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No juried publication can excel, unless experts in the field serve as anonymous reviewers. Indeed, the ultimate guarantors of quality and appropriateness of scholarly materials for a professional journal are the knowledge, integrity, and thoroughness of those who serve in this capacity. The thoughtful, careful, and timely work of the Editorial Board and each of the following professionals added substantively to the quality of the journal, and made the editor's task much easier. Thanks are extended to each reviewer for performing this critically important work.

In addition to the members of the UAA Publications Committee, the reviewers include:

David Scott Worrells	Southern Illinois University – Carbondale
Bernard W. Wulle	Purdue University
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In addition, the editors express thanks to Ms. Sheron Griggs, Purdue University, for her tireless and very effective efforts in assembling and formatting the manuscript.

STATEMENT OF OBJECTIVES

The *Collegiate Aviation Review* is published semi-annually by the University Aviation Association. Papers published in this volume were selected from submissions that were subjected to a blind peer review process, for presentation at the 2007 Fall Education Conference of the Association.

The University Aviation Association is the only professional organization representing all levels of the non-engineering/technology element in collegiate aviation education. Working through its officers, trustees, committees and professional staff, the University Aviation Association plays a vital role in collegiate aviation and in the aviation industry.

The University Aviation Association accomplishes its goals through a number of objectives:

To encourage and promote the attainment of the highest standards in aviation education at the college level.

To provide a means of developing a cadre of aviation experts who make themselves available for such activities as consultation, aviation program evaluation, speaking assignments, and other professional contributions that stimulate and develop aviation education.

To furnish a national vehicle for the dissemination of knowledge relative to aviation among institutions of higher education and governmental and industrial organizations in the aviation/aerospace field.

To foster the interchange of information among institutions that offer non-engineering oriented aviation programs including business technology, transportation, and education.

To actively support aviation/aerospace-oriented teacher education with particular emphasis on the presentation of educational workshops and the development of educational materials in the aviation and aerospace fields.

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Call for Papers

for the

2008 UAA Fall Education Conference

and the

Collegiate Aviation Review (CAR)

Both qualitative and quantitative research manuscripts are acceptable. All submissions must be accompanied by a statement that the manuscript has not been previously published and is not under consideration for publication elsewhere.

All authors will be required to sign a "Transfer of Copyright and Agreement to Present" statement in which (1) the copyright to any submitted paper which is subsequently published in the ***CAR*** will be assigned to the University Aviation Association (UAA) and in which (2) the authors agree to present any accepted paper at a UAA conference to be selected by the UAA, if requested.

Authors should email an electronic version of their manuscript to the editor, conforming to the guidelines contained in the *Publication Manual of the American Psychological Association*, 5th Ed. (APA). The UAA review process incorporates editorial input and recommendations from "blind" peer reviewers. A list of all reviewers is available from the ***CAR*** editor and is published annually in the ***CAR.*** If the manuscript is accepted for the publication, the author(s) will be required to submit a final version of the manuscript via e-mail, in "camera-ready" Microsoft Word format, by the prescribed deadline. *Authors should use the previous year's CAR for guidance in format and page layout.*

All manuscripts must be emailed no later than December 1, 2007 (Spring 2008 Issue) or June 1, 2008 (Fall 2008 Issue), and should be sent to the editor, Dr. Richard O. Fanjoy, at rofanjoy@purdue.edu.

Questions regarding the submission or publication process may be directed to the editor at (765) 494-9964, or may be sent by email to: rofanjoy@purdue.edu.

Students are encouraged to submit manuscripts to the ***CAR***. A travel stipend up to $500 is available for successful student submissions. Please contact the editor or UAA for additional information.

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Quality Improvement in Aviation Education: A Framework for Programmatic Assessment and Quality Improvement

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ABSTRACT

There is a growing concern in higher education for a system of assessment and program quality improvement. This paper introduces a program evaluation system that may be used for evaluating higher education programs in a manner that provides an understandable quantitative quality metric. It provides background on the movement of higher education into the realm of quality management of educational processes, the national quality movement in public education, and efforts by the International Standards Organization and its affiliate organizations to establish international standards for education. Finally, it describes a seven-step assessment and quality improvement process. These steps reflect structure found in the Kirkpatrick Model of Program Evaluation and guidelines provided by the Central Missouri State University Quality Improvement Plan.

INTRODUCTION

The purpose of this paper is to discuss and propose a program for collegiate aviation programs that can act as a framework assessment and quality improvement. This proposal suggests what needs to be done to improve the programmatic quality of academic and technology aviation courses through the application of Central Missouri State University's (CMSU) quality program guidelines to an existing programmatic evaluation concept developed by Kirkpatrick (Phillips,1997) called the Kirkpatrick Four-Level Approach. This paper discusses the Kirkpatrick model, the CMSU Quality Improvement Program, and the Aviation Quality Improvement Program which combines them into a useful tool for assessing and controlling aviation education programs. It suggests how to develop a program with moderate effort on the part of the department and its faculty to provide a control mechanism (the last function of management according to Bateman and Snell (2004)) that may be used to manage an academic program and improve the quality of its graduates.

Since 1983 and the publication of *A Nation at Risk* (National Commission on Excellence in Education U.S., 1980), the public school system has been struggling with the concept and requirement of measuring (assessing) student accomplishment against a set of desired learning outcomes. From the outset, there has been resistance to evaluating students against fixed outcomes. Teachers believe that their classrooms are being invaded by people and agencies that have no understanding of the pedagogical challenges faced daily by teachers and that their traditional freedom to interpret the curriculum in their own way is being threatened by this intrusion.

A quick review of *Phi Delta Kappan - The Professional Journal for Education* for the last decade will provide ample examples of the basis of the statements above. An example would be the comments made by Professor Emeritus Maurice Holt (2002) when he wrote: “The curriculum straitjacket is the price extracted for believing that education is about assessed performance on specified content” (p.1). Holt continues with this theme by suggesting that “Commitment to standards-led school reform means creating a system of schools geared solely to the product—test results—and not to the process of creating educative experiences” (p.3).

About a decade ago, this movement began to spread into higher education, and today the budding concept of improving the quality of the educational experience is beginning to bloom in the ivy halls of higher education institutions. Ten years ago at Central Missouri State University, the North Central Association of Colleges and Schools (NCACS) indicated that the university assessment system was in need of strengthening. This concern stems from the NCACS's Academic Quality Improvement Program (North Central Association of Colleges and Schools, 2004) that begins with a complete assessment of member school performance. Thus, for the past 10 years there has been an accelerating effort at many universities to develop and institute a meaningful system of quality improvement and assessment of student achievement.

Surely, this movement in education has been a spin-off from our national enchantment with a management movement developed during the last quarter of the 20th Century called Total Quality Management (TQM). In multiple forms, quality management has caught on in businesses around the world. This growing interest has spawned the need for quality standards and created an international clearing house of standards for quality improvement in various industries. Since 1996, various members of the International Organization for Standardization (ISO) have published proposed or final quality standards for education. For example, the *International Workshop Agreement (IWA) 2:2003* provides guidelines for the application of ISO 9001:2000 in educational organizations providing educational products. This standard basically applies the procedures of quality improvement used by industry for almost two decades to education. The goal is simple: improve the processes used to educate students, ultimately improving student learning (International Organization for Standardization, 2003). This document was preceded by a proposed base document created by the *American Society of Quality's ASQ Z1.XX: Guidelines on the Application of ISO-9001:2000 to Knowledge Work and Lifelong Learning* (Pivec, Schoening, & Sinitsa, 2001) and by the American National Standards Institute (1996) in its document, *ANSI/ASQC Z1-11-1996: Guidelines for the Application of ANSI/ISO/ASQC Q9001 or Q9002 to Education and Training Institutions*.

THE KIRKPATRICK PROGRAM EVALUATION MODEL

Before describing the Aviation Quality Improvement Program (AvQIP) the basis of its design should be discussed. The framework used to build this evaluation system was the Kirkpatrick Program Evaluation Model. This is one of several models that have been used successfully to measure the effectiveness of training programs.

The Kirkpatrick model was selected from five models facilitating this process. The other models included the Kaufman Five-Level model, the CIRO Approach, the CIPP and the Phillips' Five-Level model. Kirkpatrick's model was chosen for its adaptability to the higher education process. (Phillips,1997).

According to Nickols (2000), Donald Kirkpatrick set forth his four-level approach to the evaluation of training in a series of articles appearing in the journal of what was then known as the American Society of Training Directors. The first of these four seminal articles was published in November of 1959. The remaining three articles were published in the succeeding three months, with the fourth and final article appearing in February of 1960. These articles can be found in *Evaluating Training Programs*, a collection of articles compiled by Kirkpatrick from the pages of the American Society & Training and Development (ASTD) Journal and published by ASTD in 1975. The phases of the Kirkpatrick program evaluation model are defined below.

Level 1: Reactions. This phase is an assessment of how well the students liked a particular training program. Reactions are typically measured at the end of training. They may also be measured during the training, even if only informally in terms of the instructor's perceptions (Nickols, 2000). This level of program evaluation is common to universities and usually called an "end-of-course" evaluation. Phillips (1997) states that this level asks the question: "Were the participants pleased with the program" (p.39)? This definition suggests the validity of the reaction level is questionable because of the subjective nature of the response; i.e., students who believe they have done well in a course will tend to rate it higher than those who believe they did not do well.

Level 2: Learning. This phase is characterized by what the student learned while in the course. It measures what the student has learned – "What principles, facts, and techniques were understood and absorbed by the conferees?" (Nickols, 2000, p.1) This formative assessment is made throughout the course via various means and instrumentalities such as examinations, quizzes, project work, etc. Usually, this assessment requires an entry diagnostic assessment of knowledge so that subsequent assessments clearly identify what was learned (Nickols, 2000). Phillips (1997) agrees with this definition stating it answers the question, “What did the participants learn in the program” (p.39).

Level 3: Behavior. This level deals with changes in behavior on the job or in other situations where the new knowledge can be applied. Nickols (2000) believes that any evaluation of change in on-the-job behavior must occur in the workplace itself:

> It should be kept in mind, however, that behavior changes are acquired in training and they then transfer (or don't transfer) to the work place. It is deemed useful, therefore, to assess behavior changes at the end of training and in the workplace. Indeed, the origins of human performance technology can be traced to early investigations of disparities between behavior changes realized in training and those realized on the job. (p.5)

However in educational institutions, applying the model to the workplace is problematic, since students usually have not entered the workplace at this point in their lives. To accommodate this element of the model, the AvQIP had to incorporate a supervisor/instructor/peer evaluation system that applies to a workplace if one is available as well as to classroom application performance.

Phillips (1997) states that this level answers the question, “Did the participants change their behavior based on what was learned” (p.39). His perspective of Kirkpatrick’s intent appears to be more useful than Nickols’ in the context of evaluating post-secondary aviation education programs. Consequently, Phillip’s concept of this level is applied to the AvQIP.

Level 4: Results. According to Nickols (2000), Kirkpatrick did not define this element of his framework. Instead, he relied on a range of examples to make clear his meaning such as: “Reduction of costs; reduction of turnover and absenteeism; reduction of grievances; increase in quality and quantity or production; or improved morale which, it is hoped, will lead to some of the previously stated results" (p.5).

Phillips (1997) on the other hand says this level asks the question: “Did the change in behavior positively affect the organization” (p.39)? Again, this definition is most useful in the post-secondary program evaluation because it does not directly tie the results to the workplace. This is important because educational institutions attempting to assess the effectiveness of their educational effort may not have the benefit of observing the student in the workplace while they are still in school. However, post-graduation surveys of student performance in the workplace should be a part of any educational programmatic evaluation. Indeed, this has been a mainstay of numerous university post-graduate program evaluation schemes.

THE CMSU QUALITY IMPROVEMENT PROGRAM

The AvQIP was designed to support the CMSU Quality Improvement Program (CQIP) for Academic Departments. A quality improvement system defines a method for improving a process. In this case, the process is that of creating student learning. Hence, the purpose of the CQIP program is to improve the quality of student learning at CMSU.

But what is quality? According to Besterfield (1994) and the ANSI/ASQC Standard A3-1987, "Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy implied or stated needs" (p. 1). Besterfield continues by defining the results of a quality assurance or control system. He writes that quality assurance (a) determines the effectiveness of the quality improvement system, (b) appraises current quality, (c) determines quality problem areas, and (d) assists in correction or minimization of these problems. The AvQIP attempts to implement each of these actions.

In the CQIP model, continual process improvement requires the identification of clear programmatic objectives (student-learning outcomes) and a means of assessing the changes in student learning by measuring student accomplishment of the objectives. It also requires the development of processes and materials that support the quest for continuing student learning improvement. It is easy to see the parallel to the quality assurance discussed by Besterfield (1994).

CQIP is a locally developed program evaluation system. It stresses three primary goals. These goals are the (a) identification and validation of student learning outcomes, (b) identification of methods to assess student achievement of these outcomes, using the results to improve student learning, and (c) implementation of student assessment that documents student progress and shows how to use this information to improve student learning.

The CQIP, however, suggests just one of several programmatic evaluation systems that have been developed over time. As noted earlier, Phillips (1997) discusses several of these, including his own. Where business profit is a factor, systems such as the Kirpatrick Four Levels of Evaluation, Kaufman's Five Levels of Evaluation, the CIRO Approach, and Phillips Five Level Return on Investment Systems have been shown to be effective programmatic evaluation systems. In non-profit situations, the Kirkpatrick system has been shown to be effective. As the reader will recall, the Kirkpatrick system measures (a) Reaction – participant evaluation of the system, (b) Learning – what the participants learned, (c) Behavior – whether participants change their behavior based on what was learned, and (d) Results - did the change in behavior positively affect the organization (Phillips,1997). In this case, the organization(s) affected (customer) by the process is the aviation industry served by the Department, the University, and its graduates.

The goals of the AvQIP are to combine the elements discussed above into a cohesive and meaningful system that defines industry and university requirements for aviation program graduates; to establish a curriculum and supporting courses designed to bring students to this level of ability in knowledge, skills, and attitudes; to assess student ability to meet these requirements as they progress through their university experience, at the point of graduation, and as their careers progress; and then to determine effective interventions that will improve the quality of learning as the AvQIP process ensues.

PREPARATION FOR AVQIP

Attempting to develop a quality improvement program without knowing where the affected organization is attempting to go and having a management structure that supports movement toward the organization's goals are problems that should be addressed before the AvQIP can be an effective mechanism. Consequently, to prepare for AvQIP, it is recommended that the organization have a strategic plan, an operating paper that deals with the actions required by the AvQIP, as well as the AvQIP. In addition, student information guides should provide students information on the assessment processes used in the AvQIP and specifically seek their response to post-graduation surveys. Not the least of these concerns should be getting graduates of the department to help it or the related alumni association keep their address information current after graduation.

THE AVIATION QUALITY IMPROVEMENT SYSTEM (AVQIP)

A schematic of the entire AvQIP is provided at Figure 1. The diagram depicts how the various elements of the process are related to each other and how they affect the overall quality of the aviation program. The AvQIP is composed of seven basic steps:

Step 1 - Reaction Survey. The reaction survey is the first element of the Kirkpatrick model. The purpose of this survey is to get the student's perspective of how the course has gone. At the end of each course, students are asked to provide their assessment of the course and the instructor using an instrument that asks questions about the quality of the course and the instruction.

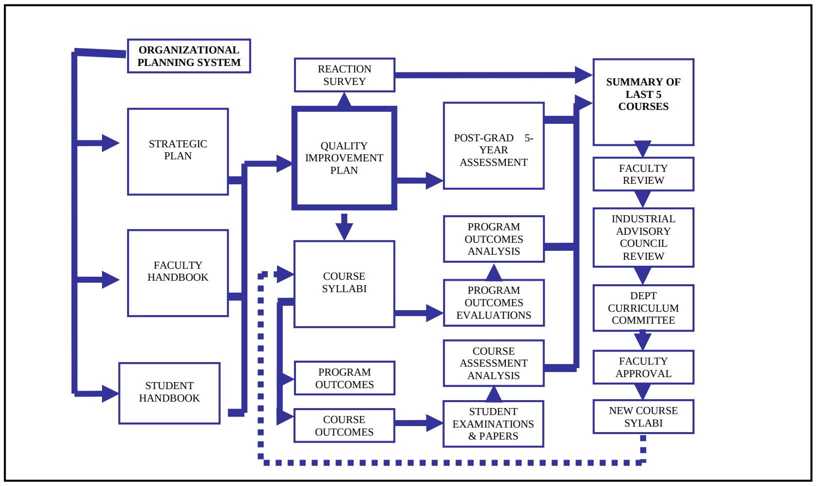

Figure 1. AvQIP Schematic

While faculty has students accomplish this, they do not participate in the process in any way except have a student proctor handle the completed instruments. Normally, the proctor forwards the surveys to the university's computer support service for processing, and the surveys and a computer analysis of them are then returned to the faculty member and/or department Chair. Data from the analysis is entered into the Department's Course Reaction Spreadsheet (Table 1).

Table 1. *Student Post-Course Evaluation of Courses by Year*

Course #	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AVIA 1020	4	3.5	4.7	5	3.5	3.3	4.6	5	3.5	4.9
AVIA 1025	3.5	4.75	5	3.5	3.3	4.6	5	3.5	4.9	3.5
AVIA 1200	3.5	4.9	3.5	4.7	5	3.5	3.35	4.6	5	3.5
AVIA 1210	5	3.5	4.9	3.5	4.7	5	3.5	3.3	4.6	5
AVIA 1310	4.6	5	3.5	4.9	3.5	4.7	5	3.5	3.3	4.6
AVIA 1320	3.5	4.6	5	3.5	4.9	3.5	4.7	5	3.5	3.3
AVIA 1321	3.5	3.35	4.6	5	3.5	4.9	3.5	4.7	5	3.5
AVIA 2220	5	3.5	3.3	4.6	5	3.5	4.9	3.5	4.7	5
AVIA 2230	4.7	5	3.5	3.3	4.6	5	3.5	4.9	3.5	4.7
AVIA 2310	4	3.5	4.7	5	3.5	3.3	4.6	5	3.5	4.9
AVIA 3010	3.5	4.7	5	3.5	3.3	4.6	5	3.5	4.9	3.5
AVIA 3020	3.5	4.9	3.5	4.7	5	3.5	3.3	4.6	5	3.5
Mean	4.1	4.2	4.3	4.2	4.2	4.2	4.2	4.2	4.3	4.2

Note 1. Subordinate spreadsheets for each course feed this spreadsheet
Note 2. Reaction surveys use a five-level Likert scale.

This spreadsheet summarizes the scores for each course over ten deliveries which usually cover a period of five years.

Data from the Course Reaction Spreadsheet are linked to and summarized in the Department Effectiveness Summary (Table 2) through Excel spreadsheet programming.

The Effectiveness Summary summarizes the status of the department program over a five-year period. It provides trends in course effectiveness, student perspective of their learning, instructor perspective of student learning, the means of post-graduate surveys taken over a five year period, and an overall program performance factor for each of the five years in the database.

Table 2. *Effectiveness Summary*

Year	Specific Learning Outcomes Mean	Program Goals Student Mean	Program Goals Instructor Mean	5-Year Post Grad Mean	Dept. Mean
2004	68.12%	83.78%	89.09%	76.00%	79.25%
2005	68.12%	83.78%	89.09%	77.00%	79.50%
2006	68.12%	83.78%	89.09%	80.00%	80.25%
2007	68.12%	83.78%	89.09%	85.00%	81.50%
2008	68.12%	83.78%	89.09%	71.00%	78.00%
Mean	68.12%	83.78%	89.09%	77.70%	79.67%

Note. This chart summarizes the scores in each of the areas shown for all courses delivered by the department during a five year period.

Step 2 - Learning Evaluation. The second step is an evaluation of student learning. This follows the Kirkpatrick model and is accomplished by faculty members establishing specific learning outcomes for their courses and evaluating student achievement of these objectives using examination instruments throughout the course. The learning outcomes follow the Mager (1984) behavioral objective format which requires a statement of the conditions of the question, the use of an action verb, and a required observable action. For example: Given an E6B computer, the student will solve a ground speed problem. After each evaluation, the instructor or department administrative personnel enter test data and learning outcomes into the Instructor's Course Assessment Spreadsheet (Table 3).

This spread sheet is designed to evaluate the difficulty, outcome effectiveness, and ability of the question to discriminate between students who understand the material being tested and those who do not.

The background for the difficulty and discrimination values may be found in Grunlund (1998). The outcome effectiveness is a simple average for each examination question linked to its driving learning goal. The examination questions reflect the learning outcomes for each overarching goal. As was the summary of the reaction surveys, a summary of data from these spreadsheets is entered into the Department Effectiveness Summary (Table 2).

