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ABSTRACT

In the summer of 1996, the U.S. Armed Services will implement the computerized adaptive testing version of the Armed Services Vocational Aptitude Battery (CAT-ASVAB). When conversion is completed at the 65 targeted military entrance processing stations, about half the applicants will take this test version. This paper describes the efforts that led to the decision to implement the CAT-ASVAB, progress in its implementation, and the next steps in research on improvements in Department of Defense testing programs. The adaptive nature of the new format significantly reduces the time required to determine aptitudes of examinees as well as time to obtain official scores of record. Estimation of potential cost savings led to the decision to implement the computerized version. Hardware and software requirements were determined, and the adaptive version of the test, which allows items to be presented to the applicant based on his or her success in answering previous questions, was developed. If implementation progresses as expected, use of the computerized test will be expanded to other military evaluation sites. (Contains two references.) (SLD)

IMPLEMENTATION OF THE COMPUTERIZED ADAPTIVE VERSION OF THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY

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Implementation of the Computerized Adaptive Version of the Armed Services Vocational Aptitude Battery[1]

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In the Summer of 1996, aptitude testing for enlistment in the Armed Services of the United States is going high-tech with the implementation of the computerized adaptive testing version of the Armed Services Vocational Aptitude Battery (CAT-ASVAB). When the conversion is complete at the 65 Military Entrance Processing Stations (MEPS), approximately half of all applicants will be tested with the CAT-ASVAB. CAT-ASVAB provides numerous advantages over the current paper-and-pencil (P&P) lock-step administration of the battery, including shorter testing time, increased test security, decreased test development costs, flexible start times, and immediate availability of scores. This paper will describe the efforts that led to the decision to implement CAT-ASVAB, the progress in implementation at the MEPS, and next steps in research on improvements in the Department of Defense (DoD) testing programs.

Background

ASVAB. The ASVAB is a multiple aptitude battery used by the Military Services to determine the enlistment eligibility of applicants and to assign qualified applicants to military occupational specialties. The ASVAB is administered at 65 MEPS, where other aspects of enlistment processing also are conducted, and at about 700 Mobile Examining Team (MET) sites, located nearer to the applicant, where only ASVAB testing is conducted. Over 600,000 tests are administered annually in MEPS and MET sites.

P&P and computer adaptive versions of the ASVAB are available for administration at the enlistment testing locations. The primary mode of ASVAB administration is lock-step as a P&P test. In P&P mode, the ASVAB requires about three and one-half hours to administer in P&P mode and is scored by an optical mark reader (OMR). The score sheets from tests administered at MET sites must be physically transported to MEPS for official scoring, delaying the receipt of official scores by one to three or more days.

The CAT-ASVAB is adaptive in that items presented to the applicant depend on the applicant's success in answering previous questions. The adaptive nature of the test significantly reduces the time required to determine aptitudes of examinees and time to obtain official scores of record. On average, examinees can complete the CAT-ASVAB in less than two hours. This reduction in testing time, in comparison with the P&P test, combined with reduced costs for computers has made CAT-ASVAB a viable alternative to P&P testing. At this time, the CAT-ASVAB is administered in five of the 65 MEPS and at one MET site location as part of an operational test and evaluation (OT&E).

[1] Presented at the National Council on Measurement in Education, New York City, April 1996

Review of the Enlistment Testing Process. About five years ago, the ASVAB Review effort was initiated to review the total enlistment processing system with an emphasis on aptitude testing, namely the administration, content, and scoring of the ASVAB in the ETP. The purpose of the ASVAB Review was to develop and evaluate various ASVAB alternatives and to make recommendations based on cost, technical, and policy considerations.

The initial step to identify alternative testing concepts was to review current aptitude processing and identify strengths and weaknesses. An analysis of the current aptitude processing, presented in detail in Hogan and Mullin (1993), found the system to operate reasonably well at relatively low capital costs plus testing capacity can be expanded rapidly with minimal expenditure. Hogan and Mullin identified a few areas for potential improvement. One of these is the length of the P&P battery, which at three and one-half hours may prevent some prospects from applying, does reduce the efficiency of recruiters who wait while their applicants take the test, and causes most MEPS processing to take two days or more. A second area is the lag time between test completion and availability of official scores; this further reduces recruiter efficiency, and may cause some applicants to lose their motivation to enlist. The third area is the rigidity in processing. The P&P ASVAB is administered lock-step with separately timed tests. Applicants who arrive late to a test session (after testing has begun) are not allowed to test and must be rescheduled; the time of the applicant and the recruiter who brought the applicant to testing and travel costs are wasted in this situation.

