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ABSTRACT

This informal presentation describes how and why the Air Force uses the job inventory approach for collecting, analyzing, and reporting information describing the work performed by its personnel. This is followed by a brief description of the Comprehensive Occupational Data Computer Program (CODAP) system, the applications of job survey information to problems in managing the personnel system, and information on task and job difficulty levels with data describing job descriptions. Included are a 23-item bibliography and an appendix giving brief descriptions of selected CODAP programs. (Author/BP)

AFHRL-TR-73-75

AIR FORCE

HUMAN RESOURCES

THE UNITED STATES AIR FORCE OCCUPATIONAL RESEARCH PROJECT

By

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OCCUPATIONAL RESEARCH DIVISION
Lackland Air Force Base, Texas 78236

January 1974

Approved for public release; distribution unlimited.

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NOTICE

This report was submitted by the Occupational Research Division, Air Force Human Resources Laboratory, Lackland Air Force Base, Texas 78236, under project 7734, with Hq Air Force Human Resources Laboratory, Brooks Air Force Base, Texas 78235.

This technical report has been reviewed and is approved.

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Approved for publication.

HAROLD E. FISCHER, Colonel, USAF
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This paper describes a significant segment of the Air Force's occupational research project. It was originally presented at a U. S. Navy sponsored symposium on the state-of-the-art in occupational research and development. The first part of the paper describes how and why the Air Force uses the job inventory approach for collecting, analyzing, and reporting information describing the work performed by its personnel. This is followed by a brief description of the Comprehensive Occupational Data Computer Program system (CODAP), a major product of the Air Force's occupational research project which is now being

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used by all U. S. Military Services and the U. S. Coast Guard. Finally, the last section describes applications of job survey information to problems in managing the personnel system. The applications section had to be restricted because of time and space limitations. It is limited primarily to one stream of research which combines information on task and job difficulty levels with data describing individual jobs. This report should be of interest to all individuals who participate in the management of the Air Force personnel system as well as to individuals who conduct occupational research.

Since this was an informal presentation, normal citation practices were not followed. A reference and credits section is included in the back of the paper. An appendix has been included which presents abbreviated descriptions of major CODAP programs.

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THE UNITED STATES AIR FORCE OCCUPATIONAL RESEARCH PROJECT

I. INTRODUCTION

The United States Air Force Occupational Research Project was established in 1958, some 15 years ago, and has been supported continuously since that time. The project objectives call for the development of methodologies in a number of areas, including the following:

Job Analysis (Collection, analyses, and reporting of information defining work performed by personnel)

Job Evaluation (for grade, pay and skill levels)

Job Structures (including job engineering, work organization, and occupational classification)

Job Requirements (for aptitude, training experience, etc.)

Career Development

Personnel Utilization

Job Satisfaction (in particular, as it relates to retention)

Obviously, there's no way I can discuss even the highlights of a 15-year program in the limited time we have today. What I propose to do is to make some observations about the techniques the Air Force has developed for collecting, analyzing, and reporting occupational data; then I will discuss a few recently completed or ongoing studies in other occupational research areas which may be of interest to you. Since this is an informal survey paper, I will draw freely from previously published papers, my own memory, and data from studies yet to be published. My apologies to those of you who are already familiar with our job survey procedures, but I feel I must go into some detail describing this technology to participants here who have not had access to our in-service report series.

II. DEVELOPMENT OF JOB SURVEY TECHNIQUES[1]

Reasons for selecting the Job Inventory Approach

In the Air Force we chose the job inventory as the only feasible approach for collecting work-task information from large numbers of workers. There were a number of reasons for this decision: First, the technique is economical. Data can be collected from thousands of people throughout the Service for less than it would cost to collect data on a few people using professional job analysts. Second, the information obtained using job inventories is quantifiable. That is, you can actually count the number of people performing any particular task, and describe their characteristics. Note that data collected by traditional job analysis are not quantifiable. No two analysts will describe a job in exactly the same terms. Third, the fact that information collected with job inventories is quantifiable means that it can be stored, manipulated, analyzed, and reported by computer. Finally, the fact that information is quantifiable also means that it can be validated and checked for stability using conventional statistical techniques.

Now let me describe a job inventory. It contains two sections. The first section has questions to be answered by a worker about his job and himself - questions relating to name, identification number, previous education, time-on-the-job, tools used, job location, equipment worked on, training schools, pay grade, job attitudes, and so on. Any item can be included in the background information section of an inventory which may help answer questions posed by managers of the personnel system. The second section of a job inventory is simply a list of all the significant tasks that may be performed by workers in the occupational area to be surveyed. That is, it includes tasks being performed by apprentices, journeymen, first-line supervisors, and superintendents in one or more occupations, such as supply specialist or engine mechanic. If the task list is properly constructed, and this point is important to understand, then every worker in the occupation should be able to define his job adequately in terms of a subset of tasks in the inventory.

Construction of Job Inventories

Let me describe some of our experiences in constructing and administering job inventories. Ordinarily, an initial task list is constructed from available printed materials. In the Air Force program, this list is first reviewed by 5 to 10 senior supervisors

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[1] See "Credits" page at the end of the paper for information on references.

in an interview situation; they correct technical wording and add additional tasks which they know are being performed by workers in their occupational area. This expanded task list is then sent by mail for a field review by supervisors at various locations throughout the Air Force. According to the complexity of the occupational area, these mail reviews may be obtained from as few as 25 to as many as 100 supervisors. At some time during the construction phase, the task list is also reviewed by technical school instructors. The final task list is arrived at through this iterative process.

There is some variation in construction techniques used by the military services. For example, the Marine Corps does not use a mail review procedure, but makes extensive use of personal interviews at many locations. The Army makes use of technical school instructors as inventory constructors. The Coast Guard, which also constructs and administers inventories, essentially follows the Air Force techniques.

Air Force experiences have led to two conclusions. First, individuals who are untrained in writing task statements do a poor job of building job inventories for their own occupational area. It is better to keep the pencil in the hands of a trained inventory constructor and let supervisors in the field of interest serve only as technical advisors. Second, if inventories are constructed by technical school instructors, care must be taken to see that they are not biased through inclusion of only those tasks which have relevance for training. For example, a task concerned with sweeping the floor has little relevance for training, but may have a great deal of relevance for managers interested in job satisfaction, job evaluation, or job reengineering. It is best to have inventories constructed by individuals who have a broad perspective of all future applications of occupational data.

How many tasks should be included in an inventory? This has been a major problem faced by every organization entering the job survey business. I can only report what I believe to be a common experience. Most agencies begin with inventories which are too short. Ten years ago, the Air Force inventories were averaging 250 to 350 tasks. Today they are averaging around 500 tasks or more. Yet the Air Force has relatively narrow occupational career ladders - approximately 230 of them. Inventories constructed by smaller military services tend to be much longer. In the Australian Air Force, for example, job inventories sometimes contain more than 1,000 tasks. I realize that such lengthy instruments may appear to be a problem, but they are not as difficult to manage as one might think. If task statements are organized under duty headings, and if the worker has to mark only those tasks which he actually performs, then even a long inventory can be filled out in a reasonable period of time. Furthermore, it has been a common finding that detailed task lists lead to firmer conclusions concerning such things as the establishment of training requirements and the evaluation of occupational categories.

How many background questions are normally included in an inventory? Again, we have found more and more uses for background information. It is extremely important to be able to define any subgroup of people which may be of interest to management. If a manager wants to know the tasks being performed by aircraft mechanics working on a particular aircraft at particular locations who have taken certain training and who have been on the job less than one year, this can be obtained only if background variables have been included which define the relevant characteristics. For reasons to be discussed later, the single most important background variable for inclusion in a job inventory is worker identification.

How many workers should be sampled in an occupational area? The more the better. If one were interested only in the occupation as a whole, then perhaps a small sample would suffice. But experience has shown that managers are often interested in definable groups such as females, individuals at a particular grade or salary level, workers maintaining a particular type of equipment, and so on. Unless one has collected information from a large sample, then there will be insufficient numbers of cases to make reliable inferences about such groups of interest. Large samples are also needed to perform meaningful job-typing analyses -- especially if the occupational area is complex.

The Comprehensive Occupational Data Analysis Programs package (which we call CODAP) is designed to handle data on samples of 20,000 workers, except for programs associated with job-typing analyses, which will now accept data on 7,000 workers. In the Air Force we have attempted to obtain 100% samples in occupational areas containing 2,000 or fewer workers. In larger occupational areas, we have attempted to obtain data on not fewer than 2,000 workers. If the occupational area is known to contain a variety of job types, we may obtain data on 5,000 or more workers.

What about the costs of data collection and analysis? This is a fair question, especially when one considers administering long inventories to many workers. The cost of developing an inventory and of analyzing the results is essentially the same, regardless of the length of the inventory or the number of persons to whom it is given. It can cost between one and two hours of work time for each worker included in the survey, which is of consequence. However, in the Air Force, inventories are administered so as not to interfere with accomplishment of primary mission, so the costs and value are weighed against the costs and value of other nondirect mission programs which consume time, such as commander's calls, formations, physical training, and so on.

One cost, which can be substantial, is that of getting the response information onto magnetic tape, ready for computer input. All military services are, or soon will be, collecting data on optical scanning sheets. To the extent that data are processed by scanner, the costs of preparing data for computer input is reasonable.

I realize that I have not given you a specific answer about costs, but I can assure you that costs are modest compared with the savings which can be generated from appropriate applications of occupational data. I will address this topic directly a little later.

Administration of Job Inventories

Now let us turn our attention for a moment to the problem of inventory administration. In the Air Force, inventories are sent in bulk to Consolidated Base Personnel Offices throughout the world. Instructions specify that workers meeting certain specifications will be called into testing rooms to fill out inventory forms under controlled conditions. In the Marine Corps, the task analysis unit sends out teams to administer inventories on site at various locations. They report excellent results. However, this approach is feasible only if a Service or organization has a limited number of bases or installations.

Instructions for filling out an inventory are relatively simple. The worker completes the background section; reads the task list and checks those tasks which he performs as part of his normal job; writes in any significant tasks which he performs which were not in the task list; and then rates the tasks he has checked using a relative time-spent scale.

The write-in feature serves several useful purposes, but primarily it provides an indication of the quality of the task list. If a large number of significant new tasks are uncovered by the write-in feature, then the administration of a supplementary survey may be required; otherwise the uncovered tasks are used to guide interpretation of results and are saved for inclusion in the next form of the survey instrument.

Quality of Job Inventory Data

Perhaps the most important question which needs to be answered at this point is this: Can workers be trusted to be thorough and completely honest when they fill out job inventories? Studies have been conducted concerning this question, and I can say that the answer is definitely "Yes," at least as far as workers in the Air Force are concerned. We know that when a worker fills out an inventory on two occasions, he gives essentially the same information both times. Split-half reliabilities for information such as the percent of workers performing various tasks run from .95 to .99. Supervisors agree with the information provided by their subordinates. Information collected with daily work records is consistent with information collected with inventories. Workers do not inflate their job descriptions in terms of the number and difficulty levels of tasks they report. The work tasks reported by individuals are consistent with the information they provide in the background section concerning tools utilized and equipment worked on.

Many such studies have been conducted and reported. However, the experiences which have convinced us beyond any doubt that we are getting high-quality information are less objective and have never been fully documented. For example, during the first several years we obtained the telephone number of every worker who filled out an inventory. When we received what we thought might be false information, we called the worker and talked with him about his job. Over and over again, we found the worker was trying to be honest. Most often, the worker had been assigned a peculiar job because of local circumstances. In some instances we found our inventory contained bad task statements which did not allow the worker to reflect his true job. We did find that, while being honest, many workers will give themselves the benefit of the doubt. For example, a worker might claim to perform a task when, in fact, he only performs part of that task. This is one of the problems with task statements which are too broad, and it helps to explain why our inventories now have over 500 task statements.

Another factor which helps us to feel confident about our data is that we have published analysis results from over 200,000 cases in approximately 150 occupational areas, and these results have never been proved wrong by managers, workers, or trainers in those occupational areas. I will have to admit that there have been occasions when we were worried. In one instance, we found that very few workers were performing a large set of tasks which constituted approximately 25% of a training course. The managers of the occupational area were so unbelieving that they did an independent survey in which every worker in the occupational area was interviewed to see if, in fact, he performed any of the tasks in question.

The results of this interview-survey were for all practical purposes identical with those obtained from the inventory administration. Experiences like this have convinced not only the researchers, but also Air Force management, that job inventories yield good data.

Our latest experience with the power of job inventories to give quality data came when we surveyed approximately 5,000 civilian workers in one occupational area. We were particularly worried in this instance, since civilian pay is directly tied to job content. Under this circumstance, a worker might feel he has something to gain by being dishonest, or something to lose by being honest. We are pleased to report that analyses indicate that, even under this condition, workers are honest.

We feel that there are two factors operating which cause us to get honest reports from workers, and that these factors are interacting. First, we ask the worker to provide his name and social security number in the inventory, and second, the information he provides is objectively verifiable. It is unlikely that a worker will claim to perform a task when everyone around him knows that he does not perform that task. Similarly, it is unlikely that he will fail to report a task which everyone around him knows he performs.

Importance of Worker Identification

There are several reasons why I strongly recommend that name and identification information be obtained from workers who fill out job inventories. First, we have conducted many studies demonstrating that high-quality data can be obtained when workers provide their names. If identification information is not obtained, one cannot even conduct a study to validate his data. Second, collecting identification information enables one to follow-up workers and trace their career development over time. Third, identification information can be used to match with other personnel files to pick up additional data on workers, such as their aptitude scores and work history. Finally, identification information enables one to produce a description of the work being performed by a particular person, or to locate by name all individuals who are performing a particular task or set of tasks.

Use of the "Relative Time Spent" Rating Scale

Now let us consider the rating scale for a few minutes, because I believe this to be an important topic. Research indicated that many workers do not have a clear idea of the exact percentage of their time devoted to each task they perform. On the other hand, they can state with confidence that they spend more time on one task than on another. This led to the development of a "relative time-spent" scale, by which workers report the amount of work time they spend on each task relative to the amount of time they spend on other tasks. We use a 7-point relative time-spent scale. If an individual does not perform a task he leaves it blank. If he does perform it, he rates it from a level "1," which means that he spends an extremely small amount of time on it compared to the amount of time he spends on other tasks in his job, to a level "7," which means that he spends an extremely large amount of time on it compared with the amount of time he spends on other tasks in his job. These relative time-spent ratings are converted into estimated percent time values. The first question often asked by individuals reviewing this procedure is "Why percent time? Why not use some other factor such as frequency of performance?"

It is beyond the scope of this paper to discuss all of the factors favoring use of percent time-spent estimates, but several are sufficiently important to warrant your consideration. First, there are certain statistical characteristics which makes this approach extremely useful. It has a clearly defined range with a base value of "0." For the individual case, the values indicate the percentage of his work time spent on each task, and the sum of these values across all tasks in the inventory is 100%. In a like manner, the average values for any group of workers indicate the percentage of group time spent on each task, with the sum of these values also equalling 100%. Percent time values provide a convenient method for computing the overlap of two individual jobs with each other; of an individual job with a group job description; or of one group job description with another group job description. Results from numerous studies have indicated that matrices reflecting overlapping time among individual job descriptions, when analyzed by the CODAP grouping program, can yield a precise definition of the types of jobs existing in an occupational area. Finally, having available the percentage of time spent on tasks makes it possible to compute the time spent by individuals or groups on particular types of work. For example, a manager may wish to know how much time is being spent by a group of mechanics on preventive maintenance. This can be very quickly computed by the CODAP system. It should be noted that none of the above characteristics apply to a scale such as "frequency of performance." How could one possibly summarize the level of activity across a series of tasks in terms of frequency, when some of the tasks are performed frequently, while other tasks within the subset are performed infrequently? I strongly recommend use of the relative time-spent scale as the primary rating factor in occupational surveys, and that the obtained values be transformed into percent time-spent estimates. This is a requirement for the CODAP system, and it makes possible many types of analyses which cannot be accomplished using frequency of performance data.

III. THE CODAP ANALYSIS SYSTEM

By now you have heard me refer several times to CODAP, which is the analysis system used not only by the Air Force, but also by other military services. There is simply no way in a brief amount of time to communicate the power of this system. We have been working on it continuously for over 13 years, and the program listings now run about 1,400 pages in length. It represents an investment of hundreds of thousands of dollars, and thousands of in-service man hours. Yet, it is without question the most important product of the Air Force Occupational Research Project.

The concept behind CODAP is to provide ways for analyzing, organizing, and reporting occupational information so as to answer as many management questions as possible. CODAP currently contains approximately 40 general purpose programs, and several new ones are under development. All of these programs are interactive and highly efficient. I wish I had time to describe them to you, but it would take at least a day to cover them fully. All I can do in a few minutes is to mention a few programs which are used frequently. (See the Appendix for a description of selected CODAP programs and example CODAP outputs)

Example CODAP Programs

For example, one program produces a consolidated description of the work performed by any specified group of individuals. Such a description can be produced for workers at a particular base; or for those who have been in their jobs less than one year; or those who claim their talents are not being utilized; or those who work on a particular type of equipment -- indeed, for any group of workers which can be defined in terms of information in the background section of the job inventory. A consolidated job description indicates the percent of group members performing each task; the average percent of work time spent on the task by those who perform it; and the percent of group time spent on each task. A CODAP program prints the task statements and associated computed values, arranged in terms of percent members performing, or in terms of group time-spent values. A consolidated description of the work performed by individuals during their first year or two on the job is particularly useful in validating or designing the curricula for entry-level vocational training.

Normally when we analyze an occupation, we produce a series of job descriptions for groups at various experience levels. That is, we compute consolidated descriptions for individuals who have been in the occupation for less than one year; from one to two years; from two to four years; four to eight years; and so on. Then the CODAP system is used to gather this information into a table which indicates the percent of individuals at each experience level that perform each task in the inventory. In this way, we find when tasks tend to be assigned, and when training should be given in order to be timely.

Another CODAP program enables managers to study the differences in work being performed by any two specified groups of individuals. For example, one might wish to know the differences in work performed by individuals at one grade level and those at another grade level; or in the work performed by individuals working on two types of equipment. The CODAP system analyzes the two defined groups and prints a report summarizing the major differences in work performed.

Perhaps the most powerful CODAP program is one which identifies and describes all the types of jobs which exist in an occupational area. Beginning with 2,000 individual job descriptions, this program will compute a 4,000,000-element input matrix reflecting the similarity of each job with every other job. Then it proceeds to group similar jobs into clusters and prints out a description of work performed by individuals in each cluster. The program is iterative and may evaluate well over a billion alternative solutions in arriving at the best definition of job types and clusters in a particular occupation. Still another CODAP program can be used to determine the characteristics and locations of individuals working in each job type and cluster. The results of job typing analyses are extremely valuable in identifying changes needed in defining occupational categories in an organization or military service.

Other CODAP programs can be used to compute job descriptions for individuals, or for each individual in a specified group, or to compute the amount of work time each worker spends on a given set of tasks. Using factor ratings in conjunction with task data, CODAP can be used to compute the difficulty level or the grade requirement for each job. Programs are available within the CODAP which will produce two-way frequency distributions between background variables; compute the difficulty level of each task; compute intercorrelations among background variables; determine the reliability of task factor ratings; compute the average grade level or the average experience level of workers performing each task; compute regression equations; print task lists, or print a dictionary of background variables. The CODAP system is also a general occupational information retrieval system. All reports, descriptions, and analysis results computed by CODAP are stored and identified. Any subset of descriptions or reports can be extracted, ordered, and printed. CODAP even numbers the pages in an extracted report and automatically prints a table of contents. In general, there is a CODAP program available to organize and analyze occupational data to answer any question asked by managers of a personnel system. If we find that there is another type of analysis which would provide information on a question posed by management, then we immediately write a new program which will perform the necessary computations. This is one reason why all military services in the United States either are, or will shortly be, using the CODAP system for their occupational analyses.

