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AIR FORCE HUMAN RESOURCES LABORATORY



# ESTABLISHING APTITUDE REQUIREMENTS FOR AIR FORCE JOBS: METHODOLOGICAL APPROACHES

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AIR FORCE SYSTEMS COMMAND
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This report presents, using a systems-oriented approach, alternative methodologies that could be used to establish aptitude requirements for Air Force occupations. It covers a description of the aptitude requirements system, a review of the interaction of aptitude requirements and personnel system actions, and a functional flow for the requirements system. A flow for the developmental activities necessary to design and implement the system is also given, followed by recommendations for development of a methodology for determining aptitude requirements for effective job performance, with separate consideration for optimal aptitude types and levels with respect to career development, assignment flexibility, and job satisfaction.

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## PREFACE

The work reported here was accomplished by System Development Corporation (SDC) under Contract F41609-71-C-0033 with the Air Force. Dr. Carol E. Smith was the principal investigator for SDC and Mr. William B. Lecznar was the contract monitor for the Air Force. The work was performed during the period July 1971 to July 1972. The original single contract report was separated into three reports, each of which, though interrelated, can be read as an entity. Editing to accomplish the break out was accomplished by the CTM with permission of the authors. The views and opinions expressed are those of contractor personnel and are not necessarily endorsed by the contract monitor or the Air Force.

The reader should be aware that developments subsequent to the performance under this contract with respect to use of aptitude test results for initial enlistment classification make some of the statements in the latter sections of this report appear outmoded. The fact is that the principles represented may still be applicable even though there have been advancements in the recruiting and enlistment system.

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## I. INTRODUCTION

Contract work specifications called for a description of an "ideal" aptitude requirements system based on the view of aptitude requirements acquired during performance of three analysis tasks (see the first two reports in this series). The "ideal" aptitude requirements system is viewed here as one that will meet the needs of the Air Force and provide sufficient enlisted manpower to perform the Air Force mission successfully.

This report lists the design assumptions, conceptualizes the relationship of aptitude requirements to personnel system actions, presents system requirements, briefly describes system functions, and depicts functional flow for an operational aptitude requirements system.

## II. DESIGN ASSUMPTIONS FOR THE APTITUDE REQUIREMENTS SYSTEM

Design assumptions are listed for an "ideal" aptitude requirements system based on conclusions from earlier studies:

1. There will continue to be interest in satisfying all four Air Force primary need areas–job performance effectiveness, career development, assignment flexibility, and job/service satisfaction.

2. Job performance effectiveness for each specific job is the most important of the four areas but cannot, by itself, completely determine aptitude requirements. Career development, assignment flexibility, job/service satisfaction, and their interactions must also be accounted for.

3. Training success is important only insofar as it contributes to accomplishing Air Force goals in the four primary areas and is therefore a secondary need.

4. The Air Force will continue its policy of adjusting aptitude requirements to satisfy its needs and goals as long as this policy is more cost effective than other actions.

5. When Air Force needs cannot be met through changes in aptitude requirements, other solutions that utilize the available manpower will be tried. These solutions (personnel system actions) should be selected for their cost effectiveness with respect to all four primary need areas.

## III. INTERACTION OF APTITUDE REQUIREMENTS AND PERSONNEL SYSTEM ACTIONS

The concept of the interaction of aptitude requirements and personnel system actions that trade off with requirements is pictorially presented in Figure 1. The aptitude score continuum is represented from low to high extending vertically on the figure. The aptitude score level conceptualized as being appropriate for performance effectiveness for a given entry-level job is depicted as the center cross-bar on the aptitude level continuum. To allow for satisfactory career development, assignment flexibility, and job/service satisfaction, the optimal aptitude level has been conceptually established as higher than that determined necessary for entry-level job performance effectiveness only. The optimal aptitude level is represented by the upper crossbar. The area between the upper and the center crossbars represents less-than-optimal levels, where trade-off with special compensatory actions is judged to be unnecessary for job performance effectiveness but is required for career development and assignment flexibility. The area between the performance effectiveness center crossbar and the lower crossbar that denotes unacceptability is considered to represent less-than-optimal aptitudes for which specific personnel system actions can be implemented to compensate for the deficit in aptitude and to meet Air Force needs in all four need areas. Score levels in the area below the lower crossbar are considered to be unacceptable for any entry-level job requiring the aptitude type under consideration.

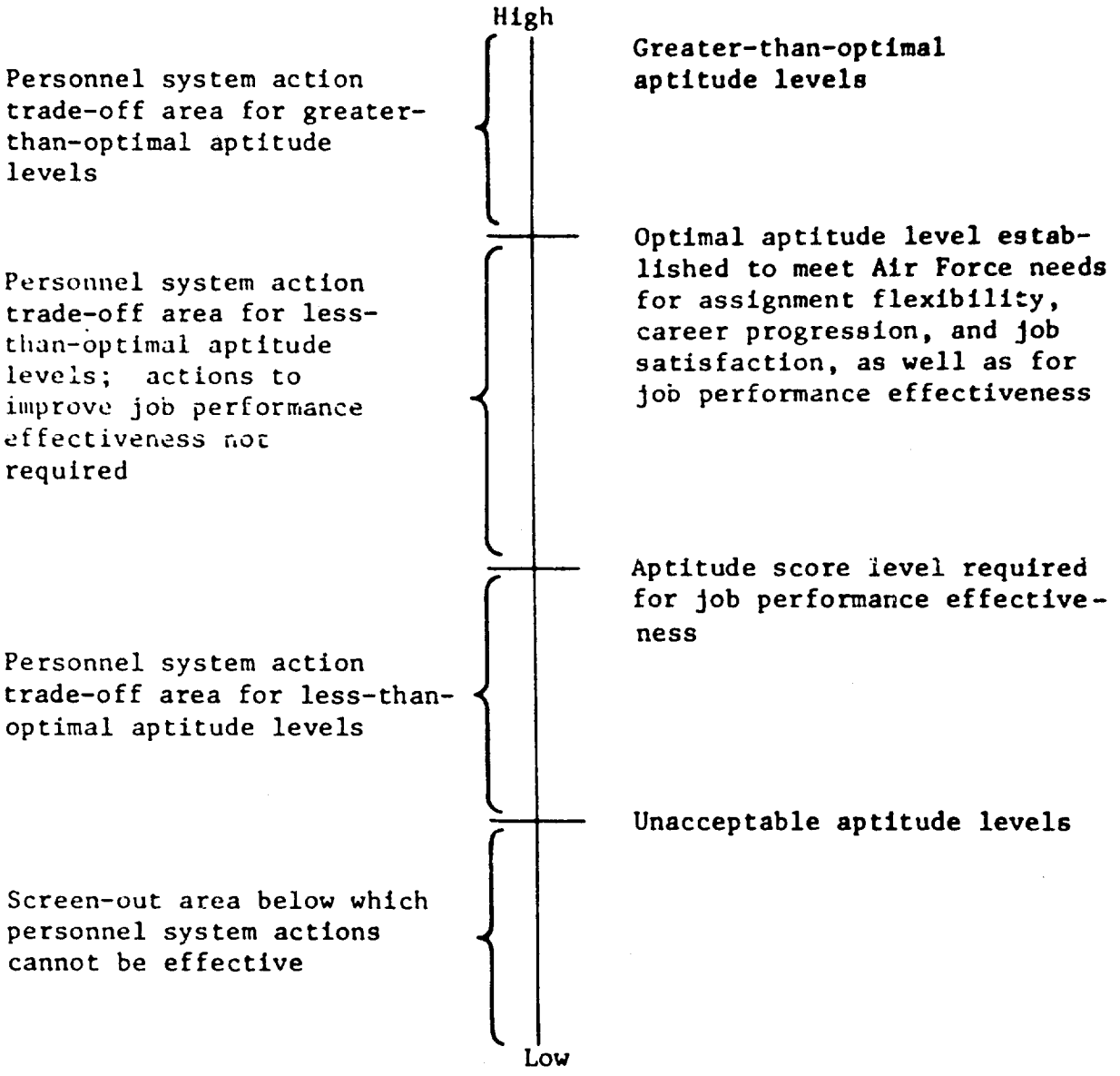



*Figure 1.* **Conceptualization of the relation of aptitude requirements to personnel system actions.**

The area above the optimal aptitude level (upper crossbar), is considered to be higher than is optimal. The need requiring most emphasis is job/service satisfaction at these levels.

