

Aeromedical Research Resume
Research Project Description Task for FY2000

1. Title: ATS Workforce Analysis and Selection Requirements	2. Sponsoring Organization/Focal Point (FP) ARX-1; J. Staples AAM-1; J. Jordan, M.D. ARX-20; S. Pansky (FP) AAR-100; L. Cole	3. Originator Name, Organization, Phone : Dana Broach, Ph.D. Michael Heil, Ph.D. AAM-520 (405) 954-6840
		4. Origination Date: October 1, 1998
5. Parent RPD Number: 586	6. Task Number: AM-B-00-HRR-517	7. Completion Date: September 30, 2001
8. Parent MNS: ATS Human Factors	9. RPD Manager Name, Organization, Phone: David J. Schroeder, Ph.D. (AAM-500) FAA Civil Aeromedical Institute (405) 954-4846	
10. Research Objective(s): <p>To develop and validate personnel selection criteria and tools to support near-term (FY1999 - FY2001) hiring requirements for the air traffic control specialist (ATCS; FG-2152), environmental and electronics technicians (ET; FG-0802 and 0856), and airway transportation systems specialist (ATSS; FG-2101) occupations.</p> <p>To develop a prototype methodology and tool for identification, description, and analysis of gaps between current and future ATS workforce knowledge, skill, and ability (KSA) and staffing profiles required under the <i>ATS Concept of Operations</i>, proposed <i>NAS Architecture v4.0</i>, and Free Flight Phase I.</p>		
11. Technical Summary: <p>The current controller, technician, and systems specialist ATS workforce was selected on the basis of the KSAs required to operate, maintain, and manage today's NAS architecture. However, the emerging modernized NAS envisioned under the <i>ATS Concept of Operations for the National Airspace System in 2005</i>, Free Flight (Phase I), and the proposed <i>NAS Architecture v4.0</i> may require new KSAs of controllers, technicians, and systems specialists. This research focuses on identifying gaps between current and future ATS workforce KSA and staffing profiles and the development of validated selection processes to reflect those KSA requirements for the ATS technical workforce. The tools and methodologies of workforce planning, job analysis, job performance measurement, test validation, and utility analysis will be applied in this task to (a) develop a methodology and tool for the identification, description, and analysis of gaps between current and future ATS workforce KSA and staffing profiles, and (b) develop, validate, and evaluate selection criteria based on continuing and new KSA requirements associated with the modernized NAS for the ATCS (FG-2152), ET (FG-0802/0856), and ATSS (FG-2101) occupations.</p>		

12. Resources Requirements:	<u>FY 99</u>	<u>FY 00</u>	<u>FY 01</u>
FAA Staff Years	5.0	5.0	5.0

13. Description of Work:

(1) Brief Background

FAA must replace controllers, technicians, and systems specialists who attrite from the workforce through retirement in the near-term (FY2000 - FY2002). GAO projected 237 ATCS retirements in FY2000 and 270 in FY2001. FAA agreed to a staffing level of 15,000 controllers in the terminal and en route facilities in the FAA-NATCA 1998 contract. With projected retirements of about 200-300 controllers in FY2000 and FY2001 and beyond, an equal number of new controllers each year will be needed to maintain the negotiated target workforce staffing levels, apart from any growth required to accommodate increased traffic operations. Similarly, about 350 new technicians were hired in FY1999 to replace retiring technicians in FY1999. Projected AF technician retirements in FY2000 are 272 and 234 in FY2001, indicating a continuing need to hire about 250 new technicians per year to maintain target field maintenance workforce staffing levels. With more applicants likely than positions to be filled, FAA will require validated criteria to select the few that possess the appropriate knowledge, skill, and ability (KSA) profiles from among the many applicants. This research specifically addresses this requirement for validated near-term hiring tools. Previous selection research by CAMI in cooperation with ATS resulted in the development and initial validation of new computer-based applicant screening [Airway Facilities Centralized Applicant Pools System (AFCAPS)] and modular, computer-administered KSA testing for ATS [e.g., the Airway Facilities Basic Electronics Screening Tool (AF/BEST) and Air Traffic Selection and Training (AT-SAT) batteries]. Additional near-term (FY2000-2001) research is required to (a) develop an ATCS applicant screening tool, (b) conduct longitudinal validation of the selection processes in accordance with the Civil Rights Act (42 **USC** 2000) and Uniform Guidelines on Employee Selection Procedures (29 **CFR** 1607), (c) develop parallel forms of the instruments to provide test security and protect their utility and validity, and (d) investigate the effects of coaching and practice on test scores and validity, and develop methods for mitigating those effects.

