A STUDY OF THE QUALITY AND EFFECTIVENESS OF THE AIRWAY SCIENCE ELECTRONIC SYSTEMS PROGRAM TO MEET THE WORKFORCE NEEDS OF THE FEDERAL AVIATION ADMINISTRATION

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

Man's dream of flight preceded its accomplishment by thousands of years. The tale of Daedalus and his son Icarus is an example of such dreams. They were imprisoned on the island of Crete and came up with the idea of flying like birds to Greece. They attached feathers to their arms with wax and began their flight. Daedalus warned Icarus against flying too high but the youth went higher and higher until heat from the sun softened the wax. The feathers loosened and came free. Poor Icarus fell to his death. Daedalus succeeded in reaching the mainland, the fable relates (Bruce, 1988).

Dreams of flight gave way to actual machines that could fly in the air. Wilbur and Orville Wright put together the Wright Flyer and on December 17, 1903, Orville Wright piloted the airplane off the ground for a distance of 120 feet.

Aviation has progressed a long way since the 120-foot flight by Orville Wright at Kitty Hawk, North Carolina, and since the first United States airline began operating between Tampa and St. Petersburg, Florida, on January 1, 1914. Today supersonic aircraft fly routinely across the ocean and more than two million people are employed in aviation, aerospace, and air transportation.

The Federal Aviation Administration (FAA) is charged with the responsibility of administering the world's busiest civil aviation system. In a single day, air traffic

controllers handle upwards of 200,000 takeoffs and landings at airports across the nation. They are responsible for the safety of half a billion passengers a year. During the same time period, other FAA specialists perform 30,000 security inspections and assessments, host more than 5,000 safety seminars, and conduct 300,000 safety inspections of airlines and aviation activities (This is the FAA, 1990).

The FAA's mission is clear and direct:

1. To ensure the safe and efficient use of the nation's airspace.
2. To foster civil aeronautics and air commerce in the United States.
3. To support the requirement of national defense (This is the FAA, 1990).

Vital to the safe and continuous operation of the air traffic control systems is a group of Federal Aviation Administration specialists known as electronics and environmental technicians working in the field of avionics (Cundy & Brown, 1997). These are the skilled professionals who instruct, install, monitor, and repair all of the sophisticated equipment that makes the air traffic control system the safest in the world. Other than the air traffic controllers, the FAA's technical work force is composed primarily of electronics technicians and engineers in various specialties. These personnel develop, modify, and maintain ground structures, communication radars, navigational aids, and a multitude of automated systems needed in the National Aerospace System (NAS) (This is the FAA, 1990, p.20).

The FAA initiated the Airway Science program that represents a joint endeavor between the FAA and the University Aviation Association (UAA) to develop and institute a unique college curriculum (Careers, 1983). As part of the Airway Science program, the FAA developed a separate selection strategy referred to as the Airway Science Register

(FAA Guidelines for an Airway Science Curriculum, 1989). Candidates qualify for this register if they have received an Airway Science degree from a recognized program. These qualification requirements differ from those traditionally used to select candidates into the FAA fields of electronics technicians. The traditional FAA electronics technician candidates are military trained. In recent years, the military has cut back in recruitment, which resulted in a shortage of military trained electronics technicians. Therefore, this study was needed to examine whether people hired via the Airway Science Electronics System selection program differ in any respect from those hired by the FAA's more traditional methods of selection.

Statement of the Problem

The FAA developed a demonstration project known as an Airway Science program. The program was to test the impact of an Airway Science degree dealing with the constantly changing technological and human resource requirements within the aviation field. From the time the FAA began looking at the academic community to prepare the technically trained people needed in aviation careers, questions have been asked about the program's success.

Purpose of the Study

The purpose of this study was to determine the quality and effectiveness of the "airway science Electronics systems program" designed to meet the workforce needs of the FAA. The study was designed to research and compare traditional FAA hired

electronics technicians and Airway Science degree graduate electronics technicians hired by the FAA.

Research Objectives

The objectives of the study were:

1. To compare traditional electronics training course requirements to the Airway Science curriculum course requirements.
2. To determine the percent of Airway Science Electronics Systems graduates to graduates in other Airway Science options and also related electronics training.
3. To determine the initial type of job description received by the airway science graduates and the initial job descriptions received by the traditional hired.
4. To examine strengths and weaknesses in the preparation of airway science electronic technicians.

Limitations

This study has the following limitations:

1. The study focused on the Airway Science Electronics Systems program and not the total airway science program.
2. The study was limited to a consideration of chairmen of recognized airway science electronics system programs.

Definition of Terms

For the purpose of this study, the following terms are defined as follows:

Air Traffic Control (ATC) System - A system that allows for tracking of any aircraft, providing the air traffic registration, altitude type identification registration, altitude, range, bearing, and airspeed.

Automation Technician - A person who works with metropolitan airport computers which optimizes the radar information processing flight. One who tracks aircraft from departure to arrival at its destination airport and monitors those computers for efficient and safe operation.

Aviation Safety Inspector - A person who develops, administers, and enforces regulations and standards concerning civil aviation safety.

Avionics - A combination of aviation electronics including electrical power and communication and navigation equipment.

Communications Technician - One who installs and maintains the vital equipment that provides voice communication.

Controlled Airspace - An airspace that has been defined and has air traffic control service available.

Department Chairman - A person who has the responsibility of coordinating and supervising the various activities of a recognized Airway Science department .

Electronics Technician -One who installs and maintains Electronics equipment required for navigation communications between aircraft and ground services and control of aircraft movements.

Engineer - A person who designs or builds. One who is trained in or follows as a profession a branch of engineering. A person who carries through an enterprise by skillful or artful contrivance to lay out, construct, or manage.

Environmental Technician - A person who maintains equipment ranging from runway approach lighting systems to emergency generators used to insure an uninterrupted flow of electricity to the equipment used in various facilities to control air traffic.

Federally Trained Technician - An Electronics technician employed by the FAA usually trained by the military.

Graduate - A person who has completed a prescribed course of study in an Airway Science Electronics System Program and has been awarded a baccalaureate degree.

Navigational Aids Technician - One who supports aviation with a vast array of equipment used to assist both pilots and controllers in the air traffic system. This equipment is capable of locating and directing aircraft and allows pilots to fly on instruments for landing in bad weather.

Radar Technician - A person who works with long range radar which scans a 200-mile radius, controlling arriving and departing air traffic. A person assigned to equipment that is vital when visibility is poor.

Overview

The entire study has five chapters. Chapter I is composed of the problem, purpose, and a brief summary of theoretical and methodological underpinnings of the study. In addition, the chapter contains a list of definitions. Chapter II contains a review

of literature related to airway science. Chapter III presents the methodology, which formed the basis for data, collection, and analysis. Chapter IV is a report based on data analysis and results. Chapter V gives summary, conclusions, recommendations, and implications.

CHAPTER II

REVIEW OF THE LITERATURE

Chapter II is a review of the literature to provide guidance for the study through research related to the airway science electronics system in the past and as airway science presently exists. The major areas of the literature reviewed were: (1) the history of airway science, (2) federally funded research, (3) literature regarding legislation (4) work force trends, and (5) comparative research studies.

The FAA and its predecessor organizations, the Civil Aeronautics Authority (CAA) 1938-1940, and the Civil Aeronautics Administration (CAA)1940-1958, have played a significant role in aviation education in the United States.

Mission of the Federal Aviation Administration (FAA)

The Federal Aviation Act of 1958, section 103 contains a declaration of policy for the FAA Administrator. The policy is as described herein:

Declaration of Policy: The Administrator

> SEC. 103. In the exercise and performance of his powers and duties under this Act the Administrator shall consider the following, among other things, as being in the public interest:
>
> 1. The regulation of air commerce in such manner as to best promote its development and safety and fulfill the requirements of national defense.

2. The promotion, encouragement, and development of civil aeronautics.

3. The control of the use of the navigable airspace of the United States and the regulation of both civil and military operations in such airspace in the interest of the safety and efficiency of both,

4. The consolidation of research and development with respect to air navigation for both military and civil aircraft.

5. The provision of assistance to law enforcement agencies in the enforcement of laws relating to the regulation of controlled substances, to the extent consistent with aviation safety.

Historically, the United States military services trained and qualified a large number of our aviation professionals. Instructor techniques, training materials, and training methods were specifically developed to prepare young women and men for full careers in military aviation. For well-trained individuals who did not complete a full military career, and for many who completed a full military career, the door to opportunity in civil aviation was immediately opened. The aviation community, both ground and air, had a seemingly endless supply of well-educated, highly-trained professionals for more than 45 years, who required a minimum of conversion training to function in the commercial system (Howard, 1997a).

> The United States and other nations have enacted regulations, developed aircrew qualification strategies, and deployed training resources in a manner dependent on the assumption that a large population of military trained aviation professionals would be continuously available. It is obvious that we could no longer rely on that assumption (Howard,1997b).

The country was faced with a potential global shortage of qualified aircrew members, mechanics, air traffic controllers, FAA inspectors, systems engineers, and technicians by the mid-1990s. The United States had very little experience in selecting civilians without previous aviation experience for education and training as professional

pilots, mechanics, and technicians. There was no historic strategy to deal with the potential of a crew member or aviation maintenance technician shortage. Once there was an acknowledgment of a problem, a meaningful alternative solution had to be found.

Program History

The Airway Science Task Force was formed in 1981 at the request of Mr. J. Lynn Helms, then the Administrator of the FAA. The task force was charged with the challenge of designing a generic curriculum for the proposed airway science program (Airway Science Curriculum Proposal, 1989). The task force members were appointed and would be representative of college and university programs throughout the country. David Carmichael, then Deputy Director of the FAA Aeronautical Center in Oklahoma City, Oklahoma, was instrumental in developing the airway science program (Carmichael,1997). The program called for an institution offering the baccalaureate degree. Shortly thereafter, the task force recognized that community colleges granting the associate degree might participate in the program by offering the lower division course work in the core curriculum, consequently community college representative was appointed to the task force (Carmichael, 1998a).

