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AIR FORCE 🛦 HUMAN RESOURCES

DESIGN OF A NATIONAL SKILLS MARKET MODEL FOR
AIR FORCE ENLISTED PERSONNEL

By

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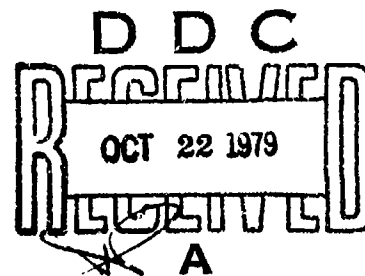
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This technical report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This technical report documents the detailed specifications developed in this study describing feasible options available for designing and implementing the National Skills Market Model—an empirically based forecasting model of economic activity in the industrial and occupational labor markets in which the Air Force competes for labor. Essentially, the model formulated in this study consists of three basic analytic components which, in combination, produce detailed forecasts of national labor market conditions, and generate projections of the total accession and retention of Air Force enlisted personnel. The basic analytic components include a non-military labor market module, a population projection module, and an accession/retention rate forecasting module. Each of these components is then subdivided into one or more analytic elements which address distinct aspects of the general issue

Item 20 (Continued)

examined in the analytic component. In all, nine analytic elements are included in the modular design of the model. The report describes the functions to be performed by each of the analytic components and elements, and specifies the procedures through which each element has been designed to accomplish its functions. Recommendations for the development and implementation of the model are presented also. Detailed supporting information is provided in appendices.

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1.0 INTRODUCTION

The objective of this study is to develop design specifications for the National Skills Market Model -- an empirically based forecasting model of the industrial and occupational labor markets in which the Air Force competes for skilled and unskilled enlisted personnel. This model is intended to serve two distinguishable but related purposes.

First, it is desired as an adjunct to the Integrated Simulation Evaluation Model (ISEM) currently being developed under the sponsorship of the Air Force Human Resources Laboratory (AFHRL). When fully developed, ISEM will be a large-scale, empirically based computer simulation model of the Air Force Manpower and Personnel System (AFM&PS) that integrates the behavioral relationships determining the structure of the enlisted and officer force; the operational linkages within the AFM&PS and between the AFM&PS and other Air Force functional components; the policy-making, information processing, and control activities related to the AFM&PS; and certain aspects of the national labor market. In particular, ISEM will be affected by the national labor market with regard to the accession of new recruits and the retention of existing airmen. Therefore, a key function of the National Skills Market Model is the provision of an analytic capability of providing periodic forecasts of Air Force accessions and retentions.

In addition, independent of ISEM, the National Skills Market Model is expected to generate information about the national labor market useful to, and usable by, Air Force policy-makers and decision-makers in the performance of their assigned functional responsibilities. In this context, the model must provide information describing the structure of the various industrial and occupational labor markets in which the Air Force competes for enlisted personnel, and predicting the supply and demand conditions in these markets as they respond to various economic influences.

Essentially, the National Skills Market Model designed in this study to fulfill the above purposes consists of three basic analytic components. These components, in combination, provide detailed projections of national labor market activity, and produce forecasts of the accession and retention of Air Force enlisted personnel. The three analytic components include:

- A non-military labor market module, which develops forecasts of those aspects of non-military labor market activity which affect the ability of the Air Force to attract and retain enlisted personnel. Thus, this module produces forecasts of such variables as unemployment rates, industrial and occupational employment levels, and industrial, occupational, and aggregate wage rates. In addition, to the extent possible, these forecasts incorporate both demographic and regional detail. Thus, by identifying the industries and/or occupations for which the module projects substantial increases in employment levels or wage rates over time, the chief competition confronting the Air Force in present and future labor markets can be determined.

- An accession/retention rate forecasting module, which uses as inputs both variables describing non-military labor market activity -- as projected by the non-military labor market module -- and variables describing Air Force and, conceivably, other military personnel policies; and produces as outputs forecasts of the accession rates and retention rates which will be experienced in different Air Force skill classifications. Thus, this module contains the basic mechanisms through which the National Skills Market Model will project the quantity and quality of airmen available for enlistment or reenlistment at any particular military or civilian wage level.

- A population projection module, which develops projections of the population of qualified military availables (the total population eligible for enlistment into the Air Force), and the population of current airmen who are eligible for reenlistment. By applying the accession and retention rates projected by the accession/retention rate forecasting module o these dual population projections, forecasts of total accessions and retentions for each Air Force skill classification are produced.

This modular structure of the National Skills Market Model is illustrated in Figure 1.
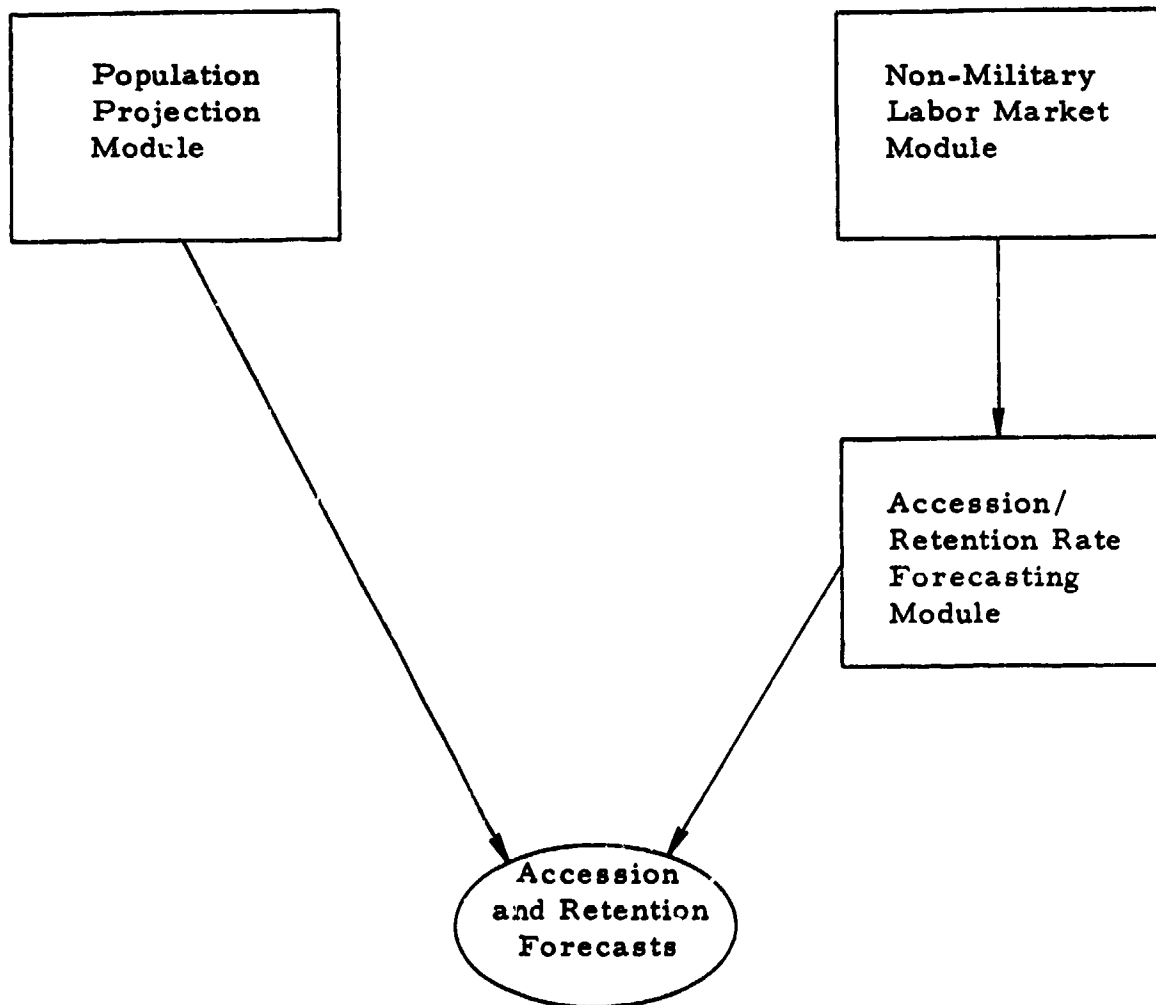
FIGURE 1: Basic Modular Structure of the
National Skills Market Model

Each of the three basic modules of this structure, in turn, contains one or more analytic elements. Specifically, five analytic elements are contained in the non-military labor market module:

- A national economy module, which produces forecasts of aggregate unemployment rates, aggregate wage rates, and industry-specific employment levels and wage rates. The module is routinely recalibrated to accommodate technological change. In this manner, it provides the basic capability required to predict the effects of technological change in any industrial sector on non-military labor market activity and, then, on Air Force accessions and retentions.

- A regionalization module, which partitions the employment projections developed using the national economy module to produce regional forecasts of industrial labor market activity.

- An industry-occupation matrix, which provides an empirical basis for decomposing total or regional employment projections for any industry to derive forecasts of occupational employment in the industry. By summing these forecasts across industries, forecasts of total or regional occupational employment are produced.

- An occupational wage rate forecasting module, which utilizes the projections developed by the national economy module and the industry-occupation matrix to generate forecasts of the wage rates expected to prevail for each occupational group contained in the National Skills Market Model.

- A demography module, which disaggregates the forecasts generated by the national economy module, the regionalization module, and the industry-occupation matrix to produce separate projections for different demographic groups.

The accession/retention rate forecasting module consists of a single element:

- The accession/retention rate forecasting module, which can reasonably be expected to evolve into separate accession rate forecasting mechanisms for different enlisted airman quality groups, and separate retention rate forecasting mechanisms for different Air Force skill classifications.

Finally, the population projection module contains two basic analytic elements:

- A qualified military availables projection module, which develops forecasts of the total population that is physically and mentally qualified for enlistment into the Air Force.

- An airman population projection module, which provides projections of the total population of enlisted airmen who are eligible for reenlistment.

A schematic diagram depicting the detailed interrelationships among these analytic elements is presented in Figure 2.

The remainder of this report describes in depth the basic analytic components and detailed analytic elements contained in the National Skills Market Model. Specifically, the report is divided into three parts corresponding to the three analytic components. Then, each part is subdivided into separate sections corresponding, in general, to the analytic elements of the associated basic component.

Thus, Part I examines the accession/retention rate forecasting module and contains two sections. Features of existing studies of military accession and retention pertinent to the National Skills Market Model are identified in Section 2. Then, Section 3 summarizes the detailed labor market characteristics that Air Force manpower and training planners would like the National Skills Market Model to provide.
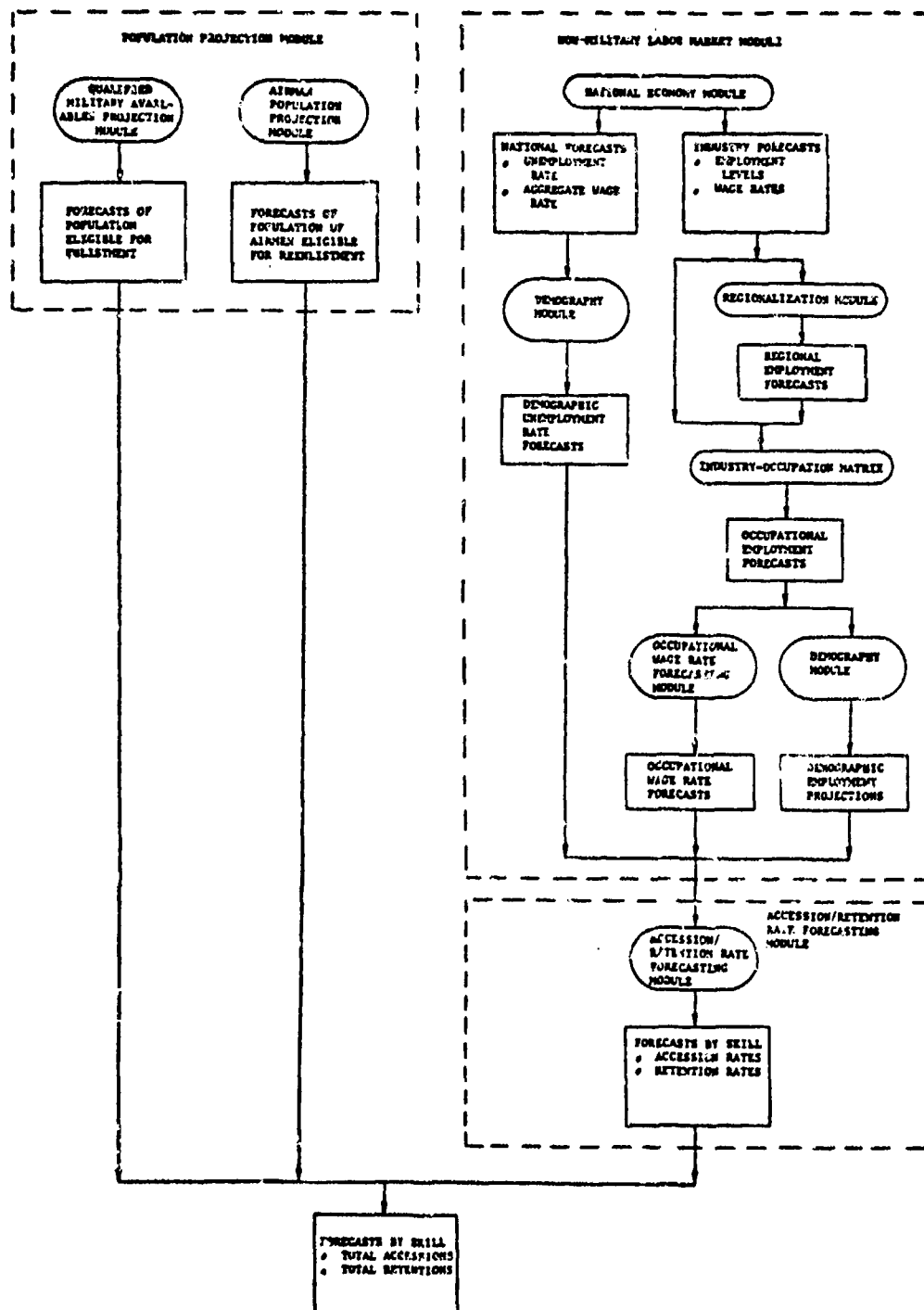
FIGURE 2: Detailed Structure of the
National Skills Market Model

The structure of the non-military labor market module is discussed in Part II, consisting of five sections. Section 4 delineates the pertinent features and analytic procedures of alternative national economic models that might be adopted as the national economy module. The proposed formulation of the regionalization module is outlined in Section 5. In Section 6, the composition and uses of the industry-occupation matrix are discussed. Next, basic procedures for occupational wage forecasting are derived, and preliminary empirical tests of these procedures are performed, in Section 7. Section 8 then examines the degrees of demographic detail potentially attainable in the forecasts generated by the National Skills Market Model.

Finally, the two sections in Part III portray the population projection module. Section 9 describes and evaluates alternative sources of forecasts of the population of qualified military availables, while Section 10 outlines procedures for the development of projections of the population of airmen eligible for reenlistment.

Section 11 summarizes the results of the analyses performed in this study and presents recommendations for the development of the National Skills Market Model.

PART I

THE ACCESSION/RETENTION RATE
FORECASTING MODULE

2.0 ACCESSION/RETENTION RATE
FORECASTING STUDIES

AFHRL is currently sponsoring research aimed at the development of a suitable accession/retention rate forecasting module for inclusion in the National Skills Market Model. However, a decision has not been made yet concerning the adoption of any particular formulation of this module. Consequently, the precise form of the accession/retention rate forecasting module has not been determined. Yet, the data needs of this module prescribe required outputs of the non-military labor market module.

Therefore, to identify prospective required outputs of the non-military labor market module, it was necessary to conduct a systematic review of existing studies of the accession or retention of military personnel which either might serve directly as the conceptual basis for the accession/retention rate forecasting module, or might contain features which could ultimately be contained in that module. In all, 32 studies of the accession or retention of military personnel were reviewed. The studies examined typically were conducted after 1970. Of the 32 studies, 25 derived and analyzed formal theoretical models of military accession, while three formulated and examined models of the demand for separation from the military. The remaining four studies developed no formal models of accession or retention. They did, nevertheless, contain features which might reasonably be embodied in the accession/retention rate forecasting module.

In reviewing these studies, all concepts which seemed potentially relevant to the accession/retention rate forecasting module were identified and isolated. To aid this process, brief abstracts were developed for all of the studies reviewed, indicating the functional forms of the models developed in the studies, and providing definitions of all pertinent concepts or variables considered in the studies. The studies examined are listed in the Bibliography.

The studies generally attempted to explain the enlistment rate for military accessions or the reenlistment rate for personnel remaining in the military. The variables used to explain these enlistment and reenlistment rates were diverse, but could be categorized into nine major classes:

- Military/civilian compensation
- Unemployment rates
- Recruiting effort
- Relevant population base
- Demography
- Seasonality
- Draft pressure
- Taste for military service
- Miscellaneous variables

The remainder of this section contains detailed discussions of these sets of explained and explanatory variables. A special effort has been made to highlight unique variables not generally found in most studies.

2.1 Enlistment and Reenlistment Rates

The studies typically examined either the enlistment rate for volunteers entering the military or the reenlistment rate for personnel remaining in the military. The rates applied either to the armed services in general or to particular branches of the military.

The enlistment rate was usually represented by the ratio of the number of male, volunteer enlistees in a specified age and mental aptitude group to the total number of civilian, noninstitutionalized males in the same age group. The age group most commonly examined in the studies ranged from 17 to 21 years, although some studies considered age groups from 16 to 19, 16 to 20, 17 to 20, 18 to 19, or 18 to 21. Mental aptitude groups were defined in terms of Armed Forces Qualification Test (AFQT) score ranges. The most frequent definition spanned Mental Groups I through III, although AFQT score ranges I through IV, I and II, and III were designated in some studies. Certain studies also delineated enlistment rates in terms of educational attainment (high school graduate versus non-high school graduate) or race (black versus non-black).

The reenlistment rate was generally represented by the ratio of the number of persons reenlisting to the number of persons eligible to reenlist. One model (32)[1] used the ratio of the number of personnel reenlisting after a certain term of service to the sum of reenlistments and voluntary separations.

2.2 Military/Civilian Compensation

Military/civilian compensation was an important explanatory variable in virtually all studies of the accession or retention of military personnel. This variable was defined in a variety of ways in the various studies. In accession studies, military/civilian compensation was represented in terms of either relative pay or absolute pay levels. The relative pay variable was generally represented by the ratio of average military pay and benefits to average civilian income over some specified period for some specified age group. In some studies, the relative pay variable was defined as the ratio of the present value of expected military income to the present value of expected civilian income. The discount rate used to compute these present values ranged from 10 to 30 percent. Alternative definitions of civilian income included the annual wage of production workers in manufacturing, the average weekly earnings of production or non-supervisory personnel on private non-agricultural payrolls, and the average of the civilian average weekly wage for both wholesale and retail trades. In one model (23), civilian income was adjusted to reflect the possibility of unemployment.

Another way of representing the influence of military/civilian compensation was in terms of absolute pay levels. Studies using absolute pay levels treated military earnings and civilian earnings as two separate variables. These variables were defined in the same manner as in the numerator and denominator of the relative pay variable.

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[1] The number in parentheses refers to the identification number of the study in the Bibliography. This notation will be used throughout this section.

In retention studies, compensation information was basically
presented in the same way as in accession models, but a greater
effort was made to compare equivalent groups of military and civilian
personnel. For example, one study (27) adjusted civilian earnings
for age, education, and race to ensure proper comparison to similar
military personnel.

Some studies placed extreme emphasis on the proper specifica-
tion of certain variables denoting military pay or civilian earnings.
One study (24) calculated military pay using perceptions of military
personnel concerning their expected compensation over several terms
of military service, discounted to the present. This formulation con-
sidered the influence of the military retirement system, which pro-
vides an annuity for men completing 20 or more years of service.
This annuity is a major reason for the high retention rate in the
career force. Another study (26) considered an alternative way of
calculating the potential civilian earnings of men separating from the
military. This study regarded the average value of civilian employ-
ment opportunities as a function of separation rates, military pay,
and characteristics of enlisted men. It contended that men who chose
to separate from the military did so because they had relatively good
civilian opportunities, so that the experience of these veterans might
not be representative of the civilian opportunities available to those
who reenlisted.

2.3 Unemployment

Unemployment was generally represented by the nationwide
unemployment rate for 16- to 19-year old civilian males as indicated
in Employment and Earnings, [2] a monthly publication of the U. S.
Bureau of Labor Statistics. In some studies, the unemployment rate
was changed somewhat to apply to different age groups (16 to 20, 16
to 21, 17 to 20, 17 to 21, 18 to 19, or 19 to 21) or to different regions
(states or recruiting districts). In one study (22), the duration of
unemployment replaced unemployment as a variable in its formal
model. The study then proceeded to experiment with "the duration

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[2]U. S. Bureau of Labor Statistics, Employment and Earnings,
monthly publication, Washington, D. C., U. S. Government Printing
Office.

of cohort unemployment" as an alternative to unemployment as an explanatory variable. The duration of cohort unemployment was represented by the product of the average duration of unemployment and the unemployment rate.

In three other studies, the unemployment rate was transformed to create the explanatory variables used in their models. In one study (23), the complement of the unemployment rate (1 - U) was used. In another study (18), the inverse of the complement of the unemployment rate (1/(1 - U)) was adopted. In the third study (30), the unemployment rate was adjusted to give larger weights to larger deviations from a "natural" unemployment rate. In this case, the transformed rate was defined to be $(U - 4.0)^{1.5}$, where U was the original unemployment rate.

Finally, one study (12) used the labor force participation rate as an explanatory variable. This variable, represented by the total number of labor force participants (employed plus unemployed) divided by population in the relevant age/sex group, was proposed as an indicator of the total -- observed and hidden -- unemployment in that age/sex group.

2.4 Recruiting Effort

Recruiting effort was most often represented by the ratio of the number of recruiters assigned by a branch of the armed forces to the number of qualified military availables (QMAs). This ratio generally applied to a specific geographic area, such as the nation, a state, or a recruiting district.

In one study (20), alternative ways of specifying the Army's recruiting effort were examined in an evaluation of Army Manpower Accession Programs. In addition to the number of recruiters, the number of unit canvassers and recruiter assistants were also tested as explanatory variables. Another study (17) tried to account for inter-service recruiting competition. This study included the total number of recruiters of the other armed services per QMA as an explanatory variable, in addition to examining the effects of its own number of recruiters per QMA. Finally, one study (30) transformed the total number of recruiters (factor canvassers) to develop a

composite explanatory variable for recruiting effort. In this study, the number of Navy recruiters (U. S. Navy, Reserve, and Temporary Active Duty canvassers) for each Naval Recruiting District were weighted according to the experience of each recruiter. An individual recruiter was not treated as a whole recruiter until he or she had served as a recruiter for more than 12 months.

In some models, recruiting effort was represented by the amount of money spent on advertising, in addition to the number of recruiters per QMA. One model (5) defined advertising as the amount of money spent in "print media advertising and related advertising funds." Another study (20) considered the amount of money spent on paid radio and television advertisements and the amount of money spent on print media advertisements as two separate explanatory variables. The Navy Recruiting Service (30) used the effect of advertising rather than the amount of money spent on advertising as an explanatory variable. In this model, the number of leads developed by the Navy Opportunity Information Center (NOIC) divided by the total population of the Naval Recruiting District served as an explanatory variable. NOIC leads are mailed responses to various forms of advertising (magazine, public service, direct mail, etc.), and are tabulated by Zip Code.

2.5 Relevant Population Base

Three general types of explanatory variables were used to represent the relevant population base. The population base for blacks was generally represented by the proportion of 17- to 21-year-old black military QMAs to the total number of 17- to 21-year-old QMAs. The Navy Recruiting Service (30) represented the population base for non-black males as two separate explanatory variables: the number of urban, non-black, Mental Groups I and II QMAs; and the number of rural, non-black, Mental Groups I and II QMAs. It represented the population base for black males as the number of black, Mental Groups I and II and Mental Group III high school graduate QMAs. The population base of high school graduates not entering college was represented by the ratio of male high school graduates to the number of male college enrollments per state or per Recruiting Main Station (19). This variable also measured the competition for recruits from colleges.

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2.6 Demography

In studies of military retention, demographic distinctions were generally represented in terms of dummy variables. In one study of the retention of Air Force enlisted men (32), dummy variables were used to represent race, age, marital status, education, mental aptitude, and occupational group. Another study of Navy reenlistment (21) used dummy variables to represent age (1 if less than 23, 0 otherwise) and dependency (1 if 1 dependent, 0 otherwise; and 1 if 2 or more dependents, 0 otherwise).

2.7 Seasonality

In studies of accession, dummy variables were generally used to reflect seasonality in recruiting success. Dummy variables were usually defined for the spring, summer, and fall seasons; although, in some studies, the winter, spring, and summer quarters were represented by dummy variables.

2.8 Draft Pressure

Studies which examined military accession and retention for time periods during which the military draft was in force generally included measures of the influence of the draft on voluntary enlistments as explanatory variables. Several studies merely used dummy variables to indicate the presence or absence of the draft, either for married men only or for all males. One study (3) used dummy variables to distinguish periods of high draft pressure and low draft pressure. The probability of being drafted, or the military induction rate, was employed as an explanatory variable in numerous studies. Other studies used as an explanatory variable the proportion of volunteers who were motivated to enlist by the presence of the draft, as measured in a Department of Defense survey. Finally, the total number of accessions -- including both enlistments and inductions -- and the total military accession rate were utilized as measures of the draft pressure in several studies.

2.9 Taste for Military Service

Taste for military service was represented by survey responses indicating potential recruits' willingness to serve in the military. In one study (17), this taste for military service variable was defined as the percent response on the 1972 Gilbert Youth Survey to the question, "Do personal feelings strongly prevent you from entering?". Another study (30) measured the propensity to serve in the military on the basis of responses to the Youth Attitude Tracking Study.

2.10 Miscellaneous Variables

In reviewing models of accession and retention of military personnel, six explanatory variables were identified which could not be easily classified into any broader categories. These variables, which all apply to accession models, include:

- Force level -- the Congressionally mandated end strength of the total enlisted force (12).

- The ratio of military residents to the total number of residents per state or per Recruiting Main Station (19 and 20).

- Per capita income for the entire population of a state (29).

- Mean education level for the entire population of a state (29).

- The market share of all other branches of the armed services -- Army, Air Force, and Marine Corps, Mental Groups I and II, non-black, and Mental Groups I and II and Mental Group III high school graduate, black accessions (30).

- The total number of reenlistees per Naval Recruiting District, including all enlistees with prior military service in any branch, regardless of quality or any other distinctions (30).

2.11 Design Implications of Review of Accession/Retention

The review of existing studies of the accession and retention of military personnel could not provide definitive specifications of the precise forms of the variables which must be forecast by the non-military labor market module or the population projection module of the National Skills Market Model. It did, however, identify several classes of variables and dimensions of descriptive detail which these modules might reasonably be expected to produce.

Specifically, the review suggested that the accession/retention rate forecasting module might require the non-military labor market module to produce as outputs forecasts of:

- Wage rates prevailing in civilian occupations or industries.

- Unemployment rates.

- Demographic detail by race, age, mental aptitude, educational attainment, occupational group, and dependency.

- Temporal detail by season of the year.

Similarly, the population projection module might be required to provide as outputs forecasts of population by race, age, mental aptitude, education, and urban or rural residence.

The remaining explanatory variables identified in the review of accession and retention studies represented measures of military policy, other public policies, military labor market activities, or personal preferences. These variables do not constitute reasonable outputs of the non-military labor market module, since they describe either public sector actions or behavior that is not observable in the labor market.

