, substitution case accessions were structured not only to replace civilian S&E losses but also to increase the size of the civil service workforce by 197 in FY 2002, trending up to 1845 in FY 2012.

The number of civilians in each civil service occupational area covered by retirement system *r* who are *a* years old and in grade *g* in FY *t* was projected as

$$c_{rag}(t) = civ\_acc_{rag}(t) + c_{r,a-1,g}(t-1)\ civ\_ret_{r,a-1,g}\ (1-prom_{a-1,g}) + c_{a-1,g-1}(t-1)\ civ\_ret_{r,a-1,g-1}\ prom_{a-1,g-1}$$

This expression is simply the number of accessions plus the number of civil servants a year younger in the preceding year who were retained and not promoted out of grade *g*, plus the number of civil servants a year younger and a grade lower in the preceding year who were promoted into grade *g*, where

- $c_{rag}(t)$ is the number of civil servants covered by retirement system *r* (CSRS, FERS) who are *a* years old and in grade *g* in FY *t*.
- $civ\_acc_{rag}(t)$ is the number of accessions into grade *g* in FY *t* who are *a* years old.
- $civ\_ret_{r,a-1,g}$ is the retention rate of civil servants covered by retirement system *r* (CSRS, FERS) who are *a-1* years old and in grade *g*.
- $prom_{a-1,g-1}$ is the promotion rate of civil servants who are *a-1* years old and in grade *g-1*.

We distinguished between the two retirement systems because the retention rates differ between them. We assumed that these retention rates and the promotion rates would not change during the projection period.

The retention rates we used were the average retention rates over the period FY 1998–2000 for each retirement system/age/grade cell.

We calculated the total number of civilian accessions for each occupational group in the Substitution/No Bonus case as the number sufficient to replace losses. Accessions in the substitution case were calculated to be the number required to replace losses plus increase personnel strength to the newly desired levels. We assumed that the proportional age and grade distribution of each civil service occupation's accessions would remain

unchanged from the distribution in 1999-2001.[14] This assumption could be way off the mark if the level of accessions required to meet personnel strengths were to increase significantly, but our results (below) show that the changes in required civil service accessions do not seem to be large relative to the market of scientists and engineers.

Table V-6 displays how much the number of civilians in each of the three occupational areas increases in the substitution case to substitute for the officers who would have been attracted to stay by the CSRB. The changes in officer endstrengths are included in the table for comparison purposes.

Table V-6. Additions to Endstrength: Military with CSRB and Civil Servant Substitution/No Bonus (CSRB)

Military Officers											
	2002	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
32E	24	48	70	90	110	128	145	163	180	194	208
33S	81	153	225	294	361	424	486	549	610	670	725
61S	15	30	44	59	74	89	103	119	134	149	163
62E	48	90	131	169	204	237	267	297	326	354	380
63A	29	57	86	118	151	186	220	256	293	331	368
TOTAL	197	378	557	730	900	1063	1222	1383	1544	1699	1845
Civil Servants											
	2002	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
08XX	169	324	477	624	768	904	1038	1171	1306	1434	1555
13XX	13	25	37	49	61	73	85	98	110	123	134
15XX	15	29	43	57	71	86	99	114	128	142	156
TOTAL	197	378	557	730	900	1063	1222	1383	1544	1699	1845

Because the civil service S&E personnel force is aging, we expected an increasing number of retirements to drive a strong upward trend in the number of accessions required to sustain the size of the personnel force. For example, Figure III-2 showed that 66 percent of these civilians were over 40 years old in FY 2001; 32 percent were over 50. To get a more complete picture of the effects of the aging workforce on civil service accessions, we projected the number of accessions needed in career series

[14] The 1999-2001 age distribution of accessions was little different from the 2001 age distribution in Figure III-1 above.

08XX through FY 2030. We found that the number of required accessions peaks at 525 in 2021—a seven percent increase over FY 2002—and declines thereafter.

This relatively modest increase in accession requirements is attributable to high retention rates. The overall loss rate in our historical data among those covered by FERS was about five percent, and about six percent among those covered by CSRS. The loss rates increase slightly as a higher proportion reach their late 50s and older ages, but the retention rates are still high enough to not increase the overall personnel turnover by much. Figure V-1 displays retention rates by age and retirement plan in for the 08XX career series to illustrate this point.