Following FAA approval of the airway science curriculum as designed by the task force, it was determined by the FAA that the review of airway science curricula submitted by colleges and universities necessitated an academic review committee for purposes of standardization. From this, the airway science curriculum committee was formed. The airway science curriculum committee evolved from the airway science task force. The purpose was to provide technical educational expertise in the development and

national implementation of the airway science curriculum. The committee serves in an advisory capacity to the FAA and provides service under the provisions of a statement of work in an airway science contract between the FAA and the University Aviation Association. Functions of the committee include but are not necessarily limited to:

1. Reviewing proposals from institutions requesting recognition of new, additional, or modified airway science programs.
2. In connection with # 1 above, conducting evaluation visits to institutions seeking recognition.
3. Acting as a liaison between the FAA and the academic community in support of the airway science program.
4. Assisting in the development of guidelines specifically for current FAA employees. These programs will be modeled after the generic curriculum and will probably include nontraditional delivery systems.
5. Providing an ongoing evaluation of the generic curriculum.

The success of the FAA's Aviation Education Program plan rests on the degree to which headquarters, regional, and local facility staff understand their roles and responsibilities for carrying out the programs (Careers, 1983).

The University Aviation Association provides contracted services to the FAA for the airway science curriculum program (Schukert, 1983). Much of the contract work is accomplished through the airway science curriculum committee consisting of eight to ten members including two industry representatives, and a central office staff with one dedicated full time educator professional staff member and one support staff member to the performance of services under the ANS contract. The services include:

1. Reviewing associate and baccalaureate aviation curriculum proposals for institutions establishing new AWS programs, adding additional areas of concentration or modifying existing programs and making recommendations to the FAA for approval;
2. Conducting on-site inspection visits of institutions establishing new AWS programs or adding areas of concentration and making recommendations to the FAA related to recognition;
3. Conducting a continuous review and evaluation of the AWS curriculum and making recommendations for its modifications;
4. Maintaining contracts with all recognized institutions through informational visits, correspondence, and/or telephone contact to monitor AWS programs progress and the implementation of the AWS curriculum;
5. Conducting periodic assessments and preparing reports to the FAA on the role and effectiveness of the airway science curriculum programs;
6. Keeping the aviation community informed and helping to Advance the AWS program through an AWS symposium and professional meetings, news releases, reports and articles in University Aviation Association (UAA) publication (Airway Science Task Force, 1984).

A copy of correspondence (letters from the FAA in Washington, D.C.) as it relates to the UAA and an Airway Science program as well as the UAA statistics is included in Appendix A.

Airway Science Curriculum Definition

The FAA Airway Science Curriculum project is a landmark effort to make use of selected colleges and universities in meeting some of FAA's personnel requirement goals. FAA Administrator J. Lynn Helms developed the airway science program as a response to the August 1981 strike and subsequent firing of air traffic controllers. The FAA used the technical, professional, and educational advice and assistance of the University Aviation Association and developed five curriculum outlines (Airway Science Curriculum proposal, 1989).

The five areas are:

Airway Science Management

Airway Computer Science

Aircraft Systems Management

Aviation Maintenance Management

Airway Electronics Systems

One of the most unusual features of the FAA Airway Science curriculum project is that the U. S. Office of Personnel Management (OPM) has given approval to a demonstration project wherein graduates of this program may be hired directly by the FAA without regard to the usual hiring criteria and system (Careers, 1983, 1). A personal interview with Dr. David Carmichael (1998b) reveals "I don't believe the special hiring criteria has ever been approved."

Once the airway science curriculum was developed, any institution requesting an Airway Science program must complete a proposal which is made up of the following:

Generic Curriculum Outline – Guideline 1985

General Studies (27 semester hours) - To include written and oral communication, social and behavioral sciences, humanities and the arts.

Mathematics (25 semester hours, math, science and technology combined) Basic math courses to serve as foundations for computer science, science, and areas of concentration.

Science and Technology (combined with math) - To include physics, geography, chemistry and appropriate technology, and/or engineering courses.

Computer Science - (nine semester hours) - to include basic applied computer science courses.

Management - (nine semester hours) - to include general management courses

Aviation (15 semester hours)

Airway Science Curriculum General Studies – 27 Semester Hours

Purpose – To provide the opportunity for the extension of basic learning and communication skills, development of intellectual curiosity, and assessment of a social and historical perspective necessary for a broadly based, "well-rounded" individual.

Course Content – Courses will be designed to teach the skills that have been called "the foundations" of education. Critical thinking, cognitive and analytical skills, artistic skills, and communication skills are typical areas to be offered to satisfy this section of the curriculum.

Examples – Composition, speech, economics, languages, logic, government and technical writing.

Mathematics – Math, Science and Technology

Combined – 27 Semester Hours

Purpose – To offer a mathematical background specifically directed toward managerial personnel functioning in high technology environment, including the preparation necessary for an area of concentration in Airway Computer Science and in Airway Electronic Systems.

Course Content – Specific topics should include college level algebra, analytical geometry, trigonometric functions, exponential and logarithmic functions, vectors and vector notation, matrix theory and applications, functional notation, basic integration and differentiation, linear equations and inequalities, elementary probability and descriptive statistics and linear programming.

Examples – Algebra calculus, geometry, trigonometry, analytic geometry, statistics and math methods.

Science and Technology

Purpose – To expose the student to those scientific disciplines which foster and develop logical and in-depth thought processes particularly pertinent for managers in such a fast developing and electronically evolving working environment.

Course Content – Specific topics should include data processing, computer languages, data base management, computers, computer security, office automation, special impacts, graphic usage and simulation.

Examples – Information systems, introduction to computers, micro computers, systems analysis, data processing, computer science, computer programming, computer and society and computer architecture.

Management – 9 Semester Hours

Purpose – To provide an educational background in management related areas expressly directed toward understanding and interacting with the human and interpersonal relationships necessarily developed in such a diverse field as aviation.

Course Content – The student will be required to have a general understanding of basic management concerns including those topics dealing with organization, motivation and interpersonal relations. Curriculum is to include basic supervision concepts.

Examples – Business communications, personnel management, principles of management, techniques of supervision, organizational behavior and administrative problems.

Aviation – 15 Semester Hours

Purpose – This section of the curriculum will provide the student with a broad knowledge of aviation operations, the aviation industry, the problems of flight and aircraft

systems, and the need to integrate these facets into a comprehensive understanding of the aviation community as a whole.

Course Content – Courses in the areas are designed to create an awareness of the operational environment or flight and aircraft systems, as well as the problems of aviation as a dynamic and growth oriented industry.

Examples – Aviation history, navigation and communication, introduction to aeronautics, aviation meteorology, aviation safety and aerospace legislation.

AIRWAY SCIENCE CURRICULUM PROPOSAL – PART II
SCIENCE MANAGEMENT AOC

Generic Curriculum Course Description
Proposed Curriculum Course Description (Use Actual catalog copy)
Indicate revisions with an appropriate number of asterisks preceding the course number
Explanation, Clarification and Justification (as necessary).

Airway Science Management	Semester Hours
Air Traffic Control System	3
Air Transportation	3
Airport Management	3
Personnel Management	3
Labor/Management Relations	3
Business Policies	3
Management Decision Making	3
*Psychology and/or Human Behavior and/or Communications	9-12
*Aviation Management or Business Management Electives	9-12
Minimum semester hours for AOC	40

Note – *Upper division level only.

This concentration is designed to provide students with a knowledge of basic management techniques, preparing them for a variety of aviation-related administrative and management positions in fields including air traffic control.

AIRWAY SCIENCE CURRICULUM PROPOSAL – PART II
COMPUTER SCIENCE AOC

Generic Curriculum Course Description
Proposed Curriculum Course Description (Use Actual catalog copy)
Indicate revisions with an appropriate number of asterisks preceding the course number
Explanation, Clarification and Justification (as necessary).

Airway Computer Science	Semester Hours
Computer Programming II	3
Advanced Computer Programming	3
Computer Operation Systems	3
Assembly Language Programming	3
Data Structures	3
Computer Methods and Applications I	3
Computer Methods and Applications II	3
Theory of Programming Languages and Complex Construction	3
Computer Architecture	3
Computer Electives	13
Minimum semester hours for AOC	40

This concentration provides students with knowledge of computer hardware/software and operations, preparing them to function in areas such as computer operations, software design, systems analysis and computer programming.

This concentration is designed to provide students with a knowledge of basic management techniques, preparing them for a variety of aviation-related administrative and management positions in fields including air traffic control.

AIRWAY SCIENCE CURRICULUM PROPOSAL – PART II
COMPUTER SCIENCE AOC

Generic Curriculum Course Description
Proposed Curriculum Course Description (Use Actual catalog copy)
Indicate revisions with an appropriate number of asterisks preceding the course number
Explanation, Clarification and Justification (as necessary).

Airway Computer Science	Semester Hours
Computer Programming II	3
Advanced Computer Programming	3
Computer Operation Systems	3
Assembly Language Programming	3
Data Structures	3
Computer Methods and Applications I	3
Computer Methods and Applications II	3
Theory of Programming Languages and Complex Construction	3
Computer Architecture	3
Computer Electives	13
Minimum semester hours for AOC	40

This concentration provides students with knowledge of computer hardware/software and operations, preparing them to function in areas such as computer operations, software design, systems analysis and computer programming.

AIRWAY SCIENCE CURRICULUM PROPOSAL – PART II
AIRCRAFT SYSTEMS MANAGEMENT AOC

Generic Curriculum Course Description
Proposed Curriculum Course Description (Use Actual catalog copy)
Indicate revisions with an appropriate number of asterisks preceding the course number
Explanation, Clarification and Justification (as necessary).

Aircraft Systems Management	Semester Hours
Commercial Pilot Certification	5
Instrument Rating	5
Multi-Engine Rating	1
**CFI-Airplane	5
**CFI-Instruments	3
*Advanced Aerodynamics & Aircraft Performance	3
*Advanced Aircraft Systems	3
Meteorology	3
Air Transportation	3
*CFI-Multi-Engine	3
*Aviation Electives	6
Minimum semester hours for AOC	40

Note – *Upper division level only. **Recommend upper division level

These graduates must hold a Commercial Pilot Certificate with Airplane Single and Multi-Engine Land and Instrument Airplane Ratings and a Flight Instructor Certificate with Airplane, Instrument and Multi-Engine Ratings.

The sponsoring institution must hold FAR Part 141 Air Agency Certificate with appropriate ratings and/or have a contractual/articulation agreement with a properly certified agency.

This concentration focuses on aircraft flight operations and the preparation of professional pilots and flight instructors with a science/technology orientation. FAA certification requirements associated with these areas of concentration include Commercial Pilot with Single Engine Land, Multi-Engine Land and Instrument ratings Engine, Multi-Engine and Instrument ratings.