Table 3. *Instructor's Course Assessment Spreadsheet*

			Evaluation	Mid Term		Final Exam		Paper	Project
			Learning Objective #	1.1	1.2	2.1	2.2	3.1	4.1
Last	Score	Credit	Adj Score - Question #	1	2	1	2		
A	5.2	0	5.2	1	1	1	1	0.7	0.5
B	2.2	1	3.2			1	X	0.7	0.5
C	1.2	1	2.2				X	0.7	0.5
D	4.2	1	5.2	1	1	1	X	0.7	0.5
E	4.2	1	5.2	1	1	1	X	0.7	0.5
F	4.2	1	5.2	1	1	1	X	0.7	0.5
G	5.2	0	5.2	1	1	1	1	0.7	0.5
H	5.2	0	5.2	1	1	1	1	0.7	0.5
	0		0						
J	5.4	0	5.4	1	1	1	1	0.6	0.8
K	5.4	0	5.4	1	1	1	1	0.6	0.8
L	2.4	1	3.4			1	X	0.6	0.8
M	2.4	1	3.4			1	X	0.6	0.8
N	2.4	0	2.4				1	0.6	0.8
O	5.4	0	5.4	1	1	1	1	0.6	0.8
P	5.4	0	5.4	1	1	1	1	0.6	0.8
Q	3.6	0	3.6	1	1	1	1	0.6	0.8
TOP HALF NUMBER CORRECT				6	6	7	3	5.6	4
MIDDLE NUMBER CORRECT				0	0	0	0	0	0
BOTTOM HALF NUMBER CORRECT				5	5	7	6	4.8	6.4
TOTAL IN CLASS	17								
DIFFICULTY				0.75	0.75	0.88	0.38	0.70	0.50
EFFECTIVENESS				64.71%	64.71%	82.35%	52.94%	61.18%	61.18%
DISCRIMINATION				0.125	0.125	0	-0.375	0.1	-0.3
MEAN SCORES	4.50		4.89						

The specific learning objectives established for each course are developed by the professor given responsibility for the course design and may be reviewed by the faculty during faculty meetings with the objective of confirming content validity of the course and with industry advisory committees for the same purpose. Courses may also be reviewed by the Aviation Accreditation Board International (AABI) teams as part of its oversight of the department's programs. In addition, the outcomes may be used by the Federal Aviation Administration (FAA) to validate courses delivered by the department.

Step 3 - Evaluate Program-level Learning Outcomes. The third step is to evaluate student progress in the general department learning objectives. General department learning goals might be the following:

1. The ability to express oneself clearly and quickly in writing and speech.
2. The ability to read and comprehend literature in the student's field and have developed a reading program that will keep the student current in aviation.
3. The ability to continue one's training, education, and intellectual development when one leaves school.
4. The ability to exhibit the highest level of aviation professionalism in the student's career area.
5. The ability to solve problems in the student's aviation field.
6. The ability to work effectively as part of a team.

7. Possess the knowledge, skills, and attitudes necessary to be a success in the student's area of the aviation industry.
8. Possess the basic understanding of the leadership and managerial skills graduates will need to be an effective leader in the aviation industry.
9. The ability to successfully compete for employment in the student's aviation field.
10. The ability to do basic research, interpret and analyze the data and make useful presentations based on that research.
11. Possession of the basic knowledge, skills, and attitudes needed to be a useful participant in the student's profession, society, and country.
12. Possession of the university-desired skills of higher order thinking, communicating, interacting, managing information, and valuing.

This step of the process is accomplished by post-course evaluations of student progress in and application of the general goals established by the collegiate entity and is conducted by students and instructors using the form shown in Figure 5.

During this phase, the Program Learning Outcome Evaluation is presented to students near the end of each course. The student completes the student self-evaluation portion of the form and returns it to the course instructor for the instructor's evaluation. The form is then forwarded to department administration and its data entered into a Program Goals Evaluation Spreadsheet (Table 4).

Step 4 - Monitor Progress. The fourth step is to monitor student progress through the curriculum. Each full-time faculty member is assigned a list of students to monitor, mentor and advise. Freshmen are contacted at the beginning of their first semester and advised on the normal progression and course schedule for their degree program. After this initial contact, department administration advises faculty members if one of their students departs from this recommended schedule or does not perform satisfactorily during a course. This is accomplished at the end of each semester by entering student grades into a four-year course plan and record form. This record is kept on file in the department. In addition to their advisory role, faculty members are encouraged to establish a mentoring relationship with their assigned students.

Student advisement includes the responsibility to:

1. Help the student develop his/her personal program plan (following the established four-year program whenever possible but adjusting for unique student needs such as being a transfer student or coming into the program with a FAA certificate),
2. Counsel when the student has difficulty with the plan or courses in the plan,
3. Recommend any necessary course substitutions,
4. Initiate credit by evaluation requests if appropriate, and
5. Monitor student progress.

Step 5 - Evaluate Application of Learning. This step complies with Level 3 of the Kirkpatrick model – measure how well student learning is applied on the job. Hence, work for university airport management, the flight operations management program, internships, or maintenance management is monitored through supervisors, and work in the classroom is monitored by course instructors. Each semester students, instructors, and departmental supervisors of aviation students complete the Program Learning Outcome Evaluation form (Figure 2) to provide an assessment of the student's ability to apply what he/she has learned during their coursework to their current or future job. These evaluation forms are collected, entered into a Program Goals Evaluation Spreadsheet (Table 4) and then filed in the student's hard copy file.

In addition, all four-year students are required to complete a capstone course which requires students to apply what they have learned during their degree program to simulated aviation problems. Students taking the capstone course complete the Program Learning Outcome Evaluation form at the end of the class just as they would for any other course.

Step 6 - Post-graduation Application Evaluation. This step monitors students after graduation by periodically surveying their evaluation of the impact of the courses they took in college on their current work experience. It complies with Level 4 of the Kirkpatrick model. Graduates are encouraged to involve their supervisors in the completion of this survey, whenever possible. Annual post-graduate course evaluations are conducted each spring for the first five years after graduation. The data obtained from these surveys are entered into the Post-graduation Course Evaluation Spreadsheet and is ultimately summarized in the Department Effectiveness Report (Table 2).

Step 7 - Industry Review. The final step of the assessment is an annual review of courses by the department's Industry Advisory Council. This step also complies with Level 4 of the Kirkpatrick model. This council is composed of individuals or subcommittees representing each of the concentration areas in the academic program. At advisory council meetings, the subcommittees review the specific and general learning outcomes for courses in their specialty area and access the department's effectiveness in facilitating student learning of these outcomes through review of the Department Effectiveness Summary (Table 2).

This evaluations was related to (Check One):	Work		Course			Student Name					Instructor Name		
Student: Please check the block in the student column that best represents your progress in the skill area.	Not Observed		Unsatisfactory		Poor		Fair		Good		Excellent		Instructor / Supervisor Remarks
Instructor: Please check the block in the instructor column that best represents student progress in the skill area.	**0**		**1**		**2**		**3**		**4**		**5**		
	Student	Instructor	Student	Instructor	Student	Instructor	Student	Instructor	Student	Instructor	Student	Instructor	
Effective in writing and speech													
Read and comprehend literature in the student's field													
Developed a reading program													
Continue training, education, intellectual development													
Solve problems in the student's aviation field													
Work effectively as part of a team													
Knowledge, skills, and attitudes for success in aviation													
Leadership and managerial skillseffective leaders													
Ability to compete for employment in the aviation field													
Research, interpret and analyze the data													
Useful participant in profession, society, and country													
Higher order thinking													
Communicating													
Managing information													
Interacting													
Valuing													
COLUMN TOTAL (Count checks and multiply by column value)													
TOTAL SCORE	Student Score						Instructor / Supervisor Score						

Figure 2. Program Goals Course Evaluation Form

Table 4. *Programs Goals Evaluation Spreadsheet*

	Delivery 1		Delivery 2	
Student Number	Self Evaluation	Instructor Evaluation	Self Evaluation	Instructor Evaluation
1	85	85	85	85
2	57	66	57	66
3	85	85	85	85
4	57	66	57	66
5	85	85	85	85
6	57	66	57	66
7	85	85	85	85
8	57	66	57	66
9	85	85	85	85
10	57	66	57	66
Mean	71	75.5	71	75.5
%	83.78	89.09	83.78	89.09

It is possible to reduce the manpower involved in this program through automation of the data collection and analysis programs. With time, the spreadsheets and other records required by the program can be generated automatically using electronic data collection and reporting technology to minimize the student, faculty, and staff effort required to input, analyze and report on the data by using the Scantron Par System to reduce much of the handwork discussed above.

> The Scantron Company's ParSYSTEM is an integrated suite of powerful software modules that allow you to create, administer and score tests on paper, via networks or over the Internet. With ParTEST, teachers can develop multi-format tests from item banks. ParTEST Online enables test takers to take tests online or on a network. And ParSCORE completes the suite allowing educators to manage student records, analyze test outcomes and create reports. (Scantron, 2006, p. Products/ParSystem).

In the meantime, the author will provide electronic copies of the spreadsheets and forms designed to support this system.

CONCLUSION

The quality improvement system proposed in this article is based on a classic program evaluation model and techniques and processes produced by practitioners in quality management. The process has seven primary steps that comply with Central Missouri State University Quality Improvement Plan goals and follow the challenges our students and the aviation industry will face tomorrow.

In summary, post-secondary educational institutions are feeling increasing pressure to improve the product of their institutions through student assessment and quality improvement programs that make use of outcome-based assessment data. While some will feel that this is an encroachment on the academic freedom post-secondary education has traditionally enjoyed, a more positive view would suggest that moving in this direction may be the only way for modern educators to keep up with the exponential growth in the knowledge pool at a time when the world is moving faster and faster toward an information-based-economy that demands that its workforce be able to access this knowledge pool and use it efficiently and effectively.

RECOMMENDATIONS

This paper proposes one way to structure a teaching organization, to monitor its processes and products, and to continually improve its processes both to the betterment of the segment of industry and the economy served by the organization and its graduates. If there is a recommendation supported by this paper, it is not to emulate the system explained in this paper, but to set about producing a system that fits one's own environment while accepting the underlying rationale that the quality of the educational experience provided students today can be and must be steadily improved to meet the steps of program evaluation recommended by Kirkpatrick.

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A FITS Scenario-Based Training Program Enhances GPS Pilot Proficiency in the General Aviation Pilot[1]

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ABSTRACT

General Aviation (GA) pilots working toward their instrument rating in aircraft equipped with Global Positioning System (GPS) technology often receive little, if any, formal flight instruction on the use of GPS technology. The goal of this study was to empirically evaluate a single pilot crew, FAA Industry Training Standards (FITS) scenario-based training program designed to increase the knowledge and safety of pilots using this technology by focusing on GPS mode awareness, situational assessment, risk and time management, and situational awareness. This study included forty-six pilots who had completed their instrument rating in a GPS-equipped aircraft within the last 12 months. The results of this study revealed that utilizing a GPS FITS scenario-based training program for GPS training significantly reduced omission errors and incorrect or inappropriate use of the GPS when compared to controls. These results support the premise that a specific GPS FITS-based training course be required for pilots unfamiliar with GPS navigation, and those pilots should be required to obtain a logbook endorsement before acting as pilot in command of aircraft with IFR-approved GPS units.

INTRODUCTION

Despite the many advantages of increased flight deck automation (Amalberti, 1998; Fanjoy & Young, 2005; Funk et al., 1997), automated flight decks are now placing cognitive demands on crews that have never before been experienced. As a result, some researchers and aviation experts argue that more, rather than fewer errors, are being observed (Funk, Lyall, & Niemczyk, 1997; Parasuraman & Riley, 1997; Roessingh et al., 1998). Many automation human factors issues have recently been raised (Billings, 1997; Fanjoy & Young, 2005). Two of the most common problems being observed in the modern flight deck are "lack of mode awareness" and "loss of situational awareness" (Nikolic & Sarter, 2000; Sarter & Woods, 1995). Lack of mode awareness results from a situation where flight crews are confused about the status of the automation after the aircraft performs a flight maneuver that was not anticipated by the crew (Endsley & Kaber, 1999). Lack of situational awareness is when a flight crew is not precisely sure of where they are, and often occurs when a flight crew is overly dependent on the navigational moving map displays that are characteristic of automated flight decks (Uhlarik, Raddatz, & Elgin, 2002; Funk et al., 1997). This lack of mode awareness, when accompanied by a lack of situational awareness, has led to several controlled flight into terrain (CFIT) accidents. CFIT accidents occur when an aircraft strikes the ground under controlled conditions or in a near wings level attitude without the crew being aware of the impending disaster. One infamous example occurred on December 20, 1995, when American Airlines flight 965, a Boeing 757, crashed into mountainous terrain while on an approach into Cali, Colombia killing 152 passengers and 8 crew (Aeronautica Civil of the Republic of Colombia, 1996). Less than one year after the Cali tragedy, on August 6 1997, Korean Air flight 801, a Boeing 747, crashed with 254 people on board including 2 pilots, one flight engineer, and 14 flight attendants. The airplane had been cleared to land on runway 6 Left when it struck high terrain only 3 miles southwest of the airport at Nimitz Hill, Guam. Of those on board, 228 were killed (NTSB, 2000). In both cases, it was concluded that lack of mode awareness was a contributing factor (Aeronautica Civil of the Republic of Colombia, 1996; NTSB, 2000).

One critical component of any automated cockpit is its flight navigation system (Wiener, 1988). One of the most popular in the General

Aviation (GA) community is the Global Positioning System, commonly referred to as GPS. GPS is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. The satellites continuously broadcast signals that are received by GPS units that are either "hand-held" portable devices, or permanently installed in an aircraft. Navigational signals transmitted by the satellites are then received by these GPS units and this information is used to calculate the aircraft's exact location. It is estimated that as many as two thirds of GA pilots in the United States use some form of GPS technology as their primary means of navigation (Casner, 2002; Casner, 2005). While GPS moving map displays should increase situational awareness in pilots, several recent studies have reported that the lack of thorough knowledge of GPS functionality and dependability has actually lead to a loss of situational awareness in GA pilots (Adam, Deaton, Hansrole, & Shaikh, 2004; Casner, 2005).

Currently, in the GA community, there is no accepted training program for pilots flying aircraft equipped with GPS technology. This has led to a kind of "self-instruction" where GA pilots either teach themselves to use their GPS or obtain informal instruction from other GPS users. While in some cases this has resulted in relatively minor problems, for example, penetrating a restricted airspace, in other cases, the results have been more tragic (O'Hare & St George, 1994). Consequently, one key issue with the establishment of GPS technology in GA aircraft is how to train pilots/students to take advantage of the increased safety opportunities available with the new technology. It can be argued that a thorough training program is needed to educate pilots on the use of GPS technology. Indeed, in a recent study on GPS usability (Adam et al., 2004) it was recommended that a specific GPS training program be compared to a control group not receiving any formal GPS training. If successful, the training program could be submitted to the FAA for incorporation in flight schools (Adam et al., 2004). While there is a substantial literature base supporting the notion that a training program on a specific task will increase a learner's proficiency of that task (Schwartz, Wasserman, & Robbins, 2001), the authors are unaware of any empirical data that currently exists to support the claim that a GPS training program will increase pilot proficiency in the use of GPS technology. Moreover, what constitutes a viable training program is also unknown.

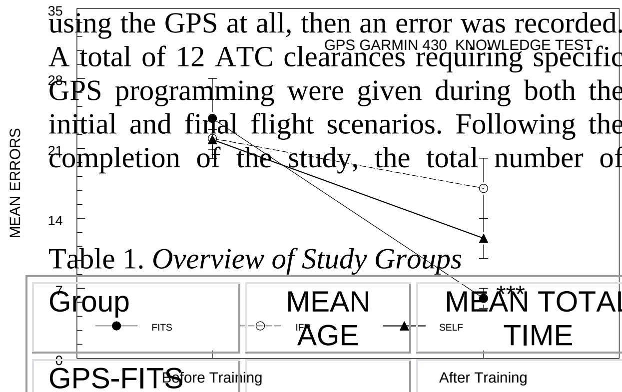
In 2001, the FAA implemented the FAA-Industry Training Standards (FITS) program. The FITS training program uses highly structured "scripts" of flight training objectives using "real-world" objectives in order to increase safety in increasingly complicated (automated) aircraft. This training places a major emphasis on: aeronautical decision making skills, risk management, situational awareness, and single pilot resource management using real-time flight scenarios (Ayers, 2006; Glista, 2003). Studies from Embry-Riddle Aeronautical University, the University of North Dakota, and Middle Tennessee State University on the effectiveness of the FITS curriculum have resulted in the FAA accepting the FITS training approach as the industry standard for all future flight training in GA (Ayers, 2006; Craig, Bertrand, Dornan, Gossett, & Thorsby, 2005a, 2005b; Dornan, Craig, Gossett, & Beckman, 2006; Glista, 2003). In this study, a FITS training program focusing on GPS navigation using real flight scenarios in a computer-based GPS training (CBT) program was utilized. The results of the group of pilots trained in this manner were compared to two groups of pilots which did not receive a GPS FITS training program.

METHODOLOGY

This study was comprised of forty-six college student pilots who had completed their instrument rating in a GPS-equipped aircraft within the last 12 months. All participants completed two written pre-screening tests. The first was a 25 question test to evaluate their overall GPS knowledge, while the second was a 50 question test to assess their specific knowledge of the Garmin 430 system. In addition, all participants were administered a questionnaire regarding demographics and flight experience. Before the beginning of the training experiment, each participant was given a familiarization session in a Middle Tennessee State University Frasca 142 flight training device. While this device is equipped with a panel-mounted, IFR-approved, Garmin 430 GPS, the point of this session was solely to expose each participant to flight in this particular FTD, not to measure the participant's ability to operate the GPS. During this familiarization session, pilots were instructed to fly an instrument approach into Nashville International Airport without using the GPS. After the familiarization session, participants were randomly assigned to one of three groups: 1) FITS-GPS based training, 2) IFR Control or 3), Self-Instruction Control. Each participant was then evaluated on an IFR flight scenario that was designed to assess their aircraft monitoring skills (situational assessment), GPS mode awareness, situational awareness, and understanding of the appropriate Garmin 430 IFR programming. The flight scenario lasted approximately 60 minutes. After this initial evaluation flight, each group received different training.

The FITS-GPS group received four, two hour training sessions using scenarios based on a FITS training syllabus and concentrating on SRM, mode awareness, situational awareness, time management, and situational assessment (situational assessment stresses the importance of flight parameter monitoring, e.g. engines systems airspeed, while flying an automated aircraft). This training was conducted using PC-based computer based training (CBT) utilizing a Garmin 430 simulation software program. In addition, the FITS "Personal and Weather Risk Assessment Guide" was also incorporated into the training program for this group. The "Personal and Weather Risk Assessment Guide" is designed to assist pilots in developing their own personal weather minimums, using Aeronautical Decision Making as a key element in the decision making process. The following is an example of what was included in the FITS-GPS group training sessions: 1) Overview of Automation Issues (e.g. mode awareness, automation traps), 2) Situational Awareness: An overview of techniques to enhance situational awareness, 3) An Overview of General Principles of GPS technology, 4) Specific Garmin 430 programming skills, 5) PC-Based CBT using FITS training principles, 6) Critical thinking skills using NTSB reports of fatal aircraft accidents that were automation induced, and 7) The importance of using the "Personal and Weather Risk Assessment Guide" when making Go/No Go decisions. Since the FITS-GPS group was provided four training sessions, for a total of eight hours with an instructor, to reduce the likelihood of experiencing a treatment effect, a similar amount of training exposure was given to the IFR control group. This group of participants, received four, two hour training sessions. These sessions, however, only covered basic IFR flying skills, and were designed as essentially an IFR refresher course.

Since one of our earlier premises about GPS training is that the majority of pilots learn via "self instruction" where they basically read the GPS manual supplied by the manufacturer, a third group of participants was included in the study. This group called the "Self-Instruction" group, was each given a copy of the Garmin 430 manual after their initial GPS evaluation flight, and was instructed to read the manual and become familiar with the Garmin 430 before the final GPS evaluation flight. Following the various training sessions or self study, all three groups were evaluated on their performance on another flight scenario in the Frasca 142 FTD. During both their initial and final flight sessions, incorrect or correct GPS mode usage was recorded. A "GPS error" was recorded for the following pilot actions: 1) An air traffic control (ATC) clearance was given requiring GPS programming, but the programming was not performed by the pilot. 2) An ATC clearance was given requiring GPS programming, but the GPS was used inappropriately, 3) An ATC clearance was given requiring GPS programming and the pilot used appropriate GPS programming, but failed to comply with an ATC instruction (e.g. the pilot was too busy programming the GPS and so forgot to level off at an assigned altitude). No errors were recorded if a pilot followed an ATC clearance accurately and used appropriate GPS programming. For example, in one instance an ATC clearance was given which instructed the pilot to cross a particular fix at a specific altitude. No error was recorded if the pilot used the "VNAV/VSR" on the GPS (an appropriate GPS mode). If the pilot began to descend immediately, however, without



using the GPS at all, then an error was recorded. A total of 12 ATC clearances requiring specific GPS programming were given during both the initial and final flight scenarios. Following the completion of the study, the total number of GPS errors from each flight were analyzed using an analysis of variance (ANOVA) 2 X 3 mixed design. Any significant main effects were assessed by post hoc analysis using the Scheffe's test.

Table 1. *Overview of Study Groups*

Group	MEAN AGE	MEAN TOTAL TIME	MEAN TOTAL INSTRUMENT	MEAN TOTAL ACTUAL
GPS-FITS Training (n=17)	20	181.6	43.1	4.2
IFR Training (n=19)	21	220.3	42.7	2.3
Self Instruction (n=10)	20	195.7	44.6	5.1

RESULTS

As can be seen in Table 1, a multivariate comparison of group means of total flight time, total instrument time, and total actual instrument time, revealed non-significant differences between the three groups utilized in the study ($p > 0.05$). Figures 1 and 2 depict the results of the participants on the written overall GPS knowledge test (Figure 1), and the specific Garmin 430 knowledge test (Figure 2), of all three groups both before and after the training program. As can be seen from these figures, before training all participants experienced a high number of errors on both the overall GPS knowledge test and the specific Garmin 430 knowledge test. Following the use of the FITS training program on GPS and Garmin 430 procedures, however, a significant decrease in errors on both overall GPS (Figure 1) and Garmin 430 (Figure 2) knowledge was observed as compared to both control groups.

