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ABSTRACT

The study outlines the development of a methodology for meaningfully estimating the value of classification information used by the Air Force to make selection and job assignment decisions which lead to the satisfaction of first-term enlisted manpower requirements. The methodology, called the optimal allocation strategy, is employed to solve a representative allocation problem in a hypothetical enlistment year. The exercise serves to show how the value of available personnel information may be estimated when used in the most efficient manner possible. Four conclusions are drawn from the study: the value of military classification information currently available to the Air Force can be estimated in tangible terms; the value of even better classification information which could become available in the future as a result of specific research can be estimated in tangible terms; the means for getting the most out of current available information exist; and a variety of personnel policies and programs can be evaluated in terms of both real and realizable dollar payoffs. (Author/PR)

AFHRL-TR-75-2

AIR FORCE

HUMAN RESOURCES

VALUE OF PERSONNEL CLASSIFICATION INFORMATION

PERSONNEL RESEARCH DIVISION
Lackland Air Force Base, Texas 78236

March 1975
Final Report for Period June 1972 – March 1974

Approved for public release; distribution unlimited.

LABORATORY

AIR FORCE SYSTEMS COMMAND
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20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study outlines the development of a methodology for meaningfully estimating the value of classification information used by the Air Force to make selection/assignment decisions which lead to the satisfaction of first-term enlisted manpower requirements. The methodology, called the optimal allocation strategy, is employed to solve a representative allocation problem in a hypothetical enlistment year. This exercise serves to show how the value of available information may be estimated when used in the most efficient manner possible. Four conclusions are drawn from the study. (1) the value of classification information currently available to the Air Force can be estimated in tangible terms, (2) the value of even better classification information which could become available in the future as a result of specific research can be estimated in tangible terms, (3) the means for getting the most out

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of currently available information exist, and (4) a variety of personnel policies and programs can be evaluated in terms of both real and realizable dollar payoffs.

PREFACE

The work reported in this study was accomplished under Project 7719, Air Force Personnel Systems Development on Selection, Assignment, Evaluation, Quality Control, Retention, Promotion and Utilization; Task 771914, Development of Criteria for Validation of Selection and Classification Procedures.

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VALUE OF PERSONNEL CLASSIFICATION INFORMATION

I. INTRODUCTION

In calendar year 1972, almost 200,000 young men (without prior service) applied for enlistment into the United States Air Force. All were administered the Airman Qualifying Examination (AQE) or its near equivalent, and 81,563 applicants were selected for assignment to Air Force basic training.[1] Between 90% and 95% of all enlistees satisfactorily completed basic training and continued on to any one of several hundred more specialized training programs. Only 75% or 80% of the original enlistment group may be expected to complete a full four-year term of service ending in 1976.[2] Of those who will complete the first term, some 5% to 10% will do so in a second career field after having demonstrated insufficient aptitude for the first assigned job.

The Air Force first-term manpower requirements, which make the 1972 classification, selection, assignment and training activity necessary, will presumably be satisfied by the collective contribution made by all selected applicants who succeed in completing the full four-year term of enlisted service. If the Air Force had been able, at the point of enlistment, to accurately identify those men among the 200,000 applicants who were capable of successfully completing four years of service in specific types of jobs, only potentially successful applicants would have been enlisted. The number of people initially assigned to specific job training programs would exactly equal the number completing the first term. Attrition rates in basic training, advanced or special training, and discharge from service at any other time during the first four years would all be zero. As a result, the Air Force could achieve its manpower objectives without writing as many paychecks as it does now.

The key to accomplishing the goal of zero attrition is information. With perfect information, the same requirements could be satisfied with no waste due to inefficient classification and selection. Attrition rates are not zero in reality, so it is clear that we operate in a world of less than perfect information. Yet we do develop some information on applicants through the administration of the Armed Services Vocational Aptitude Battery (ASVAB) and the collection of other "background" data. Information of this type must have some value, and it should be possible to ascertain the value of currently available information and also the value of even better information which could become available in the future as a result of specific research.

The purpose of this report is to develop an analytical framework for meaningfully estimating the value of information as it is used to allocate manpower resources in the Air Force. A very simple example has been chosen as the vehicle for demonstrating the methodology. The next section begins with a contrived scenario which, in its simplicity, bears little similarity with the numerous details of reality, but captures the essential features of the Air Force first-term manpower allocation problem. To avoid confusion with real, current Air Force policies and problems, the scenario is set in 1982. The reader should keep in mind that all necessary techniques and data for applying this methodology to conditions in the real Air Force are available right now, or can be developed from currently available data.

The approach is to show, within the scenario, a systematic (though rather simplified) way of looking at how available classification information is now used to allocate available manpower resources. In describing the allocation process, the authors show what the final output of the 1982 effort would be in terms of the scenario analogue to current Air Force allocation practices, and what variable costs would thereby be generated. An inefficient assignment policy has deliberately been inserted in this scenario example, in order to show how the proposed model can quantify the cost of inefficient allocation decision making. Then it is shown how this same available information could be used to allocate people in an alternative manner which would lead to the same output at the lowest possible total cost. This model will be called the optimal allocation strategy.

[1] Male accessions in 1972 characterized by Vitola, Mullins, and Brokaw (1973). The total applicants estimate is based upon numbers of Airman Qualifying Examination answer sheets collected by the Air Force Recruiting Service in 1972, and later received by the Air Force Human Resources Laboratory, Personnel Research Division at Lackland AFB, Texas.

[2] A 75% full-term retention figure was quoted by Lt Gen John W. Roberts, Deputy Chief of Staff for Personnel, United States Air Force, in his keynote address to the Military Testing Association Conference in San Antonio, Texas, 28 October 1973.

We then calculate what the total allocation cost would be if we tried to satisfy the same manpower requirements (required output) by assigning people *without using any* classification information. This figure is compared with the total allocation cost estimated for the earlier case when currently available classification information *is* used and an optimal allocation strategy is employed.

The difference, a net cost reduction, is a measure of the value of classification information used by the Air Force in the simplified hypothetical scenario. A similar value could be calculated for the real situation in the current Air Force, given the resources necessary to process the available data and perform the calculations. This model also permits us to show how much further we can theoretically go in the future. That is, we calculate by how much the total allocation costs would be further reduced in the scenario if we could produce absolutely accurate classification information—if personnel could be assigned so efficiently that none of them would fail in his first assigned specialty.

Farther on, application of the strategy for evaluating a variety of personnel policies is discussed. Possible directions for applied research are suggested.

II. METHOD

An Example: The Hypothetical Accessions Scenario

A strictly hypothetical accessions scenario is introduced in this section. Throughout the next few pages we will speak of the scenario as though it represents what actually occurred. The year 1982 was chosen to remind the reader that the scenario setting of the report is hypothetical, not actual. The conditions specified in the scenario are artificial for two reasons.

a. Although real information of the sort used in the scenario is available or could be derived from available information, the organization of the information for analysis would require an effort beyond resources available.

b. Conditions in the scenario are simplified to make the demonstration more comprehensible to the reader. Nothing in the model requires this over-simplification. Complexities of real life selection, assignment, and allocation can be reflected by additional sets of equations and variables within the analytical framework presented here.

Some 200,000 men (non-prior service) apply for enlistment from January through December 1982. We will assume, for simplicity, that the applicants are administered a single aptitude test. The test has been normed recently on the population of enlistment-eligible males, and aptitude, as measured by this test, is assumed to be distributed normally for the population. Exactly twenty percent of the applicants achieve a score above the 80th percentile, the high-aptitude group (H). Eighty percent of the pool achieve a score below the 80th percentile, the low-aptitude group (L).

For simplification, we will also assume that the Air Force offers only two types of jobs, and we will consider only 4-year contracts. Initial assignment to Job 1 involves a total of 3 months of training (basic plus advanced, travel and processing time included) from the day a man enlists until the day he departs formal training and is ready to enter the productive phase of his first term (3.75 years in length). Initial assignment to Job 2 involves 6 months of training, implying 3.5 years remaining in the productive phase.

Let us assume that historical success/failure rates in each of the two jobs have been calculated as a result of previous research. These rates, by aptitude group, job assigned, and condition of assignment, are presented in Table 1. The aptitude (classification) test has been validated with respect to the success/failure criterion in both Job 1 and Job 2. The point-biserial correlation coefficients have been estimated to be ($r_1 = +.75 \pm .05$) for Job 1 and ($r_2 = +.55 \pm .05$) for Job 2. These coefficients indicate the validity of the aptitude test, but the actual success/failure rate statistics (upon which estimates of test validity are based) are of primary interest to those personnel involved in the manpower allocation decision making process.

The success/failure rates for first-time failures (termed "retrainees" in alternative assignments) are specified because the Air Force has traditionally given first-time failures a second chance in an alternative job.[3]

[3]The retention rate for low-aptitude retrainees entering Job 1 as a second assignment (24.2%) is actually greater than the rate for low-aptitude applicants (17.5%). Low-aptitude applicants who participate in Job 2 training, even if they fail, acquire knowledge and skills which give them a better chance for succeeding in Job 1 than low-aptitude applicants who have not received the benefit of Job 2 training.

Based upon the data displayed in Table 1, it is estimated that 34,840 (87.1%) of the 40,000 high-aptitude applicants and 28,000 (17.5%) of the 160,000 low-aptitude applicants are capable of succeeding in Job 1. It is also estimated that 19,600 (49.0%) of the high-aptitude and 17,760 (11.1%) of the low-aptitude applicants can succeed in Job 2. Altogether, 62,840 (31.4%) of the 200,000 total applicants, if entered into Job 1, could be expected to complete successfully four years of service in Job 1, and 37,360 (18.7%) of the 200,000-man applicant pool, who begin their Air Force careers in Job 2, could make it through four years in Job 2.