Although a large number of operational changes were initially considered, the list was reduced to eight options that included various combinations of two kinds of changes: 1) automation of some or all of the aspects of test administration and scoring through the use of computers or digital response testing (DRT) pads and 2) expansion of MET site concepts to include ASVAB administration in commercial testing centers (CTCs) staffed by contractor personnel. DRT pads are hand-held touchpads the size of large calculators, are used by examinees to record their answers, and can be hooked up to modems to transmit raw item responses to a central location for scoring. Contract test centers are commercial facilities that administer primarily computer-based tests. Over the past few years, the number of commercial testing facilities has grown and some companies have hundreds of testing sites available throughout the country. For more information on the process to identify alternative testing concepts see McBride (1993).

All of the concepts involving computerized testing in the MEPS resulted in net savings. Table 1 presents savings and costs associated with implementing CAT-ASVAB at the MEPS. Experience with the OT&E of CAT-ASVAB in the MEPS convinced policymakers that the concepts being evaluated were, in fact, feasible, and that the results reasonably represented likely costs and benefits. On 13 May 1993, the Manpower Accession Policy Steering Committee (MAPSC) approved plans to implement CAT-ASVAB in all MEPS as soon as possible and to continue research on automating testing at MET sites.

Table 1: Key Costs and Savings from Implementation of CAT-ASVAB at MEPS

Cost and Savings Categories	Amounts
Estimated Annual Costs of Implementing: (Equipment, Training, Site Mods)*	$ 660,000
Estimated Annual Savings	
From Reduced Meals and Lodging:	$2,000,000
From Reduced Administration Costs: (includes scanning)	$ 300,000
From Reduced Printing and Scoring Costs:	$ 400,000
From Increased Recruiter Efficiency:	$1,000,000
From Reduced Test Development Costs:	$ 50,000
ANNUAL TOTAL FOR KEY SAVINGS:	$3,750,000
Estimated Annual Net Savings:	$3,090,000

*Note: assumes a five-year life cycle for computer hardware.

Progress in Implementation

Since the MAPSC decision to implement CAT-ASVAB in the MEPS, notable progress has been made in planning and executing implementation steps. The steps fall under the general categories of 1) hardware purchase and set-up, 2) equating of new hardware, and 3) administration plan. Each will be described in turn along with corresponding progress.

Hardware Purchase and Set-up. To determine the amount of money that would be required and to initiate the purchase of the computers, the first step in the implementation planning process was to address equipment specifications and quantity requirements. The computer specifications were defined by memory requirements of the adaptive testing system, the desire to use the computers in a networking mode within a MEPS, plus the requirement to have the CAT-ASVAB testing system interface with the information management system in use at the MEPS. Minimum requirements for desktop computers for the MEPS include the following specifications: 80486 (Intel or Intel Compatible) microprocessor with 25 Mhz, 4MB RAM, VGA color monitor with 14 inch CRT, extended graphics resolution modes (640 X 480 pixels), .28 mm dot-pitch, and video adapter (512 Kb Video RAM); and 3.5" 1.44 Mb high density floppy disk drive and 40 Mb internal hard disk drive.

The numbers of computers needed at each MEPS were determined based on P&P testing session sizes. The distribution of testing sizes for each MEPS for a fiscal year were analyzed, and the testing session sizes at the 75th percentile was used as a conservative

estimate of the required number of computers. On average, about 20 computers per MEPS are required, for a total of around 1,400.

Besides hardware and software costs, costs associated with equipment maintenance and the upgrading of MEPS facilities to accommodate a computerized testing platform needed to be considered. To address the facilities issue, the Military Entrance Processing Command conducted a site survey of the MEPS. Results of the survey indicated that electrical upgrades and the purchase of tables and chairs would be required at the sites. In all, costs for the equipment, maintenance of the equipment, furniture, and upgrades of testing facilities will be about $3.3 million.

One of the most critical steps in the implementation was acquiring the funding to pay for all the costs associated with fielding CAT-ASVAB. A small amount of funds were expended in FY 1995 to begin the electrical upgrades of the MEPS. The bulk of the funds were acquired this year. Plans are to conduct a phased implementation of CAT-ASVAB over a six month time period beginning this fall. In the first phase, computers will be implemented at 20 MEPS locations. Four teams of staff members from the Defense Manpower Data Center will set-up the computers and provide training to MEPS personnel on computer set-up and administration of the CAT-ASVAB.