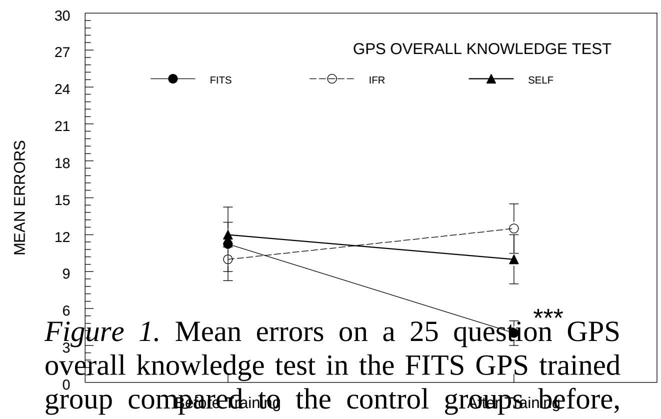


Figure 1. Mean errors on a 25 question GPS overall knowledge test in the FITS GPS trained group compared to the control groups before, and after a specific training program (see text for specific details). *** = significantly different from all other groups ($p < 0.01$).

Figure 2. Mean errors on a 50 question Garmin 430 knowledge test in the FITS GPS trained group compared to the control groups before, and after a specific training program (see text for specific details). *** = significantly different from all other groups ($p < 0.01$).

This was revealed by a significant group by treatment interaction for overall GPS knowledge ($F (2,85) = 7.5$, $p < 0.001$), and specific Garmin 430 knowledge ($F (2,86) = 5.6$, $p < 0.005$). Post hoc comparison revealed that both the Self Instruction control group and the FITS-GPS group improved in their Garmin 430 knowledge compared to the IFR control group. Further post hoc analysis revealed that the FITS-GPS group was significantly different from all other groups on both tests.

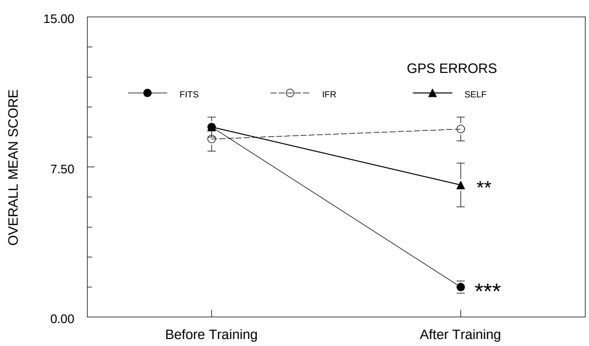


Figure 3. GPS mean errors in the FITS GPS scenario-based training group compared to controls on two simulator flight scenarios. *** = significantly different from all groups, ($p < 0.01$); ** = significantly different from the IFR and FITS group, ($p < 0.01$).

Figure 3 illustrates GPS competency scores in the three groups before and after training. An ANOVA revealed a significant group by treatment interaction ($F (2,86) = 29.6$, $p < 0.001$). Post hoc analysis again revealed that both the FITS GPS training program pilots and the self taught pilots made significantly fewer errors compared to the IFR control group. As can be seen from Figure 3, however, the FITS trained group had significantly fewer errors when compared to both groups.

DISCUSSION

The results of this study revealed that prior to undertaking a training program focusing on GPS technology, GPS flight planning, mode awareness, and situational awareness, pilots who had recently obtained their instrument rating in a panel mounted, IFR-approved GPS aircraft in reality knew very little about appropriate GPS procedures. This was demonstrated first by participants' poor scores on the initial written tests evaluating both general GPS and Garmin 430 specific knowledge. Very few subjects displayed in-depth knowledge of GPS technology, or a commanding knowledge of the Garmin 430. For example, fewer than ten percent of the pilots were able to choose the correct answer to the following multiple choice question: "When using the approach page on the Garmin 430, if the "VOR 03" approach is highlighted and "GPS" is in italics beside the "VOR 03", what does this mean?"

Secondly, participants did not demonstrate an acceptable level of operational GPS knowledge when evaluated in the baseline flight scenario ("Before Training", Figure 3) Indeed, in the initial flight evaluation scenario that occurred before the training sessions, all participants displayed a significant amount of inappropriate GPS programming, omission errors (when the GPS was not used following an ATC clearance), poor time management, and lack of mode awareness. This lack of GPS awareness resulted in a significant amount of time spent pre-occupied with the GPS, which resulted in a lack of situational awareness (many participants were completely disoriented and, as a result, often dangerously off course). Situational assessment suffered as well, this is where a pilot spends a significant amount of time focusing on his/her automation and considerably less time monitoring the flight instrument/engine panel. For example, in many cases, the focus on the GPS display resulted in altitude busts or overshooting an assigned heading; or, in other situations, not noticing a precipitous increase in oil temperature.

The lack of GPS knowledge that was observed at the beginning of this study was in striking contrast to pilots' self-reported comfort levels with a GPS equipped aircraft. Before the study began, 93 percent of pilots reported feeling "comfortable" using a GPS in the IFR environment, while 83 percent felt "comfortable" shooting a GPS approach (data not shown). The results of the baseline data gathered for this study strongly suggest that the traditional GPS training given to instrument rating applicants is insufficient, given the dramatic changes in technology that now typify GA aircraft. Since the traditional IFR training curriculum focuses on rote learning, this method is arguably antiquated and must be changed to prepare pilots to handle the technology with which their aircraft is equipped. For example, more emphasis should be placed in the current Part 141 instrument syllabus on GPS mode awareness and proper time management skills. Instead, the focus is on learning how to fly GPS approaches, and this is accomplished by executing multiple practice approaches. While the ability to fly a GPS approach correctly is certainly a requirement for effectively operating a GPS-equipped aircraft, there is much more that needs to be learned to safely operate a GPS-equipped aircraft in the IFR environment.

In this study, the experimental group which received four CBT seminars using the FITS training approach, demonstrated significantly better scores on both the post-training general GPS assessment test and the Garmin 430 assessment test than did either control group. Even more importantly, this group committed fewer errors on the post-training evaluation scenario, compared to either the IFR or Self instruction groups. These results suggest that a training intervention is a positive factor in enhancing a pilot's ability to appropriately utilize a GPS.

It is important to note that one control group, which was assigned to "self-instruction" utilizing the Garmin 430 manual, also showed significant improvement in all areas at post-assessment, although not as much as the FITS-GPS group. Therefore, it can be argued that while self-instruction is beneficial, it is not as effective as a formal GPS training program. A possible explanation for the improvement in the "self instruction" group was that after experiencing poor performance on both the written assessments and the initial flight scenario, that they were motivated to increase their knowledge of GPS procedures. This explanation, however, does not account for the lack of improvement in the IFR group, who experienced similar performance deficits on the initial scenario flight.

Given the stronger post-training performance of the group which received the FITS GPS scenario-based training using a CBT, it seems to follow that all curricula which utilize aircraft with GPS technology should incorporate at least two components. First, ground school should focus on both general GPS technology considerations and on specific GPS knowledge regarding the equipment available in the training aircraft. This training should be followed by specific tests to assess the students' knowledge. Second, GPS ground training should incorporate realistic, GPS scenario-based training using the FITS approach in a CBT program for the specific GPS installed in the aircraft. The use of CBT provides the advantage of enabling both the instructor and the student to focus on such critical tasks as time management, proper mode awareness, and situational awareness. Finally, while not a part of this study, it seems only logical that some minimum number of flight training hours be dedicated for either simulator or flight training immediately following the CBT training. These training hours should also be FITS-based so further real-life scenarios could be experienced. The focus would be on incorporating system management, mode awareness, and situational assessment while actually flying the aircraft. While at first glance this level of training may appear to be overwhelming, all of the training that was done in this study could conceivably be completed over a weekend. The total FITS ground training using a CBT approach was four two-hour sessions. This ground training could then be followed by simulator or aircraft training on the following day.

In conclusion, the results of this study revealed that utilizing a FITS scenario-based GPS training program in a CBT significantly improved subject performance on both GPS knowledge tests and on a flight test measuring appropriate use of a GPS when compared to both an IFR control group and a Self-instruction group. However, it must be pointed out that these pilots were ALL college students. Nonetheless, we would argue that these results are still applicable to the general pilot population. Our results further suggest that, given the lack of initial GPS knowledge that seemed to be prevalent in our sample, a specific logbook endorsement should be required of pilots who wish to fly under IFR in a GPS-equipped aircraft. Lastly, anyone interested in obtaining this training program should contact the first author.

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Machiavellianism and Personality Typing as Determinants for Screening Commercial Pilot Candidates

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ABSTRACT

The association between personality and effective team leadership in the cockpit environment has been a major focus of research in aviation management. The major air carriers incorporate in their assessment process personality style and decision-making skills by placing pilot candidates through a two or three stage interview process. In an ongoing effort to develop a comprehensive pilot candidate selection model, university researchers have studied the relationship between personality type and skill in small group manipulation. In this study, the Myers-Briggs Type Indicator as a construct of personality type and the Mach V scale as a construct of skill in small group manipulation were employed in the survey of 52 commercial flight officers. Eight-five percent of the surveyed pilots fell into one of the sixteen personality types measured by the MBTI scale, which correlated significantly with Machiavellian orientation as measured by the Mach V scale. Research indicates a significant relationship in success in leadership of small groups and the Mach V scores. The results of this study suggest the potential of select dimensions of the MBTI and the Mach V instruments in the screening of commercial pilot candidates for hire.

INTRODUCTION

Commercial aviation, in particular the major air carriers, are well aware of the criticality in selecting those pilot candidates with the highest overall return on the training investment. It is expensive, and to fail means not only increased training costs and lost revenue, but the consequences of greater risk of accidents and the resultant fallout of public perception are unacceptable.

It is not enough to 'screen-out' those who fail to meet the needed set of technical qualifications and operational experience. The industry recognizes the need to incorporate into the selection protocol an assessment of personality factors to include attitudes related to crew coordination and effective team work under stressful safety of flight conditions (Chidester et al, 1991). Research suggests that pilot selection protocols may have low predictive validity and their content has remained relatively unchanged over the decades. These protocols may reflect higher predictive validity in the training regimen rather than in that of the operation line (Damos, 1996).

Yet the critical point of screening those who are not amenable to team-oriented training occurs before—not after the applicant becomes an employee. When considering the implicit costs of bringing on board pilots who resist development of team skills, the industry would benefit greatly from a low-cost 'selecting-in' of candidates using a model based on the attitudes and temperament of those pilots having the leadership potential sought.

RESEARCH QUESTIONS

Given the criticism of current pilot selection protocols, little research has been undertaken to improve them prior to the decision to interview and administer the typical phased selection process. This research aims at providing the first step to screening candidates based on a model reflecting the personality and leadership temperament of those pilots the carrier identifies as optimum. To explore improvements in the initial screening of applicants for interview, the following research questions were raised.

Is there an identifiable personality and leadership temperament associated with those pilots a carrier deems most successful in crew coordination and performance under stress? Given such a temperament, are there instruments with the discriminatory power to 'select-in' applicants who meet the personality and leadership temperament profile of the select pilot group?

BACKGROUND

The Myers-Briggs Type Indicator (MBTI) was chosen as the instrument to evaluate personality temperament. To augment the MBTI in measuring strength of leadership of informal, small groups, Christie and Geis' (1970) Mach V scale was selected. The purpose in this study was to assess the MBTI as a psychological instrument in facilitating the screening of pilot applicants through the development of a discriminate function or variant that would be both reliable and consistent. The Kiersey version of the MBTI was employed (Kiersey & Bates, 1998). Included as well was the Mach V instrument because of its strong correlation to effective leadership in informal, small groups (Christie & Geis, 1970). A two-group discriminant analysis was conducted using data collected on active commercial pilots serving with a major air carrier.

Psychological Type

The Myers-Briggs Type Indicator (MBTI) is a self-reporting, nonjudgmental psychological instrument designed to categorize individuals based on their preferences in four areas: where people obtain their energy (internally or externally), how people perceive their surroundings (denotative or intuitive), their approach to decision making (rational or value oriented), and the approach employed in assessing their environment (judging or perceiving).

Based on Carl Jung's research, Isabel Briggs Myers and Katherine Briggs developed the MBTI instrument, adding an aspect that deals with an individual's lifestyle choices. The self-reporting and self-validating accomplished with the MBTI sorts people into four categories. The first category is extraversion or introversion. The person who indicates a preference for extraversion is one whose energy is directed outward and prefers to interact with people and things. A person who indicates a preference for introversion is one whose energy is directed inward and prefers concepts and ideas. For example, an extrovert might "speak before he or she thinks" and an introvert would probably "think before speaking." The second category is that of perceiving or data collection (sensing or intuition). Those who prefer sensing rely on actual data and pay attention to details. Those who prefer intuition rely on inspiration and look at the "big picture." The third category addresses the decision-making process that people use. Those who prefer thinking make their decision emphasizing logic and principles. Conversely, those who prefer feeling rest their decisions on human values and harmonious relationships. The fourth category addresses lifestyle. In this category people indicate their preferred and most often used mental preference (judging or perceiving). Those who prefer judging indicate decisiveness and task or project completion are important. Those who prefer perception indicate that curiosity and starting a task or project is of higher value. Among active flight officers, over 80 percent fall into two of sixteen categories: ESTJ and ENTJ. There is a dominant category for any generic job classification or profession (Myers & McCaulley, 1985). Our interest is in the dominant category for successful, professional pilots. Their scoring on the MBTI or another suitable temperament measurement might aid in developing a discriminant function that would serve to screen professional pilot applicants for hire.

Machiavellianism

Machiavelli's *The Prince* and *The Discourses*, in the view of many researchers who study organizational power in administration in both public and private sectors are viewed as viable guides to success. Machiavelli used inductive reasoning and empirical evidence based on his own experiences in formulating his precepts for organizational power. Today the public generally associates the terms power and manipulation with the name of Machiavelli. Christie and Geis (1970) presented Machiavellianism as the concept of interpersonal behavior. A Machiavel is defined as one who is able to influence others to achieve a particular end. To measure Machiavellian orientation, Christie and Geis designed and developed the

Mach IV and Mach V inventories. According to Christie and Geis (1970), the contrast between a high and low Mach is the degree of freedom from emotional attachment. One with a high Machiavellian orientation:

a. would not be concerned with conventional morality;
b. would conduct one emotionally detached from others with the view that personal involvement would limit the ability of one to treat people as objects;
c. would be concerned primarily with ends rather than means—manipulating others would be a prerequisite for achieving goals; and;
d. would be in full control of faculties, able to assess rationally one's relationship to the psychological environment—neither pathologically disturbed nor possessing a psychosis or neurosis (p.3).

In the formation phase of groups, high Machs tend to emerge as the "key player" or "key man" more so than low Machs; hence, high Machs more frequently guide and direct group planning. This earlier stage of group formation when planning plays a more prominent role, presents a greater opportunity to improvise—a situation tailored to Machiavellian orientation. High Machs exhibit greater detachment from emotions and thus are able to make decisions more effectively and to resist altering opinion after being subjected to counter-argument. Thus, those who score high on the Mach V scale are more likely to be more effective than low Machs in controlling the views of low Machs when conducting group planning activities in initial stages when the environment is less structured.

In attempting to answer the question "how much do high and low Machs exercise manipulations," Christie and Geis (1970) studied people in a laboratory setting where game simulations were conducted. They found that high Machs consistently manipulated more regardless of whether the circumstances were ambiguous or unambiguous. Christie and Geis assert that high Machs are able to assess the weaknesses of people better than low Machs and, thus, are able to capitalize on their weaknesses. This, coupled with a greater insensitivity to people, enables the high Machs to pursue personal or organizational goals more effectively.

How does Machiavellianism relate to cognitive dissonance? Low Machs have difficulties with dissonance traced to higher personal involvement in beliefs whereas high Machs are able to remain detached from personal beliefs and attitudes. High Machs were able to rise above dissonant behavior because of their more practical approach to problem solving. High Machs appear to bargain more effectively in achieving what they want. High Machs appear to be much more aggressive in bargaining, anticipate others to be more aggressive, and are more prone than low Machs to counter aggression with aggression. In addition, high Machs are more inclined to be risk-oriented in their efforts to influence group decision-making. In their assessment of studies of Machiavellianism, Christie and Geis (1970) conclude that those who score higher on the Mach IV and Mach V scales

> ". . . manipulate more, win more, and are persuaded less, persuade others more, and otherwise differ significantly from low Machs as predicted in situations in which subjects interact face-to-face with others, when the situation provides latitude for improvisation, and the subject must initiate responses." (p. 312)

Both experimental and correlational studies suggest that a person's Machiavellian orientation impacts personal behavior—specifically on behavioral patterns in small group settings and relative success in exercising referent power and leadership. (Christie & Geis, 1970)

METHODOLOGY

For Group 1 (G1), the population consisted of 52 professional commercial flight officers actively serving on the line. Group 2 was comprised of 40 non-pilot employees of a commercial air carrier. Permission to conduct the survey was obtained from each respondent. The respondents completed the questionnaires in confidence and were guaranteed anonymity regarding the results. Each respondent participating in the study voluntarily submitted data pertaining to MBTI classification.

Similarly, the respondents completed the Mach V questionnaires in confidence with anonymity guaranteed; in addition, the author was also able to collect MBTI surveys using the 1998 Keirsey version of the scale.

Instrumentation

For Groups 1 and 2, quantitative data were collected using the 1998 Keirsey MBTI inventory. The Keirsey instrument is a seventy-item, dyadic, forced-response survey instrument based on the original Myers-Briggs Type Indicator. Professor David Keirsey has investigated personality differences so as to refine his theory of the four temperaments identified in the Myers-Briggs research, and to define the aspects of character that differentiate one from another. His efforts have resulted in his version of the MBTI, The Keirsey Temperament Sorter II, which provides a perspective of how the temperaments differ in the intelligent roles they are likely to develop (Kiersey & Bates, 1984).

Both the Mach IV and Mach V attitude inventories are derived from the Mach II attitude inventory presented in Likert format to 1,196 college undergraduates in three different universities. Conducting a factor analysis, Christie and Geis selected 20 of the most effective items of the Mach II inventory for further research and analysis. Half of these 20 items were structured so that agreement with them was scored in a positive direction while the other half was reversed so that disagreement with them was scored in a negative direction. The resulting revised 20-item inventory was designated the Mach IV attitude inventory by addressing the possibility of respondents answering in socially desirable way, Christie and Geis (1970) developed the Mach V attitude inventory, a forced response, triadic questionnaire that "makes it difficult for the average respondent to determine which is the socially "correct" answer between the keyed and matched items." (pp. 19-20)

Both the Mach IV and Mach V attitude inventories consist of 20 questions that address the nature of interpersonal tactics, view of human nature, and conventional morality. The Mach IV attitude inventory is a Likert-type questionnaire whose items allow the respondent to answer based upon levels of disagreement or agreement; in contrast, the Mach V contains a force choice pattern that forces the respondent to avoid biasing the selected answer by seeking a socially desirable answer. Contained in each triad of statements is the variable the scale is designed to measure. Included in the triad is another answer similar to the variable statement in social desirability and a third statement that is the antithesis of the other two statements in social desirability. The respondent is directed to pick the statement that is the most accurate in describing personal beliefs and the answer that is the least descriptive of personal beliefs. The Mach V was selected for surveying both Groups 1 and 2 because of the social desirability bias present in the Mach IV instrument.

Data Collection and Statistical Analysis

Data was collected via a demographic survey, the 1998 Keirsey version of the MBTI and the Mach V attitude inventory. A discriminant procedure was used to identify a linear combination of quantitative predictor variables that best characterized the differences among the groups. The quantitative predictor variables consisted of the four MBTI dimensions: (1) Extroversion-introversion, (2) Intuiting-Sensing, (3) Thinking-feeling; and (4) Judging-perceiving, and the three Machiavellian variables: (1) conventional morality, (2) interpersonal tactics, and (3) view of people as resources (Huberty, 1984, pp. 156-160).

To derive the discriminant function (Variate), selected first was the method of estimation for assessing a singular variate given two groups. The number of observations or cases classified into the correct group determined the predictive accuracy. A number of criteria were available to determine whether the classification achieved practical or statistical significance. The discriminant function sums the products of the variables multiplied by coefficients. The procedure estimates the coefficients and the resulting function can be used to classify new cases (or, as in the proposed employment of the technique, to identify pilot candidates for hire). The classification of pilot candidates using this function would be based on the temperament and leadership styles of successful professional pilots.

Simultaneous estimation was employed by computing the Variate so that the predictor variables could be considered concurrently; hence, the Variate was computed based on the entire set of predictor variables regardless of the discriminating power of each predictor variable. This approach was deemed appropriate since the goal was to evaluate each dimension of the complete personality and Machiavellian orientation instruments. The focus on the MBTA and Mach V instruments is based on research that shows successful leaders in informal group settings reflect a specific personality type and Machiavellian orientation different from the general adult population. The average profile of the successful informal group leader would reflect either an ENTJ or ESTJ MBTI category, and a Machiavellian orientation significantly higher than the general adult population norm.

Statistical Significance

After computing the Variate, the level of significance was assessed by calculating Wilks' Lambda in order to evaluate the discriminatory power of the Variate. The conventional significance criterion of .05 was used with the view that if the Variate was not significant at or beyond the .05 level, there would be little justification for retaining the Variate. Ninety-two cases were used in this analysis. By examining the sample means in Figure 1, differences between pilots (Group 1) and non-pilots (Group 2) are noted. The F statistics and significance values in columns three and six are calculated from a one-way ANOVA computed for each variable (see Figure 2). The F statistic equates to the square of the *t* statistic for a two-sample pooled variances *t* test. Wilks' Lambda indicates differences among groups. The discriminatory value of the MBTI E/I axis appears nil. Based on Wilks' Lambda, the remaining variables are reasonable candidates for inclusion in the discriminant function.