3.0 AIR FORCE DESIRES
FOR MODEL OUTPUTS

The review of existing studies of military accession and retention identified the principal types of variables and dimensions of descriptive detail which the National Skills Market Model might reasonably be required to produce either as final outputs, or as intermediate products to support subsequent operations within the model. However, the review did not identify the precise level of descriptive detail in the model's outputs which would be most useful to Air Force manpower and training planners; nor did it indicate the kinds of intermediate results -- either required to produce the final outputs, or easily derivable in the course of producing the final outputs -- which might be independently useful to these planners.

To resolve these important model design issues, 15 Air Force manpower and training planners involved in recruitment and/or reenlistment were interviewed. The placement director of the Non-Commissioned Officers Association in San Antonio, Texas, was also contacted. Appendix A contains a list of the organizational affiliations of all persons interviewed. Each of these people was asked a set of open-ended questions pertaining to recruitment, reenlistment, or both. The interview protocols for recruiting and reenlistment are presented in Appendix B.

In the next two subsections, the responses to the interviews are summarized insofar as they pertain to defining design specifications of the National Skills Market Model. The results are reported separately for recruiting and reenlistment. The results generally represent a consensus of the respondents' views. Whenever a respondent's thoughts differed substantially from those of the other people interviewed, these opinions are identified separately.

In these subsections, the various desires of Air Force manpower and training planners for information about the national labor market are reported without regard for the feasibility of satisfying these desires using available or obtainable data. The subsections are not intended to indicate all types of information that can be provided in the National Skills Market Model. The capability of existing data and analytical structures to fulfill the desires of Air Force manpower planners will be discussed in subsequent sections.

3.1 Recruiting

3.1.1 Desired Information About the National Labor Market

Air Force manpower planners desired certain information about economic trends and private sector competition to support thei. estimation of the supply of Air Force recruits. In particular, they indicated that:

- A desirable metric would be an index of new employment projected by industry group or by occupation.

- In examining industries' forecasts for expansion, one needs to know whether hiring will focus on skilled personnel (enlistee competition) or unskilled labor (recruit competition).

- Information about the general business cycle would be helpful to correlate with enlistment rates.

- Major modelling objectives should be:

  - Forecasts of the volume of available recruits.
  - Recruit quality forecasts (even as simple as high school or non-'iigh school graduate).
  - Projection of impacts of competition by the other services (recruiter competition).

- Data paralleling items received during enlistment standards review would be useful. Such data might include:

  - Mental capacity.
  - Scores on the Armed Forces Qualification Test (AFQT) of the Armed Services Vocational Aptitude Battery (ASVAB), indicating ability to pass technical training.

• Desired information about competitive sectors includes:

   .. Data on governmental and private institutional programs, describing programs offered and trends.
   .. Vocational training available in high school.
   .. Other factors, such as welfare and unemployment benefits.

• Desired information for recruiting includes:

   .. Demographic information.
   .. Unemployment rate by region.
   .. Total unemployment.
   .. School population.
   .. High school graduates.

• Desires for disaggregation include:

   .. Detail by standard metropolitan statistical are (SMSA), region, or county.
   .. Information at each level of the recruiting hierarchy -- squadron, recruiting station, and recruiting district.
   .. Annual and quarterly projections for planning purposes and monthly reports for recruiting stations.
   .. Quarterly or semiannual reporting of trends.

3.1.2 Critical Skill Areas

The skill areas in which the Air Force has the most difficulty recruiting generally involve dull, mundane jobs requiring little skill and providing little training. On the other hand, a few critical skills require a high intellect and a security clearance. In 1977, there were 14 critical skill areas for recruiting, but now only nine skills are indicated as critical by Air Force Manpower and Personnel Center (AFMPC) and United States Air Force Recruiting Service (USAFRS). The career fields containing these critical skills, and the critical skills themselves, are:

- Intelligence

  - Morse system operator
  - Printer systems operator
  - Voice processing specialist

- Munitions and weapons maintenance

  - Munitions systems specialist
  - Aircraft armament systems specialist
  - Explosive ordnance disposal specialist

- Fire protection

  - Fire protection specialist

- Fuels

  - Fuels specialist

- Security police

  - Security specialist

3.1.3 Competing Industries

The primary competition for recruits is provided by colleges and vocational schools. An important factor affecting the accessibility of college to high school students is the availability of educational loans.

Similarly, apprenticeships (to become electricians, plumbers, masons, etc.) are key competitive factors in the private sector. Competing industries in the private sector which were mentioned include:

- Aerospace industry

- Air transportation

  - Mechanics
  - Air cargo specialists

- Electronics

- Computers/data processing

- Construction work (housing, roads, other)

- Service, maintenance, and allied industries
  (automotive, aircraft, equipment, etc.)

Government job programs are also believed to compete for recruits. One such program is the Comprehensive Employment Training Act (CETA) apprenticeship, which provides training in automotive mechanics, electrical work, automotive body work, and plumbing, among other areas. Finally, other branches of the armed forces are an important source of competition.

The Air Force generally gets a sufficient number of high aptitude recruits. In fact, recruitment of more highly qualified recruits can result in decreased retention, because persons overqualified for a particular job may get bored and leave the Air Force.

3.1.4 Desired Demographic Data

In general, demographic information about the pool of eligible recruits is already available to the Air Force. One officer indicated that recruiters currently receive forecasts of QMAs by sex and race; another officer in recruiting expressed general satisfaction with current demographic data. Nevertheless, one officer involved in reenlistment requested demographic detail by age, sex, race, education, and region (state/city) for the pool of eligible recruits.

Attitudinal data for potential recruits could be valuable to the Air Force, particularly if the data are reliable and valid. Such data would be useful in predicting success in recruiting. Potential attitudinal data suggested by officers include measures of:

- Motivational factors stimulating potential recruits.

- The perceived value of military training.

- The value systems of potential recruits, as bases
  for interpreting their attitudes.

3.2 Reenlistment

3.2.1 Desired Information About
the National Labor Market

Air Force manpower planners desired certain information about economic trends and private sector competition to aid their determination of the demand for separations by Air Force personnel. The information they desired about the national labor market includes:

- Economic forecasts from a general viewpoint, to assist in the assessment of prevailing incentives to stay in the service.

- Projections of economic growth by industry categories or fields, such as computer operation, laser technology, nuclear reactors, and the aircraft industry.

- Indications of future demand for certain skills/occupations, focusing on:

    - Projections of demand for the next 2 years.
    - Forecasts of wages, benefits, stability of employment.
    - Estimation of the prevailing wage rate for specific skills.

    This information can be used to support reenlistment bonuses and to predict losses.

- Total employment, and unemployment rates, by region.

- Demographic information concerning females in the civilian labor force.

- Disaggregation of data in terms of:

    - Skill/occupation.
    - State, district, or regional area grouping, then by occupation/skill within that area, to determine regional reenlistment bonuses or wages.

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3.2.2 Critical Skill Areas

Of the more than 300 Air Force Specialty Codes (AFSCs), 117 skills were designated critical by the Air Force as of October 1978. These critical skills are listed in Table 1. Critical, in this context, means that less than a 50 percent reenlistment application rate was experienced relative to the Air Force's stated objective. Also, there are 70 skills for which a reenlistment bonus is provided. These skills, identified in Table 2, generally represent a subset of the 117 critical skills listed in Table 1. Furthermore, there are an additional 115 to 120 skills the Air Force is concerned about, but does not consider critical.

The critical skills are generally skills with high technical requirements such as advanced electronics, difficult mechanical skills, or skills requiring high intelligence. The Air Force is particularly concerned about losing skilled personnel who have taken long, expensive training courses, since the Air Force has a substantial investment in such people. The Air Force also has difficulty attracting reenlistments in skills which involve long alert duty at relatively boring jobs. The critical skills specifically mentioned by the people interviewed in this study are:

- Electronic specialists

    - Communications electronics
    - Radar electronics
    - Missile electronics
    - Avionics electronics

- Security police and military police

    - Guards for nuclear weapons
    - Base traffic controllers

- Aircraft mechanics

    - Engineering system mechanics
    - Hydraulic mechanics
    - Avionic mechanics

- Computer specialists

TABLE 1: Critical Skills (Skills with Less Than 50 Percent Reenlistment Application Rate Against Given Objective) as of October 1978

AFSC*	Reenlist-ments Desired (1)	Reenlist-ment Applica-tions (2)	Reenlist-ment Applica-tion Rate [(2)/(1)]	Skill
114X0	226	81	35.8	Aircraft Loadmaster
202X0A	204	82	40.2	Radio Communications Analysis Specialist
202X0B	11	3	27.2	Communications Security Specialist
203X0	10	0	0.0	Linguist/Interrogator Specialist
205X0	57	12	21.1	Electronic Intelligence Operations Specialist
206X1	5	2	40.0	Target Intelligence Specialist
208X0	299	117	39.1	Voice Processing Specialist
231X0A	5	0	0.0	Audiovisual Media Specialist
231X1A	4	0	0.0	Graphics Specialist - Medical Illustrator
232X0A	4	0	0.0	Motion Picture Camera Specialist - Medical
232X0B	8	0	0.0	Motion Picture Camera Specialist - Optical Instrumentation
232X1	4	0	0.0	Television Production Specialist
233X1	8	1	12.5	Photoprocessing Control Specialist
241X0	71	22	31.0	Safety Specialist
272X0D	33	7	21.2	Air Traffic Control Operator - Combat Control Team Operations
274X0	281	52	18.5	Command/Control Specialist
276X1	20	1	5.0	Electronic Warfare Countermeasures Specialist
276X2	6	3	50.0	Intercept Director Specialist
293X3B	1	0	0.0	Radio Operator, Airborne Radio/Countermeasure
296X0	15	0	0.0	Communications-Electronics Program Management Specialist
297X0	2	0	0.0	Radio Frequency Management Specialist
302X1	7	1	14.3	Airborne Meteorological/Atmospheric Research Equipment Repairman
303X2	216	1	0.5	AC&W Radar Repairman
304X0	291	3	1.0	Radio Relay Equipment Specialist
304X4	523	168	32.1	Ground Radio Communications Equipment Repairman
306X0	281	72	26.6	Electronic Communications and Cryptographic Equipment Systems Repairman
306X1	123	38	31.0	Electronic-Mechanical Communications and Cryptographic Equipment Systems Repairman
307X0	247	86	34.8	Telecommunications Systems Control Attendant
309X0A	17	1	5.8	Missile Warning and Space Surveillance Sensor Repairman - Missile Detection and Warning Radar
309X0B	13	3	23.1	Missile Warning and Space Surveillance Sensor Repairman - Space Surveillance Radar
316X0	11	3	27.2	Missile Systems Analyst Specialist
316X0F	48	2	4.2	Missile Systems Analyst Specialist - LGM-25
316X0G	198	14	13.0	Missile Systems Analyst Specialist - WS-133AM/6DB
316X0S	20	1	5.0	Missile Systems Analyst Specialist - ADM-20
316X0T	77	19	24.7	Missile Systems Analyst Specialist - AGM-69A
316X1F	9	1	11.1	Missile Systems Maintenance Specialist - LGM-25
316X1P	11	0	0.0	Missile Systems Maintenance Specialist - RPV/Drone
316X2G	69	12	17.4	Missile Electronics Equipment Specialist - WS-133A, WS-133A/M
316X2T	12	0	0.0	Missile Electronics Equipment Specialist - AGM-69A.
316X3	100	16	16.0	Instrumentation Technician

TABLE 1 (continued)

AFSC*	Reenlist-ments Desired (1)	Reenlist-ment Applica-tions (2)	Reenlist-ment Applica-tion Rate [(2)/(1)]	Skill
321X0K	69	12	17.4	Bomb-Navigation Systems Mechanic - B-52E/F/G/H (ASQ-4, ASQ-38 System)
321X0L	17	5	29.4	Bomb-Navigation Systems Mechanic - B-52C/D (ASB-15 System)
321X1E	12	0	0.0	Defensive FCS Mechanic - B-52H (ASG-21 Turret)
321X1G	27	7	25.9	Defensive FCS Mechanic - B-52D/F/G: (MD-9, ASG-15 Turret)
321X2C	5	2	40.0	Weapon Control Systems Technician - F-106A/B: (MA-1, ASQ-25 Subsystems)
321X2N	6	1	16.1	Weapon Control Systems Technician - F-105D/F: (ASG-19 System)
321X2P	67	29	43.3	Weapon Control Systems Technician - F-4C/D (APQ-109/APA-105)
321X2S	14	6	42.9	Weapon Control Systems Technician - A-7D (AN/APQ-126); B-57G (AN/APQ-139)
325X0	140	64	45.7	Automatic Flight Control Systems Specialist
325X1	22	1	4.5	Avionics Instrument Systems Specialist
326X0A	18	6	33.6	Manually Operated Avionics Aerospace Ground Equipment Specialist
326X0B	30	12	40.0	Automatic Avionics Aerospace Ground Equipment Specialist
326X0C	22	1	4.5	A-7D Avionics Aerospace Ground Equipment Specialist
326X1C	32	7	21.9	Integrated Avionics Component Specialist, Manual Avionics
326X1D	69	1	1.5	Integrated Avionics Component Specialist, Automatic Avionics
326X1E	32	9	28.1	Integrated Avionics Component Specialist, Penetration Aids
326X2A	60	0	0.0	Inertial Bomb Navigation, Fire/Weapons Control, Digital Computers, and Multi-Sensor Displays
326X2B	44	11	25.0	Flight Control and Integrated/Mechanical Instrument Duties
326X2C	54	6	11.1	Communication, Navigation, and ECM Systems
328X0	209	52	24.9	Avionic Communications Specialist
328X0A	45	2	4.4	Avionic Communications Specialist - Airborne Command Post Communications Equipment Repairman
328X1	229	73	31.9	Avionic Navigation Systems Specialist
328X2A	3	1	3.3	Airborne Warning and Control Radar Specialist, EC-121
328X3	219	89	40.6	Electronic Warfare Systems Specialist
328X4	173	29	16.8	Avionic Inertial and Radar Navigation Systems Specialist
341X1	45	12	26.7	Instrument Trainer Specialist
341X2	18	5	27.8	Defensive Systems Trainer Specialist
341X3	82	12	14.6	Analog Flight Simulator Specialist
341X5	32	2	6.3	Analog Navigation/Tactics Training Devices Specialist
341X7	20	5	25.0	Missile Trainer Specialist
391X0C	32	10	31.2	Maintenance Analysis Specialist - Motor Vehicle
426X1	11	0	0.0	Reciprocating Engine Mechanic
443X0	6	0	0.0	Missile Mechanic
443X0E	30	1	3.3	Missile Mechanic - LGM-25
443X0G	143	30	21.0	Missile Mechanic - WS-133A, WS-133A/M, WS-133B
443X0P	11	0	0.0	Missile Mechanic - Drone/RPV
463X0	159	2	1.3	Nuclear Weapons Specialist
464X0	86	15	17.4	Explosive Ordnance Disposal Specialist
511X1	39	11	28.2	Programming Specialist
511X2	10	0	0.0	Computer System Analysis and Design Specialist

TABLE 1 (continued)

AFSC*	Reenlist-ment Desired (1)	Reenlist-ment Applica-tions (2)	Reenlist-ment Applica-tion Rate [(2)/(1)]	Skill
541X0F	50	16	32.0	Missile Facilities Specialist - LGM-25
541X0G	49	16	32.6	Missile Facilities Specialist - WS-133A, WS-133B, WS-133A/M
591X1	8	0	0.0	Marine Engineman
605X0A	20	4	20.0	Air Passenger Specialist - In-Flight Passenger Service
645X0A	66	0	0.0	Inventory Management Specialist - Munitions
645X2	101	18	17.8	Supply Systems Specialist
673X0	3	0	0.0	Auditing Specialist
691X0	70	26	37.1	Management Analysis Specialist
732X1	54	18	33.3	Personal Affairs Specialist
732X4	11	3	27.3	Career Advisory Specialist
734X0C	9	1	11.1	Social Actions Specialist - Human Relations
742X0	29	7	24.1	Steward Specialist
751X0	32	14	43.8	Education Specialist
791X0	92	29	31.5	Information Specialist
791X1	66	9	13.6	Radio and TV Broadcasting Specialist
821X0	30	0	0.0	Special Investigations and Counterintelligence Specialist
821X0A	5	0	0.0	Special Investigations and Counterintelligence Specialist - Technical Investigation
871X0M	2	0	0.0	Instrumentalist - Piano
871X0P	2	0	0.0	Instrumentalist - Music Arranger
871X0T	8	0	0.0	Instrumentalint - Military Band Support - USAF Band or USAF Academy Band
904X2	2	0	0.0	Cytotechnology Specialist
909X2	3	0	0.0	Neurology Specialist
912X0	3	0	0.0	Ophthalmology Surgical Specialist
912X1	4	0	0.0	Otorhinolaryngology Surgical Specialist
912X3	9	1	11.1	Orthopedic Clinic Specialist
912X4	12	1	8.3	Allergy/Immunology Specialist
913X2	7	3	42.9	Orthotic Specialist
917X0	10	1	10.0	Physician Assistant Trainee
99007	19	4	21.1	Manager - Centralized Enlisted Dormitory Housing
99102	6	2	33.3	Airman Aide
99501	2	0	0.0	Engineering or Scientific Assistant
99504	3	1	33.3	LGM-30 Facility Manager
99505	2	0	0.0	Courier
99509	2	0	0.0	Data Formating Equipment Operator
99600	9	2	22.2	Student Training Advisor
99602	1	0	0.0	Sensor Operator
99603	1	0	0.0	Minuteman NCO Controller

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*An "X" as the fourth character of the AFSC code indicates that the skill is critical at skill levels 3, 5, and 7 (semi-skilled, skilled, and supervisor levels, respectively).

TABLE 2: Zone A and Zone B Skills Approved
for Selective Reenlistment Bonus (SRB)
Effective October 1978

Zone A - First Term Reenlistment (Years 2 to 6)

SRB*	AFSC**	Skill
SRB-4	272X0	Air Traffic Control Operator
SRB-3	111X0	Defensive Aerial Gunner
	112X0	Inflight Refueling Operator
	208X0***	Voice Processing Specialist
	276X0	Aerospace Control and Warning Systems Operator
	306X0	Electronic Communications and Cryptographic Equipment Specialist
	324X0	Precision Measuring Equipment Specialist
	463X0	Nuclear Weapons Specialist
	511X0	Computer Operator
	691X0	Management Analysis Specialist
	99104	Systems Repair Technician
	99105	Scientific Measurements Technician
	99106	Scientific Laboratory Technician
SRB-2	113X0	Flight Engineer
	114X0	Aircraft Loadmaster
	115X0	Para-Rescue/Recovery Specialist
	204X0	Intelligence Operations Specialist
	208X0***	Voice Processing Specialist
	222X0	Geodetic Specialist
	251X0	Weather Specialist
	274X0	Command/Control Specialist
	304X0	Radio Relay Equipment Specialist
	306X1	Electronic-Mechanical Communications and Cryptographic Equipment Specialist
	308X0	Space Systems Command and Control Equipment Operator/Technician
	309X0	Missile Warning and Space Surveillance Sensor Repairman
	316X0	Missile Systems Analyst Specialist
	321X1	Defensive Fire Control Systems Mechanic

TABLE 2 (continued)

Zone A (continued)

SRB*	AFSC**	Skill
SRB-2 (continued)	326X2	Integrated Avionics Systems Specialist
	328X2	Airborne Warning and Control Radar Specialist
	341X1	Instructor Trainer Specialist
	341X2	Defensive Systems Trainer Specialist
	341X5	Analog Navigation/Tactics Training Devices Specialist
	341X7	Missile Trainer Specialist
	362X2	Electronic Switching Systems Repairman
	391X0	Maintenance Analysis Specialist
	464X0	Explosive Ordnance Disposal Specialist
	472X4***	Vehicle Maintenance Analysis Specialist
	511X1	Programming Specialist
	541X0	Missile Facilities Specialist
	544X0	Cryogenic Fluids Production Specialist
	645X2	Supply Systems Specialist
	651X0	Procurement Specialist
	791X0	Information Specialist
	791X1	Radio and TV Broadcasting Specialist
SRB-1	207X2	Printer Systems Operator
	208X0***	Voice Processing Specialist
	241X0	Safety Specialist
	305X4	Electronic Computer Systems Specialist
	341X6	Digital Navigation/Tactics Training Devices Specialist
	361X1	Minuteman Hard Intersite Cable Maintenance Specialist
	403X0	Biomedical Equipment Maintenance Specialist
	404X0	Precision Photo Systems Specialist
	404X1	Aerospace Photo Systems Specialist
	426X0	Aircraft Propeller Mechanic
	427X2	Nondestructive Inspection Technician
	545X0	Refrigeration and Air Conditioning Specialist
	553X0	Site Development Specialist
	554X0	Real Estate Cost-Management Analysis Specialist

TABLE 2 (continued)

Zone B - Second Term Reenlistment (Years 6 to 10)

SRB*	AFSC**	Skill
SRB-3	272X0	Air Traffic Control Operator
	208X0***	Voice Processing Specialist
SRB-2	208X0***	Voice Processing Specialist
	241X0	Safety Specialist
	341X1	Instructor Trainer Specialist
	341X2	Defensive Systems Trainer Specialist
	341X7	Missile Trainer Specialist
	511X1	Programming Specialist
	541X0	Missile Facilities Specialist
	645X2	Supply Systems Specialist
	99104	Systems Repair Technician
	99105	Scientific Measurements Technician
	99106	Scientific Laboratory Technician
SRB-1	112X0	Inflight Refueling Operator
	113X0	Flight Engineer
	208X0***	Voice Processing Specialist
	222X0	Photo Cartographic Specialist
	251X0	Weather Specialist
	276X0	Aerospace Control and Warning Systems Operator
	296X0	Communications/Electronic Program Management Specialist
	297X0	Radio Frequency Management Technician
	306X1	Electronic-Mechanical Communications and Cryptographic Equipment Specialist
	326X1	Integrated Avionics Component Specialist
	326X2	Integrated Avionics Systems Specialist
	361X1	Minuteman Hard Interside Cable Maintenance Specialist
	46JX0	Nuclear Weapons Specialist
	511X0	Computer Operator
	672X1	General Accounting Specialist
	791X1	Radio and TV Broadcasting Specialist
	911X0	Physiological Training Specialist

TABLE 2 (continued)

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*SRB-4, 3, 2, and 1 indicate reenlistment multiples. For example, when SRB is 4, the Selective Reenlistment Bonus = 4 x (monthly salary) x (years in reenlistment term). Similarly, SRB-3, 2, and 1 use multipliers of 3, 2, and 1 respectively to calculate reenlistment bonuses. See Office of Secretary of Defense Directive 1304. 22 for further explanation.

**An "X" as the fourth character of the AFSC code indicates that the skill is approved for SRBs at skill levels 3, 5, and 7 (semi-skilled, skilled, and supervisor levels, respectively).

***Bonuses are approved for certain languages only.

- Loadmasters, flight engineers, aerial gunners, inflight refuellers

- Intelligence specialists

- Certain groups of support personnel assigned to overseas duty

- Munitions specialists (bomb loaders)

3.2.3 Competing Industries

Industries that compete most heavily with the Air Force for reenlistments have skill requirements that match up closely with certain skill areas in the Air Force.[3] These industries are generally technical types of industries. The skill areas sought by private industry require longer training times than most Air Force skills. Competitive industries mentioned are:

- Electronics

  - Manufacturing
  - Service

- Computer and related computer software

  - Maintenance
  - Operation
  - Programming

- Aerospace

  - Production
  - Avionics

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[3]According to one officer, other skills for which there is no demand for outside employment (e.g., bomb loader, airplane guard) still suffer the same losses as skills for which there is a civilian demand.

- Air transportation

  - Maintenance
  - Mechanics

- Federal Aviation Administration (FAA) -- virtually all second term air traffic controllers go to FAA

- Medicine

  - Radiologist
  - Laboratory technician
  - Dental technician
  - Medical technician
  - Medical equipment maintenance

- Law enforcement -- security police

- Weather services

- Other government agencies

- Sales organizations (especially for people in recruiting service)

- Construction

  - Plumber
  - Carpenter
  - Bricklayer

- Communications

- Companies with Air Force contracts

- Companies working in overseas areas supplying Saudi Arabia, Iran, etc.

- Large retail department stores

  - Major chain stores in the same geographic area as the Air Force base
  - Television repairman, air conditioning maintenance, installation of fencing or roofing, salesmen

3.2.4 Desired Demographic Data

Certain Air Force manpower planners were interested in obtaining demographic characteristics of current and/or separating Air Force personnel along with attitudinal data for current Air Force personnel. The data they desired included:

- For separating person

  - Aptitude
  - Education

- For current and/or separating Air Force personnel

  - Sex
  - Educational level (at least high school versus non-high school)
  - Term of enlistment -- 4 years versus 6 years
  - Attitude
  - Age
  - Performance data/skill level (AFSC)
  - Marital status
  - Number and age of dependents
  - Educational level of wife
  - The number of assignments (including remote assignments) a person has had versus his occupation

One officer expressed a desire for attitudinal data in the form of job satisfaction indices, which he intended to use to measure the maximum retention likelihood.

3.3 Design Implications

The interviews of Air Force manpower and training planners provided detailed indications of Air Force desires for outputs from the National Skills Market Model in terms of:

- Desired types of national labor market information.

- Desired degrees of regional detail.

- Critical skill areas to be addressed by the model.

- Principal competing industries to be incorporated in the model.

- Desired dimensions and levels of demographic detail for both recruiting and reenlistment.

The realistic capability of developing a National Skills Market Model fulfilling these desires is discussed in the remainder of this report.

PART II

THE NON-MILITARY LABOR MARKET MODULE

4.0 NATIONAL ECONOMY MODULE

The current structure and forecasting capabilities of the major econometric models of the United States economy were reviewed to determine how adequately each could serve as the national economy module of the National Skills Market Model. Each examination compared the features of a model with the established and prospective data requirements of accession and retention models, and with the capabilities desired by the Air Force personnel interviewed. The model features considered most relevant to these concerns were given special emphasis. The characteristics receiving special attention were:

- **Unemployment rates.** Most accession and retention models reviewed in this study included unemployment rates as explanatory variables. Accession models, in particular, often used some form of unemployment rate for teenagers to explain recruiting success.

- **Employment in specific industries.** Since the National Skills Market Model would be used to forecast economic conditions in industries that compete with the Air Force for personnel, the provision of employment projections for such industries would be a necessary feature of any national economic model considered for use in the National Skills Market Model. Clearly, the degree of industry detail incorporated in a model's structure would limit the extent to which Air Force manpower forecasts could be associated with relevant industry types.

- **Wage rates.** General civilian wage rates, or wage rates in certain specific industries, were used in most accession and retention models and were shown to influence enlistment decisions.

- **Regional employment.** Projections of localized trends in labor market conditions would be useful in structuring recruiting and reenlistment efforts.

- Demographic detail in population and unemployment forecasts. To use existing accession models to predict total enlistments, population forecasts for various age groups would be necessary. In addition, since accession models often use some form of unemployment rate for teenagers as an explanatory variable, demographic detail would also be desirable in forecasts of unemployment rates.

- Technological change. Improvements in technology would be expected to modify industry skill requirements, to affect industry growth, and consequently to alter the occupational structure of industry employment.

After examining a number of models, six were chosen for detailed review. These models included:

- Bureau of Labor Statistics Economic Growth Model (BLS Model).

- INFORUM: The Interindustry Forecasting Model of the University of Maryland.

- Michigan Quarterly Econometric Model.

- Chase Econometric Long-Term Interindustry Forecasting Model (Chase Model).

- Data Resources Incorporated Model (DRI Model).

- Wharton Long-Term Annual and Industry Forecasting Model (Wharton Model).