Over the longer-term, the FAA will continue to modernize the NAS under the ATS *Concept of Operations for the National Airspace System in 2005* and the *NAS Architecture v4.0*. The Administrator's 1998 NAS Modernization Task Force identified a need to identify, describe, analyze, and resolve gaps between current and future workforce KSA and staffing profiles in that modernization effort. The NAS Sustainability Core Team recommended that workforce analysis be integrated into the FAA Acquisition Management System (AMS). However, such workforce analysis tools, to address staffing, hiring, training, and KSA profiles, are not currently available in the FAA. This research specifically addresses the requirement to develop a prototype workforce analysis tool and approach. Research by CAMI in cooperation with ATS began in FY1999, by building on the NAS Modernization Task Force results to identify the baseline KSA profile for the Airway Facilities field maintenance workforce.

(2) Statement of Work

Task 1: Develop and validate computerized application evaluation systems with standardized rating and ranking algorithms for ATCS, ET, and ATSS occupations within ATS. These application systems are the first phase of selection. They provide a tool for evaluating large numbers of applicants quickly and efficiently against occupational qualification standards. For example, the AFCAPS application form and computerized scoring, rating, and ranking algorithm were developed by the CAMI Selection and Validation Team in 1996 and 1997. AFCAPS also provides the capability to make tentative grade determinations on the basis of education, training, and experience. Only candidates who qualify for the grade being hired are then referred to the next phase of more intensive, and expensive, formal testing of electronics skills and knowledge. A longitudinal evaluation of the fairness, reliability, validity, and effectiveness of AFCAPS is required under 42 **USC** 2000 and 29 **CFR** 1607; this research will specifically

Statement of Work (Continued)

address that mandated, legal requirement. Research to support the longitudinal evaluation of AFCAPS includes (1) development of an AF applicant data base, (2) development and collection of training and job performance criteria, and (3) analyses of the technical characteristics of AFCAPS as a predictor of those job-related criteria. Other AF research includes (1) the identification of successful applicant profiles to support recruitment and (2) investigation of the incremental validity of alternative predictors such as biodata and temperament. AT intends to implement a similar approach called AT/CAPS for evaluation of candidates relative to basic occupational qualification standards. However, under AT/CAPS, applicants meeting basic qualifications will be referred on the basis of a lottery to the more intensive and expensive formal testing of required cognitive aptitudes. Such an approach does not take into account applicant training, education, experience, and other biographical characteristics that are predictive of success in training and on the job, and that might be inexpensively assessed at the time of application. This research proposes the development and validation of a biographical assessment of applicants within AT/CAPS to improve the efficiency and effectiveness of the ATCS selection system.

Finally, an assessment of applicant temperament and stability is required under the medical standards for the ATCS occupation. An empirical evaluation (Schwarzkopf, Buckley, & Pace, 1996) of the current narrowly-focused assessment process concluded that it has some utility, but that recent advances in personality theory and assessment might provide a basis for a broader and more useful assessment approach. Research on the stability of personality, the impact of self-presentation tactics on the assessment, and the relationship of the assessment to ATCS performance and other job-related outcomes is required to identify and develop assessments of applicant temperament and emotional stability to support the future concepts of operation in the modernized NAS architecture.