Table 1. **Success/Failure Rates in Two Air Force Jobs by Aptitude Group and Condition of Assignment**

Types of Subjects	High-Aptitude Group (H) Succeed %	High-Aptitude Group (H) Fail %	Low-Aptitude Group (L) Succeed %	Low-Aptitude Group (L) Fail %
Initially assigned to Job 1	87.1	12.9	17.5	82.5
Initially assigned to Job 2	49.0	51.0	11.1	88.9
Failed Job 1, assigned to Job 2	0.1	99.9	0.1	99.9
Failed Job 2, assigned to Job 1	74.8	25.2	24.2	75.8

To simplify the discussion, assume that all attritions in both Job 1 and Job 2 occur during the last few days of specialized training. Therefore, it effectively takes three months to identify all Job 1 failures (since Job 1 is a 3-month course) and six months for all Job 2 failures. This implies that no attrition occurs at earlier points in the respective specialized training programs, or during basic training. It implies further that no attrition occurs after entry into the productive phase of the first term of service. These assumptions are not necessary for application of the model. They are made to simplify the discussion.

Let us assume that requirements exist for 36,000 fully qualified, reliable Job 1 holders and 14,000 Job 2 holders for the 1982 enlistment year. Regardless of the manner in which we choose to allocate the available manpower, we must succeed in satisfying these two requirements with people who will complete their remaining terms of service. Any acceptable allocation strategy we may consider must yield these specified numbers of fully qualified, reliable first-termers. See Appendix A for a more complete discussion of this assumption.

Finally, taking a conservative position, we will assume that the allocation process must be developed on a quarterly basis, and that acceptable estimates of applicant pool characteristics can be obtained with no more than three months' lead time. Allocation decisions for the first quarter of 1982 can, therefore, be made no earlier than the beginning of the first quarter. At that time we can accurately estimate what the applicant pool will look like for the next three months, but we know nothing at all about the fourth, fifth, or later months. We must wait until the first day of the second quarter before we begin making allocation decisions for the second quarter, and so on. First-quarter decisions must, therefore, be made independent of either our manpower requirement or applicant pool expectations for subsequent periods of time.

The Allocation for the 1982 Scenario

The traditional allocation strategy. To demonstrate the utility of the analytical approach to be developed in this study, let us create allocation decision rules which are recognizably absurd. Let us specify that traditionally the Air Force has established an H score as the lowest permissible score which an applicant may achieve to qualify for assignment to Job 1 (the "easier" job). The single exception to this policy is that low-aptitude retrainees who have failed Job 2 will be eligible for assignment to Job 1, since they are already on board. Job 2 (the "harder" job), on the other hand, is open to applicants with either H scores or L scores. Certainly the Air Force would never really do anything so clearly inefficient. These specifications are made to show that the model will reveal the inefficiency of the practice.

In practice, then, any H score applicants remaining after Job 1 quotas are satisfied are assigned to Job 2, and low-aptitude people are selected to "top off" remaining Job 2 quotas.

We know that attrition will occur in both jobs and that some initial failures, once identified, will go on to succeed in the alternative job, thereby contributing to the satisfaction of an overall trained manpower requirement for each job. It is hard to keep track of how much "switching back and forth" goes on, but we will say that experience has shown that matters tend to work out all right over time, and that requirements seem to be satisfied generally. We will say that this particular strategy for allocating personnel by aptitude group has "worked" for many years, in the sense that, despite the poor allocation procedure, enough of each type of job holder are being produced. It is expected to "work" now and in the future. There are an infinite number of alternative allocation strategies which the Air Force could implement, but no one is prepared to tamper with any proven system that satisfies trained manpower requirements. People, reasonably enough, see little incentive for introducing changes which might send the entire process out of balance.

Specific inputs and outputs. We now examine in detail how the 1982 scenario allocation was developed by the manpower planners, how numerical quotas were established (in accordance with the traditional strategy), how the allocations proceeded, and what was produced as a result.

During the first quarter 40,000 low-aptitude people and 10,000 high-aptitude people applied for enlistment, in close accord with preliminary forecasts of applicant pool characteristics for the first quarter. Before establishing Recruiting Service enlistment quotas, the manpower planners noted that a large number of retrainees who enlisted during an earlier period in 1981 and failed in their first assigned jobs would be entering alternative training programs in the first quarter of 1982.

Starting with Job 1, the planners scheduled a total of 15,222 retrainees for entry into Job 1. These were all of the personnel who failed in their initial assignement to Job 2 at an earlier time. A closer examination revealed that this group was composed of 1,848 high-aptitude people and 13,374 low-aptitude people, all of them first assignment failures.

Keeping in mind a specific numerical requirement for fully qualified Job 1 holders to be produced from entries into Job 1 training, the planners estimated how many of the 15,222 retrainees would be successful in their second assignment. For the high-aptitude retrainee group, they computed:

1,848	X	(.748)	=	1,382
(All high-aptitude retrainees entering Job 1)		(Success rate for high-aptitude retrainees entering Job 1; see Table 1)		(Expected number of high-aptitude retrainees who will succeed in Job 1)

Like wise, for the low aptitude retrainees who were entering Job 1:

13,374	X	(.242)	=	3,237
(All low-aptitude retrainees entering Job 1)		(Success rate for low-aptitude retrainees entering Job 1)		(Expected number of low-aptitude retrainees who will succeed in Job 1)

Without much difficulty, the planners were able to forecast the number of successful Job 1 holders that would be produced from the 15,222 retrainees entering Job 1 during the first quarter of 1982. They compared this figure, 4,619, with the Job 1 manpower requirement of 9,000 (36,000 ÷ 4) established by the manpower managers and strategic force planners for the first quarter activity. The difference, 4,381, represented the number of applicants who would have to be selected for initial assignment to Job 1 and who would have to succeed to satisfy the Job 1 requirement.

Since only high-aptitude applicants could be assigned to Job 1, the planners calculated the number of high-aptitude applicants who would have to be assigned to Job 1 during the first quarter in order to meet the requirement. These were:

5,027 (All high-aptitude applicants initially assigned to Job 1)	X	(.871)* (Success rate for high-aptitude applicants entering Job 1)	=	4,381 (Expected number of high-aptitude applicants who will succeed in Job 1)

*Rounded from .8715.

Thus, the manpower planners were able to fix a Recruiting Service quota of 5,027 high-aptitude applicants to be selected and assigned to Job 1.

Next, the Job 2 manpower requirement was established at 3,500 (14,000 ÷ 4). Before attempting to define the Recruiting Service quotas for assignments to Job 2, the planners first considered the number of retrainees who would be entering Job 2 after having failed in their initial assignment to Job 1 during an earlier period of time. There were 645 such people, all of whom were high-aptitude, since no low-aptitude enlistees in the earlier period were eligible for initial assignment to Job 1 (remember, this is a deliberately poor procedure for illustrative purposes). The number of successful graduates in this group was calculated to be:

645 (All high-aptitude retrainees entering Job 2)	X	(.001) (Success rate for high-aptitude retrainees in Job 2)	=	0 (Expected number of high-aptitude retrainees who will succeed in Job 2)

Since no retrainees were likely to succeed in Job 2, the 3,500 Job 2 manpower requirement would have to be satisfied entirely by the selection and assignment of applicants to Job 2.

Knowing that a quota for 5,027 high-aptitude applicants had already been established to satisfy Job 1 requirements, the planners established a quota for 4,973 high-aptitude applicants to be selected and assigned to Job 2, thereby exhausting the original supply of all 10,000 high-aptitude applicants. Computing the number of successes in Job 2 to be expected from this group, they found:

4,973 (All high-aptitude applicants entering Job 2)	X	(.490) (Success rate for high-aptitude applicants in Job 2)	=	2,437 (Expected number of high-aptitude applicants who will succeed in Job 2)

After comparing this figure with the manpower requirement for 3,500 Job 2 holders and finding that they were still short by 1,063, the planners computed the number of low-aptitude applicants who would have to be selected and assigned to Job 2 in order to fill the Job 2 manpower requirement.

They found:

9,580 (All low-aptitude applicants entering Job 2)	X	(.111) (Success rate for low-aptitude applicants in Job 2)	=	1,063 (Expected number of low-aptitude applicants in Job 2 who will succeed)

Thus, the Recruiting Service quota for low-aptitude applicants to be selected and assigned to Job 2 was fixed at 9,580.

Bringing together all of the established applicant pool quotas, the Recruiting Service enlisted 10,000 high-aptitude applicants and 9,580 low-aptitude applicants. These people were assigned to each of the two jobs in exactly the manner prescribed by the manpower planners. Coupled with the retrainees who entered each of the training programs, 9,000 Job 1 and 3,500 Job 2 holders were produced on schedule.

Inspection of Table 2 reveals the manpower input breakdown by job, aptitude group, and entry status. In accordance with Air Force policy prescribed by the traditional allocation strategy, the 9,580 low-

Table 2. **The First Quarter Inputs by Aptitude Group, Job Assignment, and Entry Status**

Types of Subjects	All applicants initially selected for assignment to Job 1	All Applicants initially selected for assignment to Job 2	All "retrainees" who enlisted in III, 1981 and have been reassigned to Job 1	All "retrainees" who enlisted in IV, 1981 and have been reassigned to Job 2	All unselected applicants
H scorers (high aptitude)	5,027	4,973	1,848	645	0
L scorers (low aptitude)	0	9,580	13,374	0	30,420
H and L scorers (Total)	5,027	14,553	15,222	645	30,420

aptitude applicants who were selected were assigned to Job 2 only, and first [illegible] failures in Job 1 and Job 2 from previous enlistment quarters were reassigned to the a' [illegible] Of the 10,000 high-aptitude applicants selected, 5,027 were assigned to Job 1, and the rest [illegible]

Table 3 shows the same data, but we introduce notation which identifies major subsamples of interest with labels. H and L indicate aptitude group membership. The first numbered digit identifies the initial job assignment. Second numbered digit, if any, indicates the subsequent assignment disposition. In all cases, zero implies "out of service." The final digit always indicates final disposition of the subsample. For example:

Table 3. **The First Quarter Inputs (Classification Notation Added)**

Types of Subjects	All applicants initially selected for assignment to Job 1	All applicants initially selected for assignment to Job 2	All "retrainees" who enlisted in III, 1981 and have been reassigned to Job 1	All "retrainees" who enlisted in IV, 1981 and have been reassigned to Job 2	All unselected applicants
H1*					
H1 2	5,027				
H1 20					
H2					
H2 1		4,973			
H2 10					
L1					
L1 2	0				
L1 20					
L2					
L2 1		9,580			
L2 10					
FH12				645	
FH12 0					
FH21			1,848		
FH21 0					
FL12				0	
FL12 0					
FL21			13,374		
FL21 0					
HO					0
LO					30,420
Column Totals	5,027	14,553	15,222	645	30,420

*D'gits indicating present and future assignment dispositions, if different, are separated by a blank space for emphasis. For example, H1 2 indicates that *right now* the group is initially assigned to Job 1, and it is predicted that the group will fail and *in the future* will be reassigned to Job 2 (where all members will succeed.) FH12 0 indicates that these subjects failed in their earlier, initial assignment to Job 1 and *right now* are reassigned to Job 2, and it is predicted that they will fail and be discharged *in the future* (will be assigned out-of-service).