S   .ral general observations should be made about these models. The models commonly project economic activity on an annual basis throughout a ten to fifteen year forecasting period, and on a quarterly basis throughout a two to three year period. All of the models are recalibrated periodically to adjust model characteristics to changes in the structure of the economy. Because a basically macroeconomic approach is employed in all models, the industry-specific variables are derived by partitioning the national economic forecasts to obtain disaggregated forecasts by industry.

In addition to these comments on model mechanics, several aspects of their use should be noted.[4] Operational models must occasionally be modified to maintain their reasonableness. Thus, all of the models examined in this study are refined periodically through the adjustment of internal parameters and the selection of appropriate inputs. Though many modifications pertain only to details, occasionally theoretical structures are reworked or completely new components are added.

Such manipulation is essential to the continued success of the economic modelling. Continual updating facilitates the incorporation of novel trends resulting from technological change. The inclusion of the latest data and the most recent versions of theoretical structures not only satisfies the desire for theoretical appropriateness, but also fulfills the need for accurate parameter estimates.

General comments aside, the models selected for detailed evaluation can be grouped into two classes. Whereas several derive unemployment estimates endogenously, two of the models employ exogenously supplied forecasts of unemployment. Both INFORUM and the BLS Model assume a sequence of unemployment levels for the quarters of the forecasting period. As a result, the economic forecasts are forced to be compatible with unemployment goals. Since, as explained in Section 3, unemployment rates are included as explanatory variables in most accession and retention models, neither INFORUM nor the BLS Model seem appropriate components of the National Skills Market Model.

The remaining four models all derive unemployment rate forecasts endogenously. However, it appears that the Michigan Quarterly Econometric Model provides forecasts that are highly aggregated and do not contain the detail required of the National Skills Market Model. Therefore, the DRI Model, the Wharton Model, and the Chase Model appear to be most appropriate for Air Force purposes. The remainder of this section summarizes the fundamental characteristics of these three models, focusing on the six features of special interest previously listed.

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[4]Additional comments concerning the use of econometric models in forecasting are available in A Comparison of Econometric Models: A Study Prepared for the Use of the Joint Economic Committee, Congress of the United States, July 28, 1978, Washington, D. C., U. S. Government Printing Office. 30-317, 1978.

4.1 Data Resources Incorporated (DRI) Model

4.1.1 Model Structure and General Economic Forecasts

The DRI Model uses the income-expenditure approach to develop its forecasts. The circular flow of income and expenditures, as measured in the national income accounts, defines the relationship among the spending and income variables in the model. The financial sector and wage-price mechanism interact simultaneously with the expenditure variables. Many of the model's individual equations embody the most recent consensus of economic theory, including a neoclassical production function, an employment-adjustment function for productivity, and a price-cost relationship for profits. The DRI Model employs 392 stochastic equations, 441 identities, and 174 exogenous variables. In all, the model contains some 1,000 variables. The major components of the model and their interrelationships are depicted in Figure 3.

Short-term forecasts of Gross National Product, total unemployment, and the unemployment rate throughout a 3 year forecasting period are provided quarterly. Long-term projection of these variables through the year 2003 are updated annually.

4.1.2 Employment Forecasts

The DRI Model contains equations for production in 75 industries. Using these relationships, employment forecasts are developed for the 29 industrial sectors listed in Table 3. Production is the key determinant of investment and employment. The model uses an input/output matrix to produce a projected output series. Standard regression techniques are then applied in comparing actual and projected output to detect implicit changes in input/output coefficients. Additional information is used to alter the coefficients whenever the 1967-based information is judged atypical or when structural changes have substantially altered interindustry relationships. The coefficients have also been systematically recalibrated to reflect 1972 and, then, 1975 experiences.
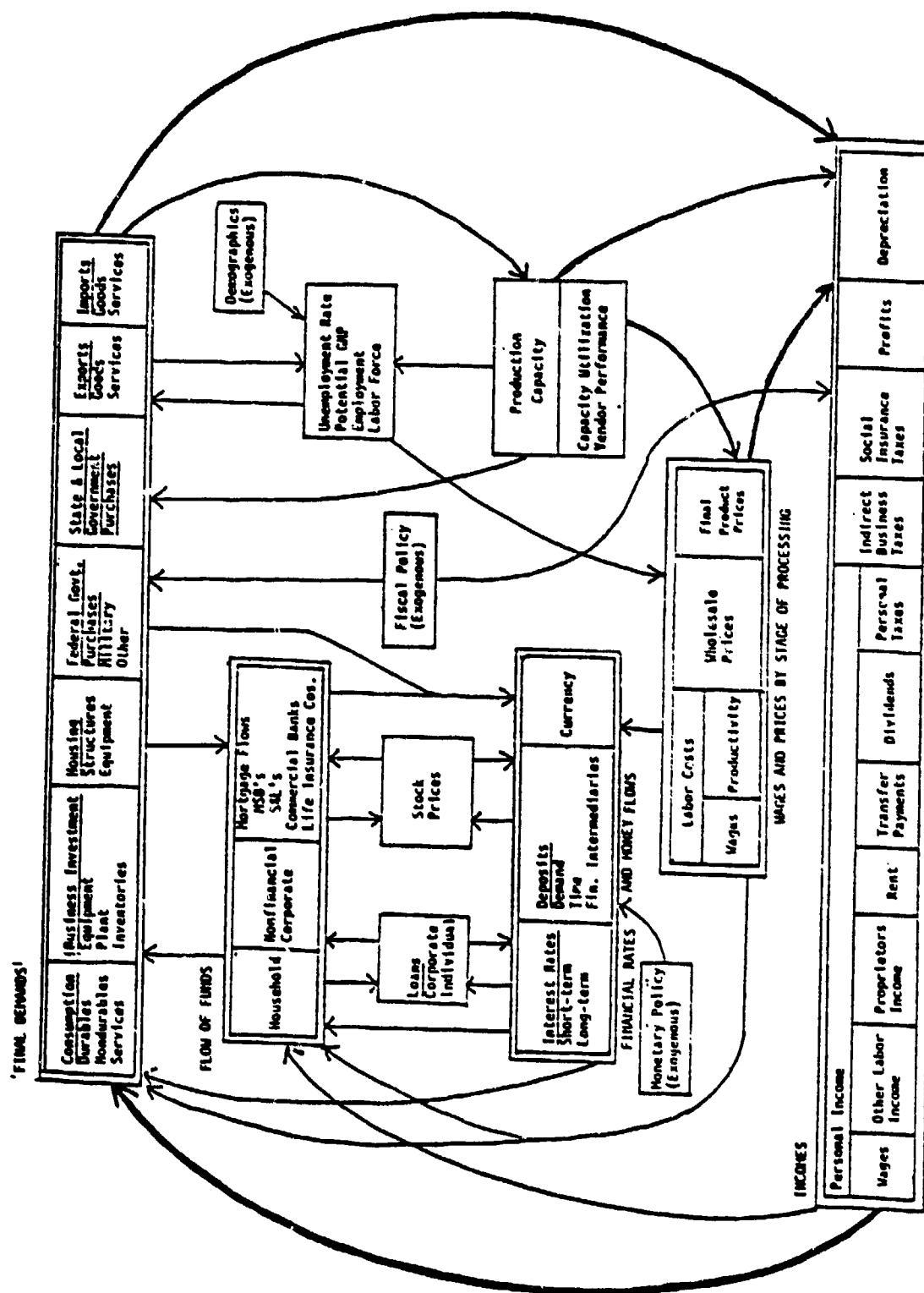
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FIGURE 3: Overview of the DRI Quarterly Model of the United States Economy

TABLE 3: Industrial Sector Employment Forecasts
Developed in the DRI Model

SIC Code*	Sector Description
10-14	Mining
15-17	Contract Construction
20	Food and Beverages
21	Tobacco
22	Textile Mill Products
23	Apparel and Related Products
24	Lumber and Wood Products
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing and Publishing
28	Chemicals
29	Petroleum Refining
30	Rubber and Miscellaneous Plastic Products
31	Leather and Leather Products
32	Stone, Clay and Glass Products
33	Primary Metals
34	Fabricated Metal Products
35	Nonelectrical Machinery
36	Electrical Machinery
37	Transportation Equipment
38	Instruments Manufacturing
39	Miscellaneous Instruments Manufacturing
40-49	Transportation and Public Utilities
50-59	Wholesale and Retail Trade
60-67	Finance, Insurance and Real Estate
70-89	Services
91-97	Federal Government
91-97**	State and Local Government
91-97	Military

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*Standard Industrial Classification Code, as defined in Executive Office of the President, Office of Management and Budget, Statistical Policy Division, Enterprise Standard Industrial Classification Manual. 1974, Washington, D.C., U. S. Government Printing Office, 1974.

**The state and local government sector includes portions of SIC 80 (Health Services), SIC 82 (Educational Services), and SIC 83 (Social Services).

Industry employment projections are derived from the model's production forecasts using a standard production function which relates industry output to employment, the elasticity of output with respect to employment, and labor productivity growing exponentially over time. By applying this formulation, a desired level of employment corresponding to the previously calculated production forecast is developed. Equations translating desired employment into projections of actual employment then capture any delays in filling employment opportunities. Military employment is entered exogenously; and government spending is used as a surrogate for production in the civilian government employment equations. Total employment is not projected as the sum of the various industry employment forecasts. Instead, it is estimated using a relationship between the unemployment rate and the size of the civilian labor force. The size of the labor force, in turn, is derived from forecasts of population and labor force participation rates.

4.1.3 Wage Rate Forecasts

The Cost Forecasting Service of DRI develops wage rate projections for 27 manufacturing sectors corresponding to various two-, three-, and four-digit SIC codes. Table 4 lists these manufacturing sectors. Wage forecasts are also developed for the construction and retail trade sectors. All wage forecasts are projected through the year 1990.

The DRI Model develops its wage forecasts on the basis of three general concepts: inflationary pressure, production effects, and contract negotiations. Inflationary pressure is measured in terms of the consumer price index (CPI), wages in other economic sectors, and aggregate wages. Production effects are indicated by a production index, overtime, the demand for labor, and the unemployment rate. Contract negotiations and strike considerations are used to forecast wage rates for industrial sectors defined by three- or four-digit SIC codes.

4.1.4 Regionalization

The State and Area Forecasting Service of DRI provides projections of manufacturing and nonmanufacturing employment for each state. National employment figures are disaggregated to the state level using a shift share analysis procedure. Military employment is not forecast. In the future, DRI plans to develop projections of manufacturing employment by state at the two-digit SIC level. Forecasts of total population are also available at the state level.

TABLE 4: Industrial Wage Rate Forecasts
Developed in the DRI Model

SIC Code	Sector Description
101	Iron Ores - Metal Mining
12	Coal Mining
27	Printing and Publishing
281	Industrial Inorganic Chemicals
291	Petroleum Refining
30	Rubber and Miscellaneous Plastics Products
33	Primary Metal Industries
331	Blast Furnace and Basic Steel Products
333	Primary Nonferrous Metals
3334	Primary Aluminum
34	Fabricated Metal Products
35	Machinery, Except Electrical
36	Electric and Electronic Equipment
3694	Engine Electrical Equipment
37	Transportation Equipment
372	Aircraft and Parts
3721	Aircraft
3724	Aircraft Engines and Engine Parts
373	Ship and Boat Building and Repairing
3731	Ship Building and Repairing
381	Engineering and Scientific Instruments
421 & 423	Trucking, Local and Long Distance/Trucking Terminal Facilities
422	Public Warehousing
46	Pipelines, Except Natural Gas
481	Telephone Communication
489	Communication Services
701	Hotels, Motels and Tourist Courts
15-17	Construction
52-59	Retail Trade

4.1.5 Demographic Detail

National forecasts of unemployment rates are developed for married males, all males, females, white, nonwhites, teenagers, and adults. Total population and the annual rate of change in population are projected for three overlapping age groups: 16 and over, 16 to 19, and 18 to 64. Forecasts are also developed for the size of the civilian population and the civilian labor force participation rate. All forecasts are available for both the short-term (the next 3 years) and the long-term (through the year 2003).

4.1.6 Technological Change

Different sectors of the model are recalibrated periodically to reflect changing manufacturing processes and fundamental changes in the structure of the economy.

4.2 Wharton Long-Term Annual and Industry Forecasting Model (Wharton Model)

4.2.1 Model Structure and General Economic Forecasts

The Wharton Model is an income-expenditure model which incorporates a 47 industrial sector input/output model as an integral part of its structure. The major components and causal flows of the model are illustrated in Figure 4. The model currently contains 264 stochastically estimated equations, 207 exogenous variables, and 324 identities. An important feature of the model structure is the inclusion of sectoral prices in the input/output sector. These prices aid in estimating the impact of price-induced substitutions among inputs.

Ten year and 10 quarter projections of Gross National Product, total unemployment, and unemployment rates are updated quarterly. Long-term forecasts of these variables through the year 2000 are provided annually.

FIGURE 4: Overview of the Wharton Long-Term
Annual and Industry Forecasting Model
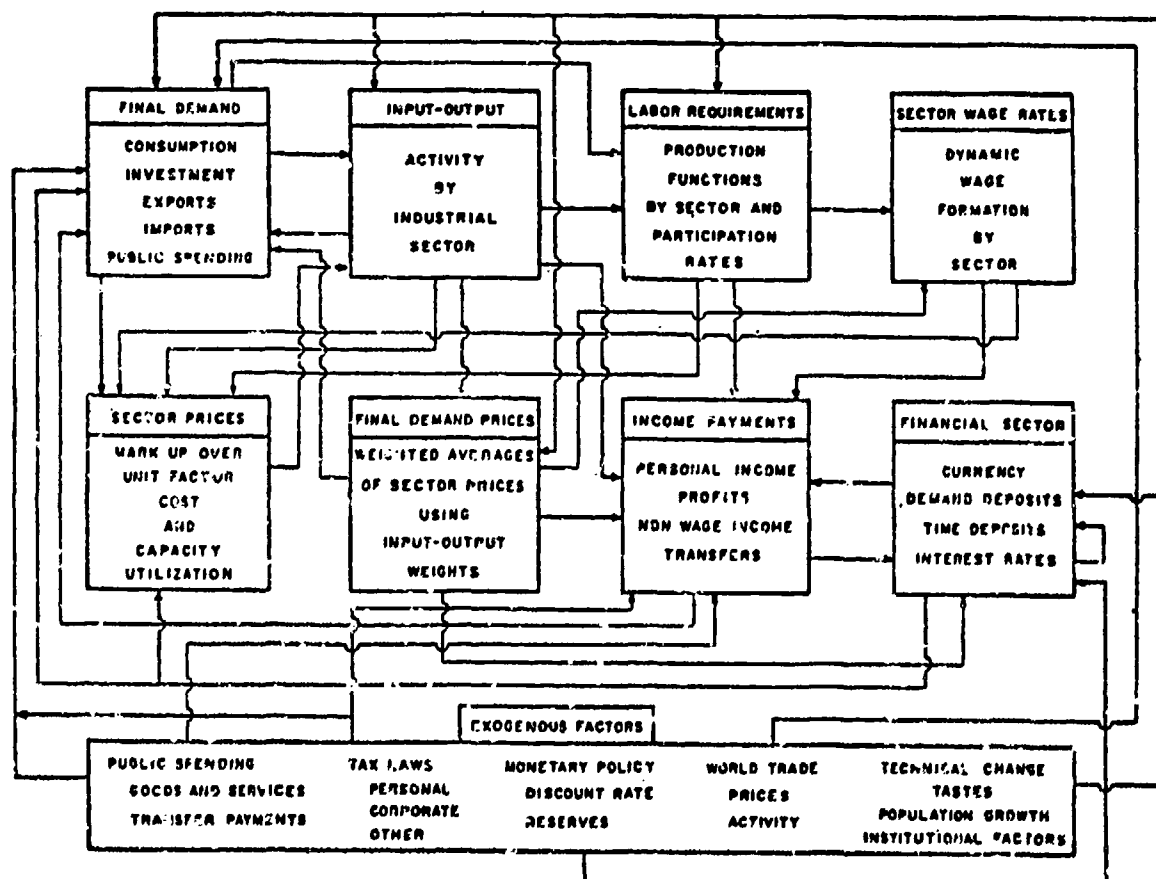
Republished with permission from Wharton Econometric Forecasting
Associates, Inc., The Wharton Annual and Industry Forecasting Model,
Philadelphia, Pennsylvania, July, 1976.

4.2.2 Employment Forecasts

The labor requirements sector of the Wharton Model is parti-
tioned by industry, and contains 22 manufacturing and 10 nonmanufac-
turing production functions. Each production function is represented
by a standard neoclassical formulation which assumes unit elasticity
of substitution between labor and capital and includes a surrogate
variable for technological change. Labor requirements are derived
by expressing the production functions as equations specifying labor
or person-hours, with capital stock, output, and technological change
remaining as explanatory variables. Person-hour projections are
developed separately from employment forecasts due to differences
in their speeds of adjustment to equilibrium. Direct employment fore-
casts are available for the 32 industrial sectors indicated in Table 5.

The model's representation of the labor force treats males and
females separately. Important inputs to this representation include
variables measuring population and labor market tightness. The tight-
ness variables capture variation in labor force participation rates in
response to opportunities available within the economy over the course
of the business cycle. Both male and female labor force equations are
sensitive not only to the corresponding population categories, but also
to a lagged distribution of the reciprocal of the unemployment rate.
The results suggest that males and females are drawn into the labor
force in a non-proportionate way over the course of the business cycle.
The equations also include a downward trend for male participation
rates and an upward trend for female participation rates.

After total employment and the size of the labor force have been
determined, the unemployment rate is derived from an identity which
treats total unemployment as the difference between the labor force
and total employment.

4.2.3 Wage Rate Forecasts

Wage rates are projected using linear regression equations
which include previous price changes, the demand for labor, and
unemployment rates as explanatory variables. The wage equations
also contain lag/lead relationships among various industrial sectors
within the economy.

TABLE 5: Industrial Sector Employment Forecasts
Developed in the Wharton Model

SIC Code	Sector Description
00-09	Agriculture
10-14	Mining
15-17	Contract Construction
19	Ordnance
20	Food and Beverages
21	Tobacco
22	Textile Mill Products
23	Apparel and Related Products
24	Lumber and Wood Products
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing and Publishing
28	Chemicals
29	Petroleum Refining
30	Rubber and Miscellaneous Plastic Products
31	Leather and Leather Products
32	Stone, Clay and Glass Products
33	Primary Metals
34	Fabricated Metal Products
35	Nonelectrical Machinery
36	Electrical Machinery
371	Motor Vehicles
372-379	Non-Auto Transportation Equipment
38	Instruments Manufacturing
39	Miscellaneous Instruments Manufacturing
40-47	Transportation
48	Communications
49	Utilities
50-59	Wholesale and Retail Trade
60-67	Finance, Insurance and Real Estate
70-89	Services
91-97*	Federal Government
91-97	State and Local Government

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*The state and local government sector includes portions of
SIC 80 (Health Services), SIC 82 (Educational Services), and SIC 83
(Social Services).

Using these equations, hourly wage rate forecasts are developed selectively at the two-digit SIC level in manufacturing. In addition, weekly wage rate forecasts are provided for certain nonmanufacturing sectors. The industrial sectors for which wage projections are produced are identical to the sectors for which employment is forecast, as listed in Table 5. Wage forecasts for every year through 2000 are produced semi-annually.

4.2.4 Regionalization

The Wharton Model provides regional detail in its employment forecasts only for the New England states. As a service to the New England Economic Project, a consortium of six business firms and one state government, Wharton Econometric Forecasting Associates develops projections of manufacturing and nonmanufacturing employment for six states: Massachusetts, Connecticut, Rhode Island, Vermont, New Hampshire, and Maine.[5] Moreover, the state forecasts of manufacturing employment are disaggregated selectively to the two-digit SIC level; while nonmanufacturing employment is projected at the division level. The 10 SIC code divisions included in the New England state employment forecasts are presented in Table 6.

4.2.5 Demographic Detail

As a product of contract research conducted for the Office of Naval Research, Wharton Econometric Forecasting Associates has developed methods of forecasting labor force participation rates, unemployment rates, and school enrollment by age group. Unemployment rate and labor force participation rate projections are provided for males and females in seven distinct age groups: 16 to 19, 20 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and over. School enrollment, and school enrollment rates, are projected for five age/sex groups: females ages 16 to 19, females ages 20 to 24, males ages 16 to 17, males ages 18 to 19, and males ages 20 to 24. No racial detail is provided in either the unemployment or the population forecasts.

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[5]Also, Bill Milne, in his doctoral dissertation for the Wharton School of Business, developed a methodology for using the Wharton Model to develop regional employment forecasts for 12 industrial sectors in nine regions of the United States. This regional forecasting adjunct is not routinely available in the Wharton Model.

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TABLE 6: Industrial Division Employment Forecasts
Developed for New England States
by the Wharton Model

SIC Code	Divisions
00-09	Agriculture, Forestry and Fishing
10-14	Mining
15-17	Construction
20-39	Manufacturing
40-49	Transportation and Public Utilities
50-51	Wholesale Trade
52-59	Retail Trade
60-67	Finance, Insurance and Real Estate
70-89	Services
91-97	Public Administration
(99)	(Nonclassifiable Establishments)

4.2.6 Technological Change

Different sectors of the Wharton Model are recalibrated annually to incorporate changes in industrial processes or other fundamental characteristics of the structure of the economy.

4.3 Chase Econometric Long-Term Interindustry Forecasting Model (Chase Model)

4.3.1 Model Structure and General Economic Forecasts

The Chase Econometric Long-Term Interindustry Forecasting Model links the Chase Long-Term Macroeconomic Model with the Interindustry Forecasting Model of the University of Maryland (INFORUM) to create an income-expenditure model embodying a dynamic 200 industrial sector input/output model as a basic structural component. In all, the model develops forecasts of more than 600 types of key income, price, investment, financial, and industrial variables. The major components and basic structure of the model are depicted in Figure 5.

Short-term forecasts of general economic activity -- including projections of Gross National Product, total unemployment, and unemployment rates -- are developed monthly for the succeeding 10 quarters. Similar long-term forecasts are provided monthly for the next 10 years.

4.3.2 Employment Forecasts

The Chase Model contains equations to forecast labor productivity in 95 industrial sectors formed by selectively combining the 200 industries described in its input/output matrix. These equations relate utput per full-time equivalent employee to such variables as industry output, the growth rate of industry output, the average installation date of capital stock, lagged labor productivity, and time. Using these relationships, labor productivity is forecast for each industrial sector. These productivity forecasts are then combined with the model's output projections for the 95 industrial sectors to generate forecasts of the number of full-time equivalent employees

Macroeconomic Environment
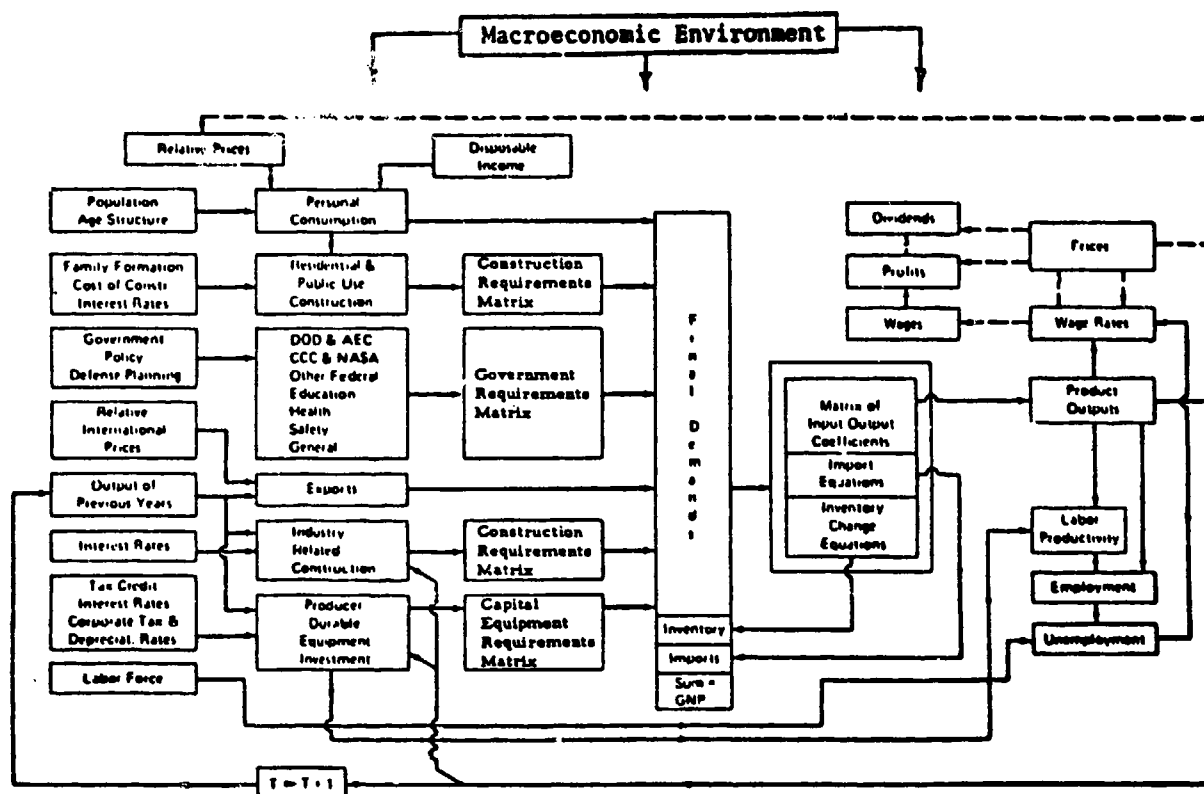
Dotted lines indicate work still under development.

Republished with permission from Chase Econometric Associates, Inc.,
INFORUM, A User's Guide to the Long-Term Interindustry Forecasting
Model, Bala Cynwyd, Pennsylvania, p. 19.

FIGURE 5: Overview of the Chase Econometric
Long-Term Interindustry Forecasting Model

in each sector. Table 7 presents a list of the industrial sectors for which employment forecasts are developed. Forecasts are produced three times per year for the succeeding 10 quarters and 10 years.

4.3.3 Wage Rate Forecasts

The Chase Model provides minimal detail in its wage rate forecasts. Hourly wage rate forecasts are developed only for three broad industry groups: manufacturing, construction, and other industry. Wage forecasts are generated monthly for the next 10 quarters and 10 years.

4.3.4 Regionalization

Chase Econometric Associates has developed an individual model of the economy of each of the 50 states. The models take into account such factors as the cost of doing business, state responses to the business cycle in the various states, tax policies, energy conditions, and the age of the capital stock.

Using these models, manufacturing and nonmanufacturing employment, unemployment, and the size of the civilian labor force are forecast for the 50 states and the District of Columbia. Moreover, the forecasts of manufacturing employment are disaggregated to provide employment projections for almost all manufacturing sectors at the two-digit SIC level, as appropriate to the individual state's economy. In addition, Chase Econometric Associates plans to provide forecasts of nonmanufacturing employment for six industrial divisions within 4 to 5 months.

Finally, projections of manufacturing and nonmanufacturing employment, unemployment, and the size of the labor force are also prepared for 104 of the country's largest metropolitan areas.

4.3.5 Demographic Detail

The Chase Model uses U. S. Bureau of the Census data to forecast the national population aged 16 and over. Econometrically-derived population projections for each state are partitioned by age and sex within 5 year age cohorts. In addition to forecasting general unemployment rates, separate unemployment rate forecasts are provided for married men. Finally, separate projections of the number of self-employed people and the number of farm laborers are prepared.