Group 1	Mean	Std.	Valid N (list wise)	
Pilots		Deviation	Unweighted	Weighted
Var1 [EI]	5.1935	1.8694	52	52
Var2 [NS]	12.451	3.1606	52	52
Var3 [TF]	13.548	3.0314	52	52
Var4 [JP]	15.129	2.8489	52	52
Var5 [VIEWS]	35.612	3.7388	52	52
Var6 [TACTIC]	40.709	3.5795	52	52
Var7 [CONV]]	9.1613	2.7700	52	52
Group 2	Mean	Standard	Valid N (list wise)	
Non-pilots		Deviation	Unweighted	Weighted
Var1 [EI]	4.9254	1.6173	40	40
Var2 [NS]	6.5672	2.7819	40	40
Var3 [TF]	9.6269	2.9120	40	40
Var4 [JP]	10.477	2.1416	40	40
Var5[VIEWS]	38.835	2.9418	40	40
Var6[ACTIC]	36.373	2.5216	40	40
Var7 [CONV]	6.6269	2.7015	40	40

Figure 1. Group Statistics

	Wilks' Lambda	F	df1	df2	Sig.
E-I	.995	.527	1	90	.359
N-S	.525	86.964	1	90	.000
T-F	.719	37.456	1	90	.000
J-P	.544	80.594	1	90	.000
VIEW	.818	21.336	1	90	.000
TACT	.669	47.586	1	90	.000
CONV	.839	18.359	1	90	.000

Figure 2. Tests of Equality of Group Means

	CATEGORY	
	Group One	Group Two
Extroversion-Introversion [EI]	1.579	1.162
Intuiting-Sensing [NS]	1.574	.984
Thinking-Feeling [TF]	.661	.473
Judging-Perceiving [JP]	1.277	.657
Machiavellian Views [VIEW]	2.873	3.279
Machiavellian Tactics [TACT]	4.378	3.872
Disregard for Conventional Morality CONV]	.542	.356
(Constant)	-171.486	-147.762

Figure 3. Classification Function Coefficients

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	2.469a	100.0	100.0	.884

Figure 4. Eigenvalue

The classification functions shown in Figure 3 allow the calculation of Fisher's linear discriminant function by taking the difference between the coefficients of the non-pilot and pilot classification functions: *Z* = (1.579-1.162)[EI] + (1.574-.)984[NS] + (0.661-0.473) [TF] + (1.277-.657) [JP] + (2.873-3.279) [VIEW] + (4.378 – 3.872) [TACT] + (0.542-0.356) [CONV]. Hence, *Z* = (0.417) [EI] + (0.590) [NS] + (0.188) [TF] + (0.620) [JP] - (0.406) [VIEW] + (0.506) [TACT] + (0.186) [CONV]. The Z score is the "cut" score for discriminating those applicants matching the desired pilot temperament profile for hire.

The Eigenvalue is the ratio of the between-groups sum of squares to the within-groups or error sum of squares. The percentage of variance and cumulative percentage of variance are always 100% for a two-group model such as we have presented. The magnitude of the Eigenvalue indicates strong differentiation between the groups based on the cases used in this study (See Figure 4). If the pilot cases in this study were deemed representative of the cockpit resource management (CRM) standard sought for hire, this specific discriminant function would be useful for current use in pilot selection.

Wilks' lambda is the proportion of the total variance in the discriminant scores not explained by differences between the two groups; in our study, about 29 percent of the variance is not explained by group differences (See Figure 5). We use Wilks' Lambda to test the null hypothesis that the means of the variables across the two groups are equal and present little benefit regarding the success of the discriminant function for classifying cases (selecting pilot candidates).

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.288	115.045	7	.000

Figure 5. Wilks' Lambda

In this study, that null hypothesis is rejected. By transforming Lambda to a variable with a chi-square distribution, we are able to assess whether there is a significant difference between the two group centroids. With a chi-square of 115, a significant difference between the two group centroids (the means of the seven variables calculated simultaneously) is noted.

Predictor Variables	Function
	1
Extroversion-Introversion [EI]	.212
Intuiting-Sensing [NS]	.513
Thinking-Feeling [TF]	.166
Judging-Perceiving [JP]	.442
Machiavellian Views [VIEW]	-.390
Machiavellian Tactics [TACT]	.438
Disregard for Conventional Morality [CONV]	.151

Figure 6. Standardized Canonical Discriminant Function Coefficients

Because the predictor variables have different ranges, we have elected to examine the coefficients after they have been standardized. Doing so, allows us to determine those variables having the greatest effect on the model. NS, JP, and TACT appear to discriminate the most in sorting pilot candidates (See Figure 6).

The structure matrix shows the pooled within-groups correlations between discriminating variables and the standardized canonical discriminant function. Variables are ordered by absolute size of correlation within the function (See Figure 7).

Within-group means are computed for each canonical variable, in our study with two categorical groups, the means for our seven-variable model are -1.259 and 2.270. Figure 8 shows the unstandardized canonical discriminant function evaluated at the group means.

Predictor Variables	Function
	1
Intuiting-Sensing [NS]	.606
Judging-Perceiving [JP]	.583
Machiavellian Tactics [TACT]	.448
Thinking-Feeling [TF]	.398
Machiavellian Views [VIEW]	-.300
Disregard for Conventional Morality [CONV]	.278
Extroversion-Introversion [EI]	.047

Figure 7. Structure Matrix

Category	Function
	1
Group One	2.286
Group Two	-1.058

Figure 8 -Functions at Group Centroids

CONCLUSIONS

The resulting Variate or discriminant function reflects strong discriminant power in identifying those individuals who are successful commercial air carrier pilots from their non-pilot counterparts. Further refinement is needed to include examining the discriminatory power of other instruments suitable for assessing temperament and personality characteristics. There is present a cynicism among many aviation professionals regarding the selection process for pilots and a doubt that new approaches will significantly improve the process in place (Orlady & Orlady, 1999). Yet the need is present to enhance the means of 'selecting-in' those candidates who match in temperament and attitude the interpersonal aspects of the flight crew environment.

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Prioritizing Tasks in the Cockpit: A Review of Cognitive Processing Models, Methods of Dealing with Cognitive Limitations, and Training Strategies

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ABSTRACT

Pilots must continuously assess, prioritize, execute, monitor, and terminate tasks to the best of their ability to safely and effectively complete the flight mission, often in time critical situations and in a dynamic environment. Limitations on pilot abilities to multitask are related to many factors described in the literature. To better understand and manage those limitations cognitive processes, such as single channel theory, multiple channel theory, and multiple resource theory are identified and related to cognitive limitations. Methods pilots use to deal with those cognitive limitations, including attention management, workload management, and task management are explored. Results from task prioritization specific training studies indicate multitasking may be trainable. Outcomes from studies reviewed can be used to inform design and implementation of training curricula. Some strategies for design and implementation of task prioritization training are presented.

INTRODUCTION

December 28, 1978 was a clear, calm night in Portland, Oregon, and certainly not the kind of tapestry against which one would think to paint the scene of a major airline accident. But for the crew of a United Airlines DC-8 overhead the inability to properly prioritize tasks was soon to become disastrous. As the aircraft circled near the airport the captain became obsessed about a malfunction in the landing gear and allowed the aircraft to run out of fuel, even after other crew members warned him several times about the critically low fuel situation. The DC-8 crashed into a suburban neighborhood, destroying the aircraft and killing eight passengers and two crewmembers. The accident investigation report states that a major cause of the accident was the captain's "diverted attention from operation of aircraft" (National Transportation Safety Board, 1979, p. 1). When the gear malfunction initially occurred it took priority. But as the airplane burned more and more fuel the situation changed and priorities shifted. When the fuel became critically low the captain neglected the most important task (ensuring the aircraft had sufficient fuel) to attend to the landing gear, a task he should have shed as it became less urgent with respect to immediate flight safety. That type of error can be classified as a task prioritization error (Funk, Colvin, Bishara, Nicolalde, Shakeri, Chen, & Braune, 2003; Hoover & Russ-Eft, 2005; Wickens, 2002), which occurs when a pilot gives preferential attention to a lower priority task rather than to a task that should take higher priority with regards to flight safety (e.g., it is more critical, more urgent, or not being performed satisfactorily).

Such prioritization errors have contributed to a significant number of aircraft incidents and accidents (Chou, Madhaven, & Funk, 1996; Damos, 1997; Dismukes, Loukopoulos, & Jobe, 2001; Latorella, 1996; Raby & Wickens, 1994; Rogers, 1996; Schutte & Trujillo, 1996). For example, Chou et al. (1996) conducted an in-depth review of 324 National Transportation Safety Board (NTSB) aircraft accident reports and 470 National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) aircraft incident reports. They found that task prioritization errors were significant in 23% of the NTSB accidents and 49% of the ASRS reported incidents.

Like the United Airlines captain, all pilots are required to perform multiple tasks simultaneously during both normal and emergency operations. Pilots must continuously assess, prioritize, execute, monitor, and shed tasks to the best of their ability, often in time critical situations and in a dynamic environment. At any given time a pilot's ability to multitask may be limited by many factors, including how effectively the pilot manages inputs and executes tasks to accomplish the flight mission safely and efficiently. Better understanding and managing of those limitations include identifying cognitive theories of multitasking behavior presented in the literature as well as identifying methods of dealing with cognitive limitations to pilot multitasking. Additionally, synthesis of studies that address whether cockpit task prioritization ability may be specifically trained can inform future training studies and task prioritization training programs.

COGNITIVE THEORIES OF MULTITASKING BEHAVIOR

Several theories of multitasking behavior are posited in the literature. Wickens (1992, 2002) defined multitask performance as the allocation of differentiated cognitive resources among competing tasks. Raby and Wickens (1994) explained it as an attempt to manage workload and to balance acceptable levels of performance with acceptable levels of cognitive stress. A similar presentation of multitask performance as a function of workload was given by O'Hare and Roscoe (1990), but they related performance to the ability of the pilot to time share between concurrent tasks. Kern (1998) discussed effective execution of cockpit tasks as a function of proper procedural discipline in prioritizing both inputs and tasks.

Multitasking has been recognized as a key element to successful performance in complex systems (O'Hare & Roscoe, 1990; Raby & Wickens, 1994; Wickens 1990, 1992, 2002; Wickens, Dixon, & Chang, 2003). In the mid 20th century, cognitive psychologists used computer metaphors to describe the brain and cognitive processes related to performing multiple tasks. Three basic theories of multitasking and task management that have evolved from research in cognitive psychology are 1) single channel theory, 2) single resource theory, and 3) multiple resource theory. Each of these is discussed below in the context of processes involved and limitations they present to effective multitasking abilities.

Single Channel Theory

Early researchers concluded that information must be processed sequentially based on the time available to perform tasks and that there is an overall limit on human ability to handle information and perform associated tasks (Broadbent, 1958; Lindsay & Norman, 1972; Welford, 1952, 1967). That type of mental processing is called the "single channel bottleneck" or single channel theory (SCT), and it assumes that no parallel processing or timesharing can take place: two tasks cannot be performed concurrently, and one will be dropped until the other is completed (Moray & Rotenberg, 1986; Wickens et al., 2003). Since SCT predicts that tasks must be performed sequentially, the following summarizes the relationship of concurrent tasks to time available:

> SCT has different manifestations. All versions of strict SCT predict that progress on information processing can only take place on one task at a time, and therefore the completion time for two tasks imposed concurrently will equal the sum of the completion times for each done alone. This concurrent completion time will increase to the extent that information for a second arriving task is closer in time to the initiation of the first arriving task. (Wickens et al., 2003, p. 12)

Based on time-limited models of mental capacity described by SCT, studies done for the U.S. Navy in the 1960's to develop more efficient ways of attending to sequential tasks focused on the amount of time it took for a pilot to process a task. For example, studies done by the Boeing Company (Premesalar, 1969) determined that it took an average of 3.9 seconds for the pilot to acknowledge course data, 1.8 seconds to check attitude and heading, 3.8 seconds to change course to the new heading, and 5.0 seconds to monitor systems status. Next, procedures were developed to maximize the relationship between information processing and task performance times so pilots performed tasks in a specific sequence based on their priority and on the time allocated for each task, which optimized overall task performance (Premesalar, 1969).

Another aspect of SCT processing identified by Moray and Rotenberg (1986) was the phenomenon of "cognitive lockup" that occurred when pilots become attentionally locked onto one task to the exclusion of other tasks. Moray and Rotenberg (1986) concluded that cognitive lockup behavior represented evidence that people deal with problems serially rather than switching between tasks. In experiments conducted by Hoover and Russ-Eft (2005) pilots exhibited cognitive lockup when they became fixated on operation of the GPS system and ignored large deviations in primary aircraft control, indicating they were processing inputs and tasks according to SCT.

Single Resource Theory

Single Resource Theory (SRT) differs from SCT in that cognitive resources, rather than amount of time available, predict task interference and performance (Wickens et al., 2003). SCT posits that there is a single pool of cognitive resources available, but those resources are undifferentiated with regards to attention, and when more than one task is performed, or when tasks become more difficult, this pool of resources become limited (Kahneman, 1973). For example, experimental subjects who were asked to process simultaneous messages could recall some characteristics of the second message, such as whether a speaker was male or female, but not the context of the message (Lindsay & Norman, 1972). Lindsay and Norman postulated that some kind of filtering mechanism limited the overall capacity to transfer incoming sensory information into working memory. However, Moray (1967) determined that there were certain circumstances where humans had the ability to share cognitive resources between tasks, and Hoover and Russ-Eft (2005) showed that in a given scenario some pilots had the ability to share resources between two tasks simultaneously and others did not. Other studies showed that motivation and subsequent mobilization of increased effort could overcome the penalties of increased task difficulty so that two tasks could be performed simultaneously, although task performance might be degraded in one or both tasks (O'Hare & Roscoe, 1990; Wickens et. al., 2003).

Multiple Resource Theory

Tasks that do not compete for the same resources, such as a visual task and an auditory task are easier to perform simultaneously than two tasks that use the same resources (Wickens, 1980, 1992; Wickens et al., 2003) which represent application of the multiple resource theory (MRT) model of cognitive processing first described by Wickens (1980). For example, monitoring flight instruments is a visual and spatial task, whereas listening and responding to an air traffic control clearance is an aural and verbal task. Because spatial and verbal tasks operate in distinctly different ways and take place in separate parts of the brain, there will be less conflict between those types of tasks, because they are not competing for the same mental resources. If tasks are competing for the same type of resources, then task performance for both tasks may deteriorate as resources are reduced (Wickens et al., 2003). A practical application of MRT includes cockpit design items such as voice activated control systems and auditory displays, which are less likely to interfere with the primarily visual spatial task of flying (Liu & Wickens, 1992; O'Hare & Roscoe, 1990; Wickens et al., 2003).

One aspect of MRT involves the concept of time-sharing, or the ability to alternate between different sources of information (Wickens et al., 2003). During initial training the majority of a pilot's time is spent focusing on the primary task of learning to control the aircraft, but as skill and confidence are gained more time becomes available to share attention with other tasks such as scanning for traffic, monitoring instruments, and assessing the status of current and future situations. The ability to perform tasks concurrently and efficiently depends not only on time-sharing ability but also on the cognitive resources or processing demands imposed by each individual task (North, 1977; Wickens, 1980; Wickens, Vidulich, & Sandry-Garza, 1984).

The way in which a pilot allocates cognitive resources to perform multiple concurrent tasks is an important aspect of multitasking theory. Regardless of what theory is used to describe how a pilot processes information and performs tasks, limitations to cognitive resources hinder a pilot's ability to allocate those resources and present a challenge to flight operations and flight safety.

METHODS OF DEALING WITH COGNITIVE LIMITATIONS

A certain level of multitasking ability that can be described by one or more cognitive processing models (SCT, SRT, and/or MRT) is required to perform even at a basic skill level adequate to achieve pilot certification, and individualized skills may vary from one pilot to another. However, pilots will be limited in varying degrees by their ability to prioritize and execute tasks in the context of flight operations. This section draws from literature that focuses on ways in which a pilot can deal with limitations related to cognitive processing and to use cognitive resources in managing attention, workload, and prioritizing flight tasks.

Attention Management

One approach to multitasking in the cockpit focuses on managing pilot attention with respect to inputs and to prioritization and execution of tasks. Kern (1998) put it this way:

> “Attention management is a very complex phenomenon involving both the conscious and subconscious. It keys off of pattern recognition, or the ability of the brain to make sense out of multiple inputs by arranging them to fit patterns it has seen before. Often in aviation, there is no pattern established in your memory banks for a new situation, and this can lead to severe task saturation and channelized attention, two of the grim reaper's favorite tools for use on aviators. In order to make sure that we have the necessary attention available to complete mandatory procedures, we must learn to manage our attention.” (p. 90)

Kern (1998) also described occurrence of task saturation as a result of two different situations. The first is information overload, where the brain's ability to comprehend is simply overwhelmed by the mass of sensory input. As described by SRT this would result in degradation in performance of one or more tasks as cognitive resources become limited (O'Hare & Roscoe, 1990; Wickens et. al., 2003). The second situation described by Kern (1998) occurs when a pilot fails to adequately prioritize inputs so that unwise time-sharing between important and unimportant tasks occurs. According to MRT, that inability to effectively time-share is linked to the level of cognitive resources required to process each input, regardless of its level of importance. Attention failures are also linked to errors such as breakdown in visual scan patterns, task fixation, and even inadvertent activation of controls such as that which lead to the crash of Eastern Airlines Flight 401 into the Florida Everglades in December, 1972 (Shappell and Wiegmann, 2001). In the Flight 401 crash the crew became fixated on a landing gear indicator light and one of them bumped the control yoke causing the autopilot to initiate a descent that caused the airplane to crash into the ground (National Transportation Safety Board, 1972). Shappell and Wiegmann (2001) compared that accident to a driver who is in hurry, or daydreaming, and misses an exit. They added, "These are both examples of attention failures that are commonly occurring highly automated behavior. While at home or driving around town, these attention failures may merely be frustrating. However, in the air they can become catastrophic" (Shappell & Wiegmann, 2001. p. 63).

In order to effectively prioritize inputs and actions "one key is to stay ahead of the aircraft and to use times of relatively low workload to accomplish future tasks" (Kern, 1998, p. 90). Kern described a second "indispensable survival tool for pilots when dealing with task saturation is a system for prioritization when the stuff hits the fan" (p. 91) and pointed out that pilots must not only be able to prioritize tasks, but also be able to prioritize information and input to avoid time-sharing between important and unimportant tasks; failure to do so can result in channelized attention or task overload, which is a major cause of breakdown in procedural discipline. It follows that in order to effectively execute tasks with proper priority and avoid task saturation pilots must learn to manage their attention. Kern (1998) emphasized that procedural discipline is the best solution for prioritization during busy times and that pilots should use an “aviate, navigate, communicate” (ANC) hierarchy to assist with prioritization. Chappell (1998) amplified this concept with the following words:

> From the very first flight lesson, we were taught to "aviate, navigate, communicate," in that order. To aviate, navigate, and communicate, you must be aware of the plane, the path, and the people (crew, passengers, dispatchers, and air traffic controllers). Not only do you need to monitor and evaluate these three things now, but also you need to anticipate what's going to happen in the future and consider contingencies. The current and future state of the plane, the path, and the people are the components of the plan. (pp. 249-250)

As discussed by Kern (1998) and Chappell (1998), flight training places strong emphasis on procedural discipline as paramount to managing attention; when sensory overload, interruptions, and distractions threaten flight safety, procedures may be all pilots have to fall back on to prioritize their inputs, tasks, and actions.

Workload Management

The ability to prioritize tasks is closely related both to a pilot's ability to focus attention and their ability to manage workload (Kern, 1998; Wickens, 2002, Wickens et al., 2003). A majority of accidents occur during periods of high workload, which include takeoff, approach, and landing, and effective workload management is paramount to avoiding distractions during critical flight times (Chappell, 1998; Federal Aviation Administration, 1999; Jeppesen, 2006; Kern, 2001). From an aviation psychology perspective workload seems to be a variable concept depending on the ability of the pilot or crew and on their preparation and planning strategies and practices. With certain combinations of tasks, individuals differ in their ability to process simultaneous inputs (Braune & Wickens, 1986). Wickens (1992) determined that individuals have an optimal level of workload and that above or below that level both individual and composite task performance is diminished:

> Mental workload can be described as the relationship between resource supply and task demand. If supply exceeds demand, then performance is constant. But if demand exceeds supply, then performance will decrease as the resource demand (workload) further increases. Each of the pilot's responsibilities impose a certain amount of demand. The question is how much supply the pilot has available to cope with that demand, and when the demand reaches a point where performance drops due to a lack of resources. (Wickens et al., 2003, p. 3)

During initial training pilots are introduced to the concept of workload: "Effective workload management ensures that essential operations are accomplished by planning, prioritizing, and sequencing tasks to avoid work overload" (Jeppesen, 2003, p. 3-34).

While the ability to manage workload may be highly individual, both practice and adherence to procedures can contribute to increased ability to manage workload effectively in the cockpit (Chappell, 1998; Kern, 1998).