"LO" means "unselected low aptitude people (final disposition is out of service)"

"L1" means "Low aptitude, initially assigned to Job 1, will succeed in Job 1 (final disposition will be Job 1)"

"L1 2" means "Low aptitude, initially assigned to Job 1, will fail, will be reassigned to Job 2 in future quarter, will succeed in Job 2 (final disposition will be Job 2)"

"L1 20" means "Low aptitude, initially assigned to Job 1, will fail, will be reassigned to Job 2, will fail, will be discharged (final disposition will be out of service)"

F[illegible] previous enlistment quarters who become entrants to alternative jobs in the present quarter [illegible] prefixed with F. For example:

"FL12" means "Low aptitude, entered Job 1 in previous enlistment quarter, failed, reassigned to Job 2 in current quarter, will succeed in Job 2 (final disposition will be Job 2)"

The twenty-two labels may be arranged to define every unique grouping of interest. For example:

H1)
H12) means "H1 + H12 + H120" means "All high aptitude applicants selected for assignment to Job 1 in the current quarter"
H120)

The data in Table 4 show what will be the output of the first quarter allocation. Retrainees who enter their second assignment, fail, and are subsequently discharged are treated as part of the output. Of particular interest are the total number of people (Columns 2 and 3) who will successfully complete the job which they enter in the first quarter.

Table 4. **Final and Intermediate Outputs of the First Quarter Allocation**

Types of Subjects	All applicants and retrainees assigned to Job 1 or Job 2 during 1st Qtr	All applicants and retrainees assigned to Job 1 who will succeed	All applicants and retrainees assigned to Job 2 who will succeed	All retrainees now assigned to Job 1 who will fail and be discharged	All retrainees now assigned to Job 2 who will fail and be discharged	All new assignees who will fail first job and become retrainees in future quarters
H1*	)**	)4,381				
H1 2	) 5,027					) 646
H1 20	)					)
H2	)		)2,437			
H2 1	) 4,973					} 2,536
H2 10	)					
L1	)	) 0				
L1 2	) 0					} 0
L1 20	)					
L2	)		)1,063			
L2 1	) 9,580					} 8,517
L2 10	)					
FH12	) 645		) 0			
FH12 0	)				)645	
FH21	) 1,848	)1,382				
FH21 0	)			) 466		
FL12	) 0					
FL12 0	)					
FL21	)13,374	)3,237				
FL21 0	)			)10,137		
Column Total	35,447	9,000	3,500	10,603	645	11,699

*See coding explanation, Table 2.

**Parentheses indicate subgroups comprising number shown.

The data in the right-hand column of Table 4 also show what the intermediate output of the allocation will be. These are the groups of people who will fail in the first job to which they have been assigned and will be reassigned to the second job in a subsequent quarter. Table 5 shows the composition of various groupings of subjects involved in the first-quarter allocation. Note that 9,000 successful Job-1 and 3,500 Job-2 subjects were produced.

Table 5. **Summary Data for First Quarter Allocation**

Types of Subjects	Composition of Group	Number in Group
All H applicants initially selected for assignment to JOB 1	H1 + (H12 + H120)	5,027
All H applicants initially selected for assignment to JOB 2	H2 + (H21 + H210)	4,973
All unselected H applicants	H0	0
All L applicants initially selected for assignment to JOB 1	L1 + (L12 + L120)	0
All L applicants initially selected for assignment to JOB 2	L2 + (L21 + L210)	9,580
All unselected L applicants	L0	30,420
All retrainees enlisted in III, 1981 who are reassigned to JOB 1	FH21 + FH210 + FL 21 + FL210	15,222
All retrainees enlisting in IV, 1981 who are reassigned to JOB 2	FH12 + FH120 + FL12 + FL120	645
All applicants and retrainees assigned to JOB 1 who will succeed	H1 + L1 + FH21 + FL21	9,000
All applicants and retrainees assigned to JOB 2 who will succeed	H2 + L2 + FH12 + FL12	3,500
All retrainees who will fail in JOB 1 and be discharged	FH210 + FL210	10,603
All retrainees who will fail in JOB 2 and be discharged	FH120 + FL120	645
Applicants assigned to JOB 1 who will fail and be reassigned to JOB 2 in II, 1982	(H12 + H120) + (L12 + L120)	646
Applicants assigned to JOB 2 who will fail and be reassigned to JOB 1 in III, 1982	(H21 + H210) + (L21 + L210)	11,053

Table 6 displays the same categories of data for the second quarter allocation. The applicant pool was again composed of 40,000 L-score and 10,000 H-score applicants. We selected 10,000 H scorers (all available), and our requirement to produce 9,000 Job-1 and 3,500 Job-2 successes dictated the selection of 12,927 L scorers.

Tables 7 and 8 show that the applicant pools for quarters III and IV in 1972 were each made up of 40,000 low-aptitude and 10,000 high aptitude applicants. Each of the allocations is somewhat dependent upon previous allocation results because of the retrainee reassignment policy, and each produced 9,000 Job 1 and 3,500 Job 2 first-term airmen who will successfully complete their remaining terms of service.[4] In that sense, the allocation strategy described—though obviously inefficient—was a "successful" strategy.

[4]A more precise accounting of the outputs of each quarter shows that the 3,500 fully-qualified Job 2 holders are made up of two distinct groups. First, there are those who will spend 4.0 years (the full contract term) in Job 2, .5 years in training followed by 3.5 years in the productive phase. These people are the applicants who are initially assigned to Job 2 and succeed (H2 and L2). Second, there are those who will spend 3.75 years in Job 2, encompassing the training and the productive phases. These are the retrainees who spent 3 months in Job 1 training during an earlier quarter in which they were found unsuited for continued Job 1 duty (FH12 and FL12). In a very real sense we may consider the retrainees as applicants assigned to Job 2 with 3.75 year contracts which begin the moment the assignment is made. The Air Force operates *as though* it wishes to satisfy specific requirements for both 4.0 and 3.75 year contracts in Job 2. The general requirement for 9,000 Job 1 holders for each quarter may be more accurately defined in contract length-specific terms in the same manner.

Table 6. **Summary Data for Second Quarter Allocation**

Types of Subjects	Composition of Group	Number in Group
All H applicants initially selected for assignment to JOB 1	H1 + (H12 + H120)	5,786
All H applicants initially selected for assignment to JOB 2	H2 + (H21 + H210)	4,214
All unselected H applicants	H0	0
All L applicants initially selected for assignment to JOB 1	L1 + (L12 + L120)	0
All L applicants initially selected for assignment to JOB 2	L2 + (L21 + L210)	12,927
All unselected L applicants	L0	27,073
All retrainees enlisting in IV, 1981 who are reassigned to JOB 1	FH21 + FH210 + FL21 + FL210	11,053
All retrainees enlisting in I, 1982 who are reassigned to JOB 2	FH12 + FH120 + FL12 +FL120	646
All applicants and retrainees assigned to JOB 1 who will succeed	H1 + L1 + FH21 + FL21	9,000
All applicants and retrainees assigned to JOB 2 who will succeed	H2 + L2 + FH12 + FL12	3,500
All retrainees who will fail in JOB 1 and be discharged	FH210 + FL210	7,095
All retrainees who will fail in JOB 2 and be discharged	FH120 + FL120	646
Applicants assigned to JOB 1 who will fail and be reassigned to JOB 2 in III, 1982	(H12 + H120) + (L12 + L120)	744
Applicants assigned to JOB 2 who will fail and be reassigned to JOB 1 in IV, 1982	(H21 + H210) + (L21 + L210)	13,641

Table 7. **Summary Data for Third Quarter Allocation**

Types of Subjects	Composition of Group	Number in Group
All H applicants initially selected for assignment to JOB 1	H1 + (H12 + H120)	5,786
All H applicants initially selected for assignment to JOB 2	H2 + (H21 + H210)	4,214
All unselected H applicants	H0	0
All L applicants initially selected for assignment to JOB 1	L1 + (L12 + L120)	0
All L applicants initially selected for assignment to JOB 2	L2 + (L21 + L210)	12,927
All unselected L applicants	L0	27,073
All retrainees enlisting in I, 1982 who are reassigned to JOB 1	FH21 + FH210 + FL21 + FL210	11,053
All retrainees enlisting in II, 1982 who are reassigned to JOB 2	FH12 + FH120 + FL12 + FL120	744
All applicants and retrainees assigned to JOB 1 who will succeed	H1 + L1 + FH21 + FL12	9,000
All applicants and retrainees assigned to JOB 2 who will succeed	H2 + L2 + FH12 + FL12	3,500
All retrainees who will fail in JOB 1 and be discharged	FH210 + FL210	7,094
All retrainees who will fail in JOB 2 and be discharged	FH120 + FL120	744
Applicants assigned to JOB 1 who will fail and be reassigned to JOB 2 in IV, 1982	(H12 + H120) + (L12 + L120)	744
Applicants assigned to JOB 2 who will fail and be reassigned to JOB 1 in I, 1983	(H21 + H210) + (L21 + L210)	13,642

Table 8. **Summary Data for Fourth Quarter Allocation**

Types of Subjects	Composition of Group	Number in Group
All H applicants initially selected for assignment to JOB 1	H1 + (H12 + H120)	5,291
All H applicants initially selected for assignment to JOB 2	H2 + (H21 + H210)	4,709
All unselected H applicants	H0	0
All L applicants initially selected for assignment to JOB 1	L1 + (L12 + L120)	0
All L applicants initially selected for assignment to JOB 2	L2 + (L21 + L210)	10,744
All unselected L applicants	L0	29,256
All retrainees enlisting in II, 1982 who are reassigned to JOB 1	FH21 + FH210 + FL21 + FL210	13,641
All retrainees enlisting in III, 1982 who are reassigned to JOB 2	FH12 + FH120 + FL12 + FL120	744
All applicants and retrainees assigned to JOB 1 who will succeed	H1 + L1 + FH21 + FL21	9,000
All applicants and retrainees assigned to JOB 2 who will succeed	H2 + L2 + FH12 + FL12	3,500
All retrainees who will fail in JOB 1 and be discharged	FH210 + L210	9,253
All retrainees who will fail in JOB 2 and be discharged	FH120 + FL120	744
Applicants assigned to JOB 1 who will fail and be reassigned to JOB 2 in I, 1983	(H12 + H120) + (L12 + L120)	680
Applicants assigned to JOB 2 who will fail and be reassigned to JOB 1 in II, 1983	(H21 + H210) + (L21 + L210)	11,953

Development of an Optimal Allocation Strategy: The Least Cost Alternative

The objective function: allocation cost components. The objective of any alternative allocation strategy may now be seen as the selection and assignment of personnel leading to the production of 9,000 Job 1 and 3,500 Job 2 holders for four successive quarters in 1982, subject to the quarterly applicant pool characteristics already established. The objective of an optimal allocation includes all of this while at the same time minimizing resource expenditures.