I have probably bored some of you with the details concerning the collection, analysis, and reporting of occupational data. What you may wish to hear about are some experiences in using the information.

Adoption of Job Survey Technology by Various Agencies

In the Air Force we did research on various techniques from 1958 until 1967. During this period, we collected experimental data from over 100,000 cases and developed most of the programs in the CODAP system. Although cost savings data were not accumulated during this time period, occupational data led to numerous changes in training programs and occupational structures. In late 1967 the Air Force established an operational unit with 15 persons who devoted full time to the construction, administration, and analysis of occupational survey data. Its mission called for the completion of 15 surveys per year. In 1969, the staff of this organization was increased to 28, and the mission increased to 24 surveys per year. Last year the staff was increased again, to 42 persons, and the mission was moved up to 51 surveys per year. Each of these increases in staff and mission was due to demonstrated pay-offs of occupation information, and to increased demands from managers for more timely data. So far, the operational unit has surveyed over 200,000 enlisted persons in over 150 occupations. At the present time 68 surveys are in various stages of completion, and plans have already been made for expanding the capability of the unit to meet the increased demands for more occupational data.

In the Air Force, the greatest pay-off from occupational data so far has been in the area of training. Significant changes have been made in every training course associated with an occupational survey. Frequently these changes have not led to cost savings, since they have been in the form of reducing training on certain tasks while increasing it on others. Even so, approximately $7,000,000.00 cost avoidance has been documented during the past two years alone, which was directly attributable to reductions in training based on occupational survey information.

Encouraged by the Air Force occupational survey research findings, the Marine Corps established an operational unit which is currently manned by 37 persons, three of whom work full time in maintaining job structures. So far they have surveyed 11 of their occupational areas, which contain nearly one-third of their manpower. The Marine Corps had the Air Force CODAP system reprogrammed to operate on an IBM 360-65 computer. They are particularly happy with the job-typing programs, which have produced results leading to major changes in the job structures in every occupation surveyed thus far. During the past year, they have documented over $4,000,000.00 in cost avoidance based upon their occupational analysis results. That is a large savings considering the relatively small size of their personnel system. This year, the Marine Corps task analysis group received a Presidential Management Improvement Award.

The Army has an operational job-task analysis group consisting of 35 full-time persons. They have been collecting occupational data using job inventories for a number of years. To date they have been using their own analysis programs, but I understand that they are planning several significant changes in their procedures. These include the collection of worker identification data; use of the relative time-spent factor for a portion of their task list, and use of the CODAP to supplement their own analysis system.

The Navy has recently conducted several large-scale occupational surveys using job inventories and process the data with CODAP. The Navy officially established an operational job-task group this month and is pledged to use the CODAP system for analyses.

The Coast Guard has been conducting occupational surveys for several years with job inventories patterned after those used in the Air Force. All of their analyses thus far have been conducted using the CODAP system. They have now surveyed about one-third of their occupational areas.

The Canadian Forces have surveyed most of their occupations using job inventories, although, to date, they have used their own computer analysis programs. The Australian Air Force has 70 inventories in some stage of development. While these instruments tend to include a large number of task statements, they are otherwise patterned after those produced by the U. S. Air Force. An exchange officer from the Australian Air Force has recently completed a 2 1/2 year tour working in the Air Force occupational research program and studying the CODAP system. A second exchange officer has now moved into this position.

Many Universities, government agencies, and government contractors have collected occupational data using job inventories, and a number of these have accomplished their analyses using the CODAP system. To date, the CODAP system has not been available to industrial organizations, although it has been used by many non-profit organizations, especially those conducting research under government sponsorship.

I mention all of these programs to emphasize three points. First, there seems to be a large movement toward conducting occupational surveys using job inventories; second, many agencies are using, or are planning to use the CODAP system for data analyses; and third, occupational analysis programs are generally in good health and expanding.

IV. APPLICATIONS OF JOB SURVEY INFORMATION

So far I have mentioned applications of occupational data in the areas of training and work structures. Actually occupational data can and should have an impact on almost every part of the personnel system. The only thing that is lacking is the development of appropriate technology, and this is a major mission of the Air Force Occupational Research Division. I will have time to mention only a few of the applications being studied by this organization.

Task-Level Experience Records

To my knowledge, no military service and few industrial organizations maintain individual work experience records at the work-task level. In the Air Force a man may be assigned for a two-year period as a jet engine mechanic at a particular base and spend nearly all of this time working in a shop balancing jet engine rotors. When he is transferred to a new base, about all we know about him is that he spent two years at a particular base as a jet engine mechanic. We may assume that he gained experience on many maintenance tasks during this period which, in fact, he did not perform. We also have no record that he has received so much experience in balancing rotors.

Since a job inventory contains all of the significant tasks being performed by personnel in an occupational area, it provides an ideal framework for establishing and maintaining individual experience records. We know that individuals can be trusted to provide an accurate statement of tasks they are currently performing by using a job inventory. It may be that they can also be trusted to report their past experiences in terms of tasks listed in the inventory. This is a topic for research. We see many potential applications for task-level experience records. They can be used to evaluate the capabilities of the personnel force, to guide on-the-job training programs, to locate individuals with particular skills, and to guide reassignments.

Development of Task and Job Difficulty Indexes

One recent breakthrough by the occupational research group is the development of a technique for evaluating the relative difficulty levels of tasks and jobs in an occupational area (Mead, 1970a; 1970b; Mead & Christal, 1970). Task difficulty is a complicated concept. A task can be difficult to perform because repair parts are hard to get; the technical manual is hard to understand; the environment is hot; and several other reasons. After considering many alternatives, a definition was selected which reflects the amount of time it takes for individuals to learn to perform a task adequately. Supervisors in an occupation cannot rate the time it takes for workers to learn to perform tasks; but they can agree that, other factors held constant, workers can learn to perform some tasks faster or slower than they learn to perform other tasks. Inter-rater reliability coefficients concerning the relative difficulty of tasks within an occupation, based upon 30 to 40 raters, generally range in the middle to upper 90's.

We have also developed an equation which enables us to determine the relative difficulty levels of jobs within an occupation. First, we used the CODAP system to randomly select and publish multiple copies of 250 individual job descriptions in one career ladder. Then we had supervisors in the field to rank these jobs in terms of their relative difficulty levels. Again, we found high inter-rater agreement. Using the job rankings as a criterion vector, we applied the policy-capturing model (Christal, 1968a; 1968b; Bottenberg & Christal, 1968) in an attempt to develop an equation which would reproduce the policy decisions of the supervisors concerning job difficulties. Twenty-two predictors were hypothesized; but only three predictors entered into the equation. The same approach was repeated in 11 other ladders, and in every instance, the same three predictors were able to reproduce the supervisory rankings. These results are shown in Table 1.

Let's study this table for a minute. First notice the three predictors. Predictor 1 is the number of tasks in the job, and Predictor 2 is the number of tasks squared. Inclusion of the squared term is necessary because there is a curvilinear relationship between the number of tasks in jobs and their perceived difficulty levels. Predictor 3 is a complex variable reflecting the average difficulty level of tasks performed per unit time. This variable is computed by the CODAP Variable Generation Program (VARGEN), and is simply the cross-products of time spent and task difficulty, summed across all tasks in the inventory for a particular job.

Table 1. **Standard Score Job Difficulty Equations for 12 Career Ladders**

AFSC	Name	V1 Num Task	V2 Num Tasks Squared	V3 Avg Task Diff Per Unit Time	Validity
915X0	Medical Materiel	1.12583	−0.58673	0.45263	.949
811X0	Security Police	1.21517	−0.69250	0.49006	.922
702X0	Administrative	1.51433	−0.78250	0.24270	.977
671X0	Acctg & Finance	1.58511	−0.95836	0.39230	.951
647X0	Materiel Facilities	1.47237	−0.87075	0.33103	.942
645X0	Inventory Management	1.82866	−1.14425	0.22359	.936
631X0	Fuel Services	1.36857	−0.81885	0.49672	.942
605X0	Air Transportation	1.69565	−1.07968	0.30385	.930
571X0	Fire Protection	0.93890	−0.50649	0.66558	.939
551X0	Amn. Civ. Eng.; Pavements	1.38743	−0.77055	0.28059	.928
543X0	Elec. Power Production	1.66067	−0.94110	0.20593	.937
473X0	Vehicle Maintenance	1.29126	−0.61530	0.51612	.927
	General Equation	1.42366	−0.81392	0.38343	

Notice that when these three variables are properly weighted, the resulting composite shows remarkable ability to predict the supervisory job difficulty rankings. Also notice that the standard score weights in all 12 equations look very similar. As a matter of fact, they looked so similar that we began to wonder if it might not be possible to develop a universal job difficulty equation. In order to run a first test of this hypothesis, we averaged the standard score weights across the 12 ladders for each predictor; then we applied this single general equation back to the 12 samples to determine its predictive efficiency. Table 2 presents the results from this exercise.[2] Notice that in every instance, the general equation is almost as efficient as the least squares equation developed within the sample.

All of the career ladders shown in Tables 1 and 2 are relatively low level, and there is some question as to whether the general equation will be applicable to more technical occupations. In one recent study the general equation yielded a valid coefficient of .89 for the Information career ladder, which is moderately encouraging, and .80 for the Weather Observer career ladder,

[2]Only 11 ladders are shown; computations for the remaining ladder have not been completed.

Table 2. **Efficiency of the Job Difficulty General Equation**

Specialty	Name of Specialty	Least Squares R	General Equation R
811XX	Security Police	.922	.914
702XX	Administrative	.977	.970
671XX	Accounting and Finance	.951	.950
647XX	Materiel Facilities	.942	.930
645XX	Inventory Management	.936	.917
631XX	Fuel Services	.942	.938
605XX	Air Transportation	.930	.925
571XX	Fire Protection	.939	.888
551XX	Civil Engineering, Pavements	.928	.926
543XX	Electrical Power Production	.937	.923
473XX	Vehicle Maintenance	.927	.916

which is not so encouraging. If it turns out that the general equation holds up, we will no longer have to go to the trouble of establishing criterion vectors. We will simply have 30 to 40 supervisors in each area rate the task difficulties; then we can apply the general equation to determine the difficulty levels of all jobs surveyed. We already have programs in the CODAP system for performing the necessary computations.

Now I will discuss a few of the applications we have made of task and job difficulty indexes.

Technical School Versus On-The-Job Training

In over 30 career ladders, the Air Force has established what it calls a Category B training plan. Under this plan, a proportion of the assignees to the ladder are sent directly to the field with no formal training, while the remaining individuals go through an entry-level resident training course, and then are sent to the field. One would think that, if there is any flexibility in work assignment, those who have had the benefit of formal resident training would tend to inherit the more complex and difficult jobs. We have tested this hypothesis, using the job difficulty index as one criterion. The analysis is a model-seeking design, with two treatments and a concomitant variable. The two treatments are Technical School Graduates (TSG) and Directed Duty Assignees (DDA); the concomitant variable is Time in Military Service (TMS); the criterion is job difficulty level; and aptitude is held constant. Figure 1 shows some of the possible models.

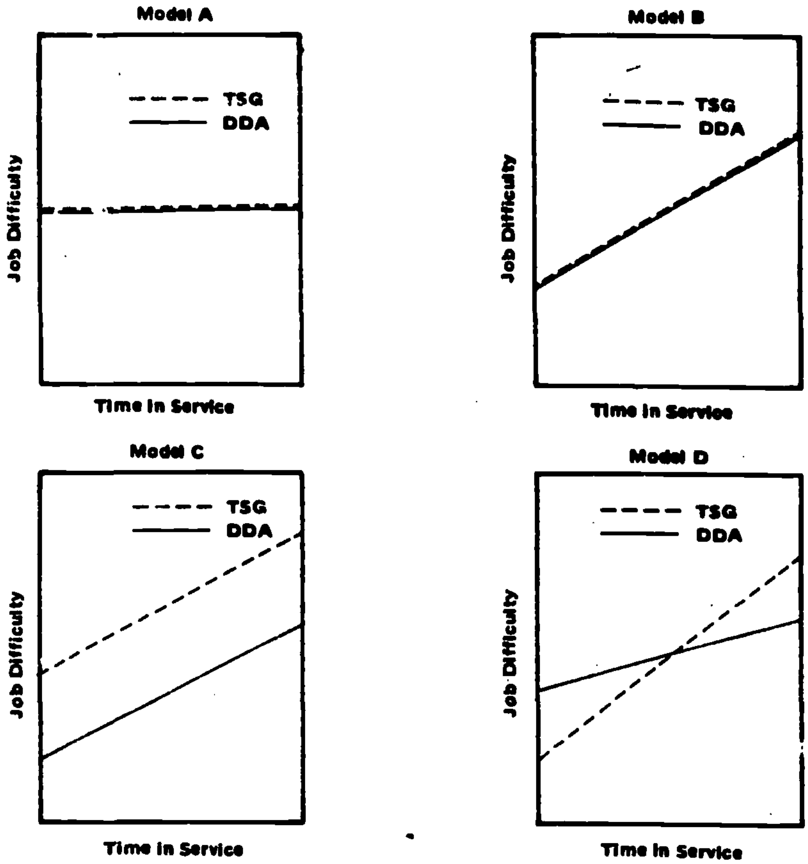

Fig. 1. **Comparison of technical school graduates and directed duty assignees in terms of difficulty level of work inherited.**

Model A shows an unlikely situation where the difficulty of work does not change over time, and where the regression lines for TSGs and DDAs are identical. Model B shows job difficulty increasing over time, but again, the regression lines for the two groups are identical. Model C shows the difficulty level of work increasing over time, and the regression lines to be parallel: but at all points in time, the TSGs are inheriting more complicated jobs than the DDAs. Model D was considered to be the most likely. It shows the difficulty level of work increasing for both groups over time. However, during the early time period, the TSGs are being assigned less difficult work than the DDAs. This makes sense, since the DDAs will have been on the job while the TSGs were in the classroom. However, Model D shows the TSGs catching up with and passing the DDAs in terms of the difficulty level of work inherited. The basic question is when does this cross-over occur. With a re-enlistment rate of 20 or 30 percent, it needs to occur well before

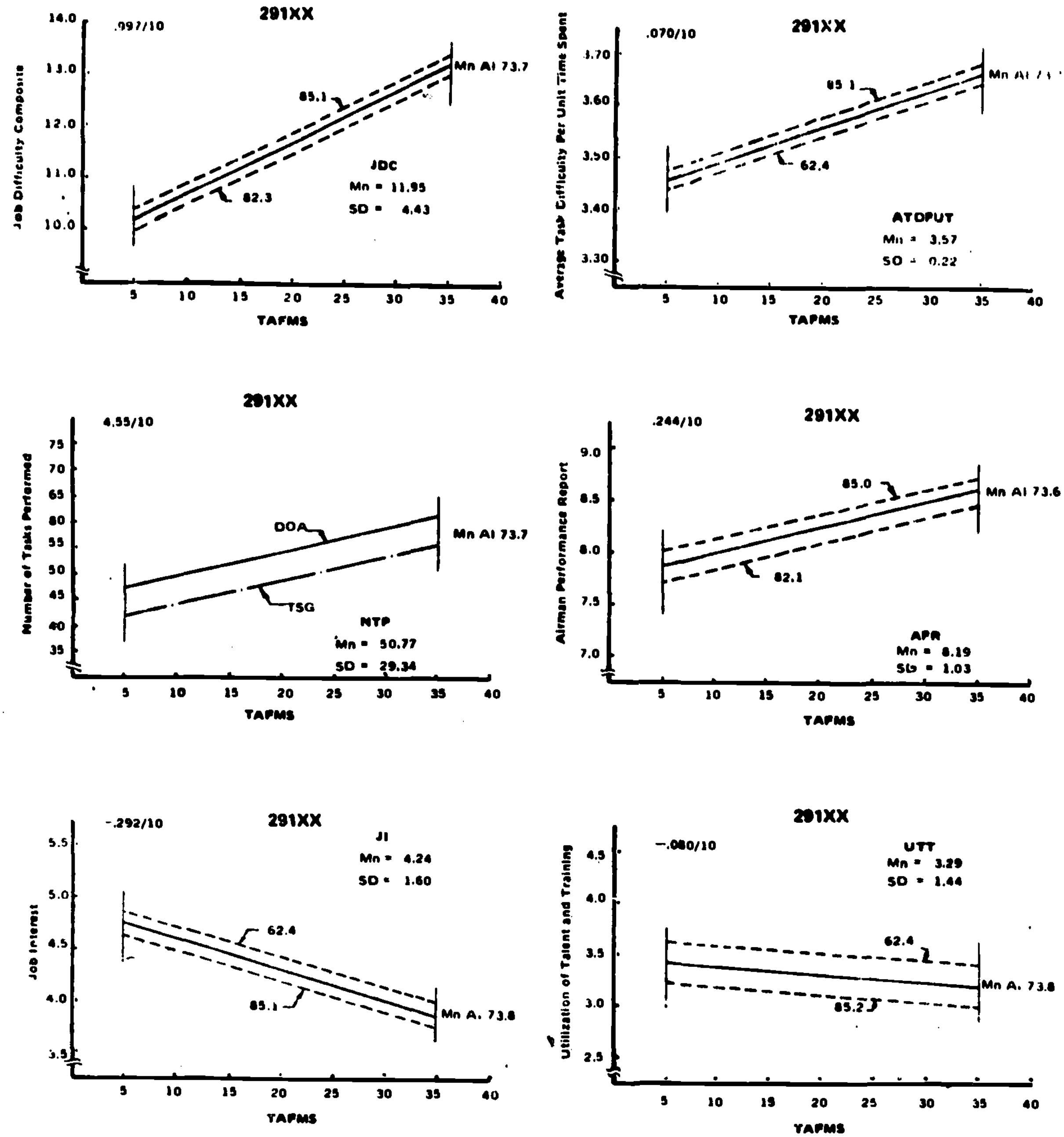

Fig 2. Comparison of technical school graduates and directed duty assignees on various criteria

the end of the first enlistment if the technical training course is to be worth its cost. The analysis program locates the appropriate model and reports all of the parameter values.

Detailed results from application of the model to eight career ladders are reported by Lecznar (1972). In general, Model B was found to be the correct representation. That is, while the difficulty levels of jobs increased over time, at no point (between the 5th and 35th month of service) was one group revealed to perform more difficult jobs than the other. The same type of analysis was run against five other criteria: (a) number of tasks performed, (b) average difficulty level of tasks performed per unit time, (c) official airman performance ratings, (d) job interest, and (e) felt utilization of training and talents.

With a few minor exceptions, no differences were found between TSGs and DDAs in any of these analyses. Figure 2 displays results for the Communications Center Career Ladder (291X0). The regression lines are identical for TSGs and DDAs against all criteria except for the number of tasks performed. There is a slight tendency for those trained on the job to perform more tasks than those trained in the formal entry-level course.

There has been a concerted effort in the Air Force to make On-the-Job Training (OJT) programs equivalent to resident training programs for the Category B areas. This study provides more evidence that equivalency is being attained. As an interesting sidelight, a recent study has been completed comparing the relative costs of resident training versus OJT for the 291X0 Career Ladder (Dunham, 1972). The results of this study indicated the cost of technical school training to be $2,780, while the cost of OJT was estimated to be $1,311 (median cost estimate). The upper limit of OJT cost estimates (95% confidence) was reported to be $1,515, which is still considerably less than the reported cost of resident training. Most of this difference is attributable to the costs of equipment, maintenance, training aids, and administration, which are calculated to be considerably less for on-site training.