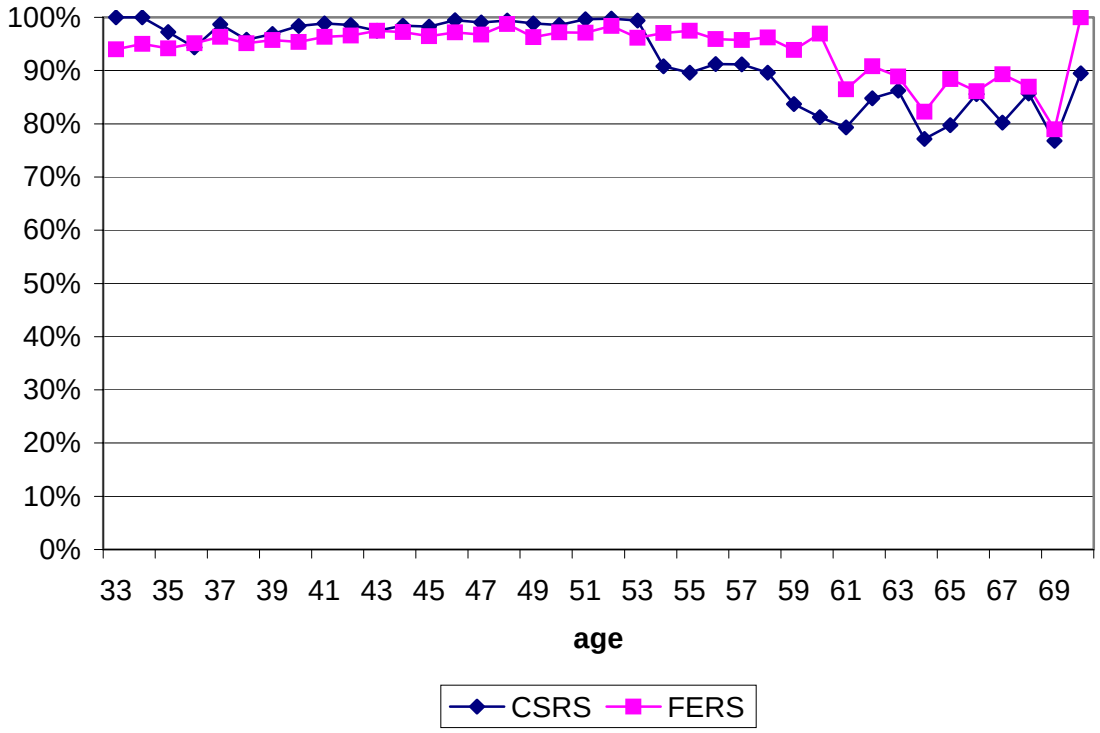

Figure V-1. 8XX (Engineering) Retention Rates by Age and Retirement Plan

Table V-7 presents the numbers of civil service S&E accessions required to maintain the civilian S&E occupations' personnel strengths (CSRB case) and the numbers required to increase personnel strengths by the amounts in Table V-3 (substitution case). Increasing civil service S&E endstrengths resulted in substantial percentage increases in required accessions, but the increases do not appear large relative to the size of the market.

This analysis suggests that the aging of DoD civilians with technical skills may not create the wave of imminent retirements some might expect. Retention rates, even among older workers, are high enough not to raise required accessions by very much. Since Air Force requirements are only a small part of the S&E employment market, the Air Force should be able to fill its positions without increasing salaries. We examined only the Air Force. Nevertheless, if other S&E civilians in the Federal government exhibit similar retention patterns, widespread concerns about baby boomer retirements decimating the ranks may be overstated.