Exact identification of resource expenditure associated with recruiting, transportation, training, medical care, and a host of other functions are so interrelated that to include estimates of costs associated with each is to invite fire from all sides. Whatever estimate one makes of these extremely complex costs is certain to seem too small for some of one's critics and too large for the rest. It should be emphasized that such estimates certainly can be used in the model, but for purposes of this discussion, it was decided to confine cost figures to those which are largest and which are unarguable–direct salary payments to subjects.

Two fundamental types of salary costs may be discerned. First, there are the costs of paying salaries to men who successfully complete training and contribute their skilled services for the remainder of their first terms of service. We will call these productive costs.

Second, there are the costs of paying salaries to men during the period in which the Air Force determines they are unable to meet minimum standards of performance in a given job. These payments are termed identification costs.

Productive costs are uniformly associated with maintaining H1, H2, FH12, FH21, L1, L2, FL12, and FL21 people from the time they enter their last course of training (which would also be the initial course of training for all applicants who succeed in their first assignment) through their remaining terms of service.

Identification costs in this context are primarily those salary payments made to personnel during the period of their assignment to jobs in which they will fail—almost 4 years in some cases. These people are represented in groups H12, H120, H21, H210, L12, L120, L21, L210, FH120, FH210, FL120, and FL210. In this scenario, the assumption was made that all failures occur at the end of technical training. Therefore, the situation for this example is a little different. Since all failures in Job 1 occur at the end of training which lasts 3 months, or .25 years, the total time spent in identifying failures among all personnel entering job 1 training during an allocation quarter is: .25 times (H12 + H120 + L12 + L120 + FH210 + FL210). For Job 2, the total time spent is: .50 times (H21 + H210 + L21 + L210 + FH120 + FL120).[5]

Total time during which salaries are paid to first-term airmen who will satisfactorily complete their remaining first terms of service are: 4.0 times (H1 + H2 + L1 + L2), plus 3.75 times (FH12 + FL12), plus 3.50 times (FH21 + FL21).

Note that the productive salaried time, measured in years, associated with first-time failures is less than 4.0 because the first few months' salary of a retrainee's four-year enlistment are spent by the Air Force acquiring the valuable information that he cannot meet minimum standards of performance in the job to which he was initially assigned. The price of such information is the sum of all salary payments paid throughout initial training to those people who were rejected from earlier programs. This price, which we call an identification cost, was explicitly accounted for during the earlier period in which the retrainee's initial assignment decisions were made. As the retrainees become available for their second assignments in the current period, the only costs considered are those directly associated with second assignment options. Thus, identification costs are tied to the specific allocation decisions which generated them, and the error of counting the same expenditure twice is avoided.

As a consequence, it may appear superficially that retrainees are less expensive and therefore more desirable Job 1 and Job 2 holders than newly selected applicants. Clearly, a retrainee who is assigned to and will complete either job will receive a smaller total payment from that moment through the end of his enlistment than his applicant counterpart, for whom all salary payments made during his 4-year enlistment will be counted as productive costs. Indeed, this fact might lead someone to mistakenly conclude that the least-cost allocation consistent with predetermined manpower requirements is one which produces the greatest number of retrainee graduates (in their second assignment) who have the shortest amount of time remaining on their four-year enlistment contracts.

The error in this thinking has two components. First, the cost of producing retrainees (by failing them in their initial assignments) is quite high. This will be dramatically illustrated later when a random allocation strategy is discussed. Second, Air Force requirements are taken to be unalterable demands, and Air Force's decision to use retrainees is taken for what it really is—a requirement for some number of short-term contract employees. We seek to satisfy these demands in the least expensive manner possible. The Air Force acts as though it requires specific numbers of both short-contract-length (retrainee) and full-term-contract-length (applicant) people who will perform satisfactorily in Jobs 1 and 2. The production of retrainee graduates in Jobs 1 and 2 (FH12, FH21, FL12, and FL21) in numbers which would exceed current specific demands, or quotas, for these types of successful short-contract employees would only add to the total cost of an acceptable allocation. This is because we are still compelled to produce specifically required numbers of full-term (applicant) graduates in both jobs.

[5]To simplify the specification of costs, we further assume it takes six to seven weeks before a first-time failure can be scheduled for entry into the alternative course. This means that a retrainee, once identified, must wait in casual status during the period that newly selected applicants are going through basic training. Therefore it takes just as much salaried time to get a retrainee all the way through training (whether he succeeds or fails) as a newly selected applicant, even though the retrainee does not have to go through basic training a second time. We also assume that the cost of transporting a one-time failure from the site of one training program to the other is zero. These assumptions are certainly not of central importance to the analysis. They merely permit us to work with simplified cost figures. Note also that the model could just as easily be set up to consider *all* training, successful or unsuccessful, as identification costs, and productive costs could include only the expenses incurred during the period of post-graduate job performance. However, in a sense, the only product is a subject who can handle his job through the end of his contract. In the real world of continuously occurring attrition, positive identification cannot be made until the contract term is completed. So the costs of performing positive identification cannot be confined to expenses incurred exclusively during the training period. Moreover, the costs of training which culminates in a useful output are conceptually productive in nature.

The determination of which mix of contract lengths is best for the Air Force or for individual career fields is not dealt with here. The goals of this analysis are to show that the least expensive way of meeting an established set of manpower requirements can be determined; that the allocation decisions which the Air Force currently makes may lead to a greater expenditure than is either necessary or desirable, and, most important, that the value of classification information may be estimated by evaluating the role it plays in minimizing the total cost of satisfying the established set of manpower requirements. The achievement of these goals will likely lead to analytical evaluations of differential contract length considerations and other matters related to the determination of Air Force demands for first-term manpower which support national security objectives. Such an investigation is outside the scope of this study.

We assume hereafter that monthly salary payments are the same for each of the 48 months of the first term. Hence, the total salaried time (expressed in years) associated with an allocation which satisfies Air Force manpower needs is the total cost implied by the allocation. The allocation which minimizes salaried time minimizes total salary payments; the optimal allocation strategy is one which minimizes salaried time.

We define the sum of all salaried time associated with identification costs plus all salaried time associated with productive costs as an objective function. The value of the objective function therefore is an expression of total allocation cost.

Input constraints, output constraints, and input/output relationships. If we also specify relationships between manpower resources (inputs) and manpower requirements (outputs) in linear algebraic form, we can structure the allocation problem as a linear programming problem. That is, we will seek to minimize total resource expenditures (defined by the objective function) subject to a set of linear constraints which express known relationships between specific classes of manpower resources and job-specific manpower requirements.

To begin, the need for Job 1 graduates during a quarter must be satisfied as follows:

$$(H1 + L1 + FH21 + FL21) = 9{,}000$$

Similarly,

$$(H2 + L2 + FH12 + FL12) = 3{,}500$$

expresses the constraint on Job 2 graduates.

Since we have only 10,000 H scores available for enlistment during a given quarter, it follows that

$$(H1 + H12 + H120 + H2 + H21 + H210 + H0) = 10{,}000$$

and also

$$(L1 + L12 + L120 + L2 + L21 + L210 + L0) = 40{,}000$$

The availability of first-time failures (retrainees) from previous enlistment quarters for entry into current quarter training programs is expressed as:

FH12 + FH120 $\leq$ Number of high-aptitude personnel enlisting one quarter earlier who failed Job 1 training

FH21 + FH210 $\leq$ Number of high-aptitude personnel enlisting two quarters earlier who failed Job 2 training

FL12 + FL120 $\leq$ Number of low-aptitude personnel enlisting one quarter earlier who failed Job 1 training

FL21 + FL210 $\leq$ Number of low-aptitude personnel enlisting two quarters earlier who failed Job 2 training

Relationships between successes and failures by aptitude group, job assignment, and entry status are expressed as:

$$\frac{H1}{H1 + (H12 + H120)} = (.871)$$

$$\frac{H2}{H2 + (H21 + H210)} = (.490)$$

$$\frac{H12}{H12 + H120} = (.001)$$

$$\frac{H21}{H21 + H210} = (.748)$$

$$\frac{L1}{L1 + (L12 + L120)} = (.175)$$

$$\frac{L2}{L2 + (L21 + L210)} = (.111)$$

$$\frac{L12}{L12 + L120} = (.001)$$

$$\frac{L21}{L21 + L210} = (.242)$$

$$\frac{FH12}{FH12 + FH120} = (.001)$$

$$\frac{FH21}{FH21 + FH210} = (.748)$$

$$\frac{FL12}{FL12 + FL120} = (.001)$$

$$\frac{FL21}{FL21 + FL210} = (.242)$$

The reader may realize that the first equation overlooks the possibility of H10 prospects (that is, those expected to fail Job 1 who would be subsequently released from service rather than entered into Job 2 during a later quarter). However, this is a problem of notation and semantics. The term (H12 + H120) represents the expected total number of high aptitude applicant failures in Job 1 becoming available for later entry into Job 2 as retrainees. To the extent that the Air Force might choose to deviate from an automatic retraining policy, some members of this pool would be discharged rather than entered into Job 2 (where they would either succeed or fail). The notation employed here, however, characterizes all first-time failures as *potential* entries into the alternative job at a later time. Among those who would become available for retraining, the number of such people who would actually be permitted to enter the second job is a determination which cannot be properly made at the time of initial assignment (the current quarter). Therefore, it is convenient and notationally concise to characterize such people as potential successes and failures in the alternative job, which indeed they are. The second, fifth, and sixth equations involve analogous comments about the possibility of H20, L10, and L20 propects, respectively.