Task 2: Develop technical refinements to and conduct longitudinal validations of prototype modular, computer-based selection tests for near-term hiring into the ATCS, ET, and ATSS occupations within ATS. Modular, computer-based tests such as AT-SAT (Air Traffic Selection and Training) and AF/BEST (Airway Facilities Basic Electronics Screening Tool) serve as the second, intensive, and much more expensive, assessment of job-related knowledges, skills, and abilities. Longitudinal studies of the fairness, reliability, and validity of the prototype batteries are required under 42 USC 2000 and 29 CFR 1607. This research proposes development of the required longitudinal databases, job performance criteria, and studies required to fulfill this mandated, legal requirement for selection tests. In addition, parallel forms of the batteries are required to ensure test security over repeated administrations. The Variable Item Generator (VIGOR) procurement is intended to develop the technology for on-line generation of test items assessing electronics knowledge and skill. The result will be a unique test for each applicant, regardless of number of times tested, that is equivalent to and parallel with the test given to any other applicant. The VIGOR technology can be adapted for some components of the AT-SAT battery as well; however, other AT-SAT components will require a more traditional approach to parallel form development. This research specifically addresses the requirement for parallel forms and other technical improvements of the test batteries to ensure their viability, security, and ease of administration and management.

Task 3: Develop a prototype workforce analysis application, for identification, description, and analysis of gaps between current and future workforce KSA and staffing profiles in the NAS architecture. As documented by the NAS Sustainability Core Team report (1998) and the Administrator's NAS Modernization Task Force, workforce planning issues such as staffing, hiring, training, and KSA profiles have not been addressed in a systematic manner in the identification of mission needs, comparison of investment alternatives, and implementation of solutions to those mission capability shortfalls. Nor have the changes in workforce KSA and staffing profiles resulting from new technology implementations or proposals been systematically tracked for long-range impacts on staffing, hiring, and training. Development of such a workforce analysis tool, for integration in the AMS, requires development

Statement of Work (Continued)

of detailed and specific current job and incumbent workforce KSA and staffing data bases. In addition, such workforce analysis requires a methodology for identifying and evaluating changes in KSA and staffing profiles resulting from new technologies or changes in mission requirements. Moreover, future KSA and staffing profiles will be significantly influenced by factors such as retirements and age-related changes in cognitive abilities and temperament.

The CAMI Selection and Validation Research Team directed the initial development of a strategic job analysis methodology in 1997. This research proposes to refine, extend, and validate that methodology as a prototype tool for integration into the AMS in 3 major work elements: (a) development of the software tool itself; and (b) development of the data required to populate the prototype tool; and (c) integration and testing of the software with data. Development of the data to populate the prototype tool will include research to (1) establish baseline KSA requirements for the current NAS architecture for selected ATSS occupations, (2) evaluate the impact of new technologies on ATCS, ET, and ATSS KSA requirements, (3) initiate investigation of the relationship of workforce aging to staffing profiles, changes in cognitive abilities and temperament, and assessment and accommodation strategies, and (4) develop procedures and methods for conducting an inventory of relevant workforce KSAs.

14. Intended End Products/Deliverables:

Application forms and scoring algorithms for automated, standardized scoring, rating, and ranking of applicants to the ATCS, ET, and ATSS occupations on the basis of training, education, experience, and other biographical characteristics.

Modular, computer-administered tests of job-relevant KSAs, with parallel forms, for the ATCS, ET, and ATSS occupations.

Selection test reliability, fairness, and validity reports in accordance with 42 **USC** 2000 and 29 **CFR** 1607.

Prototype, computer-based workforce analysis methodology and databases to support the identification, description, and analysis of gaps between current and future workforce KSA and staffing profiles.