Difficulty of Work Assigned to Personnel as a Function of Their Aptitude Levels

In 1967 the Department of Defense established a program titled "Project 100,000" which required the military services to accept quotas of personnel who fell below previously operating mental standards. The Air Force initiated a number of studies to determine how these individuals succeeded during their first enlistment (four years). Data were easily obtained concerning elimination rates in basic training, technical schools, and during post-school service. Scores were also available on written proficiency tests and official performance rating forms. However, there was one matter which plagued the investigators: "How do we know that these individuals are not being assigned tasks to perform as a function of their aptitude levels?" True, aptitude scores were not being provided to supervisory personnel. However, a supervisor might perceive that some of his subordinates are more talented than others, and he might assign the brighter airmen to do the complicated tasks, while assigning tasks such as sweeping the floor to airmen he perceives as being "dull." And if a "dullard" does an excellent job of sweeping the floor (his assigned task), and if he does it with a good attitude and with enthusiasm, will the supervisor give him a bad performance rating? Answer: "Probably not." Since the Air Force can use only so many floor sweepers in a specialty, it was deemed important not to draw any conclusions about the success of "New Mental Standards" (NMS) airmen until it was determined whether they had been given differential treatment as a function of their ability.

Since the definition of New Mental Standards airmen changed several times during the course of Project 100,000, the question was generalized to evaluate the difficulty of work assigned personnel as a function of their aptitude levels (Wiley, 1972). Data were collected using job inventories from approximately 14,000 airmen in 11 career ladders which had received large inputs of low aptitude personnel. In fact, approximately 47% of the cases (6,520) were Category IV personnel, while nearly 27% of the cases were classified as New Mental Standards airmen.[3]

The data were analyzed using the Multiple Linear Regression Model. In general, the approach was to determine the unique contribution of aptitude in accounting for the variance in (a) job difficulty, (b) the number of tasks performed, and (c) the Average Task Difficulty Per Unit Time (ATDPUT). Variables such as in-service training, time-in-service, time-in-job, grade, job location, command assignment, etc., were held constant. Results of these analyses are summarized in Table 3.

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[3]As an interesting side issue, a record was kept of the number of booklets which had to be rejected from processing because of failure to follow instructions by the incumbents. Only about 2% of the booklets were rejected from the NMS subsample, which is evidence that even these personnel could read and provide the required data in an occupational survey conducted with job inventories. Nothing was revealed during the analysis phase which caused the investigators to question the quality of information provided by this subsample.

TABLE 3. UNIQUE CONTRIBUTION OF APTITUDE (AFQT) IN PREDICTING DIFFICULTY OF WORK ASSIGNED

AFSC	N	Unique Contribution of Aptitude to R^2: ATDPUT[a]	# Tasks	Job Difficulty
291X0	862	.014[b]	.001	.006
473X0/1	720	.011[c]	.004	.000
543X0	470	.002	.021[c]	.019[c]
551X0/1	835	.006	.001	.002
571X0	1,214	.006[c]	.001	.002
605X0/1	813	.001	.000	.004
631X0	875	.011[b]	.004	.003
645X0	1,567	.007[c]	.001	.002
647X0	1,469	.011[b]	.011[b]	.013[b]
702X0	2,452	.019[b]	.005	.011[b]
811X0	2,644	.022[b]	.000	.004

[a]Average Task Difficulty Per Unit Time
[b]Sign. at .01 level
[c]Sign. at .05 level

Although several of the R^2s in Table 3 are significant at the .05 or .01 levels, in no instance did the unique contribution of aptitude exceed .02. It was concluded that there was no practical difference in the difficulty level of work being assigned to personnel in these 11 ladders as a function of their aptitude levels. Various interpretations can be placed upon this finding. It could be that supervisors in these ladders have very little flexibility in the way that they can assign work to subordinates. Another, and possibly more straight-forward interpretation, is that personnel assigned to these ladders have sufficient aptitude to perform all available tasks. In any event, it appears that the NMS airmen did not receive differential treatment with respect to their work assignments.

One unexpected finding was that, in nearly all Air Force Specialties (AFSs), aptitude correlated higher with the ATDPUT variable than it did with the job difficulty composite. A tendency was observed in several ladders for supervisors to assign fewer, but more complex tasks, to the brighter personnel. The significance of this finding will be discussed later.

Differences in Work Assigned to Blacks and Non-Blacks

Since approximately 19% of the cases in the NMS airman study described above were Black, the data provided an ideal base analyzing racial differences on variables such as the difficulty of work assigned, job interest, and felt utilization (Christal, 1972). Table 4 presents zero-order correlations between Race (Black = 1; Ø otherwise) and selected variables within each of the 11 career ladders in the NMS study. Although some of the relationships reported in this table are significant, they are all very low. The more meaningful findings are reported in Table 5, which displays the unique contribution of Race in the prediction of the job assignment-satisfaction criteria. The variables held constant in each equation are presented in Table 6.

Three of the criteria are associated with the nature of work being performed by incumbents in the various career ladders: (a) the number of tasks being performed, (b) the average task difficulty per unit time, and (c) an index of job difficulty. As indicated in Table 6, the variables held constant related to age, training, aptitude, education, and experience. When these variables were held constant, it was found that there were no significant differences in the number of tasks being assigned to Blacks and Non-Blacks in the samples under consideration. Furthermore, there were no significant differences in the average difficulty levels of tasks performed, weighted by the time spent on each task. However, when these two criteria were weighted into an index of overall difficulty level, it was found that Blacks were being assigned significantly less difficult jobs in two career ladders: 605X0 Air Passenger/Air Cargo and 702X0 Administrative. Although these differences were statistically significant at the .01 level, they were, nevertheless, small. In each instance, the race variable uniquely accounted for less than 1% of the criterion variance.

Table 5 also reflects racial differences in expressed job interest and in reported utilization of talents and training. Significant racial differences appeared in only two career ladders. In each instance, however, they were in the direction that suggested the Blacks found their jobs more interesting and felt that their talents and training were being better utilized than did the Non-Blacks. These findings are unusual in two respects. First, in the case of the 291X0 Communications Center Ladder, the unique contribution of race in accounting for feelings of being well utilized had an F ratio of 27.48, which is highly significant. Even though the Blacks and Non-Blacks were being assigned jobs and tasks of comparable difficulty levels in this ladder, the Blacks felt that they were being better utilized. In the case of the 702X0 Administrative Career Ladder, it was found that the

TABLE 4. CORRELATIONS BETWEEN RACE AND SELECTED VARIABLES IN 11 CAREER LADDERS

	Career Ladder										
Variable	291	473	543	551	571	605	631	645	647	702	811
Job Difficulty Index	-.01	.03	.05	-.06	.01	-.09	-.09	-.06	.06	-.09[a]	-.04
No. Tasks Performed	.02	.05	.06	-.06	.04	-.06	-.04	-.03	.06	-.07	.00
ATDPUT	-.08	-.01	-.03	-.04	-.03	-.11[a]	-.10[a]	-.01	.03	-.06	-.07[a]
Job Interest	.15[a]	.02	.10	-.12[a]	.02	-.02	-.01	-.09[a]	.06	-.09[a]	-.01
Felt Utilization of Talents & Training	.26[a]	.00	.15[a]	-.04	-.00	.01	-.00	.12	.04	-.12[a]	.02
N	691	538	373	643	1,003	714	724	1,397	1,262	1,944	2,109
% Black	12.0	8.4	18.2	21.3	23.8	14.3	23.2	11.8	22.1	23.0	23.3

[a]Significant at the .01 level of confidence.

TABLE 5. UNIQUE CONTRIBUTION OF RACE IN ACCOUNTING FOR THE VARIANCE IN CERTAIN MEASURES OF JOB ASSIGNMENT AND JOB SATISFACTION

	Unique Contribution of Race by Career Field										
Criteria	291	473	543	551	571	605	631	645	647	702	811
Job Difficulty	.0000	.0000	.0000	.0061	.0000	(-).0095[a]	.0079	.0029	.0006	(-).0041[a]	.0000
No. of Tasks	.0000	.0000	.0000	.0076	.0000	.0036	.0030	.0004	.0007	.0019	.0000
ATDPUT	.0026	.0000	.0000	.0026	.0021	.0048	.0050	.0014	.0000	.0000	.0011
Job Interest	(+).0097[a]	.0000	.0007	.0073	.0000	.0003	.0000	.0002	.0000	(+).0051[a]	.0015
Felt Utilization of Talents & Training	(+).0340[a]	.0000	.0100	.0012	.0003	.0000	.0000	.0016	.0000	(+).0066[a]	.0000

[a]Significant at the .01 level of confidence

Table 6. **Predictors Used to Account for Variance in Selected Criteria**

	Criterion				
Predictor	Job Difficulty Index	Number of Tasks Performed	Avg Task Difficulty Per Unit Time	Job Interest	Felt Utilization of Talents and Training
Months in Job	x	x	x	x	x
Months in Career Ladder	x	x	x	x	x
Total Months Active Military Service	x	x	x	x	x
Years of Education	x	x	x	x	x
AFQT Centile	x	x	x	x	x
AQE Mechanical AI	x	x	x	x	x
AQE Administrative AI	x	x	x	x	x
AQE General AI	x	x	x	x	x
AQE Electronics AI	x	x	x	x	x
Technical School Graduation (Yes/No)	x	x	x	x	x
Age at Enlistment	x	x	x	x	x
Job Difficulty Index				x	x
Number of Tasks Performed				x	x
Average Task Difficulty Per Unit Time				x	x
Grade				x	x
Number of Subordinates				x	x
CONUS Assignment				x	x

Blacks were being assigned jobs which were slightly less difficult than jobs assigned the Non-Blacks. In spite of this, the Blacks expressed a higher feeling of utilization and job interest than did the Non-Blacks. In the remaining nine career ladders, there were no significant differences in expressed attitudes.

Prediction of Civilian Grade Classification and Analysis of Biases in Classification Actions

Until recently, Air Force experience in conducting occupational surveys with job inventories was restricted to enlisted and officer samples. Analyses revealed survey data to be of good quality. In 1971 a first attempt was made to survey Civil Service personnel (Garza, 1972). Since civilian grades are tied to job content, there was some fear that a civilian might feel he had something to gain by being dishonest, or something to lose by being honest in describing his job. Fortunately, there was no indication of distortions in the data received from 5,485 job incumbents surveyed in seven series of the Accounting and Finance occupational area. Several analyses were made of these data (Carpenter & Christal, 1972) which utilized task and job difficulty indexes. One involved an attempt to predict the official grade classification of each position, and the second involved an analysis to detect biases in grade classification actions. The reader should understand that grade classification actions are based upon job descriptions provided to the classifier by the supervisor, while the analyses reported below are based entirely upon data reported by job incumbents in job inventory forms.

Table 7 indicates multiple Rs which were obtained from information concerning the amount of time spent by incumbents on particular tasks. In order to reduce the problem of overfitting, the tasks were split into two problems, and those entering either equation were used as predictors in a third problem. Although this did not completely eliminate capitalization on chance, it did reduce it to tolerable limits, considering the number of criterion observations available.

TABLE 7. CORRELATION OF TASK VARIABLES WITH AUTHORIZED GS GRADE

		Group A		Group B		Composite	
GS Series	N	# VARs Entering	Mult. R	# VARs Entering	Mult. R	# VARs Entering	Mult. R
501	856	68	.741	73	.755	77	.813
520	1,305	55	.564	49	.582	76	.649
525	1,710	66	.720	69	.691	81	.755
530	203	39	.869	36	.896	38	.924
540	307	49	.724	49	.752	65	.819
544	604	29	.725	32	.759	44	.793
545	500	41	.772	48	.752	57	.805

The task variables which entered the composite model were then combined with certain background variables to predict authorized GS grade. These background variables included those relating to the difficulty level of the job (Number of tasks, ATDPUT, and Job Difficulty Index); job location; command; personal characteristics of the incumbent (such as sex, age, marital status, etc.); and a large number of incumbent experiences and training variables. Readers who wish detailed information concerning the subsequent analyses can refer to the published report (Carpenter & Christal, 1972). A series of full and restricted regression models were computed to determine whether non-job-related variables had influenced grade classification actions. In general, it was found that factors such as the incumbent's age, sex, marital status, and factors such as command assignment and job location, did not systematically demonstrate a significant source of bias in grade determinations. One exception was the discovery that jobs in the Washington DC area are classified about one-half grade level higher than jobs located elsewhere, other factors held constant.

Table 8 presents the zero validity coefficients of the Number of Tasks Performed, ATDPUT, and the Job Difficulty Index (computed with the general equation) for the authorized GS grade levels of jobs in the seven series. Except in the 520 and 540 series, the ATDPUT variable showed substantial validity for all series. One discouraging finding was that in three ladders, the job difficulty equation, as computed by the general equation, had less validity than one of the individual variables weighted into that equation. Although the general equation may universally predict supervisor's ratings of job difficulty, it would appear wise to retain the separate elements of the equation in attempting to predict other criteria.

TABLE 8. VALIDITY OF CERTAIN MEASURES OF JOB DIFFICULTY FOR PREDICTING AUTHORIZED GS GRADE CLASSIFICATION

	GS Series						
Predictor	501	520	525	530	540	544	545
ATDPUT[a]	.51	.17	.54	.47	.23	.58	.51
No. of Tasks Performed	.25	.20	.23	.65	.18	.35	.32
Job Difficulty Index	.45	.30	.39	.67	.29	.46	.51

[a]Average Task Difficulty Per Unit Time

Task Factor Approach to Job Evaluation

Another potentially important use of occupational data is in the area of job evaluation -- the process by which pay and grade requirements are associated with jobs. Although there are a number of approaches to job evaluation, most large agencies use some type of point rating system. In such a system, each job is rated on a series of job evaluation factors, and the factor ratings are weighted into a job evaluation composite score. The job evaluation composite score is, in turn, converted into a grade or pay requirements level. The factors and factor weights employed in many job evaluation systems are in reality regressions equations developed to predict agreed-upon grade or pay levels for a set of benchmark jobs.

Although development of a job evaluation system is relatively straight-forward, applying it is another matter. How does one obtain unbiased factor ratings on tens or hundreds of thousands of jobs? We are working on a system using task-level data which may be of interest to you. Instead of obtaining factor ratings on jobs, we are obtaining them on tasks which have been included in job inventories. Since every job in an occupation can be described in terms of the tasks in an inventory, we can simply apply CODAP and compute the factor scores for each job. Also, CODAP can be applied to weight the factor ratings for each job into a job evaluation composite. This process assures that job evaluation is conducted in a systematic and unbiased manner.

In one recent test of this technology, an attempt was made to develop a system for evaluating the skill-level requirements for jobs in two Air Force career ladders. Task-level job descriptions were published using the CODAP system for 400 positions in the Fuel Services ladder (631XX) and 677 positions in the Personnel career ladder (732XX). These descriptions were rated for appropriate skill-level requirements by senior supervisors in the field, yielding mean ratings with computed inter-rater reliability coefficients of .95 and .92, respectively.

An independent group of supervisors in each ladder rated all tasks in a job inventory for their ladder on a series of job evaluation factors, such as knowledge requirements; responsibility for use and control of money, supplies, or equipment; required special training and work experience; oral and written communications; supervisory responsibility; decision-making requirements; task difficulty; etc. All such ratings were collected using an 8-point relative task comparison scale. The instructions went something like this: "Compared with other tasks in your career ladder, when a man is performing this task, what level of communications skill is he exercising?" If no communication skills are required, the task is assigned a value of "0." If communication skills are involved in performing the task, a rating of from 1 to 7 is assigned, according to the level of requirement compared with other tasks in the ladder. Reliability coefficients for the various factors (based on vectors of mean ratings) ranged from .93 to .99.

Scores were developed on each job description for each factor using the CODAP system. For example, one variable reflected "the average level of communication skills exercised per unit time." For a particular case, this is simply a sum of the cross-products of the time spent values and task indexes, across all tasks in the inventory. The factor information was then combined with other job information, such as the number of subordinates supervised, in an attempt to predict the supervisory skill-level criterion ratings.

It was found that a major portion of the criterion variance could be accounted for by only four variables plus two squared terms, as follows:

1. Number of tasks performed

2. Number of tasks performed, squared

3. Number of subordinates

4. Number of subordinates, squared

5. ATDPUT (Average Task Difficulty Per Unit Time)

6. ADMPUT (Average Decision-Making Requirement Per Unit Time)

TABLE 9. PREDICTION OF SKILL LEVEL REQUIREMENTS FOR JOBS IN TWO AIR FORCE CAREER LADDERS[a]

Career Ladder	N Jobs	R Full Model	R 6-Predictor Model
Fuel Services	400	.96	.95
Personnel	677	.94	.92

[a]See text for definition of predictors.

Table 9 reports the Multiple Correlation Coefficients for the full model (33 predictors) and for the six variables previously shown. It should be noted that application of the six-variable equations require obtaining task ratings from supervisors on only two factors: Task Difficulty and Decision-Making Requirement. The number of tasks performed by each worker is automatically computed by CODAP, and the number of subordinates is normally obtained by a background question included in job inventories. The two squared terms in the equation were required in order to account for anticipated curvilinear relationships. The number of tasks in jobs normally increases from the apprentice level through the first-line supervisory level; then falls off somewhat at the superintendent level. This is because a first-line supervisor both supervises and performs tasks, while a superintendent normally does not perform journeyman-level tasks. In a like manner, the number of immediate subordinates reaches a peak at the first-line supervisor level. Note all three variables which enter into the Job Difficulty Equation entered into the skill-level equation for the two ladders.

Use of Task Difficulty Indexes in Determining Training Requirements

In the Air Force we have saved millions of dollars by eliminating training on tasks which occupational survey data have revealed to be performed by few workers. However, data concerning the probability of school graduates doing certain tasks in their first or second assignment is insufficient to make sound decisions concerning school curricula (Christal, 1970). We are attempting to collect additional information on each task in an inventory in order to determine how much emphasis should be given to it in the entry-level course. These factors give consideration to such things as the consequences of inadequate performance; the probability that the task can be performed adequately without specialized training; the estimated cost of teaching the task in a formal training course as compared with teaching it on the job; the probability that the task may have to be performed in an emergency condition, where there is no time to obtain information on how it should be done; the perishability of the skill; and so on. The method for combining such information into curriculum decisions is not simple. For example, ordinarily a task will not be included in a course if the probability of a worker having to perform it is very low. On the other hand, if the task might have to be accomplished in an emergency, such as performing mouth-to-mouth resuscitation, or fighting a certain type of chemical fire, or evaluating a radiation count -- and if the consequences of inadequate performance are serious, and if the probability of being able to perform the task adequately without formal training is low -- then it certainly should be included in the entry-level course. Our goal is to develop procedures for evaluating each task on factors such as those I have described, and to develop equations which can be applied to each task to determine how much emphasis should be given to it in the training course.

Data on factors such as those previously mentioned have been collected on tasks in the Medical Services Career Ladder. Analyses revealed that correlation between Task Difficulty Indexes and the rater "probability of adequate performance without specialized training" was .96. Thus, once again, Task Difficulty Indexes, where difficulty is defined in terms of relative time to learn, will assist in solving an operational problem.

Before leaving this topic, I would like to make two points concerning the application of occupational data to training. First, one simply cannot provide massive computer printouts of occupational information and expect trainers to use them. He will have to explain how the data can be used and also convince trainers that the data are trustworthy. In some instances you will find trainers who are reluctant to eliminate training or tasks, even though there is overpowering evidence that such a move would be cost effective. In the Air Force, directives have been issued which require trainers to review survey data and to "show cause" as to why tasks performed by few workers should be included in the entry-level course. Second, a course curriculum cannot be designed solely from job survey data. Once the tasks to be trained have been identified, trainers must go into the field to observe the number and sequence of steps required in the performance of each task to be included in the course.