TABLE 7: Industrial Sector Employment Forecasts
Developed in the Chase Model

SIC Code	Sector Description
00-09	Agriculture
10-14	Mineral and Coal Mining; Petroleum and Gas Mining
15-17	Construction
19	Ordnance
20	Meat Products; Dairy Products; Canned and Frozen Foods; Grain Mill Products; Bakery Products; Sugar; Confectionery Products; Beverages; Miscellaneous Food Products
21	Tobacco Products
22	Fabrics, Yarns and Threads; Floor Coverings; Knitting Mill Products; Knit Fabrics and Apparel
23	Apparel; Household Textiles
24	Logging and Lumber; Plywood and Millwork; Wooden Containers
25	Furniture
26	Pulp and Paper Products; Paper Containers
27	Newspapers; Printing and Publishing
28	Industrial Chemicals; Agricultural Chemicals; Miscellaneous Chemical Products; Plastics and Synthetics; Drugs; Cleaning and Toilet Preparations; Paints and Allied Products
29	Petroleum Refining
30	Tires and Inner Tubes; Rubber Products; Miscellaneous Plastic Products
31	Industrial Leather and Tanning; Footware, Other Leather, and Luggage
32	Glass and Clay Products; Stone and Clay Products
33	Iron and Steel; Nonferrous Metals
34	Metal Containers; Plumbing and Heating Equipment; Structural Metal Products; Stamping and Screw Machine Products; Hardware and Pipe
35	Engines and Turbines; Farm Machinery and Equipment; Construction, Mining, Oil and Material Handling Equipment; Metalworking Machinery; Special Industry Machinery; General Industry Machinery; Machine Shop Products; Office and Computing Equipment; Service Industry Machinery

TABLE 7 (continued)

SIC Code	Sector Description
36	Electrical Transmission Equipment; Electrical Industrial Apparatus; Household Appliances; Electrical Wiring and Lighting Equipment; Radios, TVs, Phonos and Records; Communications Equipment; Electronic Components; Miscellaneous Electrical Machinery and Supplies
37	Motor Vehicles and Parts; Aircraft and Parts; Ship and Boat Building and Repair; Railroad Equipment; Cycles, Trailers, Other Transportation
38	Engineering and Scientific Instruments; Mechanical Measuring Devices; Medical Instruments and Supplies; Optical, Photographic Goods and Clocks
39	Miscellaneous Manufacturing
40-47	Railroads; Trucking and Warehousing; Other Transportation; Airlines
48	Communication Services
49	Electrical Utilities; Natural Gas, Water and Sewer Services
50-59	Wholesale and Retail Trade
60-67, 70-89	Finance and Services
91-97	Federal Government; State and Local Government; Domestic Servants; Federal Civilian Defense; Federal Non-Defense; Public Education; Armed Forces; State and Local Non-Education

No racial detail is available in any of the model's population or unemployment forecasts.

4.3.6 Technological Change

The introduction of new technologies generally necessitates changes in the technical coefficients of the input/output matrix embedded in the Chase Model. Similarly, changes in technical coefficients can be compelled by changes in laws or regulations, changes in preferences, or changes in relative prices. In those industries in which changes in technical coefficients are expected, analyses are performed to determine the actual paths of the coefficients over time.

Four basic methods are used to project the values of the technical coefficients of the Chase Model into the future:

- Developing ex ante forecasts of coefficient values by estimating the technical input structure of the industry in some future year, transforming the estimated input structure into a numerical format compatible with input/output analysis, and deriving from these data a new set of technical coefficients for the input/ output matrix. This method is only employed infrequently.

- Identifying the historical pattern of changes in the values of the technical coefficients, and approximating that pattern with a logistic curve.[6] This is the most commonly used method of adjusting coefficient values.

- Determining the relative price elasticities of the technical coefficients in terms of the changes induced in coefficient values by changes in input prices relative to the prices of substitutes. This method is applied only to the energy-related industrial sectors.

- In a small number of cases, assuming that the coefficients will remain unchanged.

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[6]The logistic curve is an S-shape curve depicting the growth pattern of a technology's market share over time. Such curves have been demonstrated to provide good empirical approximations to the growth patterns of the market shares gained by successful innovations.

Thus, the Chase Model contains standardized procedures to anticipate the impacts of technological change, rather than merely responding to such change after it has occurred. The modifications in model projections associated with this capability will be most noticeable in relatively long-term forecasts, especially forecasts extending more than 5 years into the future.

4.4 Summary and Recommendations

Three major econometric models of the United States economy were examined in detail to determine how adequately each could fulfill the requirements of the National Skills Market Model. This examination focused on six specific forecasting characteristics of the models: unemployment rates, employment in specific industries, wage rates, regional employment, demographic detail, and technological change. The capabilities of the three models with respect to each of these six characteristics are summarized in Table 8. This table demonstrates that each of the models has its own special strengths. Specifically:

- The DRI Model provides extensive demographic detail in its unemployment forecasts, which are partitioned by sex, race, and age. In addition, it uses a rigorous economic approach to produce wage rate forecasts for a relatively large number of industries.

- The Wharton Model develops wage rate forecasts for precisely the same industrial sectors for which it produces employment forecasts. Thus, its employment and wage rate forecasts are highly compatible. In addition, the model provides detailed age classification in its unemployment rate, labor force participation rate, school enrollment, and school enrollment rate projections.

- The Chase Model provides abundant industrial detail in its employment and labor productivity forecasts. It also offers a high degree of regional detail in its employment, unemployment, and civilian labor force projections. Finally, the model attempts to anticipate the consequences of technological changes on the economy, rather than merely adjusting for technological changes after they occur.

TABLE 8: Characteristics of National Economic Models

Model	Unemployment Rate Forecasts	Employment Forecasts	Wage Rate Forecasts	Regionalization	Demographic Detail	Technological Change
Data Resources Incorporated Model (DRI Model)	• Short-term (three year) forecasts are updated quarterly • Long-term (through 2005) forecasts are updated annually	• Total employment forecasts for 29 industrial sectors	• Wage forecasts for construction, retail trade, and 27 manufacturing sectors corresponding to various 2, 3, and 4 digit SIC codes	• Forecasts of manufacturing and nonmanufacturing employment by state • Total population forecasts by state	• Forecasts of national unemployment for all males, married males, females, whites, nonwhites, teenagers, and adults • Population and annual growth rate of population projected for ages 16 and over, 16 to 19, and 18 to 64 • Forecasts of the civilian labor force and the labor force participation rate	Model updated periodically to reflect technological change
Wharton Long-Term Annual and Industry Forecasting Model (Wharton Model)	• Ten quarter and ten year forecasts are updated quarterly • Long-term (through 2000) forecasts are updated annually	• Total employment forecasts for 32 industrial sectors	• Hourly wage rate forecasts for 22 selected manufacturing sectors at the 2 digit SIC level • Weekly wage rate forecasts for 10 nonmanufacturing divisions • Wage rate forecasts developed for same industrial sectors as employment forecasts • Wage rates projected for every year through 2000 and updated semiannually	• Forecasts of manufacturing and nonmanufacturing employment for six New England states • Manufacturing employment forecasts are disaggregated selectively to the 2 digit SIC level • Nonmanufacturing employment forecasts are developed at the division level	• Unemployment rate and labor force participation rate forecasts for males and females for ages 16 to 19, 20 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and over • School enrollment and school enrollment rate forecasts for females aged 16 to 19 and 20 to 24, and for males aged 16 and 17, 18 and 19, and 20 to 24 • No racial detail in any unemployment or population forecasts	• Model updated periodically to reflect technological change
Chase Econometric Long-Term Interindustry Forecasting Model (Chase Model)	• Ten quarter and ten year forecasts are updated monthly	• Total employment and labor productivity forecasts for 95 industrial sectors	• Hourly wage rate forecasts for manufacturing, construction, and all other industry • Wage rates projected for succeeding 10 quarters and 10 years, and updated monthly	• Forecasts of manufacturing and nonmanufacturing employment, unemployment, and civilian labor force for 50 states and the District of Columbia • Manufacturing employment forecasts disaggregated selectively to 2 digit SIC level • Nonmanufacturing employment to be forecast for six divisions within 4 or 5 months • Forecasts of manufacturing and nonmanufacturing employment for 104 of the country's largest metropolitan areas	• Forecasts of national population aged 16 and over, self-employed persons, and farm laborers • Unemployment rate forecasts for married men • State population forecasts by age and sex with five age categories • No racial detail in any population or unemployment forecasts	• Model adjusted periodically in anticipation of technological and other changes

Thus, none of the three models uniformly provides all of the capabilities desired by the Air Force for the National Skills Market Model. Consequently, it will be necessary for the Air Force to determine the relative importance it attaches to each of these capabilities before a single national economic model can be selected as the national economy module of the National Skills Market Model.

5.0 THE REGIONALIZATION MODULE

The Air Force manpower and training officers interviewed in this study generally expressed a desire for regional detail in the forecasts produced by the National Skills Market Model. Yet, none of the three national economic models examined in detail in Section 4 provides state or regional projections of labor market activity containing as much industrial sector detail as is included in its national forecasts. The DRI Model produces forecasts of total manufacturing employment and total nonmanufacturing employment for each state, while it provides national employment projections for 29 industrial sectors. The Wharton Model develops subnational employment forecasts for six New England states. Finally, the Chase Model generates national employment forecasts for 95 industrial sectors; but provides, or soon will provide, state employment forecasts for just six nonmanufacturing divisions and selected manufacturing sectors at the two-digit SIC level.

This section examines the feasibility of developing a regionalization module to enhance the National Skills Market Model's capability of developing state or regional employment forecasts with improved industrial sector detail. Thus, in Subsection 5.1 a general methodology is developed for disaggregating national forecasts of industrial sector employment to produce state or regional forecasts containing the same level of industrial sector detail. Subsection 5.2 then investigates the availability and quality of existing data bases which might be used to implemer the regionalization methodology. Finally, in Subsection 5.3 the implications of this examination for the design and implementation of a regionalization module are summarized.

5.1 General Regionalization Methodology

The disaggregation of national forecasts of industrial sector employment into a compatible set of state or regional forecasts of industrial sector employment can be readily accomplished through the use of existing data describing the observed or estimated geographic distribution of employment in the various industrial sectors for a suitable base year. Such data can be used to calculate the proportion of each industrial sector's total national employment that was located in each state or region of interest to the Air Force in the base year. The calculated proportionality factors can then be applied to the national

forecasts of industrial sector employment generated by the National Skills Market Model's national economy module to produce projections of state or regional employment in each industrial sector.

The general procedure for developing state or regional forecasts of industrial sector employment can, therefore, be expressed as:

$$E_{jkt} = E_{jk}^0 \cdot E_{jt} / \sum_{k=1}^{n} E_{jk}^0$$

where:

E_{jkt} = projected employment in industrial sector j in state or region k for year t.

E_{jk}^0 = observed or estimated employment of industrial sector j in state or region k for the base year.

E_{jt} = projected total national employment of industrial sector j in year t.

n = the number of states or regions of interest to the Air Force.

This formal expression of the calculation procedure emphasizes one important fact. The same classification of industrial sectors must be contained in both the base year observations or estimates of industrial sector employment for states or regions and the national economy module's forecasts of total industrial sector employment. Thus, the degree of industrial sector detail contained in the state or regional employment projections produced using this procedure cannot exceed the industrial sector detail contained in the more highly aggregated of these two data sources.

Recognizing this limitation, the following subsection examines two promising alternative sources of base year observations of industrial sector employment for states or regions.

5.2 Alternative Data Sources

Two alternative sources of data describing industrial sector employment for states or regions have been identified in this study. These data bases are Regional Employment by Industry, 1940-1970[7] and Regional Work Force Characteristics and Migration Data.[8] Both are compiled by the Bureau of Economic Analysis of the Department of Commerce. The first contains a relatively high level of industrial sector and geographic detail, but is only compiled decennially; while the second contains substantially more limited industrial sector and regional detail, but is updated annually.

Specifically, Regional Employment by Industry, 1940-1970 contains decennial Census of Population employment tabulations by place of residence of the employees for the United States, eight regions, the 50 states and the District of Columbia, and the counties within the states. The employment data are compiled for 30 civilian industrial groups in 1940 and 35 such groups in 1950, 1960, and 1970. The regions for which the data are tabulated, and the states included within each region, are listed in Table 9; and the industrial groups described by the data, and the approximate SIC sectors which are equivalent to these groups, are presented in Table 10.

In contrast, Regional Work Force Characteristics and Migration Data contains annual employment tabulations developed from the Continuous Work History Sample assembled from employers' quarterly reports to the Social Security Administration. The employment data are compiled for only nine major industrial groups in the nine Census regions. Thus, the regions for which the data are accumulated include the New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific regions. The major industrial groups for which tabulations are prepared include: Agriculture, Forestry, and Fisheries; Mining;

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[7]U. S. Department of Commerce, Bureau of Economic Analysis, Regional Employment by Industry, 1940-1970, Washington, D. C., U. S. Government Printing Office, 1975.

[8]U. S. Department of Commerce, Bureau of Economic Analysis, Regional Work Force Characteristics and Migration Data, Washington, D. C., U. S. Government Printing Office, 1976.

TABLE 9: Regions Included in Regional Employment by Industry, 1940-1970

Region	States Included Within Region
New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Mideast	Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania
Great Lakes	Illinois, Indiana, Michigan, Ohio, Wisconsin
Plains	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
Southeast	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia
Southwest	Arizona, New Mexico, Oklahoma, Texas
Rocky Mountain	Colorado, Idaho, Montana, Utah, Wyoming
Far West	Alaska, California, Hawaii, Nevada, Washington, Oregon

TABLE 10: Industrial Groups and Standard Industrial
Classification Equivalents Included in
Regional Employment by Industry, 1940-1970

Industrial Group		Approximate SIC Equivalent	
Code	Title	Code	Title
1	Agriculture and agricultural services	01	Agricultural production
		07	Agricultural services and hunting and trapping except 0713
2	Forestry and fisheries	07	Forestry
		08	Fisheries
3	Mining	10	Metal mining
		11	Anthracite mining
		12	Bituminous coal and lignite mining
		13	Crude petroleum and natural gas
		14	Mining and quarrying of nonmetallic minerals, except fuels
4	Contract construction	15	Building construction -- general contractors
		16	Construction other than building construction -- general contractors
		17	Construction -- general trade contractors
5	Food and kindred products	0713	Grist mills, including custom flour mills
		20	Food and kindred products
6	Textile mill products	22	Textile mill products

TABLE 10 (continued)

Industrial Group		Approximate SIC Equivalent	
Code	Title	Code	Title
7	Apparel and other fabri-cated textile products	23	Apparel and other finished products made from fabrics and similar materials
8	Lumber, wood products, and furniture	24	Lumber and wood products, except furniture
		25	Furniture and fixtures
9	Printing, publishing, and allied industries	27	Printing, publishing, and allied industries
10	Chemicals and allied products	28	Chemicals and allied products
11	Machinery, except electrical	35	Machinery, except electrical
12	Electrical machinery, equipment, and supplies	36	Electrical machinery, equipment, and supplies
13	Motor vehicles and motor vehicle equipment	371	Motor vehicles and motor vehicle equipment
14	Transportation equipment, except motor vehicles	37	Transportation equipment, except 371
15	Paper and allied products	26	Paper and allied products
16	Petroleum refining and related industries	29	Petroleum refining and related industries
17	Primary metal industries	33	Primary metal industries

TABLE 10 (continued)

Industrial Group		Approximate SIC Equivalent	
Code	Title	Code	Title
18	Fabricated and not specified metals	34	Fabricated metals products, except ordnance, machinery, and transportation equipment
19	Miscellaneous manufacturing	19	Ordnance and accessories
		21	Tobacco manufactures
		30	Rubber and miscellaneous plastic products
		31	Leather and leather products
		32	Stone, clay, glass, and concrete products
		38	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks
		39	Miscellaneous manufacturing industries
20	Railroads and railway express	40	Railroad transportation
21	Trucking and warehousing	42	Motor freight transportation and warehousing
22	Other transportation	41	Local and suburban transit and interurban highway passenger transportation
		44	Water transportation
		45	Transportation by air
		46	Pipeline transportation
		47	Transportation services

TABLE 10 (continued)

	Industrial Group		Approximate SIC Equivalent	
Code	Title	Code	Title	
23	Communication	48	Communication	
24	Electric, gas, and sanitary services	49	Electric, gas, and sanitary services	
25	Wholesale trade	50	Wholesale trade	
26	Food and dairy product stores	54	Food stores	
27	Eating and drinking places	58	Eating and drinking places	
28	Other retail trade	52	Building materials, hardware, and farm equipment dealers	
		53	Retail trade -- general merchandise	
		55	Automotive dealers and gasoline service stations	
		56	Apparel and accessary stores	
		57	Furniture, home furnishings, and equipment stores	
		59	Miscellaneous retail stores	
29	Finance, insurance, and real estate	60	Banking	
		61	Credit agencies other than banks	
		62	Security and commodity brokers, dealers, exchanges, and services	
		63	Insurance carriers	

TABLE 10 (continued)

Industrial Group		Approximate SIC Equivalent	
Code	Title	Code	Title
29	(continued)	64	Insurance agents, brokers, and services
		65	Real estate
		66	Combinations of real estate, insurance, loans, law offices
		67	Holding and other investment companies
30	Lodging places and other personal services	70	Hotels, rooming houses, camps, and other lodging places
		72	Personal services
31	Business and repair services	73	Miscellaneous business services
		75	Automobile repair, automobile services, and garages
		76	Miscellaneous repair services
32	Entertainment and recreation services	78	Motion pictures
		79	Amusement and recreation services, except motion pictures
33	Private households	88	Private households
34	Professional services	80	Medical and other health services
		81	Legal services
		82	Educational services
		84	Museums, art galleries, botanical and zoological gardens

TABLE 10 (continued)

Industrial Group		Approximate SIC Equivalent	
Code	Title	Code	Title
34	(continued)	86	Nonprofit membership organizations
		89	Miscellaneous services
35	Public administration	91	Federal government except 9190 (part)
		92	State government
		93	Local government
36	Federal military	9190	Federal government (part)
--	Industry not specified	99	Nonclassifiable establishments

Contract Construction; Manufacturing; Transportation, Communications, and Public Utilities; Trade; Finance, Insurance, and Real Estate; Services; and Government.

5.3 Design Implications

Neither of the data bases described in the preceding subsection provides notably superior industrial sector or geographic detail to the levels of detail routinely provided by the Chase Model. Therefore, if the Chase Model is the national economic model selected for inclusion in the National Skills Market Model, it would be, at best, superfluous to implement the regionalization procedures developed in this section. If either the DRI Model or the Wharton Model is chosen as the national economy module for the National Skills Market Model, the creation of a regionalization module embodying the procedures developed in this section might be beneficial to the Air Force.

Unless the geographic distributions of employment within industrial sectors is believed to change rapidly over time, and unless projecting these distributions using the d.. a contained in Regional Employment by Industry, 1940-1970 is felt to be infeasible, the regionalization procedures should be developed and calibrated on the basis of this data base. Only if the preceding conditions are fulfilled should the employment data tabulated in Regional Work Force Characteristics and Migration Data be used to develop and calibrate the regionalization module.

6.0 THE INDUSTRY-OCCUPATION MATRIX

Whichever national economic model is chosen for inclusion in the National Skills Market Model, the model forecasts are likely to focus on the economic behavior of industrial sectors. Employment requirements will be forecast for each industry sector as a whole. Inasmuch as certain industrial sectors employ persons whose particular skills are needed by the Air Force, detailed employment behavior in these sectors can provide indicators of Air Force manpower impacts. Forecasts of employment requirements in these industries could be used in subsequent estimation of retention rates for Air Force specialties which require skills also needed in the related industries. However, the relationship between most Air Force specialties and identified industry sectors would likely remain vague at best.

If employment demand were known in specific occupations, rather than merely by industrial sector, labor market behavior could be more clearly related to specific Air Force specialties. The Air Force specialties for which retention is problematic could be more closely controlled if employment demand for these skills could be identified specifically. A set of occupation-specific employment forecasts would be preferable to industry-specific employment forecasts.

6.1 Matrix Structure

The mechanism for transforming industry-specific employment estimates into occupation-specific estimates already exists. The U. S. Department of Labor maintains a National Industry-Occupation Matrix describing employment patterns in all industrial sectors of the economy. [9] Estimates of employment are made in each of 420 specific occupations for 201 industrial sectors. These occupational groupings

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[9]U. S. Department of Labor, Bureau of Labor Statistics, Handbook of Methods, Bulletin 1910, pp. 53-55. The description of the National Industry-Occupation Matrix as presented here draws directly from this bulletin.

and industrial sectors were derived from the 1970 Census of Population.[10] The 201 industrial sectors, and their corresponding SIC codes, are listed in Appendix C, while the 420 occupations are presented, with summary national employment data for these occupations, in Appendix D. At present, employment matrices are available for 1970, 1976, and 1985.

The matrices are revised periodically as required using a combination of several data sources. Decennial <u>Occupation by Industry</u>[11] reports from the Bureau of the Census describe usual occupational patterns by industrial sector. Actual employment levels are updated periodically using the data files maintained by the Bureau of the Census describing the results of its <u>Current Population Surveys</u> (CPS). In addition, employment trends are tracked individually in a few occupations and industries. Among these industries are electronics and air transportation, industries already identified as particularly important Air Force labor market competitors. The matrices produced are asserted to be "consistent with (a) national employment by industry, (b) broad occupational employment levels from the CPS, (c) trends in production (and non-production) worker employment by industry, (d) anticipated trends in occupational structure within industries, and (e) reliable estimates of detailed occupational employment available from the CPS and other sources."[12] This combination of data sources provides the matrix with overall quantitative consistency while maintaining sensitivity to trends in particular industries and occupations.

The occupational structures of industries remain relatively stable over periods as long as 5 years. However, updates are required periodically as technological innovations gradually change the occupational requirements of industries. The Bureau of Labor Statistics modifies initial employment estimates as needed using information on technology and labor supply changes. The matrix is updated periodically using the best available estimates of employment

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[10]U. S. Department of Commerce, Bureau of the Census, <u>1970 Census of Population Alphabetical Index of Industries and Occupations</u>, Washington, D. C., U. S. Government Printing Office, 1971.

[11]See, for example, U. S. Department of Commerce, Bureau of the Census, <u>U. S. Census of Population: 1970, Subject Reports, Occupation by Industry</u>, Final Report, PC(2)-7C, 1973.

[12]U. S. Department of Labor, <u>Handbook of Methods</u>, <u>op. cit.</u>, p. 54.

patterns. Furthermore, changes in the current patterns expected during the near future can be approximated by interpolating between the current matrix and the available projected matrix, such as the matrix for 1985.

The remainder of this section examines the potential usefulness of the National Industry-Occupation Matrix in the context of the National Skills Market Model. Thus, Subsection 6.2 demonstrates how career fields in the Air Force can be related to occupations in non-military sectors of the economy. Subsection 6.3 then shows how industries for which employment is forecast in the national economic models are related to industries in the National Industry-Occupation Matrix. Finally, Subsection 6.4 forecasts the demand for a particular occupation -- electrical/electronics technician -- to demonstrate the use of the National Industry-Occupation Matrix in the occupational employment forecasting process.

6.2 Relating Air Force Career Fields
     to Non-Military Occupations

The Air Force has shown substantial interest i the relationship between Air Force skills and non-military occupations. AFR 39-1, Airman Classification Regulation (June 1977, with updates), matches each Air Force skill to appropriate non-military occupations as described in the Dictionary of Occupational Titles (DOT). [13] For each AFSC, AFR 39-1 specifies between one and five DOT occupational titles which correspond to the Air Force skill. In a few skills, no appropriate DOT title is specified.

With the aid of the DOT, skills in the Air Force can be linked to occupations in the National Industry-Occupation Matrix. For example, a linkage of this type can be demonstrated between matrix occupations and the Air Force skills for which reenlistment bonuses are provided. Appendix E lists in detail the reenlistment bonus skills and the corresponding DOT titles specified in AFR 39-1. Using this list, all of the DOT titles corresponding to the reenlistment bonus skills were

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[13]U. S. Department of Labor, Dictionary of Occupational Titles, Third Edition, Washington, D. C., U. S. Government Printing Office, 1965.

independently clustered into nine general occupational groups in this study. Then, the AFSCs corresponding to these various DOT titles were assigned to each of the nine occupational groups. The nine summary occupational groups and the corresponding AFSCs are presented in the first two columns of Table 11, while the related matrix occupations are listed in the third column. In some cases, individual matrix occupations were linked directly to individual AFSCs. In other cases, clusters of matrix occupations were related to groups of AFSCs.

These nine occupational groups, translated into matrix occupations, can be used to identify industries competing for reenlistment bonus skills. Combining the 1976 occupational employment figures in the National Industry-Occupation Matrix with the matrix occupations listed in the third column of Table 11 produces the results summarized in Table 12. This table provides an indication of the general industrial groups competing for each particular Air Force skill.

The National Industry-Occupation Matrix can also indicate the detailed industry groups which compete for a certain Air Force skill. For example, the matrix indicates that 168,853 electrical/electronics technicians were employed in 1976. Of these technicians, 85,057 (0.50) were employed in the manufacturing area. The employment levels of such technicians in major manufacturing sectors were: Electronic Computing Equipment (8,714); Radio, Television, and Communications Equipment (20,558); Electrical Machinery, Equipment, and Supplies (29,597); Aircraft and Parts (5,470); and Scientific and Controlling Instruments (3,203). These manufacturing sectors employed 40 percent of the total number of electrical/electronics technicians working in 1976.

6.3 Relating Matrix Industries to National
Economic Model Industries

For occupational employment forecasting purposes, the National Industry-Occupation Matrix must be compatible with the national economic model selected as the national economy module of the National Skills Market Model. If the matrix is to use industry-specific employment forecasts from either the DRI, Wharton, or Chase Models to produce occupation-specific employment forecasts, the industrial sectors defined in the national economic model must be consistent

TABLE 11: Occupational Groups Relating
Reenlistment Bonus AFSCs to
Comparable Matrix Occupations

Occupational Group*	Reenlistment Bonus AFSCs**	Comparable Matrix Occupations***
Electronics, Avionics, and Communications	305X4, 306X0, 308X0, 309X0, 316X0, 326X1, 326X2, 341X7, 362X2, 541X0 (Electronics); 328X2, 341X1, 341X2, 341X5, 341X6 (Avionics); 297X0, 304X0 (Communications)	Engineers, Science Technician . Electrical/Electronics Technician Technicians, except Health . Radio operators Crafts and Kindred Workers . Electricians and Apprentices Mechanics, Repairers, Installers . Radio, Television Repairers
Managerial, Accounting, Office Workers	296X0, 391X0, 472X4, 554X0, 651X0, 672X1, 691X0	Other Professional, Technical . Accountants Managers, Officials, Proprietors . Buyers, Sales, Loan Managers . Administrators, Public Inspectors . Other Managers, Officials, Proprietors
Computer Personnel	511X0, 511X1, 645X2	Computer Specialists . Computer Programmers . Computer Systems Analysts . Other Computer Specialists Office Machine Operators . Computer Peripheral Equipment

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TABLE 11 (continued)

Occupational Group*	Reenlistment Bonus AFSCs**	Comparable Matrix Occupations***
Air Traffic Control and Weather Specialists	272X0, 274X0, 276X0 (Air Traffic Control); 251X0 (Weather Specialist)	Technicians, except Health • Air Traffic Controllers Life and Physical Scientists • Atmosphere, Space Specialist
Air Transportation Workers	113X0 (Flight Engineer Specialist)	Technicians, except Health • Flight Engineers
	114X0 (Aircraft Loadmaster)	Other Managers, Officials, Proprietors
	426X0 (Aircraft Propeller Mechanic)	Mechanics, Repairers, Installers • Aircraft Mechanics
Public Relations/Media Personnel	791X0 (Information Specialist)	Writers, Artists, Entertainers • Editors and Reporters • Public Relations Specialists
	791X1 (Radio and TV Broadcasting Specialist)	Writers, Artists, Entertainers • Radio, TV Announcers
Intelligence Area	204X0 (Intelligence Operations Specialist)	Other Professional, Technical • Research Workers, n.e.c.
	207X2 (Printer Systems Operator) 208X0 (Voice Processing Specialist)	Technicians, except Health • Radio Operators

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TABLE 11 (continued)

Occupational Group*	Reenlistment Bonus AFSCs**	Comparable Matrix Occupations***
Intelligence Area (continued)	222X0 (Geodetic Specialist)	Engineers, Science Technician • Drafters • Surveyors
Munitions and Weapons	463X0 (Nuclear Weapons Technician) 464X0 (Explosive Ordnance Disposal Specialist)	None specified
Miscellaneous Technicians and Repairers	241X0 (Safety Specialist), 427X2 (Nondestructive Inspection Technician)	Administrators, Public Inspectors • Construction Inspector, Public • Inspectors, except Construction, Public
	324X0 (Precision Measuring Equipment Specialist), 911X0 (Aerospace Physiology Technician)	Health Technologists and Technicians • Clinical Lab Technologists, Technicians
	361X1 (Minuteman Hard Intersite Cable Maintenance Specialist)	Transportation, Public Utility Crafts • Electric Power Line Installers, Repairers • Telephone Line Installers, Repairers
	544X0 (Cryogenic Fluids Production Specialits)	Transportation, Public Utility Crafts • Power Station Operators

TABLE 11 (continued)

Occupational Group*	Reenlistment Bonus AFSC**	Comparable Matrix Occupations***
Miscellaneous Technicians and Repairers (continued)	545X0 (Refrigeration and Air Conditioning Specialist)	Mechanics, Repairers, Installers • Air Conditioning, Heating, Refrigeration Mechanics
	553X0 (Site Development Specialist)	Engineers, Science Technicians • Drafters • Surveyors

*Natural clusters of occupations based on correspondence of DOT titles associated with Reenlistment Bonus AFSCs and comparable matrix occupations.

