

AIR FORCE



**HUMAN
RESOURCES**

**GENERAL PURPOSE PERSON-JOB MATCH SYSTEM
FOR AIR FORCE ENLISTED ACCESSIONS**

By

**David K. Roberts, Capt, USAF
Joe H. Ward, Jr.**

**MANPOWER AND PERSONNEL DIVISION
Brooks Air Force Base, Texas 78235**

December 1982

Special Report

Approved for public release; distribution unlimited.

LABORATORY

**AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235**

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder, or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The Public Affairs Office has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

RONALD W. TERRY, Colonel, USAF
Commander

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFHRL-SR-82-2	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) GENERAL PURPOSE PERSON-JOB MATCH SYSTEM FOR AIR FORCE ENLISTED ACCESSIONS		5. TYPE OF REPORT & PERIOD COVERED Special Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) David K. Roberts Joe H. Ward, Jr.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Manpower and Personnel Division Air Force Human Resources Laboratory Brooks Air Force Base, Texas 78235		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62703F 20770419, 77192003
11. CONTROLLING OFFICE NAME AND ADDRESS HQ Air Force Human Resources Laboratory (AFSC) Brooks Air Force Base, Texas 78235		12. REPORT DATE December 1982
		13. NUMBER OF PAGES 14
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS (of this report) Unclassified
		15.a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of this abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
computer-based personnel assignment	optimization	policy capturing
job assignment	Person-Job Match	policy specifying
job analysis	personnel assignment	utility functions
judgment modeling	personnel selection	
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
<p>This report describes the research to modify and generalize the algorithm used to classify enlisted recruits into first-term specialties. The algorithm used in the pre-enlistment classification system, called the Procurement Management Information System (PROMIS), was modified to include variables relating to the return on Air Force training investment and the recruit's vocational interest. This algorithm was generalized to the post-enlistment classification case by the inclusion of two more variables—an interviewer rating of the individual and the individual's preference for the job specialty. A joint working group composed of representatives from the Air Force Manpower</p>		

Item 20 (Continued)

and Personnel Center, Air Training Command, and the Air Force Human Resources Laboratory developed these algorithms, using an approach called Policy Specifying to model the payoff of each individual on each job. The pre-enlistment classification payoff algorithm was not implemented. The Air Training Command decided to replace the current post-enlistment classification system with the new post-enlistment algorithm and is in the process of implementation.

**GENERAL PURPOSE PERSON-JOB MATCH SYSTEM
FOR AIR FORCE ENLISTED ACCESSIONS**

By

**David K. Roberts, Capt, USAF
Joe H. Ward, Jr.**

**MANPOWER AND PERSONNEL DIVISION
Brooks Air Force Base, Texas 78235**

Reviewed by

**Nancy Guinn, Technical Director
Manpower and Personnel Division**

Submitted by

**J. P. Amor, Lt Col, USAF
Chief, Manpower and Personnel Division**

This is a Special Report prepared for the Air Force Manpower and Personnel Center.

PREFACE

This development supports Request for Personnel Research (RPR) 79-2, *Development of a General Purpose Person-Job-Match Model for Air Force Enlisted Accessions*. It was performed under work units 20770419 and 77192003, Development of the Enlisted Pipeline Management System (PMS) Person-Job Match (PJM). The work is a follow on to RPR 74-23 under work units 20770401 and 20770407 and supports the force acquisition and distribution system subthrust.

Many people have made valuable input to this effort. Major contributors from the user agencies were Maj Harry Haltman (MPCDDP), Maj D.J. Walen (MPCMS), Maj Larry Kurtz (MPCMO), Lt Scott McFarlane (MPCDD, earlier with AFHRL at Brooks AFB), Mr. Tom Beatty (MPCDDP), Maj Ben Varn (RSM), Mr. Bob Cantu (RSM), Lt Col Gordon Marham (CC/3507 ACS), Capt John Cleveland (3507 ACS), and Capt Keith Thurston (3507 ACS).

Contributors from the Air Force Human Resources Laboratory were Capt Jonathan Fast (Principal Investigator to August 1980), Mr. Manuel Pina, Capt Lynn Scott, Dr. Hendrick Ruck, SrA Tom Martin, Mr. Larry Whitehead, Ms. Janice Buchhorn, A1C Gregg Gilbert, A1C Laurel Popkin, and Sgt Susan Tobey.