Based on this conceptualization, the task of developing an aptitude requirements methodology involves the following steps:

1. Determine the types and levels of aptitude required for performance effectiveness for each specialty at the entry level.

2. Determine optimal aptitude requirements for enlistment and assignment to promote career development, assignment flexibility, and job/service satisfaction.

3. Develop aptitude requirements and quotas for enlistment and assignment that meet all four primary needs.

4. Develop a contingency model for selecting and implementing cost-effective personnel system actions to be taken when (a) aptitude quotas cannot be met, and (b) quotas are being filled with persons of aptitudes higher than required.

When personnel system actions that have trade-off potential with aptitude level are examined, it seems clear that very few actions are likely to be cost-competitive in a trade-off with an upward change in aptitude level. When high-quality manpower is available, "creaming" is very cost effective compared to implementing special programs and policy changes in order to utilize lower aptitude personnel. The trade-off is clearly in favor of maintaining high aptitude requirements when enough high-quality manpower is available.

When high-quality manpower cannot be obtained easily, then the major trade-off possibilities are to (a) spend more money on recruitment and on programs to make the Air Force more attractive to high-quality personnel, (b) make use of high-quality manpower outside the Air Force, or (c) use Air Force personnel system actions to offset the lower quality input and utilize the input effectively. Here the cost considerations are less clear. The money spent on recruitment of high-quality personnel or on hiring from the civilian sector must be spent each time the shortage of high-quality manpower recurs. Costs to develop programs that offset lower quality input and utilize the input effectively may be fairly high initially, but the result is permanent in that thenceforward the concern for higher quality manpower is not as great. In some cases the maintenance costs for such programs may exceed the maintenance costs for the programs they replace; therefore, differentials in program maintenance costs should certainly be considered in selecting a special program from a group of alternatives.

Some high-aptitude personnel will enter the Air Force even when the average quality of candidates is low. These people cannot be channeled through a personnel system designed entirely for lower aptitude personnel, particularly in peacetime, without decreasing job satisfaction and retention rates, which is costly. Some special programs that allow successful utilization of lower aptitude personnel may have an opposite effect regarding high-aptitude personnel, thereby making it necessary to set maximum aptitude level requirements for some jobs or to implement some special programs and policies that increase the satisfaction and morale of high-aptitude personnel. The latter course, while more costly, is probably preferable because Air Force career development needs are better met by having a good number of personnel with all of the attributes required to perform higher level jobs. It is difficult to implement special programs at the NCO level for low-aptitude personnel in order to maintain job performance effectiveness.

It seems that the best overall course of action would be as follows:

1. first, to establish objectively the optimal baseline set of requirements for meeting Air Force needs for job performance effectiveness, career development, assignment flexibility, and job/service satisfaction;

2. second, to plan a procedure for utilizing lower aptitude personnel—a procedure to be used only when the enlisted input cannot meet the optimal requirements;

3. third, to plan a procedure for increasing the job satisfaction and retention rates of personnel of greater-than-optimal ability, to be utilized (at least in peacetime) when the input quality is higher than the optimum or when special programs designed for lower aptitude personnel have negative effects on the personnel of high aptitude; and

4. fourth, to develop and implement a coordination and feedback function that (a) updates the optimal baseline requirements as a result of any relatively permanent personnel system actions that trade

off with aptitude requirements, and (b) determines the most cost-effective set of personnel system actions and temporary aptitude requirements for offsetting the negative impacts of changes in input manpower quality.

## IV. SYSTEM REQUIREMENTS

System requirements are listed as follows:

1. Establish and maintain an optimal baseline set of valid aptitude requirements and quotas that meets personnel system needs for job performance effectiveness, career development, assignment flexibility, and job/service satisfaction.

2. Be able to specify short-term aptitude requirements different from the optimal to allow total manpower quotas to be met.

3. Be able to select cost-effective personnel system actions to offset negative impacts of changes in aptitude requirements necessitated by changes in manpower quality.

4. Be able to respond to long-term personnel system changes with changes to the optimal baseline set of aptitude requirements.

5. Meet needs of aptitude requirements system personnel for simplicity of administration, scoring, and interpreting aptitude measures while meeting rigorous standards of prediction.

6. Provide means for coordinating aptitude requirements actions with actions taken in other parts of the personnel system.

7. Provide socially acceptable and effective solutions to selection and assignment problems.

8. Encourage the utilization of lower aptitude personnel without compromising mission effectiveness.

9. Deemphasize the role of purely secondary needs (e.g., academic proficiency) in setting selection and assignments criteria and emphasize the roles of those needs that contribute directly to mission success.

## V. SYSTEM FUNCTIONAL FLOW

Figure 2 shows the functional flow for the aptitude requirements system. Each function box (rectangle) in the figure is explained in the following paragraphs. The tasks and activities to be performed in the development of such a system are discussed in the recommendations section.

### Monitor, Analyze, and Integrate

A basic function of the system, to be performed in real time, will be to continuously monitor, analyze, and integrate the following inputs:

1. manpower availability data for each aptitude index and level;

2. manpower requirements (number of personnel required);

3. personnel data (job performance effectiveness, career progression, assignment flexibility, job/service satisfaction);

4. Air Force requirements for job performance effectiveness, career development, assignment flexibility, job/service satisfaction;

5. personnel system data such as changes in programs (including training programs), policies, and procedures.

The purpose of this function is to determine whether:

6. aptitude requirements in use fit the manpower input satisfactorily, and

7. personnel system programs and policies (and changes in programs and policies) are compatible with the aptitude score levels of enlisted personnel and therefore contribute to fulfilling Air Force needs for job performance effectiveness, career development, assignment flexibility, and job/service satisfaction.