Finally, we must explicitly recognize Air Force requirements for specific types of Job 1 and Job 2 holders distinguished on the basis of contract lengths. That is, the Air Force currently operates as though it wishes to satisfy quotas for 4.0 and 3.5 year contracts in Job 1 and 4.0 and 3.75 year contracts in Job 2.[6] These requirements are expressed as:

[6]The attempt to produce job-specific *and* contract length-specific output from each quarters's inputs creates a number of practical difficulties. For example, the optimal allocation for the first quarter may yield fewer Job 1-bound retrainees than are sufficient to satisfy pre-determined third quarter requirements for Job 1 holders on 3.5 year contracts. This may be easily seen in the extreme case of an allocation based upon "perfect" information which produces no Job 1-bound retrainees whatsoever during the first quarter (zero applicant attrition from Job 2 training). In this case of underavailability of retrainees, we have assumed that retrainee shortfalls can be filled by selecting additional third quarter applicants in numbers sufficient to make up the difference between required numbers and available numbers of short-contract graduates. This is based upon the assumption that any applicant for a 4.0-year contract would, if given the option, sign up for a 3.5 or 3.75 year contract contingent upon his success in the first job to which he is assigned. On the other hand, we may encounter the problem of overavailability of retrainees. Here, the reassignment of all retrainees produced in a given quarter to the alternative job in a later quarter leads to the production of 3.5 year or 3.75-year contracts in numbers which exceed the requirements dictated by the outcome of 1982 allocation. To deal with situations of this type, we reassign retrainees up to the point that 3.5 and 3.75 contract requirements will be satisfied. Any remaining retrainees are discharged without the benefit of a second assignment opportunity. In this way we are able to exactly satisfy all manpower requirements.

FH12 + FL12 = requirement for 3.75 year contracts in Job 2

and

FH21 + FL21 = requirement for 3.5 year contracts in Job 1.

The specific numerical quotas are taken from the quarterly outputs of the 1982 scenario allocation, since the Air Force operated as though it was satisfying such quotas when it made its 1982 allocation decisions in accordance with the traditional strategy. The reader must keep in mind that this is not a study of the wisdom or folly of using retrainees as opposed to new applicants. This is a study of the least expensive way of producing exactly what *was* produced by the allocation which was dictated by the traditional allocation strategy hypothesized earlier. Thus, these two constraints serve to guarantee that an optimal allocation will yield *exactly* the same output, including an identical mix of differential contract lengths. See Appendix B for a more complete discussion of differential contract length considerations.

We have been careful to exclude the single constraint which would make the optimal allocation strategy, and therefore its outcome, identical to the traditional strategy. The constraint is

L1 + L12 + L120 = 0.

This equation can be satisfied only if low-aptitude applicants are prohibited from entering Job 1 training. The assignment restriction is taken as a matter of policy. There is no evidence that the policy can be justified, unless tradition itself is a justification. Exclusion of the equation permits us to identify the least-cost allocation unrestricted by tradition. No other constraint is specified which would otherwise artificially restrict applicant pool entries into either job on the basis of aptitude score.

These twenty-two constraints must all be satisfied simultaneously. An optimal allocation strategy must additionally minimize the value of the objective function specified earlier. The linear programming solution to this mathematical structure then becomes the optimal allocation.[7]

It would certainly be tedious, and probably of little interest, to demonstrate how each of these constraints was formatted for use in a linear programming package. Therefore, the specification of slack variables, artificial variables, etc. will be omitted.

III. RESULTS AND DISCUSSION

Comparison of Costs, the Traditional Allocation Strategy vs. the Optimal Allocation Strategy

We have computed the "least cost" allocation for the 1982 enlistment year, quarter by quarter, based upon the optimal allocation strategy. The input constraints (applicant pool characteristics) and output constraints (manpower requirements) were taken from the 1982 scenario in which a traditional strategy was assumed.

The cost of misusing information. What are the relevant data for comparing the traditional allocation with an optimal allocation? We may start with the estimated total salaried time which each of the two allocations implies. These figures are presented in Table 9.

The first number in the first row (56,352) came from the computation specified above in the sixth paragraph after the heading "Development of an Optimal Allocation Strategy The Least Cost Alternative" of the Method section.

[7]Brevity requires us to omit the explicit specification of more than twenty additional equations, one for every group, or variable, in the model. That is, the linear programming solution requires that all variables have values greater than or equal to zero. For example H1 $\geqslant 0$, H12 $\geqslant 0$, H120 $\geqslant 0$, and so on. The inclusion of these constraints is consistent with common sense to the extent that, say, a negative number of high aptitude applicants succeeding in Job 1 (H1 < 0) has no practical meaning.

Table 9. **Comparison of Total Salaried Time (in Manyears) for Optimal Allocation vs Traditional Allocation in 1982**

Conditions	1st Quarter Allocation	2d Quarter Allocation	3rd Quarter Allocation	4th Quarter Allocation	Enlistment Year 1982
Salaried time, in manyears, associated with 1982 traditional allocation	56,352	57,124	57,173	56,637	227,286
Salaried time, in manyears, associated with the optimal allocation	54,806	54,715	55,241	55,241	220,003

$$
\begin{aligned}
&.25(H12 + H120 + L12 + L120 + FH210 + FL210) \\
&+ .50(H21 + H210 + L21 + L210 + FH120 + FL120) \\
&+ 4.0(H1 + H2 + L1 + L2) \\
&+ 3.75(FH12 + FL12) \\
&+ 3.50(FH21 + FL21)
\end{aligned}
$$

The other numbers in the first row came from similar computations for the other three quarters of 1982.

The numbers in the second row are computational results from application of the linear programming model called the optimal allocation strategy, with the requirements and constraints described in detail above.

Other relevant data which would likely be of interest to command-level personnel managers, training program administrators, force level managers, and Recruiting Service personnel, are presented in Table 10. Many of the figures presented are of the type actually used today to manage the force, the training environment, and of course the allocation activity itself.

It is particularly interesting to note that the optimal allocation implicitly limits Job 2 assignments to applicants with H scores only, while Job 1 assignments are open to H scores (all H applicants remaining after Job 2 quotas are satisfied) and L scores. This clearly violates the assignment policies which led to the traditional allocation in the 1982 scenario.

It is now possible to identify a very specific cost associated with allocating personnel in accordance with the arbitrary, non-optimal 1982 allocation strategy. In Table 11, the difference between the respective total costs for each strategy are estimated by first performing a simple transformation of man-years (total salaried time, Table 9) to paycheck dollars, based upon an assumed salary of $5,000 per year (present discounted value) regardless of time in service. This shows how expensive it can be to misuse (or underuse) classification information. Without varying quarterly input, i.e., applicant pool size or aptitude distribution, or quarterly output; i.e., production of the required numbers and types of fully-qualified personnel, the Air Force could have substantially reduced its direct salary payments to personnel by implementing this strategy. (In dealing with instances of retrainee underavailability, we made up the difference between required numbers and available numbers of 3.5 and/or 3.75 year contracts by selecting additional applicants. This was done in both the third and fourth quarters (the only quarters affected). In each of the two quarters several thousand applicants were additionally selected for assignment to Job 1 to eliminate the shortfall of Job 1–bound retrainees (FH21 + FL21) needed to satisfy 3.5-year contract requirements. Each of these additionally selected applicants who succeeds will serve for 3.5 years rather than 4.0 years, and the quarterly total allocation cost estimates have been revised to reflect the reduced contracts for these particular applicants. Table 12 shows how the revised total allocation costs were calculated.)

But the value of available information, by itself, in its entirety, has yet to be calculated. As a first step we will estimate the value of classification information in general.

Table 10. **Comparative Data for Optimal Allocation vs Traditional Allocation in 1982**
(statistics for Traditional Allocation in Parentheses)

Types of Subjects	1st Quarter Allocation	2nd Quarter Allocation	3rd Quarter Allocation	4th Quarter Allocation	Enlistment Year 1982
All H applicants initially selected for assignment to JOB 1	2,857 (5,027)	2,857 (5,786)	2,857 (5,786)	2,857 (5,291)	11,428 (21,890)
All H applicants initially selected for assignment to JOB 2	7,143 (4,973)	7,143 (4,214)	7,143 (4,214)	7,143 (4,709)	28,572 (18,110)
All unselected H applicants	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
All L applicants initially selected for assignment to JOB 1	10,807 (0)	14,583 (0)	21,630 (0)	21,630 (0)	68,650 (0)
All L applicants initially selected for assignment to JOB 2	0 (9,580)	0 (12,927)	0 (12,927)	0 (10,744)	0 (46,178)
All unselected L applicants	29,193 (30,420)	25,417 (27,073)	18,370 (27,073)	18,370 (29,256)	91,350 (113,822)
All retrainees enlisting in previous quarter who are reassigned to JOB 1	15,222 (15,222)	11,053 (11,053)	3,643 (11,053)	3,643 (13,641)	33,561 (50,969)
All retrainees enlisting in previous quarter who are reassigned to JOB 2	645 (645)	0 (646)	0 (744)	0 (744)	645 (2,779)
All applicants and retrainees assigned to JOB 1 who will succeed	9,000 (9,000)	9,000 (9,000)	9,000 (9,000)	9,000 (9,000)	36,000 (36,000)
All applicants and retrainees assigned to JOB 2 who will succeed	3,500 (3,500)	3,500 (3,500)	3,500 (3,500)	3.500 (3,500)	14,000 (14.000)
Attrition rate in JOB 1 (total failures ÷ total entries)	.688 (.556)	.684 (.466)	.680 (.466)	.680 (.525)	.683 (.506)
Attrition rate in JOB 2 (total failures ÷ total entries)	.551 (.770)	.510 (.804)	510 (.804)	.510 (.784)	.521 (.791)