TABLE OF CONTENTS

	Page
I. Introduction	5
II. Approach	5
Pre-Enlistment Classification Payoff Algorithm	5
Post-Enlistment Classification Payoff Algorithm	6
III. Results	6
References	7
Bibliography	7
Appendix A: Person-Job Match Variables	9

GENERAL PURPOSE PERSON-JOB MATCH SYSTEM FOR AIR FORCE ENLISTED ACCESSIONS

I. INTRODUCTION

This report addresses research and development (R&D) in response to Request for Personnel Research (RPR) 79-2, *Development of a General Purpose Person-Job Match Model for Air Force Enlisted Accessions*. Under this RPR, the Air Force Manpower and Personnel Center (AFMPC) and the Air Training Command Recruiting Service (ATC/RS) asked the Air Force Human Resources Laboratory (AFHRL) to modify and generalize the algorithm used by the Air Force to classify enlistees into their first term occupational specialties. This algorithm was imbedded in the Person-Job Match (PJM) portion of the Air Force Procurement Management Information System (PROMIS). AFHRL had assisted in the development of the original PJM algorithm under RPR 74-23, *Development of an Advanced PJM System for Air Force Enlistees for Use in the All-Volunteer Environment*. The development of this original PJM algorithm, implemented in November 1976, was documented by Hendrix, Ward, Pina, and Haney (1979). A major part of the RPR 74-23 effort was to model the Air Force payoff policy of classifying any given recruit into any given specialty. A policy modeling approach called Policy Specifying, discussed in Ward (1977), was used to develop part of the original algorithm.

After PROMIS was implemented in 1976, several needed improvements were identified. Through RPR 79-2, the Skills Management Branch, then identified as AFMPC/MPCMS, asked AFHRL to generalize the PJM classification algorithm to handle classifications of new recruits either before or after their enlistment. PROMIS had been designed to classify only the pre-enlistment recruits as part of the Recruiting Service's job reservation system. RPR 79-2 also called for the addition to the algorithm of new variables relating to the Air Force's return on training investment.

II. APPROACH

The major focus of RPR 79-2 was to modify the classification payoff algorithm, that is, the formula that assesses a single payoff value to each potential person-job combination. To do this, AFHRL supported a joint AFMPC-ATC-AFHRL working group by using Policy Specifying to model the group's classification payoff policy. Two separate but similar payoff algorithms were developed to classify pre-enlistment and post-enlistment individuals.

Pre-Enlistment Classification Payoff Algorithm

All of the variables originally included in the initial PROMIS system, such as job difficulty, individual aptitude, and rate of job fill, were also included in the new payoff algorithm (see Appendix A). The working group decided to add three variables concerning the cost of investing in each recruit:

1. Cost of Training
2. Loss Rate
3. Completion Probability

These new variables were included to ensure that placing a recruit with a small predicted chance of completing his first term into a specialty with a high cost of Training would receive a relatively low payoff, particularly if the specialty had experienced high attrition losses.

Since a measure of vocational preference was also advocated in RPR 79-2, the working group included in the algorithm the recruit's appropriate score on the Vocational Interest Career Examination (VOICE). The VOICE is a good predictor of job satisfaction (Alley, 1978). The VOICE score was to be included as a replacement for the individual's stated preference for one of the four enlistment aptitude areas (Mechanical, Administrative, General, or Electronic) when VOICE was approved for operational use.

The evaluation scheme for the new pre-enlistment classification algorithm was very simple. The working group selected several representative sets of individual cases and job data. AFHRL used the proposed algorithm to generate person-job payoffs for these sample profiles. As does PROMIS, each set of jobs for each person was rank-ordered, and presented to the working group. The working group representatives then took the sample profiles to their respective offices for review and comment. After any necessary changes, this working group review continued until there was a group consensus that these rankings were acceptable.

Post-Enlistment Classification Payoff Algorithm

All of the variables of the pre-enlistment algorithm were also included in the post-enlistment algorithm in the same Policy Specifying structure. Two additional variables, which are collected after the recruit's arrival at Basic Military Training (BMT), were also included (see Appendix A). The first variable was the Preference Match. The second variable was the trainee's rating by a classification interviewer on the trainee's general potential for success in the service. Both of these items were incorporated into the proposed algorithm according to the suggestion of the 3507 Airman Classification Squadron (3507ACS), which manages the post-enlistment classification system at BMT.