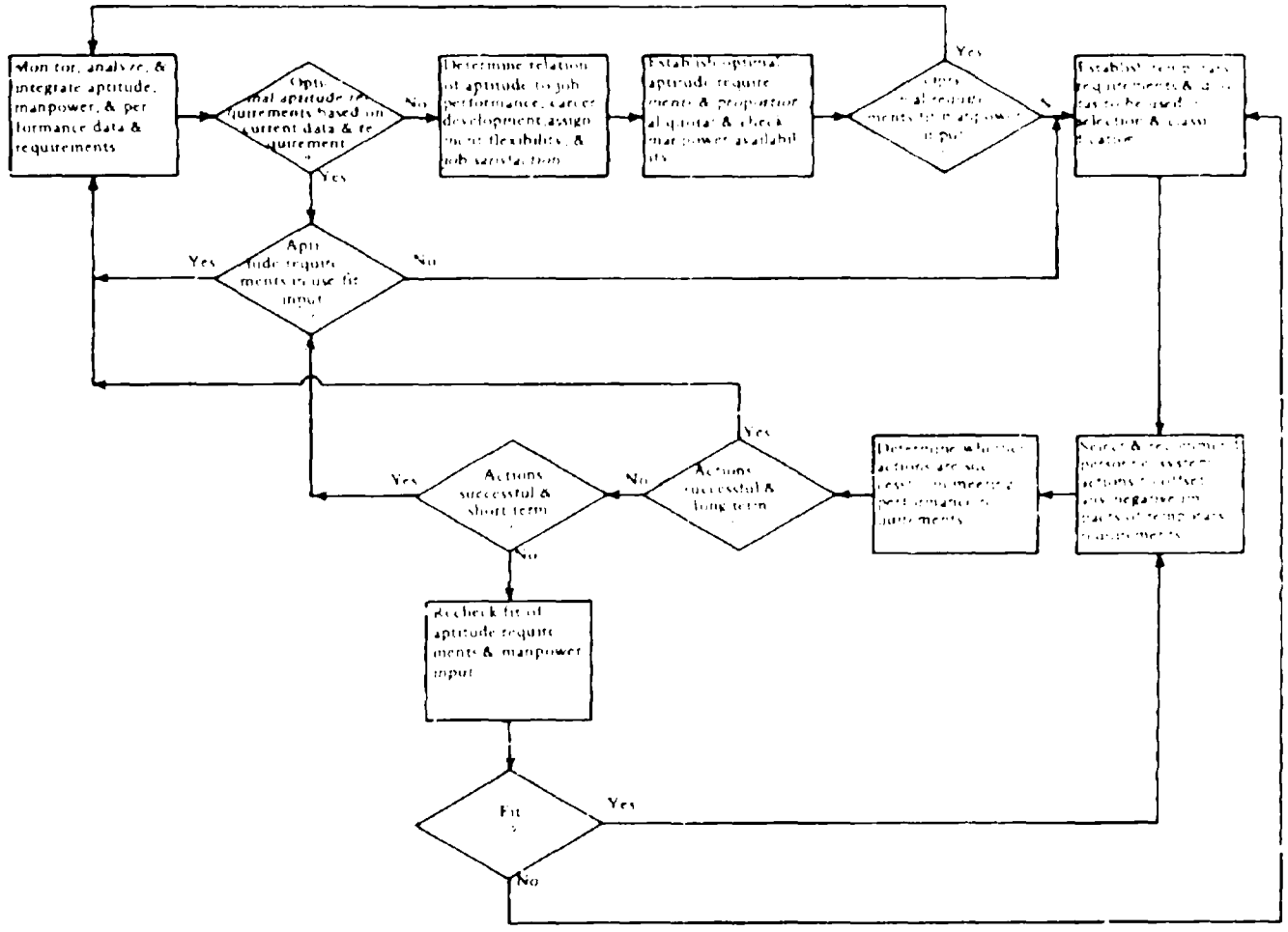



*Figure 2.* Aptitude requirements subsystem–functional flow of operations and decisions.

To perform this function, personnel will be assigned to input data from several sources. Each source will have to agree to provide appropriate data or to allow aptitude requirements system personnel to gather data periodically.

**Determine Relations**

A major task in system development will be to determine the relation of aptitude to (a) job performance effectiveness, (b) career development, (c) assignment flexibility, and (d) job/service satisfaction. Once the aptitude requirements system is operating, a redetermination or partial redetermination of relationships will be necessary when new jobs are added, old jobs are changed, or other long-range personnel system changes are made.

Initial determination of these relations is a large and complex task. Aptitude requirements must be as objective as is feasible. Multiple and sometimes conflicting Air Force needs must be attended to. Rigorous standards of prediction must be developed. Development methodology is discussed in the recommendations section.

**Establish and Output Optimal Requirements**

The relation of aptitude to job performance effectiveness, career development, assignment flexibility, and job/service satisfaction can be used to establish optimal aptitude requirements for fulfilling Air Force needs. The set of optimal requirements will then be output for use in selection, classification, and assignment whenever sufficient manpower at each level for each index is available to fill all positions. Optimal requirements will remain stable except when Air Force personnel system programs and policies change in such a way that standards for job performance, career development, assignment flexibility, and/or job/service satisfaction are either no longer being met or are being exceeded.

Optimal requirements will specify for each specialty or each group of specialties appropriate aptitude composites and appropriate score levels for one or more personnel quota categories. Selection requirements and quotas will be based on the specialty requirements.

**Establish and Output Temporary Requirements**

When the manpower input to the Air Force cannot meet the optimal requirements, then temporary requirements that fit the input must be established if total recruitment quotas are to be met. Establishing lower requirements will generate the need to implement some special programs and policies designed to offset the negative impacts on the personnel system caused by the lower quality input.

When the manpower input to the Air Force exceeds the optimal requirements by 20 percentile points on the average, the decision may be to initiate temporary requirements that are higher than the optimal in order to "cream" the input. Whether or not new temporary higher requirements are established, some special programs and policies may have to be implemented for higher caliber personnel, especially in peacetime, so that an adequate level of job/service satisfaction is maintained.

Temporary requirements should probably be established on a specialty-by-specialty basis rather than simply lowering a basic cutoff score used in screening all candidates. Changes in training programs and in job structure and content are some of the most positive actions that can be taken to enhance the performance effectiveness of lower aptitude personnel. Making these kinds of changes for one specialty or for a group of related specialties is must less costly than an across-the-board change. Research into the job groups in which a shortfall in meeting new optimal requirements exists can pinpoint the jobs for which temporary aptitude requirements should be established.

It may be that temporarily lowering aptitude requirements for a specialty will not always lower job performance effectiveness. Entry-level aptitude requirements previously established may already be higher than required to meet the need for successful job performance. Requirements could therefore be lowered without impacting negatively on performance effectiveness. When this is the case, personnel system actions need be selected to offset only those impacts in the career development, assignment flexibility, and/or job/service satisfaction need areas.

**Select and Recommend Personnel System Actions**

Whenever temporary aptitude requirements must be implemented, some negative impacts on the personnel system can be expected. If aptitude requirements cannot be adjusted to the optimal, special

actions and policies designed to offset the negative impacts must also be implemented. The special actions must offset the particular impacts expected and must also be consistent with fulfilling job performance effectiveness, career development, assignment flexibility, and job/service satisfaction. There will be times when all four need areas will not be considered. For example, in times of mobilization, job satisfaction and career development needs will be of much lower priority than job performance effectiveness and assignment flexibility.

Personnel system actions should be categorized by their suitability for implementation on a short-term basis. The distinction between actions suitable for a short term and those that are not is of importance because many times temporary aptitude requirements will be in effect for a period of several months only. The cost effectiveness of implementing a special action may vary depending on the length of time it is needed. Some training program changes are cost effective only if the changes are to be relatively permanent or are designed for a *periodic* implementation. Such changes, when made, may permanently alter optimal aptitude requirements and, thus, make future temporary requirements changes downward less necessary.

The ultimate model for selecting personnel system actions would be very amenable to computerization. The state-of-the-art, at present, allows this to be easily accomplished.

### Determine Success of Actions

Determining whether special personnel system actions are successful will be an almost continuous activity in the aptitude requirements system. Data on, and standards for, job performance, career development, assignment flexibility, and job/service satisfaction will be collected periodically for personnel of each aptitude type and level, with reference to the requirements in effect as they entered the service and to the personnel system actions in effect that could have affected their performance.

It is important to be able to implement new special actions or to adjust aptitude requirements quickly if job performance effectiveness decreases. The mechanisms by which data are collected and analyzed, conclusions drawn, and actions taken should be carefully planned so that a quick response time is possible.

### Recheck Fit of Requirements and Input

When personnel system actions are not successful in offsetting negative impacts, it may be that manpower quality and aptitude requirements are not longer compatible. This possibility must be checked before the decision is made to revise the set of personnel system actions currently in effect.

## VI. RECOMMENDATIONS

Development of an aptitude requirements methodology actually involves the development of an aptitude requirements system. Methodological considerations pertain to the requirements themselves and also to the system structure and functional framework in which the requirements are embedded.

