AN ANALYSIS OF THE VALIDITY OF COMMERCIAL INDUSTRY EMPLOYMENT BARRIERS FACING UNEMPLOYED AEROSPACE ENGINEERS AND AEROSPACE SCIENTISTS

By

FREDERICK ANDERSON WARE, JR.

A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree
of
Doctor of Philosophy in Business Administration
in the
School of Business Administration
of
Georgia State University

GEORGIA STATE UNIVERSITY
SCHOOL OF BUSINESS ADMINISTRATION
1973

ACCEPTANCE

This dissertation was prepared under the direction of the candidate's dissertation committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the School of Business Administration of Georgia State University.

Dean
School of Business Administration

Dean of Graduate Studies
School of Business Administration

Dissertation Committee:

Chairman

ACKNOWLEDGMENTS

The author is grateful to the many persons who assisted in this study. Particular thanks go to the members of my committee: Dr. Leon H. Robertson, Chairman, Dr. Augustus E. Jordan, Dr. Robert Techo, and Dr. Harding B. Young, for their interest, encouragement, and guidance. Special mention is made of the inspiration provided by the late Dr. Elbert T. Eggers, an original member of the committee.

Appreciation is also expressed to Dr. A. L. Addington, Dr. Randall C. Hicks, Dr. John H. Curtis, Dr. Marianne K. Mayo, Mr. LeRoy Babcock and Mr. Alton K. Hall, of Valdosta State College for their valuable advice and assistance.

My wife, children, and parents furnished invaluable optimistic support throughout the study.

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By

Frederick Anderson Ware, Jr.

December, 1973

Committee Chairman: Dr. Leon H. Robertson

Major Department: Management

The purpose of this dissertation was to study the conditions associated with the hiring of former aerospace scientists and engineers in commercial (non-aerospace) industry, and to examine the validity of certain apparent employment barriers. These particular barriers were hypothesized to be presuppositions by commercial industry employment managers based on incorrect information, such as anticipated behavior patterns of ex-aerospace employees. The investigation also identified other barriers to commercial employment. Dependency relationships were determined between certain attributes of former aerospace professionals and their behavior patterns. Attributes and behavior of commercial industry employment managers were

also examined for dependency relationships.

Two mail-questionnaire surveys were conducted concurrently, one to 614 unemployed or once-unemployed individual aerospace scientists and engineers and another to 300 employment managers of commercial firms. The sample covered individuals who had been laid off from three major areas of high-aerospace unemployment: Huntsville, Alabama; Cape Kennedy, Florida; and Atlanta, Georgia. The commercial firms were the one-hundred largest (by employment) corporations in the states of Alabama, Florida, and Georgia. Response rates exceeded 60% for both surveys. The following hypotheses were tested:

1. A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists will return to aerospace work when it is offered.

2. Once employed in a non-aerospace job which is not merely of an emergency stop-gap nature, paying substantially less than the amount earned in aerospace, most former aerospace scientists and engineers will not return to aerospace work when given the opportunity.

3. A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists are, or will become, dissatisfied and poorly motivated in non-aerospace work due to their previous high salary ranges, more challenging jobs and general overqualifications.

4. A majority of former aerospace engineers and scientists adapt readily to non-aerospace work and become effective, motivated and satisfied employees.

Sample proportions were used as estimates of population proportions and independency was examined with the chi-square statistic. The first and third hypotheses were rejected; the second and fourth hypotheses were accepted. Statistically significant dependency was found between an individual's tendency to eventually return to aerospace employment and the attributes of age, highest college degree held, and state where the layoff took place. Dependency was also seen in a commercial firm's general industrial classification and its tendency to hire ex-aerospace professionals.

The study indicated that the most significant barrier to commercial employment faced by former aerospace scientists and engineers is the lack of non-aerospace experience or overspecialization.

Recommendations were made that further study be done on the overspecialization problem and the potential problem of aerospace manpower shortages.

CHAPTER 1

INTRODUCTION

This study centers on the problems facing unemployed aerospace engineers and aerospace scientists as they attempt to gain employment in commercial, or non-aerospace industry. Specifically, it identifies and analyzes for validity, certain barriers to commercial employment. Its general purpose is to study the conditions associated with the hiring of ex-aerospace engineers and scientists in non-aerospace industries.

Statement of the Problem

Massive reductions in research, development, and procurement of high-technology defense hardware by the United States Government have caused significant unemployment of aerospace personnel. The usually low jobless rate for engineers increased four-fold between 1968 and 1971 (0.7% to 2.9%).[1] Aerospace engineers, approximately 6% of the total, had the highest unemployment rate among

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[1]Gloria P. Green and John F. Stinson, "Changes in the Employment Situation in 1972," Monthly Labor Review, February, 1973, p. 27.

engineers at 5.3% in late 1971.[2] Editorials decry the wasting away of brainpower,[3] and family crises mount among the unemployed.[4] As with any situation of oversupply of labor, a gradual readjustment will take place; meanwhile, the nation is faced with a diminishing pool of technological talent and the entire engineering profession suffers, as once-elite professionals accept menial jobs or remain unemployed.[5]

As former aerospace engineers and scientists have attempted to gain employment in non-aerospace industries,

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[2]Kathleen Naughton, "Characteristics of Jobless Engineers," Monthly Labor Review, October, 1972, p. 17.

[3]"Squandered Brainpower," Business Week, March 17, 1971, p. 106; "Brains on the Shelf," Nation's Business, May, 1971, pp. 66-69; Robert Anderson, "Scientific Starvation," Aviation Week, May 17, 1971, p. 9; Robert E. Templeton, "The Engineer: Yesterday's Hero-Today's Forgotten Man," Management Review, June, 1972, pp. 11-19.

[4]"As Jobs Stay Scarce, Unemployed Engineers Face Family Crises," Wall Street Journal, November 30, 1971, p. 1; "Laid-off Men Suffer Mentally, Physically, Detroit Study Finds," Wall Street Journal, February 22, 1972, p. 5; Douglas H. Powell and Paul F. Driscoll, "Middle-Class Professionals Face Unemployment," Society, January-February, Parade, June 13, 1971, p. 10.

[5]Judson Gooding, "The Engineers are Redesigning Their Own Profession," Fortune, June, 1971, p. 72; Richard B. Matthews, "'Just Needed to Eat,' Says Engineer Turned Guard," Atlanta Journal and Constitution, May 9, 1971, p. 14-A.

a number of employment "barriers" have been observed. For instance, commercial employers may be reluctant to hire ex-aerospace personnel, fearing that the employee will return to aerospace work at the first opportunity.[6] Employers may also feel that the commercial job cannot match the former aerospace job in challenging work and high pay and hence expect the ex-aerospace employee to become dissatisfied and poorly motivated.[7] These two possible barriers emerged as particularly significant in the course of personal interviews at state employment offices, attendance at a congressional subcommittee hearing, meetings and correspondence with individuals involved in job counseling and review of the literature.[8]

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[6]"Money Bind Perils Program Retraining Jobless Engineers," Atlanta Journal and Constitution, Feb. 10, 1972, p. 6-C; John Walsh, "Aerospace: Unemployed Scientists, Engineers Have no Place to Go," Science, December 25, 1970, p. 1384; Naughton, "Jobless Engineers," p. 17.

[7]Gooding, "Engineers are Redesigning," p. 77.

[8]Fred Huntington of the Lockheed-Georgia Company's "Employment-in-Reverse" placement program, private interview, Marietta, Ga., May 6, 1971; William Breen of Personnel, Inc. employment specialists, private interview, Huntsville, Ala., May 13, 1971; William Ragsdale of Associated Engineers, private interview, Huntsville, Ala., May 13, 1971; Kenneth Almond of the Florida State Employment Service TMRP program, Cocoa, Fla., August 18, 1972; James Routt of the Alabama State Employment Service TMRP program, Huntsville, Ala., September 6, 1972; Cobb County Courthouse, Marietta, Ga., Hearings before the House Subcommittee on Science, Research and Development of the Committee on Science and Astronautics, August 5, 1971.

Hypotheses to be Tested

The following hypotheses are stated for testing by the study:

1. A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists will return to aerospace work when it is offered.

2. Once employed in a non-aerospace job which is not merely of an emergency, stop-gap nature, paying substantially less than the amount earned in aerospace, most former aerospace engineers and scientists will not return to aerospace work when given the opportunity.

3. A barrier to employment is a widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists are, or will become, dissatisfied and poorly motivated in non-aerospace work due to their previous high salary ranges, more challenging jobs, and general overqualifications.

4. A majority of former aerospace engineers and scientists adapt readily to non-aerospace work and become effective, motivated and satisfied employees.

Objectives

Besides testing these hypotheses, the study is sufficiently open-ended to identify other employment barriers. By determining which barriers are real and which are merely presuppositions, this study may clarify qualifications of former aerospace engineers and scientists. The study is designed to provide profiles of the types of commercial firms which are more (or least) likely to hire ex-aerospace professionals, as well as of the categories of engineers

and scientists who are better risks for hiring by the commercial firms.

Scope and Limitations

Two populations are involved:

1. Unemployed or previously unemployed aerospace engineers and scientists

2. Commercial (non-aerospace) firms as represented by their employment managers

In April, 1971, the President announced the forty-one million dollar Technology Mobilization and Reemployment Program (TMRP) to assist ex-aerospace professionals in relocating; three of the original fourteen TMRP "target" areas of high aerospace unemployment geographically encompass the first population for this study.[9]

Huntsville, Alabama (Madison County)
Cape Kennedy, Florida (Brevard County)
Atlanta, Georgia (Greater Metropolitan area)

Questionnaires were sent to several hundred engineers and scientists released or "laid-off" in these three areas.

The second population consists of commercial (non-aerospace) firms in the states of Alabama, Georgia, and

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[9]The fourteen original "target" areas were Huntsville, Los Angeles, San Diego, Orange County, San Jose, Cape Kennedy, Atlanta, Boston, St. Louis, Long Island, Dallas, Philadelphia, Seattle, and Wichita. Added later were New York City, Chicago, Buffalo, Rochester, and Washington, D.C. In December, 1971, the program was extended throughout the United States.

Florida. Questionnaires were sent to the one hundred firms with the largest number of employes. The three-state geographical limitation was set to maintain the study within a manageable scope.

Definitions and Terminology

Commercial industry, for purposes of this study, means any non-aerospace employer in the profit oriented, private sector of the industrial portion of the economy. Thus, following the U.S. Department of Commerce categorization, these sectors would be included:

Agriculture, Forestry and Fisheries
Mining and Construction
Manufacturing (Durable and Non-durable Goods
Transportation, Communication, and Utilities
Wholesale and Retail Trade
Finance, Insurance and Real Estate
Services

For compatibility with the U.S. Department of Labor's Technology Mobilization and Reemployment Program (TMRP), non-aerospace employers are those firms with less than forty percent of their business derived from defense or aerospace sources. For the same reason, unemployed aerospace engineers and scientists are defined as those who at any time were eligible for assistance by TMRP, excluding technicians. (Standard occupation classifications used by the Federal Government in gathering unemployment statistics are not adaptable; such categories combine

aerospace and non-aerospace engineers.[10] The definition is expanded from a standpoint of time to include those who would have been eligible for TMRP assistance prior to the establishment of the program in April, 1971 and no earlier than January 1, 1971. The TMRP requirements are:[11]

A. Engineers and scientists must have been employed as such in defense and aerospace for at least 12 of the 24 months prior to registration, or have had substantial attachment of at least 24 months within the past five years;

B. At least 40 percent of the past employers' local business, service or product must have been derived from defense or aerospace sources;

C. Their past employers' cutbacks must have been due to contract reductions, cancellations, terminations, etc.;

D. They must not have resigned voluntarily or been discharged for cause;

E. If employed, their present jobs must be of an emergency, stop-gap nature, paying substantially less than they earned in their primary qualifying employment;

F. They must have thoroughly canvassed all employment opportunities and not refused reasonable suitable job referral or job offer within their home area.

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[10]U.S. Department of Labor, Manpower Administration, Dictionary of Occupational Titles, Vol. 1 (Washington, D.C.: U.S. Government Printing Office, 1965).

[11]U.S. Congress, House, Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, Background Material for Hearings on Conversion Research and Education, Committee Print (Washington, D.C.: U.S. Government Printing Office, 1971), p. 26.

Some Important Literature in the Field

Literature in the area of unemployed aerospace scientists and engineers is generally limited to public documents, research reports, and periodicals. A search of the literature yielded information about existing and proposed governmental legislation aimed at remedying aerospace unemployment and a number of statistical and human interest reports and articles on the severity of the problem.