The 3507ACS also helped AFHRL design the tests of the proposed post-enlistment algorithm. For each of the four enlistment areas, a set of 10 representative specialties was chosen. Using a randomly selected set of 60 trainees for each area, the payoff algorithm was used to compute all the possible person-job payoffs. These 60 trainees were then classified into the specialties, using an optimization program (Langley, Kennington, & Shetty, 1974) to maximize the overall payoff sum. These four tests were repeated with 20 sets of 670 randomly selected trainees, with the main criteria, determined by the 3507ACS, being the preference matching and the priorities of the specialties being filled.

III. RESULTS

1. For a recruit with a small probability of completing his first term, the pre-enlistment algorithm ranked high cost/high loss jobs at the bottom of his list, all other variables held constant.

2. AFHRL delivered the pre-enlistment classification payoff algorithm by letter and computer documentation to AFMPC in January 1980.

3. In repetitive simulation situations, the post-enlistment algorithm filled the highest priority specialties before the lower priority ones and matched about 85% of the trainees' preferences. This compares to about 60% preference matching for the operational system in effect at that time.

4. AFHRL delivered the post-enlistment classification by letter and computer documentation to AFMPC in November 1979, with copies to the 3507ACS. ATC decided to use the algorithm to replace the current post-enlistment classification system, called the Processing and Classification of Enlistees (PACE). AFHRL provided extensive mathematical and computer programming support to the ATC Data Automation Directorate.

REFERENCES

- Alley, W.E.** *Vocational interest-career examination: Use and application in counseling and job placement.* AFHRL-TR-78-62, AD-A063 657. Brooks AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, October 1978.
- Hendrix, W.H., Ward, J.H., Jr., Pina, M., & Haney, D.L.** *Pre-enlistment person-job match system.* AFHRL-TR-79-29, AD-A078 427. Brooks AFB, TX: Occupation and Manpower Research Division, Air Force Human Resources Laboratory, September 1979.
- Langley, R.W., Kennington, J., & Shetty, C.M.** *Efficient computational devices for the capacitated transportation problem.* Naval Research Logistics Quarterly, Office of Naval Research, December 1974, **21**(4), 637-647.
- Ward, J.H., Jr.** *Creating mathematical models of judgment processes: From policy-capturing to policy-specifying.* AFHRL-TR-77-47, AD-A048 983. Brooks AFB, TX: Occupation and Manpower Research Division, Air Force Human Resources Laboratory, August 1977.

BIBLIOGRAPHY

- Black, D.E.** *Development of the E-2 weighted airman promotion system.* AFHRL-TR-73-3, AD-767 195. Lackland AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, April 1973.
- Bottenberg, R.A., & Ward, J.H., Jr.** *Applied multiple linear regression.* PRL-TDR-63-6, AD-413 128. Lackland AFB, TX: 6570th Personnel Research Laboratory, Aerospace Medical Division, March 1963.
- Christal, R.E.** *JAN: A technique for analyzing group judgment.* PRL-TDR-63-3, AD-403 813. Lackland AFB, TX: 6570th Personnel Research Laboratory, Aerospace Medical Division, February 1963.
- Christal, R.E.** *Selecting a harem-and other applications of the policy-capturing model.* PRL-TR-67-1, AD-658 025. Lackland AFB, TX: Personnel Research Laboratory, Aerospace Medical Division, March 1967.
- Gott, C.D.** *Development of the weighted airman screening system for the air reserve forces.* AFHRL-TR-74-18, AD-781 747. Lackland AFB, TX: Computational Sciences Division, Air Force Human Resources Laboratory, March 1974.
- Gustafson, D.E., Mehra, R.K., Ledsham, W.H., & Sajan, S.** *Recursive forecasting system for person-job match.* AFHRL-TR-79-83, AD-A090 499. Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory, September 1980.
- Koplyay, J.B.** *Field test of the weighted airman promotion system: Phase I. Analysis of the promotion board component in the weighted factors system.* AFHRL-TR-69-101, AD-689 751. Lackland AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, April 1969.
- Koplyay, J.B.** *Field test of the weighted airman promotion system: Phase II. Validation of the system for grades E-4 through E-7.* AFHRL-TR-69-102, AD-697 798. Lackland AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, May 1969.
- Koplyay, J.B.** *Extension of the weighted airman promotion system to grades E-8 and E-9.* AFHRL-TR-70-2, AD-703 687. Lackland AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, January 1970.
- Koplyay, J.B., Albert, W.G., & Black, D.E.** *Development of a senior NCO promotion system.* AFHRL-TR-76-48, AD-A030 607. Lackland AFB, TX: Computational Sciences Division, Air Force Human Resources Laboratory, July 1976.