AIRWAY SCIENCE CURRICULUM PROPOSAL – PART II
AIRWAY ELECTRONIC SYSTEMS AOC

Generic Curriculum Course Description Proposed Curriculum Course Description (Use Actual catalog copy) Indicate revisions with an appropriate number of asterisks preceding the course number Explanation, Clarification and Justification (as necessary).	
Airway Electronic Systems	Semester Hours
Theory of Electronics	3
Microprocessor Theory and Application	3
Advanced Computer Programming	3
Solid State Devices	3
Integrated Circuits	3
Engineering Drawing	3
Electrical Circuits	3
Digital Logic Applications	3
Electrical and Power Principles	2
Electronics/Avionics Electives	15
Minimum semester hours for AOC	40

This concentration is designed to provide students with knowledge of basic and advanced electronics theory, preparing them to work in the maintenance, troubleshooting, testing, and development of avionics and navigational equipment.

AIRWAY SCIENCE CURRICULUM PROPOSAL – PART II
AVIATION MAINTENANCE MANAGEMENT AOC

Generic Curriculum Course Description
Proposed Curriculum Course Description (Use Actual catalog copy)
Indicate revisions with an appropriate number of asterisks preceding the course number
Explanation, Clarification and Justification (as necessary).

Aviation Maintenance Management	Semester Hours
Engineering Drawing	2
Aircraft Materials	2
Propulsion	6
Propulsion Laboratory	6
Structures	6
Structures Laboratory	6
Aircraft Systems	3
Avionics Systems	3
*Technical Electives	6
Minimum semester hours for AOC	40

Note – *Upper division level only.

These graduates must hold the Airframe and Powerplant Technicians Ratings (Mechanics). The sponsoring institution must hold FAR 147 certificate with appropriate ratings and/or have a contractual/articulation agreement with a properly certified agency.

This concentration focuses on both theoretical and practical knowledge of airframe, powerplant, and propeller theory, as well as with the many relevant technical documentation methods, specifications, and standards. Certification requirements associated with this area of concentration include a FAA Mechanics certificate with Airframe and Powerplant ratings. Graduates will be prepared to work in maintenance and troubleshooting.

Areas of Concentration – 40 hours

1. Airway Science Management
2. Airway Computer Science
3. Airway Electronics Systems
4. Aviation Maintenance Management
5. Aircraft Systems Management

Once the institution has met all requirements for a curriculum proposal, a site visit must be performed. (Appendix B)

Airway Electronics Systems

The area of Airway Electronics Systems will include a comprehensive study of the theories of electronics as well as practical experiences which would prepare the graduate to assume duties for a career in government and general aviation electronics. They will be qualified to work, not only in maintenance and trouble shooting, but also in supervision,

management, testing and developmental work, also as an engineer, radar, automation, communication, navigational aids and environmental technicians (Appendix C).

National transportation policy calls for a safe and full capacity aviation system to be developed and maintained by public and private efforts. Competent personnel must be trained and available to assume maintenance responsibility for new equipment and systems. Quality training for the highly sophisticated hardware and specially designed software of new automated equipment is essential (This is the FAA, 1990).

Research data gathered from interviews with airway science program coordinators at 20 of the 32 colleges and universities participating in airway science programs heavily emphasized the FAA's failure to provide the number of jobs to program graduates (Bowen, 1990).

In January 1994, the contract between the FAA and the University Aviation Association was modified to include an additional work element. The UAA was to provide assistance in evaluating and monitoring the compliance of airway science program policies and procedures to include statistical teaching and monitoring of students and individual reporting program requirements. Final conclusions were undefined. "Since this is the first year of data collection by UAA, we are unable to make any comparisons or establish trends" (UAA, 1994).

Workforce Trends

As the world prepares for the 21st century, there is much concern about the predictable workforce for the year 2000. The question of who will be responsible for the

provision of training opens the door to a discussion of what may be a watershed of changes in how the United States labor market defines the job (Barth, 1995). Louis V. Gerstner, Jr., CEO of IBM, held educators accountable for not increasing America's supply of world-class workers—those with high-tech skills and problem-solving abilities—that he claimed the corporations sorely needed (Boutwell, 1997). Cetron (1984) states: "Without a doubt, maintaining a skilled work force will take an enormous amount of resources" (p 45). An impressive array of evidence testifies to the importance of education and vocational skills. An extra year of schooling adds about 10 percent a year to average earnings. Vocational training yields commensurate private returns. And returns to society in reduced social problems and increased productivity match these private rates (Osterman, 1996). According to Johnson and Packer (1987), in their book Workforce 2000, more joblessness for the unskilled and less unemployment for the highly trained worker will exist. Additionally, Johnson and Packer point out that minorities will account for an increasing share of the work force, with African Americans and Hispanics leading the way. Johnston and Packer further state that a major problem African Americans will have to overcome is their lack of technical education.

> Electronics technician new-hire training can be accomplished by accredited, post-secondary educational institutions. This is part of an ongoing effort to recruit highly qualified developmental Electronics Technicians (ET) who can become productive members of the airway facilities work force in a shorter period of time. Moreover, since the FAA is placing a high priority on the recruitment of females and minorities, it is seeking schools that have an aggressive and successful program of recruitment for such candidates. (J. P. Kisick, Personal communication, December 5, 1991)

The Federal Aviation Administration developed an annual study report on demographic profiles of the airway science facilities (AF) workforce. The latest data

available to this effort was FY 1990 year-end data. This study report displays only that information considered essential to make a statement that, based only on retirement eligibility, there will be a significant and substantial need for airway facilities engineers and technicians through the year 2000 (FAA, 1990) (Appendix D).

Summary

The review of literature provided historical, legal and research support for the study of the quality and effectiveness of the airway science Electronics systems program to meet the workforce needs of the FAA. The airway science program is a cooperative effort with the FAA to prepare technically qualified graduates to enter a rapidly expanding workforce. The program combines course work and laboratory experiences to equip graduates to perform a variety of technical tasks in the aviation industry. Competent personnel must be trained and available to assume maintenance responsibility for new equipment and systems. Quality training for the highly sophisticated hardware and specially designed software is essential. The numbers and types of personnel required in the future far exceed that which can be provided by attraction from the military careers as in the past. Government and industry must now focus on technical trade schools and colleges for recruitment activities. It is the desire of this researcher to assist in collecting new data about Airway Science Electronics Systems to help determine future electronics training.

CHAPTER III

RESEARCH DESIGN PROCEDURES

The purpose of this study was to determine the quality and effectiveness of the "airway science electronics systems program" to meet the workforce needs of the FAA. The study was to research and compare traditional FAA hired electronics technicians and Airway Science degree graduate electronics technicians hired by the FAA.

Faced with a potential global shortage of qualified aircrew members, mechanics, air traffic controllers, FAA inspectors, systems engineers and technicians by the end of the 1990s, a strategy to deal with the potential shortages was the airway science Electronics system program.

Chapter III gives a description of data collection methods and instrumentation. The purpose of this chapter is to describe the subjects who participated in the study, to describe the sources used, and to describe the procedures and treatment of the data.

Population and Sample Design

Data for the study were obtained through:

1. Personal interviews conducted with department chairmen from the Oklahoma City Aviation Alliance, the FAA Oklahoma City personnel office, and the FAA Airway Facilities administration.

2. A survey instrument designed to obtain basic information (data) from chairmen of college and university airway science departments.

The search of the literature produced items pertaining to the field of airway science electronics systems, which were put into question form. The survey instrument used was a combination of (a) an instrument developed by Bowen (1990 University Aviation Association (1994), and the researcher.

A survey review was designed and submitted to a panel of judges selected from colleges and universities who are members of the Oklahoma City Aviation Alliance and supervisors of electronics technicians at the Mike Monroney Aeronautical Center, Oklahoma City, Oklahoma, and two Airway Science graduates from Langston University. Educational institutions that make up the Oklahoma City Aviation Alliance include: (1) Francis Tuttle and Metro Tech Vocational Technical Centers, (2) Oklahoma City Community College, (3) Oklahoma State University Technical Branch-Oklahoma City, (4) Rose State College, (5) Langston University, (6) Oklahoma State University, and (7) the University of Oklahoma. The judges were asked to respond to each item as appropriate, not appropriate, or uncertain. Each judge was also asked to return the form within a period of 14 days. From the responses, only items checked appropriate by at least 60 percent of the total items were retained in the questionnaire.

The validated questionnaire was then administered to the 61 recognized Airway Science institutions (six are two-year schools).

Personal Interviews

Another source used of data was personal interviews with department chairmen who are members of the Oklahoma City aviation/aerospace alliance. Personal interviews were also conducted with electronics technicians and supervisors at the Mike Monroney Aeronautical Center, Oklahoma City, Oklahoma (Appendix E).

Study Population

Department chairmen of UAA approved airway science programs were mailed letters of introduction from the principal investigators, Dr. Kenneth Wiggins, Chairman, Department of Aviation and Space Education, Oklahoma State University, and this researcher (Appendix F). The letter requested the cooperation and participation of each college/university. Enclosed with the letter of introduction were additional instructions, copies of the survey instrument, and a self-addressed stamped envelope (Appendix G).

The difference among UAA approved programs created a problem. Approved airway science programs may have all five program options or any combination. Some of the college/universities may have Electronics Engineering and Electronics Technology programs.

Institutional Review Board (IRB)

The Oklahoma State University Institutional Review Board, operating in accordance with federal regulations 45 CFR 46 and 21 CFR 50, 56, reviews all research

involving human subjects. This Review Board approved the methodology of this study. (Appendix H).

Summary

Three sources of data were used as a basis for finding causes and feelings concerning the Electronics system program: (1) a validated questionnaire, (2) personal interviews and surveys, and (3) phone interviews.

A panel of judges selected from colleges and universities who are members of the Oklahoma City Aviation Alliance, supervisors of Electronics Technicians at the Mike Monroney Aeronautical Center, Oklahoma City, Oklahoma, and two recent Airway Science graduates were asked to review the questionnaire and make suggestions. The validated questionnaire was sent to all 61 UAA approved airway science programs.

Visitations were scheduled with technology and engineering department chairmen in Oklahoma, offering both baccalaureate degree programs and associate degree programs, in order to collect data for the study. The institutions chosen were selected because of (1) location, (2) student clientele, and (3) electronics programs.

CHAPTER IV

PRESENTATION OF THE DATA

Data were obtained from (1) interviews conducted with department chairmen from the Oklahoma City Aviation alliance, FAA Oklahoma City personnel office and airway facilities administration; and, a (2) survey instrument (Appendix H) designed to obtain basic information from chairmen of college and university Airway Science departments.