Table V-7. Civil Service S&E Accessions

	2002	2003	2004	2005	2006	2007
08XX Engineering						
CSRB	481	482	486	486	483	488
Substitution	650	646	657	660	661	666
Difference	*169*	*164*	*171*	*173*	*178*	*178*
13XX Physics, Chemistry, and Related						
CSRB	37	45	39	43	38	37
Substitution	50	58	53	57	52	52
Difference	*13*	*13*	*13*	*14*	*15*	*15*
15XX Mathematics, Statistics, & Operations Research						
CSRB	34	38	36	35	34	38
Substitution	49	52	51	51	51	56
Difference	*15*	*15*	*15*	*16*	*16*	*18*
Total						
CSRB	551	565	561	565	555	563
Substitution	748	757	761	768	764	774
Difference	*197*	*192*	*199*	*203*	*209*	*211*

	2008	2009	2010	2011	2012
08XX					
CSRB	493	488	491	493	497
Substitution	676	677	686	690	691
Difference	*183*	*189*	*195*	*196*	*194*
13XX					
CSRB	40	37	38	38	40
Substitution	56	54	54	56	56
Difference	*16*	*17*	*17*	*18*	*16*
15XX					
CSRB	35	34	39	38	36
Substitution	52	53	58	57	56
Difference	*17*	*19*	*19*	*19*	*20*
Total					
CSRB	568	558	568	569	573
Substitution	783	784	798	803	803
Difference	*215*	*226*	*230*	*234*	*230*

VI. COST COMPARISONS

A. COSTING THE OFFICER INVENTORIES

We estimated costs as if changes in the science and engineering total personnel strength and personnel strength in each grade would not be offset by opposite changes in the rest of the officer force.[15] Our costing of Air Force officers included the following elements:

- Basic pay
- Permanent change of station (PCS) costs
- Basic allowances for housing and subsistence
- Miscellaneous (includes subsistence, family separation allowance, separation payments, employer's social security tax contribution, overseas station allowances, death gratuities)
- Initial skill training costs
- Health care for active-duty service members and their families
- Accrual costs for retirement[16] and retiree health care
- CSRB payments.

Basic pay is a matter of public record. We obtained this information from the Selected Military Compensation Tables published by OSD's Directorate of Compensation.[17] We obtained per capita PCS costs, basic allowances for housing and subsistence, and the miscellaneous costs from AFI 65-503 Cost and Planning Factors, Table 19-1, Military Annual Standard Composite Pay, published on the Assistant

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15 In fact, these offsetting changes probably would occur for relatively small changes in strengths. For example, during those years in the late 1990s when the Air Force fell short of its accession goals for the five core groups, it increased accessions into other core groups rather than allowing total officer personnel strength to decline. However, doing this is a decision, not a given.

16 Each military Service is required to contribute a fixed percentage of basic pay into the military retirement fund. The percentage is calculated using a complex formula based on projected retirement patterns. Retiree health care costs are treated similarly, with Service contributions being dollars per member rather than a percentage of basic pay.

17 Department of Defense, ASD(FMP)DASD(MPP), Directorate of Compensation, *Selected Military Compensation Tables*, 1 January 2002, available on the World Wide Web at http://dod.mil/prhome/docs/greenbook_fy2002.pdf .

Secretary of the Air Force (Financial Management) web site.[18] We obtained initial skill training costs from Table 18-1b in AFI 65-503.

The Congressional Budget Office estimated DoD's health care for active-duty personnel and their families to be $7000 per active duty member.[19]

The Office of the Actuary, OUSD (P&R), provided us with estimates of accrual costs of military retirement and retiree health care specific to each core group in the baseline and CSRB cases. The accrual costs were calculated based on the retention rates provided by AFPOA. We adapted the costs provided by the Actuary to account for past under-funding of retirement and retiree health care caused by the introduction of the CSRBs. That is, in the initial years of the CSRB program, we applied the higher retention rates under the CSRB to officer year groups whose past accrual charges had been based on lower projected retention rates. We calculated the extent of under-funding and amortized these amounts over the remaining years of each officer year group.

We used FY 2002 values for each of these cost elements and did not embed predictions of future pay raises or increases in other costs except to the extent future pay raises in excess of inflation were embedded in the accrual cost estimates.