Governmental programs include the United States Department of Labor's Technology Mobilization and Reemployment Program (TMRP) which provides job finding assistance, retraining, skill transferability studies and relocation grants. Details of the concept are documented in:

> U. S. Department of Labor, Manpower Administration. Technology Mobilization and Reemployment Program Handbook. Washington, D.C.: U.S. Government Printing Office, December, 1971.

The National Society of Professional Engineers won a contract to conduct the Technology Mobilization and Reemployment Program's skill transferability, or skill conversion studies. These studies were completed in March, 1972 and have been published in twenty-one separately bound chapters. The reports examine transition mechanisms required to convert available technological manpower from

aerospace and defense industries into other areas of employment in private industry and public service:

> National Society of Professional Engineers. Report to the U. S. Department of Labor. Skills Conversion Project. Washington, D. C., National Society of Professional Engineers, March, 1972.

Documentation of pending legislation in the form of published hearings and background material for hearings has been the most fruitful literature. These publications include a considerable number of statements made at hearings by representatives of virtually all groups interested in remedying the aerospace unemployment problem. Many pertinent newspaper and periodical articles are included in their entirety. These publications also contain valuable cross-references to other public documents as well as chronologies of related legislative actions:

> U. S. Congress. House. Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics. Background Material for Hearings on Conversion Research and Education. Committee Print. Washington, D. C., U. S. Government Printing Office, June 18, 1971.

> U. S. Congress. House. Committee on Science and Astronautics. The Conversion Research and Education Act of 1971. Hearings before the Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, House of Representatives, on H.R. 34, 92d Cong., 1st sess;, 1971.

U. S. Congress. Senate. Committee on Labor and Public Welfare. National Science Foundation Conversion Programs, 1971. Hearings before the Special Subcommittee on National Science Foundation of the Committee on Labor and Public Welfare, Senate, on S. 32 and S. 1261, 92d Cong., 1st sess., 1971.

U. S. Congress. House. Committee on Government Operations. Application of Aerospace and Defense Industry Technology to Environmental Problems. Hearings before the Subcommittee of Conservation Operations, House of Representatives, 91st Cong., 2d sess., 1970.

The bill making the most progress to date is S. 32, the National Science Policy and Priorities Act. The Senate Labor and Public Welfare Committee approved the bill on June 28, 1972, and it was reintroduced to the Senate on January 4, 1973.[12] The bill provides funds for transition to civilian projects and creates a Civil Science Systems Administration within the National Science Foundation to conduct research, design, testing, evaluation and demonstration of scientific solutions to public social problems. Some 40,000 jobs for scientists and engineers are anticipated with the passing of this bill.

The National Science Foundation has published the results of a 1971 survey of some 6,300 scientists and

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[12]"New Congress Gets Science Priorities Bills," Science News, January 13, 1973, p. 25.

59,200 engineers. The population consisted of active members of professional societies and the study was designed to measure changes in employment status during the past year. Many types of profiles are provided according to geographical location, age, type of work, nonscience positions held, reasons for accepting nonscience jobs, etc.:

> National Science Foundation. Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971. Washington, D.C.: U.S. Government Printing Office, January, 1972.

Searches by way of the Business Periodicals Index, The Wall Street Journal Index and the New York Times Index have generally yielded human interest stories and coverage of government and private programs to aid unemployed aerospace people. Approximately 250 such articles have been accumulated and categorized as background information.

Design of the Study

The following outline, beyond this introduction, describes how the techniques and results of this study will be presented:

Background Information- Severity of problem
Remedial actions
Historical experience
Related research

Research Methodology- Questionnaire design
Hypothesis testing methods
Identifying related employment barriers
Variable independency
Sample size consideration

Collection of Data- Obtaining mailing lists
Mailing procedures
Response rates
Frequency distributions

Analysis of Data- Data reduction
Hypothesis testing
Related employment barriers
Statistical independency
Development of profiles

Summary, Conclusions and Recommendations for Further Study

CHAPTER 2

BACKGROUND

To develop background information on the severity of the problem, on remedial actions, on historical parallels, and on related research, a survey of the literature, travel to the affected areas and state capitals, personal interviews, correspondence and telephone interviews were used.

SEVERITY OF THE PROBLEM

Unemployment of aerospace engineers and scientists not only has caused severe personal hardships for individuals but may affect the National Welfare, manpower utilization, and educational policy of the United States.[1] With supply constrained by educational time constants and demand subject to rapid change, such as the recent sudden decline in aerospace programs, periods of imbalance are inevitable. While there is hope that better national, state, and local scientific manpower planning will minimize

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[1]Charles E. Falk, Scientific Human Resources: Profiles and Issues (Washington, D.C.: National Science Foundation, October, 1972), p. 2.

future imbalances, the painful readjustment of the scientific manpower supply is now underway and is likely to recur periodically.

In spite of the slight improvement in the unemployment rate of professional and technical personnel (from 2.9% in 1971 to 2.4% in 1972),[2] aerospace engineers and scientists continue to have difficulty in finding jobs.[3] Accurate unemployment statistics for this special portion of the engineering and scientific labor force are not readily discernable in the United States Department of Labor's Bureau of Labor Statistics. Ephraim Weiss, of the Association of Technical Professionals, challenges the sampling and extrapolation techniques used in most studies and claims that 10% unemployment is a realistic figure for scientists and engineers.[4] Moreover, state department of labor statisticians may compile similar employment figures under different categories. This

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[2]Gloria P. Green and John F. Stinson, "Changes in the Employment Situation in 1972," Monthly Labor Review, February, 1973, p. 28.

[3]"Aerospace Employment: Outlook Remains Bleak," Electronic News, March 20, 1972, p. 32; "Engineers, Scientists Continue Job Hunt, Debate Slow Pickup," Industry Week, April 3, 1972, p. 23.

[4]Ephraim Weiss, "Unemployed Engineers," Letters, Science, October 20, 1972, p. 240.

disparity is seen in the labor force figures for the target areas selected for this study, as shown in Table I.

Besides the category inconsistencies, labor force statistics by individual firm are privileged information. Hence, exact aerospace engineer and scientist unemployment figures are unavailable. To indicate the severity of the problem for purposes of this regional study, the general trends in the civilian work force categories which include aerospace engineers and scientists were used as a point of departure, as depicted by Table II. According to the labor statisticians, cited in Table I, rough estimates of the engineering and scientist portion of these categories can be obtained by using a 25% factor of the general labor trends. The estimates are detailed in Table III, which shows a decrease in aerospace scientist and engineering manpower of seven thousand from 1968 to 1972.

REMEDIAL ACTIONS

A number of programs to remedy the problems have been implemented or proposed. The most significant programs are briefly described below as background information:

U.S. Government Programs

The major governmental programs are the Technology Mobilization and Reemployment Program (TMRP), Manpower

TABLE I

LABOR FORCE REPORTING CATEGORIES BY TARGET AREA
WHICH INCLUDE CIVILIAN AEROSPACE SCIENTISTS AND ENGINEERS

Target Area	Major Category	Subcategory
Huntsville	Manufacturing, Durable Goods:	Ordnance
	Nonmanufacturing:	Service and Miscellaneous
Cape Kennedy	Manufacturing, Durable Goods:	Ordnance and Electrical Equipment
		Transportation Equipment
	Nonmanufacturing:	Miscellaneous Business Services
		Other Business Services
		Other Services
Atlanta	Manufacturing, Durable Goods:	Transportation Equipment

Sources: Larry D. Smith of the Alabama State Employment Service, private interview, Huntsville, Ala., September 6, 1972; Douglas Dyer of the Department of Industrial Relations, State of Alabama; private interview, Montgomery, Ala., July 7, 1972; William J. Sims, Jr. of the Georgia Department of Labor, private interview, Atlanta, Ga., September 7, 1972; Mabel Walters of the Florida State Department of Commerce, private interview, Tallahassee, Fla., July 3, 1972; Charles Johnson of the Florida State Employment Service, private interview, Cocoa, Fla., August 18, 1972.

TABLE II

YEARLY AVERAGE LABOR FORCE ESTIMATES
WHICH INCLUDE AEROSPACE SCIENTISTS AND ENGINEERS
(Thousands)

Target Area	1968	1969	1970	1971	1972	Net Change: 1968-1972
Huntsville	21.8	19.4	18.7	18.3	18.4	(3.4)
Cape Kennedy	41.7	38.9	31.6	27.3	26.4	(15.3)
Atlanta	35.9	41.7	35.2	30.8	26.9	(9.0)
Total	99.4	100.0	85.5	76.4	71.7	(27.7)

Source: Alabama Employment Service, Labor Market News-Huntsville Metropolitan Area (Huntsville, Alabama: Alabama Department of Industrial Relations) January through December, 1972, and 1968-1971 summary sheet furnished by Larry D. Smith of the Alabama State Employment Service, Huntsville, Alabama; Florida Bureau of Employment Services, Brevard County Labor Market Trends (Cocoa, Florida: Florida Department of Commerce) January through December, 1972 and 1968-1971 summary information furnished by Charles Johnson of the Florida Bureau of Employment Services, Cocoa, Florida; Georgia State Employment Service, Atlanta Area Manpower Trends (Atlanta, Georgia: Metropolitan Manpower Center) January through December, 1972 and 1968-1971 summary information furnished by William J. Sims Jr., of the Georgia Department of Labor.

TABLE III

YEARLY AVERAGE LABOR FORCE ESTIMATES
OF AEROSPACE SCIENTISTS AND ENGINEERS
(Thousands)

Target Area	1968	1969	1970	1971	1972	Net Change: 1968-1972
Huntsville	5.5	4.9	4.7	4.6	4.6	(0.9)
Cape Kennedy	10.4	9.7	7.9	6.8	6.6	(3.8)
Atlanta	9.0	10.4	8.8	7.7	6.7	(2.3)
Total	24.9	25.0	21.4	19.1	17.9	(7.0)

Source: Figures are 25% of Figures from Table II.

Development and Training Programs, the Emergency Employment Act, National Science Foundation grants, and pending legislation entitled The National Science Policy and Priorities Act of 1973 (S. 32/H.R. 32).

TMRP provided for the establishment of a special Engineers, Scientists and Technicians Development Unit (EST Unit) at affected state employment service offices, grants for individual job search and relocation expenses, retraining, a national job-placement registry, counseling service, and funds for skills conversion studies. The American Institute of Aeronautics and Astronautics has played a major role in the program by supplying volunteer assistance and administration under contract.[5] The National Society of Professional Engineers conducted the skills conversion studies, identifying some 55,000 professional-level jobs which could theoretically be filled by unemployed engineers and scientists by 1975.[6]

Manpower Development and Training Programs, covering a broad range of unemployment, have been underway since 1962. Two major areas are involved: Institutional training and on-the-job training. Thus federal funds are either

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[5]"More Engineer Retraining Studied," Aviation-Week, September 6, 1971, p. 14.

[6]"Study Identifies Engineer, Scientist Jobs," Aviation Week, August 28, 1972, p. 21.

provided to the individual for classroom instruction or to the employer to cover training expenses.[7] One example of this funding is seen in Project RETRO (Regional Environmental Training and Research Organization), where Brevard Community College at Cocoa, Florida, provides courses specifically designed to retrain unemployed aerospace personnel for positions in the environmental field.[8]

The Emergency Employment Act, a large-scale public employment effort, is the first major program of its kind since the New Deal. It provides funds for state and local governments to hire unemployed workers. Aerospace workers are included in the list of target groups for this Act, but no evidence has been found to show that scientists and engineers are significantly involved. Emphasis has been on hiring Vietnam veterans and disadvantaged persons.[9]

The National Science Foundation has awarded grants for experimental training programs, such as the one conducted

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[7]Sylvia S. Small, "Statistical Effect of Work-Training Programs on the Unemployment Rate," Monthly Labor Review, September, 1972, p. 9.

[8]P. D. Smith, "Reorbiting Aerospace Technicians," American Education, March, 1972, p. 15.

[9]Sar A. Levitan and Robert Taggart, "The Emergency Employment Act: An Interim Assessment," Monthly Labor Review, June, 1972, pp. 3-11.

by Emory University, to retrain ex-aerospace scientists and engineers for jobs in areas of public need. Training is given in the fields of biology-ecology, cardiology, physical medicine, physiology, and urban sociology. Unfortunately, from a percentage standpoint and in absolute numbers, few professionals are reached in these programs.