Determination of Relative Aptitude Requirements Using a Benchmark Scale

Aptitude requirement levels for entry into various Air Force career ladders were initially established by judgment. Adjustments have been made from time to time, based on recommendations from field commanders and trainers. When an aptitude requirement has been raised, it has generally been because someone has gone to a great deal of trouble documenting the fact that the jobs in an occupational field have become more complex and demanding. Requirements for new career ladders have been set by comparing them with similar existing career ladders. The subtests entering into aptitude composites have routinely been validated against training course grades; but only in a few instances have attempts been made to correlate subtests or composites with actual performance on the job. This has been due mainly to the non-existance of acceptable job performance measures.

During the past 25 years I can remember many times when Hq USAF asked us to validate aptitude requirements for all career ladders. In each instance, we had to provide soft answers. The fact of the matter is that, at the present time, it is not possible to defend any level of aptitude as being an absolute minimum for success in a career ladder. If training is carefully designed and increased, individuals with lower aptitude might succeed who otherwise would not. Job performance aids and automatic checkout equipment can reduce the requirements for high aptitude personnel in some ladders. Given sufficient time on the job, low aptitude personnel can learn to perform many tasks which they could not learn in a short period of time. There are many such factors that have trade-off values with aptitude.

Even if factors such as training, experience, and performance aids are held constant, there is still no completely satisfactory way to establish aptitude minimums in the absence of objective work performance standards and a method of evaluating personnel against such standards.

Yet, the matter of setting realistic aptitude requirements can be extremely important. For example, lowering a requirement from the 80th to the 60th centile could double the number of individuals eligible to volunteer for service in a particular career ladder. As we have moved into a zero-draft environment, there has already been some degradation of high aptitude talent in the applicant pool. We may reach a point where it is no longer possible to fill quotas at stated requirement levels. What then?

One solution would be to generate more applicants through offerings of increased pay and benefits. However, predictions of lower budgets and expenditures on national defense does not make this approach look promising. It may become necessary to find some way of operating the force with less talent. This being the case, now is the time to begin building contingency plans for actions which could be taken if we run into trouble.

During the course of some of the studies described earlier in this paper, several members of the occupational research team developed a strong feeling that task and job difficulty, defined in terms of time to learn, reflects aptitude requirements. Some support for this hypothesis can be found from the results of training research. If training time is held constant, then aptitude relates to the amount of material mastered; but if everyone is trained to a standard and allowed to move at his own pace, then aptitude relates to training time. Another clue came from a study in which we computed a correlation of .92 between supervisory ratings of task difficulty and the proportions of an independent group of supervisors agreeing that tasks could be performed adequately by low ability workers.

Following these clues, we initiated a series of systematic studies to determine the relationship between relative aptitude requirements for work tasks as judged by behavioral scientists, and relative difficulty levels for the same tasks as judged by supervisors (Fugill, 1972; 1973). In the first study, a correlation of .89 was obtained for a set of mechanical tasks. In a follow-on study, a correlation of .93 was obtained for a set of electronic tasks. Finally, a correlation of .89 was obtained for a set of administrative tasks. Thus, a close correspondence between difficulty defined in terms of "time to learn" and aptitude requirements was established.

These findings suggest that one can use relative difficulty ratings from supervisors to compare the relative aptitude requirements for tasks and jobs within career ladders. This information alone can be of some benefit for building contingency plans. For example, most career ladders contain several types of jobs which may vary in difficulty. The CODAP analysis system can be used to identify these job types, and difficulty indexes can be used to determine which job types might be shredded out into new management units for performance by lower aptitude personnel. The task difficulty indexes can also be used to identify tasks which might be pulled out of existing jobs and engineered into new jobs for performance by less talented individuals. However, in order to build the most meaningful contingency plans, what is needed is a method for comparing aptitude requirement levels for jobs across all career ladders. This would help the Air Force determine where stated requirements can be reduced with the least danger to mission accomplishment, and without changes in the classification structures. The approach taken to solve this problem was the development and application of benchmark scales.

Now, let me outline this approach in general terms.

Step 1. Select a set of career ladders requiring the same type of aptitudes, for which job inventories and recent occupational survey data are available.

Step 2. Collect ratings from supervisors to determine the relative difficulty levels of all tasks within each ladder.

Step 3. Select 30 to 40 tasks at various difficulty levels from each ladder. This will form the benchmark set. Reliability of final results will be enhanced if the tasks selected for the benchmark set are well known or easily observed.

Step 4. Obtain relative aptitude requirement ratings for tasks in the benchmark set from knowledgeable behavioral scientists.

Step 5. Within each ladder, compute least squares regression equations to predict task aptitude requirements form task difficulty levels.

Step 6. Apply the equations developed in Step 5 to rescale all tasks in all ladders into a common aptitude requirements framework (the benchmark scale).

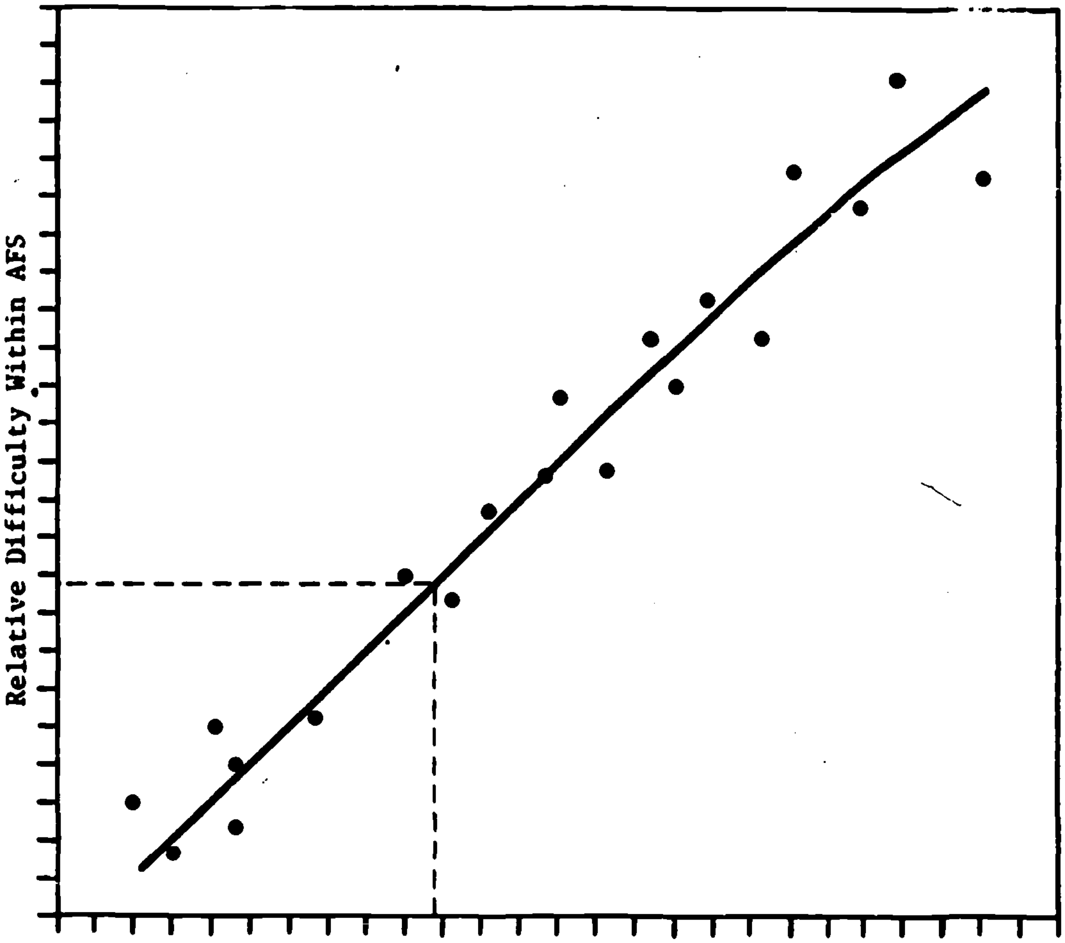

Figure 3. Relative Aptitude Requirement Within Benchmark Set

I'd better stop at this point to make sure that these last two steps are understood. Figure 3 presents 20 points representing 20 tasks on a particular career ladder which were included in the benchmark set. The position of a task on the vertical axis represents its difficulty level relative to all other tasks in its own career ladder. Its position on the horizontal axis represents its aptitude requirement level relative to other tasks in the benchmark set of tasks. A line of best fit has been drawn through the points. Using this graph, the relative difficulty index values can be converted into aptitude requirement levels for all tasks in the career ladder. If this procedure is repeated for all ladders having tasks represented in the benchmark set, the final product is a set of values indicating the relative aptitude requirement levels for all tasks in all ladders. The same results can be obtained, without actually plotting points and reading graphs, by simply developing and applying least-squares regression formulae.

Step 7. Using the task aptitude requirement data, the CODAP system is applied to occupational survey data to determine the relative aptitude requirement levels for all jobs in all ladders.

Step 8. The requirement levels for 1st term jobs are compared across ladders.

Step 9. The requirements levels are determined for each type of job identified in each career ladder by the CODAP system.

Step 10. The amount of work time being spent on low requirement tasks is determined for each job in every career ladder.

A test application of this technology was made by the Air Force Human Resources Laboratory's Occupational Research Division. Part of this study was accomplished in-house, and partly by contract with the Systems Development Corporation. I won't have time to report all of the details of the study, but I will report generally how it was conducted.

In the first stage, an in-house study was completed which involved 10 ladders in the Administrative and General aptitude areas. Two hundred and seven tasks were selected for inclusion in the benchmark scale, which represented the range of difficulty in each ladder. As a second consideration, the tasks selected were those which in-service personnel were most likely to understand without observation in the field. Twelve in-service behavior scientists rated tasks in the benchmark set on relative aptitude requirements, and 40 to 100 supervisors in the field rated all tasks within their respective career ladders on a relative difficulty scale. Correlations between task difficulty levels and aptitude requirement levels were generally in the upper 80's for the benchmark tasks representing various ladders. Regression equations were computed and applied to rescale all tasks in all ladders in terms of their relative aptitude requirement levels.

Realizing the dangers of having in-service personnel rate tasks without first-hand knowledge, a contract was negotiated with Systems Development Corporation to repeat the study on 10 career ladders, six of which were identical to those in the in-house study.

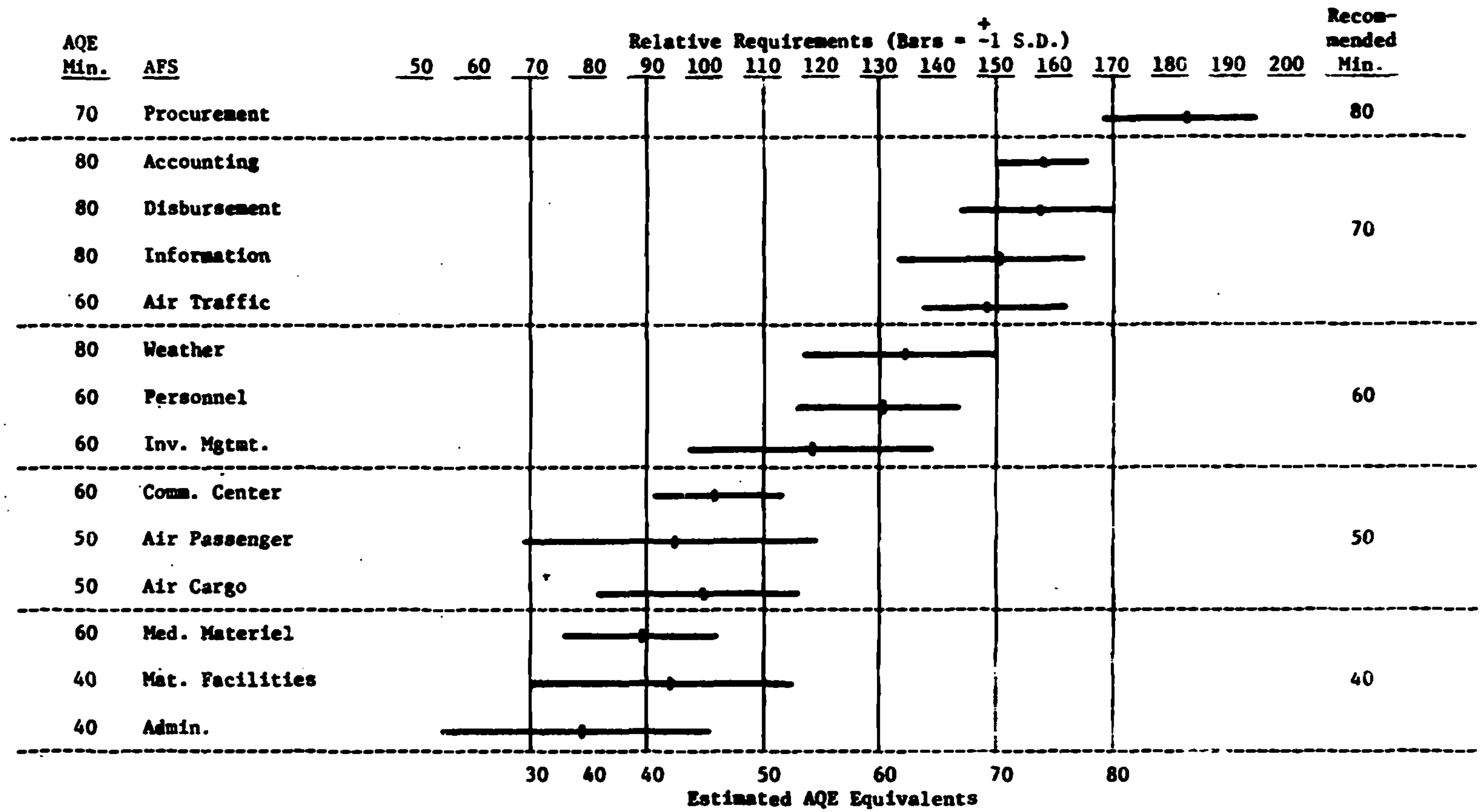

Figure 4. Relative Aptitude Requirements for 1st-Termer Jobs in 14 Career Ladders.

The contractor study involved 280 benchmark tasks. Six behavioral scientists spent six weeks at several bases observing these 280 tasks being performed and interviewing workers and supervisors before executing their independent ratings of relative aptitude requirements.

It turned out that, for the six common career ladders, the contractor and in-house studies produced essentially equivalent results. Therefore, the two studies were merged, yielding relative aptitude requirement levels for all tasks in 14 career ladders. These aptitude requirement indexes were applied to occupational survey data in the 14 career ladders, and relative aptitude requirement levels were computed for every position in each of these ladders. For reasons which are too complicated and numerous to discuss in this presentation, the individual position requirements were based upon the "average requirement level of tasks performed per unit time." The CODAP system was then used to compute the mean, distributions, and standard deviations for first-termer jobs in each ladder, as well as for each job-type in each ladder.

The primary results of the completed study are shown in Figure 4. Remember that the data in Figure 4 gives consideration to the difficulty level of every task in thousands of individual first-termer jobs. For each ladder, the horizontal line reflects the relative aptitude requirement levels for first-term jobs falling minus one and plus one Standard Deviation around the Mean. That is, the bars show the aptitude requirement levels for approximately the middle 68% of jobs in each ladder. The left hand column in this Figure indicates the current aptitude requirement levels for the 14 ladders. The vertical lines, representing estimated AQE equivalents, have been drawn arbitrarily, and are designed to assist in evaluating the relative aptitude requirements.

If the Air Force cannot fill quotas at the 80th centile level, it would appear that requirements could be lowered to 70 in both the Information and Weather career ladders. Under more severe pressures, the Accounting and Disbursement requirements could be dropped from 80 to 70. The actual aptitude requirements for all four of these ladders appear to be less than they are for the Procurement ladder; yet the current stated requirement for the Procurement ladder is only at the 70th centile level.

At the 60 level, the Air Force should be able to drop the requirement for the Communications Center ladder to 50 and the Medical Material Ladder all the way down to 40. In the face of drastic shortages, consideration could be given to dropping the requirement for the Administrative Ladder to 30. Even if we do

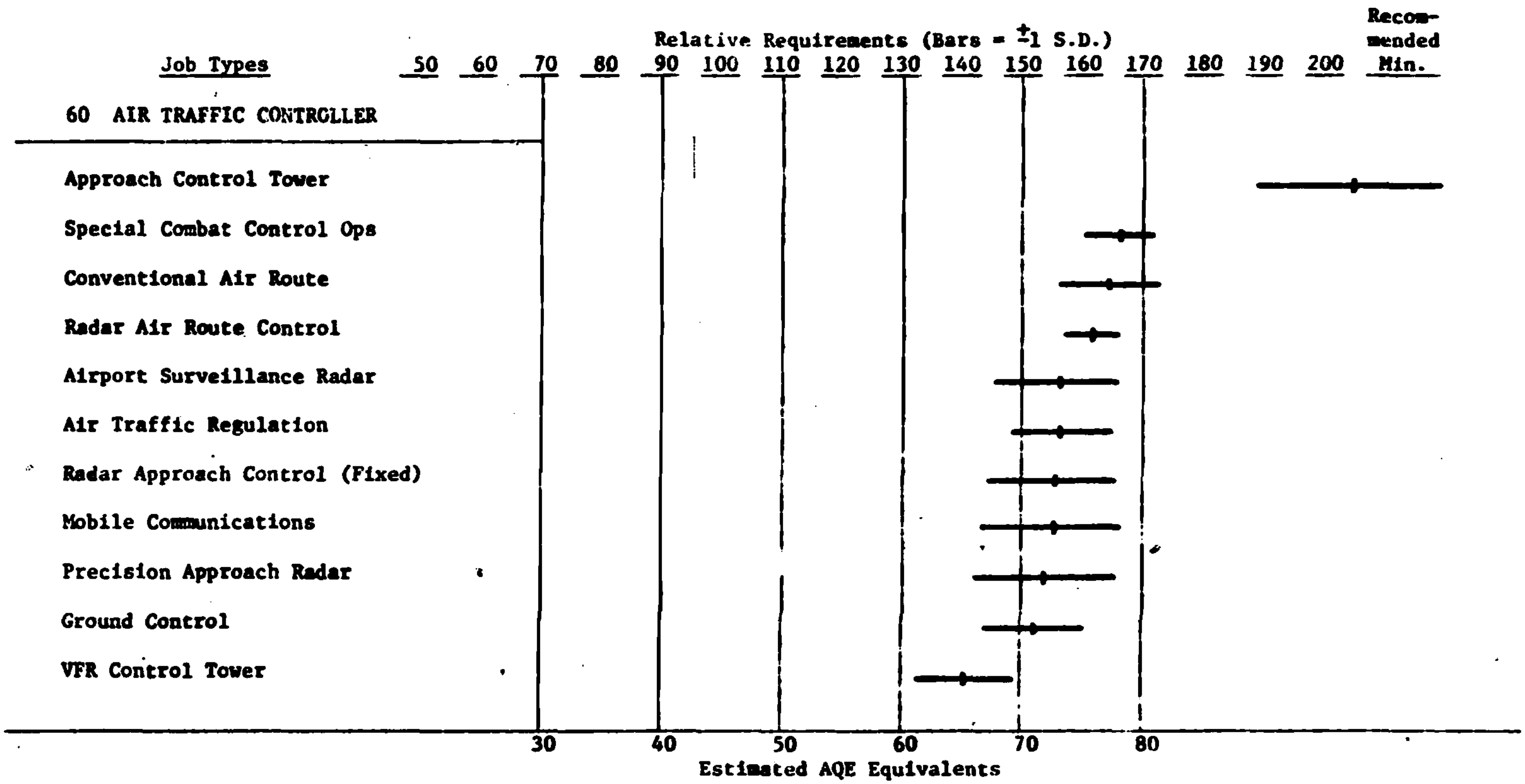

Figure 5. Relative Aptitude Requirements for 1st-Termer Job Types in the Air Traffic Controller Career Ladder.