Table 11. **Comparison of Total Allocation Costs (Direct Salary Payments) for Optimal Allocation vs Traditional Allocation in 1982**

Conditions	1st Quarter Allocation Costs	2nd Quarter Allocation Costs	3rd Quarter Allocation Costs	4th Quarter Allocation Costs	1982 Allocation Costs
Total salary payments associated with 1982 traditional allocation	$281,760,000	$285,620,000	$285,865,000	$283,185,000	$1,136,430,000
Total salary payments associated with the optimal allocation	$274,030,000	$273,575,000	$273,122,000	$272,045,000	$1,092,772,000
Difference in total salary payments	$ 7,730,000	$ 12,045,000	$ 12,743,000	$ 11,140,000	$ 43,658,000

Table 12. **Allocation Costs**

	3rd Qtr Allocation	4th Qtr Allocation
Initial total allocation cost estimate	$276,205,000	$276,205,000
Number of successful applicants selected for 3.5 year contracts	1,233	1,664
Amount of cost reduction associated with shortened contracts ($2,500 per additional successful applicant)	$ 3,083,000	$ 4,160,000
Revised total allocation cost estimate	$273,122,000	$272,045,000

The Value of Classification Information

The extremes and orders of magnitude. The value of information is intricately tied to the manner in which it is used. In the case of satisfying Air Force first-term manpower requirements, aptitude information is used to allocate manpower resources efficiently. It is a small matter to characterize efficient allocation in a perfect information world. We have the fully-qualified manpower levels to be generated from applicant pool classification, selection, and training. If the 31.4% of the total pool who could satisfy Job 1 standards and the 18.7% who could satisfy Job 2 standards were identifiable at time of application for enlistment, the Air Force would undoubtedly select and assign exactly the numbers required to satisfy manpower needs. Assuming that perfect information became available January 1, 1982, some retrainees from 1981 would be available for reassignment. Only those retrainees from 1981 (quarters III and IV) who were capable of succeeding in their second assignments would be selected. Non-productive training time; i.e., the time spent in identifying both one-time and two-time failures, would be zero. Without some type of change in the characteristics of the pool, the training program, job standards, or manpower requirements, direct payments to personnel could be reduced no further. The total cost of the allocation would consist solely of productive costs.

At the other end of the spectrum, consider a world in which allocation is performed without any classification information whatsoever. The corresponding allocation strategy would amount to nothing more than *randomly* selecting from the applicant pool and assigning selectees to each job in numbers sufficient to attain manpower requirements after the elimination of all failures. In terms of the selection and assignment of aptitude group members (H and L) we have already classified, we may simulate the zero-information, random allocation strategy by requiring H and L group applicants to enter each job in the same proportion as they exist in the applicant pool. This new constraint was expressed in the form of two linear equations which were added to the twenty-two constraints already specified in the development of the optimal allocation strategy. The linear programming solution to the resulting system of twenty-four equations is presented in Table 13, along with comparative data describing the allocation in a perfect information world.

The net difference in total allocation costs is estimated to be approximately a quarter of a billion dollars. This represents the maximum reduction in direct salary payments to personnel which may be achieved as the extent of classification information increases from nothing to perfection. What we are really talking about is the reduction of classification mistakes expressed in terms of the costs associated with making those mistakes. There are very real and substantial costs associated with classification errors; the purpose of gathering information at the point of enlistment may be viewed as the attempt to minimize such errors. In the 1982 scenario, it seems clear that potential returns to classification efforts are quite large indeed.

Personnel classification research as an Air Force investment. It is now possible to gauge the value of classification information acquired through an aptitude testing program relative to both the zero information starting point and the perfect information goal. The pertinent data are presented in Table 14. (It is important to note that the figures displayed for the use of aptitude information are taken from the optimal allocation strategy rather than the traditional allocation strategy the Air Force hypothetically

Table 13. **Comparative Data for "Zero Information" Allocation vs "Perfect Information" Allocation ("Zero Information" Statistics in Parentheses)**

Types of Subjects	1st Quarter Allocation	2nd Quarter Allocation	3rd Quarter Allocation	4th Quarter Allocation	Enlistment Year 1982
All applicants initially selected for assignment to JOB 1	4,382 (13,940)	5,042 (16,044)	9,000 (16,043)	9,000 (14,671)	27,424 (60,698)
All applicants initially selected for assignment to JOB 2	3,500 (18,736)	3,500 (18,736)	3,500 (18,736)	3,500 (18,736)	14,000 (74,944)
All unselected applicants	42,118 (17,324)	41,458 (15,220)	37,500 (15,221)	37,500 (16,593)	158,576 (64,358)
All retrainees enlisting in an earlier quarter who are reassigned in JOB 1	4,618 (15,221)	3,958 (11,050)	0 (12,358)	0 (14,139)	8,576 (52,768)
All retrainees enlisting in an earlier quarter who are reassigned to JOB 2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
All applicants who will succeed in JOB 1 on 4.0 year contracts	4,382 (4,382)	5,042 (5,042)	5,042 (5,042)	4,611 (4,611)	19,077 (19,077)
All applicants who will succeed in JOB 1 on 3.5 year contracts	0 (0)	0 (0)	3,958 (0)	4,389 (0)	8,347 (0)
All retrainees who will succeed in JOB 1 (effective 3.5 year contracts)	4,618 (4,618)	3,958 (3,958)	– (3,958)	– (4,389)	8,576 (16,923)
All applicants who will succeed in JOB 2 on 4.0 year contracts	3,500 (3,500)	3,500 (3,500)	3,500 (3,500)	3,500 (3,500)	14,000 (14,000)
All applicants who will succeed in JOB 2 on 3.75 year contracts	– (–)	– (–)	– (–)	– (–)	– (–)
All retrainees who will succeed in JOB 2 (effective 3.75 year contracts)	– (–)	– (–)	– (–)	– (–)	– (–)
Total salaried time (manyears) associated with allocation	47,691 (60,349)	48,021 (60,163)	48,021 (60,489)	47,805.5 (60,376)	191,538.5 (241,377)
Total salary payments associated with allocation	$238,455,000 ($301,745,000)	$240,105,000 ($300,815,000)	$240,105,000 ($302,445,000)	$239,028,000 ($301,880,000)	$ 957,693,000 ($1,206,885,000)

Table 14. **Reduction in Total Allocation Costs (Direct Salary Payments) Made Possible by the Use of Classification Information**

Conditions	Maximum possible reduction of salary payments	Reduction of salary payments made possible by classification information currently available	Maximum additional reduction of salary payments through development of even better information
Total allocation cost associated with a "zero information" allocation (=$1,206,885,000)	$1,207 million	$1,207 million	
Total allocation cost associated with an optimal allocation based upon information currently available (=$1,092,772,000)		minus $1,093 million	$1,093 million
Total allocation cost associated with a "perfect information" allocation (=$957,693,000)	minus $ 958 million		minus $ 958 million
EQUALS:	$ 249 million (This is the reduction we can attempt to achieve)	$ 114 million (This is how far we've come)	$ 135 million (This is how much further we have to go)

$$\frac{\text{Reduction made possible with currently available information}}{\text{Maximum reduction possible}} = \frac{\$114\text{ M}}{\$249\text{ M}} \quad \text{Relative efficiency of current classification efforts} = 46\%$$

employed in 1982. This is done because it is necessary to distinguish between the value of information in its most efficient feasible use and its depreciated value when it is misused for any reason. One way of expressing the guideline for identifying such situations is to say that information is misused if there are no structural reasons precluding its being used in an alternative, feasible manner which leads to an allocation of lower total cost.)

The figures in Table 14 show that, within the scenario, classification efforts permit us to reduce the total costs of satisfying Air Force manpower requirements by approximately $114 million. If, in the absence of aptitude classification, the Air Force randomly allocated its manpower resources, then the above figure less the cost of producing aptitude data would reflect the true value of aptitude classification information currently available to the Air Force within the artificial setting, taking the conservative position of considering only direct salary payments as relevant variable costs involved in selection, training, and utilization. Similarly, the difference between the total costs implied by the optimal allocation and the perfect-information allocation estimates the maximum potential value of even better classification information which could become available in the future.

If we consider $249 million in identification costs (zero information) to be our starting point and zero identification costs (perfect information) to be our goal, then our current classification efforts have been 46% efficient in the 1982 scenario. We have been able to reduce identification costs by almost one-half of the original amount ($114 million divided by $249 million).

Let us suppose that these figures are representative of each of the ten enlistment years from 1973 through 1982. Further suppose that the money budgeted and expended to produce aptitude information averaged $5 million per year. If we view the Air Force as an investor who spends $5 million a year and receives more than $100 million a year as a return on his investment, then the Air Force's investment in aptitude information has been extraordinarily shrewd. Few investments today yield a more than 20 to 1 benefit-to-cost ratio. A 1.1 to 1 ratio probably overestimates the yield for next-best alternative, non-research investments available to the Air Force.

As the Air Force plans its capital expenditures for the next year and considers, say, a $10 million budget for research in personnel classification, selection, training, and utilization over that period, let us estimate what *amount* of return would justify a $10 million investment. If, in the first year the results of classification research are implemented, total allocation costs can be reduced by an additional $11 million (present discounted value), then the yield will be 10%, a 1.1 to 1 benefit-to-cost ratio, *in that year alone.* And this additional $11 million reduction in identification costs would reflect an increase in the relative efficiency of our classification effort on only about four percentage points, bringing the overall measure of efficiency up from 46% $\frac{(\$114M)}{(\$249M)}$ to 50% $\frac{(\$125M)}{(\$249M)}$.

It is not certain that current state-of-the-art research capabilities will permit us to realize a 10% yield on an *additional* $10 million research expenditure; risk is an element of every investment. However, we cannot fail to notice that the Air Force stands to lose between $100 and $200 million *a year* in the future in the form of identification costs (it was $135 million in our 1982 scenario) if it elects to forego this type of investment.