The following activities are recommended as those required to develop an aptitude requirements system that functions dynamically to meet Air Force personnel system needs:

1. Determine aptitude requirements for effective job performance as objectively as is feasible and cost effective.

2. Determine Air Force needs for career development, assignment flexibility, and job/service satisfaction, expressed in terms of aptitude requirements.

3. Consolidate aptitude requirements for all four need areas into a single optimal baseline requirements set that specifies aptitude types, levels, and desirable enlistment quotas.

4. Develop a feedback function so that performance data from recruitment, training, job performance, and retention sources of information can influence aptitude requirements or cause personnel system actions to be implemented.

5. Develop a plan for using the new aptitude requirements and for implementing the feedback function to make cost-effective changes in aptitude requirements and/or in other parts of the personnel system.

Figure 3 shows a flow of the developmental activities necessary to design and implement the aptitude requirements system. Flow charts for five major development tasks are shown in the figure. Each

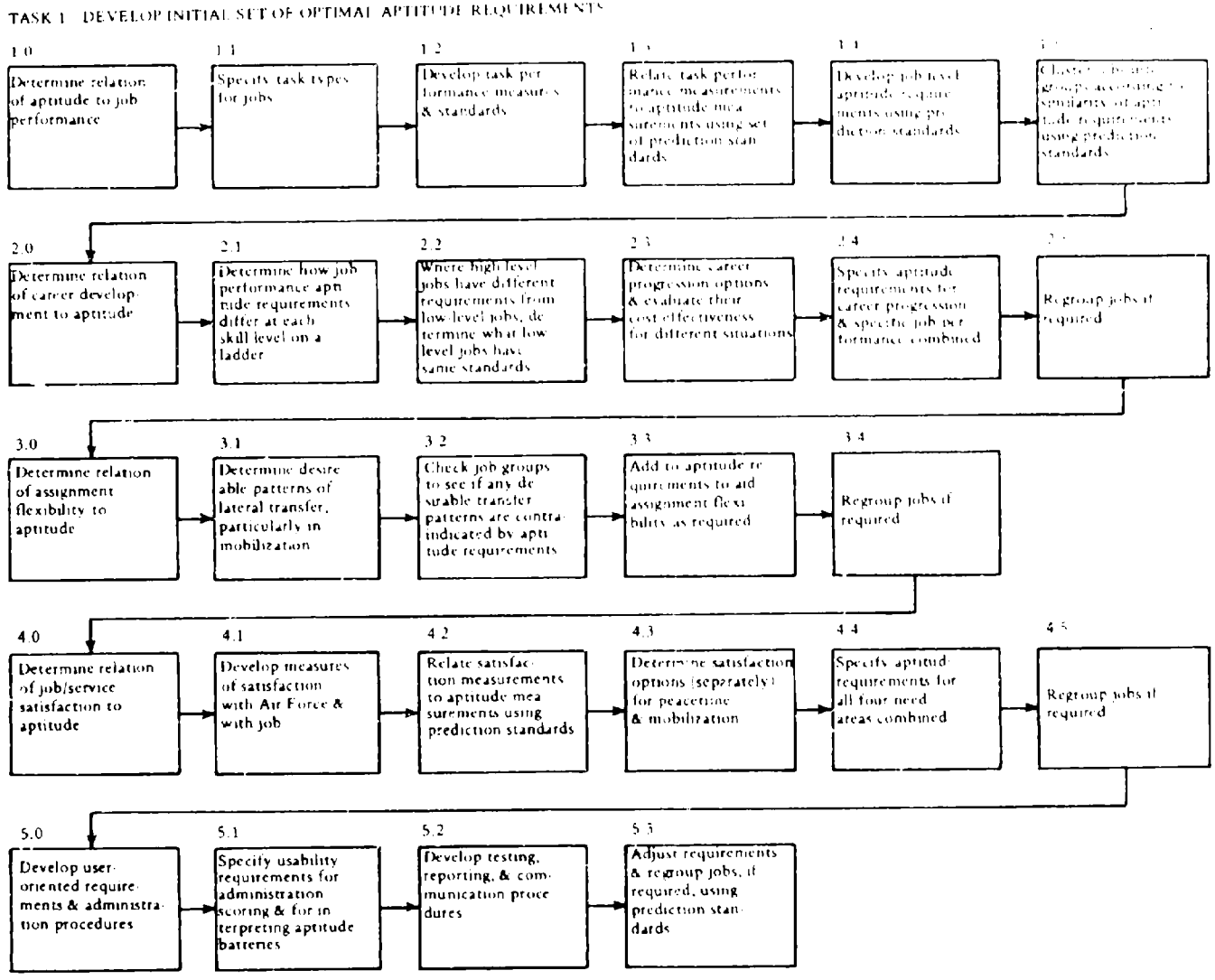
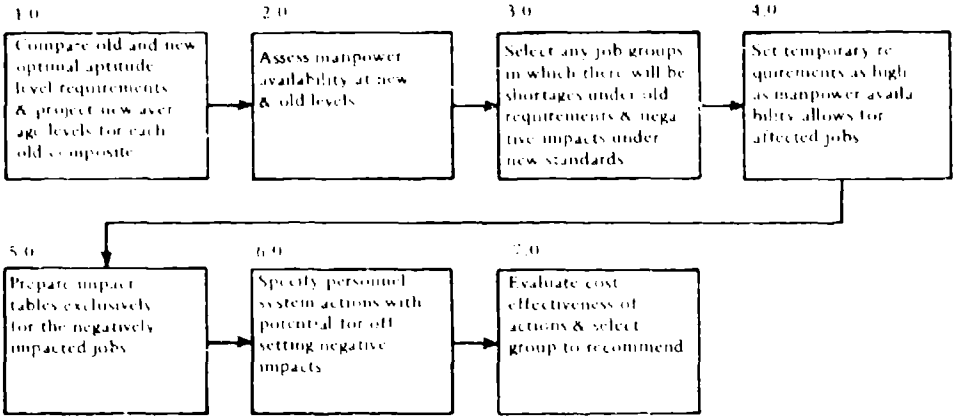
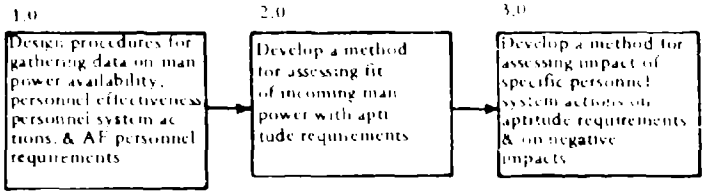



*Figure 3.* **Aptitude requirements subsystem--developmental process flow.**

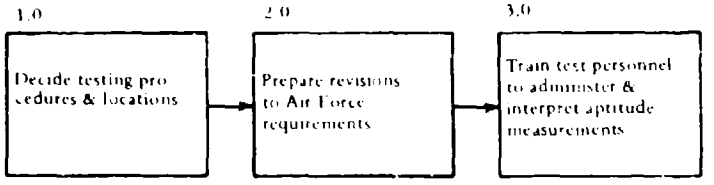
TASK 2: ESTABLISH INITIAL SET OF TEMPORARY REQUIREMENTS AND OFFSETTING PERSONNEL SYSTEM ACTIONS




TASK 3: DEVELOP MONITORING AND ANALYSIS TECHNIQUES




TASK 4: DEVELOP ADMINISTRATION, SCORING, AND INTERPRETATION TECHNIQUES




TASK 5: DEVELOP ORGANIZATIONAL STRUCTURE FOR PERFORMING APTITUDE REQUIREMENTS SYSTEM FUNCTIONS

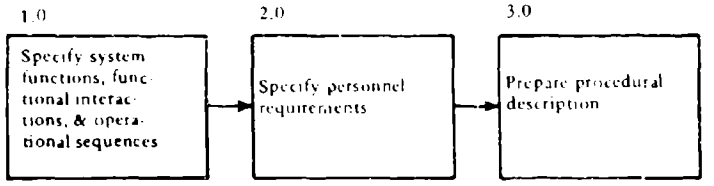



*Figure 3.* (Continued)

development task corresponds to one of the basic points listed. The flow chart for a task describes activities required to develop the aptitude requirements system and shows the general sequence in which activities must be performed. For Task 1, Develop Initial Set of Optimal Aptitude Requirements, the assumption is made that Method 1 (to be discussed in following paragraphs) for determining aptitude requirements for job performance effectiveness will be used. This is depicted in this way for the sake of simplicity—if another method of determining aptitude requirements for job performance effectiveness is selected, boxes 1.1 through 1.5 for Task 1 would require revision to reflect the method chosen. Within Figure 3, the term "job" is to be considered equivalent to an Air Force specialty.