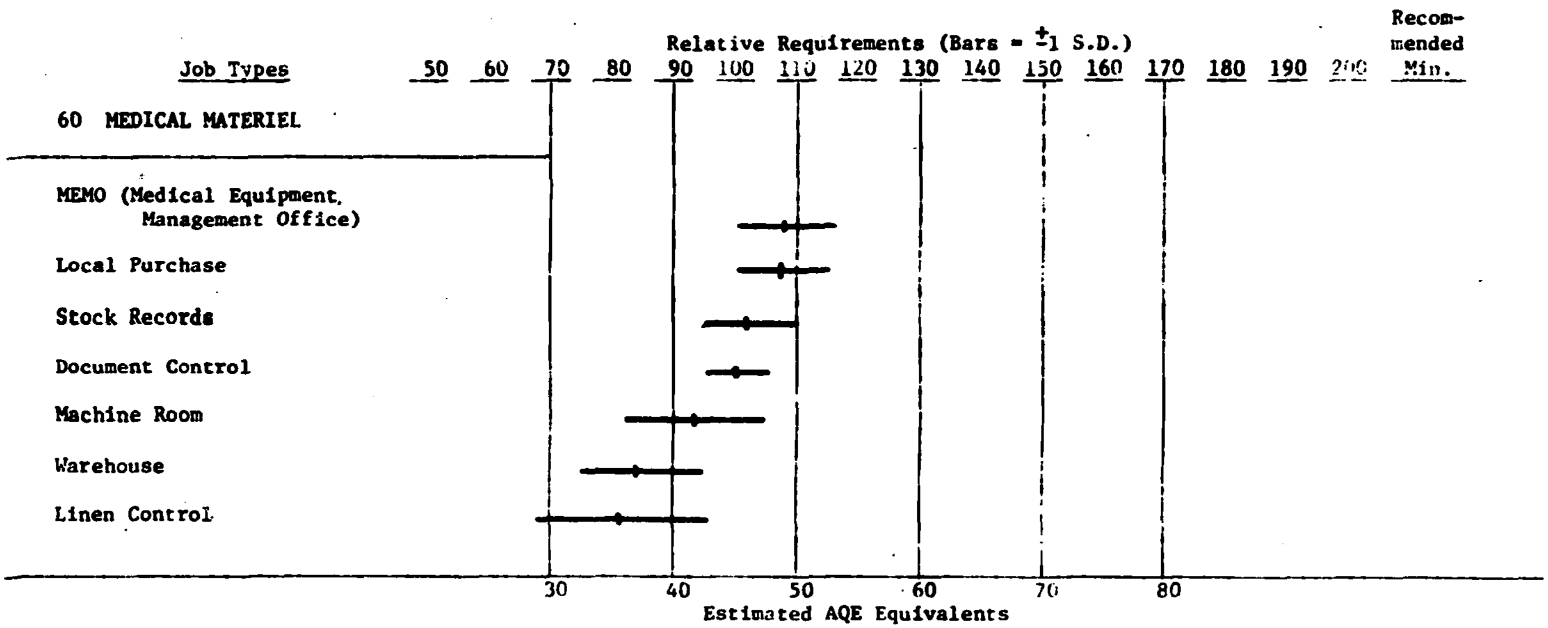

Figure 6. Relative Aptitude Requirements for 1st-Termer Job Types in the Medical Materiel Career Ladder.

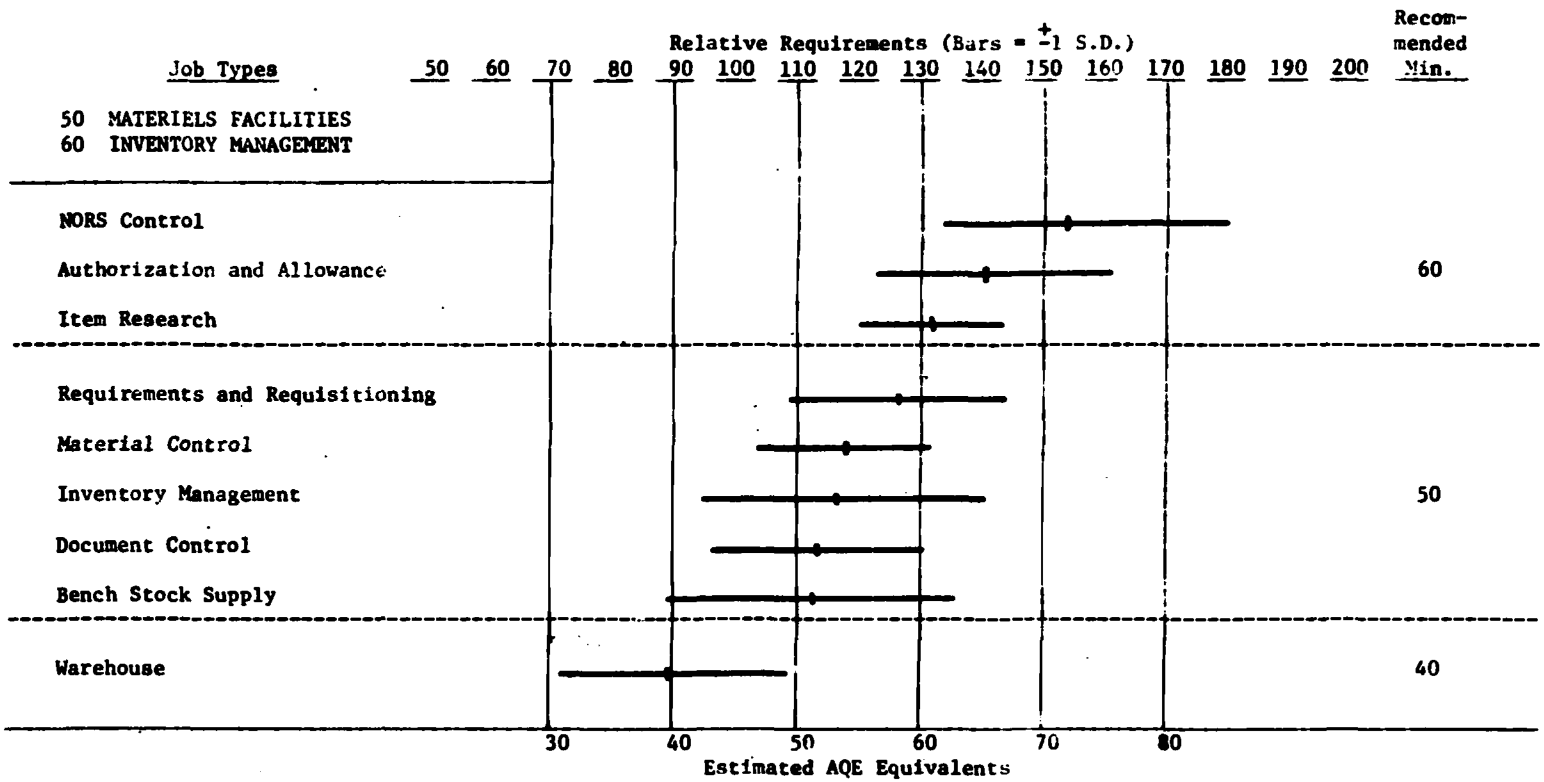

Figure 7. Relative Aptitude Requirements for 1st-Termer Job Types in the Materiels Facilities and Inventory Management Career Ladders.

not run into problems in filling quotas, the data in this figure could be used to make certain adjustments which would bring ladders into proper alignment.

Most career ladders in the Air Force contain more than one type of job. For example in the Disbursement Accounting ladder, some individuals spend full time computing travel vouchers, some keeping manual military pay records; some operating military pay computers; some paying and collecting cash; and so on. The CODAP system includes programs for identifying and defining the job types in each ladder. One type of contingency plan which could be implemented in an emergency is to shred out certain job types within ladders which can be performed by individuals with lower aptitudes. A few examples are shown in Figures 5, 6, and 7.

So far I have described two types of contingency plans. One involved identifying career ladders for which the aptitude requirements can be lowered with the least danger to mission accomplishment. The second involved identifying job types within existing ladders which can be separated out and made into new specialties for performance by individuals with less talent. A third type of plan involves removing simple tasks from existing jobs and engineering them into new jobs for performance by individuals with less talent. While I will not discuss this third alternative today, I would like to mention that the CODAP analysis system will compute the amount of work time being spent by every individual in a career ladder on such easy tasks. Other CODAP programs can provide summary tables indicating the amount of time spent on low-level tasks by all individuals at various locations. If one proposed to re-engineer jobs, this would tell him where he might have the best chance of success.

Job Satisfaction Research

There is a great deal of research evidence in the civilian sector indicating that factors related to job content and job conditions influence the decisions of individuals to stay with or leave work situations. In the Air Force, factors related to job content, assignment location, and worker-supervisor interactions are among those frequently cited by individuals for their decisions to leave the service. As we have moved into a zero-draft environment, retention of qualified workers has become an extremely important goal. Such individuals are available in limited quantities, and they are difficult to enlist, expensive to train, and hard to replace. In recognition of this, the Air Force has recently placed increased emphasis on job satisfaction research. A full-time effort in this area was initiated a little over a year ago. Fortunately, data on two factors ("Job Interest" and "Utilization of Talents and Training") had already been collected in job inventories for over 130,000 workers in approximately 150 occupational areas. Detailed analyses of data on these two factors are currently underway, but a few observations have already been made (Gould, 1972). Extensive differences in expressed job satisfaction have been found to exist between career ladders and among individuals within career ladders. For example, in some ladders fewer than 5% of the workers report that their talents and training are not being utilized in their present work assignment; while in other career ladders, over 50% of the workers report their talents and training are being utilized "very little" or "not at all." We have conducted intensive studies in a few career ladders in which a large number of individuals report low interest and utilization, and we find that in many instances there is ample justification for such feelings (Stacy, 1973).

So far, we have been able to account only for a modest portion of the variance in attitudes among individuals <u>within</u> career ladders. Tables 10 and 11 report the validities of certain predictors for the interest and utilization factors. The full model includes predictors such as job difficulty, grade, time-on-job, aptitude, education, command, unit and base size, and age. All of these variables in combination yielded Rs which are only of modest size (.29 - .47). The largest and most consistent relationships are associated with the difficulty level of the work assigned and the aptitude level of the worker. These relationships are not large; but they are significant and always in the same direction. The most satisfied workers tend to be those who have the lowest relative aptitude and who are assigned to the most difficult work. In these tables, the variable "Work Difficulty" represents a least-squares weighted combination of (a) the number of tasks performed, (b) the number of tasks performed (squared), (c) the Average Task Difficulty Per Unit Time, and (d) a complex variable which is the sum of the cross-products of time spent on each task and the average grade level of all personnel in the career ladder currently performing that task.

The long-term job satisfaction research program of the Occupational Research Division involves three phases. <u>First</u>, we recognize that job satisfaction is multi-dimensional. We are attempting to isolate and define all significant job-related factors which should be included in our job satisfaction studies. <u>Second</u>, we want to determine the impact of each factor on career decisions. <u>Finally</u>, we want to determine how jobs and job conditions can be modified so that workers will look favorably on the Air Force as a career choice.

TABLE 10. PREDICTION OF REPORTED "UTILIZATION OF TALENTS AND TRAINING" BY FIRST-TERM AIRMEN

Career Ladder	N	Full[a] Model	Work[a] Difficulty	No. Tasks Performed	ATDPUT[b]	Avg AI
291	862	.44	.21	.21	-.03	-.20
473	720	.36	.28	.21	.18	-.03
543	470	.40	.22	.21	.07	-.21
551	836	.45	.32	.28	.30	-.11
605	814	.43	.27	.23	.20	-.16
631	876	.36	.19	.07	.15	-.20
645	1,568	.34	.10	.05	.06	-.18
647	1,470	.34	.14	.11	.12	-.14
702	2,452	.35	.22	.20	.09	-.18
571	1,214	.29	.14	.07	.13	-.15
811	2,644	.32	.22	.15	.21	-.10

[a]See text for definition
[b]Average Task Difficulty Per Unit Time

TABLE 11. PREDICTION OF REPORTED "JOB INTEREST" BY FIRST-TERM AIRMEN

Career Ladder	N	Full[a] Model	Work[a] Difficulty	No. Tasks Performed	ATDPUT[b]	Avg AI
291	862	.38	.18	.16	.00	-.14
473	720	.40	.26	.15	.22	-.03
543	470	.34	.16	.15	.07	-.14
551	836	.47	.28	.25	.23	-.02
605	814	.41	.28	.21	.22	-.13
631	876	.40	.24	.06	.20	-.16
645	1,568	.30	.11	.10	.04	-.06
647	1,470	.32	.16	.12	.13	-.03
702	2,452	.32	.18	.15	.09	-.08
571	1,214	.30	.19	.09	.18	-.02
811	2,644	.38	.29	.19	.27	-.06

[a]See text for definition
[b]Average Task Difficulty Per Unit Time

With respect to the first goal, we have developed a group of 330 attitude statements which we feel cover the satisfaction domain. These are being analyzed using a combination of cluster analysis, factor analysis, and regression analysis, with the goal of producing a minimum set of attitude measures which cover all important dimensions. Phase II will involve determining the impact of each attitude on the reenlistment decisions of workers in each career ladder. This turns out to be a very complex problem. In the civilian sector, one can simply administer a job attitude questionnaire to a sample of workers and, at a later point in time, relate the score values to a criterion of "1 if still on the job; 0 otherwise." In the military setting jobs are constantly being modified, and individuals are frequently moved from one location to another. We have no easy way of continuously tracking each individual and measuring changes in job content, job conditions, and job attitudes over time. Furthermore, we don't know when each individual finalizes his decision to reenlist or get out of service.

We have developed a method, based on cross-sectional data, for inferring the probable impact of a particular job attitude on the reenlistment decisions of personnel in a particular career ladder. The model is made possible by the fact that all enlistments in the Air Force have been for a 48-month period. It involves construction of a regression curve which predicts the attitude of individuals still on board at each month of military service. In order to afford some protection against the problems of interpreting cross-sectional data in a longitudinal manner, aptitude is held constant, and the regression line is drawn for those at the mean aptitude level.

To be more precise, assume that we are predicting the job interest level for a particular group. The predictors included in the equation would be as follows:

X_1 = Months of Service (continuous)

$X_2 = 1$ if $X_1 = 0\text{–}48$; 0 otherwise

$X_3 = 1$ if $X_1 > 48$; 0 otherwise

$X_4 = X_1$ if $X_2 = 1$; 0 otherwise (or X_1X_2)

$X_5 = {X_4}^2$

$X_6 = X_1$ if $X_3 = 1$; 0 otherwise (or X_1X_3)

$X_7 = {X_6}^2$

X_8 = Average Aptitude Index on the AQE

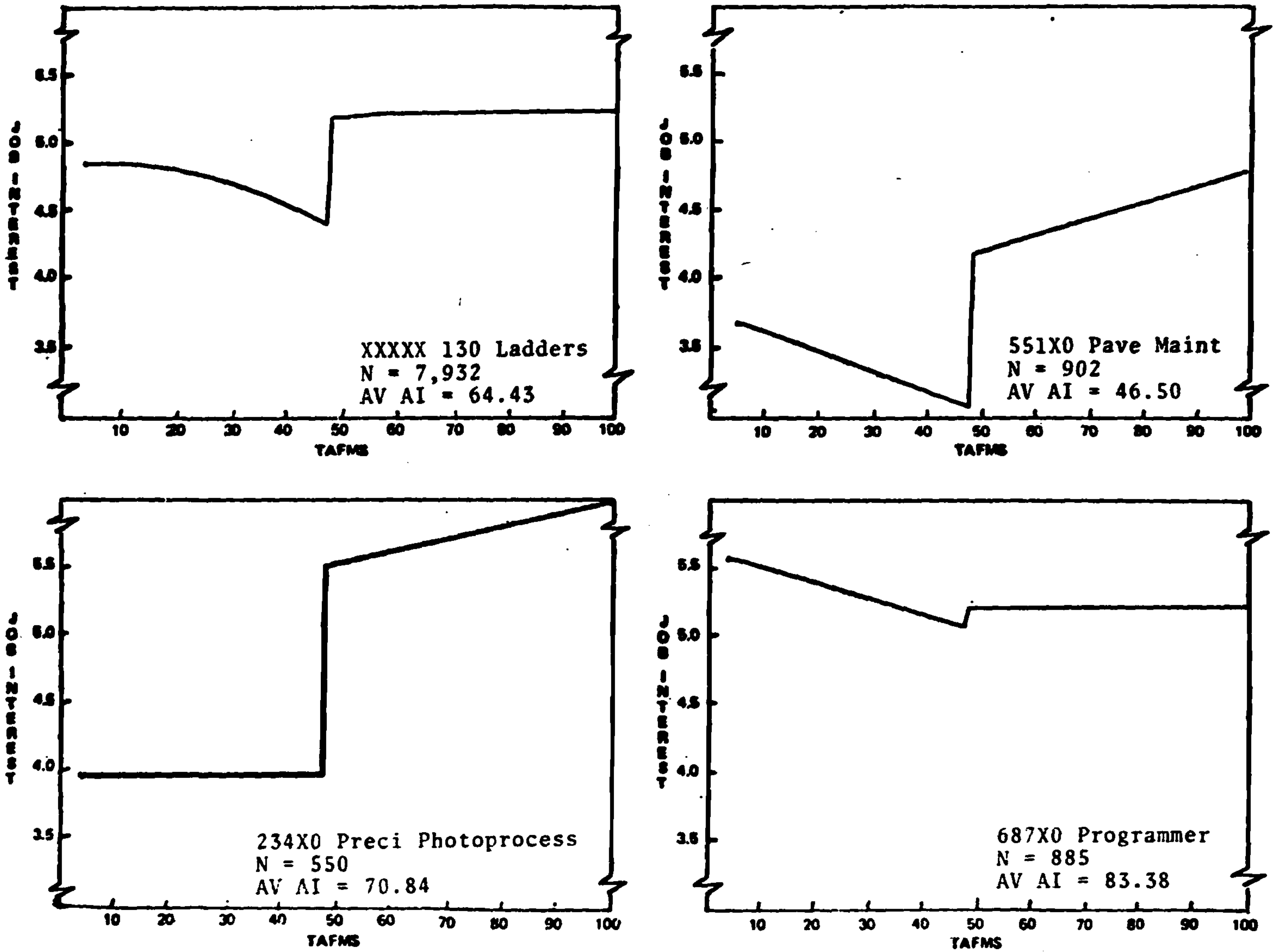

Figure 8. Job Interest *versus* TAFMS (Holding Aptitude Constant) for Career Fields XXXXX, 551X0, 234X0, and 687X0