- Martin, T.J.** *Person-job match: Aptitude-difficulty match analysis*. Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory. Unpublished manuscript, 1981.
- Mullins, C.J., & Usdin, E.** *Estimation of validity in the absence of a criterion*. AFHRL-TR-70-36, AD-716 809. Lackland AFB, TX: Personnel Division, Air Force Human Resources Laboratory, October 1970.
- Ruck, H.W., Edwards, J.O., Jr., & Hrymoc, G.R.** *The development of organizational effectiveness measures for security police units*. Paper presented at the 22nd annual conference of the Military Testing Association, Toronto, October 1980.
- Ward, J.H., Jr.** *Use of a decision index in assigning Air Force personnel*. WADC-TN-59-38, AD-214 600. Lackland AFB, TX: Personnel Laboratory, Wright Air Development Center, April 1959.
- Ward, J.H., Jr.** *Interaction among people characteristics and job properties in differential classification*. Paper presented at the 21st annual conference of the Military Testing Association, San Diego, October 1979.
- Ward, J.H., Jr., & Davis, K.** *Teaching a digital computer to assist in making decisions*. PRL-TDR-63-16, AD-407 322. Lackland AFB, TX: 6570th Personnel Research Laboratory, Aerospace Medical Division, June 1963.
- Ward, J.H., Jr., & Haltman, H.P.** *Computer-based enlistment quota reservation system using the general data management system 2000: Programming and implementation details*. AFHRL-TR-75-71, AD-021 340. Lackland AFB, TX: Occupational and Manpower Research Division, Air Force Human Resources Laboratory, December 1975.
- Ward, J.H., Jr., Haney, D.L., Hendrix, W.H., & Pina, M.** *Assignment procedures in the Air Force procurement management information system*. AFHRL-TR-78-30, AD-A056 531. Brooks AFB, TX: Occupation and Manpower Research Division, Air Force Human Resources Laboratory, July 1978.
- Ward, J.H., Jr., & Jennings, E.** *Introduction to linear models*. Englewood Cliffs, NJ: Prentice-Hall, 1973.
- Ward, J.H., Jr., Pina, M., Jr., Fast, J.C., & Roberts, D.K.** *Policy specifying with applications to personnel classification and assignment*. Paper presented at the 21st annual conference of the Military Testing Association, San Diego, October 1979.

APPENDIX A: PERSON-JOB MATCH VARIABLES

Original 1976 Implementation

Aptitude-Difficulty Component: match between specialty's difficulty and person's aptitude

Technical School Success Component: success predicted by—

- Armed Forces Qualifying Test Score
- Mechanical, Administrative, General, and Electronic composites of the Airman Qualification Examination (predecessor of the Armed Services Vocational Aptitude Battery)
- Graduation from High School
- Completion of Algebra, Geometry, Trigonometry, Physics, Chemistry, Biology, English

Area Preference Component: individual's stated preference for the appropriate enlistment aptitude area

Variable Fill Component: priority of the specialty, number of days remaining to fill the specialty, number of jobs remaining in the specialty, total number of jobs released for the specialty

Minority Fill Component: total number of jobs released for the specialty, number of minorities classified into the specialty, minority goal for the specialty

Proposed Additions for Pre-Enlistment and Post-Enlistment Classification

Cost of Training: specialty's cost from Air Training Command cost factors

Loss Rate: specialty's last-year attrition rate from AFHRL files

Completion Probability: individual's predicted probability of completing first term, based on age, test scores, high school courses (from Air Force Project IMAGE [Improved Minimum Airmen Guidelines for Enlistment])

VOICE Score: individual's VOICE score for the specialty

Proposed Additions for Post-Enlistment Classification

Preference Match: the degree to which specialty matches trainee's specialty preferences collected at BMT

Interviewer Rating: trainee's rating by a BMT classification interviewer on trainee's general potential for service success