The National Science Policy and Priorities Act of 1973 (S. 32/H.R. 32) would create an agency, the Civil Science System Administration, to direct research on domestic problems and assist in the transition of manpower from defense/aerospace-oriented programs to civilian-oriented research and development. Specifically, funds would be provided for state and local government agencies as well as private firms to hire engineers, scientists, and technicians, to establish fellowships and placement programs, and to provide grants for on-the-job training. Passage of the bill has been delayed, according to Representative Alphonzo Bell (R-Calif.), for fear that it would usurp much of the National Science Foundation's funding of basic research. The House of Representative's version of the bill contains provisions to offset this problem.[11]

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[10]"Unemployed Scientists Retrained at Emory," The Emory Magazine, December, 1971, p. 10.

[11]"S. 32: Civilianizing Federal Science-National Science Policy and Priorities Act," Science News, August 12, 1972, p. 102.

State and Local Governmental Programs

Most state programs to assist unemployed aerospace personnel, such as TMRP, are funded by the Federal Government. The Departments of Labor in Alabama, Florida, and Georgia are providing excellent service to unemployed aerospace professionals in the administration of TMRP. Local governments have organized and funded some retraining programs. For example, Project Restart, a technicians' retraining program, has been conducted in the Atlanta area by the Marietta-Cobb Area Vocational Technical School.[12]

Private and Non-Profit Organization Programs

Four major types of private or non-profit organizations are involved in remedying the aerospace unemployment problem: Associations of unemployed aerospace professionals, professional societies, chambers of commerce, and aerospace firms.

Unemployed aerospace scientists and engineers have formed local organizations with the specific goal of alleviating the unemployment problem. In Huntsville, for example, Associated Engineers and Alpha Institute were established. These organizations provide locations for job interviews while actively marketing the talents and training

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[12]"Cobb Retrains Layoff Victims for New Jobs," Atlanta Constitution, Oct. 20, 1972, p. 3-B.

of their members.[13] Similarly, ALVEST (Atlanta Volunteer Engineers, Scientists, and Technicians) has been operating since 1971 to aid its members in finding jobs.[14]

Professional societies, most notably the American Institute of Aeronautics and Astronautics (AIAA), have been actively involved in aiding unemployed engineers and scientists. As previously mentioned, AIAA contracted to carry out portions of TMRP. The National Society of Professional Engineers, too, has contributed much by conducting the TMRP skill conversion studies.

In Georgia, the Chamber of Commerce has been active at the state and local level. An interview program designed to find job opportunities for out-of-work engineers ("Tech-Match") was sponsored by the Georgia Chamber of Commerce.[15] The Cobb County (Georgia) Chamber of Commerce organized a group calling itself Partners for the Advancement of the Cobb Economy (PACE), to retrain aerospace professionals.[16]

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[13]William Ragsdale of Associated Engineers, Private Interview, Huntsville, Ala., May 13, 1971.

[14]"Professionals Join in Job Hunt," Atlanta Constitution, Oct. 20, 1972, p. 3-B.

[15]"Tech-Match to Place Engineers," Atlanta Constitution, April 3, 1972, p. 7-C.

[16]"Some Jobless at Lockheed to Get Help," Atlanta Journal and Constitution, May 30, 1971, p. 2-B.

Finally, help has come from the aerospace firms. As examples, the Lockheed-Georgia Company operates an "Employment in Reverse" employment program for placing engineers and scientists,[17] and the Boeing Company has advertised the availability of highly-skilled personnel in the Wall Street Journal.[18]

HISTORICAL EXPERIENCE AND RELATED RESEARCH

There is no close historical parallel to the current unemployment problem of aerospace scientists and engineers, according to a Stanford Research Institute Report.[19] This report is an excellent source for a bibliography on the following broad aspects of aerospace/defense unemployment:

Historical Experience with Cutbacks
Impact of Disarmament
Labor Economics
Structural Unemployment
Manpower Planning
Industry Conversion and Diversification
Transferability

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[17]Fred Huntington of the Lockheed-Georgia Company's "Employment-in-Reverse" Placement Program, Private Interview, Marietta, Ga., May 6, 1971.

[18]Classified Advertisement, Wall Street Journal, Apr. 15, 1971.

[19]Terence G. Jackson, A Preliminary Appraisal of the Implications of Mass Displacement of Defense- and Space-Related Scientists and Engineers, (Menlo Park, Calif.: Stanford Research Institute, January, 1971).

Discussion of these topics, however, is beyond the plan and scope of this study.

Related Research

Several studies have been conducted which involve the unemployment problems of scientists and engineers. The major types related to this study are: Unemployment statistics and characteristics of affected individuals, analysis of age factors, mobility studies, and attitude studies.

Unemployment statistics and personnel characteristics have been developed by the National Science Foundation in the Report, Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971.[20] The survey was conducted among registrants on the 1970 National Register of Scientific and Technical Personnel and a sample of members of major engineering professional societies. It consists of sixty-six statistical tables, graphs, and narrative. A similar report is to be published with 1972 data. Another significant statistical work is A Survey of Aerospace Employees Affected by Reductions in NASA Contracts, prepared by the Battelle Columbus Laboratories under a contract from the National Aeronautics and Space

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[20] (Washington, D.C.: U.S. Government Printing Office, January, 1972).

Administration.[21] Nationwide statistics--including such areas of interest as rate and duration of unemployment, losses to federal and state budgets resulting from unemployment, and the extent of mobility--are shown.

Age factors were examined in a doctoral dissertation by Lee D. Dyer which is summarized in the April, 1973 issue of Industrial and Labor Relations Review.[22] Dyer developed a profile of the more successful middle-aged job hunter. For instance, the applicants with more dependent children found work quickly. Dalton and Thompson have also examined age, highlighting the problem of early obsolescence of engineers.[23]

A Wichita, Kansas, regional mobility study sheds light on the behavior patterns of unemployed aerospace engineers.[24] Perline and Presley concluded that older

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[21]Battelle Columbus Laboratories, A Survey of Aerospace Employees Affected by Reductions in NASA Contracts (Columbus, Ohio: Battelle Columbus Laboratories, 20 May 1971).

[22]Lee D. Dyer, "Job Search Success of Middle-Aged Managers and Engineers," Industrial and Labor Relations Review, April, 1973, pp. 969-979.

[23]Gene W. Dalton and Paul H. Thompson, "Accelerating Obsolescence of Older Engineers," Harvard Business Review, September-October, 1971, pp. 57-67.

[24]Martin M. Perline and Ronald W. Presley, "Mobility of Unemployed Engineers: A Case Study," Monthly Labor Review, May, 1973, pp. 41-43.

workers establish ties which make the cost of moving prohibitive. Other factors, including homeownership, education, dependents and prospect of recall, were also analyzed.

The impact of layoff on attitudes of aerospace engineers has been examined by Gannon, Foreman, and Pugh.[25] They found that attitudes of displaced professionals are kept positive when the former aerospace employer makes an honest effort to assist in relocation.

BACKGROUND SUMMARY

Approximately 7,000 aerospace scientists and engineers in the Huntsville, Alabama; Cape Kennedy, Florida; and Metropolitan Atlanta, Georgia areas have lost their jobs during the period between 1968 and 1972. The major relief program is the forty-two million dollar Technology Mobilization and Reemployment Program (TMRP); a proposed major program remains bogged down in Congress. The particular unemployment problem has not occurred in the past. Related studies have been identified in the areas of statistics and characteristics of affected individuals, age factors, mobility, and attitudes.

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[25]Gannon, Martin J., Foreman, Charles, and Kenneth Pugh, "The Influence of a Reduction in Force on the Attitudes of Engineers," Academy of Management Journal, June, 1973, pp. 330-334.

CHAPTER 3

RESEARCH METHODOLOGY

Surveys of individual scientists and engineers, and surveys of commercial firms were required in order to test hypotheses, identify related employment barriers, analyze statistical independence, and develop profiles. Questionnaires were designed accordingly, sample size was considered, and use of appropriate statistics was planned.

Types of Questionnaires

Data from individuals were gathered by two similar questionnaires: One designed for persons who are unemployed or have been unemployed, and one for those anticipating unemployment. The latter was a special-purpose version of the former, prepared after one aerospace firm agreed to distribute an in-house questionnaire rather than furnish the writer with a mailing list. Data from commercial employers were obtained by a third questionnaire. The three questionnaires are displayed in Appendix A as Figures 1, 2, and 3, respectively. The dissertation committee evaluated the questionnaires and modifications were made prior to printing. Cover letters, mailing lists, and tabulation techniques are discussed in Chapter Four, Collection of Data.

Hypothesis Testing

All hypothesis testing was done by using sample proportions (p) as estimates of population proportions (Π). Two employment barriers in the minds of commercial employers are set forth by Hypothesis Number 1 and Hypothesis Number 3. Hypothesis Number 2 and Hypothesis Number 4, respectively, state that these same two barriers exist only in the eyes of commercial employers. The hypotheses are stated in Chapter One. In all cases, the testing involves determining if the majority (more than 50%) of respondents agree. For instance, Hypothesis Number 1 states that a barrier to employment is the presupposition, widely-held by non-aerospace employers, that former aerospace engineers and scientists will return to aerospace work when it is offered. This was tested by two questions to commercial employers and one question to unemployed or once-unemployed engineers and scientists:

1. Question to commercial employers: When openings are available for engineers or scientists, how do you feel about someone with an aerospace background?

   One multiple-choice answer: Reluctant, as they are likely to return to aerospace when the opportunity arises.

2. Question to commercial employers: In your opinion, what could be done to make the ex-aerospace applicant more salable in the non-aerospace job market?

   One multiple-choice answer: Assurance that he is not taking the job as a temporary measure until an aerospace position opens up.

3. Question to individual: What were the major obstacles which you found in attempting to secure non-aerospace employment?

   Open-ended answer.

Sample proportions (p) of each of these questions were determined as estimates of the population proportions (Π). The null hypothesis would be:

$$H_o : \Pi \leq 50\%$$

and the alternative hypothesis would be:

$$H_1 : \Pi > 50\%$$

Since the alternative hypothesis is stated on a greater-than basis, the test will be a right hand (right-tail) test. Using a level of significance of 0.05 (confidence level of 95%), the critical value of z is 1.64. The decision rule was established that the null hypothesis cannot be rejected if the computed value of z was less than 1.64; if it was more than 1.64, the null hypothesis was to be rejected.

The formula for computing z is:

$$z = \frac{p-\Pi}{\sqrt{(\Pi)\ (1-\Pi)/n}}$$

or:

$$z = \frac{p-0.5}{\sqrt{(0.5)\ (0.5)/n}}$$

where n is the number of respondents.[1]

Cross-referencing of questions to hypotheses is provided in Chapter Five, Analysis of Data.

Identifying Related Employment Barriers

Open-ended questions were included in questionnaires to individuals and employers to allow for identification of barriers besides those included in the hypotheses. It was felt that an exclusive, multiple-choice checklist would have introduced bias.[2]

Independency

Independency between pertinent variables, such as age and tendency to return to aerospace employment, was tested

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[1]Ann Hughes and Dennis Grawoig, Statistics: A Foundation for Analysis (Reading, Massachusetts: Addison-Wesley Publishing Company, 1971), p. 218 and Lawrence L. Lapin, Statistics for Modern Business Decisions (New York: Harcourt Brace Jovanovich, Inc., 1973), p. 301.

[2]Paul L. Erdos, Professional Mail Surveys (New York: McGraw-Hill Book Company, 1970, pp. 48-52.

with the chi-square statistic. These statistics were developed using the Data-Text Social Data Analysis Program, an elaborate package of "canned" statistical routines.[3] The utilization of Data-Text will be discussed in Chapter Five, Analysis of Data.

Developing Profiles

The Data-Text program presents basic statistics and frequencies of all variables and attributes. Profiles were developed by analyzing the Data-Text reports.

Sample Size Considerations

It was recognized at the outset of this study that developing a mailing list of unemployed aerospace engineers and scientists would be no small task. All major aerospace employers in the three target areas would have to be individually approached and asked to supply names and addresses; such information is normally considered confidential. Hence, the general plan was to gather the maximum number of names available as a judgment sample and to assume the risk that insufficient data might be the result.

Fortunately, most aerospace firms cooperated, resulting in an original mailing list of 659 scientists and engineers

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[3]David S. Armour and Arthur S. Couch, Data-Text Primer (New York: The Free Press Division of the Macmillian Company, 1972).

and a response rate of 63.3% from a net mailing of 614 or 389 replies. Distribution and response rate details are discussed in Chapter Four, Collection of Data.