Our cost estimates for officers almost surely err on the low side because there are some cost categories we did not account for.[20] In particular, practically every Air Force officer who reaches lieutenant colonel has a master's degree, and many of these officers were sent for full-time schooling to the Air Force Institute of Technology at Wright-Patterson AFB or under Air Force sponsorship to a civilian institution. Officers commonly attend intermediate and advanced Service schools as well as various refresher-training courses. We did not have estimates of the costs of this schooling, and we did not include estimates of the costs of the ROTC and Officer Training School accession programs. We also omitted recruiting costs and the cost of family support services. We assumed that the increased retention of scientists and engineers due to CSRB payments would not be large enough to noticeably affect the timing of promotions in the officer

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18 http://www.saffm.hq.af.mil/

19 Congressional Budget Office, *Military Compensation: Balancing Cash and Noncash Benefits*, Economic and Budget Issue Brief, January 16, 2004, p. 3.

20 It is likely that military S&Es spend less time overseas than other Air Force officers. Thus Air Force-wide average family separation allowance, overseas station allowances, and PCS costs may be somewhat higher than actual costs. However, the magnitude of the overstatement is not large enough to alter the conclusions of this study.

force. Thus, the grade distribution for each year of service is the same for the baseline and the CSRB projections.

Table VI-1 compares the cost per officer under the baseline and CSRB cases for every second year from FY 2002 to FY 2012. The effects of low retention on cost per officer are clearest for 33S, the core group with the lowest retention. Lower retention causes lower accrual costs as well as lower pay costs per officer.

Basic pay accounts for about 45 percent of the total officer cost; in 2002 basic pay ranged from an average of approximately $47,000 for 33S officers to $50,000 for 32E and 62E officers. About $34,000—30 percent of the total cost—is attributable to retirement and retiree health care accruals. The remaining 25 percent are for health care for active duty officers and their dependents, permanent change of station, initial skill training, CSRBs, and other costs. The average CSRB cost per officer varies from just over $1000 (33S) to over $4000 (61S), depending on the proportion of officers eligible to receive the bonus.

The CSRB increases the cost per officer by 5-8 percent, depending on the core group, in FY 2002. Cost per officer increases by 9-11 percent by FY 2012. Less than one-half of the increased cost per officer comprises CSRB payments;, most is attributable to the increased number of captains, majors, and, in the later years, lieutenant colonels relative to the number of lower-cost lieutenants. By FY 2012, about two-thirds of the increase in each core group's cost per officer is attributable to the greater seniority of the officer force.[21]

[21] If we were able to account for training costs, this more senior mix of officers may actually cost less than the current mix, because the Air Force is reaping the return on its training investment for a longer time.

Table VI-1. Costs Per Officer, FY 2002 Dollars

	FY 2002	FY 2004	FY 2006	FY 2008	FY 2010	FY 2012
32E						
Baseline	$105,035	$104,388	$103,811	$102,908	$102,085	$101,252
CSRB	111,902	111,901	112,023	111,980	112,009	111,973
Difference	*6,867*	*7,514*	*8,212*	*9,072*	*9,924*	*10,720*
Bonus cost	3,051	3,221	3,373	3,591	3,583	3,561
33S						
Baseline	97,793	96,267	95,516	94,676	94,227	94,060
CSRB	102,720	102,720	102,720	102,720	102,720	102,720
Difference	*4,928*	*6,453*	*7,204*	*8,044*	*8,494*	*8,660*
Bonus cost	1,011	1,015	1,022	1,062	1,029	999
61S						
Baseline	102,457	102,457	102,457	102,457	102,457	102,457
CSRB	110,814	110,291	110,351	110,635	110,982	111,572
Difference	*8,357*	*7,834*	*7,894*	*8,178*	*8,525*	*9,115*
Bonus cost	4,694	4,619	4,589	4,689	4,475	4,287
62E						
Baseline	102,594	102,159	101,277	99,959	98,820	97,921
CSRB	108,307	108,522	108,450	108,049	107,765	107,684
Difference	*5,714*	*6,363*	*7,173*	*8,090*	*8,945*	*9,763*
Bonus cost	1,647	1,736	1,841	1,989	1,994	1,982
63A						
Baseline	104,696	102,407	100,937	99,555	98,536	98,277
CSRB	110,539	108,843	108,065	107,504	107,272	107,785
Difference	*5,842*	*6,436*	*7,128*	*7,949*	*8,736*	*9,508*
Bonus cost	1,940	1,902	1,898	1,961	1,895	1,819

B. COSTING THE CIVIL SERVICE S&E INVENTORIES

Our costing of the civil service S&E personnel inventories included the following cost elements

- Salaries
- An acceleration factor applied to salaries; includes retirement accrual and health care costs.