Task Management

Rather than focusing on workload management, some studies have approached multitasking from the concept of task management, which entails managing discrete tasks, rather than total workload, by continuously prioritizing concurrent tasks and allocating resources to them based on perceived priority (Funk et al., 2003; Raby & Wickens, 1994; Rogers, 1996; Schutte & Trujillo, 1996). As defined by Funk (1991) and Funk et al. (2003), concurrent task management (CTM) is an ongoing process by which pilots initiate new tasks, monitor on-going tasks, selectively prioritize tasks, and terminate, or shed tasks deemed less important or that have been completed:

> CTM is not new; in fact, pilots have always done it. CTM is a cognitive function that is intuitively well understood by pilots and almost always performed satisfactorily. However, there are many documented instances in which tasks were not managed properly, resulting in an aircraft incident or accident (Chou et al, 1996). Often, during critical phases of flight, this form of human error results in minor regulations violations or unsafe conditions that are rectified before a more serious situation develops. However,

> the consequences of improper CTM can be a catastrophic event resulting in many fatalities and loss of the aircraft. (Funk et al., 2003, p. 9)

Another factor that seems to affect task management performance is the type of task being performed, as described by MRT. Liu and Wickens (1992) conducted experimental studies in which pilots were assigned a primarily visual task of tracking a course and then asked to perform either a spatial decision task (e.g., predicting the future position of a vector) or a verbal task, such as mental arithmetic. Those studies found that an inherently spatial visual scanning task produced more interference with a concurrent spatial task than with a concurrent verbal task and that pilots were better at performing concurrent tasks that used different cognitive resources such as a visual task coupled with an auditory task: "tracking error, decision accuracy, and workload all suffered more when both tasks involved spatial activities" (Liu & Wickens, 1992, p. 141). Wickens et al. (2003) stated that increased perceptual competition disrupts a cognitive task more than a motor task:

> Primary task performance can suffer immensely while a pilot focuses most, or all, of her attention on dealing with the secondary task. When designing a system that requires a cognitively challenging secondary task, it is important to determine exactly how that secondary task will affect performance in other concurrent tasks. (p. 8)

In order to improve task prioritization Wickens (2002) suggested using an aviate, navigate, communicate, operate systems (ANCS) hierarchy to prioritize tasks. However, even when using such a method, the extent to which the hierarchy is maintained when an ongoing task is interrupted by an incoming task can depend on the type of interrupting task:

> Some evidence suggests that auditory tasks low on the ANCS hierarchy, and particularly auditory communication tasks, tend to be both more interrupting and less interruptible than tasks with a higher priority (e.g. navigation). Studies comparing better and more poorly performing pilots have indicated that better multitask performance results from rapid switching between tasks (Wickens, 2002, p. 132).

Experiments conducted by Hoover and Russ-Eft (2005) corroborated the tendency of auditory communication tasks to be more interrupting. Using the ANC hierarchy to define task priorities, their experiments interrupted the pilot’s primary task, such as basic aircraft attitude control, with a lower priority task, such as tracking or intercepting a course or responding to air traffic control instructions. Hoover and Russ-Eft (2005) found that pilots tended to misprioritize tasks as much as 47% more frequently when the interruption involved a communications task rather than a visual navigation task.

The tendency for a lower priority communications task to interrupt a higher priority aviation or navigation task cited by Wickens (2002) and Hoover and Russ-Eft (2005) supports anecdotal wisdom in the flight training industry that pilots will typically place communications first on the list of tasks, even when they know it should be lowest priority. Popular aviation magazines that target student pilots and flight instructors repeatedly publish articles addressing this issue of task misprioritization. For example, Miller (2003) wrote: "You may not have heard of Marconi's law. Named somewhat facetiously for Guglielmo Marconi, who transmitted the first wireless message in 1895, it says, 'fly the airplane, not the radio!’" (p. 38)

RELATIONSHIP OF ATTENTION, WORKLOAD, AND TASK MANAGEMENT

Although some researchers address workload and task management separately, many studies show a strong relationship between pilot workload and the ability to effectively prioritize and execute tasks. Raby and Wickens (1994) investigated how the pilots decided to prioritize tasks and shed tasks once they were completed and determined that people adapt to high workload periods by prioritizing tasks; the higher the priority, the closer the task was performed at the optimal time. In their study, 30 student pilots flew three simulated landing approaches under low, medium, and high workload scenarios. As workload increased, some pilots' performance on primary tasks (flying the airplane) diminished to the point of creating dangerous situations. The inverse relationship of task prioritization performance to pilot workload was corroborated through empirical studies conducted by Chou et al. (1996) and Wickens et al. (2003). Those studies found that pilots mis-prioritized tasks more frequently during periods of high workload.

A significant outcome of Raby and Wickens (1994) study was that individuals assume or shed tasks in order to maintain workload at a relatively constant level which varies with the individual. Pilots who were most successful were those who scheduled discrete tasks during periods of low workload (Raby & Wickens, 1994). Wickens (2002) wrote, "Task management is directly related to mental workload as the competing demands of tasks for attention exceed the operator's limited resources" (p. 128). Indeed, a critical factor is for pilots to stay ahead of the aircraft and use times of relatively low workload to accomplish future tasks, which requires a high level of discipline (Chappell, 1998; Kern, 1998).

Strategies used to deal with cognitive limitations and to facilitate cockpit multitasking performance center on pilot ability to manage attention and workload, and effectively prioritize and allocate tasks. Ultimately, those allocations should be based on which tasks are most critical at the time with regards to flight safety and performance. Because often the number of concurrent tasks is great and because in many cases each task is critically important to flight safety, pilots are accustomed to relying on standard operating procedures (SOPs) checklists, cockpit flow checks, and mnemonic memory aiding devices (such as the ANC hierarchy), with the assumption that by following those procedures they are conducting tasks in the proper sequence. Additionally, engine and systems controls, fuel selectors, switches, and other important items may be positioned so the pilot can perform tasks in a certain sequence (for example left to right or up to down) as part of a flow check. Procedures and checklists may be constructed so that pilots perform tasks in an exact sequence, often in the order of importance or highest to lowest priority. However, task priorities will change, and when a pilot must rapidly switch between tasks, or when unexpected events require actions that are not a part of standard or emergency checklists and procedures, some highly cognitive tasks, such as maintaining situational awareness, cannot be easily codified in checklists and procedures and it is difficult for any hierarchical scheme to stand up completely under close scrutiny (Wickens, 2002).

TRAINING IN ATTENTION, WORKLOAD, AND TASK MANAGEMENT

A pilot’s ability to always be aware of the tasks that need to be performed and in what order they must be performed is critical, and begs the question as to whether attention management, workload management, and task prioritization are improved solely through experience gained, or whether they can be improved through specific training. Based on empirical findings, O'Hare and Roscoe (1990) stated that "It is possible to perform certain non-conflicting tasks concurrently without decrement to either, and workload studies have shown that this can indeed be the case" (p. 193). However, they noted that experts’ and novices’ performance varied significantly and concluded that extensive practice that comes with flight experience is necessary to improve the ability to time share between tasks and perform multiple tasks concurrently. Conversely, other experimental studies show evidence that training specific to task management improved cockpit multitasking performance (Gabriel & Burrows, 1968; Hoover & Russ-Eft, 2005; Premesalar, 1969).

Hoover and Russ-Eft (2005) conducted experiments with university flight students who exhibited equivalent task prioritization performance in the context of the ANC hierarchy. After two weeks, students who received task prioritization specific training showed as much as a 56% reduction in multitasking errors, while students that did not receive training showed no significant change (Hoover & Russ-Eft, 2005). However, their study did not address longer term effects of the training. In a study conducted with U.S. Marine aviators (Gabriel & Burrows, 1968), pilots were trained to prioritize cockpit tasks and to acquire all necessary information from cockpit instruments before refocusing their attention outside. Pilots who had this training were much better at detecting external targets than those who were not trained, even several months after the training had occurred (Gabriel & Burrows, 1968), which indicates they were better able to divide their attention and resources as a result of specific training.

DESIGN OF FLIGHT TRAINING CURRICULA

Flight instructor training curricula based on FAA standards addresses training in task prioritization, attention management, workload management (FAA, 1999; Jeppesen, 2006a). Despite that apparent emphasis, mis-prioritization of cockpit tasks had contributed to a significant number of aircraft incidents and accidents as previously discussed. It is possible that although concepts of multitasking, workload management, and task prioritization training are introduced, they may be lost in the larger scope of components required by a typical training curriculum and environment. Alternatively, it may be that the manner in which the concepts are introduced and practiced do not lend themselves to effectively developing strategies to overcome the cognitive limitations just described.

According to the dual memory model of learning and retention as described by Schunck (2004) and adopted by the FAA in their flight instructor training literature (Federal Aviation Administration, 1999), information is processed through inputs (primarily visual and auditory) to the sensory register. In order to transfer information to long term memory the learner must relate incoming information to concepts and ideas already in memory. Therefore, in order to be effective, training curricula must include the linking of multitasking and prioritization skills to a pilot's existing core of experience and practice during flight training. Training must also facilitate higher levels of learning by developing the pilot's ability to correlate what they learn from the specific training to general flight operations.

Several training strategies are suggested here that could be used to incorporate cognitive processing models and methods of dealing with cognitive limitations in the design and implementation of training curricula. One strategy is to place pilots in situations where they experience limitations just discussed such as sensory overload or cognitive lockup and are given the opportunity afterwards to self-analyze and reflect on strategies they used (or did not use) to deal with the situation. An effective way to do that is to make a video recording of the session for playback and analysis. Scenario based training is ideal for designing these types of sessions and can be used in simulator sessions as well as more limited use in the aircraft.

Another method is to have pilots conduct analysis of accidents and incidents taken from the NTSB and NASA databases with respect to multitasking errors. After analysis, pilots should recreate the accident and incident scenarios and provide possible points in time at which a different action or decision with respect to attention or workload management or task prioritization could have changed the outcome of the flight.

Exercises in which pilots reflect on a flight with respect to multitasking concepts and strategies they used for in-flight decision making can also be designed, and both written reflection and verbal debriefings can be used. The reflection should include emphasis on procedural discipline, adherence to SOPs, checklists, briefings, flow checks, and mnemonic memory aids at appropriate times in order to link concepts to task prioritization and attention and workload management to task performance. Additionally, learning sessions can be designed to include role-playing scenarios to give pilots insight into their reactions and behavior in the cockpit when confronted with cognitive limitations and multitasking challenges.

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Gender and Multi-Cultural Curriculum Issues for Undergraduate Aviation Students

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ABSTRACT

St. Cloud State University aviation students were asked about their perception of completed multicultural, gender and minority (MGM) diversity course requirements and their beliefs concerning current aviation industry workplace practices regarding gender and minority issues. The authors' goal was to examine how students are being prepared for employment in a diverse aviation work environment. Data were collected through the use of a survey questionnaire distributed amongst undergraduate students ($n = 99$) about their experiences with MGM coursework. Students were asked demographic related questions regarding age, school year, major area of study, and then were directed to respond to questions which used a Likert-type five point scale. The results were not generalized to the larger post secondary student population as this study is institution and domain specific. The researchers found that respondents surveyed for this study were exposed to the MGM component about non-Western societies. The respondents indicated that qualified candidates should be considered equally for employment regardless of gender and/or ethnicity. Results also indicated that respondents would like the existing work culture to be preserved and they did not believe that the courses prepared them to work in a diverse organizational environment.

INTRODUCTION

Beginning with the 1990-91 academic year, St. Cloud State University has required students to take three multicultural, gender and minority (MGM) designated courses as part of their undergraduate baccalaureate load; one of these courses must be a racial issues course requirement taken in the first year of enrollment (St. Cloud State University, 2004). The MGM requirement is designed to foster respect for human dignity and differences by methods that employ and strengthen the cognitive powers of students by an impartial and critical examination of facts, interpretations of facts, and arguments. These MGM courses are offered in a variety of educational disciplines to expose students to various pedagogies addressing the MGM components in non-Western societies.

There are 60 designated MGM courses offered through 34 different departments or specialized programs at St. Cloud State University (St. Cloud State University, 2004). The Aviation Department offers a *Women in Aviation* course which is designated as an MGM course. Students may take no more than one course from any one department while pursuing their MGM designated coursework requirement. One of the anticipated outcomes of the MGM program is that students will be introduced to the unique interpretations and philosophies of diverse areas by taking MGM courses from different departments or programs (St. Cloud State University, 2004).

The authors' goal was to examine aviation student perceptions of these courses and whether they thought the coursework prepared them to work in a racially and gender diverse aviation industry. After a literature review, the results of the survey conducted during early spring 2006 semester are presented. Surveying helped determine how students are being exposed to the MGM components.

AVIATION EMPLOYMENT DEMOGRAPHICS

Although the primary demographic component of the aviation industry as a whole remains the Caucasian male, the number of minorities and women employed in specific sectors of the aviation industry is significant. Employment data (see Table 1) illustrates the number of women and minorities employed in the aviation industry. Additionally, the Federal Aviation Administration (FAA) reported total permanent employee numbers of 48,503 for fiscal year 2004. This number includes 36,668 men (75.6%), and 11,835 women (24.4%). In addition, the total FAA employment number for 2004 included 9,604 minorities (19.8%).

The data in Table 1 suggests that, although these segments of aviation employment are populated mostly by Caucasian males, there is a measure of diversity that is present in the aviation industry. With this knowledge in mind, it is important that postsecondary aviation programs are cognizant of the need to prepare their students to thrive in a culturally diverse work environment typically found in the aviation industry. Many aviation organizations have increasingly recognized the value of a diverse environment and have implemented internal initiatives which not only acknowledge diversity, but are actually providing specific training in diversity to their employees.

Table 1. *U.S. Equal Employment Opportunity Commission, 2003*

Air transportation type	**Total**	**Male**	**Female**	**Minority (M & F)**
Scheduled air carriers	429,377	244,805 (57%)	184,572 (43%)	109,829 (26%)
Nonscheduled	21,377	15,223 (71%)	6,154 (29%)	3,384 (16%)
Support areas	74,620	57,294 (76%)	17,326 (23%)	35,184 (48%)

GENDER AND MINORITY ISSUES IN AVIATION

Employment in the aviation industry has consisted primarily of white males (Turney & Bishop, 2002). Hansen and Oster (1997) reported that "aviation occupations, although changing, do not mirror the diversity of the overall American workforce". (p.44) This relatively homogeneous work environment has established a certain culture that has permeated the work environment of the flightdeck and females and minorities have assimilated themselves to the existing culture.

World War II gave minorities, such as African American males and women, the opportunity to enter the aviation field through the Army Air Corps pilot training program and the Women Airforce Service Pilots (WASPS). After much pressure from the black community, African American males were accepted for aerial combat training at Tuskegee Institute on January 16, 1941 (Netty, 2000). These pilots were placed in a separate unit in an era and area that was heavily racially segregated. "African American aviators in the Army Air Corps flew 1,578 missions and 15,533 sorties with the Twelfth and Fifteenth Air Corps and destroyed or damaged 409 enemy aircraft in World War II" (Netty, 2000, p. 352). Wilson (2004) noted that the WASPS, a group of women charged with ferrying military planes during World War II, proved themselves to be competent pilots. The WASPs and Tuskegee Airmen made extraordinary inroads into the white male dominated aviation industry. At the time, their impact was felt, but not sustained, because of a variety of social barriers.

It has been the practice of women and minorities to assimilate themselves into the established environment. Davey and Davidson (2000) found that women who were hired as airline pilots had not changed the culture of the flightdeck, but rather had conformed to the traditional masculine values and practices already imbedded in the culture. Women on the flightdeck are visibly different to both colleagues and passengers. A female pilot was quoted as saying "….it was like having two heads really to start with. It wasn't hostility. It was just that people weren't used to you" (Davey & Davidson, 2000, p. 214). Male pilots were reluctant to change their ways when paired with female pilots (Davey & Davidson, 2000). Some flight crew members became more aware of their language, behavior and topics of conversation when a female flight crew member was present. Women also found it unusual to fly with other female crew members. Female pilots had traditionally been trained in a male environment and worked with other male pilots.

Turney and Bishop (2002) found that there are more than gender differences in the flight deck culture between men and women. There is a difference, both perceived and real, regarding how females and males learn and lead. There is also a difference in how different cultures view leadership and authority. Both of these elements have an effect on Crew Resource Management (CRM) on the flightdeck. The differences in gender and culture must be recognized and understood to make CRM effective and the flightdeck environment safer (Turney & Bishop, 2002).

Female and minority crew members hired by an airline have experienced a degree of harassment on the flightdeck. The harassment varied from pornographic material placed in their flight bag, to sexist or racist comments being made in their presence. "Reporting these comments to a manager did nothing to improve the environment" (Davey & Davidson, 2000, p. 208). The female or minority crew member felt it was best not to respond to these comments in a defensive manner in order to keep their jobs. Some female or minority crew members did not take jokes or comments personally, rather as a sign their fellow crew members felt comfortable enough with them, and had accepted them as a part of their culture. Charles stated that "we are killing people and crumbling aluminum because of poor communication and lack of basic people management skills" (as cited in Turney and Bishop, 2002, n.p.). This is an event that can be precluded by the inclusion of gender and cultural differences in the learning and leadership processes.

AVIATION INDUSTRY DIVERSITY INITIATIVES

A review of scholarly aviation literature suggests that very little has been written on the subject of diversity within the aviation industry workforce. While there are some published works (Firmin, 2002; Perkins, 2004; Turney, Bishop, Karp, et al., 2002; WMU News, 2004) on the subject of aviation diversity, the literature review revealed that most of these papers tend to focus on certain aspects of the flightdeck environment, such as diversity issues in crew or cockpit resource management (CRM). This may suggest that the aviation industry remains a largely untapped potential source for scholarly research, and subsequent potential publications. The literature also appeared to be lacking in the area of collaborative relationships between the airlines and collegiate aviation. In developing and enhancing diversity initiatives in the airline industry, the literature also does not reflect any conscious efforts to actively address the needs of working with the mentally and physically challenged employee and the actively employed worker with a terminal illness.

Despite the lack of scholarly work on the subject, specific segments of the aviation industry have determined that providing diversity training to their leadership employees is not only a good idea, but a necessary business practice to ensure inclusion of all groups and persons. Toward this end, Delta Airlines (DL) has not only embraced the workplace diversity movement, they have created an entire "global diversity" department that is devoted to promoting workplace diversity throughout their global operation. According to Paul Graves, DL Vice President of Global Diversity, "Diversity is not a social experiment for us. When we look at our business, we realize that it's essential to understand and manage differences. Diversity is not a 'nice-to-have,' it's a 'got-to-have'" (Diversity/Careers in Education & Information Technology, 2003, par. 15).

In recognition of the veracity of the diversity viewpoint espoused by Delta, Atlantic Southeast Airlines (ASA), formerly a wholly owned subsidiary of Delta Airlines, followed the lead of their parent company before ASA was sold in September 2005. ASA required their managers and supervisors to attend a mandatory diversity training session titled *Valuing Diversity*. In this training, ASA leaders were taught the value of embracing a diverse workforce, and overcoming stereotypes. According to the *Valuing Diversity* training manual (2004) created by Coleman Management Consultants, Inc., diversity in the workplace is not meant to be a substitute for Affirmative Action programs, nor is diversity meant to be a way of showing favoritism or preferential treatment to certain groups at the expense of other groups. Rather, valuing diversity in the workplace is working to obtain the objectives of an organization by "maximizing the contributions of individuals from every segment of the employee population" (*Valuing Diversity*, 2004, p. 3). In other words, true diversity in the workplace means not only embracing ethnic differences, but also fostering an organizational culture that harnesses the collective talents of each department and the individual talents of each employee. For example, ASA/Delta Connection integrates diversity programs into the workplace by using professional coaches. Valuing diversity at ASA is more than race and gender, it promotes the understanding of individual needs, actively shows sensitivity to other employees at all levels in the organization, recognizes the value of a diversified workforce, broadens individual norms of acceptance, creates an environment where people respect each other, etc.

Perkins (2004) wrote "The strength of any corporation's commitment to diversity can be evaluated across five categories: products and services, leadership, employment, procurement, and community outreach" (np). Continental Airlines has shown a strong commitment to diversity in the workplace by excelling in four of the five aforementioned criteria (Perkins, 2004). In addition, Continental's corporate commitment to diversity (Latinization Initiative) is also reflected in the number of minorities in their workforce. Perkins also noted that over 10 percent of Continental's management is Hispanic and Hispanics account for about 16.7 percent of the total employee population.

As the general and aviation workforces become more and more diverse in terms of ethnic differences and job specialization, it is very important that students in postsecondary aviation programs become prepared to work in an increasing diverse industry. Consequently, postsecondary aviation programs need to effectively develop ways to prepare their students for the realities of a diverse workplace. By doing so, students may gain a greater benefit by being better equipped to succeed in an industry that is highly kinetic in terms of change in operational issues and expanding diversity.

COLLEGIATE AVIATION DIVERSITY INITIATIVES

The low number of women and minority members considering a career in aviation still remains troublesome despite recent gains during the past two decades. Turney (2000) found that the percentage of women attracted to aviation careers in addition to collegiate aviation enrollment and retention rates have remained marginally low. A research study conducted by Firmin (2002) found that Hispanics account for 11 percent of the workforce in the year 2000 and are projected to increase to 24 percent by 2050. Firmin's study of the workforce also indicated that Asians will increase five percent (six to 11 percent) compared to a marginal growth rate of two percent (12 to 14 percent) for African-Americans during the same time period. A review of the literature (Firmin, 2002; Perkins, 2004 & Wilson, 2004) would seem to suggest that despite a significant projected increase in minority growth into the workplace, the aviation industry remains unprepared to meet the opportunities provided by an increasingly diversified workforce.

Collegiate aviation diversity initiatives are relatively new considering that collegiate aviation is less than 100 years old. During the 1990-91 academic year, two Department of Aviation faculty members at St. Cloud State University actively explored opportunities to attract and retain more female students into the aviation program which ultimately led to the creation of a new course during the following year – *Women in Aviation*. This course was never before offered at the postsecondary level making St. Cloud State University the first university in the nation to specifically address women's contributions (*Flightlines*, 1992) and was developed into a university approved general education multi-cultural/multi-gender course. *Women in Aviation* was specifically designed to educate students on the role and contributions of women to the aviation industry and the original course was team taught by two aviation professors – a male and female. According to Thornberg and Mattson (1992), the male-female team-teaching course delivery utilized the "diverse strengths of two professors and encourages open discussion of the historical and contemporary cultural and societal issues, particularly those which relate to gender definition, which have had significant impact upon women's role in aviation" (p. 6). Furthermore, Thornberg, Mattson, and Sundheim (1995) conducted a research study using pre- and post- survey instruments and found that students completing the *Women in*

Aviation course had an overall favorable attitude transformation towards women in the aviation industry.