Since the hypotheses involved estimates of population proportions, namely that the majority (more than 50%) of ex-aerospace professionals behave in certain ways, statistics could be used to present optimum sample sizes. If the null hypothesis is:

$$H_o : \Pi \leq 50\%$$

and the alternate hypothesis is:

$$H_1 : \Pi > 50\%$$

then, assuming that the risk of rejecting a true hypothesis (Type I error) is set at 0.05 (α), and the risk of accepting a false hypothesis (Type II error) is set at 0.10 (β), when $\underline{p} = 0.45$, the optimum sample size may be found using the formula[4]

$$\underline{n} = \frac{\underline{z}_o^2 \, \underline{p}_o \, (1 - \underline{p}_o) + \underline{z}_1^2 \, \underline{p}_1 \, (1-\underline{p}_1)}{(\underline{p}_1 - \underline{p}_o)^2}$$

where $\underline{z}_o = 1.64$ (since $\alpha = 0.05$)

$\underline{z}_1 = 1.28$ (since $\beta = 0.10$)

$$\underline{n} = \frac{(1.64)^2(0.5)(1.0-0.5) + (1.28)^2(0.4)(1.0-0.4)}{(0.40-0.50)^2}$$

$$\underline{n} = 107$$

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[4]Hughes and Grawoig, Statistics, p. 219.

The 0.05 significance level was chosen over 0.01 to allow for a reasonable balance between Type I and Type II errors.

Using the estimates of scientific and engineering employment developed in Table III, page 18, it can be seen that the 1971-1972 change was a decrease of approximately 1,200 positions. A sample size of 389 (32.4%) can be considered reasonable to cover that period of time.

The sample mailing of 300 questionnaires to commercial (non-aerospace) employers was considered adequate for the scope of this study. The 60.0% response rate, or 175 replies, is considered to be a representative judgment sample. The logic in selecting firms according to employment size was that the employment managers would more likely have experience in hiring large numbers of engineers and scientists. Firms which do not utilize scientists or engineers were excluded.

Since all respondents were assured of anonymity, no follow-up sample of non-respondents was possible.

CHAPTER 4

COLLECTION OF DATA

Two distinct operations were executed in the location and collection of data: Obtaining data from individuals and obtaining data from commercial firms.

DATA FROM INDIVIDUAL ENGINEERS AND SCIENTISTS

The basic approach was to determine who the major aerospace employers were in the three target areas (Huntsville, Cape Kennedy, and Atlanta), learn which of these firms have experienced significant layoffs of scientists and engineers since January 1, 1971, obtain as many names and addresses of individuals as the firms are willing to release, and use mail questionnaires to compile the data.

Development of Mailing List

Trips were required to the three areas, preceded and followed by correspondence and telephone conversations. In each area, general guidance was received from state departments of labor. Employment figures for individual firms, however, could not be divulged.

Huntsville, Alabama. Seven aerospace firms were visited during September 6 and 7, 1972. Meetings were held with employment managers or personnel directors. As a result, 218 names and addresses were obtained. Three of the firms cited corporate policies as a reason for not allowing release of names.

Atlanta, Georgia. One firm represents the majority of aerospace work in this geographical area. This company, in personal interviews and correspondence in September, 1972, provided 307 names of scientists and engineers laid-off since January 1, 1971. It was noted that the bulk of the engineering and scientific layoffs for the firm were made prior to the preestablished cut-off date. Nevertheless, this time constraint was kept because of the probability that mail sent to those persons laid off before 1971 would not likely be forwarded.

Cape Kennedy, Florida. From August 17 through August 21, 1972, nine aerospace firms were visited in the Cape Kennedy-Titusville, Florida, region. Several companies reported most layoffs prior to 1971, and others had policy restrictions which prevented release of names. Ninety-six names were obtained for the mailing list, and one company agreed to distribute an in-house questionnaire to engineers and scientists anticipating layoff (announcements had already been made of a forthcoming layoff). The total mailing

list, including the in-house questionnaire, was 134. Meetings were also held with officials of the RETRO Program at Florida Technological University in Orlando, and Brevard Community College at Cocoa, but their mailing lists were considered confidential.

The final mailing list of 659 names and addresses was established by November 15, 1972.

Mailing and Response

Questionnaires (Appendix A, Figure 1), each accompanied by a cover letter (Appendix B, Figure 4) and a pre-addressed stamped envelope, were mailed; an overall response rate of 63.3% was experienced, as detailed in Table IV. These numbers include responses from the thirty-eight special purpose in-house questionnaires (Appendix A, Figure 2).

Tabulation

Upon receipt, the completed questionnaires were separated according to target areas (sorted by type of commemorative stamp on the envelope) and sequentially numbered. In preparation for key punching, integer codes had been assigned to each multiple-choice response. A detailed analysis and manual frequency tally were made of the answers to all open-ended questions. Additional integer codes were then developed, based on the most frequently found answers

TABLE IV

DISTRIBUTION AND RESPONSE RATE OF QUESTIONNAIRES TO INDIVIDUAL SCIENTISTS AND ENGINEERS

	Atlanta, Georgia	Huntsville, Alabama	Cape Kennedy, Florida	Unknown[a]	Total
Gross Mailing	307	218	134		659
Undelivered	41	2	2		45
Net Mailing	266	216	132		614
Replies	164	122	98	5	389
Response Rate (%)	61.7	56.5	74.3		63.3

[a]Respondents removed commemorative stamps used on return envelopes to distinguish the three target areas.

to each open-ended question. The codes were manually posted to a special eighty-column worksheet, and finally key punched, one card per questionnaire. The in-house survey was handled in a similar manner with another special worksheet; columnar information was kept consistent with the major survey instrument.

A series of FORTRAN IV computer programs were written and executed to screen the data for inconsistencies, key punch errors or omissions. For compatiblity with the Data-Text analysis program, other programs were carried out to merge responses from the two types of questionnaires to individuals, group the data, and/or rearrange the order of the figures in preparation for statistical analysis. Details are explained in Chapter Five, Analysis of Data.

Frequency Distributions

Tables V and VI provide frequency distributions and basic statistics of the discrete and continuous attributes of interest.

TABLE V

FREQUENCY DISTRIBUTIONS: DISCRETE ATTRIBUTES OF INDIVIDUAL ENGINEERS AND SCIENTISTS

	Sex		Marital Status				
	Male	Female	Single	Married	Widowed	Divorced	Separated
Frequency	389	0	24	346	1	17	1
% (N = 389)	100.0	0.0	6.2	88.9	0.3	4.3	0.3

	Classification		Highest Degree Attained				
	Engineer	Scientist	None	Two Yrs.	Bachelor	Master	Doctor
Frequency	367	22	68	7	251	57	6
% (N = 389)	94.3	5.7	17.5	1.8	64.5	14.7	1.5

CONTINUATION TABLE V

FREQUENCY DISTRIBUTIONS: DISCRETE ATTRIBUTES
OF INDIVIDUAL ENGINEERS AND SCIENTISTS

	Engineering/Science Field								
	Aero-space	Mech.	Nuclear	Chemical	Civil	Electronic	Computer	Electrical	No Respon.
Frequency	50	54	2	4	6	37	18	30	188
% (N=389)	12.9	13.9	0.5	1.0	1.5	9.6	4.6	7.7	48.3

	Major Function Performed in Aerospace							
	Admin.	Commun.	Design	Develop.	Gen'l Eng.	Construct.	Research	No Respon.
Frequency	5	16	86	28	5	1	8	240
% (N=389)	1.3	4.1	22.1	7.2	1.3	0.3	2.0	61.7

CONTINUATION TABLE V

FREQUENCY DISTRIBUTIONS: DISCRETE ATTRIBUTES
OF INDIVIDUAL ENGINEERS AND SCIENTISTS

	Reason For Leaving Aerospace				Stayed Unemployed (1 Week Minimum)		
	Layoff	Voluntary	Forced Retirement	No Response	Yes	No	No Response
Frequency	304	32	14	1	273	77	1
% (N=351)	86.6	9.1	4.0	0.3	77.8	21.9	0.3

	Circumstances Upon Leaving Aerospace						Registered Professional Engineer?	
	Contract Reduction	Political & Public Apathy	Preferential Treatment Of Others	Sought New Job	Other	No Comment	Yes	No
Frequency	181	8	8	21	25	108	47	304
% (N=351)	51.5	2.3	2.3	6.0	7.1	30.8	13.4	86.6

CONCLUSION TABLE V

FREQUENCY DISTRIBUTIONS: DISCRETE ATTRIBUTES OF INDIVIDUAL ENGINEERS AND SCIENTISTS

	Currently Employed?	
	Yes	No
Frequency	250	101
% (N = 351)	71.2	28.8

	Type of Employer		
	Aerospace	Commercial	Borderline
Frequency	53	191	6
% (N = 250)	21.2	76.4	2.4

	Questionnaire Signed?[a]	
	Yes	No
Frequency	130	259
% (N = 389)	33.4	66.6

	Is Job Temporary?		
	Yes	No	Uncertain
Frequency	16	172	3
% (N = 191)	8.4	90.0	1.6

[a]For possible follow-up studies.

TABLE VI

BASIC STATISTICS: CONTINUOUS ATTRIBUTES
OF INDIVIDUAL ENGINEERS AND SCIENTISTS

Attribute	n	Mean	Standard Deviation
Age	389	40.789	10.161
No. of Dependents	389	2.643	1.716
Length of Aerospace Employment (Years)	389	12.602	7.598
Length of Unemployment Experienced (Weeks)	273	19.081	20.585
Current Length of Unemployment (Mos.)	101	6.287	6.268
Current Length of Employment (Mos.)	250	6.756	6.847

DATA FROM COMMERCIAL FIRMS

The task of obtaining data from commercial firms began with a search to determine the one-hundred largest firms by size of employment in the states of Alabama, Florida, and Georgia. Next, the name of each company's chief executive officer was found and individually-addressed cover letters were prepared. Finally, questionnaires were used to obtain the data.

Development of Mailing List

Trips were made to the state capitals, resulting in the following sources being chosen for developing the mailing list:[1]

Alabama Chamber of Commerce. Industrial Alabama. Montgomery, Alabama: Industrial Division, Alabama Chamber of Commerce, 1972.

Florida State Chamber of Commerce. Directory of Florida Industries, 1971-1972. Jacksonville, Florida: Florida State Chamber of Commerce, 1971.

State of Georgia. Georgia Manufacturing Directory, 1972. Atlanta, Georgia: Research Division, Georgia Department of Industry and Trade, June, 1972.

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[1]Douglas Dyer of the Department of Industrial Relations, State of Alabama, private interview, Montgomery, Alabama, July 7, 1972; R. C. Steward-Sidney, Department of Commerce, Division of Commercial Development, State of Florida, private interview, Tallahassee, Florida, July 3, 1972; C. H. Armfield, Department of Industry and Trade, State of Georgia, private interview, July 10, 1972.

Endorsement Letters

Requests for written endorsements of the study to be used as response incentives were made to United States Senators and Representatives in Congress. The results were endorsement letters from Democratic Senators Herman E. Talmadge of Georgia, John Sparkman of Alabama, and Lawton Chiles of Florida (Appendix C, Figures 6, 7 and 8). Copies of an endorsement letter corresponding to the state of the commercial firm were included in the mailing.

Mailing and Response

A cover letter was designed, directed to the attention of the company president (personally addressed), requesting that the employment manager be asked to complete the questionnaire. Appendix B, Figure 5, is a copy of this cover letter. The three-hundred questionnaires (Appendix A, Figure 3), along with the cover and endorsement letters and pre-addressed, stamped envelopes, were mailed. In some cases, personal contact was made with the company president by a meeting or telephone conversation.

The response is shown in Table VII, with an overall return of 60.0%.

Tabulation

Different types of stamps were used on return envelopes to distinguish the respondents geographically. As with the

TABLE VII

DISTRIBUTION AND RESPONSE RATE OF QUESTIONNAIRES TO COMMERCIAL FIRMS

	Georgia	Alabama	Florida	Unknown[a]	Total
Gross Mailing	100	100	100		300
Undelivered		3	5		8
Net Mailing	100	97	95		292
Replies	61	57	55	2	175
Response Rate (%)	61.0	58.8	57.8		60.0

[a]Respondents removed commemorative stamps used on return envelopes to distinguish the three states.

questionnaires to individuals, the forms were coded and the data were transferred to punched cards by the use of an interim eighty-column worksheet. Computer programs were written, as before, and executed to screen the data for errors and to rearrange them prior to Data-Text statistical analysis.

Frequency Distributions

Frequency distributions and basic statistics of the discrete and continuous attributes and variables of interest are shown in Tables VIII and IX, respectively.

TABLE VIII

FREQUENCY DISTRIBUTIONS: DISCRETE ATTRIBUTES OF COMMERCIAL FIRMS

	Classification							
	Agri-Culture	Mining or Const.	Durable Mfg.	Nondurable Mfg.	Transpor-tation	Communi-cation	Utility	Service
Frequency	4	13	72	61	6	12	6	1
% (N=175)	2.3	7.4	41.1	34.9	3.4	6.9	3.4	0.6

	Co. Name Given?[a]	
	Yes	No
Frequency	16	159
% (N = 175)	9.1	90.9

[a]For possible follow-up studies.