The remainder of this report describes and recommends possible methodological procedures required for system development and operation. Needs for research and problems that are likely to be encountered are discussed, and recommendations for action are presented.

**Development of a New Methodology for Determining Aptitude Requirements for Effective Job Performance**

Three alternative methods for determining the aptitude requirements necessary for effective job performance are discussed in this section, and recommendations are made as to selection of the most feasible method.

*Discussion of Method 1 – Job/Task Analysis.* The most objective method of determining aptitude requirements for Air Force jobs would involve four main activites:

1. Performing an analysis of each specialty to identify and characterize the tasks and behaviors that make up the specialty and to identify task performance standards.

2. Developing task performance measurement tools and relating task performance measurements to aptitude measurements to determine which aptitude subtests and score levels, if any, predict effective task performance.

3. Developing aptitude composites and score levels for each specialty, based on the task level results.

4. Finding alternative or additional predictors for specialties for which current aptitude test items are poor predictors.

Task analysis is an appropriate tool for determining the job behaviors for which specific aptitudes might be required and for identifying performance measures and standards, but it has some negative aspects. First, it is difficult to derive task performance measures and standards from job/task data, particularly objective measures and standards. Second, data collection, data storage, and analysis for this type of analysis is a very large task in itself. Third, there are many factors involved in job/task performance that may not be discovered by a behaviorally oriented task analysis, such as motivation, interest, and for some jobs, crucial personality traits such as agreeableness, dependability, flexibility, or concentration.

On the positive side, data collection, storage, and analysis are not monumental tasks as they have been in the past, due to additional automated data processing and data management capability. Also, task analysis itself has become a more sophisticated tool, and the new data management capability allows more conclusions to be drawn more easily. Task analyses are already performed within the Air Force, and they can be an effective tool in determining aptitude requirements.

Since performance-oriented measures are not acceptable as part of the aptitude testing situation itself due to high costs for equipment and lengthy administration times, supervisor, peer, and self ratings should be the primary tools used to measure job performance in the experimental studies and to identify effective and ineffective performers who can serve as criterion groups for these studies.

It is suggested that a rigorous prediction standard for aptitude measures be established. If, for a particular specialty, aptitude tests cannot predict performance effectiveness above this standard, then other predictors should be sought, and no new specialty aptitude requirements should be established until prediction standards can be met.

It is important to establish performance effectiveness measures and standards at the task level initially, rather than at any higher level. Many types of tasks comprise the typical specialty, and few individuals are equally effective in all tasks. Analysis at the task level will allow restructure of certain career ladders for increased performance effectiveness as well as development of more efficient predictors of

effectiveness. Analysis at the task level also allows for identification of performance deficiencies in those personnel who perform their overall jobs well. Identical or very similar tasks appear in a large number of specialties, so each task within each specialty will not have to be related to aptitude measures separately, making the task-level analysis less formidable than it appears.

After aptitude measures that predict effectiveness at the task level have been determined, specialty level measures can be derived through rational analysis and empirical studies. Career fields and ladders can be restructured, if required, to group jobs with similar aptitude requirements. Each step in the process of determining specialty-level aptitude requirements using task analysis is discussed below, in terms of the methodology to be applied.

Data collected for determining aptitude requirements should be of the type known as behavioral task analysis information. Skill, knowledge, attitude, and personal trait data should be collected on a detailed level for each task, to allow the grouping, across specialties, of tasks that are identical or very similar. Each task within a specialty should be rated for its criticality with respect to the Air Force mission and for the amount of time required to perform it relative to the other tasks. The criticality and time measures can be used in developing specialty-level aptitude measures. Known standards of performance can also be collected. Figure 4 shows an example of a form that could be used to collect and/or organize the task analysis data. A large-scale field collection effort is not envisioned because much of the required information is available in the Air Force occupational data banks or task analysis documentation produced to modify or develop training courses. Data, not now rountinely collected, could be obtained by adding data items to the background information section of the United States Air Force Job Inventory Booklets, as they are periodically updated. The second step of the analysis, grouping of similar and identical tasks across specialties, can be a computerized operation, in which codes are matched within each code group as shown in Figure 4. A computer can also be used to list job-task interrelations, criticality and time ratings, performance standards, and current aptitude requirements.

Once tasks have been classified as to similarity, a group of performers of each task type, irrespective of job classification, should be selected for performance measurement. Peer ratings, supervisor ratings, and self ratings based on actual observation of task performance might be used to measure performance effectiveness. Written tests and official proficiency ratings should be avoided because they are often unrelated to actual task performance. The most difficult step is that of defining performance effectiveness and ineffectiveness objectively. Most of the commonly used personnel measures, such as number of transfers, number of months in pay grade, or number of punishments are not related to task performance. Many Air Force specialties are so team oriented that units of work completed/time measures do not completely reflect an individual's effectiveness. Clearly defined "go, no go" standards (acceptable-unacceptable performance), applicable to the task level of performance, are probably the most efficient and valid.

Another possible problem is that because of the simplicity of some tasks, there are no, or few, ineffective performers within the normal working group. Consequently, aptitude measures could not predict success within this group of performers. Performance of tasks may have to be measured using criterion groups that are more restricted in ability and experience than is the normal working group. For this reason, the actual job experience of criterion groups should be a controlled variable. It would be preferable to use men still in training or to train an unselected group in the skills and procedures required to perform each task; however, the latter alternative would be costly.

To determine the aptitude characteristics of the criterion groups, it would be best to use the subtest or item scores of the Airman Qualifying Examination (AQE) that was administered to criterion group personnel as they entered the Air Force, rather than administering a new AQE. AQE scores change with age and job experience, and since results must be applicable at the job entry level, retest of somewhat older, more experienced personnel would be inappropriate.

Aptitude and performance effectiveness measures should be related at the task level (for each group of similar tasks) as a first step, even though use of such a method to actually assign enlistees would not be feasible. After the aptitude subtests or item clusters that predict effectiveness/ineffectiveness at the task level have been determined, a procedure for reconstituting the AQE composites to predict on the specialty level can be developed. Prediction at the career ladder level or for an entire career field is probably not warranted, due to the differences in task types at different levels on a career ladder and among jobs within a career field.

Job Title: _____ Documentation References:

AFSC: _____

Skill Level: _____

Current Aptitude Requirements: _____

Task: _____

Task Criticality to Specialty: 1 (Low) 2 3 4 5 (High)

Relative Amount of Time Spent Performing this Task: _____%

Task/Personnel Characteristics

Check Skill Codes:

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | |

Check Knowledge Codes:

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | |

Check Significant Attitudinal Requirements Codes:

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | |

Check Significant Personal Trait Requirements Codes:

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | |

Known Objective Performance Standards: _____

*Figure 4.* Example task analysis data organization form.