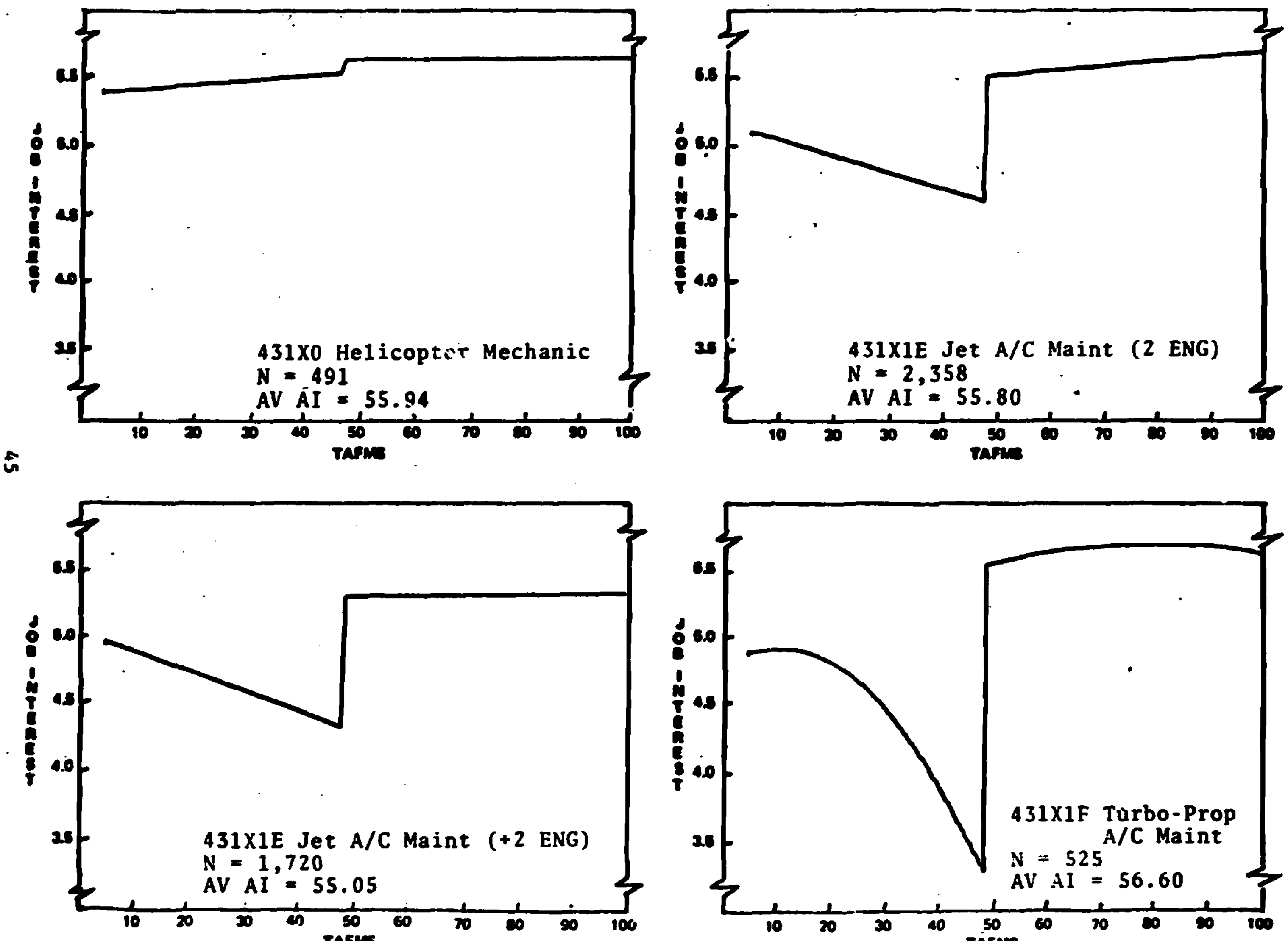

Figure 9. Job Interest *versus* TAFMS (Holding Aptitude Constant) for Career Fields 431X0, 431X1E, 431X1E, and 431X1F

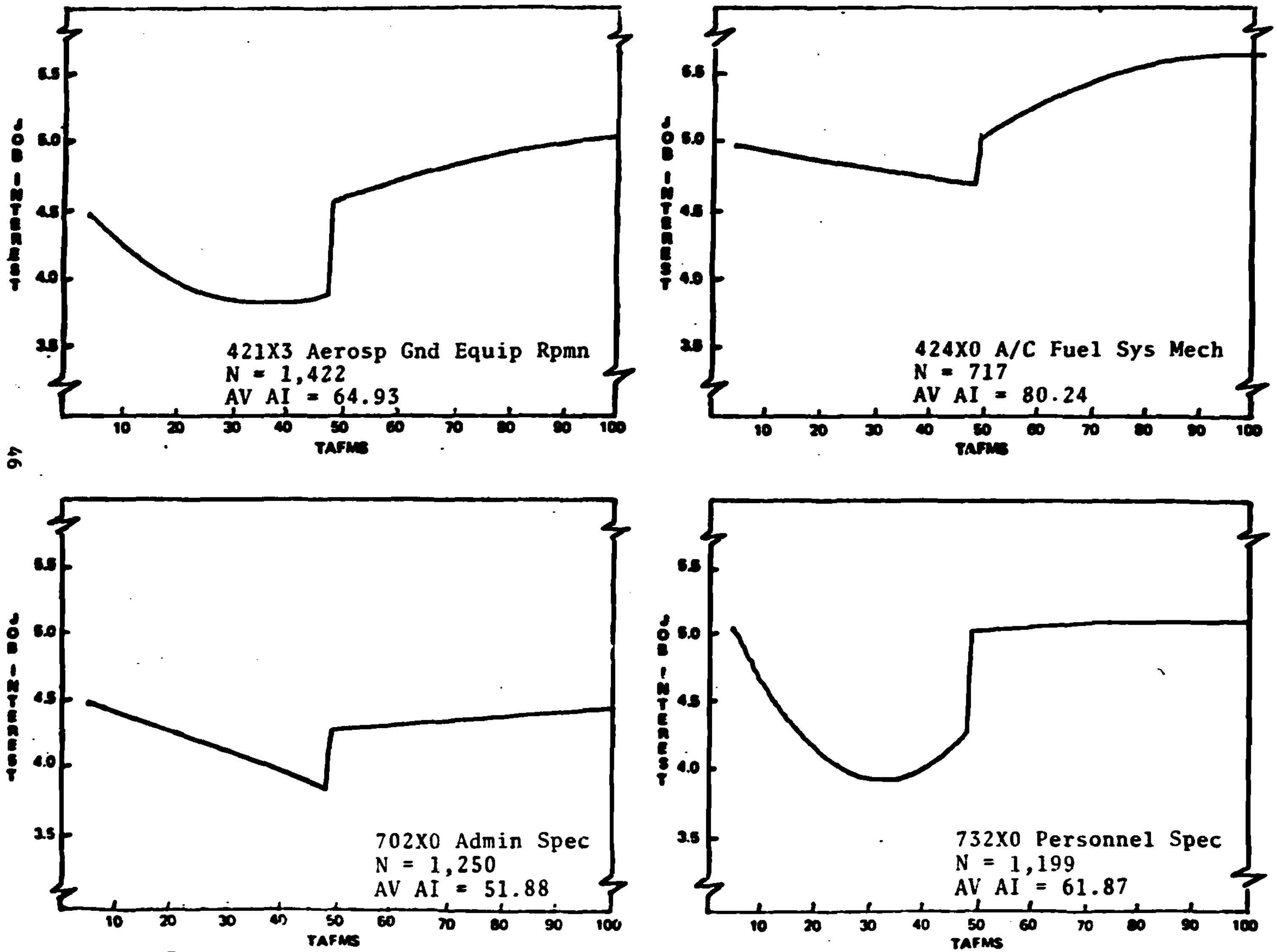

Figure 10. Job Interest <u>versus</u> TAFMS (Holding Aptitude Constant) for Career Fields 421X3, 424X0, 702X0, and 732X0

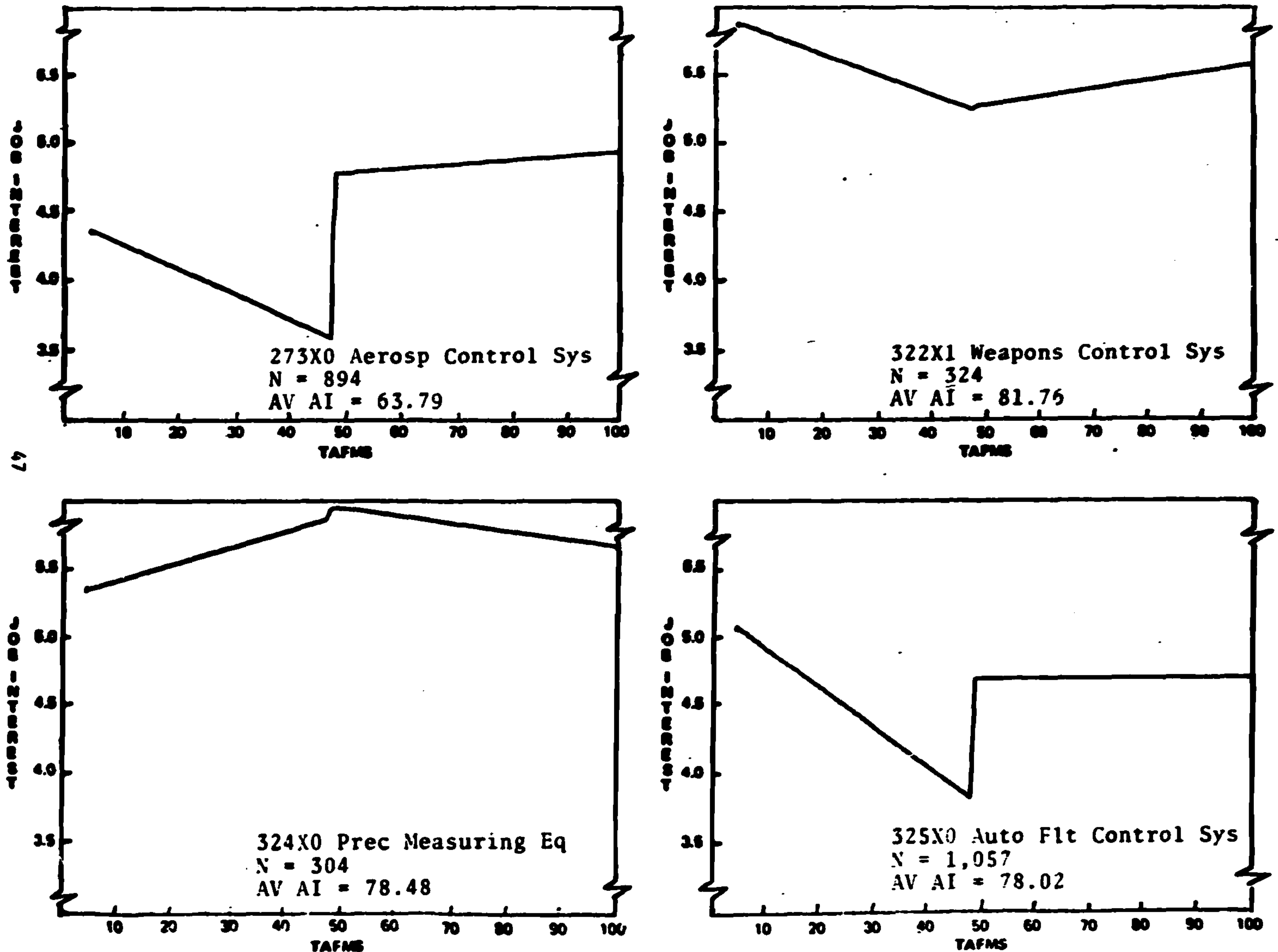

Figure 11. Job Interest *versus* TAFMS (Holding Aptitude Constant) for Career Fields 273X0, 322X1, 324X0, and 325X0

Note that the regression weights associated X_2, X_4, and X_5 will have an impact only with respect to individuals in their first enlistment. The weights associated with X_3, X_6 and X_7 will impact only upon individuals who have elected to reenlist in the Air Force, and who are now beyond the 48th month of service.

The upper left curve in Figure 8 presents a regression curve for a subsample of nearly 8,000 cases drawn at random from 130 Air Force career ladders. Interpreting this curve in a longitudinal manner, it appears that Air Force personnel have a slight decline in job interest during their first enlistment. The jump in the curve between the 48th and 49th month of service is hypothesized to be a function of residualization. That is, those who found their jobs dull tended to get out in greater numbers than those who found their jobs interesting. One might assume that the jump in the curve simply reflects a change in attitude by individuals after they decided to reenlist; but this assumption is weakened by the observation that little or no jump occurs in the regression curves for many ladders. Regression curves for other ladders are shown in Figures 9, 10, and 11. Where little difference is found between the level of the regression curve at the 48th and 49th month, it is assumed that efforts to make jobs more interesting may have very little impact on retention. Such is the case for the 687X0, Programmer, where individuals who left the service evidently were finding their jobs as interesting as those who reenlisted. Perhaps some other factor, such as "pay in service compared with expected pay in comparable civilian jobs" would demonstrate a larger "impact gap." If so, the service might better improve retention by special pay benefits, or by educating workers concerning the reality of pay differentials.

Hopefully, we will eventually come up with more direct measures of the impact of job attitudes on retention. In the meantime, regression analyses, such as those described above, will provide clues as to what factors may influence career decisions in each ladder.

The third phase of the job satisfaction program, which is the most exciting, will be an attempt to find out what changes in jobs and job conditions will produce positive changes in those attitudes which influence reenlistment decisions. Here the military services are in an ideal position to provide answers. Since jobs and job conditions are frequently changing, we can conduct Time 1 - Time 2 studies in which we simply relate changes in jobs and job conditions to changes in expressed attitudes.

Of course we recognize that changing jobs and job conditions is not the only approach to enhancing job satisfaction. For example, all would agree that its better to marry a mate who is compatable than to marry one who is not, and try to change him or her. In a like manner, proper selection and classification actions can contribute toward future job satisfaction. This is not a neglected area of research, but I simply don't have time to discuss it here today. Nor do I have time to discuss the various theories of job satisfaction and relate them to our research. An excellent paper on the implications of theories for Air Force job satisfaction research is currently in press (Tuttle & Hazel, 1973).

As I mentioned earlier, factors related to job content, assignment preference, and worker-supervisor interactions are among those frequently cited by personnel for their decisions to leave the Air Force. We are currently conducting an extensive study of the preferences of individuals for assignment locations. I can report that most individuals express very strong positive and negative valences for particular assignment locations. If the services cannot assign individuals to their most preferred location, perhaps they can at least avoid assigning them to locations for which they have a strong negative valence.

The matter of supervisor-worker relationships is multi-faceted, and we will study each facet separately. One matter which should be of concern to all services is that of supervisory incompetency. We have evidence that occupational structures and personnel assignment practices can create situations where first-line supervisors have had no direct experience on critical tasks being performed by their subordinates. There is a particular danger of this occurring in complex career ladders involving numerous job types or having varied equipments to maintain.

V. SUMMARY AND CLOSING REMARKS

I have described the occupational survey techniques developed by the Air Force's Occupational Research Division. These techniques make extensive use of job inventories to collect information directly from workers in the field. I have described the CODAP analysis system, and given a few examples of how it can be applied to job survey data. I have presented a few examples of how job survey data can be combined with task and job difficulty information to obtain answers to questions posed by managers of the personnel system.

I wish I had time to describe other research areas being pursued by the Occupational Research Division -- including performance evaluation at the task level, definition of career progression routes; advanced assignment systems; job engineering; and so on. But I guess I must come to a close.

My understanding is that you asked me to come to this symposium to share our experiences with you. I would like to close by repeating a set of recommendations, based upon experience, which I would make to any organization planning a large-scale job analysis system based on administration of task-level job inventories:

1. Use full-time inventory writers to develop task lists and background questions.

2. Write specific task statements, rather than broad task statements.

3. Include any background items which might answer questions asked by managers of the personnel system.

4. Collect worker name and identification information.

5. Administer inventories to large samples.

6. Collect data on optical scanning sheets.

7. Use a "relative time spent" scale as the primary rating factor, and convert ratings into percent time estimates.

8. By all means, obtain and use the CODAP system if at all possible. You can modify it to your needs, but it will be expensive and time consuming to build your own analysis system.

9. Establish an occupational research group to develop applications of occupational data in your military service or organization.

Thank you for the opportunity to participate in this symposium.

REFERENCES

Bottenberg, R. A. & Christal, R. E. An iterative technique for clustering criteria which retains optimum predictive efficiency. *The Journal of Experimental Education, 36, (4), Summer 1968. 28-34.

Carpenter, J. B. & Christal, R. E. Predicting civilian position grades from occupational and background data. AFHRL-TR-72-24. AD-754 966. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), March 1972.

Christal, R. E. JAN: A technique for analyzing group judgment. *The Journal of Experimental Education, 36, (4), Summer 1968, 24-27.(a)

Christal, R. E. Selecting a harem - and other applications of the policy-capturing model. *The Journal of Experimental Education, 36, (4), Summer 1968, 35-41.(b)

Christal, R. E. Implications of Air Force occupational research for curriculum design. Report of a Seminar: Process and Techniques of Vocational Curriculum Development. Edited by Brandon B. Smith and Jerome Moss, Jr. Minnesota Research Coordinating Unit for Vocational Education, University of Minnesota, Minneapolis, Minnesota, April 1970. 27-61.

Christal, R. E. Analysis of racial differences in terms of work assignments, job interest, and felt utilization of talents and training. AFHRL-TR-72-1. AD-741 758. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), January 1972.

Dunham, A. D. Estimated cost of on-the-job training to the 3-skill level in the communications center operations specialty. AFHRL-TR-72-56. AD-753 093. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), June 1972.

Fugill, J. W. K., Sqdn Ldr, USAF(RAAF) Task difficulty and task aptitude benchmark scales I. Mechanical and electronic career fields. AFHRL-TR-72-40. AD-754 848. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), April 1972.

*This journal solicited and received permission to republish these related papers in a single issue. The papers are essentially identical to the PRL Technical Documentary Reports having the same titles.

Fugill, J. W. K., Sqdn Ldr, USAF(RAAF) Task difficulty and task aptitude benchmark scales for the Administrative and General career fields. AFHRL-TR-73-13. (In Press) Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), 1973.

Garza, A. T. Occupational survey of seven Accounting and Finance civil service series. AFHRL-TR-72-67. AD-754 967. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), July 1972.

Gould, R. B. Reported job interest and perceived utilization of talents and training by airmen in 97 career ladders. AFHRL-TR-72-7. AD-745 099. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), January 1972.

Lecznar, W. B. The road to work: technical school training or directed duty assignment? AFHRL-TR-72-40. AD-754 845. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), April 1972.

Mead, D. F. Continuation study on development of a method for evaluating job difficulty. AFHRL-TR-70-43. AD-720 254. Lackland AFB, Tex.: Personnel Division, Air Force Human Resources Laboratory (AFSC), November 1970.(a)

Mead, D. F. Development of an equation for evaluating job difficulty. AFHRL-TR-70-42. AD-720 253. Lackland AFB, Tex.: Personnel Division, Air Force Human Resources Laboratory (AFSC), November 1970.(b)

Mead, D. F. & Christal, R. E. Development of a constant standard weight equation for evaluating job difficulty. AFHRL-TR-70-44. AD-720 255. Lackland AFB, Tex.: Personnel Division, Air Force Human Resources Laboratory (AFSC), November 1970.

Stacy, W. J. Felt utilization of talent and training in two civil engineering career ladders. AFHRL-TR-73-32. (In Press) Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), November 1973.

Tuttle, T. C. & Hazel, J. T. Implications of job satisfaction and work motivation theories for Air Force research. AFHRL-TR-73-56. (In Press) Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), 1973.

Wiley, L. N. Analysis of the difficulty of jobs performed by first-term airmen in 11 ladders. AFHRL-TR-72-60. (In Press) Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory (AFSC), July 1972.

CREDITS

There was simply no easy way to follow normal citation procedures in this paper. Readers who are interested can obtain a copy of a listing of over 200 papers, technical reports, and journal articles published by the Air Force Human Resources Laboratory's Occupational Research Division by writing to the author. In preparing this paper, I have taken the liberty of freely extracting information from the following papers.