Other schools such as The College of Technology and Aviation at Kansas State University (KSU) in Salina have taken a proactive stance on African-American diversity initiatives by entering into a joint program with Tuskegee University. Diversity has moved from the institutional to the programmatic level in KSU's aviation program. Culture is a set of beliefs, norms, attitudes and practices within a certain population (Pidgeon & O'Leary, 1995) and consequently, diversity initiatives must take into account the diverse culture that often exists within various groups enrolled in collegiate aviation programs. Notwithstanding culture, the complexity is often too real with gender as illustrated by the results from a study by Turney, Bishop, Karp, et al., (2002) that found similar dominant learning styles with collegiate aviation men and women. With respect to cultural diversity initiatives in collegiate aviation, the challenges that lie ahead for educators to favorably affect change not only within various cultural subgroups, but across the entire spectrum of the aviation student body, may appear as extremely daunting.

In 2004, five historically black colleges that offer aviation programs (Delaware State University, Florida Memorial College, Hampton University and Tennessee State University) joined Western Michigan University's College of Aviation to form an Aviation Education Consortium in an attempt to work together to diversify the aviation industry workforce as well as to expand opportunities for minority students and women (WMU News, 2004). According to the WMU News:

> The aim of the new organization is to use the resources and expertise of all consortium members to identify and support minority individuals who have an interest in pursuing an aviation career and establish a strategy and process for taking such individuals seamlessly 'from ninth grade to the airline industry door'. (p. 1)

Dennis stated that the Aviation Education Consortium "will attempt to build an aviation work force that more accurately reflects the industry's work force development needs" (as cited in WMU News, 2004, n.p.) by working to identify, recruit and train students. The five school consortium continues to actively address the problems involving women and minorities and looks for long term solutions. The consortium is a positive step in addressing gender and minority opportunities in aviation careers although the effectiveness could be further realized if a strong connection to the aviation industry was developed and maintained. The lack of related literature would seem to suggest that a significant disconnect between collegiate aviation and the airline industry presently exists.

RESEARCH METHOD

A survey, adapted from Czech, Kelly, and Mattson (2002), was administered during spring 2006 semester in an attempt to assess the perceptions and attitudes of students about their MGM course requirement experience(s). Ninety-nine students enrolled in aviation courses completed the questionnaire. Students were asked to indicate demographic information such as gender, class level, age, and the number of MGM courses completed to date. The selection of classes assessed was based on convenience, and as such we did not randomize the sample selection; all administrations were completed within a one-week period of time. Respondents ranged from first year students to seniors and there were more males (85) than females (14); the ages reported represented typical traditional college age students (see Figure 1).

In surveying students' perceptions of MGM courses, the following construct questions needed to be raised: (1) Do the required MGM courses address non-Western and/or female issues? (2) Do the students perceive that the courses are balanced in their presentation of the required MGM components? and (3) Had the courses helped students' in shaping their attitudes about working in a diverse environment? The responses indicate students' perception of their MGM educational experience and how they view these issues as it might relate to their aviation careers.

Gender	Frequency	Percent
Male	85	85.9
Female	14	14.1
Total	99	100.0

Age	Frequency	Percent
18-20	34	34.3
21-23	50	50.5
24-30	13	13.1
31+	2	2.0
Total	99	100.0

Ethnicity	Frequency	Percent
African American	4	4.0
White	86	86.9
Hispanic/Latino American	1	1.0
Native American	1	1.0
Biracial	4	4.0
Not listed above	3	3.0
Total	99	100.0

School Year	Frequency	Percent
Freshman	10	10.1
Sophomore	24	24.2
Junior	27	27.3
Senior	38	38.4
Total	99	100.0

Major	Frequency	Percent
Management	21	21.2
Operations	30	30.3
Flight	38	38.4
Maintenance	4	4.0
Other	6	6.1
Total	99	100.0

Career	Frequency	Percent
Commercial pilot	57	57.6
ATC	7	7.1
Airport Management	8	8.1
A&P mechanic	3	3.0
Airline Management	6	6.1
FBO	4	4.0
Not listed above	14	14.1
Total	99	100.0

SCSU MGM Taken	Frequency	Percent
Yes	85	85.9
No	14	14.1
Total	99	100.0

Number MGM Taken	Frequency	Percent
One	17	17.2
Two	32	32.3
Three	34	34.3
More than three	10	10.1
Missing Response	6	6.1
Total	99	100.0

MGM Gender or Cultural	Frequency	Percent
Mostly Gender	2	2.0
Mostly Cultural	47	47.5
Equally Gender & Cultural	42	42.4
Other	2	2.0
Missing Response	6	6.1
Total	99	100.0

Figure 1. Demographic Information

The survey results are reported with a Cronbach's Alpha of .754 and standardized items alpha of .733. Carmines and Zeller (1979) indicate an Alpha of .70 or above is considered acceptable for internal reliability and is in a satisfactory range.

The survey instrument used items one through six as the demographic items. Items seven, eight, and nine asked students the number of MGM classes they had taken, when they had taken their most recent MGM class, and whether their MGM courses stressed instruction in only one of the MGM components, or were balanced equally among the components. The last question was to check to see if the student's experience was balanced across cultural and/or gender issues depending upon which area the course was taught in; this is one of the stated goals of SCSU's MGM curriculum.

DATA ANALYSIS

After answering the demographic items students were asked to react to various statements about MGM courses and their attitudes about aviation industry hiring practices and aspects of aviation employment practices in a diverse environment. Students were asked to rate their reaction, according to the five point Likert Scale, to these statements. There was no time limit imposed on the students as they completed the survey.

The 11 question survey instrument used Likert-type scales for responses, an appropriate means of capturing degrees of attitudes or perception from those assessed in order to measure a variety of characteristics including personal attitudes and knowledge (Tuckman, 1994). Choices available on the questionnaire were (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree or (5) Strongly Agree. Survey items 10 through 16 asked about students' perceptions of being exposed to new ideas and interpretations of viewing gender and/or non-Western societies, as well as similarities among those items (see Table 2).

Table 2. *MGM Course Questions*

Descriptive Statistics (Questions 10-16)	**N**	**Mean**	**SD**
Q10 MGM courses identified differences between Western and non-Western cultures.	97	3.52	0.948
Q11 MGM courses identified differences between males and females.	97	3.25	1.031
Q12 MGM courses identified similarities among Western and non-Western cultures.	97	3.13	1.017
Q13 MGM courses identified similarities among males and females.	97	3.04	1.060
Q14 MGM courses proposed new ways in which to view minority aviation work roles.	97	2.70	1.165
Q15 MGM courses proposed new ways in which to view female aviation work roles.	97	2.87	1.169
Q16 MGM courses encouraged respect for human dignity and differences.	97	3.88	0.960

Item analysis Question 10-16

Question 10 Almost one-half of the students (47.5%) reported taking courses that were multicultural or cultural in nature. 62.9% (n = 97, Mean 3.52, SD .948) of students surveyed agreed or strongly agreed that the MGM courses identified differences between Western and non-Western cultures.

Question 11 49.5% (n = 97, Mean 3.25, SD 1.031) of students surveyed agreed or strongly agreed that MGM courses identified differences between males and females. The respondents were mostly male (85.9%) and 47.5% reported taking courses that were multicultural or cultural in nature. MGM courses were somewhat successful in exposing the student to ideas about various gender differences. Results of further research may indicate the true extent of MGM success. Although the data show promise, there is more work that needs to be done to increase awareness of gender differences.

Question 12 43.3% (n = 97, Mean 3.13, SD 1.017) of students surveyed agreed or strongly agreed that MGM courses identified similarities among Western and non-Western cultures. Based upon the results of the study, questions regarding the extent of similarities between Western and non-Western cultures seem to arise.

Since students more easily identify differences between Western and non-Western cultures than similarities, future research activities could address how similarities can be used in MGM courses to assist students in better understanding cultural differences.

Question 13 39.2% (n = 97, Mean 3.04, SD 1.060) of students surveyed agreed or strongly agreed MGM courses identified similarities among males and females. The literature review has suggested that gender similarities also exist and it is important that students understand how males and females process information and work together in a team environment.

Question 14 27.8% (n = 97, Mean 3.04, SD 1.060) of students surveyed agreed or strongly agreed that MGM courses proposed new ways in which to view minority aviation work roles. Learning new ways to view things could be helpful in breaking stereotypes which may allow open dialogue to enable an effective, diverse work environment. Based upon the results of question 14, it would. appear that MGM courses have not sufficiently offered new ways to view minority aviation work roles. Perhaps one solution is to develop stronger relationships between successful diversity programs used by aviation industry and collegiate aviation.

Question 15 32.0% (n = 97, Mean 2.87, SD 1.169) of students surveyed agreed or strongly agreed that MGM courses proposed new ways in which to view female aviation work roles. This is not an encouraging result in that 85 of the 99 respondents were male; more than likely it will take actual work experiences to affect change if it will happen. Perhaps even before an attempt to propose new ways to view female aviation roles within MGM courses, academicians should place emphasis on why it is important for males to view female work roles and its impact on the organization.

Question 16 72.2% (n = 97, Mean 3.88, SD .960) of students surveyed stated agreed or strongly agreed that MGM courses encouraged respect for human dignity and differences. It is very possible that the students surveyed had a high respect for others and they were reflecting these values in their responses. Since almost three-fourths of the respondents reported a favorable view of MGM courses fostering human dignity and differences, the student results for question 16 are encouraging in that many students are being exposed to dignity and respect for cultural differences and it is hopeful that these types of favorable experiences in MGM courses will carry over into the aviation industry.

Item analysis Question 17-20

Survey items 17 through 20 asked the student what they thought about aspects of aviation employment practices and if the courses helped them prepare to work in a diverse environment. (See Table 3)

Table 3. *Aviation workplace employment specific questions*

Descriptive Statistics (Questions 17-20)	**N**	**Mean**	**SD**
Q17 Qualified candidates should be considered equally for employment regardless of gender.	99	4.38	0.866
Q18 Qualified candidates should be considered equally for employment regardless of ethnicity.	99	4.41	0.769
Q19 Aviation employees should strive to blend into the existing work culture.	98	3.56	1.016
Q20 College classes in gender, cultural, and/or ethnic studies have prepared me to work in a diverse organizational environment.	99	2.93	1.180

Question 17 86.9% (n = 99, Mean 4.38, SD .866) of students surveyed indicated that qualified candidates should be considered equally for employment regardless of gender. This is not too surprising as the majority of respondents were males.

Question 18 89.9% (n = 99, Mean 4.41, SD .769) of students surveyed indicated that qualified candidates should be considered equally for employment regardless of ethnicity. Respondents indicated that professional qualifications should be the determining factor in employment decisions and candidates should not receive preference given their ethnicity.

Question 19 60.2% (n = 98, Mean 3.56, SD 1.016) of students surveyed said that aviation employees should strive to blend into the existing work culture. It appears that the survey population desires few changes to the workplace demographics.

Question 20 35.4% (n = 99, Mean 2.93, SD 1.180) of the students surveyed felt that college classes in gender, cultural, and/or ethnic studies prepared them to work in a diverse organizational environment. This number is disturbing in that the goal of the courses is to help students become better prepared. We can only conclude that the courses are not satisfying this outcome. Aviation educators may benefit from collaboration with those responsible for designing and implementing aviation industry diversity programs.

CONCLUSION AND COMMENTS

Assessment of the reaction of aviation students who have completed MGM courses is important in determining if the MGM general education requirement is effective at this university. After analyzing the survey results, it does not appear to the researchers that the MGM course completion provides a significant benefit to these aviation college students, the very group that professors are trying to influence. Possibly, the aviation industry diversity practices could be incorporated into the academic classroom. This way the students could see the relevance of what they learn in the classroom as it applies to their professional careers.

Completing these courses may help the student develop a sense of fairness across disciplines and recognize that all people contribute to the fabric of life. Too often, society does not acknowledge the achievements made by persons of color and women. These courses should serve as a starting point for all aviation students to gain a respect for all contributions to the field as well as a dose of self-confidence to accomplish their chosen life’s work. Formal post-secondary education programs should provide a global education to allow students to be prepared for an ever increasingly diverse workforce. Students should be informed of multicultural, gender and minority differences in the global environment in which we live and work. They should be given the tools to succeed with different cultures and genders in a dynamic aviation industry.

It might be beneficial to survey a group of alumni and compare their answers on survey items 17 through 20 to those asked of the students in this research. This may lead to changes in how MGM classes are taught to include material about aviation employment practices and actual preparation to work in a diverse environment. In surveying alumni, attention should be given to the various segments within the industry itself as alumni responses may vary significantly depending on the culture and demographic makeup.

Caution is advised in attempting to categorize and interpret responses based upon demographic makeup in some segments within the aviation industry as the results may be unreliable. For example, the percentage of women and minorities employed in groundside airline operations may be significantly higher than corporate aviation. This type of data analysis across non-homogenous disciplines within the aviation field may not yield any significant results.

Women and minorities have achieved some degree of success in the aviation industry. Relevant and ongoing aviation diversity initiatives must evolve as the aviation industry becomes more diverse. If academicians can transform student perceptions of diversity that are meaningful from aviation industry standards, students may truly understand the value that a diversified workforce has to offer.

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The Importance of Reliever Airports in the USA

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ABSTRACT

The purpose of this study was to (1) conduct a literature review of reliever airports with a focus on historical reliever airport funding, including the importance of reliever airports and reliever airport employment; and (2) to conduct a survey of reliever airports to determine (A) the total number of employees directly employed by the operating entities; and (B) a total on-airport employment estimate. The economic impacts of reliever airports will be reviewed in order to provide information to policy makers about the importance of reliever airports from an employment perspective. The literature review found little existing data pertaining to reliever airport employment. Additionally, the currency of the data could not be reliably verified. Reliever airports surveyed in this research are those designated as reliever airports by the Federal Aviation Administration in a document entitled "National Plan of Integrated Airport Systems." A total of 253 of 278 designated reliever airports were contacted via mail and afforded the opportunity to participate in the survey. A total of 25 reliever airports were not included in the study due to a lack of contact information or change in airport status. Responses from 197 (77.9 % of those contacted) airports were received at the completion of the data collection period. Survey results indicate that respondents reported 2,906 full-time operating entity employees, 419 part-time operating entity employees, and 95,489 total on-airport employees. Additionally, the ten airports that reported the highest number of operating entity employees comprise 45.7% of all responding reliever airport operating entity employees. The ten airports that reported the highest number of on-airport employees comprise 57.7% of all responding reliever on-airport employees.

INTRODUCTION

The Federal Aviation Administration's (FAA) aerospace forecast for FY 2006-2017 indicates that the general aviation fleet will grow 1.4% annually during the 12-year forecast period (FAA, 2005, p. 20). This 12-year forecast also indicates a yearly increase of 3.2% in the number of general aviation hours flown. Serving this demand are 19,596 airports in the United States (FAA, 2004, p. 1). Of these 19,596 airports, the Federal Aviation Administration's National Plan of Integrated Airport Systems (NPIAS) distinguishes 3,444 selected airports as being vital to the nation's transportation infrastructure, and these airports are eligible to receive federal funding via the Airport Improvement Program (AIP). Of the 3,444 existing NPIAS airports, 278 are designated as reliever airports. Reliever airports are defined as "specialized high capacity general aviation airports whose purpose is to ease congestion at hub airports." Relievers must have more than 100 based aircraft and/or more than 25,000 annual itinerant operations (FAA, 2004, p. 8). Reliever airports are not only economic forces in their own respect, their symbiotic relationship with hub airports implies their role as an economic multiplier.

Reliever airports play a vital role in the aviation industry's infrastructure; historically, however, their importance has been questioned. In 1994, the General Accounting Office (GAO) released a report entitled "Airport Improvement Program: Reliever Airport Set-Aside Funds Could Be Redirected." The key point to this report is that "…conditions under which the reliever set-aside was created to address, do not exist today; largely because of a long and steady decline in general aviation traffic—a trend unforeseen when the set-aside was created" (GAO, 1994, p. 1). The report further states that, "… the [FAA] has not done any detailed studies or analyses to identify which relievers contribute to the national airport system" (GAO, 1994, p. 2). In addition, there are questions about general aviation and reliever airport funding being raised in the reauthorization of the Airport Improvement Program in FY 2007.

More recently, in the October 18, 2006 CRS report entitled "Reauthorization of the Federal Aviation Administration: Background and Issues for Congress," discretionary fund set-asides have again been scrutinized. Set-asides for reliever airports, the Military Airports Program (MAP), and the capacity/safety/security/noise program are all subject to alteration (CRS, 2006, p. 26). The Air Transport Association (ATA) has argued that *non-commercial service* airports currently receive funding that could better be obtained from user taxes (CRS, 2006, p. 26).

With policy makers questioning the importance of reliever airports, a study of their vital role is warranted. This data is necessary in defining the reliever airports distinctive role in the aviation industry. Therefore the purposes of the study are:

1. To conduct a literature review of reliever airports with a focus on historical reliever airport funding, including the importance of reliever airports and reliever airport employment. Also, to assess the economic impacts of reliever airports in order to provide information to policy makers about the importance of reliever airports from an employment perspective.
2. To conduct a survey of reliever airports to determine (A) the total number of employees directly employed by the operating entities; and (B) a total on-airport employment estimate.

DEFINITIONS

Evolution of Reliever Airport Definitions

Historically, reliever airports were first defined in the National Airport Plan (NAP). In subsequent years, the definition has undergone change under the NAP, the National Airport System Plan (NASP), and finally the NPIAS. The following is a chronological anthology of those definitions:

- NAP – a general aviation airport that will "serve to divert a substantial degree of general aviation traffic from a congested airline served airport" (USDOT, 1966/67, p. 18).
- NASP – an "airport whose primary purpose is to serve general aviation and, at the same time, relieve congestion at a major airport having a high density of scheduled airline traffic (including military, if appropriate) by attracting and diverting general aviation traffic away from the major airport to the airport providing relief" (USDOT, 1972, p. 23).
- NPIAS – a "specialized airport which provides pilots with attractive alternatives to using congested hub airports" (FAA, 2004, p. 8).

By means of the NPIAS, the FAA designates certain airports as being important in meeting present and anticipated needs regarding civil aviation, national defense, and the postal service (FAA, 2004, p. 4). With their importance recognized, NPIAS airports are entitled to a portion of funding through the AIP. Commercial service, reliever, and general aviation airports must meet certain entry criteria in order to receive funding. The section below outlines the entry requirements for reliever airports receiving two-thirds of the 1% allotted appropriations when total AIP funding is above the required level for the fiscal year. In order to receive the allotted monies the airport must:

- Have 100 based aircraft.
- Have more than 75,000 annual operations.
- Have a runway with a minimum usable landing distance of 5,000 feet.
- Have a precision instrument landing procedure.
- Have at least 20,000 hours of annual delays in commercial passenger aircraft takeoffs and landings at the airport relieved (FAA, 2005, p. 11).

The main function of a reliever airport is to provide general aviation traffic with an alternative airport near a commercial service airport, thereby easing congestion at commercial service airports.

METHODOLOGY

The purpose of this study is to establish a base figure of employment at reliever airports in the United States. As a result of the increased amount of traffic that the U.S. National Airspace System is experiencing, reliever airport employment data are essential. Due to the broad scope of the topic, a general survey instrument was prepared and administered. To facilitate the search for reliever airport employment data adequate to the direction of this study, the following methods were incorporated:

- Mass mailed a six-question airport employment survey instrument.
- Organized and filed responses according to date of mailing.
- Recorded data in a Microsoft Excel database involving many individual spreadsheets.
- Reviewed journals and studies on aviation industry employment data and statistics.
- Explored and evaluated reliever airport and aviation employment material from Internet Web sites and pages.

In preparation for this study, a review of airport employment literature was performed in order to assess the need for expanded research. The literature review provided:

- Employment numbers for airport operating entities and total on-airport employment.
- Historical legislation and funding procedures.
- Nationally-based employment studies involving reliever airport employment.

The official websites of reliever airports were also reviewed. However, there were not many that existed, and success in finding airport employment numbers was minimal. Airport websites also lacked dated material; no reliable method of extracting data within a given time frame was available. The FAA's NPIAS list of airports is the original source used for the list of reliever airports. A total of 278 reliever airports were listed in this report, according to their 2004 estimate. However, in their list of airports, only 260 were found (FAA, 2004).

Resources from the National Airport Safety Data Collection Program at SIUC provided a means to gather contact names and addresses for the reliever airports from the GCR & Associates, Inc. (GCR) / FAA 5010 database. In retrieving the contact information, seven airports were not found in the database. Those airports were Troy-Oakland, Berz-Macomb, Angola, Lancaster, Wallkill, Wings Field, and Rostraver; this reduced the total number of airports to be contacted in the survey to 253.

In order to collect data specific to this area of research, airport-entity personnel at reliever airports had to be contacted. Before facilitating this process, permission was requested from the Southern Illinois University Carbondale (SIUC) Human Subjects Committee. It is SIUC research policy to apply for such permission via a special application when conducting research involving human subjects. An extension of approval was granted on December 15, 2005, effective through March 31, 2006, the last day of mailings.

The first mailings were sent out just two days before Christmas 2005. Data collection began shortly thereafter and continued through April 25, 2006; a period of approximately five months. Throughout the data collection period, there were a total of three mass mailings; 253 packages were sent the first time, with mailings reduced subsequently based on those returned. The entire package included a signed cover letter explaining the purpose of the study, the survey instrument (see Appendix A), and a self-addressed postage-paid envelope.