One might ask if the scenario figures are representative of the actual figures associated with the production and use of classification information in the Air Force today, the real world. There is no clear answer. Due regard must be given to population attrition rates and selection device validity in each of many hundreds of different jobs, characteristics of the entire applicant pool, variable costs associated with attrition for each unique job, limits on students capacity within each job training program, and a host of other factors. Although the figures presented here are probably representative of the order of magnitude for the current situation, there is no good substitute for the more realistic, and therefore more complex, analytical assessment of the Air Force allocation problem and the role classification information plays in improving manpower allocation decision making. This study suggests guidelines for a major analysis. It will be shown later that there are many other incentives for performing such an assessment.

Incremental analysis: estimating the true value of specific types of classification information. It is now appropriate to introduce another concept which is certainly not original to the present study, that of marginal or incremental analysis. Within the scenario, we have already established the total allocation cost associated with the most efficient feasible use of aptitude information. In order to determine the true value of this rather specific form of classification information to the Air Force, we must describe what the situation would be like if the Air Force did not have aptitude information available for use in making allocation decisions. To begin, this means that the total allocation cost associated with the *next best alternative* solution to the Air Force manpower allocation problem must be identified.

Suppose that at the present time the Air Force bases its manpower allocation decisions solely on Armed Services Vocational Aptitude Battery (ASVAB) classification data. Let us also assume that the only practical alternative source of classification information, and therefore the next best alternative to using ASVAB, is some sort of general screening instrument–such as the Armed Forces Qualification Test (AFQT). To determine the true value of the information provided specifically by the ASVAB, it would first be necessary to ascertain what the total allocation cost would be if AFQT data formed the basis for making Air Force manpower allocation decisions. To do so, the mathematical constraints of the optimal allocation strategy dealing with success rates for ASVAB groupings would be replaced by corresponding historical rates for the AFQT groupings. The solution for the revised model would provide estimates of the total allocation cost associated with the next best alternative strategy, one based upon the use of AFQT classification data. The difference between this allocation cost estimate and the allocation cost estimate for an ASVAB-based optimal allocation would represent the *marginal benefit* associated with ASVAB information as it is used to reduce allocation costs.

It would then be appropriate to determine independently the actual costs of producing each type of data. The difference between the two production cost estimates would represent the *marginal cost* of

ASVAB data. The true value of ASVAB aptitude information is the difference between additional benefit and additional cost, the marginal benefit in terms of reducing total allocation expenditures less the marginal cost of producing ASVAB information.

It should be recognized that the information base the Air Force utilizes for making manpower allocation decisions is made up of many more data elements than ASVAB scores alone. Efforts to estimate specifically the true value of ASVAB data, or of the other types of available classification information by themselves, would require a similar approach which recognizes the partial contribution made by a specific form of data. It would be necessary to determine what the allocation situation would be like if a particular class of information were not available to guide decision making. To the extent that total allocation expenditures would be higher, the collection and use of the information in question yields a marginal benefit to the user, the Air Force. When compared with the marginal cost of producing it, the true value of the information could be estimated in a meaningful manner.

No attempt is made here to illustrate this type of analysis because it would require the construction of a second scenario. The historical data are available and, if suitably analyzed, will tell the whole story.

Applications in the Evaluation of Personnel Policy Alternatives and Other Structural Changes

Some important considerations. As we leave behind the 1982 scenario and the development of the optimal allocation strategy methodology, three ideas should be considered. First, the preceding discussion was designed to show that classification information has some value to the Air Force. It is possible to develop meaningful estimates of the value of currently available information relative to a zero-information world, a next-best alternative, and a perfect information world. All are tied to the manner in which information is rationally used for making very real first-term personnel allocation decisions.

Second, the linear programming approach requires the specification of a rather large number of variables, and its solution produces a surprisingly large number of figures as a by-product, all for a simple two-job, two-aptitude group scenario. But a model of the world, even in crude form, must be almost as complex as the underlying reality which it is supposed to characterize. While some short cuts are possible, and even absolutely necessary, in order to maintain the analysis at a manageable level, many simplifications can be made only at the expense of the utility of the model itself. Fortunately, linear program solution techniques lend themselves even to problems which include variables and linear constraints which number in the many thousands. Typically, the critical factors are the reliability of the input data and the appropriate specification of constraining relationships.

Third, it is well-recognized that personnel costs account for almost 50% of a many-billion dollar Air Force budget each year. Therefore, when the subject of controlling direct salary payments to first-term personnel is discussed from almost any viewpoint, the order of magnitude of variable costs, savings, benefits, etc. is likely to go well beyond a nickle-and-dime level.

This analysis focuses on salary payments simply because they are enormous and are indisputably variable. A more realistic analysis would include other types of variable costs as well, such as unavoidable travel expenses. An attempt was made to avoid the practice of including every conceivable non-salary cost in such an analysis, as is the Air Force cost analysis custom, because many do not vary with the types of allocation choices considered here, and others vary only at the limits of broad ranges.

To highlight this point, consider the costs of providing expensive electronic equipment used in a specific training program. When we wish to evaluate the consequences of an allocation decision leading to a 10% reduction of course enrollments, we must determine whether the cost of the equipment can also be reduced. The answer may be no, in which case it should not be included in the analysis as a variable cost.

Each type of cost should be judiciously considered in the same manner. The common alternative approach, averaging all possible costs across either total entries or total graduates, frequently fails to characterize the real resource trade-offs associated with alternative allocation decisions being evaluated.

A practical guideline which merits consideration is to first include only those costs which can be clearly shown to vary with allocation choices. Other costs should then be incorporated on an iterative basis, subjecting each additional type of cost to close objective scrutiny prior to inclusion.

A note on the scenario: oversimplification. It should be apparent that a number of strong assumptions have been made in developing a scenario which was supposed to characterize the manpower allocation problem the Air Force faces today. Many of these are clearly untrue. For example:

1. Attritions from the Air Force occur continuously throughout a four-year period, rather than at the end of a second course of training. (The means for altering the analysis to deal with situations of continuous attrition are at hand, however.)

2. Salary payments do not remain constant throughout the first term. (Specification of a more realistic salary structure can be easily accomplished.)

3. Very real constraints such as maximum tech school class capacities must be included as a part of the system of structural constraints. (Such constraints were omitted here to minimize the number of details, thereby simplifying exposition of the methodology.)

4. It is unlikely that applicant pool characteristics can be forecast even one month in advance of entry with perfect accuracy. (Acceptably precise, reasonable estimates are likely possible at the present time, however.)

5. Classification information includes aptitude data which are far more comprehensive than a high/low dichotomy. Also, other indexes such as education, sex, record of moral reliability, and, more recently, applicant job preference are all part of the information base developed on individual applicants prior to making selection/assignment decisions. (The model may be tailored to consider a more complex and comprehensive information base.)

6. Actual attrition rates from career fields and from the Air Force are substantially lower than the contrived rates employed in the scenario. (Realistic rates may be easily incorporated in the analysis.)

7. Personnel who have failed in their initial assignment are not "automatically" reassigned to an alternative career field. (It happens often enough to warrant analytical attention, however.)

8. Low aptitude personnel given a second job opportunity are typically barred from career field reassignments for which they initially failed to qualify on the basis of aptitude score. (The model can be altered to account for this type of constraint.)

There are numerous other qualifications not listed here. The discussion which follows will consider as many of these points as brevity permits. However, we believe that the means for resolving questions of structural realism are available; the presentation of an original approach to estimating the value of classification information has therefore proceeded without attempting to fine-tune the methodology in a way which satisfies all desires for realism. Each point may, and should, be given special attention at a later time.

Application: specifying job/aptitude cutoffs and quotas. If the rather crude approach to modelling the simplified 1982 scenario could be expanded to fairly accurately describe a system of 4 aptitude indexes (with 5 or 10 groupings per index) and many hundreds of jobs, plus some educated guesses about the next period's (quarter, month, or even week) applicant pool size and aptitude distribution, plus a determined effort by force planners to specify fully-qualified manpower requirements, then it would be possible to realistically and rationally set desired aptitude quotas and cutoffs for each job. This could be done on a frequent, and perhaps continuous, basis. The consequences of failing to set upper limits on aptitude could be almost routinely evaluated in both dollar terms (total allocation cost deviation from the minimum possible) and in terms of the effects on initial input specifications for other jobs.

Application: discharges. Air Force policy currently tends to encourage movement of formal tech school course failures from initial course to second course, and in the event of second course failure, sometimes to a third course. This action is predicated on the success of the airman in showing that he exceeds minimum Air Force standards for retention.

By explicitly treating the first-time failure followed by discharge-from-service as a feasible allocation option, it would be possible to evaluate the costs of maintaining the "give a guy a second chance" policy relative to its theoretical alternative. Again, the relevant comparison would be between the total cost for allocating first-term personnel in one manner and the cost of doing it the other way.

Application: technical school capacities. One important feature of an alternative to the current, real Air Force allocation strategy is that an alternative strategy will likely dictate larger class sizes than now exist for some technical schools and smaller class sizes for others. By selectively simulating the expansion of technical school classes, using the optimal allocation strategy restricted by current class size constraints as a starting point, it will be possible to evaluate the desirability of implementing a school expansion program in terms of total allocation cost reduction relative to the costs of a proposed expansion.

A discussion of the treatment of OJT jobs is required here. It is possible to explicitly incorporate OJT *and* tech training options as a part of the allocation strategy. However, a serious effort to evaluate such alternatives within the analytical framework presented here will require the estimation of OJT program success/failure rates, associated direct payment costs, and OJT student capacity limits, all by specific job type.

Application: variations in manpower requirements. It would be possible to examine variations in total costs and aptitude group allocation decisions subject to changes in projected manpower requirements for one, two, three, or many more jobs. From the point of view of the force level manager, the costs and redistribution effects of satisfying new job-specific manpower requirements could be gauged.

Application: variations in applicant pool characteristics. Some rather important applications may be realized in estimating variations in total costs as the applicant pool size and aptitude distribution vary. One very basic analysis would be the investigation of prospective variations in direct salary payments (salary structure), advertising expenditures, or recruiting practices which would be justified by affecting the applicant pool characteristics in a manner which leads to reduced total allocation costs.

Application: women in the Air Force. The methodology possesses the flexibility for explicitly dealing with more than one type of applicant pool. All that is needed is historical success/failure data (validity information plus expectations of population success and failure in each job would suffice) and accurate estimates of time-to-recognition of success or failure by job, if different from males. Men/women allocation choices can be evaluated rationally.