**An individual AFSC code may be associated with more than one occupational group.

***Developed from the National Industry-Occupation Matrix. See Appendix D.

TABLE 12: Percentage Distribution of 1976
Occupational Employment Among
General Industrial Sectors

Occupational Group and Comparable Matrix Occupations	Industrial Sector								
	100000 Agriculture, Forestry, and Fisheries	200000 Mining	300000 Construction	400000 Manufacturing	500000 Transportation, Communications, and Public Utilities	600000 Wholesale and Retail Trade	700000 Finance, insurance, and Real Estate	800000 Services	900000 Government
Electronics, Avionics, and Communications									
Engineers, Science Technician									
. Electrical/Electronics Technician	--	0.01	0.02	0.50	0.13	0.04	--	0.14	0.16
Technicians, except Health									
. Radio Operators	--	0.01	0.04	0.02	0.24	0.02	--	0.05	0.61
Crafts and Kindred Workers									
. Electricians and Apprentices	--	0.03	0.45	0.28	0.08	0.03	0.01	0.07	0.04
Mechanics, Repairers, Installers									
. Radio, Television Repairers	--	--	0.01	0.09	0.06	0.29	--	0.44	0.10
Managerial, Accounting, Office Workers									
Other Professional, Technical									
. Accountants	--	0.02	0.02	0.20	0.05	0.12	0.09	0.36	0.15
Managers, Officials, Proprietors									
. Buyers, Sales, Loan Managers	--	0.01	0.01	0.16	0.01	0.43	0.31	0.05	0.02
. Administrators, Public Inspectors	--	--	--	--	--	--	--	0.50	0.50
. Other Managers, Officials, Proprietors	--	0.01	0.05	0.16	0.07	0.42	0.07	0.18	--
Computer Personnel									
Computer Specialists									
. Computer Programmers	--	0.01	0.01	0.30	0.05	0.08	0.12	0.33	0.11
. Computer Systems Analysts	--	0.01	0.01	0.32	0.05	0.09	0.09	0.30	0.13
. Other Computer Specialists	--	0.01	0.01	0.33	0.04	0.13	0.07	0.34	0.07
Office Machine Operators									
. Computer Peripheral Equipment	--	0.01	0.01	0.26	0.07	0.11	0.19	0.25	0.10
Air Traffic Control and Weather Specialists									
Technicians, except Health									
. Air Traffic Controllers	--	--	--	--	--	--	--	--	1.0
Life and Physical Scientists									
. Atmosphere, Space Specialist	0.01	--	--	0.08	0.08	--	--	0.21	0.62
Air Transportation Workers									
Technicians, except Health									
. Flight Engineers	--	--	--	0.06	0.88	--	0.02	0.01	0.03
Other Managers, Officials, Proprietors	--	0.01	0.09	0.16	0.07	0.42	0.07	0.18	--
Mechanics, Repairers, Installers									
. Aircraft Mechanics	--	--	--	0.25	0.44	0.02	--	0.03	0.27

TABLE 12 (continued)

Occupational Group and Comparable Matrix Occupations	Industrial Sector								
	100000 Agriculture, Forestry, and Fisheries	200000 Mining	300000 Construction	400000 Manufacturing	500000 Transportation, Communications, and Public Utilities	600000 Wholesale and Retail Trade	700000 Finance, Insurance, and Real Estate	800000 Services	900000 Government
Public Relations/Media Personnel									
Writers, Artists, Entertainers									
. Editors and Reporters	--	--	--	0.62	0.07	0.04	0.01	0.21	0.05
. Public Relations Specialists	--	--	0.02	0.16	0.10	0.11	0.09	0.43	0.09
Writers, Artists, Entertainers									
. Radio, TV Announcers	--	--	--	--	0.95	--	--	0.04	0.01
Intelligence Area									
Other Professional, Technical									
. Research Workers, n.e.c.	--	0.01	--	0.14	0.01	0.02	0.03	0.69	0.10
Technicians, except Health									
. Radio Operators	--	0.01	0.04	0.02	0.24	0.02	--	0.05	0.61
Engineers, Science Technician									
. Drafters	--	0.01	0.08	0.44	0.05	0.04	--	0.31	0.07
. Surveyors	0.01	0.03	0.27	0.01	0.06	--	0.01	0.46	0.15
Munitions and Weapons (None Specified)									
Miscellaneous Technicians and Repairmen									
Administrators, Public Inspectors									
. Contruction Inspector, Public	--	--	--	--	--	--	--	--	1.0
. Inspectors, except Construction, Public	--	--	--	--	--	--	--	--	1.0
Health Technologists and Technicians									
. Clinical Lab Technologists, Technicians	--	--	--	0.01	--	--	--	0.98	0.01
Transportation, Public Utility Crafts									
. Electric Power Line Installers, Repairers	--	--	0.15	0.01	0.82	--	--	0.01	0.01
. Telephone Line Installers, Repairers	--	--	0.08	0.01	0.90	--	--	0.01	--
Transportation, Public Utility Crafts									
. Power Station Operators	--	0.01	0.01	0.19	0.74	0.01	--	0.02	0.02
Mechanics, Repairers, Installers									
. Air Conditioning, Heating, Refrigeration Mechanics	--	--	0.29	0.12	0.04	0.29	0.01	0.20	0.05
Engineers, Science Technicians									
. Drafters	--	0.01	0.08	0.44	0.05	0.04	--	0.31	0.07
. Surveyors	0.01	0.03	0.27	0.01	0.06	--	0.01	0.46	0.15

with the industrial sectors specified in the matrix. Equivalent definitions of industrial sectors can be developed with relative ease, however, because the industrial sectors contained within the National Industry-Occupation Matrix are uniformly identified in terms of SIC codes. The appropriate SIC codes for industries in the DRI, Wharton, or Chase Models are presented in Tables 3, 5, and 7, respectively. The SIC codes for the industrial sectors in the matrix are contained in Appendix C.

In most cases, the industrial sectors contained in the DRI and Wharton Models, which basically correspond to the two-digit SIC level, identically match industrial sectors in the matrix. However, both the DRI Model and the Wharton Model define government employment in a different manner than the matrix. The government sector in the two models include parts of SIC 80 (Health Services), SIC 82 (Educational Services), and SIC 83 (Social Services), which are assigned to the service sector in the National Industry-Occupation Matrix. A possible method of resolving this inconsistency is addressed in the sample occupational employment forecast developed in Subsection 6.4.

Similarly, for virtually all two-digit SIC codes, the Chase Model and the matrix are completely compatible. Yet, for certain finer levels of industrial detail, at the three- or four-digit SIC level, a disaggregation mechanism must be developed to link the Chase Model and the matrix. For example, the proportional distribution of employment among the more detailed industrial sectors in the matrix could be used to partition the more highly aggregated employment forecasts developed by the Chase Model.

6.4 Derivation of a Sample Occupational
Employment Forecast

A sample occupational employment forecast is developed in this subsection to demonstrate the basic procedure for using the National Industry-Occupation Matrix in conjunction with a national economic model to produce occupational employment forecasts. Specifically, the number of electrical/electronics technicians in the United States economy in 1981 is projected using industrial sector employment forecasts from the DRI Model and occupational employment proportions from the matrix. Table 13 summarizes the derivation of this occupational employment forecast.

TABLE 13: Sample Occupational Employment Projection for Electrical/ Electronics Technicians

Matrix Code	SIC Code	Sector Description	Occupational Employment Percentage[a] (1)	Total Industrial Sector Employment[b] (2)	Occupational Employment in Industrial Sector [(1) x (2)]
100000	00-09	Agriculture, Forestry, and Fisheries	0.00	--	--
200000	10-14	Mining	0.14	881,000	1,233
300000	15-17	Contract Construction	0.07	4,314,000	3,013
411900	19	Ordnance	1.56	157,000	2,449
422000	20	Food and Beverages	0.01	1,705,000	171
422100	21	Tobacco	0.02	66,000	13
422200	22	Textile Mill Products	0.01	992,000	99
422300	23	Apparel and Related Products	0.00	1,330,000	0
412400	24	Lumber and Wood Products	0.01	697,000	70
412500	25	Furniture and Fixtures	0.01	574,000	57
422600	26	Paper and Allied Products	0.02	715,000	143
422700	27	Printing and Publishing	0.02	1,176,000	235
422800	28	Chemicals	0.11	1,131,000	1,244
422900	29	Petroleum Refining	0.06	217,000	130
423000	30	Rubber & Miscellaneous Plastic Products	0.02	762,000	152
423100	31	Leather and Leather Products	0.00	255,000	0
413200	32	Stone, Clay, and Glass Products	0.04	731,000	292
413300	33	Primary Metals	0.07	1,264,000	885
413400	34	Fabricated Metal Products	0.06	1,582,000	949
413500	35	Nonelectrical Machinery	0.71	2,437,000	17,303
413600	36	Electrical Machinery	2.49	2,163,000	53,859
413700	37	Transportation Equipment	0.41	1,890,000	7,749
413800	38	Scientific Instruments	1.03	562,000	5,789
413900	39	Miscellaneous Manufacturing	0.06	422,000	253
500000	40-49	Transportation and Public Utilities	0.41	5,036,000	20,648
600000	50-59	Wholesale and Retail Trade	0.04	20,731,000	8,292
700000	60-67	Finance, Insurance, and Real Estate	0.00	5,216,000	0
800000	70-89	Services	0.10	28,551,000[c]	28,551
900000	91-97	Federal Government	1.31	2,833,000	37,112
900000	91-97	State Government	0.07	1,064,000[c]	744
900000	91-97	Local Government	0.02	2,056,000	411
		Total Occupational Employment			191,846

[a] The ratio of the National Industry-Occupation Matrix's projection of electrical/electronics technician employment in each industrial sector to its projection of total employment in that sector for 1985.

[b] The DRI Model's forecast of total employment in each industrial sector for 1981.

[c] The DRI Model's forecasts of government sector employment include some employment in SIC 80 (Health Services), SIC 82 (Educational Services), and SIC 83 (Social Services) which is classified as services sector employment in the National Industry-Occupational Matrix. To make the DRI Model's 1981 forecasts of employment in the services and state and local government sectors compatible with the National Industry-Occupation Matrix's classification of these types of employment, the matrix's 1985 employment forecasts were used to calculate the percentages of the combined services sector and state and local government sector employment forecasts which comprised projected services sector employment (90.15 percent), projected state government employment (3.36 percent), and projected local government employment (6.49 percent). These percentages were then applied to the DRI Model's combined services and state and local government employment forecasts to derive the forecasts of services sector employment, state government employment, and local government employment used to calculate the total 1981 employment of electrical/electronics technicians.

The DRI Model provides employment projections for 32 industrial sectors for 1981.[14] The National Industry-Occupation Matrix provides estimates of the percentage of the total employment in each of the 32 industrial sectors that is expected to consist of electrical/electronics technicians in 1985. This percentage could have been approximated for 1981 by interpolating between actual percentages derived in the matrix for 1976 and percentages projected in the matrix for 1985. However, the differences in the percentages for 1976 and 1985 were fairly minor. Therefore, no interpolation was performed.

Rather, the total employment projection for each industrial sector for 1981 was multiplied by the projected employment percentage for electrical/electronics technicians in that sector for 1985 to produce forecasts of the 1981 employment of electrical/electronics technicians in each industrial sector. These forecasts were then summed across all industrial sectors to produce a projection of the total national employment of electrical/electronics technicians in 1981.

It should be noted that the projected 1981 employment for electrical/electronics technicians derived using total employment projections for only durable and nondurable manufacturing in conjunction with the matrix percentages for these two aggregated industrial sectors provided similar estimates to those produced using total employment projections for all industrial sectors at the two-digit SIC level and the corresponding matrix percentages.

The methodology demonstrated in this section could be used to predict employment through 1985 for any of the 420 occupations included in the matrix. Moreover, this methodology can be used in conjunction with industrial sector employment forecasts produced by the DRI, Wharton, or Chase Models. Also, the matrix itself provides 1985 employment projections for 420 occupations and 201 industrial sectors.

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[14]Data Resources, Inc., The Data Resources Review of the U. S. Economy, September, 1978. The DRI Model no longer provides employment projections for the ordnance sector (SIC 19) as of January, 1979.

The methodology can be applied equally easily to national, regional, or state projections of industrial sector employment to produce compatible national, regional, or state forecasts of occupational employment. However, it is important to recognize that, whenever the methodology is applied to state or regional employment projections, it is implicitly assumed that the occupational employment mix within each industrial sector is uniform across all states or regions.

7.0 THE OCCUPATIONAL WAGE RATE FORECASTING MODULE

The interviews summarized in Section 3 revealed that Air Force planners concerned with reenlistment generally desired forecasts of occupational wage rates to assist their determination and fulfillment of Air Force requirements for skilled personnel. In addition, it is likely that the accession and retention rate forecasting module ultimately incorporated into the National Skills Market Model will require occupational wage rate projections to support its forecasting of accession and retention rates for particular skills.

Therefore, this section develops, and conducts preliminary empirical tests of, a general methodology for projecting occupational wage rates, using inputs produced by the national economy module which might be augmented by the industry-occupation matrix. The derivation of this methodology is presented and explained in Subsection 7.1. Next, in Subsection 7.2, the data used for the preliminary empirical testing of the methodology are described. The empirical results obtained by applying the general methodology to these data are summarized in Subsection 7.3. Finally, the implications of these preliminary results of the design of the National Skills Market Model are presented in Subsection 7.4.

7.1 General Methodology

For most occupations in the United States economy, wage rates and employment levels are determined through the interaction of the supply and demand for labor in reasonably competitive markets. Thus, in general, the forecasting of occupational wage rates can be accomplished by developing, applying, and empirically estimating analytic representations of the supply of labor, the demand for labor, and their interaction for individual occupational groups.

In the context of the National Skills Market Model, the supply of labor can be represented as:

$$L^S = S(W, P, G)$$

where: L^S = the quantity of labor supplied by members of the occupational group.

W = the prevailing wage rate for the occupational group.

P = the general price level of consumer goods and services.

G = general economic conditions, which affect the labor force participation rate of members of the occupational group.

Similarly, the demand for labor can be described by:

$$L^D = D(W, \pi, G)$$

where: L^D = the quantity of labor demanded by employers of the occupational group.

π = the productivity (output per person-hour) of the occupational group.

In attaining equilibrium, the interaction of supply and demand will adjust the wage rate for the occupational group until the quantity of labor supplied is equal to the quantity of labor demanded. Thus, at equilibrium:

$$L^S = L^D$$

Solving the preceding three equations simultaneously for w provides a general expression for the market wage rate for the occupational group:

$$w = f(\pi, P, G)$$

Furthermore, assuming that the determining factor in peoples' decisions to supply labor is the level of the occupational wage rate relative to the prices of the goods and services they consume, this expression can be transformed into:

$$w/P = F(\pi, G)$$

Finally, approximating this general functional form with a linear equation produces:

$$w/P = a_0 + a_1 \pi + a_2 G$$

The values of the parameters of this linear equation -- a_0, a_1, and a_2 -- can be empirically estimated using standard multiple linear regression techniques.

7.2 Data Used for Preliminary Empirical Testing

To test the empirical validity of the methodology developed in the preceding section, data were assembled describing each of the variables in the linear occupational wage rate equation for four occupational groups of potential interest to the Air Force for each year between 1967 and 1975. The occupational groups for which data were collected included secretaries, electricians, automotive mechanics, and truck drivers. In addition, two different data series were obtained to measure general economic conditions, G. These data series described total employment, E, and the unemployment rate, U, for the United States economy.

The specific data series assembled, and their precise definitions, were:

- W: occupational wage rates, as measured by the average hourly wage rates of secretaries, electricians, automotive mechanics, and truck drivers for each year between 1967 and 1975.

- P: the general price level of consumer goods and services, as measured by the consumer price index for each of these years.

- π: the productivity of labor, as measured by an index of average output per hour for all persons employed in the private business sector in each year.

99

- E: total employment, as measured by the number of persons, 16 years of age or older, employed in the United States economy in each year.

- U: the unemployment rate, as measured by the national unemployment rate of all civilian workers in each year.

The data series for w and E were obtained from the Handbook of Labor Statistics 1977,[15] while the remaining three data series were assembled from the Business Conditions Digest.[16]

7.3 Empirical Results

Three different forms of the general linear occupational wage rate equation derived in Subsection 7.1 were empirically estimated by applying multiple linear regression analysis to the data described in Subsection 7.2. The specific forms estimated were:

$$w/P = a_0 + a_1 \pi + a_2 E,$$

$$w/P = a_0 + a_1 \pi + a_2 U, \text{ and}$$

$$w/P = a_0 + a_1 \pi.$$

The estimated parameter values, t-statistics, and multiple correlation coefficients (R^2) generated by this analysis for the four occupational groups are presented in Table 14.

These results indicate that, except for secretaries, any of the three specific forms of the linear occupational wage rate equation provides very reliable estimates of wage rates for the occupational

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[15] U. S. Department of Commerce, Bureau of Economic Analysis, Handbook of Labor Statistics 1977, Washington, D.C., U. S. Government Printing Office, 1977.

[16] U. S. Department of Commerce, Bureau of Economic Analysis, Business Conditions Digest, Washington, D. C., U. S. Government Printing Office, 1977.

TABLE 14: Empirical Estimates of the Parameters of the Occupational Wage Rate Equations

Occupational Group	Coefficients of Independent Variables (and t-Statistics)				R^2 (Adjusted R^2)
	Constant	π	E	U	
Secretaries	2.22	0.265 (5.52)	-0.0281 (-4.82)		0.839 (0.759)
	2.12	0.0069 (1.30)		-0.0089 (-0.52)	0.252 (-0.122)
	2.28	0.0049 (1.39)			0.218 (0.061)
Electricians	0.838	0.353 (3.73)	-0.0103 (-0.90)		0.917 (0.875)
	1.24	0.0223 (5.21)		0.0208 (1.45)	0.930 (0.896)
	0.860	0.0274 (8.20)			0.906 (0.887)
Automotive Mechanics	-1.41	0.0425 (4.76)	0.0061 (0.56)		0.973 (0.960)
	-1.19	0.0445 (10.19)		0.0124 (0.88)	0.975 (0.963)
	-1.42	0.0472 (15.56)			0.972 (0.966)
Truck Drivers	-1.61	0.0496 (5.47)	-0.0048 (-0.43)		0.971 (0.956)
	-1.83	0.0486 (11.03)		-0.0121 (-0.86)	0.973 (0.960)
	-1.60	0.0459 (15.05)			0.970 (0.964)

groups. However, for secretaries, only the functional form containing labor productivity and total employment as explanatory variables provides a satisfactory fit. This result suggests that the labor force participation rate for secretaries is probably sensitive to the total number of employment opportunities available in the economy.

However, it should also be noted that there is substantial statistical correlation between the data series describing labor productivity and the unemployment rate (0.708). Such correlation makes it difficult to disentangle the separate influences of these explanatory variables. Thus, the parameter values estimated for the first two specific forms of linear occupational wage rate equations may not be very accurate. However, as long as the correlations among the explanatory variables can reasonably be expected to continue into the future, the estimated equations should still be satisfactory for purposes of forecasting occupational wage rates.

7.4 Design Implications

The preliminary empirical analysis reported in this section indicates the general feasibility of developing a satisfactory occupational wage rate forecasting module for the National Skills Market Model, requiring as inputs only data routinely generated by the national economy module, possibly in conjunction with the industry-occupation matrix. At least one linear occupational wage rate forecasting equation with satisfactory statistical properties was isolated for each occupational group studied. Moreover, all of the national economic models considered in detail in Section 4 provide at least the minimum data required as inputs for the equations. Specifically, all of the models generate forecasts of unemployment rates, total national employment, price indices, and labor productivity -- or total production, which can be divided by total employment to calculate labor productivity. In addition, by conjoining the national economic model and the industry-occupation matrix, it should be possible to develop procedures to forecast occupational productivity, which might permit the estimation of even more accurate occupational wage rate forecasting equations.

8.0 DEMOGRAPHY MODULE

Demographic detail may be needed in forecasts of the unemployment rate and the number of workers employed by industry and occupation to provide the specific inputs required by the accession and retention rate forecasting module. Such detail is also needed by Air Force manpower and training planners to help them attract and retain persons in particular age, sex, and race categories.

Forecasts of unemployment containing limited demographic detail are supplied by several of the national economic models examined in Section 4. However, extensive demographic detail is generally not provided in the unemployment rate forecasts and the industrial and occupational employment projections generated by the analytic structures described in Sections 4, 5, and 6. Thus, factors of proportionality derived from historical demographic data often must be applied to the employment and unemployment projections developed using these structures to create the desired demographic detail.

Such historical demographic data are routinely available in data bases compiled by the Bureau of Labor Statistics and the Bureau of the Census. Therefore, Subsections 8.1 through 8.3 will describe the demographic detail that is currently available for unemployment figures, employment by occupation, and employment by industry from these data sources. The design implications of these data bases for the National Skills Market Model are then discussed in Subsection 8.4.

8.1 Demographic Detail for Unemployment Figures

Substantial historical demographic data for unemployment figures are provided by the Bureau of Labor Statistics in _Employment and Earnings, State Profile of Employment and Unemployment_,[17] and several unpublished, but easily obtainable, data series.

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[17]U. S. Department of Labor, Bureau of Labor Statistics, _State Profile of Employment and Unemployment_, Annual Report, available from the Office of Employment Structure and Trends.

Employment and Earnings provides monthly national estimates of unemployed persons, and unemployment rates, by age, sex, and race. Specifically, the data are tabulated for white males, white females, non-white males, and non-white females in the following age groups: 16 to 17, 16 to 21, 18 to 19, 20 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 59, 60 to 64, and 65 years and over.

Employment and Earnings also provides monthly tabulations of national unemployment and unemployment rates for the following demographic groupings:

- Unemployed persons by age and sex.

- Unemployed persons by marital status, sex, age, and race.

- Unemployed persons by occupation of last job and sex.

- Unemployed persons by industry of last job and sex.

- Unemployed persons by reason for unemployment, sex, age, and race.

- Unemployed persons by reason for unemployment, duration, sex, and age.

- Unemployed persons by duration of unemployment.

- Unemployed persons by duration, sex, age, race, and marital status.

- Unemployed persons by duration, occupation, and industry of last job.

The age categories examined differ among the various tabulations.

State Profile of Employment and Unemployment provides yearly estimates of the civilian non-institutional population, and the labor force status of the civilian non-institutional population 16 years and over, by state, sex, age, and race. The labor force status information provided includes estimates of the civilian labor force, employment, unemployment, and the unemployment rate. This population

and labor force status information is provided for three general population groups: the total population, the white population, and the nonwhite (black and other) population. Each of these population groups is partitioned into: men; women; men, 20 years and over; women, 20 years and over; and both sexes, 16 to 19 years. These same age and sex categories are also tabulated for labor force status information describing the Hispanic-origin population in California, Florida, Illinois, New York, Texas, and Arizona-Colorado-New Mexico.

The unpublished data series available from the Bureau of Labor Statistics essentially provide more detailed tabulations of the data contained in Employment and Earnings. Thus, these data series specify unemployment and unemployment rates for:

- Unemployed persons by major industry group of last job, sex, and race.

- Unemployed persons by manufacturing industry of last job and race.

- Unemployed persons by major occupational group of last job, sex, and race.

- Unemployed persons by detailed occupational group of last job, sex, and race.

- Unemployed persons by detailed industry group of last job, sex, and race.

The data are tabulated for 20 major industry groups, 23 manufacturing industries, 50 detailed industry groups, 12 major occupational groups, and 31 detailed occupational groups. All of these data are available in the form of either monthly estimates or annual averages.

8.2 Demographic Detail for
     Occupational Employment

Historical demographic data for occupational employment is provided by the Bureau of the Census in the 1970 Census of Population and by the Bureau of Labor Statistics in Employment and Earnings and supplementary unpublished data.

Census of Population: 1970 Detailed Characteristics[18] provides the following demographic tabulations of occupational employment by state (and by SMSAs with populations of at least 250,000, where indicated):

- Detailed occupation of the experienced civilian labor force and employed persons by sex: 1970 and 1960.

- Detailed occupation of employed persons by residence, race, and sex: 1970 (SMSAs included).

- Occupation of the experienced civilian labor force by race and sex, and weeks worked in 1969 and experienced workers not in labor force by sex: 1970 (SMSAs included).

- Occupation of employed persons by class of worker, race, and sex: 1970 (SMSAs included).

- Occupation of employed persons by age, race, and sex: 1970 (SMSAs included).

- Occupation of the male experienced civilian labor force by earnings in 1969 and race: 1970 (SMSAs included).

- Occupation of the female experienced civilian labor force by earnings in 1969 and race: 1970 (SMSAs included).

- Selected occupation by major industry of the experienced civilian labor force by earnings in 1969 and sex: 1970.

- Occupational and geographic mobility between 1965 and 1970 by race and sex: 1970.

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[18]U. S. Department of Commerce, Bureau of the Census, Census of Population: 1970 Detailed Characteristics, Final Report PC(1), for all states and the District of Columbia.

- Occupation of employed persons by education, race, and sex: 1970.

- Occupation of employed persons by industry group and sex: 1970.

- Occupation of employed blacks by major industry: 1970.

- Occupation of employed persons of Puerto Rican birth or parentage by major industry: 1970.

This demographic detail is provided for 407 occupations, a subset of the 420 occupations contained in the National Industry-Occupation Matrix and listed in Appendix D. [19] The fundamental age groups examined for these occupations are: 14 to 15, 16 to 17, 18 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 44, 45 to 54, 55 to 59, 60 to 64, and 65 years and over.

Employment and Earnings provides monthly estimates of occupational employment by sex and age. Two age groups are examined for both sexes: 16 to 19 years and 20 years and over. Thirty-one detailed occupational groups are considered. In addition, Employment and Earnings provides monthly estimates of employment by major occupational group, sex, and race. In this instance, only 12 occupational groups are tabulated.

The Bureau of Labor Statistics also provides several unpublished data series describing occupational employment in much greater detail than is available in its published reports. These data series specify:

- Employed persons by major occupational group by age, sex, and race for, basically, five-year age cohorts.