Determining appropriate aptitude score levels for task-related aptitude requirements would be a statistical procedure. Once the most appropriate aptitude test items for prediction of successful-unsuccessful performance have been determined, a raw score sum could then be found for these items, above which level a task performer could be predicted to be successful and below which a task performer could be predicted to be unsuccessful. This level, plus a value based on sampling error, could then be converted to a centile score and become the task-level aptitude requirement cutoff score.

Standards for prediction should be set rigorously for the task-level aptitude requirements. Aptitude requirements should not be established for a given task unless a substantial amount of performance effectiveness variance can be attributed to aptitude, and unless the purported relation of aptitude to performance effectiveness is not due to chance.

Composites and score levels developed for tasks will be useful in job restructuring and in determining aptitude composites for new specialties. For a specialty or group of specialties in which all or almost all tasks are similar, developing a new composite at the specialty level will be a simple process in that the task-level composite can be used directly. For specialties with tasks that are dissimilar, restructuring may be indicated unless it can be shown that the effective performers are the same persons across all tasks within the specialty.

To develop specialty composites, the task types, task criticalities, and relative time spent performing each task must be taken into account. Tasks might be typed as broadly as possible, on the basis of similarity of the task-level aptitude composites developed in the initial stages of analysis. One or more of these task types (based on similarity of aptitude composites for tasks) make up each specialty. Therefore, a specialty can be characterized in terms of task types, average criticality of each type within this particular specialty, and relative proportion of time spent in performing each task type within this particular specialty. Thus, a specialty might be comprised of the following components:

Mechanical-aptitude-related task type: average task criticality 4 (on a 1-low, 7-high scale); relative amount of time spent 4 (on a 1-low, 7-high scale).

Electronic-aptitude-related task type: average task criticality 1; relative time spent 1.

Newly developed task type: average task criticality 5; relative time spent 3.

A mathematical function could be developed to specify the specialty aptitude composite(s) and score level(s) required, on the basis of task type. Task criticality and task time information could be used to simplify the function, to aid personnel who must score and interpret the test. For example, any task type of less-than-average criticality (criticality 1 or 2) and with a relative task time rating of 2 or less might be omitted from the aptitude requirements. In the example above, this criterion would eliminate the Electronic-aptitude-related task type from consideration in the development of specialty aptitude requirements. To simplify the function further, tasks with a criticality as low as 1 might be eliminated if relative task time were 3 or less.

Using this scheme described above, the specialty aptitude composite would be comprised of a task-level composite made up of aptitude test items that predict Mechanical aptitude and the aptitude test items that make up another composite newly developed during the task-level analysis. The score level requirements would be listed separately for each component of the specialty composite; e.g., M30N60, where M is the Mechanical aptitude component, and N is the newly developed task-level composite.

The new specialty aptitude requirements could be empirically checked by summing each worker's task performance effectiveness scores by specialty and then correlating these sums with the appropriate aptitude item total scores. Item cluster weightings could then be used to improve prediction, if required to meet the prediction standards established earlier, using task criticality and relative task time to guide the weighting procedure so that a component that predicts for a task type of low criticality and/or low proportion of time spent cannot become the prime predictive component for the specialty as a whole.

The number of different specialty composites that would result from this procedure is not known at this time. It is unlikely that each specialty would have a composite different from that for any other. On the other hand, it is quite likely that more than the current four composites would result. However, since the requirements ultimately to be established and applied to Air Force personnel will be determined on a

broader basis, taking into account Air Force needs other than simple job performance effectiveness, the problem of mass scoring and interpretation by enlistment center personnel does not arise at this point.

*Discussion of Method 2 - GATB Equivalents.* The feasibility of using General Aptitude Test Battery (GATB) job performance and aptitude requirements data to develop aptitude requirements for the Air Force was also investigated. The GATB validation studies are extensive and provide aptitude profiles for thousands of jobs and occupational categories. The profiles show, for each relevant GATB subtest, the minimum score that a worker should have to perform the job satisfactorily. The lowest 30% of the workers, in terms of job performance measurements, were not used to develop the aptitude profiles--only the upper 70% of the satisfactory work group were used. Many of the individual aptitude score levels required are quite low. For example, a job might require that the worker achieve a percentile score of only 16 on finger dexterity. Even though this would be far below the average for finger dexterity in the general working population, this score level is adequate for prediction of success on this particular job.

The question of whether Air Force equivalents to GATB aptitude profiles could be developed was explored. Air Force aptitude requirements would then reflect the aptitudes possessed by average workers in given jobs or occupational categories. This appears to be an unsatisfactory solution for determining Air Force aptitude requirements. First, not all Air Force jobs have job equivalents in the GATB scheme. Second, not all of the GATB aptitude profiles are based on job performance measures; some are based and validated upon training measures. Therefore, many jobs would not be covered. Third, requirements-setting methodology for the GATB has been heavily criticized by test and measurement experts, in that the minimum essential requirements for a job are not what is provided. Instead, aptitude characteristics of acceptable workers are simply assumed to be important in job performance. Also the item clusters (subtests) selected as appropriate for a particular job were originally selected by means of rational analysis, not by empirical research. It is true that it would have been difficult for GATB developers to overcome these objections, except at great cost in dollars and time. But even if the methodology used by the Air Force were subject to the same or other criticisms by theorists, an Air Force-specific methodology could at least cover all Air Force jobs and be based on the AQE, for which a great deal of data are available, making it more useful and practical than the GATB equivalents would be. Therefore, Method 2 is not considered practical or feasible.

*Discussion of Method 3 – External Related Variable.* It may be possible to find a variable for which data have already been collected for all enlisted specialties and which is highly correlated with aptitude level. If this is so, then once the relationship is determined statistically for a sample of tasks, jobs, and specialties, it can be extended to unsampled tasks, jobs, and specialties, and aptitude score level requirements will thereby be determined for all specialties. The Air Force Human Resources Laboratory is currently studying the relation of task difficulty to aptitude level in the hope that task difficulty can serve as this variable. Task difficulty rating data are being collected from job supervisors in several career fields.

Behavioral scientists will observe tasks being performed and judge the level of aptitude required for each. If expert observers' estimates of aptitude levels required to perform a task are reliable and also correlate highly with supervisors' ratings of task difficulty, then task difficulty data can be used to estimate adjustments in aptitude requirements. It will not be necessary for expert observers to view the performance of every task within the Air Force if the correlation between task difficulty and aptitude level is strong and holds across specialties and aptitude types when a sample of representative tasks is observed.

This method of determining appropriate aptitude levels has promise; future investigations will show whether such a method is feasible for estimating aptitude requirements. This method lacks some of the objectivity of Method 1, in that observers' ratings of aptitude level required may be reliable but not valid because (a) ratings will not be related to standards for performance, (b) ratings may be contaminated by the tendency to view all difficult tasks as requiring high aptitude when, in fact, it is unknown whether this is the case, (c) ratings can be influenced by the level of skill displayed by the particular workers observed, and this skill level may be considerably higher than the minimum needed if Air Force aptitude requirements are currently too high, and (d) ratings do not deal with the question of whether the aptitude type is suitable, only with the amount of aptitude required. Nevertheless, the relatively small expense to be incurred makes this method suitable as an interim method, if not a permanent one.

Method 3 (external variable) should be explored more fully before a final method is chosen. When results of current investigations are available[1] and if the results are positive, a determination should be made as to whether the drawbacks of Method 3 are outweighted by its simplicity, inexpensiveness, and potential for use in the near future as compared to Method 1. It appears that Method 1 is the more objective of the two but would probably cost at least five times more than Method 3.

### Determining Optimal Aptitude Types and Levels for Promoting Career Development, Assignment Flexibility, and Job Satisfaction

Once aptitude requirements for job performance effectiveness have been determined, similar techniques should be developed and used to determine optimal requirements for each of the three other Air Force need areas. Possible methods for making these determinations are discussed in the following paragraphs.