We had FY 2001 salary information for each individual in the data provided by AFPC. We estimated average salaries by civil service grade and age using a regression

equation with dummy variables for civil service grades. We found that dummy variables for education and for whether or not an individual was part of a civil service demonstration project were insignificant. This is not to say, however, that education does not affect salary. Those with advanced degrees tend to earn more because they tend to be in higher grades. Hence, the dummy variables for grades are capturing the effects of education on salary.

We used an acceleration factor specific to RDT&E civil servants: 1.258. This differs from the Air Force-wide factor of 1.332, a difference primarily attributable to the fact that RDT&E civil servants on average are higher paid than are Air Force civilians paid through O&M accounts (but their health care costs are not higher). We also increased each salary by 4.3 percent to account for the FY 2002 civil service pay raise.

Like Air Force officers, some civil servants are sent for additional education, although not with the frequency of officers. Air Force officers often are assigned student status, relieved of most other duties, and paid a salary while studying. For civilians, government help is generally limited to tuition assistance; relief from other duties is the exception rather than the rule. We did not include the costs of these educational expenses in our cost estimates, nor did we have information on the costs of hiring civil service S&Es.

We assumed that the increased number of civilian S&E accessions in the baseline case would not require the Air Force to pay accession bonuses or other additional pay or benefits to achieve the increased level of accessions. Thus, the average costs per civilian S&E were only marginally different between the baseline and CSRB cases, the differences being attributable to the different numbers of accessions.

Table VI-2 presents the average cost per civil servant in each of the three occupational areas for the substitution case. For comparison, the table also presents the costs per officer in the five core groups for the CSRB case; these are the relevant comparisons. The costs per officer are uniformly higher than the costs per civil servant. Only the cost per 33S officer comes close to the cost per S&E civil servant, because 33S has very low retention.

The large cost differences between military and civilian personnel are not attributable to higher salaries for military personnel. Indeed, the average wages for civil service S&Es during 2002 was about $70,000, whereas the average basic pay for the officers was a little less than $50,000. But accruals for retirement pay and post-retirement

health care average $34,000 per year for officers, whereas the cost of all the non-salary benefits for civilians averages about $18,000. Health care for military personnel and their dependents accounts for $7000 per officer, and allowances, initial skill training, PCS, CSRBs, and other miscellaneous costs account for the rest.

Table VI-2. Costs Per Officer and Civil Service S&E (FY 2002 Dollars)

	FY 2002	FY 2004	FY 2006	FY 2008	FY 2010	FY 2012
CSRB						
32E	111,902	111,901	112,023	111,980	112,009	111,973
33S	102,720	101,700	101,513	101,262	101,363	101,741
61S	110,814	110,291	110,351	110,635	110,982	111,572
62E	108,307	108,522	108,450	108,049	107,765	107,684
63A	110,539	108,843	108,065	107,504	107,272	107,785
Substitution						
08XX	$88,130	$88,207	$88,368	$88,750	$88,884	$89,180
13XX	89,860	90,371	90,940	91,595	92,288	92,837
15XX	88,782	89,121	89,550	90,014	90,356	90,749

If anything, we believe we have understated the cost differences between officers and civil servants. As discussed earlier, we were not able to include a number of education costs that the Air Force incurs for officers but does not incur for civilians. Both estimates omit recruiting costs, which arguably are greater for military officers. Although moving costs are not included for civil servants—some civil servants transfer among different locations—these movements do not seem to be frequent enough to noticeably affect our cost estimates.

These cost differences are sufficiently large that the civil service S&Es would cost less than Air Force officer S&Es, even if an across-the-board pay raise of up to 10 percent was awarded to the civil service S&Es to ensure adequate accessions and retention. A $10,000 bonus per accession alone, if needed to meet accession requirements, would increase cost per civil service S&E by less than $1,000.

Increasing the number of civilian S&Es rather than increasing the number of officers with the CSRB would save more than $100 million per year beginning in FY 2005. Table VI-3 displays the increase in personnel costs associated with increasing the number of people in each core group/occupational area from FY 2002-FY 2012. The last

line of the table displays the difference in total costs for using CSRBs to increase the officer inventories and the alternative, increasing Air Force civilians in lieu of increasing the number of officers.