- Employed persons by major occupational group, marital status, age, sex, and race.

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[19]Both sets are based on: U. S. Department of Commerce, Bureau of the Census, 1970 Census of Population: Alphabetical Index of Industries and Occupations, Washington, D.C., U. S. Government Printing Office, 1971.

- Employed persons by major occupational group, major industry group, sex, and race.

- Employed persons by detailed occupational group, age, sex, and race.

- Employed persons by detailed occupation by sex and race.

All of these data, except the last data series, are available as either monthly estimates or annual averages. The last data series, which examines all 420 occupations contained in the National Industry-Occupation Matrix and listed in Appendix D, is only available in the form of annual averages.

8.3 Demographic Detail for Industrial Sector Employment

Historical demographic data for industrial sector employment is provided by the Bureau of the Census in the 1970 Census of Population, and by the Bureau of Labor Statistics in unpublished data.

Census of Population: 1970 Detailed Characteristics provides the following demographic tabulations of industrial sector employment by state (and by SMSAs with populations of at least 250,000, where indicated):

- Detailed industry of the experienced civilian labor force and employed persons, by sex: 1970 and 1960.

- Detailed industry of employed persons by race and sex: 1970 (SMSAs included).

- Industry of the experienced civilian labor force by race and sex, and weeks worked in 1969 and experienced workers not in the labor force by sex: 1970 (SMSAs included).

- Industry of employed persons by class of worker, race, and sex: 1970 (SMSAs included).

- Age of employed persons by industry and sex: 1970 (SMSAs included).

- Industry of the male experienced civilian labor force by earnings in 1969 and race: 1970 (SMSAs included).

- Industry of the female experienced civilian labor force by earnings in 1969 and race: 1970 (SMSAs included).

This demographic detail is provided for 82 industries, a subset of the 201 industries contained in the National Industry-Occupation Matrix and listed in Appendix C.[20] The age categories examined in these industrial employment data are: 14 to 15, 16 to 17, 18 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 44, 45 to 54, 55 to 59, 60 to 64, and 65 years and over.

Additional industrial sector employment data are available in readily obtainable unpublished data series developed by the Bureau of Labor Statistics. These data series include:

- Employed persons by major industry group, full-time or part-time status, sex, and race.

- Employed persons by manufacturing industry, full-time or part-time status, and race.

- Employed persons by major industry group, age, sex, and race.

- Employed persons by major occupational group, major industry group, sex, and race.

- Employed persons by major industry group, marital status, age, sex, and race.

- Employed persons by detailed industry group, sex, and race.

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[20]Both sets are based on: U. S. Department of Commerce, Bureau of the Census, 1970 Census of Population: Alphabetical Index of industries and Occupations, Washington, D. C., U. S. Government Printing Office, 1971.

In all, these data are tabulated for 20 major industry groups, 23 manufacturing industries, and 50 detailed industry groups. All data series are available as either monthly estimates or annual averages.

8.4 Design Implications

The data base summaries presented in the preceding three subsections indicate that ample information exists to develop within the National Skills Market Model projections of industrial sector employment, occupational employment, and unemployment rates containing a wide variety of demographic and sectoral detail. The incorporation of demographic detail into the model's industrial sector and occupational employment forecasts merely requires the derivation and application of appropriate factors of proportionality using any of the data series described in Subsections 8.2 and 8.3.

The introduction of additional demographic detail into the unemployment rate forecasts generated by the national economic models will, however, require the application of correlation or linear regression procedures to derive relationships between the less detailed unemployment rate forecasts provided by the models and the more detailed unemployment rate estimates contained in any of the data series discussed in Subsection 8.1. In either event, careful consideration should be given to the selection of the precise level of demographic detail to be provided in any set of forecasts, since, in general, greater detail relative to any demographic or sector dimension can only be obtained by sacrificing attainable detail relative to some other dimension or dimensions.

PART III

THE POPULATION PROJECTION MODULE

9.0 QUALIFIED MILITARY AVAILABLES PROJECTION MODULE

Projections of the population of potential recruits with suitable mental capabilities serve two purposes. They supply the data required to transform the accession rate forecasts generated by the accession/retention rate forecasting module into projections of total Air Force accessions, and they provide Air Force manpower and training planners with necessary information for establishing recruiting goals. For recruiting purposes, the Air Force is generally interested in two population groups: high school seniors and 17 to 21 year old high school graduates.

Estimates and projections of the number of high school seniors in different mental categories are made available on a continuing basis by the Army's Military Enlistment Processing Command (MEPCOM). Procedures for estimating and forecasting the population of 17 to 21 year old high school graduates by mental category are currently being developed by the Defense Manpower Data Center (DMDC).

Alternatively, data describing the mental aptitude of potential recruits provided by MEPCOM can be combined with population projections supplied by the Bureau of the Census or the U. S. Office of Education to produce forecasts of the total population of potential recruits of appropriate mental quality.

Moreover, DMDC maintains an Armed Forces Examining and Entrance Stations (AFEES) transaction file which can be used to describe the segment of this population that has offered to enlist in each branch of the military.

Finally, the Air Force has conducted a one-shot forecasting effort called the Five Year Market Forecast aimed at predicting the size of a select portion of the population of 17 to 21 year old high school graduates in different mental categories.

Detailed descriptions of these prospective sources of projections of the population of QMAs are presented in the next four parts of this section. Then, Subsection 9.5 summarizes the design implications of this review of alternative population forecasting capabilities.

9.1 Military Enlistment Processing Command Capabilities

The Military Enlistment Processing Command (MEPCOM) at Fort Sheridan in Chicago, Illinois, estimates and projects the population of high school seniors in different mental categories. MEPCOM contracts with the Criterion Information Center in Denver, Colorado, to conduct an annual survey of all 22,000 to 23,000 secondary schools in the United States to determine the total student population in the tenth, eleventh, and twelfth grades, as well as a variety of other factors.[21] The surveys directly estimate the current population of high school seniors, and provide a basis for developing projections of the number of high school seniors for the next 2 years.

MEPCOM also annually measures the mental aptitudes of approximately 500,000 high school seniors, representing approximately 20 percent of all high school seniors, in schools which have historically been productive in supplying military recruits. Specifically, MEPCOM administers the Armed Services Vocational Aptitude Battery (ASVAB) to these high school seniors. ASVAB consists of 12 mental aptitude tests and one interest battery. Three of these tests constitute the Armed Forces Qualification Test (AFQT).

AFQT scores are classified into five mental categories, expressed as score ranges and designated Mental Groups I, II, III, IV, and V. MEPCOM also partitions the third score range into two categories designated upper III and lower III. Thus, the tests administered to high school seniors by MEPCOM provide the basis for determining the mental capability of high school seniors.

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[21] The Air Force Recruiting Service has contracted with the Criterion Information Center to perform a separate sample survey of 22,000 high schools to determine the population of high school seniors in different geographic areas. Such a survey was originally performed in 1976; and a second survey was conducted in 1977. The population surveyed in each year included high school juniors, high school seniors, and previous year graduates. In the future, the Air Force plans to continue to utilize Criterion Information Center to conduct similar surveys of high school student populations.

Basically, the Air Force considers a qualified military available to be a high school senior, or a 17 to 21 year old high school graduate, who scores in one of the first three ranges -- Mental Groups I, II, or III -- on the AFQT.[22] Therefore, combining the MEPCOM projections of the total number of high school seniors with the AFQT test scores for current high school seniors assembled by MEPCOM provide all of the information required to develop projections of the number of high school seniors eligible for enlistment into the Air Force.

MEPCOM also administers the application of the AFQT to all military enlistees at 66 AFEES, and at Military Enlistment Testing (MET) sites operating out of these 66 AFEES, across the country. The results of these tests provide the basis for determining the mental aptitude of 17 to 21 year old high school graduates.

Unfortunately, MEPCOM only provides estimates of the mental quality of the current population of prospective military recruits. No forecasts of expected future test scores for the ASVAB administered to high school seniors or the AFQT taken by potential enlistees are developed by MEPCOM. Moreover, it is questionable whether the students tested by MEPCOM represent a typical or random sample, since high schools -- and individual students within high schools -- can decline to participate in the testing program. Nevertheless, either the MEPCOM estimates of the mental capabilities of the current populations must be accepted as reasonable estimates of the mental aptitudes of future populations, or original procedures must be developed to forecast the mental capacities of future populations on the basis of the currently available data.

9.2 Defense Manpower Data Center Projections

The Defense Manpower Data Center (DMDC) in Alexandria, Virginia, has been directed by the Office of the Secretary of Defense to develop common data bases for recruiting purposes for all branches

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[22]The decision rule for selecting Air Force recruits is more complex, involving educational background, AFQT scores, and scores on a variety of more specialized aptitude tests. In addition, people who are more than 21 years old are permitted to enlist in the Air Force.

c. the armed forces. As part of their effort to collect, process, and disseminate information valuable to recruiters in all services, DMDC is developing procedures to estimate and project the number of 17 to 21 year old high school graduates in Mental Groups I through IV for each county in the United States.

DMDC has also arranged to obtain forecasts of the populations of counties by age, sex, and race through 1985, for use as the basis for estimating and projecting current and future QMAs. DMDC will eliminate from the acquired population projections all ineligible age groups and the military population in each county. Veterans and the physically disabled will also be deleted. Finally, the ASVAB pass rate for various geographic areas will be applied to the remaining populations to produce the desired estimates and projections of QMAs in Mental Groups I through IV.

DMDC will eventually provide this information to 20 recruiting locations throughout the country through on-line computer terminal capability. Air Force terminal locations in this network include Randolph Air Force Base, Andrews Air Force Base, Robbins Air Force Base, and Maxwell Air Force Base (Air Force ROTC). Many elements of this total information base are already being provided describing ASVAB testing results, indicators of propensity to serve in the military, demographic characteristics, and college enrollment.

9.3 Alternative Population Data Sources

As an alternative to the projections discussed in the preceding two subsections, to the extent that MEPCOM samples are representative or random, the estimates developed by MEPCOM describing the mental aptitudes of high school seniors and 17 to 21 year old high school graduates in various geographic regions could be combined with population forecasts from either of two different sources to produce projections of potential recruits in different mental categories.

The Bureau of the Census provides projections of state populations by age, race, and sex for 1980, 1985, 1990, 1995, and 2000.[23]

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[23]U. S. Department of Commerce, Bureau of the Census, Current Population Reports, Series P-25, No. 796, "Illustrative Projections of State Populations by Age, Race, and Sex: 1975 to 2000," Washington, D. C., U. S. Government Printing Office, March, 1979.

The Bureau of the Census updates these projections periodically. However, the most recent revision for total population occurred in 1972; and the latest update for population by age, race, and sex occurred in 1967.

The U. S. Office of Education projects fall enrollments in all regular public and private elementary and secondary day schools for every academic year from 1976/1977 to 1986/1987.[24] It also projects the total number of high school graduates from all public and private secondary day schools for the same years.

By appropriately extracting, aggregating, and interpolating the projections developed in either of these sources, forecasts of the total populations of high school seniors and 17 to 21 year old high school graduates can be computed for any year. Then, by applying the MEPCOM estimates of the distribution of mental aptitudes of potential recruits to these forecasts, projections of the population of potential recruits with acceptable mental capabilities can be derived.

9.4 The Five Year Market Forecast

In 1977, the Air Force Recruiting Service (USAFRS) developed a 5 year market forecast of a select group of potential recruits which it termed refined qualified military availables (RQMAs). The RQMA population is defined as the total number of 17 to 21 year old high school graduates of suitable mental quality who are truly available for military service. Relative to the usual definition of QMAs, the definition of RQMAs excludes any identifiable population segments that have a demonstrably low propensity to enlist.

To forecast the population of RQMAs, USAFRS first projected the number of high school graduates, college enrollees, and labor force participants for the subsequent five years of 17, 18, 19, 20, and 21 year old males. These projections were then refined on the basis of such factors as college enrollment rates, college dropout

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[24]U. S. Office of Education, National Center for Educational Statistics, Projections of Educational Statistics to 1986-1987, Washington, D. C., U. S. Government Printing Office, 1978.

rates, mental examination pass rates, physical examination pass rates, and labor market turnover rates to produce forecasts of the population of 17 to 21 year old high school graduates truly available for military service. USAFRS's Five Year Market Forecast study developed such forecasts for all years between 1978 and 1982. No regional detail was provided in any of these forecasts.

9.5 Design Implications

The estimates of the mental aptitudes of current high school seniors, and the estimates and projections of the current and future populations of high school seniors, developed by MEPCOM provide the best basis available for producing relatively short-term forecasts of the number of high school seniors eligible for enlistment in the Air Force. If longer-term projections of such QMAs were required, it would be necessary to conjoin the MEPCOM estimates of the mental capabilities of high school seniors with the population projections of the Bureau of the Census or the U. S. Office of Education to produce the forecasts.

Similarly, the forecasting capability being developed by DMDC to provide projections of the number of 17 to 21 year old high school graduates by mental category should be the best available source of forecasts of the number of 17 to 21 year old high school graduates with mental capabilities suitable for Air Force enlistment. Presumably these projections will be updated regularly. Only if this presumption is incorrect should the estimates of the mental aptitudes of 17 to 21 year old high school graduates developed by MEPCOM be combined with Bureau of the Census or U. S. Office of Education population projections to produce these forecasts.

The non-repetitive nature of USAFRS's Five Year Market Forecast, and the absence of regional detail in its projections, render this source of population projections inappropriate for inclusion in the National Skills Market Model.

10.0 AIRMAN POPULATION
PROJECTION MODULE

Just as projections of the population of potential recruits with
suitable mental aptitude are required to transform the accession rate
forecasts generated by the accession/retention rate forecasting module
into projections of total Air Force accessions, so are projections of
the total populations of enlisted airmen with different skills required
to transform the retention rate forecasts produced by that module into
projections of total Air Force retentions of skilled personnel.

If ISEM is ultimately developed into a fully operational model of
the Air Force manpower, personnel, and training systems, forecasts
of the total populations of enlisted airmen in different skill categories,
grade ranges, and year of service groups will be routinely developed
within ISEM itself. Thus, these forecasts could be directly applied
within the National Skills Market Model, in conjunction with the reten-
tion rate projections provided by the accession/retention rate fore-
casting module, to derive the desired forecasts of total Air Force
retentions of skilled personnel.

However, if the development of ISEM into a fully operational
model is delayed, or if the level of AFSC detail required in skilled
personnel retention projections for Air Force manpower planning
purposes exceeds the level of such detail embodied in ISEM, it will
be necessary to develop appropriate projections of the total population
of enlisted airmen from alternative data sources. Fortunately, the
basic capability required for projecting the airman population by
AFSC, grade, year of service, and enlistment category (first-term
or career enlistment) will soon be available in the Airman Skill Force
System (ASKIF), as embodied in the ASKIF II management information
system currently in the final stages of development by the Air Force
Manpower and Personnel Center (AFMPC).

Therefore, the fundamental structure of the ASKIF, as it relates
to the provision of enlisted airman population forecasts within the
National Skills Market Model, is described in Subsection 10.1. Then,
the implications of this structure for the design of the airman popula-
tion projection module of the National Skills Market Model are pre-
sented in Subsection 10.2.

10.1 Basic Structure of the Airman Skill Force System

The purpose of the ASKIF is to provide forecasts, consistent with projected Congressional authorizations and established Air Force policy, of the airman force by AFSC over a 3 year period. Thus, the ASKIF develops projections of AFSC strength by grade, year of service, and enlistment category, taking into account all constraints arising from Congressional or Air Force policy actions.

To develop these projections, ASKIF II will employ a basic forecasting procedure involving the following steps:

- Determine the beginning trained airman strengths by AFSC, grade, year of service, and enlistment category using data contained in the Airman Master Personnel File. The basic data are reconciled for changes in AFSC definitions at this time, as necessary.

- Project Air Force losses from the permanent party and the transient strength by applying loss rates normalized by grade, year of service, and enlistment category to the corresponding beginning strengths by AFSC, grade, year of service, and enlistment category determined in the preceding step. The normalized loss rates are derived by the Airman Loss Probability System (ALPS) using historical data.

- Project reenlistment for E-4s and E-5s in their fourth year of service using historical first-term reenlistment rates by AFSC, grade, and year of service measuring movements from the first-term force to the career force.

- Forecast the volume of approved retraining in each AFSC resulting from physical or mental disqualification of personnel in their current AFSCs, or from voluntary retraining in response to excess reenlistments in their current AFSCs. These forecasts are based on historical retraining rates derived from the preceding 3 years' experiences.

- Project any additional retraining, in excess of the approved retraining forecast above, which would be required to increase the total number of retrainees to the estimated number of retrainees required to fulfill total force objectives.

- Apportion the projected retrainees into AFSCs and year of service groups using percentages computed from the previous 3 fiscal years' experiences, AFSC training categories, and Air Force trained personnel requirements. The resultant allocation is adjusted, as necessary, to assure that retraining in excess of requirements is not permitted for any AFSC.

- Forecast promotions for all enlisted grades, generally by applying historical promotion rates to the total beginning strength within each grade. The projected promotions are then distributed to year of service groups on the basis of percentages derived from the past 3 years' experiences.

- Project the upward movement of airmen between AFSCs representing different skill levels within individual skill categories. These upgrade flows are calculated on the basis of the previously estimated promotion projections, presuming implementation of the Air Force's three grades per skill policy.

- Forecast the volume of lateral movement of airmen from source skills into lateral skills within the same career ladder.

- Project Air Force recruitment requirements, including allowances for basic military training attrition and for other first year losses occurring after assignment to AFSCs. Retraining projections are also taken into account in developing the recruitment projections.

- Forecast technical training requirements by AFSC, once again accounting for previously estimated retraining projections.

- Project the final trained airman strength by AFSC, grade, year of service, and enlistment category at the end of the fiscal year. This end strength is initially calculated as the beginning trained airman strength net of losses, reenlistments, upgrade and lateral flows, and promotions; and then is aged one year. If the projected end strength exceeds the total force level approved by Congress, approved retraining is adjusted as necessary.

- Apportion the projected volume of new recruits across the projected end strength in a manner creating a grade and year of service distribution for grades E-1 to E-3 and years of service 1 to 3 similar to that distribution for the beginning strengths of the preceding year.

- Adopt the resultant trained airman strength distribution by AFSC, grade, year of service, and enlistment category as the beginning strengths for the subsequent year.

The forecasting process is then repeated for two additional years. Moreover, it obviously could be continued through several additional years as desired, and judged to be acceptably accurate, by the Air Force.

10.2 Design Implications of the
       Airman Skill Force System

The Airman Skill Force System, as it will be embodied in the ASKIF II management information system, provides an airman force projection capability containing detailed representations of all major personnel actions affecting the size of the trained airman force -- losses, reenlistments, retraining, promotions, upgrade and lateral flows, recruitment, technical training, and aging. Therefore, if the planned ISEM forecasts of the enlisted airman population either are not actuated or are judged to be too highly aggregated for detailed Air Force planning purposes, the ASKIF will provide an ample source of all data necessary to develop the airman population projections required by the National Skills Market Model.

However, it will not be appropriate to introduce the projections developed in the ASKIF directly into the National Skills Market Model. Rather, in general, it will first be necessary to group the AFSCs considered in the ASKIF to correspond to the skill categories contained in the National Skills Market Model. Then, the normalized loss rates used to project losses in ASKIF must be replaced with separation rates corresponding to the retention rates projected by the accession/retention rate forecasting module. Finally, the accession rates projected by the accession/retention rate forecasting module to forecast the Air Force's success in fulfilling its recruiting requirements must be incorporated into the ASKIF recruitment projections to assure consistency in the National Skills Market Model's projections over time. With these modifications, the ASKIF procedures will be totally compatible with the remainder of the National Skills Market Model and, hence, will be entirely appropriate for adoption as the airman population projection module of that model.

11.0 SUMMARY AND RECOMMENDATIONS

In this study, detailed specifications have been developed describing feasible options available for designing and implementing the National Skills Market Model -- an empirically based forecasting model of economic activity in the industrial and occupational labor markets in which the Air Force competes for skilled and unskilled enlisted personnel. Fundamentally, the National Skills Market Model formulated in this study consists of three basic analytic components which, in combination, produce detailed forecasts of national labor market conditions and generate projections of the total accession and retention of Air Force enlisted personnel. Each of these components, in turn, contains one or more analytic elements which address distinct aspects of the general issue examined in the analytic component.

The basic analytic components, the affiliated analytic elements, and their interrelationships are represented schematically in Figure 6. The functions performed by each of the components and elements, and the procedures through which each element has been designed to perform these functions, are outlined in the next three subsections of this summary. Then, in Subsection 11.4, recommendations for the systematic development of the model are presented.

11.1 The Non-Military Labor Market Module

This module develops forecasts of those aspects of non-military labor market activity which affect the ability of the Air Force to attract and retain enlisted personnel. In addition, to the extent possible, these forecasts contain both regional and demographic detail.

Five analytic elements are included in the non-military labor market module:

- The national economy module generates forecasts of aggregate unemployment rates, aggregate wage rates, and industrial sector employment levels and wage rates. Three different major econometric models of the national economy -- the Data Resources Incorporated Model, the Wharton Long-Term Annual and
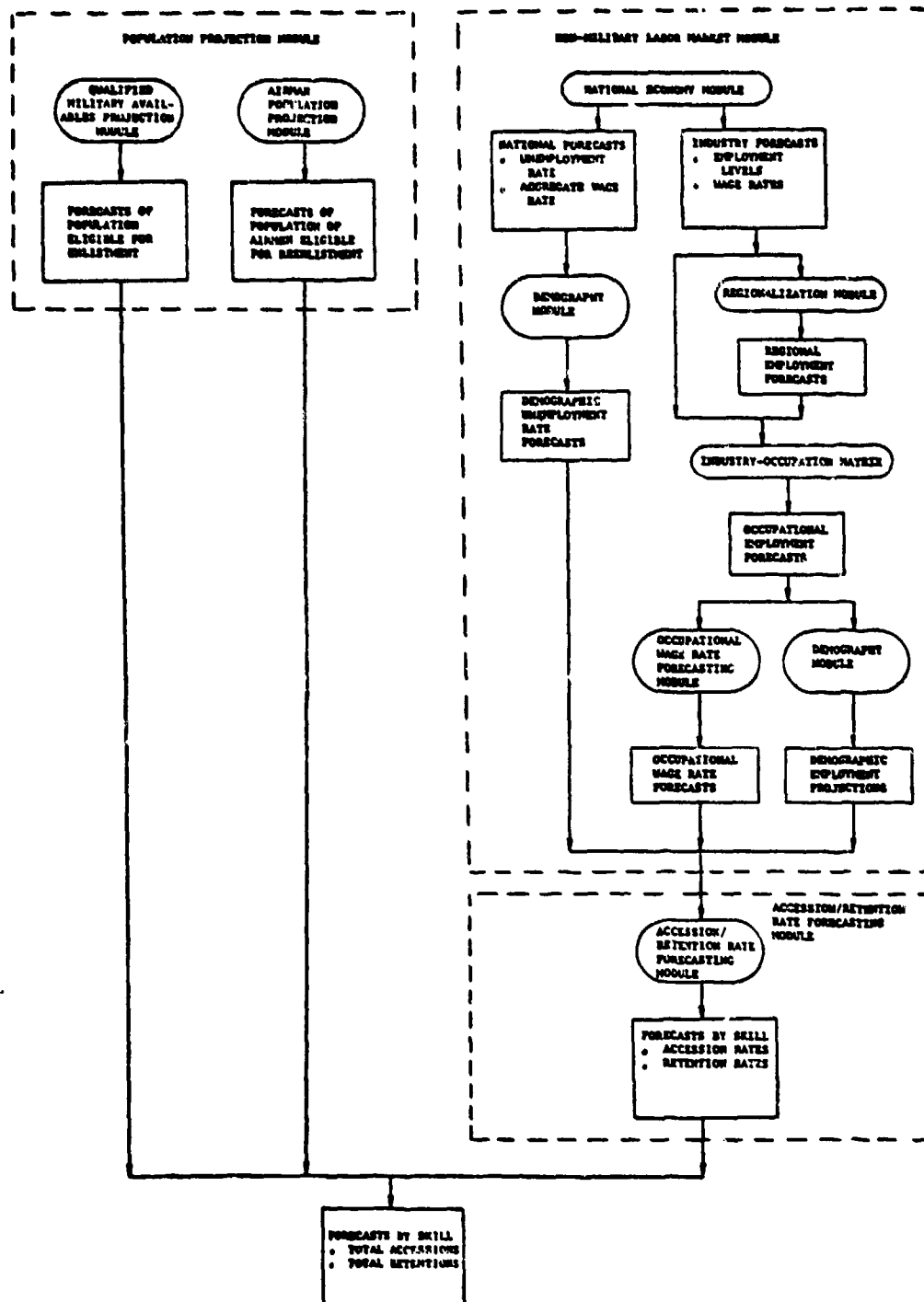
FIGURE 6: Schematic Representation of the
National Skills Market Model

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Industry Forecasting Model, and the Chase Econometric Long-Term Interindustry Forecasting Model -- have been examined in detail to determine how adequately each could fulfill the requirements of the National Skills Market Model. The examination concluded that none of the models uniformly provides all of the capabilities desired by the Air Force. Therefore, it will be necessary for the Air Force to determine the relative importance it attaches to each capability, and then to select a national economic model for inclusion in the National Skills Market Model accordingly. A detailed discussion of the strengths of the three models is contained in Section 4. Each of the models is routinely recalibrated to accommodate technological change and, hence, provides the basic capability required to predict the effects of technological change in any industrial sector or non-military labor market activity and, then, on Air Force accessions and retention.

- The regionalization module partitions the national employment projections generated by the national economy module to produce regional forecasts of industrial labor market activity. Specifically, using data describing industrial sector employment in different geographic areas, the regionalization module develops proportionality factors for decomposing national employment projections into regional forecasts. The general procedure developed to compute the proportionality factors, and two alternative data bases which might be used to calibrate these factors, are described in Section 5.

- The industry-occupation matrix provides an empirical basis for disaggregating total or regional employment projections for particular industries to derive forecasts of occupational employment in those industries. These forecasts can then be summed across industries to produce forecasts of total or regional occupational employment. The detailed characteristics of the industry-occupation matrix, its compatibility with the alternative national economic models and Air Force skill classifications, and systematic procedures for

using the matrix to derive occupational employment forecasts, or to identify the principal industrial sectors employing particular occupational groups, are all discussed in Section 6.

- The occupational wage forecasting module utilizes projections developed by the national economy module and the industry-occupation matrix to produce forecasts of the wage rates expected to prevail for each occupational group contained in the National Skills Market Model. General procedures for generating occupational wage forecasts are derived, and preliminary empirical tests of these procedures are performed, in Section 7.

- The demography module decomposes the forecasts generated by the national economy module, the regionalization module, and the industry-occupation matrix to produce separate projections of labor market activity for different demographic groups. General approaches to the demographic decomposition of different types of projections, and alternative data bases available for the implementation of these approaches, are discussed in Section 8.

Using these analytic capabilities, the non-military labor market module produces forecasts of such variables as unemployment rates, industrial and occupational employment levels, and industrial, occupational, and aggregate wage rates. Thus, by identifying the industries and occupations for which this module projects substantial increases in employment or wage rates over time, the chief competition confronting the Air Force in present and future labor markets can be determined.

11.2 The Accession/Retention Rate
     Forecasting Module

This module consists of a single analytic element that generates forecasts of the accession rates and retention rates which will be experienced in different Air Force skill classifications. Two different types of inputs are used in this model: variables describing economic

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activity in the non-military labor market -- as projected by the non-military labor market module -- and variables describing Air Force and, conceivably, other military personnel policies. Unfortunately, no comprehensive model of Air Force accession and retention rates has yet been developed and empirically tested. Consequently, it is presently impossible to specify the precise structure of the accession/retention rate forecasting module, or to determine the precise f m of its explanatory variables.