Christal, R. E. Determination of Relative Aptitude Requirements Using a Benchmark Scale. Briefing presented to OSD (M&RA), Washington DC, 13 April 1973.

Christal, R. E. Experiences in the collection, analysis, and reporting of occupational data in the USAF. Paper presented in Symposium, WEMA, contractor for Federal Republic of Germany, Koln, Germany, 24-25 May 1973.

Christal, R. E. New directions in the Air Force occupational research program. Symposium presented at the meeting of the 80th Annual Convention of the American Psychological Association, Honolulu, Hawaii, 31 August - 8 September 1972.

Christal, R. E. Combining occupational information with personnel data to resolve manpower management problems. Paper presented at meeting of the NATO Conference on Manpower Planning Models, Cambridge, England, 6-10 September 1971.

Christal, R. E. Implications of Air Force occupational research for curriculum design. Report of a Seminar: Process and Techniques of Vocational Curriculum Development. Edited by Brandon B. Smith and Jerome Moss, Jr. Minnesota Research Coordinating Unit for Vocational Education, University of Minnesota, Minneapolis, Minnesota, April 1970. 27-61.

APPENDIX

The following pages present a brief description of selected CODAP programs, along with example printouts produced by the CODAP system, as follows:

1. The first four pages of a seven-page Consolidated Job Description.

2. An Abbreviated Job Difference Description.

3. A sample Individual Job Description.

Appendix

DESCRIPTION OF SELECTED CODAP PROGRAMS

CODAP: COMPREHENSIVE OCCUPATIONAL DATA ANALYSIS PROGRAMS

CODAP is a computerized occupational data analysis system which inputs and performs calculations upon raw data from job inventories. It is designed to furnish users with a wide variety of reports that facilitate the identification of individual and group job characteristics and the detection of between-job similarities and differences.

INPSTD: RAW DATA EDITING AND INPUT

This program reads task titles, task responses, and background data from tape or card input. It edits the data, converts the raw task responses to percentages, constructs data vectors for each case, reorganizes the data to a standard history data format, and writes the formatted data on the output tape for use in subsequent programs. INPSTD will accept a maximum of: 928 background and/or computed variables, 1000 task variables, 26 duty variables, 20,000 cases, and 927 non-zero task responses per case.

JOBDEC: CALCULATING COMPOSITE JOB DESCRIPTIONS

This program calculates and prints composite job descriptions for groups formed during the hierarchical grouping process (JOBGRP) or for special groups whose membership is defined in terms of some combination of background or computed variables (JOBSPC). Both duty and task job descriptions may be reported in high to low sequence of either "average percent time spent by all members" or "percent of members performing." (A duty is a functional area comprising a number of tasks and, hence, is a summary report).

A job description produced through JOBDEC provides the following information: duty/task number, duty/task title, percent of members performing each duty/task, average percent time spent by members performing, average percent time spent by all members, and cumulative average percent time spent by all members.

GRPSUM: SUMMARIZING JOB DESCRIPTIONS

This program calculates and prints a report of either the percent of members performing each task in the job inventory or the average percent time spent on each task by all members for any number of groups whose composite job descriptions were computed by JOBDEC or JOBSPC. The summarized data is printed in task number order and the group descriptions are ordered according to the sequence of the input request cards. GRPSUM does not print task titles, as does PRIJOB, nor does it have PRIJOB's facility to specify criteria for excluding tasks from the summary report.

GPSUM: SUMMARIZING JOB DESCRIPTIONS (FORMAT 2)

This program is a version of GRPSUM containing certain desirable features adapted from PRIJOB. Like GRPSUM, GPSUM2 calculates and prints a report in duty/task order of either the percent of members performing each task in the job inventory or the average percent of time spent on each task by all members of groups whose composite job descriptions were computed by JOBDEC or JOBSPC. Whereas, GRPSUM prints no task statements and carries all percentages to three decimal places, GPSUM2 does print task statements and rounds off all percentages to whole numbers.

PRIJOB: CALCULATING PRIMARY JOB IDENTIFIERS

This program calculates and prints a report of those tasks which are determined to be "primary identifiers" of job types. Primary identifiers may be defined as the top x-number of tasks in a group job description in terms of percent of members performing or average percent time spent by all members. Primary identifiers may also be defined as those tasks performed by a specified minimum percentage of the group members or which exceed a specified average percent time spent value. This program allows a number of groups to be aligned in a single report for comparative purposes.

JOBIND AND INDJOB: CALCULATING INDIVIDUAL JOB DESCRIPTIONS

The JOBIND program calculates and prints job descriptions for individual cases. Both duty and task descriptions may be reported. Output will be task statements sequenced from high to low percent time spent, together with their percent time spent values and cumulative percentages. Selected background information may also be printed at the top of each description. JOBIND has six options for selecting cases: (1) by last two digits of service number; (2) by every Nth case beginning with a specified KPATH sequence number; (3) by meeting specified requirements on one to nine background variables; (4) by membership in a specified job type group; (5) by case control number; (6) randomly, using a random number generator. The selected descriptions may be sorted in KPATH order, in random order, by background variable, or in case control number order. The six options for selecting cases may also be used to create new categorical membership variables which are inserted in the variable dictionary as computed variables.

The INDJOB program also calculates and prints individual job descriptions, but prints only task identification numbers and percent time spent values for duties or tasks in duty/task sequence. A single report prints information for all cases in a columnar format. There are only three options for selecting cases: (1) by case control number; (2) by meeting specified requirements on one to nine background variables; (3) by membership in a specified job type group. INDJOB has no sort options.

GRPDIF: DIFFERENCE COMPARISON BETWEEN JOB DESCRIPTIONS

This program calculates and reports the difference between two job descriptions in terms of percentage of members performing each task and/or average percent time spent. Difference values are presented in ascending or descending order on either value (from largest negative to largest positive difference or vice versa) or in task number order.

AUTOJT: AUTOMATED JOB TYPE SELECTION PROGRAM

This program calculates, evaluates, and reports between-group differences for specified pairs of groups whose job descriptions were computed by JOBDEC or JOBSPC. Six comparison options are used: (1) differences in average percent time spent on each task; (2) differences in average percent time spent on each duty; (3) differences in percentage of members performing each task; (4) differences in number of tasks accounting for a major portion of average percent time spent; (5) differences in number of duties accounting for a major portion of average percent time spent; (6) differences in average number of tasks performed. As many as 850 pairs of groups can be compared in one run of AUTOJT.

VARSUM: SUMMARIZING BACKGROUND AND COMPUTED VARIABLES

This program computes and reports frequency distributions within specified intervals, makes total frequency counts, and calculates means and standard deviations on selected background and computed variables for any group of individuals whose job description has been generated by JOBDEC or JOBSPC. VARSUM can process data on as many as 20,000 cases.

DIST2X: COMPUTING A TWO-WAY DISTRIBUTION

This program distributes a group of individuals on two variables (a row variable and a column variable). The group distributed may be the total sample or the cases coded "1" or "0" on a categorical membership variable. The row and column variables may be alpha or numeric, and intervals of unequal width may be defined for any variable. The data presented may be frequencies within cells or frequencies *and* percentages within cells. The percentages are computed based on individual row frequency totals, or on individual column frequency totals, or on the total N for all rows and columns. Any or all three sets of percentages may be displayed in the two-way table. A "total" category for rows and a "total" category for columns is automatically included for percentages and/or frequencies. The total number of cases counted and the total number of valid cases are given for each row and column and for total rows and total columns. Valid cases include all *distributed numeric* data. Only valid cases are used in the computation of means and standard deviations. Optionally, an "other" category may be included for rows and columns. Inclusion of the "other" category causes *all numeric* data to be counted as valid. Another option provides for the computation of means and standard deviations for individual rows and total rows and/or individual columns and total columns. Only cases defined as valid are used in computing means and standard deviations. A summary of selected information appears at the end of the report. Any number of reports may be generated in one program execution.

AVALUE: CALCULATING AVERAGE VALUE

For each task in a job inventory, this program calculates and prints the mean and standard deviation of a selected background or computed variable, using all valid responses of individuals in a specified group who perform the task. Task titles and the number of valid respondents on each task are also reported. Average values are optionally sequenced from low-to-high average value, high-to-low average value, or in task number order. Tasks with fewer than x-number of valid respondents may be removed from the main report to a supplementary report. AVALUE can be calculated for any group of individuals who can be identified on some range of a background or computed variable or by the intersection of up to nine variables.

TSKNDX: CALCULATING AVERAGE TASK RATINGS

This program has the same options as AVALUE, except that it is used with task ratings rather than with background or computed variables. TSKNDX can also provide the following additional task information not available in AVALUE: (1) percent of members performing; (2) average percent time spent by members performing; (3) average percent time spent by all group members; (4) cumulative sum of average percent time spent by all group members. TSKNDX is primarily used to compute average task difficulty ratings.

RXXNDX: COMPUTING INTERRATER RELIABILITY

This program computes and reports for a group of raters the average interrater reliability coefficient of a single rater and the stepped up reliability coefficient for the total group of raters. The program is most often used in conjunction with sets of task difficulty ratings made by a large number of supervisory personnel.

TSKDST: DISTRIBUTING MEANS AND STANDARD DEVIATIONS OF TASK RATINGS

This program computes and reports the distribution, mean, and standard deviation of the mean task ratings and the standard deviations of the ratings for each task. The input to TSKDST is the punched output furnished by TSKNDX.

ASFACT: REPORTING SECONDARY FACTOR DATA

If the tasks in a job inventory are rated on a second scale such as "amount of training required," the data is handled through the ASFACT program. The ASFACT program reports the following information on each task for any group of individuals whose job description has been computed by JOBDEC or JOBSPC: (1) frequency distribution of members responding on the secondary factor (0 to 9 scale); (2) total number of respondents; (3) number of respondents with values outside the specified range; (4) arithmetic mean and standard deviation of acceptable responses.

VARGEN: COMPUTING NEW VARIABLES

This program calculates new computed variables by applying input data to the task values of each case. The task values may be time spent percentages or "do – don't do" values (1,0). The input data consists of a vector of weights, a scaling (standardizing) factor and a specified calculation formula (five options). A newly created variable is given a variable identification number and is added into the computed variable portion of the case data records on the history data tape.

PREGEN: GENERATING NEW PREDICTORS

This program creates new computed or background variables for input to other CODAP programs, principally the correlation and regression program (CORREG) according to certain standardized options, as follows: the new variable can be the sum of two variables, the difference between two variables, the product of two variables, or the ratio of two variables. Each option allows for adding a constant if so desired. Variables may also be created by setting certain values of a variable out of range and then, either leaving these values unchanged during the generation of the new variable, or setting them equal to zero or to some constant. This option is most frequently used to enable the selection of a specific subsample of cases by creating a categorically coded membership variable representing in-range and out-of-range cases ("1" or "0," respectively). Variables created at an early point in the program run may be used to create additional variables at some later point. Up to 500 variables can be created in a single PREGEN run.

CORREG: CORRELATION AND REGRESSION PROGRAM

This program package extracts up to 100 computed and background variables from a CODAP KPATH or history data tape and computes correlation matrices and regression problems.

The correlation program computes and prints the correlation matrix, number of valid and invalid cases in the sample, and means and standard deviations of variables. These same computations are also put on tape for future reference, and they also remain in core if they are to be fed into the regression program immediately.

The regression program has two options. One option computes regression equations for various combinations of full and restricted models and evaluates the difference between full and restricted models with an F-test. The value and the probability of the computed F-ratio are reported.

The second option is designed as an aid to building an appropriate regression model. In this option, a series of regression problems is computed iteratively. Beginning with the best combination of three predictors at iteration 1, the best remaining combination of three predictors is added to the model at each subsequent iteration. The "best remaining combination" is that which adds the most to the value of R^2 when used in conjunction with all combinations of predictors selected at previous iterations. Predictors may be used more than once during the iterative process. Iterations are continued until the increase in the value of R^2 over the previous iteration is less than some amount specified by the requester. Variable ID's, R^2 values, and the error sum of squares are reported for each iteration. The standard and raw score weights for each variable as they exist upon completion of the final iteration are reported, as well as the regression constant.

Either one or both regression options may be requested at the same time.

OVRLAP: RELATING RESPONSES TO EACH OTHER

This program generates an overlap or similarity matrix of all possible paired comparisons between individual cases. Similarity is expressed as a percentage of common tasks performed (TSKOVL) or as the total overlapping percentage of time spent on tasks (TIMOVL). Overlap in terms of percent time spent is the preferred option in most studies. OVRLAP can handle up to 2,000 cases and 1,000 tasks.

GROUP: CLUSTERING INDIVIDUALS AND GROUPS OF INDIVIDUALS

This program uses the similarity matrix computed in the overlap (OVRLAP) program to form clusters of cases. The grouping technique, called "collapsing the matrix" or "hierarchical grouping," involves repeated searching for those individuals or partially formed clusters which have the highest (or lowest) remaining similarity, depending on whether a "maximizing" or "minimizing" process was requested. The "maximizing" option is always used for job survey data.

Each new clustering or "collapse" is called a "stage" and the vectors of similarity values for the clusters being merged are combined according to a specified mathematical algorithm to form an integrated cluster. Several formulas for combining groups are available. The collapsing process continues until a single group has formed which contains all cases in a study.

KPATH AND PRKPTH: ORDERING A HISTORY DATA TAPE AND PRINTING A HISTORY DATA REPORT

After OVRLAP and GROUP have been completed, the KPATH program assigns sequence numbers to individual cases in such a way that each pair of individuals or groups which are merged during the gro ing process will have a contiguous block of KPATH sequence numbers.

PRKPTH enables the user to select variables and printout formats to produce a report of the case data values for the selected background and computed variables. The data to be printed is obtained from a history data tape which may be in case ID or KPATH order. The data is not sorted and therefore the output will be in case ID or KPATH order.

DUVARS: COMPUTING A DUTY VARIABLE FOR EACH CASE

This program uses task data to compute duty values for each case and displays the duty values in the form of a PRKPTH. Three duty variable options are available: (1) percent time spent in each duty by each case; (2) number of tasks performed in each duty by each case; (3) percent of tasks performed within each duty by each case as a function of his total number of tasks performed. This program is used principally as an aid in selecting meaningfully different job-type groups.

GRMBRS: REPORTING GROUP MEMBERSHIP

This program produces an information report that identifies the two groups combining at each stage of the hierarchical grouping process. The information includes the stage number, the number of members in the combined group, the number of members in each of the combining groups, range of KPATH sequence numbers for the combining groups, the average percentage of overlap between the members of the combining groups, and the average percentage of overlap within the combined group.

DIAGRM: GRAPHICAL PRESENTATION OF HIERARCHICAL GROUPING ACTIONS

This program uses data from the GRMBRS program to generate a treelike diagram that visually displays the order in which groups merged during the hierarchical grouping process. Each group is represented by a rectangular block of data containing the same information found in GRMBRS. Rows and columns of asterisks show the branches leading from a group to its subgroups. Control cards can be used to limit the number and type of groups displayed by DIAGRM.

MBROVL: OVERLAPPING INDIVIDUAL JOB DESCRIPTIONS WITH A COMPOSITE JOB DESCRIPTION

This program computes the overlap of individual job descriptions with the composite job description for the group and reports the individual overlap values, their mean and standard deviation, and an array of selected background data for each case. The format of the report is similar to PRKPTH, except that the cases are sequenced from highest to lowest overlap with the composite job description and only cases that are members of the selected group are included. Reports on a number of groups can be handled in one program execution. This program is useful in studying the homogeneity of membership in a group whose composite job description was computed by JOBDEC or JOBSPC.

MTXPR1: PRINTING AN OVERLAPPED MATRIX

This program calls for the subroutine OVRLAP to overlap all possible pairings of a set of composite (group) job descriptions and then uses the program MTXPRT to print the between-group overlap values in matrix form. Overlap may be computed in terms of average percent time spent on tasks or in terms of number of tasks performed in common. The maximum number of groups that can be input to MTXPR1 is 100.

JD2HDT: ADDING JOB DESCRIPTIONS TO HISTORY DATA TAPE

This program adds average job descriptions for groups to a history data tape as additional cases. Each of the new composite cases is given the next sequential case control number.

PRDICT: PRINTING DICTIONARY OF VARIABLE TITLES

This program prints a report containing the identification codes and descriptive titles of all background and computed variables peculiar to a particular study. The identification codes are used in calling for data to be reported by the PRKPTH and VARSUM programs, or to be acted upon by the VARGEN, PREGEN, PROGEN, JOBIND, AVALUE, or TSKNDX programs.

JOBINV: PRINTING OF DUTY AND TASK TITLES

This program prints a listing of the duty and task titles included in a job inventory. The titles are listed in task number sequence within each duty, and the format calls for two columns per page.

BCDEXT: REORDERING AND EXTRACTING REPORTS FROM THE BCD REPORT TAPE

All reports generated by CODAP can optionally be placed on a BCD output tape for future recall. The BCDEXT program extracts reports selected by control cards from the BCD file, prints them out in the same order as the input requests with continuous page numbering, and furnishes a table of contents with page number references.

PROGEN: PROGRAM GENERATION PROGRAM

This program permits the CODAP expert to add, extract, and manipulate data in the CODAP system in ways not encompassed by the standard CODAP programs and do so with a minimum amount of additional programming and without requiring thorough indoctrination in the CODAP system. PROGEN uses a combination of FORTRAN statements and shorthand operation codes to generate a special purpose program to read the KPATH or history data tape, either of which contains the entire data file for each case, and perform operations upon it. New variables can thereby be created and added to the CODAP variable dictionary. This program also has the facility to reconvert percent time task values for each case to the original raw response form, perform operations on the raw responses, and convert them back to percentages.