Questionnaires were designed and mailed during the Spring 1997 to gather data from Aviation Department chairpersons and members of the Federal Aviation Administration and University Aviation Association's approved Airway Science programs. It is believed that the data obtained from the questionnaires will lead to a comprehensive study of university and college aviation science electronics systems programs and subsequent evaluation of their effectiveness and the airway science preparation programs. The questionnaire items were developed to secure some means of assessing the reactions of program chairmen/chairpersons in Airway Science institutions.

The validated questionnaire was administered to 61 recognized Airway Science institutions, of which 40 (approximately sixty six percent) responded. The start time of the earliest airway science program reported by respondents was 1980 with the majority starting in the early 1990's.

Part I Question 4

From the questions on the effectiveness of the Airway Science Program as it relates to aviation programs offered, the following responses to the question were recorded:

1. Thirty-five percent of the respondents offered a Bachelor of Science in Airway Science Management.
2. Twenty-eight percent of the respondents stated that their institution offered the Bachelor of Science in Aircraft Systems Management.
3. Eighteen percent of the institutions offered the Bachelor of Science in Airway Computer Science.
4. Thirteen percent of the institutions responded that they offered the Bachelor of Science in Aviation Maintenance Management.
5. Ten percent of the institutions offered the Bachelor in Airway Electronics Systems.
6. Five percent of the responding institutions offered the Associate Degree in Aircraft System Management, Airway Electronic Systems and Aviation Maintenance Management.

Part II Question 5

The data in Table I represents opinions that department chairmen have towards the Airway Science Programs. The data revealed that, of the 26 percent institutions responding to this question, the majority disagree with the statement that airway science

graduates may be hired directly to the FAA without regard to the usual hiring criteria; 31 percent disagree and 30 percent strongly disagree with the statement.

Twenty-seven institutions responded to the statement, "I believe that it is difficult to attract new students for the Airway Science Program." 44 percent strongly agree and 26 percent agree for a total of 70 percent in agreement. This seems to reveal little difference in opinion among institutions.

Question C concerned the overall effectiveness of the Airway Science Program meeting the FAA work force requirements. Of the 26 institutions responding, the data reveal the respondents were divided on their opinions. The majority (27 percent) was undecided and (27 percent) strongly disagreed. Nineteen percent agreed and a similar number 15 percent disagreed. Twenty-six department chairmen were more in agreement that airway science graduates find greater employment opportunities outside of the FAA with 38 percent agreeing, and 19 percent strongly agreeing and 19 percent undecided.

Chairmen were asked to respond to the comparisons of the approved Airway Science Electronic Systems Program having an advantage compared with other types of Electronics Training Programs. The majority (39 percent) were undecided, 25 percent disagreed and 30 percent strongly disagreed. Of the institutions offering the Electronic Systems Program, 33 percent strongly agree those graduates in the Airway Science Electronics Systems Program do have an advantage over other electronics programs as it relates to the FAA, but the same percentage disagreed that these graduates have any advantage over other work places.

TABLE I

RATING OF QUESTION ITEMS

	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree	
Item	N	%	N	%	N	%	N	%	N	%
A	1	4	2	8	7	27	8	31	7	31
B	12	44	7	26	4	15	4	15		
C	3	12	5	19	7	27	4	15	7	27
D	5	19	10	38	5	19	3	12	3	12
E	1	5	1	5	7	35	5	25	5	30

In answer to the question "How many graduated in Airway Science Electronics during the 1997/1998 school year?" One institution reported 7 and another reported 1.

Responding to the question on the number of electronics systems students placed in internship and/or cooperative education, one respondent reported 6 and another reported 1.

Responding to the question "The number of electronics systems students placed in internship and/or cooperative education programs at the FAA, 2 respondents reported 1 each. One respondent reported that in 1997/1998, 2 electronics systems graduates were placed in graduate schools and two received employment at a FAA facility and four received employment in manufacturing.

The survey instrument was designed to obtain basic data from chairmen of college and university airway science departments consisted of the two types of questionnaires, closed or restricted and open-ended. Closed or restricted form responses that called for a "yes" or "no" answer, short response, or item checking. Open or unrestricted form questions called for free responses from the respondents (Key, 1997). Open ended questions are useful early in the interview just as they are during early stages of needs assessments and subject matter analysis (Rossett, 1987). For this questionnaire, two open-ended questions were used. The number 6 question asked "What are the strengths of the Airway Science Program?" and, the number 7 question asked "What are the weaknesses of the Airway Science Program?" Each of the respondents was given the opportunity to make comments as it related to questions number 6 and number 7. Examples are as follows:

Question 6

- FAA needs support from non-government schools (diversity is gone).
- Excellent academic standards training preparation and work experience.
- The curriculum is appropriate and sets high standards. The airway science concepts served to encourage more colleges to offer aviation. It even provided money to a few schools. The FAA really wanted to make it work but didn't know how.
- It provided a key step toward forming the council on aviation accreditation.
- The grant program (some money went to general location).

- A very complete curriculum to meet today's standards and business needs.
- Focus on current every day issues and change opportunities and discuss viable solutions. Real world experience that is transferable to other fields of study.
- It is a good program educationally.

Question 7

- The FAA personnel office wasn't included in the process.
- Lack of support at the grass roots level and the top from the university leadership (i.e., president).
- The FAA should still back the program. FAA should sponsor this program.
- It could not deliver what was promised. It was also developed without an understanding of what colleges were already doing. The concept, however, was good.
- It was too focused on FAA.
- It was too focused on business administration types of requirements. The grant money went to a number of ineffective locations, which hurt the academic program by inference. Sadly, airway science seems to be dead in the water. Other than some good public relations in the 1980s has not been a help to our institution.
- The FAA does not utilize the program. FAA employees are not aware of the program.

- It has not existed in theory or in fact for more than 3 years.
- It was dismantled and terminated by the FAA.
- There is no Airway Science Program in the FAA.

Research data were gathered from interviews with department chairmen who are members of the Oklahoma City Aviation/Aerospace alliance and personal interviews were also conducted with electronics technicians and supervisors at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma.

Located at Oklahoma City, Oklahoma the Mike Monroney Aeronautical Center provides nationwide centralization of many specialized activities of the agency. Electronics technicians in the FAA attend one or more of the electronic technical training courses conducted by the FAA Academy at the Aeronautical Center. As a result, many of the instructors begin their employment as Electronic Technicians.

Personal interviews were restricted because the center is a government facility and personal interviews must be cleared by the personnel office as well as by FAA. The purpose of this study was to determine the quality and effectiveness of the "airway science Electronics systems program" designed to meet the workforce needs of the FAA. The study was designed to research and compare traditional FAA hired electronics technicians and Airway Science degree graduate electronics technicians hired by the FAA headquarters in Washington, D.C. Completion of personal interviews of electronics personnel had to be performed outside of the FAA Academy. Nine interviews were conducted with FAA Electronics personnel.

Demographic information for those interviewed is contained in Table II.

- It has not existed in theory or in fact for more than 3 years.
- It was dismantled and terminated by the FAA.
- There is no Airway Science Program in the FAA.

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Demographic information for those interviewed is contained in Table II.

TABLE II

DEMOGRAPHICS

Category	Number	Percent
Gender		
Male	8	89
Female	1	11
Race/Ethnicity		
African American	4	44
Asian	0	0
Hispanic	0	0
White	4	44
Other	1	11
# Years Electronics Experiences		
0-2 years	1	11
3-5 years	1	11
6 – 10 years	1	11
11 – 15 years	1	11
16 and over years	5	56
Electronics Employment Position		
Radar	3	33
Automation	4	44
Communications	6	67
Navigation	5	56
Instruction	1	11
Environmental	0	0
Electronics Training		
Military	3	33
Baccalaureate program	5	56
Vocational training	1	11
Associate degree program	4	44
Other	4	44

TABLE II - Continued

Category	Number	Percent
Education		
Highschool	0	0
Associate degree	3	33
Bachelor degree	5	56
Master degree	1	11
Doctorate degree	0	0
Specialist degree	0	0
Administrative/ Supervisory Responsibility		
Yes	4	44
No	5	56
Preparation		
Internship-Coop	3	33
Networking	3	33
Advanced training	5	56
Other	11	1

Of those interviewed, 89 percent were male and 11 percent female. Practically all of the interviewees were white 44 percent or African Americans 44 percent. One technician interviewed was as a Pacific Islander. Most of those interviewed had completed the bachelor's degree 56percent. Three technicians 33 percent had completed the associate's degree in Electronics. Based on information from personal interviews, 33 percent received Electronics training from the United States military. Interviews revealed that 44 percent of the Electronics Technicians received training from an associate degree program.

Data in Table II indicate that 56 percent of those interviewed have worked with the FAA for 16 or more years. It is suggested from this data that working with the FAA and in particular as one involved in the area of electronics, that it is a stable industry.

It was interesting to note that 44 percent of those interviewed had administrative or supervisory responsibility. This could stem from the fact that of those interviewed, the majority has been employed for over 16 years. Another factor could reflect many of those interviewed were serving as part of an Aeronautical Education Advisory Team.

Table II shows the results of questions 5 and 6 from the personal interview. This table indicates which training program the respondents used to prepare themselves for their present employment positions. Question 6 asks each respondent the highest level of education achieved and the major subject areas. Those responding to question 6 stated electronics and electronics technology as major specialty areas when pursuing the associate degree program. Sixty-seven percent responded to question 6 as having earned the bachelor's degree, and their areas of specialty are: Electronics Technology, Industrial Technology, Physics, Engineering Physics, Bible Practical Theology, and Airway Science Electronics Systems.

Additional data was gained by phone interviews with chairmen of departments that are members of the Oklahoma City Aviation/Aerospace Education Alliance. Members of the alliance are Francis Tuttle and Metro Tech vocational technical centers, Oklahoma City Community College, Oklahoma State University Technical Branch—Oklahoma City, Rose State College, Langston University, Oklahoma State University, and the University of Oklahoma. Members contacted are institutions providing electronics training. Those include Oklahoma City Community College, Langston University, Oklahoma State

University-Technical Branch, Oklahoma City, and Rose State College. Phone interviews were used to gather information as to electronics curriculum in order to have a base for comparison of electronic training. Data indicate generic electronics programs include Introduction to Electronics, Circuit Analyses I and II, Digital Logic Analysis, Communication, Instrumentation and Microprocessing.