Nevertheless, to acquire available insights into the likely structure and desired level of detail of the accession/retention rate forecasting module, two research efforts were undertaken:

- A review of existing studies of military accession and retention was performed to identify explanatory variables indicating non-military labor market conditions which affect the success of military recruitment and reenlistment efforts. Key explanatory variables identified include unemployment rates, non-military wage rates, and demographic population characteristics. The full details of this review activity are presented in Section 2.

- Interviews of Air Force manpower and training planners were conducted to determine their desires for output from the National Skills Market Model in terms of both the level of detail which should be provided in accession and retention forecasts, and specific labor market characteristics of independent interest to the Air Force. The results of these interviews are summarized in detail in Section 3.

Thus, in combination, these two research activities have identified the particular types of information which the accession/retention rate forecasting module can reasonably be expected to require of the other basic analytic components of the National Skills Market Model. Using this information, the accession/retention rate forecasting module, when fully developed, will provide the basic mechanisms through which the National Skills Market Model will project the quantity and quality of enlisted airmen available at any particular military and civilian wage levels.

11.3 The Population Projection Module

The population projection module develops projections of the population of qualified military availables (the total population eligible for enlistment in the Air Force) and the population of current airmen eligible for reenlistment. Thus, this module contains two analytic elements:

- **The qualified military availables projection module** develops forecasts of the total population which is physically and mentally qualified for enlistment into the Air Force. Four alternative sources of such forecasts, or information required for the development of such forecasts, have been identified in this study. Detailed descriptions of these data sources, and recommendations concerning the conditions under which each source should be utilized, are presented in Section 9.

- The **airman population projection module** provides projections of the total population of enlisted airmen who are eligible for reenlistment. One prospective direct source of such projections, and one source of all information required for the development of such forecasts, are described in Section 10. Mechanisms for using the data in the second source to produce the required projections are also discussed in this section.

By applying the accession and retention rates projected by the accession/retention rate forecasting module to these population projections, forecasts of total accessions and retentions for each Air Force skill classification are generated.

11.4 Recommendations for Model Development

The research performed in this study clearly demonstrates the feasibility of developing the National Skills Market Model using existing data bases and established modeling capabilities. However, critical uncertainties relative to several key features of the model have

precluded the delineation of unequivocal design specifications. Rather, for several of the proposed analytic elements of the model, it has only been possible to identify and to state the comparative strengths and weaknesses of alternative design options. Nevertheless, several specific recommendations for model development can be advanced on the basis of the insights gained in this study. These recommendations a...

- The Air Force should, as quickly as possible, resolve the precise form which will be assumed by the accession/retention rate forecasting module to be included in the National Skills Market Model. This decision is critical to the ultimate development of the National Skills Market Model because the explanatory variables in the accession/retention rate forecasting model constitute required outputs of other analytic elements of the National Skills Market Model.

- Air Force manpower and training planners should determine the relative importance they attach to the various types and levels of detail which they have indicated they would like the National Skills Market Model to provide. The examinations performed in this study have demonstrated the general impossibility of simultaneously providing all of the types of detailed information requested by the Air Force personnel who were interviewed. Consequently, some reasoned choices must be made among the available options to assure that the National Skills Market Model ultimately developed is the most useful model achievable for Air Force purposes.

- Based on the resolutions of the preceding two issues, the following direct model development activities should be undertaken:

  .. Selection of a specific national economic model as the analytic core of the National Skills Market Model.

  .. Development of all required linkages between the chosen national economic model and the industry-occupation matrix.

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•• Adoption or creation of population projection
capabilities embodying, at least, demographic
detail commensurate with the accession/
retention rate forecasting module.

•• Empirical estimation of occupational wage rate
forecasting equations conforming, to the extent
feasible, to the level of occupational detail
desired by the Air Force.

•• Development of the full-scale capabilities of
the regionalization and demography modules
in conformity with Air Force desires for such
detail.

A significant feature of the proposed modular structure of the National
Skills Market Model is that this structure permits the initial develop-
ment -- and subsequent refinement -- of each analytic element of the
model to be performed relatively independently, without compromising
the analytic properties of the remaining elements. Hence, for the
most part, the model can be implemented and improved in an evolu-
tionary fashion with limited risk of subverting its continuing usefulness
to the Air Force.

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APPENDIX A: Air Force Manpower Planners Interviewed

Office Symbol	Number of Individuals Interviewed Using Interview Protocol for	
	Recruiting	Reenlistment
AF/MPCMDD	1	
ATC/TT	1	1
AF/MPCMA	3	2
AF/MPXXAO	3	
ATC/RMSY	1	1
ATC/RS	1	1
AF/MPPPN		2
AF/MPCX	1	
Non-Commissioned Officers Association, San Antonio, Texas		1

APPENDIX B: Interview Protocol for Air Force Recruiting
and Reenlistment Personnel Concerning
the National Skills Market Model

Questions for Recruiting Personnel:

1. What are the major competing industries?

   - For potential recruits

2a. How should competitive labor markets be categorized?

   - By industry (e.g., four-digit SIC code)
   - By region
   - By skill/occupation
   - By functional account code
   - Other criteria

2b. What level of disaggregation of information about these labor markets would be most relevant to you?

   - By industry
   - By skills
   - By region
     - State
     - Recruiting district
     - Multi-state region
   - By race, sex, age
   - By time period (monthly, yearly)

3a. What is the profile of Air Force recruits?

   - Age, sex, race
   - Mental capability
   - Educational attainment
   - Geographic location

3b. What demographic characteristics of Air Force recruits and/or the pool of eligible recruits are of interest to the Air Force?

3c. What are the skills which the Air Force is most concerned about and/or has the most difficulty in recruiting?

3d.   What level of disaggregation for demographic data about Air
        Force personnel (current and/or separating) would be most
        relevant to you?

        •   By industry
        •   By skills
        •   By region
              ••   State
              ••   Recruiting district
              ••   Multi-state region
        •   By race, sex, age
        •   By time period (monthly, yearly)

4.   In your opinion, what factors most influence success in
        recruiting?

5.   Would you be interested in attitudinal data concerning youths'
        (potential recruits) perceptions about job opportunities and
        general inclination to serve in the military?

6.   What other type of information concerning the national labor
        market would the Air Force like to have regarding the supply
        of recruits related to economic trends, private sector com-
        petition, and so on? What trends are of most concern to the
        Air Force?

7.   How has technological innovation, such as the introduction of
        a new airplane, affected recruiting in the past?

        •   Has this effect been substantiated?
        ○   Do you anticipate any such technological changes in the
              future?

Questions for Reenlistment Personnel:

1. What are the major competing industries?

    • For current Air Force enlisted personnel

2a. How should competitive labor markets be categorized?

    • By industry (e.g., four-digit SIC code)
    • By region
    • By skill/occupation
    • By functional account code
    • Other criteria

2b. What level of disaggregation of information about these labor markets would be most relevant to you?

    • By industry
    • By skills
    • By region
      •• State
      •• Recruiting district
      •• Multi-state region
    • By race, sex, age
    • By time period (monthly, yearly)

3. What are the skills/occupations the Air Force is most concerned about?

    • Large numbers of reenlistments required
    • Difficulty in retaining
    • Critical skill
    • High variability in retention rates
    • Other

4a. What is the profile of various classes of enlisted men separating from the Air Force? (Include profile of separating persons with the skills/occupations mentioned in Question 3, if possible.)

- Air Force specialty
- Post Air Force occupation
- Demographic characteristics
  - Age, sex, race
  - Mental capability
  - Educational attainment
  - Geographic location
- Stated reason for separation
- How could they have been retained?

4b. What demographic characteristics of current and/or separating Air Force personnel are of interest to the Air Force?

4c. What level of disaggregation for demographic data about Air Force personnel (current and/or separating) would be most relevant to you?

- By industry
- By skills
- By region
  - State
  - Recruiting district
  - Multi-state region
- By race, sex, age
- By time period (monthly, yearly)

5. In your opinion, what factor most influenced likelihood of separation?

6. How do people in the Air Force find out about job opportunities in industry?

7. What other types of information concerning the national labor market would the Air Force like to have regarding the demands for separations related to economic trends, private sector competition, and so on? What trends are of most concern to the Air Force?

8. How do commercial airlines and the aviation industry affect the Air Force?

   • Did the recent upturn (1977-1978) in business for commercial airlines cause more enlisted people to be hired away from the Air Force?

9. How has technological innovation, such as the introduction of a new airplane, affected accession/retention in the past?

   • Has this effect been substantial?
   • Do you anticipate any such technological changes in the future?

APPENDIX C: Industry Sectors Available in the
             National Industry-Occupation Matrix

	Code	
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Industry Title	Matrix	SIC (1967)
Total All Industries	000000	
Agriculture, Forestry and Fisheries	100000	
Agriculture	100100	
Agricultural production	100110	01
Agricultural services, except horticulture	100130	07 exc 0713, 073
Horticulture services	100170	073
Forestry	100800	08
Fisheries	100900	09
Mining	200000	
Metal mining	201000	10
Coal mining	201100	11, 12
Crude petroleum and natural gas extractions	201800	13
Nonmetallic mining and quarrying, except fuel	201400	14
Construction	300000	
General building contractors	301500	15
General contractors, except building	301600	16
Special trade contractors	301700	17
Manufacturing	400000	
Durable goods	410000	
Ordnance	411900	19
Lumber and wood products, except furniture	412400	24
Logging	412410	241
Sawmill, planing mills, and mill work	412420	242, 243
Miscellaneous wood products	412440	244, 9
Furniture and fixtures	412500	25
Stone, clay and glass products	413200	32
Glass and glass products	413210	321-3
Cement, concrete, gypsum, and plaster products	413240	324, 7
Structural clay products	413250	325

| | Code | |
Industry Title	Matrix	SIC (1967)
Pottery and related products	413260	326
Miscellaneous nonmetallic mineral and stone products	413280	328, 9
Primary metals industries	413300	
Blast furnaces, steel works, rolling and finishing mills	413310	3312, 3
Other primary iron and steel industries	413320	3315-7, 332, 3391, part 3399
Primary aluminum industries	413330	3334, part 334, 3352, 3361, part 3392, 9
Other primary nonferrous industries	413340	3331-3, 9, part 334, 3351, 6, 7, 3362, 9, part 3392 and 9
Fabricated metal products	413400	
Cutlery, hand tools and other hardware	413420	342
Fabricated structural metal products	413440	344
Screw machine products	413450	345
Metal stamping	413460	346
Miscellaneous fabricated metal products	413480	341, 3, 7-9
Machinery, except electrical	413500	
Engines and turbines	413510	351
Farm machinery and equipment	413520	352
Construction and material handling machines	413580	353
Metalworking machinery	413540	354
Office and accounting machines	413560	357 exc 3573
Electronic computing equipment	413570	3573
Machinery, except electrical, n.e.c.	413590	355, 6, 8, 9
Electrical machinery	413600	
Household appliances	413680	363
Radio, TV and communication equipment	413650	365, 6
Electrical machinery, equipment and supplies, n.e.c.	413690	361, 2, 4, 7, 9

Industry Title	Code Matrix	SIC (1967)
Transportation equipment	413700	
Motor vehicles and motor vehicle equipment	413710	371
Aircraft and parts	413720	372
Ship and boat building and repairing	413730	373
Railroad locomotives and equipment	413740	374
Mobile dwellings and campers	413780	3791
Cycles and miscellaneous transportation equipment	413790	375, 3799
Professional and photographic equipment, and watches	413800	
Scientific and controlling instruments	413810	381, 2
Optical and health services supplies	413880	383, 4, 5,
Photographic equipment and supplies	413860	386
Watches, clocks and clockwork operated devices	413870	387
Miscellaneous manufacturing industries	413900	39
Nondurable goods	420000	
Food and kindred products	422000	
Meat products	422010	201
Dairy products	422020	202
Canning and preserving fruits, vegetables and seafoods	422030	203
Grain mill products	422040	204, 0713
Bakery products	422050	205
Confectionary and related products	422070	207
Beverage industries	422080	208
Miscellaneous food preparation and kindred products	422090	206, 9
Tobacco manufacturers	422100	21
Textile mill products	422200	
Knitting mills	422250	225
Dyeing and finishing textiles, except wool and knit goods	422260	226

Industry Title	Code Matrix	SIC (1967)
Floor coverings, except hard surfaces	422170	227
Yarn, thread and fabric mills	422180	221 4,8
Miscellaneous textile mill products	422190	229
Apparel and other fabricated textile products	422300	
Apparel and accessories	422310	231-8
Miscellaneous fabricated textile products	422390	239
Paper and allied products	422400	
Pulp, paper and paperboard mills	422410	261-3,6
Paperboard containers and boxes	422450	265
Miscellaneous paper and pulp products	422460	264
Printing and publishing and allied products	422700	
Newspaper publishing and printing	422710	271
Printing, publishing and allied industries, except newspapers	422720	272-9
Chemicals and allied products	422500	
Industrial chemicals	422510	281
Plastics, synthetics and resins, except fibers	422520	282 exc 2823,4
Synthetic fibers	422530	2823,4
Drugs and medicines	422540	283
Soaps and cosmetics	422550	284
Paints, varnishes and related products	422560	285
Agricultural chemicals	422570	287
Miscellaneous chemicals	422590	286,9
Petroleum and coal products	422600	
Petroleum refining	422610	291
Miscellaneous petroleum and coal products	422680	295,9
Rubber and miscellaneous plastic products	423100	
Rubber products	423110	301-3,6
Miscellaneous plastic products	423170	307

Industry Title	Code Matrix	SIC (1967)
Leather and leather products	423100	
Tanned, curried and finished leather	423110	311
Footwear, except rubber	423140	313, 4
All other leather products	423180	312, 5-7, 9
Transportation, Communications and Other Public Utilities	500000	
Transportation, total	510000	
Railroads, railway express service	514000	40
Local, interurban transit	514100	
Street railways and bus lines	514110	411, 3-5, 7
Taxicab service	514120	412
Trucking and warehousing	514200	
Trucking	514210	421, 3
Warehousing and storage	514220	422
Water transportation	514400	44
Air transportation	514500	45
Pipelines	514600	46
Transportation services	514700	47
Communications, utilities, sanitary services	520000	
Communications	524800	
Telephone (wire and radio)	524810	481
Telegraph and miscellaneous communication services	524820	482, 9
Radio broadcasting and television	524830	483
Utilities, sanitary services	524900	
Electric light and power	524910	491
Electric-gas utilities	524920	493
Gas and steam supply systems	524930	492, 6
Water supply	524940	494
Sanitary services	524950	495
Other utilities, n. e. c.	524970	497
Wholesale and Retail Trade	600000	
Wholesale trade	610000	
Wholesale trade, except miscellaneous wholesale	615000	

Industry Title	Code Matrix	SIC (1967)
Motor vehicles and equipment	615010	501
Drugs, chemicals and allied products	615020	502
Dry goods and apparel	615030	503
Food and related products	615040	504
Farm products - raw materials	615050	505
Electrical goods	615060	506
Hardware, plumbing and heating supplies	615070	507
Machinery, equipment, supplies	615080	508
Miscellaneous wholesale trade	615900	
Metals and minerals, n. e. c.	615910	5091
Petroleum products	615920	5092
Scrap and waste materials	615930	5093
Alcoholic beverages	615950	5095
Paper and paper products	615960	5096
Lumber and construction materials	615980	5098
Wholesalers, n. e. c.	615990	5094, 7, 9
Retail trade	620000	
Building materials	625200	
Lumber and building material retailing	625210	521-4
Hardware and farm equipment stores	625250	525
General merchandise, total	625300	
Department and mail order establishments	625310	531, 2
Limited price stores	625330	533
Vending machine operators	625340	534
Direct selling establishments	625350	535
Miscellaneous general merchandise stores	625380	
Food and dairy stores	625400	
Grocery stores	625410	541
Dairy product stores	625450	545
Retail bakeries	625460	546
Food stores, n. e. c.	625490	542-4, 9
Auto dealers, gas stations	625500	
Motor vehicle dealers	625510	551, 2
Tire, battery and accessory dealers	625530	553

| | | Code |
Industry Title	Matrix	SIC (1967)
Gasoline service stations	625540	554
Miscellaneous vehicle dealers	625590	559
Apparel and accessories	625600	
Apparel and accessories stores, except shoe stores	625610	56 exc 566
Shoe stores	625660	566
Furniture and appliances	625700	
Home furnishing stores	625710	571
Household appliances, TV, and radio stores	625720	572,3
Eating and drinking places	625800	58
Miscellaneous retail trade stores	625900	
Drug stores	625910	591
Liquor stores	625920	592
Farm and garden supply stores	625930	596
Jewelry stores	625940	597
Fuel and ice dealers	625950	598
Retail florists	625960	5992
Miscellaneous retail trade stores	625970	593-5, 9, exc 5992
Finance, Insurance and Real Estate	700000	
Finance, total	706000	
Banking	706010	60
Credit agencies	706020	61
Stockbrokers, investment companies	706070	62,7
Insurance	706300	63,4
Real estate, including real estate-insurance-law offices	706500	65,6
Services, total	800000	
Hotels and lodging places	807000	
Hotels and motels	807010	701
Lodging places, except hotels and motels	807040	702-4
Other personal services	807200	
Laundering, cleaning and other garment services	807210	721,7
Beauty shops	807230	723
Barber shops	807240	724

	Code	
Industry Title	Matrix	SIC (1967)
Shoe repair shops	807250	725
Dressmaking shops	807260	part 729
Other personal services	807290	722,6, part 729
Miscellaneous business services	807300	
Advertising	807310	731
Business management and consulting services	807320	part 7392
Commercial research, development and testing labs	807330	7391, 7397
Computer programming services	807340	part 7392
Detective and protective services	807350	7393
Employment, temporary help	807360	736, 7398
Service buildings	807370	734
Other miscellaneous services	807390	732,3,5, 7394, 5,6,9
Automobile repair services	807500	
Automobile repair and related services	807510	753
Automobile services, except repair	807530	751,2,4
Other repair services	807600	
Electrical repair shops	807620	762, 7694
Other repair services	807630	763,4,9, exc 7694
Theaters and motion pictures	807800	78, 792
Miscellaneous entertainment	807900	
Bowling alleys, billiard and pool parlors	807930	793
Miscellaneous equipment and recreation services	807940	791, 4
Medical, other health	808000	
Offices of physicians	808010	801,3
Offices of dentists	808020	802
Offices of chiropractors	808040	804
Hospitals	808060	806
Convalescent institutions	808070	8092
Health practitioners, n.e.c.	808080	part 8099
Health services, n.e.c.	808090	807, part 8099
Legal services	808100	81

	Code	
Industry Title	Matrix	SIC (1967)
Educational services	808200	
Elementary and secondary schools	808210	821
Colleges and universities	808220	822
Libraries	808230	823
Educational services, n. e. c.	808240	824, 9
Museums, art galleries and zoos	808300	84
Nonprofit organizations	808600	
Religious organizations	808660	866
Welfare services	808670	part 867
Residential welfare	808680	part 867
Nonprofit membership organizations	808690	861-5, 9
Private households	808800	88
Other professional and related services	808900	
Engineering and architectural services	808910	891
Accounting and auditing services	808980	893
Miscellaneous professional services	808990	892, 9
Government, total	900000	
Federal public administration	909100	
Postal services	909120	part 9190
Federal public administration, other	909190	part 9190, 9490
State public administration	909200	9290
Local public administration	909300	9390

APPENDIX D: Summary Occupational Employment
Data Available in the National
Industry-Occupation Matrix

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Total, All Occupations	78,627,392	87,487,104	104,300,608
Professional, Technical, Kindred	10,911,257	13,326,652	15,756,777
Engineers, Technical	1,103,935	1,212,662	1,490,153
Engineers, Aero-Astronautic	60,996	51,886	58,498
Engineers, Chemical	49,996	53,984	63,901
Engineers, Civil	166,989	157,856	191,991
Engineers, Electrical	280,987	305,516	369,982
Engineers, Industrial	158,991	204,644	256,989
Engineers, Mechanical	184,989	203,642	243,001
Engineers, Metallurgical	14,997	17,295	22,004
Engineers, Mining	5,001	6,099	8,801
Engineers, Petroleum	11,999	20,395	27,999
Engineers, Sales	38,999	29,490	35,000
Engineers, Other	129,991	161,855	211,987
Life and Physical Scientists	206,993	284,223	357,576
Agricultural Scientists	12,999	20,396	25,997
Atmospheric, Space Scientists	6,000	11,197	11,999
Biological Scientists	29,003	51,887	69,993
Chemists	108,992	125,264	150,990
Geologists	23,998	37,690	53,698
Marine Scientists	3,001	7,098	9,001
Physicists and Astronomers	20,998	28,492	32,997
Life, Physical Scientists NEC	2,002	2,199	2,901
Mathematical Specialists	34,003	44,790	56,398
Actuaries	5,000	9,197	11,399
Mathematicians	8,001	11,197	14,998
Statisticians	21,002	24,396	30,001
Engineers, Science Technicians	819,252	930,841	1,128,961
Agricultural, Biological Tech Exc Health	35,997	43,188	45,998
Chemical Technicians	76,994	84,276	94,997
Crafters	270,282	325,809	417,987
Electrical, Electronic Technicians	153,992	168,853	204,988
Industrial Engineering Technicians	20,004	21,594	28,007
Mathematical Technicians	999	1,001	1,401
Mechanical Engineering Technicians	11,998	12,096	15,003
Surveyors	58,996	52,985	73,598
Engineering, Science Technicians NEC	189,990	221,039	246,982
Medical Workers, Excluding Technicians	1,355,198	1,730,900	2,304,507
Chiropractors	16,000	16,601	21,600
Dentists	94,103	109,003	129,001
Dietitians	30,005	45,790	51,997
Optometrists	18,006	19,100	22,500
Pharmacists	115,014	120,168	137,987
Physicians, MD Osteopaths	289,820	341,195	465,997
Podiatrists	7,003	7,599	8,564
Registered Nurses	680,038	901,361	1,219,979
Therapists	81,612	143,890	211,985
Veterinarians	22,597	24,693	31,897
Other Medical and Health	1,000	1,500	3,000

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Health, Technology and Technical	273,843	437,519	610,480
Clinical Laboratory Technology, Tech	130,019	195,550	279,197
Dental Hygienists	16,003	26,495	57,999
Health Record Technology, Technicians	12,302	16,295	20,800
Radiologic Technology, Technicians	52,008	81,478	112,001
Therapy Assistants	3,501	3,671	4,500
Other Health Technology, Technicians	60,010	114,070	135,983
Technicians, Excluding Health	154,998	199,443	263,778
Airplane Pilots	48,995	65,152	84,995
Air Traffic Controllers	25,060	31,591	41,997
Embalmers	5,000	5,019	4,995
Flight Engineers	7,499	6,099	8,000
Radio Operators	29,999	37,490	48,996
Tool Programmers, Numerical	3,003	3,297	4,803
Other Technicians, Excluding Health	35,502	50,650	69,989
Computer Specialists	279,211	393,995	501,562
Computer Programmers	176,507	233,139	271,674
Computer Systems Analysts	88,100	139,442	181,935
Other Computer Specialists	14,604	21,394	27,903
Social Scientists	115,205	207,643	270,168
Economists	66,004	105,869	134,389
Political Scientists	1,899	3,095	3,801
Psychologists	30,007	71,251	99,387
Sociologists	1,298	2,900	4,999
Urban and Regional Planners	9,000	16,945	22,997
Other Social Scientists	6,997	7,195	2,595
Teachers	3,368,979	3,635,857	3,765,926
Adult Education Teachers	58,003	55,930	74,986
College and University Teachers	518,049	537,000	552,920
Elementary School Teachers	1,350,000	1,383,000	1,518,482
Preschool, Kindergarten	183,016	227,943	284,907
Secondary School Teachers	1,100,000	1,188,000	1,053,641
Teachers NEC, Exc College, University	109,911	244,933	284,990
Writers, Artists, Entertainers	821,633	1,123,394	1,298,162
Actors	10,702	13,197	14,997
Athletes and Kindred Workers	55,705	83,975	94,987
Authors	26,002	36,190	34,997
Dancers	6,001	8,079	9,898
Designers	119,990	144,538	173,997
Editors and Reporters	150,004	165,552	204,985
Musicians and Composers	105,033	162,762	175,966
Painters and Sculptors	105,005	187,348	194,979
Photographers	70,196	86,575	94,990
Public Relations Specialists	82,009	117,072	149,982
Radio, TV Announcers	20,999	26,492	34,398
Writers, Artists, Entertainers NEC	70,007	101,573	109,486
Other Professional, Technical	2,378,007	3,124,383	3,705,106
Accountants	686,017	881,764	1,049,912
Architects	61,995	64,183	97,698
Archivists and Curators	5,997	9,395	10,000

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Clergy	228,025	265,734	279,945
Religious, Excluding Clergy	43,006	51,687	57,388
Farm Management Advisors	7,000	7,597	5,999
Foresters, Conservationists	42,997	49,187	56,299
Home Management Advisors	5,198	5,799	6,398
Judges	13,699	16,195	17,298
Lawyers	287,005	403,194	478,968
Librarians	115,014	130,366	144,963
Operations, Systems Research	78,996	97,774	128,996
Personnel Labor Relations	286,017	341,109	449,953
Research Workers, NEC	115,011	166,559	129,387
Recreation Workers	60,003	121,668	146,977
Social Workers	230,016	336,014	435,937
Vocational, Educational Counselors	112,011	176,154	208,988
Managers, Officials, Proprietors	7,484,169	9,312,478	11,278,070
Buyers, Sales, Loan Managers	1,360,062	1,555,380	2,102,867
Bank, Financial Managers	398,028	499,966	705,974
Credit Managers	69,009	52,986	59,992
Buyers, Shippers, Farm Products	24,998	21,394	21,999
Buyers, Wholesale, Retail	155,012	164,555	229,981
Purchasing Agents, Buyers, NEC	174,991	191,949	258,981
Sales Managers, Retail Trade	275,020	328,111	431,963
Sales Managers, Excluding Retail Trade	264,004	296,419	393,977
Administrators, Public Inspectors	752,023	992,845	1,219,047
Assess, Control, Loc Pub Administration	30,000	35,890	39,996
Construction Inspectors, Public	21,000	21,994	29,998
Health Administrators	100,016	159,958	232,000
Inspectors, Exc Construction, Public	89,000	113,969	144,989
Officials, Administration, Public	262,999	295,621	354,971
Postmasters and Mail Supervisors	34,933	30,000	27,514
School Administrators, College	40,004	53,485	61,991
School Administrators, Elem, Secondary	174,021	281,928	327,588
Other Managers, Officials, Proprietors	5,372,084	6,764,253	7,956,156
Funeral Directors	39,997	39,989	39,995
Managers, Superintendants, Building	100,009	134,565	183,976
Office Managers, NEC	288,022	344,505	430,956
Officers, Pilots, Pursers, Ship	31,996	32,892	35,001
Officials of Lodges, Unions	65,007	73,280	72,990
Railroad Conductors	39,997	38,589	44,700
Restaurant, Cafe, Bar Managers	463,112	551,565	619,837
Other Managers, Administrators	4,343,944	5,546,868	6,478,701
Sales Workers	5,013,358	5,495,484	6,408,518
Advertising Agents, Sales Workers	63,503	87,976	114,894
Auctioneers	5,499	6,697	6,801
Demonstrators	55,031	55,381	59,107
Hucksters and Peddlers	210,119	201,831	168,722
Insurance Agents, Brokers, etc.	412,018	488,867	579,947
Newspaper Carriers and Vendors	72,012	69,479	55,999
Real Estate Agents, Brokers	316,030	450,880	574,930
Stock and Bond Sales Agents	101,805	90,975	104,991
Sales and Sales Workers, NEC	3,777,341	4,043,398	4,723,127