Appendix (Continued)

TASK JOB DESCRIPTION FOR JOURNEYMEN MEDICAL LABORATORY SPECIALISTS (N=394)

D	TSK	TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
F	18	Collect Blood Specimens Directly from Patients	93.40	1.70	1.58	1.58
J	3	Perform Blood Count	89.09	1.56	1.39	2.98
J	17	Perform Hematology Procedures for Differential Cell Counts	88.83	1.49	1.33	4.30
J	24	Perform Hematology Procedures for Hematocrit Tests	89.09	1.45	1.30	5.60
N	2	Examine Urine Specimens Microscopically	88.07	1.43	1.26	6.85
J	5	Prepare Blood Smears	89.85	1.39	1.25	8.10
F	10	Prepare and Process Specimens	87.56	1.39	1.22	9.32
N	9	Perform Urinalyses for Glucose Tests	87.82	1.38	1.21	10.53
N	15	Perform Urinalyses for Specific Gravity Tests	87.06	1.38	1.20	11.73
N	6	Perform Urinalyses for Albumin Tests	87.06	1.36	1.19	12.92
F	3	Clean Area and Equipment Aseptically	80.96	1.46	1.18	14.10
N	1	Examine Urine Specimens Macroscopically	87.82	1.32	1.16	15.26
J	6	Separate Serum from Blood	87.31	1.30	1.14	16.40
F	11	Prepare Reagents	93.40	1.19	1.11	17.51
J	2	Identify Morphological Variations of Blood Cells	88.07	1.21	1.06	18.57
M	4	Operate Spectro-Photometer	77.66	1.34	1.04	19.62
J	21	Perform Hematology Procedures for Erythrocyte Sedimentation Rate	87.56	1.19	1.04	20.65
K	7	Perform Serological Procedures for Cardiolipin Microflocculation	78.93	1.30	1.03	21.68
G	1	Examine Specimens Microscopically	86.04	1.18	1.01	22.69
G	2	Identify and Classify Pathogenic Bacteria	78.68	1.27	1.00	23.69
G	10	Prepare Culture Media	78.68	1.26	0.99	24.68
F	12	Prepare Solutions and Standards	86.55	1.09	0.94	25.62
M	25	Perform Biochemical Procedures for Liver Function Tests	78.93	1.18	0.93	26.55
M	27	Perform Biochemical Procedures for NPN and BUN Tests	79.95	1.16	0.93	27.48
G	11	Stain Bacteriological Smears	85.28	1.08	0.92	28.41
L	3	Crossmatch Blood	72.59	1.24	0.90	29.30
L	16	Test Blood for ABO Grouping and ABO Subgrouping	80.20	1.12	0.90	30.20
J	1	Identify Immature Blood Cells	86.29	1.04	0.89	31.09
I	2	Examine Specimens Microscopically	81.47	1.08	0.88	31.97
G	6	Perform Antibiotic Sensitivity Test	75.38	1.17	0.88	32.85
F	14	Prepare Specimens for Shipment	84.26	1.03	0.87	33.72
E	3	Log Incoming or Outgoing Specimens	71.83	1.16	0.83	34.55
L	18	Type Blood of Donors and Recipients	74.87	1.10	0.83	35.38
L	2	Centrifuge and Separate Serum from Clot	73.10	1.11	0.81	36.19
M	33	Perform Biochemical Procedures for Total Protein and A/G Ratio	75.13	1.06	0.79	36.99
L	7	Test Blood for RHO or DU Factors	76.14	1.04	0.79	37.78
L	8	Perform Direct and Indirect Coombs Tests	75.38	1.04	0.78	38.56

Appendix (Continued)

D-TSK		TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
M	5	Prepare Reagents and Standards	75.38	1.01	0.76	39.32
J	27	Perform Hematology Procedures for Prothrombin Time	77.19	0.95	0.76	40.08
J	4	Perform Spinal Fluid Cell Counts	84.52	0.88	0.74	40.82
I	1	Examine Specimens Macroscopically	79.95	0.92	0.73	41.55
I	6	Identify Protozoans, Cestodes, Nematodes, or Trematodes	74.62	0.95	0.71	42.26
F	19	Collect Fecal or Urine Specimens Directly from Patients	52.79	1.33	0.70	42.96
J	28	Perform Hematology Procedures for Reticulocyte Count	84.26	0.82	0.69	43.65
N	8	Perform Urinalyses for Bile Tests	85.28	0.80	0.68	44.34
I	3	Perform Concentration and Flotation Techniques	72.84	0.93	0.68	45.02
J	13	Perform Hematology Procedures for Coagulation Times by Capillary Method	79.70	0.85	0.68	45.70
M	34	Perform Biochemical Procedures for Uric Acid Tests	70.81	0.96	0.68	46.37
N	3	Perform Kidney Function Tests	76.14	0.89	0.68	47.05
J	30	Perform Hematology Procedures for Thrombocyte Count	80.46	0.83	0.67	47.72
J	14	Perform Hematology Procedures for Coagulation Times by Lee-White Method	82.23	0.81	0.66	48.38
M	37	Utilize Methods for Colormetric Procedure	52.03	1.25	0.65	49.03
J	11	Perform Hematology Procedures for Cerebrospinal Fluid Count	80.96	0.80	0.65	49.68
M	32	Perform Biochemical Procedures for Total Cholesterol and Esters Tests	68.27	0.93	0.63	50.32
M	17	Perform Biochemical Procedures for Chlorides Tests	71.07	0.89	0.63	50.95
N	12	Perform Urinalyses for Occult Blood Tests	82.49	0.76	0.63	51.58
E	5	Maintain Files of Clinical Laboratory Requests	54.82	1.14	0.63	52.20
J	8	Perform Hematology Procedures for Bleeding Time, Duke Method	71.83	0.86	0.62	52.82
M	38	Utilize Methods for Electrolyte Determinations	61.68	1.00	0.61	53.43
J	20	Perform Hematology Procedures for Erythrocyte Indices	79.44	0.75	0.59	54.03
M	11	Perform Biochemical Procedures for Calcium and Phosphorus Tests	64.72	0.92	0.59	54.62
E	7	Maintain Files of Laboratory Records or Reports	51.27	1.14	0.59	55.20
J	25	Perform Hematology Procedures for L. E. Test	75.38	0.77	0.58	55.79
L	5	Draw Blood for Transfusions	64.47	0.90	0.58	56.36
K	13	Perform Serological Procedures for Heterophile Presumptive and Differential Antibody Test	63.45	0.90	0.57	56.94
J	18	Perform Hematology Procedures for Eosinophile Count	80.46	0.71	0.57	57.51
M	2	Operate Flame Photometer	64.97	0.88	0.57	58.08
G	8	Perform Sperm Counts	79.44	0.71	0.57	58.65
J	29	Perform Hematology Procedures for Sickle Cell Preparations	82.74	0.68	0.56	59.21
M	14	Perform Biochemical Procedures for Carbon Dioxide Determinations	67.26	0.83	0.56	59.77
E	11	Receive Incoming Supplies	55.58	0.96	0.53	60.31
L	15	Store Blood According to Grouping and Factor	59.90	0.89	0.53	60.84
F	20	Collect Pus Specimens Directly from Patients	65.99	0.80	0.53	61.37
N	20	Perform Urinalyses for Urobilinogin Tests	75.89	0.65	0.50	61.87
K	14	Perform Serological Procedures for Latex Fixation Test	59.64	0.84	0.50	62.37
K	6	Perform Serological Procedures for "C" Reactive Protein Tests	61.42	0.80	0.49	62.86
H	4	Perform KOH Preparation for Dermatophyte	68.02	0.72	0.49	63.35

Appendix (Continued)

D-TSK		TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
A	10	Develop and Improve Work Methods and Procedures	53.55	0.91	0.49	63.84
L	4	Dispose of Blood After Time Limit	62.18	0.77	0.48	64.32
M	8	Perform Biochemical Procedures for Blood Alcohol Tests	66.75	0.71	0.48	64.79
M	20	Perform Biochemical Procedures for Creatinine Tests	61.42	0.76	0.47	65.26
I	6	Maintain Donor Files	58.63	0.79	0.47	65.73
N	10	Perform Urinalyses for KETONE Studies	55.33	0.84	0.46	66.19
H	2	Examine Specimens Microscopically	60.15	0.77	0.46	66.65
J	12	Perform Hematology Procedures for Clot Retraction Test	73.35	0.63	0.46	67.11
A	5	Assure the Availability of Equipment and Supplies	42.64	1.06	0.45	67.57
A	26	Requisition Supplies and Equipment	44.67	1.01	0.45	68.02
E	12	Requisition Supplies	44.42	1.00	0.45	68.46
N	16	Perform Urinalyses for Total Protein	63.45	0.70	0.44	68.90
M	21	Perform Biochemical Procedures for Enzyme Analyses	46.70	0.95	0.44	69.35
M	42	Utilize Methods for Titrimetric Procedure	55.33	0.80	0.44	69.79
M	13	Perform Biochemical Procedures for Carbohydrates Tolerance Tests	44.67	0.98	0.44	70.23
H	5	Prepare Culture Media	57.87	0.76	0.44	70.67
H	1	Cultivate Mycology Specimens for Primary Isolation	56.09	0.77	0.43	71.10
D	6	Give On-The-Job Instruction in Medical Laboratory Activities	40.10	1.04	0.42	71.51
N	7	Perform Urinalyses for Bence-Jones Protein Tests	68.78	0.60	0.41	71.93
I	5	Stain Parasitological Smears	53.81	0.77	0.41	72.34
F	22	Collect Skin Specimens Directly from Patients	58.12	0.71	0.41	72.75
K	8	Perform Serological Procedures for Cold Agglutinations	57.11	0.72	0.41	73.16
N	4	Perform Pregnancy Tests	48.48	0.84	0.41	73.57
C	6	Evaluate the Accuracy of Routine Reports	39.09	1.04	0.41	73.98
K	5	Perform Serological Procedures for Antistreptolysin "O" Titers	48.48	0.82	0.40	74.37
L	13	Record Information on Blood Record Card	53.05	0.74	0.39	74.77
L	7	Maintain Files of Blood Banking Forms	53.30	0.74	0.39	75.16
F	9	Perform Preventive Maintenance on Laboratory Equipment	47.72	0.82	0.39	75.55
F	24	Collect Sputum Specimens Directly from Patients	52.28	0.72	0.38	75.93
L	1	Attach Serial Numbers to Units	48.22	0.78	0.38	76.30
M	1	Calibrate Instruments	52.03	0.72	0.37	76.68
L	14	Screen and Schedule Donors	50.51	0.72	0.36	77.04
N	5	Perform Urinalyses for Addis Counts	63.96	0.56	0.36	77.40
C	1	Determine Equipment Repairs or Replacements Needed	47.21	0.76	0.36	77.76
O	9	Prepare Specimens for Shipment	39.85	0.89	0.36	78.12
L	11	Prepare Blood for Shipment	46.70	0.72	0.34	78.46
M	40	Utilize Methods for Gasometric Procedure	41.37	0.81	0.34	78.79
K	1	Perform Serological Procedures for Febrile Agglutinations	45.69	0.72	0.33	79.12
A	21	Plan Reports for the Section	32.99	0.99	0.33	79.45
E	4	Maintain and Revise Stock Levels	35.53	0.92	0.33	79.77
A	20	Plan Record Keeping for the Section	30.71	1.06	0.33	80.10

Appendix (Continued)

D-TSK		TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
J	19	Perform Hematology Procedures for Erythrocyte Fragility Tests	59.14	0.55	0.32	80.42
M	30	Perform Biochemical Procedures for Serum Frog Test for Pregnancy	40.61	0.78	0.32	80.74
F	6	Perform Bacteriological or Chemical Examinations of Water	41.37	0.74	0.31	81.05
H	6	Stain Mycology Specimens	48.22	0.62	0.30	81.34
N	17	Perform Urinalyses for Urinary Calcium	54.57	0.54	0.30	81.64
N	14	Perform Urinalyses for Porphyrins Tests	54.57	0.54	0.30	81.94
G	3	Maintain Stock Cultures	35.79	0.82	0.29	82.23
C	7	Evaluate the Adequacy of Routine Reports	29.44	0.98	0.29	82.52
O	15	Submit Tissue Specimens to AFIP or Histopathology Centers	32.99	0.87	0.29	82.81
A	7	Coordinate Work Activities with Other Sections	36.55	0.77	0.28	83.09
A	14	Establish Procedures for Special Tests	36.29	0.74	0.27	83.36
B	2	Direct Subordinates in Maintaining Performance Standards	30.96	0.87	0.27	83.63
E	10	Procure and Store Biological Items	35.53	0.75	0.27	83.89
H	3	Identify and Classify Fungi	36.04	0.73	0.26	84.16
O	2	Assist with Autopsy	39.34	0.66	0.26	84.42
F	4	Perform Bacteriological or Chemical Examinations of Food Products	40.86	0.63	0.26	84.67
L	9	Perform First Aid for Shock	51.02	0.49	0.25	84.92
K	2	Prepare Antigens	32.49	0.77	0.25	85.17
F	15	Prepare Specimens for Training or Reference	36.29	0.67	0.24	85.42
N	13	Perform Urinalyses for Phenylpyruvic Acid Test	46.95	0.52	0.24	85.66
E	1	Supervise the Maintenance of Laboratory Supplies	23.60	1.02	0.24	85.90
B	5	Direct the Maintenance and Utilization of Equipment, Supplies and Work Space	27.92	0.86	0.24	86.14
A	3	Assign Specific Work to Individuals	30.96	0.78	0.24	86.38
C	18	Resolve Technical Problems of Subordinates	28.43	0.83	0.24	86.62
M	19	Perform Biochemical Procedures for Creatinine Clearance Tests	32.23	0.73	0.23	86.85
D	8	Indoctrinate Newly Assigned Personnel	35.28	0.67	0.23	87.09
C	14	Investigate Possible Sources of Staphylococcus Outbreaks	28.43	0.82	0.23	87.32
A	25	Plan Work Flow	25.13	0.92	0.23	87.56
C	9	Evaluate Work Performance of Subordinates	23.35	0.95	0.22	87.78
M	15	Perform Biochemical Procedures for Carbon Monoxide Determinations	39.09	0.57	0.22	88.00
I	8	Prepare Culture Media	29.70	0.73	0.22	88.22
A	11	Develop or Revise the Organization of the Section	26.40	0.81	0.21	88.43
B	4	Direct Subordinates in the Observance of Safety Practices	27.66	0.77	0.21	88.64
J	9	Perform Hematology Procedures for Bleeding Time, Ivy Method	29.44	0.71	0.21	88.85
D	18	Show How to Locate and Interpret Technical Information	25.89	0.78	0.20	89.06
A	18	Plan and Schedule Work Assignments	24.11	0.83	0.20	89.26
M	29	Perform Biochemical Procedures for Salicylate Level	[illegible]2.49	0.61	0.20	89.46
C	16	Recommend Special Corrective Action for Recurring Problems	26.65	0.72	0.19	89.65
C	8	Evaluate the Maintenance and Use of Equipment, Supplies and Work Space	23.86	0.80	0.19	89.84
N	18	Perform Urinalyses for Urinary Chlorides	35.03	0.54	0.19	90.03

Appendix (Continued)

SAMPLE DIFFERENCE DESCRIPTION

GROUP 1 = APPRENTICE DENTAL LABORATORY TECHNICIANS (N=30)
GROUP 2 = JOURNEYMAN DENTAL LABORATORY TECHNICIANS (N=272)

D	TSK	TASK TITLE	PERCENT PERFORMING, GROUP 2	PERCENT PERFORMING, GROUP 1	DIFFERENCE IN PERCENT PERFORMING GROUP 1 MINUS GROUP 2
K	14	Perform Dental Assistant Functions	12.87	33.33	20.47
G	3	Mix and Prepare Slurry Water	51.10	70.00	18.90
H	14	Flask Complete Dentures	54.78	73.33	18.55
M	6	Maintain Boilout Tanks	52.57	70.00	17.43
G	10	Mix or Prepare Duplicating Materials	20.96	36.67	15.71
I	3	Prepare Matrix for Denture Repair	54.41	70.00	15.59
M	7	Maintain Dehydrating Equipment Ovens	11.40	26.67	15.27
H	20	Pack Acrylic Dentures	54.78	70.00	15.22
H	10	Cure and Deflask Complete Dentures	55.51	70.00	14.49
H	26	Trim Casts	55.51	70.00	14.49
J	26	Trim and Wax-Dip Refractory Casts of Removable Partial Dentures	13.24	26.67	13.43
H	3	Articulate Cases	63.60	76.67	13.06
H	11	Eliminate Wax from Denture Molds	56.99	70.00	13.01
H	4	Bead, Box, and Pour Final Impression to Produce Stone Master Cast	47.06	60.00	12.94
H	9	Construct Trial Baseplates and Bite Rims	49.26	60.00	10.74
J	21	Soak Master Casts	29.78	40.00	10.22
M	13	Maintain Hanau Articulator and Articulator Mounting Plates	53.31	63.33	10.02
		TASKS OMITTED WHERE DIFFERENCES IN PERCENT PERFORMING = 10.00 THROUGH -20.00			
K	17	Solder Units of Fixed Partial Dentures	33.46	13.33	-20.12
B	4	Supervise Dental Laboratory Specialists (AFSC 98250)	20.22	0.00	-20.22
M	16	Maintain Manual Casting Machines	33.82	13.33	-20.49
K	9	Fabricate Stone Dies	40.81	20.00	-20.81
I	9	Replace Tube Teeth or Facings	41.18	20.00	-21.18
K	15	Pickle or Heat Treat Gold Inlays, Crowns, or Pontics	37.87	16.67	-21.20
K	1	Cast Gold Crown, Inlay, or Pontic Backing	38.24	16.67	-21.57
K	19	Test Occlusion and Fit of Inlays, Crowns, or Fixed Partial Dentures	38.60	16.67	-21.94
I	8	Repair Metal Parts of Removable Partial Dentures	25.37	3.33	-22.03
B	13	Supervise the Fabrication of Dental Prosthetic Appliances	22.06	0.00	-22.06
K	10	Finish and Polish Gold Alloy Inlays, Crowns, or Fixed Partial Dentures	38.97	16.67	-22.30
K	18	Sprue, Invest, and Burn Out Gold Alloy Inlays, Crowns, or Pontics	38.97	16.67	-22.30
K	13	Grind in Porcelain or Acrylic Facings and Pontics	39.71	16.67	-23.04
K	2	Construct and Articulate Casts	43.38	20.00	-23.38
K	5	Fabricate Acrylic Resin Jacket Crowns	32.72	6.67	-26.05

Appendix (Continued)

EXAMPLE INDIVIDUAL JOB DESCRIPTION

CASE CTRL NUMBER	= 1134
NAME	= WITHHELD
GRADE	= E-3 (A1C)
TOT MOS AFMS	= 015
NO' SUBORDINATES	= NONE
MAJOR COMMAND	= AIR FORCE SYSTEMS COMMAND
PRES WORK ASGNMT	= CIVILIAN PAYROLL CLERK
EDUCATION LEVEL	= 14
PLAN TO RE-ENLIST	= PROBABLY YES
I FIND MY JOB	= FAIRLY INTERESTING
UTIL OF TAL/TRNG	= FAIRLY WELL
JOB INSIDE US	= YES
SUM TIME - CIV PAY	= 99.9910,
ORGANIZATION/BASE	= AEROSPACE MEDICAL DIVISION AFSC BROOKS AFB TEXAS

D-TSK	TASK TITLE	Per Cent Time Spent	Cumulative Per Cent
K 24	Prepare Individual Pay Records for Civilian Employees	8.00	8.00
K 30	Process Payroll Changes for Civilian Employees	6.67	14.67
K 17	Make Payroll Adjustments for Civilian Pay	6.67	21.33
K 15	Maintain Payroll Control Register for Civilian Employees	5.33	26.66
K 25	Prepare Payroll Change Slips for Civilian Employees	5.33	32.00
K 31	Process Time and Attendance Report	5.33	37.33
K 7	Compute or Post Allowances, Deductions, or Differentials for Civilian Pay	5.33	42.66
K 38	Verify Accuracy of Payments to Civilians	5.33	48.00
K 21	Prepare Computer Input for Civilian Pay Actions	5.33	53.33
K 28	Process and Post Basic Documents Authorizing Pay and Changes of Pay for Civilian Employees,	5.33	58.66
K 19	Post Service History and Physical Data to Individual Retirement Records	4.00	62.66
K 6	Compute or Post Allotments for Civilian Pay	4.00	66.66
K 12	Maintain Civilian Individual Leave Records	4.00	70.66
K 13	Maintain Files of Civilian Pay Documents	4.00	74.66
K 29	Process Civilian Cash Awards	4.00	78.66
K 11	Issue Civilian Pay Earning Statements	2.67	81.33
K 1	Audit Individual Leave Records	2.67	83.99
K 8	Compute or Post Special Pay for Civilians Such as Firefighter Pay	2.67	86.66
K 10	Initiate Card Change to Civilian Pay Accounts	2.67	89.33
K 32	Open or Close Civilian Pay Records	2.67	91.99
K 22	Prepare Employee's Federal or State Tax Report	1.33	93.33
K 2	Balance With Carriers on Each Type of Insurance Option	1.33	94.66
K 14	Maintain Insurance Application File	1.33	95.99
K 20	Prepare Bond Issuance Schedules for Civilian Employees	1.33	97.32
K 36	Re-establish Civilian Pay and Leave Records	1.33	98.66
K 23	Prepare Employer's Federal or State Tax Report	1.33	99.99