A spreadsheet containing the data was consistently updated as responses were returned. A second mailing was completed during the week of February 9, 2006. The third and final mailing was sent on March, 31 2006. Reliever airport personnel were afforded the option to respond to these mailings by mail, fax, e-mail, or phone. The majority of the responses were returned by mail. Representatives at twelve airports responded by fax and data for two airports were received by e-mail.

Data collection was completed during the week of April 21, 2006. The study had an above average response rate of 77.9%. Out of the 253 total reliever airports surveyed, 197 responses were received, with 56 non-responses.

Assumptions and Guidelines Used in Analysis

To ensure an orderly study, the following principles were used when recording returned responses:

1. Unless otherwise noted by the respondent, the employment figures provided were believed to be current as of the day the questionnaire was returned and inputted.
2. When involving a range rather than a single figure, the low employment estimate was used.
3. When more than one questionnaire was returned in a succeeding mailing from any one reliever airport, the previously-returned questionnaire was used.
4. Numbers from on and off-airport personnel were included in the total airport employment estimate.

Limitations

Characteristic of any study, there are limitations to the research, retrieval process, and analysis of the results. Below are some of these limitations.

1. With a retrieval period of roughly four and a half months, a 100% response rate was not expected.
2. The FAA's Report to Congress 2005-2009 did not have an accurate, up-to-date list of reliever airports, thus affecting the total number of airports included in this study.
3. Seven airports listed in the 2005-2009 report were immediately excused from the study, because their addresses could not be found on the GCR / FAA 5010 database. This could be due to the lack of reporting airport closures, and/or changes in the airport identifier code.
4. Responses were self-reported, with no way for those conducting the survey to verify the accuracy.
5. An "unknown" response, as reported in the survey, was entered as a "zero" when entering the data.

RELIEVER AIRPORT EXAMPLES, FUNDING, AND EMPLOYMENT

Though the 278 reliever airports represent less than one-tenth of the airports included in the NPIAS, 29% of the nation's general aviation fleet is based at reliever airports (FAA 2004, p. 8). Additionally, over half of the nation's population resides within 20 miles of a reliever airport (FAA, 2004, p. 6).

Though the parameters presented in the *Definitions* section are very precise, reliever airports that meet these criteria vary. For example, Merrill Field, a reliever for Anchorage International Airport, has 1,052 based aircraft and nearly 200,000 local and itinerant annual operations (Form 5010-1, 2006). Fort Lauderdale Executive Airport proclaims itself to be the eighth busiest general aviation airport in the U.S. based on itinerant operations (City of Ft. Lauderdale, 2006). The airport is home to six fixed-base operators and a 200-acre industrial airpark. Palwaukee Airport, located outside of Chicago, Illinois, provides relief to the O'Hare International Airport, one of the busiest airports in the world. Seventy years ago Palwaukee was a 40-acre grassy plain with dirt runways (Palwaukee Municipal Airport, 2006). Ohio State University Airport is the nexus of the university's aviation program. Along with being designated as a reliever for Port Columbus International Airport, the university's airport provides $103.5 million in direct and indirect benefits to the state (Ohio State University 2006). Reno Stead Airport, Located in Nevada, is home to the world famous National Championship Air Races. Reno Stead Airport is a reliever for Reno-Tahoe International Airport (Reno-Tahoe International Airport, 2006).

Each of these airports plays a distinctive and very important role outside of functioning as a reliever to their congested counterparts. Students, businesses, and aviation enthusiasts in general all benefit from reliever airports.

Funding History of Reliever Airports

Funding for airports today is provided through the AIP. The origins of the AIP can be traced back to the post World War II era, and the Federal-Aid Airport Program (FAAP) (FAA, AIP, 2006). The FAAP received its authorization from the Federal Airport Act of 1946, and received its allocations from the general fund of the U.S. Treasury (FAA, AIP, 2006).

A key piece of legislation that impacted funding at reliever airports was the Airport and Airway Development Act of 1970 (AADA). Revenues from aviation-user taxes (fuel, airline fares, etc.) were placed into the Airport and Airway Trust Fund (AATF). This fund then issued grants to airports through the Planning Grant Program (PGP) and the Airport Development Aid Program (ADAP). During an 11-year period of issuing grants $4.5 billion was approved. The ADAP funded reliever airports in the amount of $61.5 million over the six-year period of 1970-1975, annually averaging a little over $10 million per year (ADAP, 1976).

During the 1980s and 1990s, reliever set-aside amounts peaked, reaching to 10% of all AIP funds, which amounted to $160 million per year. These set-aside amounts remained until 1994. In that year the GAO released a report entitled "Reliever Airport Set-Aside Funds Could Be Redirected." Some of the conclusions of the report were:

- Conditions that justified the set-aside for reliever airports do not exist today (GAO, 1994, p. 1).
- General aviation traffic is not significantly responsible for congestion and delays at major airports (GAO, 1994, p. 1)
- There is an "oversupply" of capacity for general aviation traffic at many reliever airports (GAO, 1994, p. 13).

Pursuant to this report, the set-aside funds for reliever airports were reduced to $40 million in 1994-1995, and $48 million in 1996 (GAO, 1996, p. 5). Even with the reduction in set-aside funds, reliever airports received funds in *excess* of $100 million per year during the 1994-1998 time periods (FAA, 1998). This trend is contrary to the conclusions of the GAO report. Reliever airports continued to receive significant AIP funding.

Since 1994, reliever airport set-aside funds have endured a cyclic phase of reductions and removals. In 2000, the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century was passed by Congress. Also known as Air 21, this act reinstated reliever set-aside funds. Under Air 21 reliever airports were entitled to 0.66% of discretionary funds if the amount of total AIP funding was greater than or equal to $3.2 billion (FAA, *AIP Overview*, 2005). This sliding scale lasted until 2003 when Vision 100 emerged, eliminating the reliever set-asides once again. During this time period reliever airports still received funding in excess of $100 million each year.

Figure 1 presents reliever airport AIP funding data for the years 1996-2005 as reported by the FAA. As can be seen in Figure 1, reliever airports continued to receive funding in excess of $100 million throughout the decade, with funding levels peaking over $200 million in both FY 2001 and 2003.

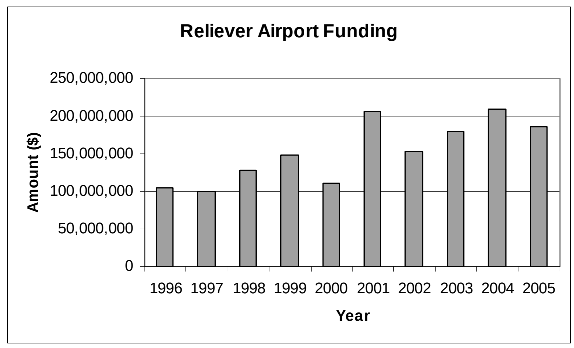

Figure 1. *Reliever Airport Funding* (*FAA, Grant histories, 2006)*

Although the importance of reliever airports has been questioned by policy makers, and set-aside funds have been adjusted and removed, reliever airports have continued to receive significant levels of funding.

More funding issues become apparent with the arrival of a new class of aircraft called Very Light Jet's (VLJ's). VLJ's have been envisioned as a mechanism that will link small communities with seamless travel. Yet the utilization of these aircraft is subject to speculation and market forces yet to be realized. It is likely that VLJ's will have substantial impact on the NAS, and specifically on reliever and secondary airports for their service. With that said, historically, fifty percent of all flights performed by aircraft in the light jet category such as Cessna's CJ1,CJ2,CJ3 and the Learjet 35 have at least one end airport in one of sixteen major metropolitan areas throughout the country. It is concluded that these destinations will be impacted similarly by the arrival of the 5,000-10,000 additional VLJ aircraft estimated to enter service by the year 2015 (FAA, 2006, Air Traffic Bulletin).

Capacity crisis at certain core airports will occur even without the emergence of this new category of aircraft. Yet with the addition of the VLJ aircraft, a redistribution of traffic is likely. This will place greater emphasis on the role of small, regional airports within these key metropolitan areas. This will create a strengthening for the need of the existing reliever airports as well as the creation of new ones to accommodate the capacity (Bonnefoy & Hansman, 2005). These accommodations will require set-aside funding.

The FAA is very optimistic in its most recent aviation forecasts which project an average annual growth of 10.2% in general aviation turbojet activity over the next ten years much of which is anticipated to be driven in large measure by the introduction of this new class of aircraft into the system (CRS Report for Congress, 2006).

This emerging market of new aircraft will add additional pressure on the NAS and additional capacity to the destination airports. Emerging operators, such as the Florida based DayJet and PogoJet, will utilize these new aircraft and will be operated under existing Part 135 Air Taxi rules. Success of these types of operators will likely influence the type of pressure exerted on their departure and destination airports.

"If the utilization of VLJs is predominantly accounted for by individual owners, corporations, and fractional ownership programs, then VLJs may have a more substantial impact on general aviation reliever airports. If, on the other hand, a large number of VLJs are used for air-taxi service with connectivity to commercial air carrier networks, then the VLJ impact could exacerbate concerns over congestion and delay at larger commercial airports," (CRS Report for Congress, 2006).

No employment data is available on the prospective employment numbers associated with VLJ's.

Reliever Airport Employment

Economic impact studies are often conducted at various airports in the airport system. Economic impact is based on "the theory that a dollar flowing into a local economy from outside of the economy is a net benefit, and measures of new economic benefits that accrue to the region due to the airport that would not have otherwise occurred" (Economic Impact Model-General Aviation, 2005). Economic impact studies allow multiple layers of government to fiscally compare airports with other public projects (Economic Impact Model-General Aviation, 2005). One of the required variables for this process is on-airport employment.

Reliever airports not only ease congestion at commercial service airports, they also have an economic presence. Geographically, reliever airports frequently are clustered near larger metropolitan areas with a commercial service airport in the close vicinity. The location of reliever airports near the commercial service airport being relieved also places them near high concentrations of nation-wide employment. As previously stated, 57.45% of the nation's population resides within 20 miles of a reliever airport. Considering the potential economic impact of reliever airports, and their historically questioned importance, an analysis of employment factors for reliever airports is considered important research that adds to the literature of the debate related to their importance.

This study will differentiate between persons employed directly by the airport (operating entity) and total on-airport (non-operating entity plus operating entity) employees. Preparation for this study includes a review of reliever airport data that are currently available. Three types of sources will be reviewed:

- Sources that provide employment numbers of the operating entity.
- Sources that provide employment numbers for total on airport employment.
- National industry employment studies that involve reliever airports.

State, Local, and Individual Airport Sources

The jurisdiction of an airport operating entity traditionally lies with, but not limited to, the city, county, port district or authority, airport district or authority, private, and/or state entity (NewMyer, Korir, & Mehta, 2005). These classifications suggest possible sources for employment data which may include local or state governments, and individual airport websites and employment studies.

The Arizona Department of Transportation website (www.az.dot.gov) offers a link to economic impact studies of Arizona airports. These studies provide information on the total economic impact of the airport, total employment, and payroll amounts. For example, the economic impact study of Chandler Municipal Airport indicates 246 employees with an annual payroll of $5.1 million (Arizona Department of Transportation, *Economic impact and aviation services*, 1998). However, no segregation between peripheral and operating entity employment is made. What this data does show is Arizona's recognition of the impact aviation has on the overall economy of the state.

The Minnesota Department of Transportation's website (www.dot.state.mn.us) offers an economic calculator, with which various data for the airport can be entered and economic impact is estimated. No viable reliever airport employment data is available.

The California Department of Transportation (www.dot.ca.gov) released an economic study which concluded that aviation accounted for 9% of the state's employment *and* 9% of the gross state product. This study estimates that there are 271,800 aviation-related jobs in California; however no estimate of reliever airport employment is provided (California Department of Transportation, *Aviation in California*, 2003).

An economic study completed by the state of Illinois offers the economic impact of Illinois airports on an airport by airport basis. This study offers a full and part-time employment figure for each airport. For example, Palwaukee Municipal Airport has 337 full-time jobs and 64 part-time jobs. This study, updated in 2004, does not differentiate between operating entity employees and total on-airport employees (Jamison, 2004).

Some individual airport websites list total employment numbers for the airport, but few offer exact numbers of operating entity employment. Many airport websites offer no data on airport employment, and many reliever airports do not have websites. There is no method of extracting national reliever airport employment data by way of individual airport websites, or by state department of transportation economic analysis.

National Employment Studies

The Bureau of Labor Statistics (BLS) offers employment data by industry. Until 1997, the BLS published this data by Standard Industry Classification (SIC). This system was replaced by the North American Industry Classification System (NAICS), which includes employment data from Canada and Mexico. The NAICS consists of 20 sectors of industry. Sector 48 includes the transportation industry. Support activities for transportation are located in section 488, and airport operations are located in sector 48811. Below are two definitions of sectors relevant to airport employment:

- NAICS definition of sector 48811; Airport Operations –"This industry comprises establishments primarily engaged in (1) operating international, national, or civil airports or public flying fields, or (2) supporting airport operations (except special food services contractors), such as rental of hangar space, air traffic control services, baggage handling services, and cargo handling services" (BLS, *NAICS Definitions*, 2004).
- NAICS definition of sector 488119; Other Airport Operations –"This U.S. industry comprises establishments primarily engaged in (1) operating international, national, or civil airports, or public flying fields or (2) supporting aircraft operations, such as rental of hangar space, and providing baggage handling and/or cargo handling services" (BLS, *NAICS Definitions*, 2004).

Both of these definitions indicated that employment for not only airport operating entities, but also hangar rental, baggage handling, and other on airport employment are included. Also, no differentiation for specific reliever airport employment data is available. However, the BLS data does prove useful in displaying the upward trend of airport employment. Employment in sector 48811, airport operations, has increased from 42,900 in 1996 to 68,100 in 2006 (BLS, *NAICS*, 2006).

The data from the BLS is not specific enough to define reliever airport employment numbers. The data includes all employees at airports, including specifically identified non-operating entity employment (hangar rental, baggage handling, etc.). Therefore, as defined, this category can include operating entity, airline, and general aviation employment. However, this category of BLS data does indicate an increase in total airport employment.

Other national studies pertaining to airport employment exist. The Airports Council International-North America (ACI-NA) conducted an analysis of both airport operating employment, and total airport related employment. This study estimated 1.9 million airport- related jobs in the United States (ACI-NA, 2002, p. 1). The American Association of Airport Executives (AAAE) has reported commercial service employment by hub category. Nonetheless, these sources did not specifically address employment figures of reliever airports.

Literature Review Conclusion

The purpose of this literature review is to provide an answer to several questions: what is a reliever airport; how has the importance of reliever airports been questioned; and how has this affected reliever airport funding? Acknowledging a correlation between employment and economic importance, what employment data exists specifically for reliever airports? This data is necessary in ensuring reliever airports are prepared for future traffic loads. The introduction of VLJs is one factor that must be considered when debating funding levels at reliever airports.

Essentially, the purpose of a reliever airport is to relieve general aviation traffic from nearby commercial service airports. Variances in general aviation traffic forecasts have made reliever airports a target for funding reduction and removal. Despite the varying nature of these set-aside levels, reliever airports have consistently justified funding in an excess of set-aside amounts. Employment estimates are necessary in gauging the economic significance of any industry. Though there are some sources that provide airport employment data, no current or specific data exists for reliever airports.

Thus, further employment studies of reliever airports are crucial in providing information as the future importance of reliever airports is considered. This study is directed toward reliever airports, and will differentiate between operating entity employment and total on-airport employment.

SURVEY RESULTS AND ANALYSIS

Overall Results

Of the 197 responses received by April 21, 2006, the total operating entity employment as reported by the responding airports was 3,325 operating entity employees. This estimate includes the total full-time operating entity employees and the low estimate for part-time operating employees. Total operating entity employment including the high part-time estimate is 3,329. No variance in full-time operating employment was supplied by the respondents. The variance between the low estimate of part-time employees and the high estimate is negligible.

The total on-airport employment (low estimate) as reported by the respondents is 95,489 employees; the high estimate is 96,139 employees. This category of the survey included persons employed by fixed-base operators, concessions, maintenance/repair organizations, flight training companies, corporate flight departments, and other airport businesses. As with the data for operating entity employees, there is a very small gap between the high and low estimate of employees.

Operating Entity Results

Reliever airports are operated by a diverse group of operating entities. These groups include (but are not limited to); towns, cities, states, airport authorities, and public universities. The operating entities are diverse; they represent different levels of public and private ownership. The results in this section contain data relating reliever airport employment to operating entity. Of the 197 respondents, 14 different operating entities were reported. Figure 2 contains the choices of operating entity offered on the survey. Figure 3 lists the operating entities listed in the "other" block.

The most reported operating entity in this survey is "city," which received a total of 69 (36%) responses, followed by "county" with 46 (23%) responses. In the "other" category, which was 3rd overall, 71% of the respondents reported being operated by a private owner. The only other entity reported under the "other" category that received more than one response was the "town" operating entity, with two responses.

As shown in Figure 4, the operating entity that reported the greatest number of employees was the airport district or authority. This group reported 1,990 full and part-time employees, or 59.8% of the total. Responding county-operated reliever airports reported the highest total of *on-airport employees*, as shown in Figure 5.

Operating Entity N=197	
City	69
County	46
Port District or Authority	10
Airport District or Authority	32
State	4
Other	35

Figure 2. *Categories of operating entity responses: Reliever airport survey.*

Operating Entity N=197	**Airports Reporting This Operating Entity**
Privately Owned	26
Town	2
Corporation	1
Metropolitan Authority	1
Private Contract to County	1
Public Building Commission	1
Public University	1
Village	1
Unknown	1

Figure 3. *Categories of other operating entity responses: Reliever airport survey.*

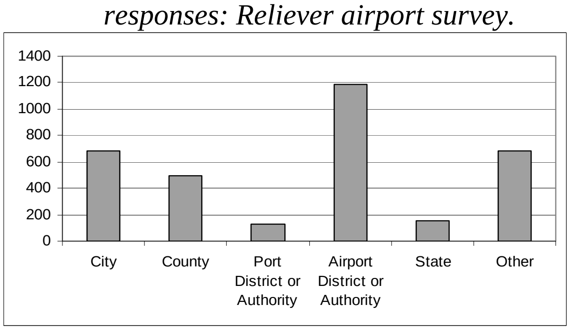

Figure 4. *Operating entity employment by category: Reliever airport employment survey*

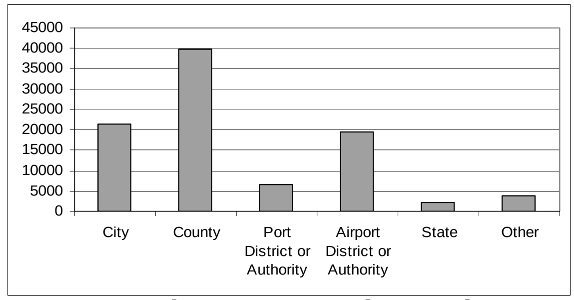

Figure 5. *Total on-airport employment by operating entity category: Reliever airport employment survey.*

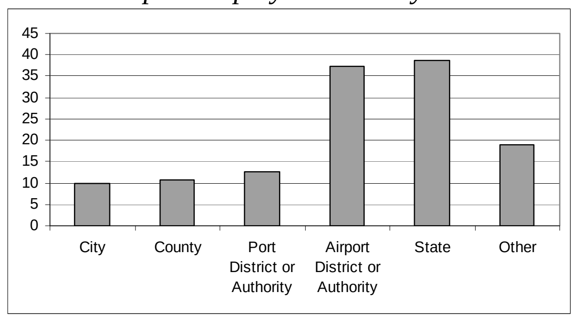

Figure 6. *Mean operating entity employment: Reliever airport employment survey.*

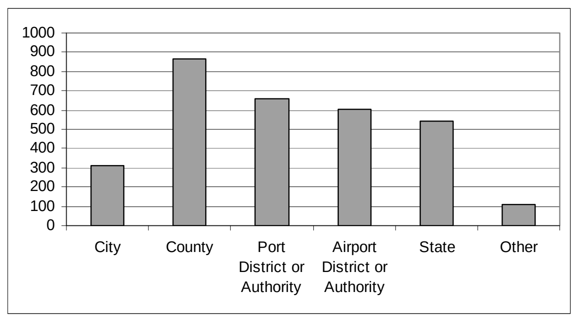

Figure 7. *Mean on-airport employment: Reliever airport employment survey*

Figure 6 and Figure 7 depict the mean number of operating entity employees, and the mean number of on-airport employees by operating entity. State operating entities have the highest reported mean concentration of operating entity employees at 38.8 operating entity employees per airport, followed closely by airport district or authorities at 37.2 operating entity employees per airport. County operating entities have the highest reported on-airport employee mean concentrations with 866.04 employees per airport.

Top Ten Representational Data

Figure 8 ranks the top ten airports according to operating entity employment. Note that these ten airports employ 1,519 full and part-time operating entity employees. This amount represents 45.7% of all reliever airport operating entity employees, full and part-time. These reliever airports also account for 36.1% of the total on airport employees reported in this survey.

Figure 9 ranks the top ten airports according to total on-airport employment. These ten reliever airports have a total on-airport employment number of 55,058. This employment number represents 57.7% all reported reliever airport employment. These airports also represent 14.3% of total reported operating entity employment.

The data in figure 10 considers entry criteria for reliever airport funding by sharing the top ten reliever airports ranked by based aircraft. The 8,787 aircraft based at these airports accounts for 14.1% of all reliever airport based aircraft as reported by the FAA (FAA, 2005, *NPIAS List of Airports*). These ten reliever airports represent 6.5% and 13.7% of operating entity and total on airport employment, respectively.

The top ten reliever airports ranked by operating entity and total on airport employment each consisted of a large quotient of the total reported reliever airport employment categories.