TABLE IX
BASIC STATISTICS: CONTINUOUS ATTRIBUTES
OF COMMERCIAL FIRMS

Attribute	n	Mean	Standard Deviation
Size of employment	175	3255.7	8099.1
Sales ($ Millions)	99	110.6	222.6

CHAPTER 5

ANALYSIS OF DATA

The analysis of data was conducted in this sequence: Data reduction, hypothesis testing, identification of related employment barriers, testing for statistical independency, and development of profiles.

DATA REDUCTION

The data were fed in punched-card form into specially developed FORTRAN programs which rearranged some of the individual columnar entries into different columns, transformed others into grouping categories or otherwise analyzed and selected information prior to final statistical analysis. These programs generated a new punched card deck ready for analysis by the Data-Text Social Data Analysis Program.

Separate data reduction programs were required for the sets of data from individuals and from commercial firms.

Data from Individuals

Certain modifications were made to the data from individuals by grouping items into categories, rounding

mathematically, correcting unrealistic entries, recoding and merging. Affected attributes were the respondents' ages, college degrees, years of aerospace experience and responses to aerospace job offers.

Age. Besides maintaining actual age in the data, the data reduction program created for each respondent a data entry into a five-year age bracket. The following groupings were used:

24 and under
25 to 29
30 to 34
.
.
.
60 to 64
65 and above

Degree. The highest degree attained was determined by a computer program subroutine which analyzed all degree entries. From the maximum possibility of three entries, one final response was selected from the following categories:

1 No degree
2 Two years of college
3 Bachelor
4 Master
5 Doctorate

Years of experience. Actual years of aerospace experience were kept in the data and entries were also created according to these two-year categories:

2 years and under
3 to 4 years
5 to 6 years
.
.
.
19 to 20 years
21 years and over

Response to aerospace job offer. Three data items were developed:

> Real response (accepted or rejected) in cases where the respondent had actually received an offer.
>
> Hypothetical response (accepted, rejected, or conditionally accepted) in cases where the respondent stated his probable response to an offer.
>
> Final response (accepted, rejected, conditionally accepted or no response), a determination for all respondents combining real with hypothetical responses. Real responses were programmed to take precedence over hypothetical responses when a respondent answered both questions. In addition, if a respondent was currently working in an aerospace firm, his final response was considered to be one of acceptance.

Rounding. In cases where years and months were entered by the respondent for a particular variable, the program automatically rounded any monthly figure of six and over into one year.

Error checking. A number of checking routines were built into the program to screen for unrealistic entries.

Key punch and coding errors were found and corrected.

Recoding. Condensation of data was attained in several areas by analyzing several raw data columns and assigning new codes depending on the columnar location. Through such recoding, the final data cards utilized sixty-five columns rather than the eighty required for the raw data.

Data from employees anticipating layoff. Information from this special form was merged with the other data from individuals wherever possible. Due to the brevity of the special-purpose form, not as much data was obtained from these 38 respondents.

Data From Non-aerospace Firms

The data from non-aerospace firms was modified as follows:

Employment size. The actual number of employees reported by the firms was maintained in the data and supplemented by a categorization scheme in blocks of five hundred:

500 employees and under
501 to 1,000 employees
1,001 to 1,500 employees
.
.
.
4,000 to 4,500 employees
Over 4,500 employees

Sales level. Reported sales level (an open-ended response) was kept and categories were used in increments of $10,000,000:

$10,000,000 and under
$10,000,000 to $20,000,000
.
.
.
$190,000,000 to $200,000,000
Over $200,000,000

General attitude about hiring ex-aerospace engineers and scientists. The program examined five possible multiple-choice responses and one open-ended response to determine the firm's general opinion on hiring former aerospace professionals. Three categories were available:

1 Willing
2 Reluctant
3 No response

Error checking and recoding. As in the first data reduction program, error checks were built in. Recoding was used to condense the data from eighty columns to thirty-nine columns prior to statistical analysis.

HYPOTHESIS TESTING

The Data-Text program developed frequency distributions of all variables. Decision rules based on sample proportions had been established with 95% confidence levels as discussed in Chapter Three. Each of the four hypotheses

was tested for a majority (more than 50%) response. z was computed in each case and compared with 1.64. If z was less than 1.64, the null hypothesis was not rejected and if z was greater than 1.64, the null hypothesis was rejected. If the null hypothesis could be rejected, the alternate or research hypothesis could be "accepted" in the sense that it could not be rejected. The following analysis considers the hypotheses in turn, using applicable questionnaire responses to test each hypothesis.

Hypothesis Number 1

Hypothesis Number 1 states that:

> A barrier to employment is the widely-held presuppostion by non-aerospace employers that former aerospace engineers and scientists will return to aerospace work when it is offered.

Three separate questions were used in testing this hypothesis. Two were directed toward employment managers of commercial (non-aerospace) firms and one was asked of individual ex-aerospace engineers and scientists.

First question. Question Number 2 to commercial firms was:

> When openings are available for engineers or scientists, how do you feel about hiring someone with an aerospace background?

One of the multiple-choice answers available was "Reluctant, as they are likely to return to aerospace work when the

opportunity arises." Of the 95 respondents (54.3%) showing a general unwillingness to hire ex-aerospace professionals, only 30 (17.1% of the total 175 respondents) indicated that potential employee's likelihood of returning to aerospace was an employment barrier. z equals -8.705, hence the null hypothesis that $\Pi \leq 50\%$ cannot be rejected.

Second question. Question Number 5 to commercial firms was:

> In your opinion, what could be done to make the ex-aerospace applicant more salable in the non-aerospace job market?

One multiple-choice answer was, "Assurance that he is not taking the job as a temporary measure until an aerospace position opens up." Thirty-nine percent of the firms selected this answer. z equals -2.910 and again, the null hypothesis cannot be rejected.

Third question. Question Number 7 to individuals was:

> What were the major obstacles which you found in attempting to secure non-aerospace employment?

This open-ended question resulted in only thirty responses (7.7%) supporting hypothesis Number 1. z equals -16.686 and the null hypothesis cannot be rejected.

All three questions lead to the same conclusion: Hypothesis Number 1 cannot be accepted. One explanation for these results is that an open-ended, rather than a

multiple-choice, question was asked of individuals in an attempt to avoid bias. Yet, the commercial employers, who were given a multiple-choice question, did not indicate a significant concern that employees might return to aerospace.

Hypothesis Number 2

Hypothesis Number 2 states that:

> Once employed in a non-aerospace job which is not merely of an emergency, stop-gap nature, paying substantially less than the amount earned in aerospace, most former aerospace engineers and scientists will not return to aerospace work when given tne opportunity.

Two questions were asked of individuals and one question was directed toward commercial firms regarding this hypothesis. As discussed in detail in the Data Reduction Section, some individuals had responses to actual job offers, others furnished probable responses to hypothetical offers and a final response determination was made by combining these responses.

First question. Question Number 6 to individuals was:

> After leaving aerospace employment, did you receive any offers to return to such work by your former employer or any other aerospace employer?

Those responding positively were then asked

> What was your response to the offer?

The multiple-choice answers were "Accepted" or "Rejected."

A total of 138 individuals received actual aerospace job offers. Of these, 63 (45.6%) accepted and 75 (54.4%) rejected the offer. z equals 1.034, so the null hypothesis cannot be rejected.

Second question. Question Number 8 to individuals was:

> What would be your response to an aerospace job offer?

Answers were, "Acceptance with no reservations," "Rejection," and "Acceptance under the following conditions:" (open-ended). Of the 325 responses to this question, 30 (9.2%) would accept an offer with no reservations, 153 (47.1%) would reject an offer and 142 (43.7%) would accept under certain conditions. The major condition of acceptance observed was the guarantee of permanent work.

Considering the unconditional categories alone, or n equal to 183, p equals .776 and z equals 7.467; the null hypothesis would be rejected. If the conditional acceptances are combined with the rejections, n equals 325, p equals .600, z equals 3.606 and the null hypothesis would again be rejected. Only if the conditional acceptances are combined with the unconditional acceptances where p equals .471 and z equals -1.046, will the null hypothesis not be rejected. The low value associated with unconditional acceptance (30 or 9.2%) supports the conclusion that the null hypothesis should be rejected.

Final response. Based on the answers to the previous two questions, a final response was developed for the majority of the respondents. Of the 380 responses, 89 (23.4%) accepted, 187 (49.2%) rejected and 104 (27.4%) conditionally accepted aerospace job offers. Viewing the unconditonal responses alone, n equals 276, p equals .677 and z equals 5.881; the null hypothesis would be rejected. Combining rejections with conditional acceptances, n equals 380, p equals .766, z equals 10.371 and the null hypothesis would be rejected again. If acceptances and unconditional acceptances are combined, p equals .492, z equals -0.312 and the null hypothesis cannot be rejected. Even with this somewhat unrealistic last combination, it is noted that there is a strong unconditional rejection response (187 or 49.2%). All evidence points toward rejection of the null hypothesis.

Third question. Question Number 4 to commercial firms was:

> Has your firm experienced abnormally high turnover rate of ex-aerospace scientists and engineers who have, in fact, returned to aerospace jobs?

Multiple-choice answers were, "Yes," "No," and "Uncertain." Of the 120 responses to this question, only 7 (5.8%) were affirmative, 78 (65.0%) were negative and 35 (29.2%) were uncertain. Considering the definite responses, n equals

85, p equals .917, z equals 7.689 and the null hypothesis would be rejected.

All of these questions provide sufficient evidence for the acceptance of Hypothesis Number 2, that former aerospace scientists and engineers are not likely to return to aerospace work.

Hypothesis Number 3

Hypothesis Number 3 states that:

> A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists are, or will become, dissatisfied and poorly motivated in non-aerospace work due to their previous high salary ranges, more challenging jobs and general over-qualifications.

This hypothesis was tested with three questions: One to individuals and two to commercial firms.

First question. Question Number 7 to individuals was:

> What were the major obstacles which you found in attempting to secure non-aerospace employment?

The open-ended answers were categorized and coded. One of the codes designated a response by the individuals which confirmed the hypothesis statement. Only 49 respondents out of 389, or 12.6% indicated that this was a barrier. In this instance, z equals -14.753 and the null hypothesis cannot be rejected.

Second question. Question Number 2 to commercial firms was:

> When openings are available for engineers or scientists, how do you feel about hiring someone with an aerospace background?

One of the multiple-choice answers was, "Reluctant, as they will not likely be satisfied with a lower salary." Thirty of the 175 employment managers, or 17.1%, felt that this area was a problem. z equals -8.705, hence the null hypothesis cannot be rejected with this data.

Third question. Question Number 3 to commercial firms was:

> How would you compare the attitudes and work performance of ex-aerospace scientists and engineers with non-aerospace professionals?

A multiple-choice ranking scale was used to answer this question, using the categories, "Superior," "Equal," "Inferior," and "No Opinion." At least half of the firms had no prior experience in this area. Only 9 firms ranked the ex-aeospace professionals as inferior in attitudes and performance. Considering only the firms with experience, n equals 64, and contrasting a rating of inferior (9 or 14.1%) with the combined ratings of equal (51, or 79.7%) and superior (4, or 6.2%), z equals -5.744 and the null hypothesis cannot be rejected.

Thus, questions to employers and individuals do not provide any indication that the null hypothesis should be rejected. Hypothesis Number 3, the alternate hypothesis, therefore, cannot be accepted.

Hypothesis Number 4

Hypothesis Number 4 states that:

> A majority of former aerospace engineers and scientists adapt readily to non-aerospace work and become effective, motivated and satisfied employees.

Three questions were used to test this hypothesis: One to commercial firms and two to individuals.

First question. Question Number 3 to commercial firms was:

> How would you compare the attitudes and work performance of ex-aerospace scientists or engineers with non-aerospace professionals?

The ranking scale which was discussed with Question Number 3 to commercial firms, under Hypothesis Number 3, was used to test Hypothesis Number 4 as well. There is not any indication from the standpoint of commercial employers that ex-aerospace scientists and engineers have been observed on the job to be poorly motivated, ineffective or dissatisfied. With n equal 64 and with 55 respondents (85.9%) ranking these employees as equal or superior to their non-aerospace counterparts, z equals 5.744. The null hypothesis was rejected.

Second question. Question Number 5 to individuals was:

> How would you compare your current job with your former aerospace position, in terms of personal satisfaction and motivation?