Application: evaluation of Project Guarantee. Now that the Air Force is committed to the policy of guaranteeing jobs to selected applicants on the broadest scale possible, it becomes important to evaluate program results. If, as a starting point, it were assumed that job guarantee status (enlistee did/did not receive his job choice) contributes nothing further to likelihood-of-success estimates based on all other classification information, research could focus on the effects which the policy has had in bringing applicants to the Air Force who otherwise would not have come. The net increase in applicant pool size, and corresponding changes in the pool aptitude distribution, could be evaluated in terms of resulting changes in the total allocation cost.

Application. satisfying career field re-enlistment objectives. There is a well-recognized need to control first-termer re-enlistment rates by career field. The development of reliable estimates of re-enlistment rates (by career field by classification grouping) would make possible the specification of additional constraints which could be formally incorporated into the model to insure that minimum desirable rates of application for re-enlistment could be expected. Any increases in total allocation costs implied by the additional constraints could be routinely identified.

Application: dollar payoffs associated with research which leads to the more efficient utilization of people. The model is based upon historical relationships between the characteristics of persons entering a career field and corresponding likelihood of success estimates. Standards of acceptable performance (both formal and informal) for each type of Air Force job, coupled with the efficiency of Air Force training programs in developing the capabilities of new personnel into job-specific skills which meet or exceed job performance standards, are assumed to be the principal determinants of historical success/failure rates.

If changes in a specific job training environment which are the result of applied research can, by themselves, be shown to significantly reduce the long-term attrition of entries into the career field, then the model can be altered to reflect the lower attrition rates. The reduction in the total allocation costs (reduction or no change at all is assured by lower attrition rates) which is made possible by the application of research can be estimated. The cost of *conducting* the research may be estimated independently. Thus, the true value of job-specific research within the training environment, the product of which is a special form of information, can be expressed to the Air Force in tangible terms. Maximum potential payoffs to successful research of this type may also be estimated on a job-by-job basis. This could lead to the articulation of personnel research proposals as investment opportunities, to be compared with each other and with alternative, non-personnel research investments on a "highest yield" basis. The ability to estimate potential payoffs to success in specific endeavors implies also the ability to evaluate the results of research efforts at time of completion.

IV. SUMMARY AND CONCLUSIONS

Many analyses have been conducted in the past to show how the Air Force may allocate its manpower resources more efficiently, more quickly, or more completely. These efforts have typically treated predetermined aptitude cutoffs and quotas as unchanging and unchallengeable elements of the personnel system's permanent structure. At the same time, others have expressed concern that career field aptitude requirements established in previous years can no longer be justified, and indeed may never have been justified.

In this study we have attempted to develop the means for determining the value of personnel classification information in general, and aptitude test classification information in particular, as it is used to allocate Air Force manpower resources. But good information, just like any other valuable resource, can be used well or misused. Early on, we realized that in order to successfully achieve the major purpose of the study the problem of evaluating alternative classification/selection/assignment decisions would have to be solved. This required an analytical framework within which the optimal allocation strategy was developed.

Similarly, we recognized the necessity for identifying a measurable criterion of job performance which is related to national security objectives and Air Force mission capabilities in a meaningful way. Also, the criterion had to be linked to resource expenditures, and resource costs had to be specified in clear-cut terms based on a variable-cost rather than an average-cost concept.

This study outlines an approach to estimating the value of all currently available classification information and other information which could become available in the future. The means for getting the most out of the information the Air Force already acquires are also developed here. A comprehensive and extensive analytical effort based upon historical data which is already available is now indicated to turn the concept into an application to meet the needs of the Air Force.

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APPENDIX A

This analysis relies heavily upon the assumption that trained manpower requirements to support national security objectives are in fact, if not in practice, expressed as numbers of fully qualified and reliable personnel fulfilling specific military roles. A first-term airman is fully qualified if he (or she) possesses the requisite knowledge and skills to perform the tasks of a specific job in a manner which meets or exceeds minimum standards of performance for the job. The airman is reliable if he can be relied upon to perform these tasks at virtually *any* time during the contractual period of enlistment, following an appropriate training period.

Our national security objectives are defined in terms of our ability to meet various contingencies. National crises and international situations requiring America's use of military force do not occur on a conveniently scheduled basis As a consequence, the services must develop capabilities, or capacities, to deal with a wide variety of military contingencies at *any* moment in time. Available manpower (fully qualified and reliable people) is a major element of the capacity which the Air Force is required to develop and maintain on a continuing basis. But a look at, say, the numbers of people on active duty overstates the measure of manpower availability at any moment in time, even when "pipeline" slack (people on leave, in hospitals, engaged in formal training, etc.) is considered. In such a figure, we invariably include many personnel who are later identified as substandard performers, people who cannot be relied upon to perform the duties of their job and are subsequently discharged for that reason. This is particularly true when the group in question includes primarily trained enlisted personnel having recently entered the post-training phase of their initial terms of active duty service. Yet we document our force strength (across the board, by career field, and so on) in numbers of people on active duty, as though all were available, both fully qualified and reliable.

It is important to distinguish between two different groups of people who are on active duty at the moment such a statistic is quoted. The first group consists of all personnel who will go on to complete their full terms of service prior to normal discharge or continuation in service on a subsequent term. The second group includes personnel who will be discharged short of completing their contractual terms of service for failing to meet minimum standards of job performance. The remainder of this group (and, we think, a very small proportion of it) includes fully qualified personnel who are prematurely discharged for reasons unrelated to job performance.

First-term enlisted personnel, who perform their jobs sufficiently well to be retained throughout four years in the career fields for which they were initially trained, are assumed to be fully qualified. Reliability of personnel is viewed as a sufficient condition for demonstrating satisfactory job performance. In a system where every airman is closely observed and evaluated each working day of the first term by one or more highly qualified professionals, we assume that an insignificant number of unqualified personnel are permitted to complete their contracts. The duty environment of the first termer could be viewed as the most comprehensive and valid "selection device" conceivable. It is, of course, also the most expensive one we have.

Enlisted personnel who are discharged short of their contract dates, members of the second group, undoubtedly include both fully qualified and unqualified people. Premature loss from the initial assignment career field is therefore a necessary but not sufficient condition for demonstrating unacceptable job performance.

It is clear that unqualified personnel contribute nothing to required capacity, as defined, regardless of the number of years they serve before they are so identified. However, we do not wish to overlook the contributions made by other individuals belonging to the second group. For example, personnel discharged for unanticipated medical reasons in the second or later years of service may have contributed a year or more of fully qualified service. But such cases are much less common than discharges or career field transfers for personnel who could not meet minimum job performance standards and escaped early identification.

Realizing that expected successful completion of the full term of service is not a "perfect" criterion of performance, we take the position that it is a better criterion than any other for measuring the manpower availability element of the capacity which the Air Force is required to maintain in support of national security objectives. Among 300,000 fully-trained first-term airmen currently on active duty whose contracts are supposed to last at least one more year, there may be only 250,000 fully qualified *and* reliable people available to the Air Force to counter a specific threat at all times throughout the year. The 300 000-man figure is more directly an answer to the question "How well is the Air Force supporting our national objectives for a fully employed labor force?" We expect that the Air Force will be better prepared to deal with the latter goal after it has first come to grips with the former

The scenario for the analysis is developed in a way that veils this philosophy. Since all failures and discharges are assumed to occur at the end of formal training, there is little need to consider the contributions made by personnel departing career fields or the service well after training but short of their enlistment terms. Such people do not exist in the scenario. However, the first step to making the analysis more realistic, and therefore more useful in its applications, is the careful specification of time-to-failure patterns for different classification groups in specific career fields. We must then ascertain whether or not premature career field departures enhance the Air Force capacity in any tangible way prior to transfer or discharge. Perhaps we should ask "If the Air Force had known at time of enlistment that this airman would fail to complete his full term of service for reasons other than changing Air Force requirements, would he have been permitted to enlist?" For the vast majority of cases, we think not.

It may seem that an undue amount of attention is given in this study to differential contract length considerations. The problem exists because the satisfaction of two separate and competing constraints dictated a *unique* allocation, the one hypothesized to have occurred in 1982. The constraints were contract-length-specific numerical requirements by job for fully qualified personnel and the policy of requiring reassignment of one-time failures to the alternative job. The attempt to reconcile both objectives, treating each as a necessary condition of the solution, effectively precluded any possibility for identifying an alternative, feasible allocation.

We dealt with this problem by interpreting the purpose of the retrainee reassignment policy simply as a means for producing desired numbers of short-contract length personnel. This was consistent with our philosophy that all acceptable allocations, regardless of relative costs, must yield *exactly* the same output. Realizing that the policy of reassigning one-time failures also is an attractive feature of Air Force enlisted service which might bring in applicants who otherwise would not apply for enlistment, we developed the alternative, optimal allocation so that the reassignment policy would be implemented to the extent that output requirements were exactly satisfied. Footnotes 4, 5, and 6, testify to the practical difficulties this approach imposed on the analysis.

The dilemma could have been resolved in at least three other ways. First, we could have assumed that many retrainees would be willing to serve a full four-year term starting the moment they were reassigned to the alternative job in which they would succeed. Thus we could have reassigned all retrainees, confident that short-length contract graduate production in either job which exceeded numerical requirements would be resolved by converting the extra contracts to full four-year terms. Successful applicant production would have been reduced by the same amount. However, the assumption of easy extended-contract convertibility seemed in many ways unrealistic.

Second, we could have assumed that manpower requirements may be satisfied by either meeting or *exceeding* numerical quotas for short-length contracts. Thus we could have reassigned all retrainees and actually produced more retrainee graduates than did the 1982 allocation. In either case, shortfalls of short-length contracts would have been made up by drawing additional applicants on reduced term contracts when necessary. However, the output of an alternative allocation would depart from the 1982 output, making comparisons between the two difficult and perhaps meaningless.

Third, the basis for comparing relative resource expenditures could have been changed from a "sum of variable costs" concept to a "productive manyears per $1,000 expended" concept. While this approach merits consideration, we found that it presents theoretical and practical problems of its own.

A serious effort to evaluate variable contract length allocation decisions will require a modification of the methodology, perhaps by using the productive years per dollar approach. We saw no compelling reason to use it in the present study, however.