*Career Development Requirements.* Successful career development from the airman's point of view might consist of (a) staying in the Air Force for several terms, (b) being promoted at the earliest opportunity, (c) becoming an NCO, and (d) meeting performance effectiveness standards for the NCO-level jobs. From the Air Force point of view, this would also constitute successful career development. However, the Air Force does not require all individuals to follow this pattern. Indeed, if all individuals did follow this pattern, the enlisted person's job structure would soon be top-heavy. Requirements for the career development area must be developed to satisfy Air Force needs. Probably an accurate enough set of requirements could be devised by applying a percentage quota to individual career development success requirements for each career field or each career ladder. That is, the Air Force would require that X percent of the personnel in career ladder A stay in the Air Force for several terms, be promoted at the earliest opportunity, become NCOs, and meet performance effectiveness standards for the NCO-level jobs. In some career fields, it may be necessary to develop more than one set of requirements, each to be met by a certain proportion of personnel in that field. A particular ladder in the field, for example, might require that 10% of its personnel become NCOs and that a different 10% serve only one enlistment and leave the Air Force. At any rate, once such needs have been formally stated for each career ladder, aptitude types and score levels that predict which of the requirements sets a person is likely to meet in a particular job can be determined from available data because aptitude requirements for jobs above entry level in a ladder will have already been determined during the job performance effectiveness analysis.

*Assignment Flexibility Requirements.* Assignment flexibility implies breadth of ability so that personnel can be assigned in other than their "optimal" specialties when necessary and still do creditable work. If job performance requirements become narrow in terms of aptitude types—that is, if the total number of composites grows and the composites do not correlate highly with each other—persons with a very limited range of aptitudes could be accepted into the Air Force if needs for assignment flexibility were ignored. A person who could meet the minimum requirements for only one or two jobs might be a liability in times of emergency or if there was a manpower shortage in other jobs. Current aptitude requirements are developed for predicting within a large career area and, thus, do not pose this kind of problem. It is possible that new, empirically determined aptitude requirements will not be limiting with respect to assignment flexibility, but assignment flexibility needs ought to be investigated separately in any case. A study should be made of how new job performance aptitude requirements could restrict or prevent lateral assignment changes if the new requirements were in effect. An analysis of these data should pinpoint job performance aptitude requirements that are too limiting—requirements that would allow a large block of candidates with very limited qualifications to enter jobs for which the Air Force can foresee that there could be considerable need for lateral transfers to jobs with higher or broader job performance aptitude requirements. For such jobs, aptitude requirements should be made broader or score levels made higher for the initially assigned jobs.

*Job/Service Satisfaction Requirements.* There is a lesser need for personnel that are satisfied with their jobs than for personnel who will not be dissatisfied to the point where performance effectiveness and

[1]The approach described has been tried in one AQE aptitude area and demonstrated to be feasible. Further information is available from AFHRL/OR, Stop 63, Lackland AFB, TX 78236.

retention rates decrease. The job satisfaction need area increases in importance when the Air Force cannot assign personnel according to optimal aptitude requirements due to manpower shortages or to an excess of highly qualified personnel. But, even with optimal aptitude requirements, it is possible that there are personnel who would qualify for a given assignment by meeting the aptitude requirements for job performance effectiveness, career development potential, and assignment flexibility potential, but who would dislike the job intensely and perform in accordance with this feeling. If it can be assumed that such personnel usually request transfers or retraining within their first few months on the job—and if the requests are not granted, leave the Air Force at the end of their first term of enlistment—then the aptitude characteristics of these personnel can be examined to determine whether there is a way to predict aptitude-related job dissatisfaction. It would be simpler, however, to correlate the aptitude scores of all those who qualify for a job (in terms of predicted job performance effectiveness, career development potential, and assignment flexibility potential) with a job interest inventory score. It may be that a very high aptitude score leads to job dissatisfaction in some specialties. In private industry, it is not unusual to set aptitude or intelligence maximums for some routine jobs; therefore, the Air Force may find this feasible for specialties or career fields in which there is very little opportunity for advancement and for which supervision could be provided from a closely related ladder should aptitude-related job dissatisfaction prove to be a factor worth consideration.

### Establishing and Maintaining Optimal Aptitude Requirements and Quotas for Enlistment and Job Assignment

When objective information about aptitude as a predictor in all four of the primary need areas is available, then new aptitude composites, score level requirements, and quotas can be established. There are several possible methods for performing this task. Final selection of the most efficient method should not be made until data pertaining to the four need areas are available, since the complexity of the task depends somewhat on the number of composites that are found to predict in these areas.

The aptitude requirements to be developed for actual use in enlistment screening and assignment must be simple and straightforward so that aptitude tests can be administered, scored, and interpreted efficiently at recruitment centers. For this reason, it would not be feasible to use more than 10 composites, unless automated data processing equipment could be used to score and interpret aptitude tests. The development of such an automated system is well within the state-of-the-art.

Ideally, aptitude requirements for actual use should be simple enough so that there would be from four to six aptitude indices that could each predict with respect to all four need areas for a particular group of specialties. It may be that the specialty groups ultimately arrived at would not include all skill levels within the career ladders, as is currently done. The aptitude predictor of job performance effectiveness for the supervisory-level jobs is the best predictor of high career development potential. The aptitude composite that predicts success at this level on the career ladder may not be the same as the one that predicts success for the lower level job group that includes entry-level jobs. Perhaps a dual aptitude requirements (and quota) system can be developed, in which one composite and score level, based on specific job performance effectiveness and assignment flexibility needs, determines assignment to a particular entry-level job and another, based on NCO-level performance effectiveness and assignment flexibility, determines potential for supervisory-level jobs.

Figure 5 shows a hypothetical example of how specialties might be grouped. The actual grouping, of course, awaits the analysis of the empirical data on job performance effectiveness and assignment flexibility needs. Ideally, there will be no Air Force need to transfer personnel among specialty groups at the same level on the career ladder, and a specialty group will not be so broad that an individual qualified for a given group cannot fill all or most of the entry-level jobs within it (given proper training) nor so narrow as to complicate the aptitude test so much that it cannot be easily scored and interpreted. For specific specialties or specialty groups, maximum score levels could be established in an attempt to prevent job dissatisfaction, or aptitude profiles could be developed to serve the same purpose in a more sophisticated fashion.

The final optimal set of aptitude requirements and quotas cannot be expected to hold for all time. Job structures will change, new jobs will be added, average aptitude centile score levels will change, and so on. The maintenance of an optimal, baseline set of requirements will have to be an ongoing function, requiring (a) periodic input of performance effectiveness data for all jobs, (b) reassessment of Air Force needs for career development, assignment flexibility, and job/service satisfaction, (c) reassessment of how certain personnel system actions trade off with aptitude levels, (d) notification of relatively permanent

personnel system action factor changes, and (e) notification of changes in quality of the manpower input. The development of a feedback function that allows maintenance of an optimal set of requirements and also the specification of short-term deviations from the optimal along with the use of personnel system actions is discussed in the next section.