Information collected from various institutions providing electronics training indicate all students are receiving similar electronic education. The interviews with the electronics department chairmen suggested the essential disciplines for an electronics technician program. The information gathered served as guidelines for assessing electronics curriculum. Other suggestions included (1) staff qualifications, (2) facilities, (3) equipment, and (4) programs.

Summary

The major sources of data used in the study as a basis for finding feelings and causes of the Airway Science Electronics Systems Program were: (1) a validated questionnaire, (2) personal interviews and surveys, and (3) phone interviews.

During the 1997/1998 academic school year 35 percent of the institutions offered a Bachelor of Science in Airway Science Management, 28 percent of the respondents offered the Bachelor of Science in Aircraft Systems Management. The Airway Science program consists of five different options and of those offered the Bachelor in Airway Electronics Systems was the smallest number.

Department chairmen revealed that approximately 60 percent believed airway science graduates do not have an advantage of being hired directly to the FAA without

regard to the usual hiring criteria. Seventy percent of the program directors also believe that it is extremely difficult to attract new students to the airway science programs.

Data indicate department chairmen believe the airway science program curriculum is appropriate and sets high standards and that the airway science concept served to encourage more colleges to offer aviation programs. The data also revealed chairmen believed the airway electronics systems program lacked administration.

Data also indicate program chairmen believed the program to be non-existent because of the end of the contract between the FAA and the University Aviation Association.

The main concern of directors, supervisors of electronic technicians, and personnel officers at FAA facilities for hiring electronics technicians is the prospective employees' knowledge of electronics and a small concern as to where the training was received.

Analysis of Findings as Related to the Objectives

1. To compare traditional electronics training course requirements to the Airway Science curriculum course requirements.

The FAA Electronics Technicians receive electronics training from a wide variety of sources, including vocational/technical schools, the military, associate degree programs and bachelor degree programs. From the data collected from Electronics Technicians and instructors, 33 percent of respondents received electronics training while in the military. Associate degree programs provided 44 percent of the same cadre with electronics training. The majority of respondents, 56 percent, indicate their electronics training was

earned from a bachelor degree program. Another significant finding was that 11 percent of respondents listed vocational education as their source of electronics training.

2. To determine the percent of Airway Science Electronics Systems graduates to graduates in other airway science options and also related electronics training.

According to a report from the University Aviation Association, Airway Science graduates seeking employment with management/sales positions 72 percent were Airway Science Management, 4 percent Airway Computer Science, 20 percent Airway Systems Management, 0 percent Airway Electronics Systems and 4 percent Aviation Maintenance Management.

Airway Science graduated placed in government positions were 43 percent Airway Science Management, 6 percent Airway Computer Science, 17 percent Aircraft Systems Management, 34 percent Airway Electronics Systems and 0 percent in Aviation Maintenance Management.

3. To determine the initial type of job description received by the airway science graduates and the initial job descriptions received by the traditional hired.

The Federal Aviation Administration hires non-college educated persons for the same entry-level jobs which are sought by Airway Science graduates. In addition, the FAA hires graduates from "look alike" programs. These programs are similar to the Airway Science program, yet they do not participate with the University Aviation Association and the Federal Aviation Administration in their guidelines to be a recognized Airway Science Program. (Bowen, 1989)

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4. To examine strengths and weaknesses in the Airway Science Electronics Systems program.

According to the University Aviation Association survey 1997:

(a) Programs in Airway Science are designed specifically to provide a comprehensive education emphasizing critical thinking, cognitive and analytical skills, communication skills, mathematics, science and technology, computers, management, and aviation to prepare the future technical managers for the National Airspace System.

(b) The data obtained in this study agrees with that published by the UAA which indicate that the majority of the students are majoring in Airway Science programs, with the largest enrollment first: Aircraft Systems Management, Airway Science Management, Airway Computer Science, Aviation Maintenance Management, Airway Electronics Management.

Chapter V presents the summary, findings, conclusions, and recommendations of the study. It points out suggestions for the upgrading of the Airway Science Electronics Systems Programs.

CHAPTER V

SUMMARY

The purpose of this study was to determine the quality and effectiveness of the Airway Science Electronics Systems Program and its meeting of the workforce needs of the FAA. The study was designed to research and compare traditional FAA hired electronics and Airway Science degree graduate electronics technicians hired by the FAA.

A critical examination of the Airway Science Systems Program was made through questionnaires completed by leaders of 40 airway science programs across the United States. Comparative program studies were made through personal interviews with the FAA Electronics Technicians and department chairmen in different schools. Chairmen of forty approved airway science programs chairmen responded to a questionnaire relative to their feelings and expectations of an airway science major with an associate or baccalaureate degree.

Four research objectives of the study were:

1. To compare traditional electronics training course requirements to the airway science curriculum course requirements.
2. To determine the percent of airway science electronics system graduates to graduates in other airway science option and also related electronics training.

3. To determine the initial type of job description received by the Airway Science graduates and the initial job descriptions received by the traditional hired.
4. To examine strengths and weaknesses in the Airway Science Electronics program.

Most of the responding institutions 35 percent offered a Bachelor of Science degree in Airway Science Management. Of the five airway options, the least popular 19 percent of the institutions offered the Bachelor of Science in Airway Electronics Systems. The majority of program chairmen 61 percent disagree with the statement that airway science graduates may be hired directly to the FAA without regard to the usual hiring criteria. Seventy percent of respondents believe that it is difficult to attract new students for the airway science program. Many of the chairmen 27 percent were undecided, and 27 percent strongly disagree concerning the belief of the overall effectiveness of the airway science program meeting the FAA work-force needs.

Approximately 50 percent of respondents believe airway science program graduates do not have an advantage over other training programs.

Findings

Below is a summary of the finding:

1. The present area of airway science curriculum encompasses Airway Science Management, Airway Computer Science, Airway Electronics Systems, Aviation Maintenance Management and Aircraft Systems Management. Programs in airway science are designed specifically to help

prepare individuals for meeting the requirements for a strong educational background for tomorrow's aviation leaders.

2. The data indicate that the majority of airway science students pursue careers with the FAA but also find greater opportunities in industry.The schools surveyed that offered electronics, included in their curriculum Introduction to Electronics, Circuit Analysis I and II, Digital Logic Analysis, Communication, Instrumentation and Microprocessing.

3. The information shows that in the surveyed schools with approved airway science programs, Airway Science Management was the most frequently offered program.

4. The FAA Electronics Technicians receive electronics training from a wide variety of sources, including vocational/technical schools, the military, associate degree programs and bachelor degree programs.

5. Electronic technicians employed by the FAA tend to have long stable employment.

6. Respondents believe the airway science programs provide stronger overall education, but the FAA program centers did not or were not encouraged to back the programs.

7. Beginning in December 1998, to be employed as a FAA electronic specialist, one must pass the basic electronics screening tool (BEST) test. (Appendix I).

Conclusions

The following conclusions were drawn upon the basis of the findings of this study:

1. The number of Airway Science majors enrolled in the electronics option is relatively small, only 10 percent of the total compared to the other four options.
2. Electronics technicians receive similar educational training from a wide variety of educational sources which all provide similar training.
3. Programs in airway science are designed specifically to provide a comprehensive education emphasizing critical thinking, cognitive and analytical skills, communication skills, mathematics, science and technology, management, computers, and aviation to prepare the future technical managers for the National Airspace System.
4. The data indicate the majority of students are majoring in Airway Science programs with the largest enrollment first:

   Airway Science Management

   Aircraft Systems Management

   Airway Computer Science

   Airway maintenance Management

   Airway Electronics System
5. The data indicate that the total number of students has decreased through the last three years.

Recommendations

Based upon the data presented and conclusions drawn from this study, the following recommendations are made and should be used for counseling purposes, curriculum development, and program planning:

1. It is recommended that the office of personnel management sponsor a revised airway science program. New hires are in a continuous state of training for about two years. Airway facilities personnel are in constant training and learning. As new systems are developed, it was recommended they modify their existing Airway Science program. It is apparent that the National Airspace Systems will require a different set of skills for the technicians and engineers. Automation and state-of-the-art technologies have changed the way they do business. The days of the toolbox and screwdrivers have passed, while totally automated systems with microchip processing and card changing are here. To remain competitive and productive through the next malenium, airway science programs need to be innovative, and provide a wide range of programs from basic skills to high-level professional development. The large scale and complex aviation system will require massive continuous education for all personnel involved. Training needs to be dynamically efficient, individualized and cost effective, while delivering a positive impact on job performance.

2. In order for federally funding programs such as the Airway Science Program to be successful, the office of personnel management must give approval for program graduates to receive special recognition.
3. To better evaluate the program of Airway Science Electronics Systems better, it is recommended that members of the FAA electronics employment work force frequently evaluate electronics programs and make recommendations to the administration and to the department chairmen. This would provide a bond between programs and the FAA. The original Airway Science program's status was a "demonstration project." Participating academic institutions were requested to provide the FAA (through the UAA) with up-to-date information on the status of their programs following FAA recognition. Airway Science student enrollment figures and the names of Airway Science graduates furnished on a regular basis are optional to documenting the overall implementation success (or problems) of the Airway Science Program. Each school's cooperation in supplying the information is necessary. It is expected that this program will allow the FAA and the collegiate aviation community to determine with greater certainty the influence of an airway science background, particularly developed through a college education at participating universities.

4. It is recommended that the office of personnel management sponsor additional research to determine further sources of funding.

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APPENDIXES

APPENDIX A

UNIVERSITY AVIATION ASSOCIATION

CORRESPONDENCE

UNIVERSITY AVIATION

July 20, 1992

Ms. Margaret Powell, Manager
Airway Science Curriculum Program
Office of Training & Higher Ed., AHT-30
Federal Aviation Administration
400 7th St., SW, PL-100
Washington, DC 20590

Dear Ms. Powell:

The University Aviation Association Airway Science Curriculum Committee has reviewed the Airway Science Curriculum Proposal submitted by Langston University. Our review included a careful examination of the proposal conformity with the spirit and intent of the FAA generic Airway Science Curriculum.

In the opinion of the Committee, the curriculum CORE and the Airway Electronics System area of concentration appear to meet the spirit and intent of the generic curriculum. The Committee expressed some concern about the academic strength of the physics and chemistry courses as well as the computer science selections and requests the site visit team look into these.

The Committee recommends that Langston University be issued an FAA letter of encouragement. Please notify our Curriculum Specialist when, in your opinion the institution is prepared for a site visit to be scheduled to ascertain the readiness and fitness of the institution to offer its Airway Science Curriculum.