15. Schedule/Milestones:

	<u>FY99</u>
Prototype AF applicant database for longitudinal validation of AF/BEST	Completed Q3
Workforce analysis baseline KSA-by-job matrices for selected ATS occupations	Contract awarded Q3 for AF
	<u>FY00</u>
Variable Item Generator (VIGOR) technology integrated with AF/BEST for on-line generation of test items	Q2
Workforce analysis future KSA-by-job matrices for selected NAS modernization projects and ATS occupations	Q4
	<u>FY01</u>
Prototype AT/CAPS standardized rating and ranking system	Q2
AT-SAT parallel form	Q2
Terminal Computer-Based Performance Measures	Q3
Inventory of current workforce KSAs relative to future requirements in selected ATS occupations	Q3
Technical evaluation reports on entry-level ATS selection procedures in accordance with 42 USC 2000 and 29 CFR 1607	Q4
Prototype workforce analysis tool for initial integration into AMS	Q4

16. Procurement Strategy/Acquisition Approach/Technology Transfer:

If fully funded, contractual vehicles such as the AHR Multiple Services (Operations/Analysis), GSA Management, Organizational and Business Services (MOBIS; <http://pub.fss.gsa.gov/services/mobis-html>), DOT Information Technology Omnibus Procurement (ITOP; <http://itop.dot.gov>), the GSA Information Technology Services (FEDSIM; <http://www.gsa.gov/iti/swmgmt2.htm>) contracts, or other procurement vehicle will be used to:

(a) Refine, validate, and extend the current, baseline NAS controller, technician and systems specialist KSA-by-job and staffing profiles developed by NAS Sustainability Core Team in FY1998 (awarded Q3 FY1999);

(b) Refine, test, and apply strategic job analyses methodologies developed in FY1997-1998 to validate and extend future KSA-by-job and staffing profiles associated with new ATC and infrastructure management technologies and systems (FY2000);

(c) Inventory current target workforce KSAs relative to future KSA requirements, and populate prototype workforce analysis tool with data developed in (a) and (b) above and current workforce KSA data (FY2001);

Procurement Strategy/Acquisition Approach/Technology Transfer (Continued):

- (d) Develop terminal computer-based performance measures to support AT-SAT longitudinal validation (FY2000);
- (e) Develop parallel forms for the AT-SAT v1.0 test battery (FY1999); and
- (f) Develop AT and AF training and performance databases to support longitudinal validation of screening and testing procedures (FY1999).

No major equipment acquisition (\$5,000 or more) is anticipated for this project.

Technology transfer will be made available through the scientific media, direct briefings, and existing FAA structures. Transfer of FAA ATCS selection technologies to foreign countries will be accomplished through appropriate international agreements.

Data and products resulting from this research sub-task have application to other lines of research. For example, data describing the baseline and future job profiles can be used as a basis for identifying potential controller, technician, and systems specialist individual and team job performance measures. Such measures can be used to compare alternative systems designs to one another and the existing baseline. Similarly, the baseline and future KSA matrices can provide a basis for training requirements to support the transition to the modernized NAS.

17. Justification/History:

The requirement for a methodology to identify, describe, and analyze gaps between current and future workforce KSA and staffing profiles was identified in late 1997 by the Administrator's NAS Modernization Task Force ("#11: Develop an overall agency plan to resolve future workforce issues as the NAS modernizes: Retention, Training, Technical Competencies, Skills, Hiring, Outsourcing, Software Maintenance"). Further work by the NAS Sustainability Core Team in Q2 FY98 defined the basic approach and framework for gap analysis, and recommended integration of workforce analysis into the FAA AMS.

Moreover, P.L. 100-591 ("Air Traffic Controller Performance Research") called for FAA research on "(T)he attributes and aptitudes needed to function well in a highly automated air traffic control system, and development of appropriate testing methods for identifying individuals possessing those attributes and aptitudes." This represents an on-going research requirement as future operations concepts such as Free Flight and phased modernization emerge and evolve.