Table VI-3. Total Cost Increases with Bonus (CSRB) vs. Substituting Civilians for Officers (FY 2002 Dollars, Millions)

CSRB	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
32E	13	16	19	21	24	26	29	31	34	36	38
33S	30	39	48	57	65	73	80	88	96	104	111
61S	10	12	14	16	18	20	23	25	27	29	31
62E	21	26	31	36	41	45	49	53	57	61	65
63A	17	21	25	30	35	40	44	49	55	60	65
Officer Total	91	115	137	160	182	204	226	247	268	290	310
Substitution											
08XX	12	23	34	45	57	68	78	90	101	112	122
13XX	1	2	3	4	5	6	6	8	9	10	11
15XX	1	2	3	4	5	7	8	9	10	12	13
Civil Service Total	*14*	*27*	*40*	*53*	*67*	*80*	*93*	*106*	*120*	*133*	*146*
Difference	77	88	97	107	116	124	133	141	149	157	164

VII. CONCLUSION

We find as a result of our research that offering bonuses to military officers to fill science and engineering positions costs more than using civil servants. We estimated that increasing S&E officer endstrengths via the bonus (CSRB) program will cost $100 million more per year by 2005 than would increasing the number of civil service S&Es. By 2012, the cost difference will be over $160 million annually.

However, there may be benefits to using military officers that offset at least some of the costs. One benefit cited by the Air Force is the need for S&E officers with operational experience, particularly in acquisition positions. These officers are expected to provide a bridge from the operators of the weapons systems, who define requirements, to the acquisition community, which oversees system development and procurement. We did not systematically examine the degree of operational experience by Air Force S&E officers in our data, but an OSD analysis found that relatively few S&E RDT&E officers (fewer than three percent) have appropriate experience.[22] Other things being equal, it is less expensive for a civilian to fill a position than for a military officer to do so, with or without operational experience. One could argue that civilians at least would be cheaper than the status quo of using military officers, most of whom lack operational experience. Alternatively, one could argue that the linkage between requirements and development in acquisition does not work well because of the lack of officers with operational experience in the program offices. This view would consider the extra money well spent.

A further benefit to using military officers is their ability to be deployed overseas and in combat situations. In the 32E career field, overseas deployments are common. Deploying civil servants in overseas positions may be infeasible, or may involve additional cost. A related benefit is the greater availability of officers, who can be ordered to work for extra hours or days. On the other hand, officer non-available time over a career due to PCS, schools, and other activities can be considerably more than that for civil servants.

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22 "Report on the Use of Air Force Military Personnel to Perform Research, Development, Test and Evaluation (RDT&E)," OUSD(P&R), Program Integration, November 2001.

We found many officers who had a duty AFSC in the S&E field, but in a core group that was unspecified or outside the S&E field; most are junior officers who may be receiving on-the-job training or testing their aptitude for further education in S&E. We also found that more than 1600 officers (about 14 percent of the total in S&E core groups) were performing non-S&E duties. The Air Force encourages officers to broaden their careers, but it may be worth examining whether some of these officers could be assigned to alleviate S&E shortages.

Because bonuses are offered to officers in S&E groups, it is possible that officers performing S&E duties but who are not in S&E core groups would work to get their core groups switched. Thus, the bonus cost might be higher than we anticipated in our analysis. The bonus also could encourage more officers to pursue advanced degrees in S&E fields, but we have no evidence on these possibilities.

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14. ABSTRACT

This paper compares the costs of increasing the number of Air Force scientists and engineers (S&Es) by awarding bonuses to officers in selected S&E career fields with the alternative of increasing the number of civil servants in similar fields. The evolution of the S&E officer personnel force is projected through 2012 with and without awarding bonuses, and the civil service S&E workforce is projected through the same year with and without increasing personnel strength to make up for the smaller officer force in the absence of bonus payments to officers. The paper estimates that increasing S&E officer personnel strengths via the Critical Skills Retention Bonus program will cost $160 million more per year by 2012 than would increasing the number of civil service S&Es.

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Scientists, engineers, manpower, costs, compensation

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