Sincerely,

Thomas E. Leonard

Thomas E. Leonard
Committee Chair

cc: Ollie Edwards
Clarence Hedge
Gary Kiteley

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

AUG 7 1992

Professor Clarence Hedge
Technologist
Langston University
P.O. Box 967
Langston, OK 73050

Dear Professor Hedge:

The Federal Aviation Administration sincerely appreciates your interest in the Airway Science (AWS) Program and in providing a strong educational background for tomorrow's aviation leaders. We have carefully reviewed your curriculum proposal and comments we requested from the University Aviation Association (UAA) AWS Curriculum Committee.

I am pleased to report that an assessment of your proposal indicates that the curriculum core and Airway Electronics Systems area of concentration appear to meet the spirit and intent of the generic curricula:

Final recognition of these curricula is subject to a certification from the highest appropriate academic official of your institution that the curricula has the necessary approvals and the courses are available for offering to students. Upon receipt of this certification, a visit to your school by members of the UAA Curriculum Committee will be scheduled. Final recognition will allow a favorable review by the visiting team. The statement should be sent to the undersigned at the following address:

Federal Aviation Administration
Office of Training and Higher Education
ATTN: Margaret Powell, AHT-30
400 7th Street, SW, Room PL-100
Washington, D.C. 20590

Again, thank you for your interest in the AWS Program. We look forward to hearing from you in the immediate future.

Sincerely,

Margaret L. Powell

Margaret L. Powell
Manager, Airway Science
Curriculum Program

- ✓ APPROPRIATED FY 82-91: $61,162,890
- ✓ 69 INDIVIDUAL GRANTS
- ✓ INSTITUTIONS
- ✓ $1,3 MILLION IN FY 91 FUNDS TO BE
- ✓ AWARDED IN FY 92

AIRWAY SCIENCE GRANT PROGRAM
MINORITY/MAJORITY AWARDS
FY 82 – 91

APPENDIX B

SITE VISIT

Federal Aviation Administration
Airway Science Curriculum Committee

Site Visit Procedures

1. The Airway Science (AWS) Curriculum proposal including any revisions must be determined by the AWS Curriculum Committee to meet the spirit and intent of the AWS Curriculum Program.

2. A letter is sent to the institution by the AWS staff with tentative visit dates. This procedures document is enclosed.

   a. The institution will be asked to prepare the following materials for mailing to the team members for preliminary.

      1) Appropriate current catalogs and brochures
      2) University and department organizational charts and mission statements
      3) Most recent department and/or division annual report

   b. The institution will be asked to have the following available for the site visit:

      1) prospective student information – brochures, outlines, handouts
      2) summary of graduates and placement (aviation) from the previous academic year
      3) resumes of all full and part-time faculty
      4) a sampling of student advisory check sheets (used in advisement)
      5) aviation program enrollment for past ten years; AWS enrollment since date of recognition, or forecast enrollment if not yet recognized
      6) a sampling of aviation and transfer policy
      7) copies of articulation agreements with institutions involved with Airway Science
      8) statement of admission and transfer policy
      9) statement of course substitution policy
      10) statement of life experience policy
      11) most recent self-study report for institutional accreditation
      12) work room for team to draft report and liaison for additional information if required
      13) if Aircraft Systems Management or Aviation Maintenance Management AOC is proposed, a copy of the appropriate FAA Air Agency Certificate(s)

3. Institutions will respond with preferred dates, suggested hotels, and name of their AWS representative.

4. Team will be assigned and notified by letter.

5. Team leader will established visit schedule and advise team members.

6. Team members will make appropriate airline and hotel reservations.

7. Second letter to institution will confirm site visit date and give names and addresses of team members, indicating team leader. List of materials to be received by team members and deadline date will be included.

8. Team leader will contact institution's AWS representative to discuss schedule for visit and hotel selected.

9. Team members arrive at the site and discuss the file prior to the visit (usually the night before).

10. The actual visit should include the following:

    a. meeting with the senior administrative official department head, and AWS institutional representative to obtain an overview and discuss the site visit schedule
    b. interviews with faculty, staff, students, alumni (if possible), and appropriate school administration
    c. facility tour including classrooms, laboratories, airport (if applicable), offices, library, and learning resources facilities
    d. examinations of FAR Part 141 – Pilot Schools and/or FAR Part 147 - Aviation Maintenance Technician Schools capabilities, if applicable
    e. scheduled time for the team to meet privately at the conclusion of events listed in (a.) through (d.) to discuss contents of the site visit report
    f. exit interview with senior administrative official department head, and AWS institutional representatives

11. Team leader complete draft report and mail to institution for factual accuracy only.

12. Team leader finalizes site visit report and forwards it to the other team members for signature. It is then sent to the UAA office no later than four weeks after the conclusion of the visit. The report should follow the format below:

a. Introduction
b. Institutional Description
c. Program Description
d. Administration and Faculty
e. Admission and Student Services
f. Facilities and Equipment
g. Readiness and Fitness to offer Airway Science Program
    1) Strengths
    2) Weaknesses
h. Conclusions and Recommendation

13. Copies of the draft site visit report are forwarded to all committee members no later than two weeks before the next scheduled meeting of the AWS Curriculum Committee.

14. At the next AWS Curriculum Committee meeting, pending site visit reports are reviewed and discussed. Reports are either adopted or rejected, with or without changes, by a majority vote of the Committee. The action of the Committee is put into the report.

15. Final visit reports are prepared by the team leader, if necessary, and are forwarded to the UAA office within one week after the Committee meets.

16. The site visit report is forwarded to the FAA by the AWS Committee Chairperson within 20 days after the Committee action on the team findings.

17. The applicant institution is notified by the FAA of the committee's action and is furnished a copy of the site visit report.

APPENDIX C

JOB DESCRIPTIONS

U.S. Department
of Transportation
**Federal Aviation
Administration**

December 9, 1998

Dear Education Professional:

This is a follow-up to a prior package that we sent to you regarding the application form and study guide for students who wish to apply for electronics specialist positions in the Federal Aviation Administration (FAA).

The FAA is seeking talented individuals with a good background in math and electronics to work in our electronics specialist occupations. We are hopeful that there are students at your institution who may be interested in employment with the FAA.

FAA's electronics specialists install, maintain, and operate all of the critical equipment supporting our nation's airspace system, the safest in the world. Positions are available for individuals to work on radar, navigational aids, telecommunications, automation, and environmental systems. The FAA has facilities and career opportunities nationwide and is currently accepting applications for employment.

The FAA electronics specialist web site (http://www.faa.gov/ats/best) provides detailed job information and the procedures for submitting an application. All documents relating to the employment process are available for download from the web site, including a study guide for our exam of math and electronics, the Basic Electronics Screening Tool (BEST). Individuals may also submit employment applications on line via the internet at our web site.

We have enclosed a floppy disk with a self-extracting file containing three important documents from the FAA web site relating to the application process for electronics specialist jobs. Please feel free to copy this disk and distribute it to students who may be interested in employment with the FAA. If you prefer hard copies of these documents please let us know and we will provide them to you.

We also invite you to place a link from your institution's career placement web site to the FAA's electronics specialist web site. It will provide immediate access to FAA job and employment information to all interested individuals.

If you have any questions regarding this matter we would be glad to speak with you. Our phone numbers in Washington, DC are 202-267-3906 (Margaret Powell) and 202-267-3638 (Jess Robinson). Thank you for your time and for your interest in the FAA.

Sincerely,

Margaret L. Powell
FAA, Program Manager, Historically Black Colleges and Universities

Jess J. Robinson
FAA, Program Manager, BEST

FAA Electronics Specialist Positions

Career Opportunities

Electronics Specialist positions with promotion potential are available in the following areas:

Radar – Radar specialists are employed in several different functions. Some are assigned to long-range radar sites, which scan a 200-mile radius. The radar information is sent via microwave link to Air Route Traffic Control Centers (ARTCCs), which control en route air traffic. Other radar specialists may work at an ARTCC on equipment creating a composite image from many long-range radars. Another possible assignment is at a large metropolitan airport that uses radar equipment to control arriving and departing traffic.

Navigation Aids – Navigational Aids specialists support the "highways in the sky" with a vast array of equipment assisting both pilots and controllers in the air traffic system. Specialists in this area install and maintain a variety of equipment providing precise approach and landing information, measuring runway visibility, allowing pilots to land their planes using instruments in bad weather, and warning pilots of drastically changing wind conditions which could adversely affect landing. Other navigational aids systems locate and direct lost aircraft using sophisticated direction finding equipment.

Telecommunications – Telecommunications specialists install and maintain the vital equipment that provides voice communications between pilots and air traffic controllers or flight service station personnel, who provide weather briefings and other services to pilots. These specialists may work at an ARTCC, an airport communications facility, or at remote locations. They are ultimately responsible for a large complex electronic network involving multi-channel recording systems and radio equipment. Air to ground radio communications must be maintained with all pilots flying in the United States.

Automation – Automation specialists work at metropolitan airports and at ARTCCs. Each of these controlling facilities has an associated computer that optimizes radar information, processes flight plans, and tracks an aircraft from departure to arrival at its destination airport. FAA automation specialists constantly monitor these computers for efficient and safe operations.

Environmental Systems and Equipment – Environmental Systems and Equipment specialists maintain equipment ranging

from runway approach lighting systems to climate control equipment in facilities, to emergency generators used to ensure an uninterrupted flow of electricity, to the equipment used in various facilities to control air traffic.


This document produced on November 25, 1998.

AMENDMENT

Department of Transportation
Federal Aviation Administration
Recruitment Bulletin
FAA-AF-98-01-20033M

Open Date: Nov 15,1998
Close Date: Open Continuous
Position: Airway Transportation Systems Specialist/Electronics Technician ,FG-2101/0856-5/7/9/11
Salary Range: $19,969 to $36,609
Location: Nationwide
Organization Location: FAA National Region, Airway Facilities Service

PCS: Expenses are not authorized for relocation/moving expenses.