A multiple-choice ranking was provided to answer this question as follows:

> Substantially below the aerospace job
> Slightly below the aerospace job
> Equal to the aerospace job
> Slightly above the aerospace job
> Substantially above the aerospace job

Of the 191 individuals who were currently employed in non-aerospace industry, the majority preferred the non-aerospace job as shown below:

Comparison of non-aerospace job to former aerospace job	Number of Respondents	Per Cent
Substantially below	28	14.7
Slightly below	17	8.9
Equal to	23	12.0
Slightly above	24	12.6
Substantially above	99	51.8
Total:	191	100.0

By combining the first two categories into one response representing general dissatisfaction with the current non-aerospace job and comparing this with the combined response of the three remaining categories (equal and above), the null hypothesis was tested. n equals 191, p equals .764 and z equals 7.297. The null hypothesis that 50% or less of the respondents are satisfied in the non-aerospace job was rejected.

Third question. Question Number 5 to individuals anticipating layoff was:

> Do you feel that you could become satisfied and motivated in a non-aerospace job?

Multiple-choice answers were, "Yes," "No," and "Uncertain." Of the 38 people in this special category, 35 (92.1%) answered positively, 1 (2.6%) answered negatively, and 2 (5.3%) were undecided. With n equal to 38, z equals 5.190 and the null hypothesis was rejected.

The three questions provide substantial evidence to reject the null hypothesis that 50% or less of former aerospace scientists and engineers adapt to the commercial environment. Thus, Hypothesis Number 4 was accepted.

Summary of Hypothesis Testing

A summarization of the results of hypothesis testing is shown below:

Hypothesis Number	Hypothesis Statement	Results of Testing
1	A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists will return to aerospace work when it is offered.	Rejected

Summary of Hypothesis Testing (Contd.)

Hypothesis Number	Hypothesis Statement	Results of Testing
2	Once employed in a non-aerospace job which is not merely of an emergency stop-gap nature, paying substantially less than the amount earned in aerospace, most former aerospace scientists and engineers will not return to aerospace work when given the opportunity.	Accepted
3	A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists are, or will become, dissatisfied and poorly motivated in non-aerospace work due to their previous high salary ranges, more challenging jobs and general overqualifications.	Rejected
4	A majority of former aerospace engineers and scientists adapt readily to non-aerospace work and become effective, motivated and satisfied employees.	Accepted

IDENTIFICATION OF RELATED EMPLOYMENT BARRIERS

Besides the employment barriers considered in hypothesis testing, the data analysis provided a list of other barriers to employment, taken from the open-ended questions to individuals and commercial employers.

Employment Barriers Reported by Individuals

Question Number 7 to individuals was:

> What were the major obstacles which you found in attempting to secure non-aerospace employment?

Table X lists the resulting categories and response frequencies of this open-ended question.

Employment Barriers Reported by Commercial Firms

Question Number 2 to commercial firms was:

> When openings are available for engineers or scientists, how do you feel about hiring someone with an aerospace background?

Besides the multiple-choice answers used in hypothesis testing, an open-ended response was provided: "Reluctant, due to _____." Table XI presents the responses to this question.

Question Number 5 to commercial firms was:

> In your opinion, what could be done to make the ex-aerospace applicant more salable in the non-aerospace job market?

One multiple-choice answer was used in hypothesis testing, another cited "Training" and an open-ended space was provided and designated, "Other factors _____." Although these factors are suggestions to remedy the unemployment problem, two barriers from the standpoint of commercial employers can be identified. Table XI includes these responses.

TABLE X

MAJOR EMPLOYMENT BARRIERS AS PERCEIVED BY INDIVIDUAL EX-AEROSPACE ENGINEERS AND SCIENTISTS[a] (n=389

	Employment Barriers	Frequency	% of Respondents Citing This Barrier
A.	Lack of non-aerospace experience (over-specialization)	149	38.3%
B.	Ex-aerospace employees demanding higher salary than commercial employer willing to pay	78	20.5%
C.	Age discrimination (ex-aerospace employee too old)	77	19.8%
D.	Existance of a general bias against ex-aerospace personnel	69	17.7%
E.	Relocation required and ex-aerospace employee reluctant to move	36	9.3%
F.	Overqualified (ex-aerospace employee's credentials too good)	35	9.0%
G.	Oversupply of talent (flooding the market)	21	5.4%
H.	Lack of cost-consciousness on part of ex-aerospace employee (not profit-oriented)	10	2.6%

[a]Source: Respondents to Question 7 to individuals.

[b]Excludes barriers relating to hypothesis testing.

TABLE XI

MAJOR EMPLOYMENT BARRIERS AS PERCEIVED BY COMMERCIAL FIRMS

	Employment Barrier[a]	n	Frequency	Percentage Of Firms Citing Barriers
	Listed Barriers[b]			
A.	Lack of non-aerospace experience (over-specialization)	101	33	32.7
	Barriers Seen in Suggestions[c]			
B.	Ex-aerospace employees do not understand that their aerospace salaries were unrealistically high	175	12	6.9
C.	Lack of cost-consciousness on part of ex-aerospace employee (not profit-oriented)	175	7	4.0

[a]Excludes barriers relating to hypothesis testing.

[b]Source: Question Number 2 to commercial firms.

[c]Source: Question Number 5 to commercial firms.

Considering the combined viewpoints of individuals and commercial employers, the most significant employment barrier facing the ex-aerospace professional is lack of non-aerospace experience or overspecialization

STATISTICAL INDEPENDENCY

Independency testing was done using the chi-square statistic on several major variables. Data from individuals were utilized first, followed by the data from commercial firms.

Data From Individuals

The primary variable of interest was whether or not ex-aerospace scientists and engineers, once employed in commercial industry, would return to aerospace jobs when the opportunity presented itself. Using the "final response" figures, developed by the data reduction computer program (combining actual responses with hypothetical responses), each respondent was assigned one of the answers from the options of, "Accepted," "Rejected," "Conditionally accepted," or "No response." The Data-Text Social Data Analysis Program was used to develop contingency tables, compute expected values and chi-square statistics, and report on statistical significance using this final response variable and the following attributes:

State
Age
Marital status
Number of dependents
Classification (engineer or scientist)
Years of aerospace experience
Degree held (highest level attained)
Professional engineer or not
Type of engineer (speciality)
Function (e.g., design, research)
Reason for leaving aerospace
Ever unemployed
How long unemployed

In each case the test was conducted to determine if the random variables and attributes were statistically independent. These hypotheses were stated:

H_o: The tendency to accept or reject an aerospace job offer is independent of the attribute of interest.

H_1: The tendency to accept or reject an aerospace job offer is dependent on the attribute of interest.

When the Data-Text Crosstabs (chi-square) program signified a chi-square with a level of significance equal to or better than .05, the null hypothesis was rejected and the alternate hypothesis of dependency was not rejected. Four of the thirteen attributes tested did show statistical significance. Each is discussed below.

Age. Ten age brackets had been developed by the data reduction program, ranging from 24 and under to above 69 in five-year increments. Chi-square was computed as 72.063 with a significance under .001 with 27 degrees of freedom.

The null hypothesis was rejected.

Table XII is a reproduction of the table generated by the Data-Text program. Examination of the cells for significant differences between expected values and observed values, indicates a tendency for the younger group (below age 35) to reject an aerospace offer more often than would be expected. Conversely, the older men (above age 50) are more likely than expected to conditionally accept an offer.

Degree held. The data reduction program selected the highest degree held by each respondent:

None
Two years of college
Bachelor
Master
Doctorate

Chi-square was computed to be 28.489, which corresponded with a level of significance of .005, with 12 degrees of freedom. The null hypothesis was rejected.

Table XIII depicts the Data-Text contingency table. Bachelor's degree holders appear to reject aerospace offers more than would be expected, while those without a degree, tend to accept offers more often than expected.

Reason for leaving aerospace. Three categories were considered:

Layoff
Voluntary termination
Forced retirement

TABLE XII

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCE: AGE AND FINAL RESPONSE TO AEROSPACE JOB OFFER
($\underline{X}^2$=72.063: Significance under .001 with 27 degrees of freedom)

Final Response	a	Age Brackets				
		≤ 24	25-29	30-34	35-39	40-44
Accepted	E	2.3	9.2	14.0	17.2	14.6
	O	1	7	17	15	11
Rejected	E	4.8	19.2	29.3	36.1	30.8
	O	7	25	35	36	35
Cond. Accepted	E	2.7	10.7	16.3	20.1	17.1
	O	2	8	8	24	14
No Response	E	0.2	0.9	1.4	1.7	1.5
	O	0	0	1	0	4
Total		10	40	61	75	64

[a]E = Expected value; O = Observed value.

CONCLUSION TABLE XII

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCE:
AGE AND FINAL RESPONSE TO AEROSPACE JOB OFFER
(X^2= 7.063: Significance Under .001 With 27 Degrees of Freedom)

Final Response	a	Age Brackets					Total
		45-49	50-54	55-59	60-64	65-69	
Accepted	E	14.4	9.4	4.8	3.0	0.2	89
	O	12	14	5	6	1	
Rejected	E	30.3	19.7	10.1	6.2	0.5	187
	O	29	13	5	2	0	
Cond. Accepted	E	16.8	11.0	5.6	3.5	0.3	104
	O	22	13	11	2	0	
No Response	E	1.5	0.9	0.5	0.3	0.0	9
	O	0	1	0	3	0	
Total		63	41	21	13	1	389

[a]E=Expected value, O=Observed value.

TABLE XIII

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCE: HIGHEST DEGREE HELD AND FINAL RESPONSE TO AEROSPACE JOB OFFER ($\underline{X}^2$=28.489: Significant at .005 With 12 Degrees of Freedom)

Final Response	a	Highest Degree Held					Total
		None	2 Yrs.	Bachelor	Master	Doctor	
Accepted	E	15.6	1.6	57.4	13.0	1.4	89
	O	21	2	51	15	0	
Rejected	E	32.7	3.4	120.7	27.4	2.9	187
	O	20	3	139	22	3	
Cond. Accepted	E	18.2	1.9	67.1	15.2	1.6	104
	O	26	1	54	20	3	
No Response	E	1.6	0.2	5.8	1.3	0.1	9
	O	1	1	7	0	0	
Total		68	7	251	57	6	389

[a]E = Expected value, O = Observed value.

Chi-square was 19.630 and the level of significance was .004, with 6 degrees of freedom. The null hypothesis was rejected.

Examination of Table XIV indicates a tendency for those who voluntarily left aerospace to reject aerospace offers, even more than would be expected.

State. Four possibilities existed:

Alabama
Florida
Georgia
Unknown

Chi-square was 24.044, significant at .005 with 9 degrees of freedom. Table XV shows the resulting table. Alabamians seemed to be more likely to accept an aerospace offer than would be expected while Georgians and Floridians appeared more likely than expected to reject such offers.

Data from commercial firms. The primary variable of interest was whether or not non-aerospace firms were willing to hire ex-aerospace engineers and scientists. The general tendency ("Willing," "Reluctant," or "No Response") had been determined by the data reduction program from an analysis of several responses, as previously discussed. The Data-Text program was utilized to develop contingency tables, compute expected values and chi-square statistics and determine statistical significance, using this general

TABLE XIV

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCY: REASON FOR LEAVING AEROSPACE AND FINAL RESPONSE TO AEROSPACE JOB OFFER ($\underline{X}^2$ = 19.630: Significant at .004 With 6 Degrees of Freedom)

Final Response	a	Reason For Leaving Aerospace			Total
		Layoff	Voluntary Termination	Forced Retirement	
Accepted	E	75.6	8.0	3.5	87
	O	75	8	4	
Rejected	E	138.1	14.5	6.4	159
	O	134	21	4	
Cond. Accepted	E	84.3	8.9	3.9	97
	O	90	3	4	
No Response	E	6.1	.6	0.3	7
	O	5	0	2	
Total		304	32	14	350

[a]E = Expected value, O = Observed value.

TABLE XV

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCE: STATE AND FINAL RESPONSE TO AEROSPACE JOB OFFER ($\underline{X}^2$ = 24.044: Significant at .005 With 9 Degrees of Freedom)

Final Response	a	State				Total
		Alabama	Florida	Georgia	Unknown	
Accepted	E	27.9	22.4	37.5	1.1	89
	O	44	19	24	2	
Rejected	E	58.6	47.1	78.8	2.4	187
	O	47	53	84	3	
Cond. Accepted	E	32.6	26.2	43.8	1.3	104
	O	30	24	50	0	
No Response	E	2.8	2.3	3.8	0.1	9
	O	1	2	6	0	
Total		122	98	164	5	389

[a]E = Expected value, O = Observed value.

tendency variable and the following attributes:

State
Classification (agriculture, mining, etc.)
Employment size (ten categories)
Sales level (sixteen categories)

Tests were conducted to determine if the random variables and attributes were statistically independent. These hypotheses were stated:

H_o: The tendency to hire or not hire an ex-aerospace engineer or scientist is independent of the attribute of interest.