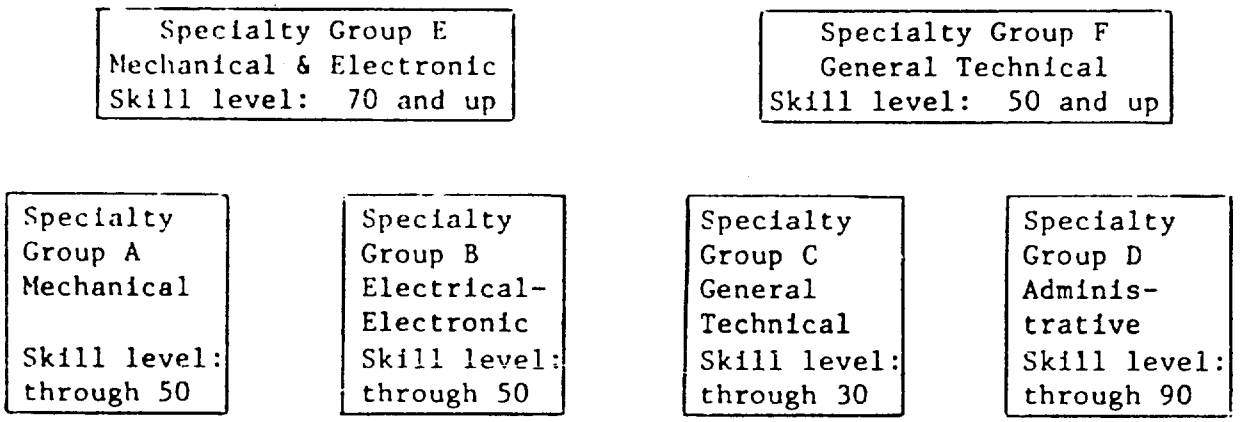



*Figure 5.* **Hypothetical example of new specialty groups corresponding to aptitude composites predicting job performance effectiveness, assignment flexibility, and career development potential.**

**Developing a Feedback Function for the Aptitude Requirements System**

Short-term changes in the quality of incoming manpower and in personnel system programs, particularly those changes related to the personnel system actions described in the second report of this study, should affect aptitude requirements quickly and directly if Air Force needs are to be met optimally. In addition, more permanent personnel system changes or manpower quality changes should cause changes in the optimal baseline aptitude requirements. The development of a feedback function for the aptitude requirements system is required to make aptitude requirements responsive to changes in the personnel system and to changes in the manpower pool. Following are some examples of the kinds of feedback activities required:

1. Alert those responsible for setting aptitude requirements and quotas when there is a trend toward higher or lower manpower quality and/or quantity among enlistment candidates. If aptitude requirements have been low due to poor quality, they can then be raised toward the optimal baseline requirements, and some of the personnel system actions utilized while aptitude requirements were low can be deemphasized or discontinued. If requirements have been optimal, they can be lowered and personnel system actions implemented to offset negative impacts.

2. Alert those responsible for setting aptitude requirements and quotas to any personnel system actions taken that tend to trade off with aptitude level or that tend to change required aptitude types. As a result, a short-term change in aptitude requirements might be cost effective, or a more long-term change in the optimal baseline requirements might be warranted.

3. Aid in selecting and implementing cost-effective personnel system actions when aptitude requirements to be used are not identical to the optimal requirements.

Provisions of the design details of such a feedback function are beyond the scope of this study. The feedback function requires cooperation and coordination among all parts of the personnel system if it is to work efficiently and provide optimal flexibility. Policy changes are required to effect this. An Air Force agency chartered to focus its attention on the interfaces among the various parts of the personnel system could probably handle the feedback problem and resultant decision-making and implementation planning most effectively.

A decision-making tool, which could be adapted and refined for use by the Air Force, is the cost effectiveness analysis presented in the second report of this series, which presents a method for selecting cost-effective personnel system actions to be taken when the aptitude requirements in actual use (and the actual manpower quality residing in the Air Force during a given period) are different from the optimal baseline requirements. A refinement that might be necessary would be to distinguish between personnel

system actions appropriate for short-term use to offset relatively temporary fluctuations in manpower quality and those to be utilized more permanently to offset the perturbing effects of frequent, but necessary, personnel system changes. Some personnel system actions trade off well with aptitude levels (allow aptitude score level requirements to be lowered) but do not have the adaptability, at least in terms of cost effectiveness, to allow short-term stops and starts. For example, many specialties cannot be restructured cost effectively two or three times a year just because the aptitude levels of enlistees fluctuate seasonally. Similarly, a training program that is not individualized sufficiently cannot be adapted easily to different aptitude groups on a short-term basis. Of course the development of more flexible training and job-structuring policies would make such short-term adaptations possible and more cost effective over the long run. The use of trained civilians to substitute for military manpower, on a short- or long-term basis, would also give considerable adaptability when quality is low, although the effects on assignment flexibility and career development might not be desirable in the long run.

### Development of an Implementation Plan

Implementation planning is an activity that must proceed in parallel with all of the other development activities discussed. The needs of the personnel who administer, score, and interpret aptitude tests must not be overlooked during the development process.

There are many implementation considerations: whether system changes should wait until new requirements can be set for all specialties; whether new requirements should be developed and implemented for one specialty group at a time; whether specialty groups with aptitude requirements that are poor predictors of performance effectiveness should be explored first; or whether the criterion for priority should be job criticality or manpower shortages. A special systems study should be performed to determine the most cost-effective implementation process for the Air Force to employ. This study should be performed in parallel with the development of the aptitude requirements methodology itself. Implementation recommendations are described as follows. However, a more thorough study, possibly using a simulation model, would be of value in making necessary implementation decisions.

It would be useful to begin methodological study and implementation of results in an area smaller than that encompassing all enlisted jobs. A useful priority scheme would be to select all entry-level jobs presently requiring aptitude scores of 60 and above. These are the jobs highly subject to manpower shortages. They include all aptitude areas, and there are enough specialties to provide large criterion groups. The major problem is that of restriction of score ranges—personnel in these high-aptitude specialties are probably the most trainable and the most verbally oriented, test-wise group. For this reason, it might be wise to include in the initial study a sample of currently lower aptitude specialties that have some tasks identical to those in the higher aptitude specialties.

This initial study might also be concentrated specifically on aptitude score level, rather than on both score level and aptitude type. Using Method 3 for estimating aptitude requirements, the current aptitude indices could be related to job difficulty and appropriate aptitude levels could be determined. These levels could then be used as new requirements while subsequent phases of the project are carried out. This priority scheme should enable the Air Force to take beneficial actions with regard to manpower shortage areas early. Actions to be taken would of course depend on initial study results. If new aptitude levels were significantly lower than those currently in effect, lower aptitude men that would be assigned to these specialties would in all likelihood have difficulty with some of the current training programs, thereby requiring the acceleration of individualized instruction and implementation of other personnel system actions.

If some new aptitude levels were the same as or even higher than the current ones, job restructuring, based on an analysis of task and job difficulty would be a possible way to utilize less-than-optimal requirements. If task-level data did not show a logical and rational structure that would utilize fewer high-aptitude men, then automation, utilization of fully proceduralized job aids, or a higher ratio of civilian to military personnel for the more difficult jobs could be considered. If the cost-effectiveness analysis model were to be more fully developed and refined, it could be used to select and sequence the actions to be taken in this case.

### A Special Note on Training

Aptitude for training has not entered into the aptitude requirements methodology discussion thus far. Training technology has advanced so much in the past few years, it is now possible to say that anyone who

can meet valid aptitude requirements for job performance effectiveness can be trained to perform the job successfully. Nevertheless, because many existing training courses require a great deal of intellectual and verbal ability, they are unsuitable for personnel who are low in these abilities but who could otherwise perform the job quite satisfactorily. To overcome this problem, it is suggested that a survey be made of the characteristics of existing training courses to determine the aptitude types and levels required to pass. It may be that the current aptitude indices and levels provide a fairly accurate picture of course characteristics, since many of the aptitude validity studies were performed with respect to training success. Until modified, those courses that require higher or different aptitudes than the job itself warrants should not have lower aptitude personnel assigned to them.

It would be very helpful to solving training problems if the Air Force were to develop a test for determining an individual's most effective learning style, so that as more training courses are individualized and self-paced, appropriate training methods and materials could be selected quickly and easily.

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