Area of Consideration: All Sources

Duties: Electronics Technicians (ET) and Airway Transportation System Specialists (ATSS) install and maintain electronic equipment and lighting aids associated with facilities and services required for aviation navigation to assure a reliable, safe and smooth flow of air traffic. This involves work with radar, communications, computers, navigational aids, airport lighting aids, and electrical/mechanical support for facilities on and off airports within the network of the National Airspace System (NAS). It includes periodic maintenance (inspection and analysis of equipment with associated adjustments), corrective maintenance troubleshooting, repair and replacement of malfunctioning equipment and certification. ET's may also assist in the design, development and evaluation of new types of electronic equipment, while ATSS's could be involved with not only electronic equipment but also lighting aids and environmental support equipment for the NAS. Many ET's and ATSS's work out of offices located at or near airports and service equipment located on airports, in Air Traffic Control Towers (ATCT), Automated Flight Service Stations (AFSS), in open fields or even on remote mountain tops. It is often necessary to drive significant distances (100-200 miles) to reach facilities. ET's and ATSS's also work in Air Route Traffic Control Centers (ARTCC) maintaining equipment within the facility. ET's normally maintain the electronics portion of facilities. ATSS's may be required to maintain entire facilities, including electronic equipment, electrical power distribution, emergency backup power, power conditioning systems, and heating, ventilation and air conditioning (HVAC); electronic equipment only; or power and HVAC only. Some ET's travel throughout a large geographic region of the country installing new electronic equipment at a wide range of facilities and remote locations.

Amendment date: Nov 23,1998
Amendment Note: Amended to correct FAA's web site address.

NOTE: Employees entering into these positions must successfully complete training requirements in the first year of employment or the result may be separation from the FAA.

Travel and Shift Work: Some ATSS's and ET's may be required to travel away from home up to 80% of the time. Some positions involve work that must be performed outdoors during various weather conditions. Most positions involve rotating shifts, weekend and holiday work.

Salary: The basic salary range is reflected above. The starting salaries for each grade are as follows: FG-5 - $19,969; FG-7 - $24,734; FG-9 - $30,257 and FG-11 - $36,609. Salary will be adjusted to include locality pay based on the duty location of the position.

Promotion Potential: FG-2101 positions have promotion potential without further competition to the FG-12 full performance level. FG-856 positions have promotion potential without further competition to the FG-11 full performance level.

Qualification Requirements: Applicants applying for these positions must possess experience as technicians, instructors, inspectors or mechanics (civilian or military) which shows progression in theoretical and practical knowledge of electronic theory and of characteristics, function, operation and capabilities of a variety of types of electronic equipment, electrical power distribution systems, emergency backup power systems, power conditioning systems, or HVAC systems. This experience must have included the use of schematic diagrams, varieties of test equipment, and the application of appropriate electronic/electrical-mechanical formulas involved in such duties as testing, troubleshooting, modifying, designing, calibrating, installing, maintaining, repairing, constructing, developing and/or instructing on the above listed systems/equipment, or similar functions.

OR Experience that provides a basic knowledge of the principles of electronics, mathematics, computers, aeronautics, or related areas, and/or an understanding, both theoretical and practical, of automated systems operations, integration, management, and maintenance. Experience may have been gained in one or more occupations including, but not limited to computer specialist, electronics technician, telecommunications specialist, engineer, etc.

OR Experience in developing policies, standards and procedures for maintenance, installation, or similar functions provided the work clearly shows that the applicant applied specialized knowledge of the theories and principles of a variety of electronics systems/equipment, electrical power distribution systems, emergency backup power systems, power conditioning systems or HVAC systems.

Additional Requirements: In addition to meeting the basic requirements, all applicants must take and pass the BEST (Basic Electronics Screening Tool). The BEST is an examination of math and electronics. Applicants who meet basic job requirements will be given information on BEST testing sites and scheduling. More information and a viewable copy of the Applicant Guide to the BEST, a preparatory guide to the BEST exam, is available on the FAA's web site at http://www.faa.gov/ats/best.

NOTE: This announcement does not cover FG-2101 positions located at the National Control Centers (NCC's) or FG-856 positions classified as Airborne Electronics Technicians.

Evaluation Criteria: Applicants will be evaluated based on their responses to the Application for Employment with the Federal Aviation Administration, FAA Form 20033. There are three versions of this form dated 12/97, 4/98 and 11/98. The version dated 11/98 is complete but the other versions require Amendment 2 to the Recruitment Bulletin dated 11/15/98. DO NOT MIX PAGES FROM THE DIFFERENT VERSIONS OF THE QUESTIONNAIRE.

Physical Requirements: You must be able to perform efficiently the essential functions of the position without hazard to yourself or others. Depending on the position, usable vision (including

APPENDIX D

DEMOGRAPHICS

Estimate of FAA Airway Science Hires

	1984	*1985*	*1986*	*1987*	*1988*
Air Traffic controller	*70*	*215*	*355*	*355*	*355*
Electronics Technician	*25*	*72*	*122*	*122*	*122*
Aviation Safety Inspector	*4*	*10*	*18*	*18*	*18*
Computer Science	*1*	*3*	*5*	*5*	*5*
Totals	*100*	*300*	*500*	*500*	*500*

APPENDIX E

PERSONAL INTERVIEWS

AIRWAY SCIENCE SURVEY 1998

Electronics and Environmental Technicians:

1. Gender:
   Male_____ Female_____

2. Race/Ethnicity:
   African American_____ Hispanic_____
   American Indian_____ White_____
   Asian_____ Other(specify)___

3. Which best describes your position?
   A. Radar_____
   B. Automation____
   C. Communications_____
   D. Navigation_____
   E. Instruction_____
   F. Environmental_____

4. How long have you worked in the electronics field?
   A. 0-2 years_____
   B. 3-5 years_____
   C. 6-10 years_____
   D. 11-15 years_____
   E. 16 or over_____

5. Where did you obtain your training?
   A. Military_____
   B. Associated Degree Program_____
   C. Baccalaureate Degree Program_____
   D. Vocational Training_____
   E. Other (specify)_____

6. What is the highest level of education you have achieved?
   A. High school diploma_____
   B. Associate degree two years_____subject area_____
   C. Bachelor degree_____subject area_____

D. Master's degree_____subject area_____
E. Doctorate degree_____subject area_____
F. Specialist degree_____subject area_____

7. What vocational training have you had?
List subject area
secondary_____
post secondary_____

8. What is the title of your current position and number of years in position?
Title of position:_____
Number of years in position_____

9. Did the formal training you had in the service or college relate to the field you are now employed in?
Yes_____ No_____

10. Do you have administration/supervision responsibility?
Yes_____ No_____

11. Indicate the experience/activities that prepared/moved you to your current position. Check all those that apply
A. Internship/Coop_____
B. Networking with professionals/friends_____
C. Advanced training_____
D. Other (please specify)_____

PLEASE PLACE A CHECK MARK IN THE SPACE BELOW THAT WOULD INDICATE WHERE YOU RECEIVED ELECTRONIC TECHNICIAN TRAINING.

Circuit Conventions: *Determine the correct direction for both conventional and electron current flow.*							
Voltage Dividers: *Solve for all output voltages from a predetermined reference point.*							
Kirchhoff's Laws: *Interpret and employ Kirchhoff's voltage and current laws.*							
Network Theorems: *Interpret and comprehend the constand voltage and current generator and its effect when applied to a load.*							
Impedance in series/Parallel RL Circuits: *Analyze a phasor diagram of a series RL circuit and vectorially solve for all voltage and current magnitudes and phase relationships.*							
Series Resonant Circuits: *Analyze a phasor diagram of a series RLC circuit and vectorially solve for all voltage and current magnitudes and phase relationships.*							
Parallel Resonant Circuits: *Analyze a phasor diagram of a parallel RLC circuit and vectorially solve for all voltage and current magnitudes and phase relationships.*							
Fillers: *Calculate the cutoff frequency, midrange output, and attenuation of RC and RL low-pass filter networks.*							
Electrical Properties and Time: *Identify the relationship between charge (Q) per-unit-time and current flow.*							
Transient Analysis of RC Circuits*: Identify the rise and decay function equations.*							
Transient Analysis of RL Circuits: *Identify the initial electrical values of an RL circuit when voltage is initially applied.*							
Waveform Analysis of RL and RC Circuits:							

Identify the initial and final values of an RC or RL transient circuit using Kirchhoff's voltage law and express this transient condition in the form of an equation.							
RC Circuit and a Repetitive Step Function Source: *Identify the steady state condition of an RC circuit.*							
RL Circuit and a Repetitive Step Function Source: *Identify the relationship between a repetitive step function source and the time constant of an RL Circuit and how this relationship effects the time required to reach a steady state condition.*							
DIODE Characteristics: *Illustrate and interpret the proper biasing for a two-terminal device.*							

APPENDIX F

SURVEY LETTER OF INTRODUCTION

OKLAHOMA STATE UNIVERSITY

OSU

School of Educational Studies

College of Education
204 Willard
Stillwater, Oklahoma 74078-4045
405-744-6275; Fax 405-744-7758

June 6, 1998

Dear Airway Science Program Educator:

The Federal Aviation Administration's (FAA) mission is to ensure the safe and efficient use of the nations airspace. To help accomplish this mission, the FAA initiated the Airway Science Program. From the time the FAA began looking at the academic community to prepare the technically trained people needed in aviation careers, questions have been asked about its success.

As a doctoral student at Oklahoma State University, I have developed an interest in the Airway Science Program and in particular the Electronics Systems option. I have discovered that newly hired FAA Electronics Technicians are coming from a wide variety of training pools. In order to determine if the Airway Science Electronics Systems Program is effective, your response and input on a national survey will provide the needed information for its effectiveness.

Adult Education
Aviation and Space Education
Higher Education
Human Resource Development
Organization and Leadership
Research and Evaluation
Social Foundations
Student Personnel
Technology

Summary of the data collected from this survey will be available to each respondent. The outcome of this survey may very well help you in further developing well-trained students in the Airway Science program at your institution.

Please take a very few minutes of your valuable time to complete the survey and return it in the enclosed stamped envelope. Your responses are strictly confidential. Please understand that participation is voluntary and there is not a penalty for refusing to participate. If you do not wish to participate, please return the uncompleted survey in the enclosed return envelope.

If you have any questions regarding this study, please do not hesitate to contact Clarence A. Hedge (405) 466-3303, Dr. Kenneth Wiggins (405) 744-7015 or Gay Clarkson, Institutional Review Board Executive Secretary (405) 477-5700.

Thank you for supporting your profession and for your assistance in completing this survey.

Sincerely,

Clarence A. Hedge
Doctoral student

Kenneth Wiggins

Dr. Kenneth Wiggins, Chairman
Department of Aviation and Space

APPENDIX G

SURVEY INTRUMENT

EFFECTIVENESS OF THE AIRWAY SCIENCE
ELECTRONICS SYSTEMS PROGRAM

SURVEY: Please take a moment to complete the following survey. The results will be sued to determine the effectiveness of the Airway Science Electronics Systems Program.