H_1: The tendency to hire or not hire an ex-aerospace engineer or scientist is dependent on the attribute of interest.

The decision rule was set up to reject the null hypothesis when chi-square had a level of significance equal to or better than .05. Only one of the four attributes showed statistical significance:

Industrial Classification. Chi-square was computed as 35.164, significant at .002 with 14 degrees of freedom. The null hypothesis of independency was rejected.

Table XVI depicts the contingency table generated by the Data-Text program. Examination of the cells indicates a tendency for mining or construction firms to refuse employment to ex-aerospace professionals more than would be expected.

TABLE XVI

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCE: CLASSIFICATION OF FIRM AND TENDENCY TO HIRE EX-AEROSPACE SCIENTISTS AND ENGINEERS ($\underline{X}^2$ = 35.164: Significant at .002 With 14 Degrees of Freedom)

Hiring Tendency	a	Agriculture	Mining or Construction	Durable Mfg.	Non-Durable Mfg.	Transportation
Willing	E	1.6	5.3	29.6	25.1	2.5
	O	0	2	24	24	6
Reluctant	E	2.2	7.1	39.1	33.1	3.3
	O	4	11	37	34	0
No Response	E	0.2	0.6	3.3	2.8	0.3
	O	0	0	1	3	0
Total		4	13	72	61	6

[a]E = Expected value, O = Observed value.

CONCLUSION TABLE XVI

CONTINGENCY TABLE FOR TEST OF STATISTICAL INDEPENDENCE: CLASSIFICATION OF FIRM AND TENDENCY TO HIRE EX-AEROSPACE SCIENTISTS AND ENGINEERS ($\underline{X}^2$ = 35.164: Significant at .002 With 14 Degrees of Freedom)

Hiring Tendency	a	Communication	Utility	Service	Total
Willing	E	4.9	2.5	0.4	72
	O	4	1	1	
Reluctant	E	6.5	3.3	0.5	95
	O	5	4	0	
No Response	E	0.5	0.3	0.0	8
	O	3	1	0	
Total		12	6	1	175

[a]E = Expected value, O = Observed value.

PROFILES

An analysis of all questionnaire responses was made for the purpose of developing profiles of individuals and commercial firms.

Individual Profiles

The average respondent was male, 41 years old, married and had 2.6 dependents. He held a bachelor's degree in engineering and had been laid off from an aerospace job due to contract reductions. He had accumulated 12.6 years of aerospace experience and was not a registered Professional Engineer. He had experienced an unemployment period of 19.1 weeks but was currently employed in a commercial (non-aerospace) job, and had held this position for 6.8 months. He did not wish to be consulted for further research (signified by not signing the questionnaire) but was agreeable to participate in the research at hand. He was not interested in returning to an aerospace job, feeling that his current commercial job offered substantially more in terms of personal satisfaction and motivation. In his opinion, the major barrier to commercial employment for ex-aerospace engineers and scientists is overspecialization or lack of commercial experience.

Persons tending to return to aerospace had this profile: He had been laid off from an aerospace firm in the Huntsville,

Alabama area. He was over fifty years old and did not hold a college degree. He would likely accept an aerospace job only with the condition that the position would be permanent.

Commercial Profiles

The average firm employed 3,256 persons and was classified under Durable Manufacturing. Sales figures were not furnished and the company did not wish to be identified. The firm is generally unwilling to hire ex-aerospace engineers and scientists, citing the main drawback as lack of commercial experience by the applicants.

No profile could be developed for firms tending to hire ex-aerospace scientists and engineers. The only characteristic was that firms classified as Durable or Non-durable Manufacturing were receptive to ex-aerospace job applicants.

CHAPTER 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

At the completion of the analysis of data, conclusions were drawn and areas were identified for possible further research. This chapter first summarizes the entire study and then presents conclusions and recommendations.

SUMMARY

The purpose of this study was to examine the conditions associated with the hiring of former aerospace scientists and engineers in commercial (non-aerospace) industry. The approach was to focus on certain apparent "barriers" to commercial employment which were hypothesized to be merely presuppositions on the part of commercial employment managers, and to show that these presuppositions were false. Thus, some barriers could be removed and unemployment problems of ex-aerospace engineers and scientists could be eased. Concurrently, the study included plans to identify other barriers to commercial employment and to search for dependency relationships among attributes and variables for predictive analysis.

The hypotheses were:

1. A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists will return to aerospace work when it is offered.

2. Once employed in a non-aerospace job which is not merely of an emergency, stop-gap nature, paying substantially less than the amount earned in aerospace, most former aerospace engineers and scientists will not return to aerospace work when given the opportunity.

3. A barrier to employment is a widely-held presuppostion by non-aerospace employers that former aerospace engineers and scientists are, or will become, dissatisfied and poorly motivated in non-aerospace work due to their previous high salary ranges, more challenging jobs, and general overqualifications.

4. A majority of former aerospace engineers and scientists adapt readily to non-aerospace work and become effective, motivated and satisfied employees.

To keep the study within a manageable scope, it focused on three major areas of high aerospace unemployment:

Huntsville, Alabama
Cape Kennedy, Florida
Atlanta, Georgia

The two populations of interest were unemployed or previously unemployed aerospace engineers and scientists, and commercial (non-aerospace) firms in the States of Alabama, Florida, and Georgia.

The study began with a survey of the literature and with travel to the geographic areas of interest. The severity

of the problem on a national basis was examined, followed by the development of unemployment figures for the affected regions. Remedial actions on national, state and local levels were described. Historical experience and related research were then discussed. Travel to individual aerospace firms experiencing heavy layoffs provided mailing lists for questionnaires to individuals.

Research methodology was planned, including questionnaire design, testing of hypotheses, identification of related employment barriers, analysis of statistical independency, and development of profiles.

Questionnaires were designed to provide data from individuals and commercial firms, as represented by their employment managers (Appendix A). Appropriate cover letters (Appendix B) were prepared, and endorsement letters were obtained (Appendix C). Plans were made to conduct hypothesis testing by considering the responses from combinations of survey questions. Sample proportions ($\underline{p}$) were to be used as estimates of population proportions (Π). Each hypothesis was to be considered in turn, setting up an appropriate null hypothesis of:

$$H_o \leq 50\%$$

and an alternate hypothesis of:

$$H_1 > 50\%$$

A decision rule was established that the null hypothesis could not be rejected if the computed value of $\underline{z}$ was less than 1.64, which corresponds to a confidence level of 95% or .05 significance.

Related employment barriers were to be obtained through multiple-choice and open-ended response from both samples.

Independency was to be checked, using the chi-square statistic as determined by the Data-Text Social Data Analysis Program. Profiles were to be developed, using all statistical data generated by the Data-Text program. Sample size, although somewhat constrained by cost, availability, and time, was considered and verified as reasonable, based on the size of the mailing list; this was subsequently shown to be adequate, due to the high response rate.

Data was then collected by mailing the appropriate questionnaires to 659 individuals and 300 firms (100 with the largest employment size in each of the three states). One aerospace firm allowed an in-house questionnaire to be circulated to persons anticipating layoff. Response rates were 63.3% for the individual questionnaire and 60.0% for the survey of commercial firms.

The data were translated into punched-card form and were first analyzed by custom-designed computer programs, followed by Data-Text statistical analysis. The results

of hypothesis testing are shown below:

Hypothesis Number	Hypothesis Statement	Results of Testing
1	A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists will return to aerospace work when it is offered.	Rejected
2	Once employed in a non-aerospace job which is not merely of an emergency stop-gap nature, paying substantially less than the amount earned in aerospace, most former aerospace scientists and engineers will not return to aerospace work when given the opportunity.	Accepted
3.	A barrier to employment is the widely-held presupposition by non-aerospace employers that former aerospace engineers and scientists are, or will become, dissatisfied and poorly motivated in non-aerospace work due to their previous high salary ranges, more challenging jobs and general over-qualifications.	Rejected
4.	A majority of former aerospace engineers and scientists adapt readily to non-aerospace work and become effective, motivated and satisfied employees.	Accepted

An analysis of related employment barriers showed that the most significant barrier facing former aerospace scientists and engineers is lack of non-aerospace experience or overspecialization. Testing the respondent's tendency to accept or reject an offer to return to aerospace for statistical independency, determined that there was statistically significant dependency when the following attributes were considered: Age, highest college degree held, reason for leaving aerospace, and state where the aerospace layoff took place. Dependency was also seen in the relationship between a firm's general classification (e.g., Non-durable Manufacturing) and its tendency to hire ex-aerospace engineers and scientists.

Finally, general profiles were stated, describing the typical respondent of each type of questionnaire, the type of person most likely to accept an aerospace job offer, and the type of firm most likely to refuse employment to ex-aerospace engineers and scientists.

CONCLUSIONS

The following conclusions are based on the findings of the study:

A. The likelihood of an ex-aerospace scientist or engineer eventually returning to aerospace employment is not a common presupposition of commercial employment managers. Hence, this factor, although frequently

mentioned among unemployed professionals, does not represent a serious employment barrier.

B. Once an ex-aerospace scientist or engineer obtains a commercial job, he is not likely to return to aerospace when the opportunity presents itself. There is a general feeling of distaste for the uncertainties of aerospace employment among former aerospace professionals.

C. The probability that ex-aerospace engineers and scientists will not be satisfied in commercial industry is not a commonly-held presupposition of commercial employment managers. Thus, this factor is not a significant barrier to employment for former aerospace professionals.

D. Ex-aerospace scientists and engineers become satisfied, motivated, and effective employees in commercial industry. It appears that the scientists and engineers themselves are often surprised and pleased with their non-aerospace positions. Many express gratitude that they have found an interesting and rewarding career.

E. The most significant barrier to commercial employment facing former aerospace engineers and scientists is their lack of non-aerospace experience or overspecialization.

RECOMMENDATIONS FOR FURTHER STUDY

The results of this study suggest that research be conducted in at least two major problem areas: The present problem of removing the overspecialization barrier facing unemployed aerospace scientists and engineers today, and the future problem of meeting a potential space or missile

crisis when ex-aerospace scientists and engineers refuse to return to aerospace jobs.

Overspecialization

Research is recommended to investigate the value of existing techniques being used to offset overspecialization, such as training programs. A number of unique training techniques have arisen since the outset of the aerospace employment slump. Yet two years ago, a number of engineers expressed doubts about training as a solution.[1] The effectiveness of training programs could now be measured since some time has passed.

Besides consideration of training, research could be aimed at identifying the most successful techniques for offsetting the overspecialization barrier. The validity of the barrier itself could be investigated in a similar manner as was done in the study at hand.

Shortages of Aerospace Manpower

Research would be valuable in the area of future aerospace manpower shortages. For example, one could examine the problem of meeting a sudden need for highly-

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[1]"Opinion Poll: Retraining not Adequate," Industrial Research, August, 1971, p. 55.

qualified and specialized scientists and engineers to close a missile gap or meet a vital military requirement. This requirement could pose a serious threat to the nation when ex-aerospace professionals refuse to leave commercial employment or when there are not enough engineering college graduates.[2]

One possibility would be to consider the degree to which space technology is being transferred to commercial industry and ways to facilitate such transfer. Evidence exists that non-aerospace industries are not taking advantage of the technology already made available to them.[3] If space technology could be adequately transferred, there would be some possibility of calling on commercial firms in time of emergency to assist in meeting the crisis.

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[2] "Shortage of Engineers Arises in Many Fields; Gap Will Probably Grow," Wall Street Journal, November 13, 1972, p. 1.

[3] "Business Urged to Utilize N.A.S.A. Data," Aviation Week, December 25, 1972, p. 17.

APPENDIXES

APPENDIX A

QUESTIONNAIRES

This questionnaire is part of an independent research project. Your response is strictly anonymous unless you wish to sign the form.

1. Classification

(A) Age _____ (B) Sex ☐ M ☐ F

(C) Marital Status ☐ S ☐ M ☐ W ☐ D ☐ Sep.