In the near-term, ATS must replace controllers, technicians, and systems specialists that attrite from the workforce through retirement, death, transfer, and promotion between FY 1999 and FY 2001. Therefore, ATS will require valid and legally defensible selection procedures to systematically assess applicants in order to select the few from among the many that possess the appropriate knowledge, skill, and ability (KSA) profiles to succeed in occupational training and/or on the job.

Those selection tools must be reliable and valid by federal law, regulation, and agency policy. Fairness in selection is an issue under civil rights law (29 **CFR** 1607 and 42 **USC** 2000), departmental and agency performance goals, and for agency employee and external interest groups. This systematic, longitudinal research will evaluate the reliability, validity, fairness, and utility of ATS workforce selection procedures, and identify changes in KSA profiles associated with new NAS technologies so that ATS selection procedures continue to evolve in parallel with changing job requirements.

17. Justification/History (Continued):

These requirements are summarized in the FY2000 ATS Human Factors Research Project Description which calls for the development and delivery of "Selection methodologies, guidelines, and criteria for NAS personnel."

18. Issues:

This research will require collection of controller and technician training and on-the-job performance data for research purposes only; therefore, formal coordination with employee bargaining agents will be required. The research will be conducted in accordance with the Department of Health and Human Services *Federal Policy for the Protection of Human Subjects* (45 CFR 46) and the American Psychological Association *Ethical Principles of Psychologists and Code of Conduct*. Research data collection protocols will be submitted to the FAA Institutional Review Board (IRB) for approval.

19. Transition Strategy:

Transition to implementation will be made directly through agency clients because prototypes in this technological area become the end product. For example, the current and future workforce baseline and future KSA-by-job matrix data will be used to populate the workforce analysis software to be procured by Airway Facilities Resource Management Directorate (AFZ). Parallel forms of the AT-SAT will be directly delivered to the program office responsible for management, oversight, and execution of the controller selection process. The VIGOR technology will be directly integrated into the AF/BEST software at the contracted testing centers under the oversight of the AF Staffing and Compensation Policy Division (AFZ-200).

20. Impact of Funding Deferral:

Without tools to analyze and forecast future selection requirements, ATS will not have sound information as the basis for the development of appropriate employee selection tools to replace the current generation of employees as the NAS is modernized. Failure to validate and incrementally improve the predictive utility of the next generation of selection tests will result in continued avoidable costs through false positives (e.g., persons hired on the basis of testing that go on to fail or perform poorly). Failure to develop parallel forms will result in significant risk of test compromise and score inflation, resulting in poorer quality hires and their associated avoidable costs. Moreover, failure to validate and evaluate those selection tools exposes ATS to significant, and avoidable, legal risks. Finally, failure to evaluate the fairness of ATS workforce selection tests preclude an assessment of the degree to which selection contributes (or not) to the FAA goal of reducing minority and female under-representation as compared to previous Affirmative Employment Program results in safety-related occupations.

21. R&D Teaming Arrangements:

CAMI works closely with cognizant management teams throughout the agency, particularly the Air Traffic and Airway Facilities services. CAMI collaborates with international research laboratories and operating organizations (e.g., EuroControl, Netherlands, Sweden, Russia, Canada, Germany) to support common employee selection standards in an increasingly globalized aviation system. CAMI collaborates with other United States federal laboratories (e.g., USAF, USN) and centers of excellence when it appears that such collaboration will further mission objectives.

22. Special Facility Requirements:

CAMI facilities are sufficient.

23. Approvals (Signature Authority):	Project Revalidation	Performing Organization
<hr/> John Staples Director, Plans and Performance Directorate (ARX-1)	<hr/> <i>Date</i>	<hr/> William E. Collins, Ph.D. Director, FAA Civil Aeromedical Institute, (AAM-3)
<hr/> Jon L. Jordan, M.D. Federal Air Surgeon (AAM-1)	<hr/> <i>Date</i>	<hr/> Date