PART I

1. Do you offer an Airway Science Electronics Systems Program?
   ( )yes ( )No

2. If yes, when did you start the Airway Science Program? _____

3. What degrees are offered? ( )Associate ( )Bachelor's ( )Master's
   ( ) Doctorate

3. What is the average yearly enrollment in your Electronics Systems Program? _____

4. Please indicate your response by checking the appropriate box of each Airway Science Program offered at your institution.
   ( )Airway Science Management ( )AA ( )BS ( )MS ( )DR
   ( ) Airway Computer Science ( )AA ( )BS ( )MS ( )DR
   ( ) Aircraft Systems Management ( )AA ( )BS ( )MS ( )DR
   ( ) Airway Electronics Systems ( )AA ( )BS ( )MS ( )DR
   ( ) Aviation Maintenance management ( )AA ( )BS ( )MS ( )DR

PART II

Graduates/Placement

1. How many graduated in Airway Science Electronics Technology during the 1997/98 school year? _____

2. Number of Electronics Systems students placed in internship and/or Co-Operative Education Programs? _____

3. Number of Electronics Systems students placed in internship and/or Co-Operative Education Programs at a FAA facility. _____

4. Please identify 1997/98 Electronics Systems graduate placement in Each box below:
   Graduate School ( )
   FAA Facility ( )
   Other Government ( )
   Manufacturing ( )
   Management Sales ( )
   Other (specify) ( )

5. To what degree do you agree or disagree with the following statements?

   A. Graduate of the Airway Science Program may be hired directly by the FAA with regard to the usual criteria.

      ( ) Strongly Agree
      ( ) Agree
      ( ) Undecided
      ( ) Disagree
      ( ) Strongly disagree

   B. It is difficult to attract new students for the Airway Science Programs.

      ( ) Strongly Agree
      ( ) Agree
      ( ) Undecided
      ( ) Disagree
      ( ) Strongly disagree

   C. The overall effectiveness of the Airway Science Program is meeting FAA work force requirements.

      ( ) Strongly Agree
      ( ) Agree
      ( ) Undecided
      ( ) Disagree
      ( ) Strongly disagree

   D. Graduates of Airway Science Programs find greater employment opportunities outside the FAA.

      ( ) Strongly Agree
      ( ) Agree
      ( ) Undecided
      ( ) Disagree
      ( ) Strongly disagree

   E. Students graduating from an approved Airway Science Electronics Systems Program have an advantage over those graduating from other Electronics programs.

      ( ) Strongly Agree
      ( ) Agree
      ( ) Undecided
      ( ) Disagree
      ( ) Strongly disagree

6. What are the strengths of the Airway Science Program?

7. What are the weaknesses of the Airway Science Program?

APPENDIX H

INSTITUTION REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 07-31-98 **IRB #: ED-99-002**

Proposal Title: A STUDY OF THE QUALITY AND EFFECTIVENESS OF THE AIRWAY SCIENCE ELECTRONICS SYSTEMS PROGRAM TO MEET THE WORKFORCE NEEDS OF THE FEDERAL AVIATION ADMINISTRATION

Principal Investigator(s): Kenneth Wiggins, Clarence A. Hedge

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: Thomas C. Collins Date: August 3, 1998

Interim Chair of Institutional Review Board
and Vice President for Research
cc: Clarence A. Hedge

APPENDIX I

BASIC ELECTRONICS SCREENING TOOL (BEST)

APPLICANT GUIDE

to the Basic Electronics Screening Tool (BEST)

Version 1
November 1997

Table of Contents

Introduction

I. Overview

The Basic Electronics Screening Tool (BEST) is an examination of math and electronics which assesses the knowledge required for entry into electronics specialist jobs in FAA's Airway Facilities Service. The BEST exam is required for entry into the following Airway Facilities positions:

- FG-2101, Airway Transportation Systems Specialist
- FG-856, Electronics Technician

Prior to taking the BEST exam, all applicants must submit an application form (FAA Form 20033) and meet the basic requirements for the job. Applicants who meet the basic job requirements will be given information on BEST testing sites and scheduling procedures.

If you haven't already submitted an application form, please call 1-800-445-4FAA or visit our world wide web site at http://www.faa.gov/ats/best for more information.

The BEST exam is a multiple-choice test which contains four separately timed sections:

	Topic	Number of Questions	Time Limit
Section 1	AC/DC and Transients	21	90 minutes
Section 2	Digital	21	60 minutes
Section 3	Solid State	23	90 minutes
Section 4	Field Effect Transistors (FET's) and Linear Integrated Circuits (IC's)	24	90 minutes

II. General Testing Information

Check-In Procedure. Upon arrival at the testing site you will be asked to present photo identification. The identification must contain your photograph and signature. You will be asked to sign in at the testing site. You will also be asked to present the testing registration number provided to you by the FAA.

Materials. All materials necessary to complete the examination will be provided to you at the testing site. The following materials will be provided:

- Texas Instrument TI-34 calculator or equivalent
- Formula sheets (identical to those found in this guide)
- Scrap paper
- Pencils

You will not be permitted to bring any of your own personal materials, such as calculators or your own formula sheets, into the testing room. If you do bring personal items to the testing session, they will be held by the test administrator during testing and returned to you upon completion of the exam.

Surveillance. Each testing session will be videotaped via a closed circuit video camera for security purposes.

Breaks. You will be allowed to take short breaks between each test section. Sufficient time will be allowed for a lunch break if desired. If you choose to take a break while working on a test section, the time limit for that section will not be extended.

Scoring. Your overall score will be calculated by the number of questions you answered correctly across all four sections. Passing grades are based on the overall score. There is no penalty for wrong answers.

Test Results and Feedback. The FAA will mail your results directly to you within two weeks of the completion of testing. If you did not achieve a passing score, your results will include feedback on the topic areas in which you need improvement. You will not be given any results or feedback at the testing site.

Retesting. If you did not achieve a passing score, you will be given the option of retaking the exam within a period of 30 to 90 days from the date of the mailing of your initial results. All persons retaking the exam must retake the entire exam regardless of prior performance on the four sections.

III. Using This Guide to Prepare for the BEST

The Applicant Guide to the BEST provides you with the following information to help you prepare for the BEST exam:

- A listing of topic areas within each test section.
- Sample references for each test section.
- Sample test questions for each test section.
- A listing of formulas commonly used in solution of test questions.

Listing of Topic Areas. For each test section, a comprehensive listing of topic areas is provided. Some topic areas are covered by a single test question; other topic areas are covered by multiple test questions.

Sample References. Each test section has a listing of electronics textbooks that contain instructional material corresponding to the topics appearing on the exam. These textbooks are only a sample of the excellent published materials available on this subject area. The FAA neither endorses nor recommends the use of any particular textbook. References are provided for the convenience of the user of this guide.

Formula Sheets. A comprehensive listing of formulas which are commonly used to solve the types of test questions found on the BEST exam is included. A copy of this formula sheet will be provided to you at the testing site.

Sample Test Questions. Each test section has a number of sample test questions with the correct solutions worked out. These sample questions are representative of the types of questions that appear on the BEST exam. The sample questions provide a representative sampling of the topics within each test section, *but not all topics covered by the BEST exam have sample questions included in the Applicant Guide.*

Summary. The information included in this Applicant Guide has been assembled to provide you with an accurate representation of what will be on the BEST exam, including topic coverage and level of depth of test questions. You have been given an opportunity to practice your skills by working out some sample test questions. You also have been provided with references to commonly used textbooks and a list of formulas which can be used to solve the types of test questions that appear on the BEST exam. We encourage you to take the time to use these materials in preparation for the BEST exam.

Topic Areas Within Each Testing Section

Section 1: AC/DC and Transients

DC and AC Circuit Analysis

- Series/Parallel Circuits
- Voltage Dividers
- Series/Parallel RL Circuits
- Series/Parallel RC Circuits
- Series Resonant Circuits
- Parallel Resonant Circuits
- Passive Circuits

Transient Circuit Analysis

- Transient Analysis of RC Circuits
- Transient Analysis of RL Circuits
- Waveform Analysis of RL and RC Circuits

Section 2: Digital

- Number Systems
- Number Codes
- Logic Signals
- Logic Switches
- Logic Gates
- Logic Families
- Flip-Flops
- Registers
- Multivibrators
- Counter Circuits
- Arithmetic Circuits
- Code Converters
- Multiplexers
- Demultiplexers
- Interface Circuits

Section 3: Solid State Devices

Semiconductor Devices

- Diode Characteristics
- Diode Analysis
- Diode Circuits
- Zeners
- Silicon Controlled Rectifiers (SCR's)
- Varactors
- Thermisters

Bipolar Junction Transistors (BJT's)

- Junction Transistor Configurations
- DC Biasing BJT's
- Small Signal Analysis
- Power Amplifiers
- Basic Differential Amplifiers
- Constant Source for Differential Amplifiers
- Differential Amplifier Circuits

Section 4: Field Effect Transistors (FET's) and Linear Integrated Circuits (IC's)

Field Effect Transistors

- JFET and MOSFET Characteristics
- JFET and MOSFET Characteristics
- JFET and MOSFET Small Signal Analysis
- JFET and MOSFET Amplifiers

Linear Integrated Circuits

- Inverting Amplifiers
- Non-Inverting Amplifiers
- Differentiators
- Comparators

References For Each Test Section

These textbooks are only a sample of the excellent published materials available on this subject area. The FAA neither endorses nor recommends the use of any particular textbook. References are provided for the convenience of the user of this guide.

Section 1

Bell, D.A. (1995). Electric Circuits: Principles, Applications, and Computer Analysis. Englewood Cliffs, NJ: Prentice-Hall.

Cook, N.P. (1996). Introductory DC/AC Electronics (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Mottershead, A. (1990). Electricity and Electronics Electron Flow Version (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Veley, V.F. & Dulin, J.J. (1992). DC/AC Fundamentals (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Section 2

Floyd, T.L. (1997). Digital Fundamentals (6th Ed.). Englewood Cliffs, NJ: Prentice-Hall.

Kleitz, W. (1990). Digital Electronics: A Practical Approach (2nd Ed.). Upper Saddle River, NJ: Prentice Hall,

Section 3 and Section 4

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VITA

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Doctor of Education

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Major Field: Applied Educational Studies

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