(D) Number of dependents _____

(E) General aerospace career classification ☐ Engineer ☐ Scientist

(F) Cumulative length of aerospace employment _____ years _____ months

(G) Degree(s) held ☐ None Bachelor of _____

Master of _____ Doctor of _____

(H) Are you a registered professional engineer? ☐ Yes ☐ No

(I) Professional area(s) of specialty _____

(J) Reason for leaving aerospace employment

☐ Layoff ☐ Voluntary termination ☐ Forced early retirement

Other: _____

Please indicate the circumstances underlying your departure from Aerospace work:

_____

(K) After leaving aerospace work are you, or were you, unemployed? ☐ No ☐ Yes

If yes, for how long? _____ weeks

2. What is your current employment status?

☐ Employed, length of job _____ months

☐ Unemployed for _____ months _____ weeks

IF YOU ARE CURRENTLY UNEMPLOYED, PLEASE SKIP TO QUESTION 6.

3. An aerospace employer is defined by the U. S. Department of Labor as a firm which derives 40 percent or more of its business from defense or aerospace sources. In your best judgment, how would you classify your current employer?

☐ Aerospace ☐ Non-Aerospace ☐ Borderline

IF YOU CHECKED AEROSPACE, PLEASE SKIP TO QUESTION 6.

4. Is your job a temporary measure until new aerospace opportunities arise?

☐ Yes ☐ No

- over, please -

Figure 1
QUESTIONNAIRE TO UNEMPLOYED OR ONCE-UNEMPLOYED ENGINEERS AND SCIENTISTS

5. How would you compare your current job with your former aerospace position, in terms of personal satisfaction and motivation?

- ☐ Substantially below the aerospace job
- ☐ Slightly below the aerospace job
- ☐ Equal to the aerospace job
- ☐ Slightly above the aerospace job
- ☐ Substantially above the aerospace job

6. After leaving aerospace employment, did you receive any offers to return to such work by your former employer or any other aerospace employer?

☐ Yes ☐ No IF NO, PLEASE SKIP TO QUESTION 7.

What was your employment status at the time of the offer?

☐ Unemployed for_____months _____weeks

☐ Employed for _____ months _____weeks

What was your response to the offer? ☐ Accepted ☐ Rejected

Was the offer a call-back from layoff? ☐ Yes ☐ No

Comments or reasons why you accepted or rejected the offer: _____

_____

7. What were the major obstacles which you found in attempting to secure non-aerospace employment?

(A) _____

(B) _____

(C) _____

IF YOU ARE CURRENTLY WORKING IN AN AEROSPACE JOB, STOP THE QUESTIONNAIRE AT THIS POINT AND RETURN IT IN THE ENCLOSED ENVELOPE. OTHERWISE, PLEASE ANSWER QUESTION NUMBER 8.

8. What would be your response to an aerospace job offer?

☐ Acceptance with no reservations ☐ Rejection

☐ Acceptance under the following conditions: _____

_____

Comments: _____

PLEASE RETURN THE QUESTIONNAIRE IN THE PRE-ADDRESSED, STAMPED ENVELOPE. IF YOU WISH TO BE CONSULTED AGAIN IN ANY FOLLOWUP STUDIES, PUT YOUR NAME AND ADDRESS BELOW. THANK YOU FOR YOUR COOPERATION.

Continuation Figure 1
QUESTIONNAIRE TO UNEMPLOYED OR ONCE-UNEMPLOYED ENGINEERS AND SCIENTISTS

This questionnaire is part of an independent research project. Your response is strictly anonymous unless you wish to sign the form.

1. Classification

(A) Age _____ (B) Sex ☐ M ☐ F

(C) Marital Status ☐ S ☐ M ☐ W ☐ D ☐ Sep.

(D) Number of Dependents _____

(E) General aerospace career classification ☐ Engineer ☐ Scientist

(F) Cumulative length of aerospace employment _____ years _____ months

(G) Degree(s) held ☐ None Bachelor of _____

Master of _____ Doctor of _____

(H) Professional area(s) of specialty _____

(I) Anticipating layoff within _____ days _____ weeks _____ months

2. In searching for a new position, what is your preference?

☐ Another aerospace job

☐ A non-aerospace job

☐ No preference between aerospace and non-aerospace

Reasons for preference _____

_____

3. What major obstacles have you found in attempting to secure non-aerospace employment?

(A) _____

(B) _____

(C) _____

4. If you accept a non-aerospace position which is not merely of an emergency, stop-gap nature, would you likely give it up later if given the chance to return to aerospace?

☐ Yes ☐ No ☐ Uncertain

Comments _____

_____

5. Do you feel that you can become satisfied and motivated in a non-aerospace job

☐ Yes ☐ No ☐ Uncertain

Comments _____

_____

Figure 2
QUESTIONNAIRE TO ENGINEERS AND SCIENTISTS ANTICIPATING LAYOFF

This questionnaire is part of an independent research project. Please be assured that your response will be held in the strictest confidence. Any published data will be summarized; firms will remain anonymous.

1. Classification of Firm

- ☐ Agriculture, Forestry or Fisheries
- ☐ Mining or Construction
- ☐ Manufacturing, Durable Goods
- ☐ Manufacturing, Non-Durable Goods
- ☐ Transportation
- ☐ Communication
- ☐ Utility
- ☐ Wholesale or Retail Trade
- ☐ Finance, Insurance, or Real Estate
- ☐ Services

Approximate number of employees _____

Previous year's general level of sales _____

2. When openings are available for engineers or scientists, how do you feel about hiring someone with an aerospace background?

- ☐ Willing, since they may contribute aerospace expertise
- ☐ Willing, since _____
- ☐ Reluctant, as they are likely to return to aerospace work when the opportunity arises
- ☐ Reluctant, as they will not likely be satisfied with a lower salary
- ☐ Reluctant, due to _____

3. How would you compare attitudes and work performance of ex-aerospace scientists or engineers with non-aerospace professionals?

	Attitudes	Work Performance
Ex-aerospace generally superior	☐	☐
Ex-aerospace generally equal	☐	☐
Ex-aerospace generally inferior	☐	☐
No opinion	☐	☐

4. Has your firm experienced a higher than normal turnover rate of ex-aerospace scientists and engineers who have in fact returned to aerospace jobs?

☐ Yes ☐ No ☐ Uncertain

5. In your opinion, what could be done to make the ex-aerospace applicant more salable in the non-aerospace job market?

- ☐ Retraining
- ☐ Assurance that he is not taking the job as a temporary measure until an aerospace position opens up.
- ☐ Other factors: _____

PLEASE RETURN THE QUESTIONNAIRE IN THE ENCLOSED ENVELOPE. THANK YOU FOR YOUR COOPERATION.

Figure 3
QUESTIONNAIRE TO EMPLOYERS AND POTENTIAL EMPLOYERS OF EX-AEROSPACE SCIENTISTS AND ENGINEERS

APPENDIX B

COVER LETTERS TO QUESTIONNAIRES

November 22, 1972

Dear Colleague:

Please take a few minutes and complete the enclosed questionnaire. It is the major input to a study on ex-aerospace scientific and engineering employment.

As a former aerospace engineer, I have experienced the impact of cutbacks in defense and aerospace industries. Many statements have been made by the press and by non-aerospace people about this situation, but few are backed by data about attitudes and employment experiences of aerospace and defense professionals. The results will be analysed, published and shared with state and federal departments of labor, appropriate United States congressional committees and other actively interested organizations.

You can be assured that your reply is anonymous. Your former employer believed that you would want to participate but insisted that your name and address remain privileged information. Only statistical summaries and recommendations will be published.

Your response is essential to the accuracy of the research. A pre-addressed, stamped envelope is included for your convenience.

Sincerely,

Fred A. Ware, Jr.
Assistant Professor of
Business Administration

Enclosures

Figure 4
COVER LETTER TO ACCOMPANY QUESTIONNAIRE TO UNEMPLOYED OR ONCE-UNEMPLOYED ENGINEERS AND SCIENTISTS

(Date)

(Personally Addressed)

Would you please ask your employment manager to fill out the enclosed, brief questionnaire concerning ex-aerospace engineers and scientists?

This is a critical input to an independent research project. The purpose of the study is to analyze employment opportunities and problems facing former aerospace professionals. Many of these people are undergoing major career changes. Your answers will assist governmental and independent job counseling efforts.

Thank you for your assistance.

Sincerely,

Fred A. Ware, Jr.
Assistant Professor of
Business Administration

Enclosures

Figure 5

COVER LETTER TO ACCOMPANY QUESTIONNAIRE TO EMPLOYERS AND POTENTIAL EMPLOYERS OF EX-AEROSPACE SCIENTISTS AND ENGINEERS

APPENDIX C

ENDORSEMENT LETTERS FOR QUESTIONNAIRES

United States Senate

COMMITTEE ON
AGRICULTURE AND FORESTRY
WASHINGTON, D.C. 20510

December 20, 1972

TO WHOM IT MAY CONCERN:

I have been advised that Mr. Fred A. Ware, Jr., Assistant Professor of Business Administration at Valdosta State College, Valdosta, Georgia, is conducting a study to analyze employment opportunities and problems facing former aerospace scientists and engineers.

The result of Mr. Ware's study could be extremely helpful in assisting those affected by adjustments in the aerospace industry, and I hope that you will give his questionnaire close attention.

With every good wish, I am

Sincerely,

Herman E. Talmadge

Figure 6

ENDORSEMENT LETTER FROM SENATOR
HERMAN E. TALMADGE OF GEORGIA

United States Senate
COMMITTEE ON BANKING, HOUSING AND URBAN AFFAIRS
WASHINGTON, D.C. 20510

August 2, 1972

TO WHOM IT MAY CONCERN:

It is my understanding that Mr. Fred A. Ware, Jr., Assistant Professor of Business Administration at Georgia State University, is planning a research study aimed at improving employment opportunities for ex-aerospace scientists and engineers. It would be part of his doctoral dissertation in the field of Business Administration.

I heartily endorse such a study. I know something of the extent to which scientists and engineers have lost employment in the aerospace field and the difficulty that they have in finding suitable employment. I think it would be a fine thing, and I am pleased to recommend your cooperation.

Sincerely,

John Sparkman

Figure 7

ENDORSEMENT LETTER FROM SENATOR
JOHN SPARKMAN OF ALABAMA

LAWTON CHILES
FLORIDA

COMMITTEES:
AGRICULTURE AND FORESTRY
GOVERNMENT OPERATIONS
JOINT COMMITTEE ON
CONGRESSIONAL OPERATIONS
DEMOCRATIC STEERING COMMITTEE

United States Senate

December 21, 1972

TO WHOM IT MAY CONCERN:

As you are aware, job opportunities for aerospace workers have markedly decreased in the past several years. As a result, many highly skilled men and women have experienced considerable difficulty in securing employment. Mr. Fred Ware, a graduate student at Georgia State University, has chosen to examine this situation in his doctoral dissertation and is currently conducting a survey regarding the transition of ex-aerospace workers to other industries. As I feel Mr. Ware's research will result in data of considerable significance, I would encourage you to complete and return his questionnaire.

Sincerely,

Lawton Chiles

LAWTON CHILES

LC/fjt

Figure 8

ENDORSEMENT LETTER FROM SENATOR
LAWTON CHILES OF FLORIDA

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VITA

Frederick Anderson Ware, Jr., was born April 27, 1935 in Melbourne, Australia of United States of America parentage. He attended the Academy of Richmond County in Augusta, Georgia and graduated from high school at the Darlington School of Rome, Georgia in 1953.

Mr. Ware received the Bachelor of Mechanical Engineering Degree from the Georgia Institute of Technology in 1957. Upon graduation, he enlisted in the United States Army and attended the Army Ordnance Missile Command School at Huntsville, Alabama. Mr. Ware was stationed as a military resident engineering representative at the Western Electric Company, Burlington, North Carolina, until completion of his enlistment period in 1961. During this time, he was awarded a direct commission as a Second Lieutenant, United States Army Reserve.

Mr. Ware attended Emory University and received his Master of Business Administration Degree in 1962. As a result of his Masters thesis on Value Engineering, he was hired as a production design engineer at the Lockheed-Georgia Company, Marietta, Georgia. He remained with this firm for eight years, serving as an engineering cost reduction specialist and management control systems analyst.

In 1969, Mr. Ware enrolled in the doctoral program in Business Administration at Georgia State University and worked as a graduate teaching assistant in the Management field. He is presently an Assistant Professor of Business Administration at Valdosta State College, Valdosta, Georgia.

Mr. Ware is married to the former Rose Marie Voorhees, of Orlando, Florida; they are the parents of three children: Frederick, III, Laura Frances, and Runa Henderson.

Mr. Ware is a member of Beta Gamma Sigma, the Academy of Management, the Southern Management Association, the Society of American Value Engineers, the Chi Phi social fraternity, Pi Delta Epsilon and Pi Tau Chi. His permanent address is: 2214 Briarcliff Drive, Valdosta, Georgia, 31601.