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Clerical Workers	13,732,288	15,553,943	20,043,232
Stenographers, Typists, Secretaries	3,886,155	4,482,801	5,977,396
Secretaries, Legal	104,006	139,963	209,988
Secretaries, Medical	79,011	85,978	154,979
Secretaries, Other	2,602,086	3,157,158	4,334,566
Stenographers	128,003	99,973	77,992
Typists	973,049	999,729	1,199,871
Office Machine Operators	632,549	725,794	725,445
Bookkeeping, Billing Operators	68,508	47,987	61,193
Calculating Machine Operators	34,004	24,990	29,698
Computer, Peripheral Equipment	150,006	286,920	338,570
Duplicating Machine Operators	19,006	22,994	26,395
Keypunch Operators	300,015	275,926	201,981
Tabulating Machine Operators	9,005	2,994	2,006
Other Office Machine Operators	52,005	63,983	65,602
Other Clerical Workers	9,213,584	10,345,348	13,340,406
Bank Tellers	287,020	370,900	449,956
Billing Clerks	123,012	146,460	215,981
Bookkeepers	1,540,051	1,687,543	1,899,837
Cashiers	969,099	1,255,667	1,638,777
Clerical Assistants, Social Welfare	1,501	39,989	51,993
Clerical Supervisors, NEC	192,010	236,936	296,964
Collectors, Billing and Accounting	60,004	63,982	79,994
Counter Clerks, excluding Food	309,023	353,905	437,969
Dispatchers, Starters, Vehicle	63,986	71,980	91,996
Enumerators and Interviewers	65,000	65,383	68,995
Estimators, Investigators, NEC	329,009	415,889	501,963
Expeditors, Product Controllers	199,983	206,941	276,001
File Clerks	270,013	268,926	319,965
Insurance Adjusters, Examiners	105,005	155,957	189,982
Library Attendants, Assistant	120,014	142,965	167,965
Mail Carriers, Post Office	267,867	250,000	250,126
Mail Handlers, excluding Post Office	130,005	137,962	172,983
Messengers and Office Helpers	56,004	58,584	59,995
Meter Readers, Utilities	36,996	38,687	40,999
Payroll, Time Keeping Clerks	174,987	207,942	241,977
Postal Clerks	314,844	270,000	240,121
Proofreaders	27,001	30,591	40,998
Real Estate Appraisers	24,002	30,292	38,996
Receptionists	423,044	501,869	639,922
Shipping, Receiving Clerks	437,983	439,881	532,969
Statistical Clerks	291,014	336,909	408,960
Stock Clerks, Store Keepers	496,018	491,865	583,953
Teachers Aides, excluding Monitors	190,022	319,918	493,836
Telegraph Messengers	2,500	1,999	1,000
Telegraph Operators	11,999	9,897	7,000
Telephone Operators	388,029	338,909	339,966
Ticket Station, Express Agents	93,989	99,573	115,992
Weighers	45,996	46,188	48,999
Miscellaneous Clerical Workers, NEC	1,166,554	1,250,859	2,393,276

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Crafts and Kindred Workers	10,444,360	11,297,874	13,714,666
Construction Crafts Workers	3,093,050	3,318,075	4,312,310
Carpenters and Apprentices	993,824	1,019,715	1,269,943
Brick and Stonemasons and Apprentices	176,485	176,950	208,994
Bulldozer Operators	99,989	126,964	189,993
Cement and Concrete Finishers	64,995	70,980	119,995
Electricians and Apprentices	471,260	571,842	710,968
Excavating, Grading, Machine Operators	279,974	290,918	409,985
Floor Layers, excluding Tile Setters	23,498	12,996	16,000
Painters and Apprentices	401,572	413,887	501,965
Paperhangers	9,999	12,997	19,499
Plasterers and Apprentices	28,497	24,993	25,999
Plumbers, Pipefitters and Apprentices	368,972	399,888	551,977
Roofers and Slaters	62,994	88,975	129,996
Structural Metal Craft Workers	78,995	70,981	111,997
Tilesetters	31,996	35,989	44,999
Blue Collar Worker Supervisors, NEC	1,374,914	1,442,601	1,773,924
Metalworking Craft Workers, exc Mechanics	1,141,706	1,189,260	1,407,314
Blacksmiths	9,999	8,998	6,000
Boilermakers	29,995	33,991	56,001
Heat Treaters, Annealers, etc.	22,997	20,693	20,402
Forge and Hammer Operators	17,998	17,695	21,301
Job and Die Setters, Metal	99,992	91,973	115,002
Machinists and Apprentices	429,970	477,868	557,998
Millwrights	80,994	95,973	105,003
Molders, Metal and Apprentices	55,795	53,983	61,001
Pattern and Model Makers	41,996	33,989	39,104
Rollers and Finishers, Metal	22,998	21,194	24,501
Sheetmetal Workers and Apprentices	150,988	144,958	180,997
Tool and Diemakers and Apprentices	177,984	187,945	220,004
Mechanics, Repairers, Installers	2,647,638	3,015,269	3,613,920
Air Conditioning, Heating, Refrig Mechanics	129,992	177,951	284,985
Aircraft Mechanics	119,994	109,970	137,994
Auto Accessories Installers	5,998	6,499	6,801
Auto Body Repairers	158,989	173,952	199,989
Auto Mechanics and Apprentices	839,537	948,736	1,100,926
Data Processing Machine Repairers	35,999	49,985	93,194
Farm Implement Mechanics	46,303	66,981	81,997
Heavy Equipment Mechanics, incl Diesel	686,957	832,769	944,980
Household Appliance Mechanics	119,995	143,963	171,992
Loom Fixers	17,999	15,995	15,400
Office Machine Repairers	64,502	57,985	79,895
Radio, Television Repairers	136,994	113,970	149,991
Railroad, Car Shop Repairers	53,995	46,587	44,800
Other Mechanics and Apprentices	230,384	269,926	300,976
Printing Trade Crafts Workers	389,702	387,191	402,183
Bookbinders	31,999	31,991	33,998
Compositors and Typesetters	170,002	151,958	139,993
Electrotypers, Stereotypers	7,000	3,998	3,200
Engravers, excluding Photoengravers	11,503	11,297	10,903

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Photoengravers, Lithographers	31,401	38,989	47,998
Printing Press Operators and Apprentices	137,797	148,958	166,091
Transportation, Public Utility Crafts	5C4,798	510,459	605,466
Electric Power Line Installers, Repairmen	99,993	110,968	139,996
Locomotive Engineers	37,497	35,890	42,500
Locomotive Engineer Helpers	17,999	9,997	6,000
Power Station Operators	17,297	17,696	19,000
Telephone Installers, Repairers	280,010	281,923	339,975
Telephone Line Installers, Splicers	52,002	53,985	57,995
Other Crafts, Kindred Workers	1,292,552	1,435,019	1,599,549
Bakers	125,006	125,866	123,985
Cabinetmakers	74,996	81,377	87,499
Carpet Installers	46,996	69,979	83,996
Crane, Derrick, and Hoist Operators	169,982	166,953	210,002
Decorators, Window Dressers	70,005	108,981	133,993
Dental Laboratory Technicians	30,005	40,998	60,000
Furniture and Wood Finishers	22,998	24,393	23,000
Furriers	2,601	2,399	2,100
Glaziers	24,999	34,990	45,999
Inspectors, Log and Lumber	16,998	18,394	19,600
Inspectors, Other	127,987	144,559	165,995
Jewelers and Watchmakers	41,503	43,988	47,998
Millers, Grain, Flour, Feed	8,799	9,898	11,200
Motion Picture Projectionists	16,001	15,996	16,998
Opticians, Lens Grinders, Polishers	27,001	36,989	50,398
Piano, Organ Tuners, Repairers	7,000	7,998	8,400
Shipfitters	10,999	10,897	10,200
Shoe Repairers	31,901	24,991	24,003
Sign Painters and Letterers	19,999	20,794	24,999
Stationary Engineers	177,991	193,948	193,988
Stone Cutters, Stone Carvers	7,000	7,398	7,600
Tailors	67,998	62,482	65,097
Upholsterers	67,996	69,980	69,998
Crafts, Kindred Workers, NEC	96,691	110,771	112,501
Operatives	13,273,171	13,352,303	15,616,334
Operatives, excluding Transportation	10,261,522	10,082,164	11,973,026
Semiskilled Metalworkers	1,330,692	1,315,026	1,586,403
Drill Press Operators	75,995	64,982	64,001
Furnace Tenders, Smelters, Pourers	74,393	71,879	87,002
Grinding Machine Operators	144,988	132,963	131,002
Heaters, Metal	7,499	6,398	6,000
Lathe, Milling Machine Operators	154,987	105,971	134,002
Metal Platers	35,996	36,389	41,101
Other Precision Machine Operators	76,495	48,986	76,001
Punch Stamping Press Operators	179,986	154,957	189,002
Solderers	42,395	33,691	25,300
Welders and Flame Cutters	537,953	658,810	832,997
Semiskilled Textile	438,371	406,785	372,312
Carding, Lapping, Combing Operators	17,799	14,395	9,200
Knitters, Loopers and Toppers	34,598	32,191	27,601

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Spinners, Twisters, Winders	149, 990	141, 660	138, 804
Weavers	45, 996	40, 688	32, 801
Other Textile Operatives	189, 988	177, 851	163, 906
Semiskilled Packing, Inspecting	1, 456, 120	1, 375, 215	1, 789, 965
Checkers, Examiners, etc., Manufacturing	689, 954	653, 816	895, 996
Graders and Sorters, Manufacturing	45, 295	44, 287	49, 001
Meat Wrappers, Retail Trade	46, 504	56, 185	63, 994
Packers, Wrappers, exc Meat, Produ.	648, 967	590, 835	747, 976
Prod. Graders, Packers, exc Fact, Fa.	25, 400	30, 092	32, 998
Other Operatives, excluding Transportation	7, 036, 339	6, 985, 138	8, 224, 341
Asbestos, Insulation Workers	26, 998	28, 992	49, 999
Assemblers	943, 932	1, 087, 695	1, 449, 983
Blasters	7, 101	7, 897	9, 301
Bottling, Canning Operators	59, 996	58, 984	60, 000
Surveyor Helpers	10, 999	12, 696	15, 301
Clothing Ironers and Pressers	200, 001	134, 962	133, 488
Cutting Operators, NEC	238, 984	236, 932	290, 410
Dressmakers, excluding Factory	110, 009	124, 965	109, 990
Drillers, Earth	57, 494	65, 981	89, 199
Dry Wall Installers, Lathes	46, 996	63, 983	99, 996
Dyers	27, 999	28, 792	34, 302
Filers, Polishers, Sanders, Buffers	125, 990	114, 966	121, 204
Garage Workers, Gas Station Attendants	498, 996	447, 876	469, 991
Laundry, Dry Cleaning Operators, NEC	190, 012	165, 956	209, 971
Meat Cutters, Butchers, excluding Manuf.	202, 014	214, 942	197, 981
Meat Cutters, Butchers	87, 995	82, 677	88, 000
Milleners	2, 000	1, 900	1, 500
Mine Operatives, NEC	164, 988	186, 947	251, 999
Mixing Operatives	80, 693	79, 978	89, 007
Oilers, Greasers, excluding Auto	50, 992	48, 385	48, 905
Painters, Manufacturing Articles	177, 987	136, 959	188, 496
Photographic Process Workers	69, 000	74, 980	110, 290
Riveters and Fasteners	28, 997	27, 392	32, 005
Sailors and Deckhands	34, 996	31, 991	31, 000
Sawyers	119, 989	128, 962	149, 001
Sewers and Stitchers	925, 948	811, 771	999, 993
Shoemaking Machine Operators	66, 995	49, 885	35, 301
Furnace Tenders, Stokers, exc Metal	93, 994	72, 980	71, 991
Winding Operatives, NEC	68, 995	69, 779	94, 999
Miscellaneous Machine Operatives	1, 306, 914	1, 310, 932	1, 504, 987
Operatives, NEC	1, 008, 335	1, 074, 001	1, 185, 751
Transportation Equipment Operatives	3, 011, 649	3, 270, 139	3, 643, 308
Boat Operators	5, 999	5, 599	5, 301
Bus Drivers	228, 992	331, 929	312, 944
Conductors and Operators, Urban Rail	8, 396	8, 799	10, 698
Delivery and Route Workers	570, 004	520, 859	582, 952
Fork Lift, Tow Motor Operatives	280, 979	355, 899	443, 003
Rail Vehicle Operators, NEC	9, 999	11, 896	12, 600
Parking Attendants	30, 498	37, 990	40, 396
Railroad Brake Operators	48, 996	47, 187	51, 000

Occupational Title	1970 Employment	1976 Employment	1985 Employment
Railroad Switch Operators	52,995	45,487	45,500
Taxicab Drivers, Chauffeurs	149,918	163,981	163,990
Truck Drivers	1,624,943	1,740,513	1,974,924
Service Workers	10,464,991	12,002,568	14,810,842
Cleaning Service Workers	1,987,966	2,283,400	2,745,565
Lodging Quarters Cleaners	213,828	180,953	322,940
Building Interior Cleaners, NEC	611,054	784,795	1,008,843
Janitors and Sextons	1,163,084	1,317,652	1,413,782
Food Service Workers	3,084,607	3,876,035	4,808,825
Bartenders	185,043	260,934	309,923
Waiters' Assistants	110,022	190,954	251,941
Cooks, excluding Private	821,158	1,064,735	1,347,664
Dishwashers	207,040	250,939	292,936
Food Counter, Fountain Workers	282,052	420,895	568,860
Waiters	1,090,229	1,258,685	1,503,623
Food Workers, NEC, excluding Private	389,063	428,893	533,876
Health Service Workers	1,451,898	1,834,702	2,610,732
Dental Assistants	100,002	133,970	198,000
Health Aides, except Nursing	133,020	228,941	349,951
Health Trainees	19,002	12,997	3,999
Lay Midwives	800	1,000	800
Nurses Aides, Orderlies	834,054	999,827	1,349,988
Practical Nurses	365,020	457,967	707,994
Personal Service Workers	1,418,594	1,581,082	1,998,597
Flight Attendants	34,197	42,389	75,996
Attendants, Recreation, Amusement	80,009	96,575	111,983
Attendants, Personal Services, NEC	62,006	69,881	74,988
Baggage Porters and Bellhops	21,003	22,694	19,000
Barbers	158,349	123,998	125,999
Boarding, Lodging Housekeepers	29,300	37,890	42,993
Bootblacks	3,200	2,200	1,000
Child Care Workers, excluding Private	339,023	380,961	619,913
Elevator Operators	39,005	37,091	27,596
Hairdressers, Cosmetologists	480,680	533,969	622,987
Housekeepers, excluding Private	111,017	120,965	134,974
School Monitors	26,503	36,689	48,683
Ushers, Recreation, Amusement	16,301	16,796	15,498
Welfare Service Aides	18,001	58,984	76,987
Protective and Service Workers	1,046,926	1,302,349	1,733,123
Crossing Guards, Bridgetenders	46,000	45,987	54,994
Firefighters	131,000	209,943	259,974
Guards	386,022	499,867	679,930
Marshals and Constables	5,900	3,999	3,300
Police and Detectives	388,004	486,868	669,932
Sheriffs and Bailiffs	40,000	55,685	64,993
Private Household Workers	1,475,000	1,125,000	914,000
Child Care Workers	557,000	429,000	345,000
Cooks, Private	39,000	25,000	25,000
Housekeepers, Private	115,000	109,000	72,000
Launderers, Private Household	13,000	9,000	4,000
Private Household Cleaners, Servants	751,000	553,000	468,000

Occupation Title	1970 Employment	1976 Employment	1985 Employment
Laborers, except Farm	4,174,811	4,323,804	4,812,162
Animal Caretakers, excluding Farm	70,990	115,167	141,991
Carpenters, Helpers	116,988	93,474	104,998
Construction Labor, exc Carpenter Helpers	804,935	714,799	899,968
Fishers, Hunters and Trappers	33,984	37,192	29,003
Freight, Material Handlers	747,939	764,583	835,019
Garbage Collectors	83,991	103,771	169,999
Gardeners, Groundkeepers, exc Farm	537,007	614,842	655,899
Longshore Workers, Stevedores	55,994	52,086	52,400
Timbercutting, Logging Workers	81,991	79,475	65,001
Stock Handlers	718,051	827,772	921,913
Teamsters	6,999	5,498	3,502
Vehicle Washers, Equipment Cleaners	175,984	185,950	199,985
Warehouse Laborers, NEC	149,006	147,059	147,996
Other Laborers	590,952	582,136	584,488
Farmers and Farm Workers	3,128,997	2,822,000	1,860,000
Farmers and Farm Managers	1,718,003	1,513,000	1,012,000
Farmers (Owners and Tenants)	1,685,000	1,488,000	973,000
Farm Managers	33,033	25,000	39,000
Farm Laborers, Farm Supervisors	1,410,994	1,309,000	848,000
Farm Labor Supervisors	31,003	31,000	27,000
Farm Laborers, Wage Workers	896,991	942,000	534,000
Farm Laborers, Unpaid Family	474,000	326,000	276,000
Farm Laborers, Self-Employed	9,000	10,000	11,000

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APPENDIX E: Air Force Reenlistment Bonus
Skills and Corresponding Dictionary
of Occupation Titles Listings

AFSC Code	AFSC Title	DOT Code	DOT Title
111X0	Defensive Aerial Gunner	--	None specified
112X0	In-Flight Refueling Operator	--	None specified
113X0	Flight Engineer Specialist	621.281	Flight Engineer
114X0	Aircraft Loadmaster	912.368	Cargo Agent
115X0	Pararescue/Recovery Specialist	--	None specified
204X0	Intelligence Operations Specialist	059.167-010	Intelligence Research Specialist
		059.267-014	Intelligence Specialist
		216.382-062	Statistical Clerk
		209.387-014	Compiler
207X2	Printer Systems Operator	193.282	Radio Operator
		379.368	Dispatcher, Radio
		235.388	Radio Message Router
208X0	Voice Processing Specialist	137.268	Interpreter
		137.288	Translator Radio Communications
222X0	Geodetic Specialist	018.188	Surveyor, Geodetic
		018.687	Surveyor, Assistant (Chainman)
		018.188	Geodetic Computer
		017.281	Draftsman, Topographic
241X0	Safety Specialist	168.168	Safety Man
		168.168	Safety Inspector
215X0	Weather Specialist	025.288	Weather Observer
		025.288	Weather Chart Preparer
		239.368	Weather Clerk
		025.688	Meteorologist
		025.688	Climatologist
272X0	Air Traffic Control Operator	193.168	Air Traffic Control Specialist, Station
		193.168	Air Traffic Control Specialist, Tower

AFSC Code	AFSC Title	DOT Code	DOT Title
274X0	Command/Control Specialist	193.167-010 193.168	Chief Controller Air Traffic Control Specialist, Station
276X0	Aerospace Control and Warning Systems Operator	213.132-014 193.168	Supervisor, Machine Records Unit Air Traffic Control Specialist
296X0	Communications-Electronic Program Management Technician	216.388	Statistical Clerk
297X0	Radio Frequency Management Technician	184.168	Traffic Chief, Radio Communications
304X0	Radio Relay Equipment Specialist	823.281 823.281	Radio Mechanic Electrician, Radio
305X4	Electronic Computer Systems Specialist	726.281-014	Electronics Tester
306X0	Electronic Communications and Cryptographic Equipment Systems Specialist	828.381-010	Electronics Mechanic
308X0	Space Systems Equipment Specialist	828.281	Electronics Specialist
309X0	Missile Warning and Space Surveillance: A; Sensor Repairman: B	828.281-010	Electronics Mechanic
316X0	Missile Systems Analyst Specialist	828.281-010	Electronics Mechanic
321X1	Defensive FSC Mechanic	--	None specified
324X0	Precision Measuring Equipment Specialist	019.281	Standards-Laboratory Technician
326X1	Integrated Avionics Component Specialist	726.684-022 726.281-014	Electronics Inspector Electronics Tester

AFSC Code	AFSC Title	DOT Code	DOT Title
326X2	Integrated Avionics Systems Specialist	828.281	Electronics Mechanic
328X2	Airborne Early Warning Radar Specialist	823.281-010	Avionics Technician
341X1	Instrument Trainer Specialist	710.281	Instrument Man
		097.228	Ground Instructor, Instrument
341X2	Defensive Systems Trainer Specialist	720.281	Radio Repairman
		823.281	Radio Mechanic II
341X5	Analog Navigation/Tactics Training Devices Specialist	720.281	Radio Repairman
		823.281	Radio Mechanic II
		711.884	Instrument Man
314X6	Digital Navigation/Tactics Training Devices Specialist	711.884	Instrument Man
		720.181	Radio Repairman
		823.281	Radio Mechanic
341X7	Missile Trainer Specialist	828.281	Electronics Mechanic
361X1	Minuteman Hard Intersite Cable Maintenance Specialist	822.381	Lineman
		829.381	Cable Splicer
362X2	Electronic Switching Systems Repairman	828.281	Electronic Mechanic
391X0	Maintenance Analysis Specialist	221.382-018	Production Clerk
		221.367-038	Statistical Clerk
40?X0	Biomedical Equipment Maintenance Specialist	003.181	Electronic Technician
		828.281	Electronic Mechanic
		729.281	Electromedical Equipment Repairman
426X0	Aircraft Propeller Mechanic	621.281	Aircraft and Engine Mechanic
427X2	Nondestructive Inspection Technician	726.384	Subassembling Inspector

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AFSC Code	AFSC Title	DOT Code	DOT Title
463X0	Nuclear Weapons Technician	632.281	Ordnanceman
464X0	Explosive Ordnance Disposal Specialist	929.687-034	Munitions Handler
472X4	Vehicle Maintenance Analysis Specialist	221.367-038	Maintenance Data Analyst
		216.382-002	Statistical Clerk
		221.382-018	Production Clerk
511X0	Computer Operator	213.382-010	Card-Tape-Convertor Operator
		203.362-010	Console Operator
		221.382-014	Control Clerk, Data Processing I
		213.382-010	High-Speed Printer Operator
		213.685-010	Auxiliary Equipment Operator, Data Processing
511X1	Programming Specialist	020.162-014	Programmer, Business
		012.167-066	Programmer, Analyst
		028.187-010	Programmer, Information Systems
541X0	Missile Facilities Specialist	828.281-018	Missile Facilities Repairer
544X0	Cryogenic Fluids Production Specialist	953.782	Gas Producerman
		953.380	Gas, Plant Operator
545X0	Refrigeration and Air Conditioning Specialist	637.261-026	Refrigeration Mechanic
		637.381-014	Refrigeration Unit Repairer
553X0	Site Development Specialist	005.281-010	Drafter, Civil
		012.261-014	Quality Control Technician
		018.167-034	Surveyor Assistant, Instruments
554X0	Real Estate-Cost Management Analysis Specialist	210.382-018	Bookkeeper II
		216.482-010	Accounting Clerk
		219.362-046	Real Estate Clerk
645X2	Supply Systems Specialist	213.382	Car-Tape Convertor Operator
		213.382	Console Operator

AFSC Code	AFSC Title	DOT Code	DOT Title
645X2	Supply Systems Specialist (continued)	213.588	Data Typist
		219.388	Control Clerk, Data Processing I
		213.382	High-Speed Printer Operator
651X0	Procurement Specialist	223.368	Procurement Clerk
672X1	General Accounting Specialist	210.388	Bookkeeper II
		215.388	Accounting Clerk
		160.188	Accountant, Cost
		219.588	Posting Clerk
		215.388	Bookkeeping Machine Operator I
691X0	Management Analysis Specialist	216.388	Statistical Clerk
		219.488	Accounting Clerk
		219.388	Budget Clerk
791X0	Information Specialist	132.268	Reporter (Printing and Publishing)
		132.288	Copy Reader (Printing and Publishing)
		052.088	Historian
		165.068	Public Relations Man
		132.288	Editorial Assistant (Printing and Publishing)
791X1	Radio and TV Broadcasting Specialist	184.168	Director, Broadcast I
		184.168	Director, Program I
		131.088	Script Writer
		159.148	Announcer
		963.168	Television Cameraman
911X0	Aerospace Physiology Specialist	199.782T	Aerospace Physiology Technician
99104	Systems Repair Technician	--	None specified
99105	Scientific Measurements Tech.	--	None specified
99106	Scientific Laboratory Technician	--	None specified

Source: Airman Classification Regulation, AFR 39-1, June, 1977, with updates.

APPENDIX F: Abstracts of Occupational
Wage Data Sources

Data Source: U. S. Bureau of Labor Statistics, "Weekly and
Hourly Earnings Data from the <u>Current Popula-
tion Survey</u>," Special Labor Force Report 195,
1977.

Description: The report tabulates information on usual weekly
and hourly earnings, collected each May with
supplemental questions to <u>Current Population
Survey</u>. The survey is conducted by the Bureau
of the Census and interviews a sample of about
56,000 households.

Data are provided for 40 occupations in 50 indus-
trial groupings. Data for certain industrial
groupings are not statistically significant due to
limited sample size.

Access: Unpublished document from the U. S. Bureau of
Labor Statistics, Division of Labor Force Studies.

Data Source: U. S. Department of Labor, Bureau of Labor
                 Statistics, <u>Union Wage Rates for Building Trades</u>,
                 January, 1979.

Description: The report presents quarterly trends in union
                 wage rates for 121 cities with 100,000 inhabitants
                 or more, and relates these figures to a ten-year
                 trend. The absolute dollar figures tabulated in
                 the report are hourly averages.

                 The employee compensation tabulated in the
                 report includes basic wage rate and employer
                 contributions for selected benefits such as
                 insurance, pension, vacation pay, and other
                 non-legally required payments.

Access: Press release provided by the Bureau of Labor
                 Statistics in the month following compilation of
                 the data.

Data Source: U. S. Department of Labor, Bureau of Labor
                    Statistics, "National Survey of Professional
                    Administrative, Technical, and Clerical Pay,
                    March, 1978," Bulletin 2004.

Description: The report summarizes the results of an annual
                    salary survey of selected white collar occupations
                    in private industry, conducted in March and
                    published in October. It provides nationwide
                    salary averages and distributions for 78 work
                    level categories covering 19 occupations.

                    Data are presented separately for establishments
                    in metropolitan areas, large establishments (over
                    2, 500 employed), and the United States as a whole.

Access: Available through:
                    Superintendent of Documents
                    U. S. Government Printing Office
                    Washington, D. C. 20402

Data Source:	U. S. Bureau of the Census, <u>Current Population</u> <u>Reports</u>, Series P-60, No. 117, "Money Income in 1977 of Households in the United States," issued December 1978.
Description:	The report presents the results of an annual survey of families done in March of each year and published 10 months later. It lists annual earnings for household heads in 12 occupational groupings for the United States as a whole and by region. It also details the employment status of the household head.
	Income is classified into 11 different categories, ranging from "Under $4,000" to "$50,000 and over," and the median and mean figures for each category are tabulated.
Access:	Available through: Superintendent of Documents U. S. Government Printing Office Washington, D. C. 20402

Data Source: U. S. Department of Labor, Bureau of Labor
                Statistics, <u>Area Wage Survey</u>.

Description: The report presents the results of an annual
                survey of occupational earnings and related
                benefits in 75 metropolitan areas across the
                United States.   Information on earnings is
                collected annually, while benefits are tabulated
                every 3 years.   The report presents hourly or
                weekly earnings for full-time workers in 70
                groupings of four basic job types: (1) office
                clerical, (2) professional and technical,
                (3) maintenance, toolroom and powerplant,
                and (4) material movement and custodial.

                The report contains tabulations of average
                earnings for each area, earnings by sex for
                major job types, and annual trends in earnings.

Access: Available through:
                Superintendent of Documents
                U. S. Government Printing Office
                Washington, D. C. 20402