Equating of New Hardware. In a hardware effects study conducted by the Navy Personnel Research and Development Center (NPRDC), it was observed that some of the tests on the CAT-ASVAB (the speeded tests, in particular) were sensitive to differences in computer hardware. Specifically, scores on Numerical Operations and Coding Speed when using desktop computers differed significantly from scores obtained using notebooks. Since new and better equipment will be purchased for implementation, new conversion tables based on the equating of new hardware to the P&P ASVAB (the reference version) must be accomplished. Current conversion tables that equate CAT-ASVAB to P&P ASVAB scores are based on use of Hewlett-Packard machines and therefore can't be used for the new equipment. NPRDC is in the process of conducting an equating on desktops, similar to what will be used in the MEPS, and notebooks, which potentially will be used at MET sites. The data collection is complete and data analyses and development of new conversion tables are underway.

Administration Plan. With the implementation of CAT-ASVAB, administration conditions (test instructions and timing) will be completely standardized. Administration will also be completely individualized so examinees can start whenever a machine is available and move at their own pace throughout the examination. Because of the adaptive nature of the test, it will be more engaging, with a minimum of questions that are too difficult or too easy. Scores will be immediately available and will be free from errors associated with marking and scanning answer sheets. Printed test booklets will be eliminated and test security will be correspondingly increased.

Experience with CAT-ASVAB has shown that the most preferable option for CAT-ASVAB administration includes a flexible start window. CAT-ASVAB

administration in the OT&E involves a two hour window in which examinees arrive for testing. This is an advantage over P&P testing which is lock-step in its administration; examinees who do not arrive in time to begin a P&P test are turned away. With a two hour window in a four hour testing session (approximately the time allowed for P&P testing), two seatings of the CAT-ASVAB test can be accomplished, thereby enabling the testing session to accommodate twice as many applicants in a day.

In the CAT-ASVAB OT&E, the computers examinees use to take CAT-ASVAB are set up in a network with a test administrator (TA) station. The software is designed to operate in stand-alone mode if the network fails. The network mode enables the TA to randomly assign examinees to test stations, track the progress of examinees, and download and print test scores. Immediate feedback of test scores is provided to applicants and recruiters after testing. This is a distinct advantage over the P&P ASVAB where answer sheets are scanned and scored overnight and scores are provided to the applicant and recruiter the day after testing. The same administration arrangement, as in the CAT-ASVAB OT&E, will be continued after implementation with the new hardware.

Next Steps

Further research is continuing in the development and evaluation of alternatives to the current method of enlistment testing, paper-and-pencil administration, at the MET sites. The MET site alternatives to paper and pencil testing are similar to the ones used for implementation at the MEPS: CAT-ASVAB and DRTs. CAT-ASVAB could be administered at MET sites using notebook or desktop computers, or at CTCs. Another option is to remain with paper-and-pencil administration.

Implementation of automated ASVAB testing in the MET sites raises issues not associated with implementation at the MEPS, such as storage and set-up of computers, transportation of equipment, availability of an adequate electrical supply, and availability of a telephone for data communications. While MEPS are permanently established, MET sites generally are not; rather a site may be a room in a National Guard Armory, a Post Office, or even a hotel, for example. Furthermore, MET sites differ substantially among themselves; thus, a reasonable option for one site may be unworkable at another.

There are two phases in the project to develop and evaluate alternative MET site concepts. The first phase is to conduct feasibility studies of various alternatives. The MET sites, unlike the MEPS, vary in terms of their operating hours and facilities. Some MET sites have high flow rates and are open once a week. Other MET sites do not test as many people and are open once or twice a month. To learn more about whether computerized or digital response testing would be feasible at MET sites, the MEPCOM conducted a site survey of the MET sites to determine each MET site's accommodations and hours of operation. In terms of facilities, the MET sites vary significantly in the availability of telephone lines, number and type of electrical outlets, accessibility (distance of testing room from parking, need to walk up stairs, etc.), type of furniture, availability of

storage, etc. Also, the number of MET sites can vary from week to week, MET site locations change frequently, and the flow rates through the sites are not as predictable.

To develop accurate estimates of costs associated with various MET site alternatives, the second phase of the effort will try out the various alternatives and will provide an empirical basis upon which to estimate the costs. Although a particular concept may be feasible, it may not be cost effective when implemented. Therefore, a pilot test of computerized and digital response testing and CTCs is necessary to accurately evaluate alternative concepts. As there are about 700 MET sites, it is not feasible to try out various testing alternatives at all of the sites. Therefore, a representative sample of MET sites will be selected in which to conduct the studies. This test will determine the effect of the new testing MET site alternative on travel costs, recruiter behaviors in taking the applicants to various testing locations, and applicant behaviors in willingness to take the ASVAB, or on possible restructuring of the number and locations of MET sites. Ultimately, the cost benefit evaluation of the MET site alternatives will enable DoD policymakers to weigh the advantages and disadvantages of various test administration media against associated costs to make a decision as to which alternative or combination of alternatives will be used in future MET site testing operations. This cost benefit evaluation is scheduled to be completed early in 1997.

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