However, total based aircraft located at an airport does not seem to have an important impact on operating entity or total airport employment at reliever airports.

Further analysis of employment data allows for many other important conclusions. Figure 11 identifies significant statistics of reliever airport employment.

Rank	**Loc ID**	**Airport Name**	**State**	**Operating Entity**	**Full-time Operating Entity Employment**	**Part-time Operating Entity Employment (Low Estimate)**	**Part-time Operating Entity Employment (High Estimate)**	**Total on Airport Employment**
1	X16	Vandenberg	FL	Airport District or Authority	542	0	0	50
2	TPF	Peter O Knight	FL	Airport District or Authority	265	0	0	5000
3	DKX	Knoxville Downtown Island	TN	Metropolitan Authority	133	16	16	1800
4	S43	Harvey Field	WA	Privately Owned	100	20	20	300
5	IWA	Williams Gateway	AZ	Airport District or Authority	99	2	2	453
6	VNY	Van Nuys	CA	City	88	11	11	1000
7	EVY	Summit Airpark	DE	Privately Owned	80	1	1	81
8	DPA	Du Page	IL	Airport District or Authority	58	2	2	600
9	OUN	University of Oklahoma Westheimer	OK	State	49	5	5	143
10	PAE	Snohomish County (Paine Field)	WA	County	45	3	3	25000
		TOTALS			1459	60	60	34427

Figure 8. *Top ten reliever airports by operating entity employment: Reliever airport employment survey*

Rank	Loc ID	Airport Name	State	Operating Entity	Full-time Operating Entity Employees	Part-time Operating Entity Employees (Low Estimate)	Part-time Operating Entity Employees (High Estimate)	Total on Airport Employment
1	PAE	Snohomish County (Paine	WA	County	45	3	3	25000
2	DVT	Phoenix - Deer Valley	AZ	City	16	0	0	5000
3	TPF	Peter O Knight	FL	Airport District	265	0	0	5000
4	FXE	Fort Lauderdale	FL	City	13	1	1	3534
5	VQQ	Cecil Field	FL	Airport District	7	6	6	3500
6	BJC	Jeffco	CO	County	20	1	1	3124
7	SUS	Spirit of St Louis	MO	County	22	2	2	3000
8	TDZ	Toledo Metcalf	OH	Port District or	43	0	0	2900
9	APA	Centennial	CO	Airport District	19	2	2	2000
10	SGJ	St Augustine	FL	Airport District or Authority	12	0	0	2000
		TOTALS			462	15	15	55058

Figure 9. *Top ten airports by total on-airport employment: Reliever airport employment survey*

Rank	Loc ID	Airport Name	State	Based Aircraft	Full-time Operating Entity Employment	Part-time Operating Entity Employment (Low Estimate)	Part-time Operating Entity Employment (High Estimate)	Total on Airport Employment
1	MRI	Merrill Field	AK	1,052	10	0	0	250
2	FFZ	Falcon Field	AZ	1,005	10	0	0	10
3	DVT	Phoenix - Deer Valley	AZ	999	16	0	0	5000
4	CNO	Chino	CA	915	10	0	0	300
5	FXE	Fort Lauderdale Executive	FL	915	13	1	1	3534
6	VNY	Van Nuys	CA	834	88	11	11	1000
7	ADS	Addison	TX	794	12	0	0	200
8	SEE	Gillespie Field	CA	791				
9	PTK	Oakland - Pontiac	MI	772	18	7	7	800
10	APA	Centennial	CO	710	19	2	2	2000
		TOTALS		8,787	196	21	21	13094

Figure 10. *Top ten airports by based aircraft: Reliever airport employment survey*

		Total On-Airport Employment	Operating Entity Employment/ Full-Time	Operating Entity Employment/ Part-Time
N	Valid	197	197	197
	Missing	63	63	63
Mean		484.72	14.75	2.13
Median		100.00	5.00	1.00
Mode		100	1	0
Minimum		0	0	0
Maximum		25000	542	26
Sum		95489	2906	419

Figure 11. *Statistics*

Multiplying the mean for each category by the *total* number of reliever airports (278) provides an estimate for reliever airport employment. The total on-airport employment estimate is 134,752, the total full-time operating entity is 4,100, and the total part-time operating entity estimate is 592. The combined total of each of these estimates is 139,444.

The data set includes results from one airport reporting 25,000 on airport employees. This figure far surpasses any other figure reported by respondents, and was treated as an outlier. Figure 12 shows the same statistics for the data set, with the outlier removed.

		Total On-Airport Employees	Operating Entity Employment /Full Time	Operating Entity Employment /Part Time
N	Valid	196	196	196
	Missing	63	63	63
Mean		359.64	14.60	2.12
Median		100.00	5.00	1.00
Mode		100	1	0
Minimum		0	0	0
Maximum		5000	542	26
Sum		70489	2861	416

Figure 12. *Statistics Outlier Removed*

The estimates using these means are: total on-airport employment 99,979, operating entity part-time employment 556, and operating entity full-time employment 4,058. The sum of these estimates is 104,593 on-airport employees.

CONCLUSIONS

The purposes of this study were:

1. To conduct a literature review of reliever airports with a focus on historical reliever airport funding, including the importance of reliever airports and reliever airport employment. The literature review assessed the economic impacts of reliever airports in order to discover what information is available to policy makers regarding the importance of reliever airports from an employment perspective.
2. To conduct a survey of reliever airports to determine:
   A. The total number of employees directly employed by the operating entities that operate reliever airports; and,
   B. The total employment present on each reliever airports, including operating entity employment and non-operating entity employment (general aviation companies, corporate flight departments, flight training companies, etc).

The following conclusions can be reached from the literature review:

1. Reliever airports serve 28.80 percent of the nation's general aviation aircraft even though, at the most, there are only 278 reliever airports (out of a total of 19,596 airports in the nation).
2. Reliever airports have, over the years, endured scrutiny and even cutbacks in funding. In spite of that, reliever airports have been able to achieve over $100 million a year in AIP funding in every fiscal year since 1996, with two of those years over $200 million.
3. Reliever airports will likely be heavily impacted by the introduction and use of Very Light Jet (VLJ) aircraft.
4. In spite of the trends mentioned above, there are calls to reduce funding to reliever airports.
5. Prior to this study, there was little comprehensive data available on reliever airport employment. Some individual studies are available for specific airports, and some states have conducted state-wide studies, but no national study of employment at reliever airports was identified in the literature review.
6. Bureau of Labor Statistics data in the NAICS category of "Airport Operations" is generalized and includes airport, airline, and general aviation data. Data on categories of airports, whether they might be hub airports or reliever airports, could not be specifically identified. However, it is clear that, with 95,489 total on-airport employees reported in this survey, the 68,100 reported in NCAIS category/sector 48811 seems under reported.

The following conclusions were interpreted from the survey, based on response rate of 77.9% of reliever airports:

- There are 2,906 reported full-time operating entity employees at reliever airports.
- There are 419 reported part-time operating entity employees at reliever airports.
- There are 95,489 reported total on-airport employees at reliever airports.
- The ten airports with the highest total of operating entity employees comprise 45.7% of all reported operating employees.
- The ten airports with the highest total of on-airport employees comprise 57.7% of reported on-airport employees.
- Considering there were 56 non-respondent airports, all of the data preliminarily reported must by expected to increase if a 100% response was achieved.
- The estimate for total on-airport employment at reliever airports is

134,752 employees, 4,100 full-time operating entity employees, and 592 part-time operating entity employees.

- The estimate for (with removal of the outlier) total on-airport employment at reliever airports is 99,979 employees, 4,058 full-time operating entity employees, and 556 part-time operating entity employees.

RECOMMENDATIONS

In compiling this research, the authors identified the following areas of investigation related to reliever airports:

1. More attention should be given to the issues related to, and the roles of, privately- owned reliever airports since they comprise a fairly large portion of the responses to this survey; considering private operating entities represent 13.2% of all surveys received, this category should be represented in future studies.
2. Further study of the different operating entities and how they approach the operation, support and economic impact of reliever airports is worthy of study.
3. With more questions now being raised about airport funding levels in the nation, reliever airports as a category deserve further study relative to their positive impacts and value to the national air transportation system.
4. More study should be given to the relationship between operational measures (such as based aircraft, itinerant operations and total operations) and employment measures in determining the value of reliever airports.
5. Additionally, further study of the impact of new aircraft, such as VLJs, is necessary in forecasting development for reliever airports.

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APPENDICES

Appendix A: Sample of Survey

Airport Employment Survey

The purpose of this research is to update a study of aviation employment that was completed in 2003. One aspect of the research is to obtain an estimate of employment at reliever airports in the USA. If you wish your airport's employment numbers to remain confidential, please inform us so that we may protect that confidentiality. In any case, Southern Illinois University Carbondale will not publish the names of those contacted for this survey.

1. Job title of person completing survey: ____

2. Airport name and associated city: ____

3. What is the operating entity of the airport?
   A. City
   B. County
   C. Port District or Authority
   D. Airport District or Authority
   E. State
   F. Other, please specify: ________________________

4. What is the total number of employees (at the airport) employed by the entity that operates the airport?
   Full-time employees: ___________
   Part-time employees: ___________

5. What is the total number of employees working at the airport (**ALL** employees, including those employed by airlines, FBOs, concessions, etc.)?
   ____

6. Comments: ____
____
____

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Experiential Learning in Collegiate Aviation: The Use and Assessment of Internships

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ABSTRACT

Experiential learning, in general, and internships, in particular, are increasing in popularity as students endeavor to gain real-world experience in their chosen career field prior to college graduation. As noted by Steffes (2004), "Providing students with a connected view of learning that integrates their real world experiences with classroom lectures and discussion can create a powerful learning environment" (p. 49). It is this *powerful learning environment* that was the focus of this paper. As part of this study, a comprehensive literature review and survey of UAA institutional members was conducted. This resulted in a more thorough understanding of the history of experiential learning, the various types of experiential learning, various aspects of internships, the role of internships in collegiate aviation, and current methods of assessing internships both within collegiate aviation and other academic fields. The paper concluded by presenting various recommendations in how to best assess internships to ensure the growth and continued success of this form of experiential learning in higher education.

INTRODUCTION

Students transitioning into the workplace upon graduation are often surprised at the magnitude of the transition, as a result of the new roles and expectations present in the workplace. While in college, students get regular feedback about their performance through faculty comments and academic grades. Students are transient and must learn new concepts quickly. They normally participate in highly structured programs that provide a great amount of direction. Schedules are flexible and allow for frequent breaks and time off during holiday periods and between semesters. Opportunities to create and explore knowledge are mostly through individual efforts.

On the other hand, the workplace can be quite different. Feedback is infrequent and less precise. Employees are considered permanent, unless something changes. Due to this permanent nature, employees generally have a longer time period to learn their specific tasks. Employees normally work in highly unstructured work environments and engage in tasks with little direction. Employees have limited time off and work within structured schedules. They work under supervision, and oftentimes in teams, to get results for the organization (Bialac & Wallington, 1985; Jones, 2002).

Regardless of these differences between the college and work environments, students can engage in learning experiences that more effectively prepare them for this transition to professional life. These learning experiences are referred to as experiential learning. Experiential learning has been defined as:

> That learning process that takes place beyond the traditional classroom and that enhances the personal and intellectual growth of the student. Such education can occur in a wide variety of settings, but it usually takes on a 'learn by doing' aspect that engages the student directly in the subject, work, or service involved. (Katula & Threnhauser, 1999, p. 238)

METHODOLOGY

This study of experiential learning was conducted as a case study inquiry with qualitative attributes. As Yin (2003) explains, the case study is preferred when "a 'how' or 'why' question is being asked about a contemporary set of events, over which the investigator has little or no control" (p. 9). Indeed, when exploring *how* internships are currently being assessed, and *why* some methods of assessment are more appropriate or preferred, the case study stood out as the most appropriate research design for this research effort.

The study involved a review of the literature on experiential learning, not only in collegiate aviation, but in other academic fields as well. Following guidance from Yin (2003), multiple sources of evidence were used. Specifically, sources include relevant literature on experiential learning (both aviation specific and non-aviation specific), as well as the American Association of Airport Executives (AAAE) Academic Relations Committee Web site and the *Airport Management Internship Program Guide* produced by AAAE (AAAE, n.d.). The qualitative component allowed for a greater understanding of the history of experiential learning in higher education, some types of experiential learning in use today, the role of experiential learning in higher education, various aspects of internships, and the role of internships in collegiate aviation.

Additionally, this study included a survey of University Aviation Association (UAA) institutional members to determine the role of internships in collegiate aviation, as well as the current methods of assessing of aviation internships. An original, researcher-designed questionnaire was developed after completion of the comprehensive literature review, so that the various methods of internship assessment utilized in other academic fields could be included in the questionnaire. To minimize expense and the time necessary to develop and distribute the survey, the Survey Monkey Web site was utilized to create a brief, on-line questionnaire with eight items (See Appendix A). Prior to distribution, the questionnaire was reviewed by three individuals in the field of collegiate aviation, which allowed for further refinement of the questionnaire. Utilizing the UAA list of institutional members, an email with a link to the on-line, researcher-designed questionnaire was sent to all 104 institutional members of the UAA in October 2006 (N=104). The initial response rate was 34 percent (n=35). After a follow-up email to non-respondents, the response rate increased to 50 percent (n=52). The survey results provide a better understanding of the role of internships in collegiate aviation, and current methods of assessing of internships within this field.

Brief History of Experiential Learning

The onsite training of new workers or young craftsmen is not a novel idea. Indeed, the craft professions, through apprenticeship and journeyman certification, have utilized the *learn by doing* method for centuries in an effort to pass down expertise from one generation to another (Steffes, 2004). Additionally, the medical profession, for example, has a long history of supporting interns who are there to assist, learn from, and work with more experienced physicians (Moriber, 1999). Labs are another manner in which students have supplemented classroom learning over the years.

The formal use of work experience in higher education began in 1906 at the University of Cincinnati. In that year, Herman Schneider instituted a cooperative education program that was designed to extend the traditional college laboratory (Ruiz, 2004a). In that sense, allowing students to gain work experience within their chosen profession, while still enrolled at the institution, created a tremendous opportunity to unite classroom theory with real-world experience. It appears that the benefits of experiential learning were clearly evident, as the number of institutions offering such an innovative learning experience began growing.

Today, whether in the form of internships, service learning, or co-ops, experiential learning is offered at approximately 900 community colleges, senior colleges, and graduate schools in the United States (Ruiz, 2004a). Clearly, many students look forward to their experiential learning opportunity, with some even choosing a college based on the potential for internship opportunities.

Types of Experiential Learning

Various types of experiential learning are in use today. Service learning is one form of experiential learning that is gaining in popularity. As proposed by Steffes (2004), "Service learning is a long way from the center of the academic center stage in higher education, but it is moving in that direction with increasing speed" (p. 48). Service learning experiences include opportunities for students to apply knowledge and skills acquired in the classroom, while also developing new skills, through active participation in community-based projects.

Specifically, the service learning experience is preplanned and encourages students to analyze and reflect on what they have learned during the experience. The service learning concept is based on the "pedagogical principle that learning and development do not necessarily occur as a result of experience itself, but as a result of a reflective component explicitly designed to foster learning and development" (Clark, 1999, p. 654-55). This need for reflection has been highlighted as a necessary ingredient in experiential education (Clark, 1999). This reflection differentiates service learning from volunteer work, wherein students invest time without connecting their service to their own reactions or educational objectives (Schwartzman, 2002). Service learning students not only provide direct community service, but also learn about the context in which the service is provided and understand the connection between the service and their academic coursework (Clark, 1999). In essence, service learning emphasizes reciprocity by creating a learning opportunity for students, while also serving the needs of the community (Kretchmar, 2001). Service learning students always serve at non-profit agencies, never get paid for their work, and engage in activities that benefit the agency, while allowing the student to tie their work in with the academic content of the class in which the service learning option was offered (Prentice & Garcia, 2000). Although it may appear that service learning is similar to other types of experiential learning, service learning differs in that "the provider and the recipient benefit equally from emphasis on both the service being provided and the learning that is occurring" (Haessig & La Potin, 1999, p. 14). Typical service learning placements may include day care centers, homeless shelters, nursing homes, hospitals, Head Start programs, English as a Second Language programs, hospices, schools, and programs for people with disabilities (Cairn & Cairn, 1999; Prentice & Garcia, 2000).

One of the more popular forms of experiential learning, at least among aviation students, is the internship. As noted in Ruiz (2004a), "the word is out that internships offer high school and college students a foolproof way to get a head start in the search for employment and career success" (p. 89). Often considered a capstone learning experience, internships take the form of a structured and supervised professional experience in an approved organization or agency where students earn academic credit upon completion of the experience (Jones, 2002). Referring to any temporary work experience in either a for-profit or nonprofit setting, the internship allows the intern the opportunity to learn while working (Ruiz, 2004a). The flexibility in the internship arrangement may allow the student to intern while continuing to maintain a normal course load at school or during a summer or semester break from school. Indeed, many internships take place during an academic semester (or longer) and require the intern to work full-time while enjoying a break in their studies. Typical internship placements for aviation students may include airports, airlines, fixed base operators, and governmental aviation agencies. According to UAA institutional members surveyed, in fact, these four segments of the aviation industry were the most popular in which to place interns, with aviation associations (such as the Aircraft Owners and Pilots Association [AOPA] and the National Business Aviation Association [NBAA]) and corporate aviation also being popular.

Similar to an internship, cooperative education (co-op) was derived from a cooperative relationship between the institution and employer. As with internships, the co-op may be a degree requirement or an elective. Students normally work full-time in the majority of co-op programs, while taking a break from their studies. Traditionally, only departments of engineering, business, and science participated in cooperative education (Ruiz, 2004a). However, the co-op arrangement is today becoming a popular form of experiential learning in many other academic departments as well. Typical placements for co-op students are similar to internship placements.

Unique Aspects of Internships

As with other forms of service learning, internships have unique characteristics. According to Jones (2002), the skills most frequently developed through internships are (a) critical thinking, (b) dealing with the pressures of professional work, (c) applying classroom learning, (d) working on challenging duties and assignments, (e) gaining a perceived edge in the job market, (f) learning about real-world politics in the workplace, (g) enhanced communication skills, (h) clarifying career direction, and (i) learning to work in teams. In contrast, the skills most frequently developed through service learning are (a) increased sense of citizenship, (b) development of stronger analytical and problem-solving skills, (c) enhanced personal development, (d) increased leadership skills, (e) greater cultural awareness and tolerance, (f) enhanced social development skills, and (g) improved interpersonal development (Steffes, 2004).

In addition to the skills developed during an internship experience, a number of researchers (AAAE, n.d.; Bialac & Wallington,1988; Dixon, Cunningham, Sagas, Turner, & Kent, 2005; Theisse, NewMyer, & Widick, 1992) have discussed the various benefits of internships. Benefits to students include (a) gaining practical experience and exposure to the dynamics of a real organization; (b) the opportunity to make many valuable contacts in the aviation industry; (c) challenging jobs that improve the student's work skills and assist in further defining the skill set; (d) a sense of importance and belonging that results from attachment to an organization; (e) helping students determine if they are pursuing a career path appropriate to their actual skills and interests; (f) the opportunity to explore different professional settings; (g) the ability to earn academic credit; (h) receiving detailed orientation to a new and unfamiliar work site, and (i) possible permanent employment for the intern.

Benefits accrue to the firm providing the internship opportunity as well. These benefits include (a) obtaining temporary, talented help that serve as a potential future hiring pool; (b) the actual work the interns perform; (c) a low cost labor source; (d) the potential to preview potential future employees; (e) seeing how an intern performs; and (f) receiving the intern's knowledge of the latest academic information and skills (Bialac & Wallington, 1988; Cook, Parker, & Pettijohn, 2004; Theisse et al., 1992).

Similarly, the institutions arranging for and offering internship opportunities for students also realize benefits. Benefits noted by researchers such as Bialac & Wallington,1988; Cook et al., 2004; and Theisse et al., 1992, include (a) receiving verification of the appropriateness of their teachings, as well as developing new channels for placement of future graduates; (b) the infusion of new ideas and industry information from current and returning interns; (c) institutional recognition and credibility; (d) a healthy recruiting mechanism; and (e) gaining credibility and relationships with industry.

Interestingly, in an evaluation of how beneficial an airport internship program is to both the intern and the airport, Prather (1999) discovered in a study of 200 airport managers that 92 percent of respondents feel an internship is either "beneficial" or "extremely beneficial" to the Intern. However, only 59 percent of respondents feel the internship is either "beneficial" or "extremely beneficial" to the Airport.

Although benefits are plentiful, potential problems exist as well. Theisse et al. (1992) explain that, for students, there is the potential that they will be assigned routine tasks that do not enhance the student learning. Students also face problems such as inappropriate pay levels, uncooperative colleagues or supervisors, labor union difficulties, and travel costs from the educational institution to the internship site. Educational institutions face the challenge in establishing "appropriate, legally correct, and internship-specific selection processes" (p. 262). As part of this challenge, there should be equal opportunity for internships in which all eligible aviation students are encouraged to apply. Internship providers must take time to establish internship experiences that match the needs of both the provider and the students. Pay and benefits must also be considered. Liability issues may also have to be satisfied before a proposed internship program is approved. Lastly, the aviation industry must oversee internships for "fairness, quality, pay standards, credit standards, and overall quality of work standards" (Theisse et al., 1992, p. 262). Further, the industry should support the use of interns and promote the establishment of internship programs by a large number of industry members.

Further recognizing the potential for problems, Cook et al. (2004) explain that if an intern program is not carefully thought out, it may result in a disappointing experience for the intern. Disappointments may result from unclear standards, misunderstanding by students regarding the merits of the job, and the misrepresentation by the firm regarding the duties required.

Granted, learning, in the form of an internship experience, can be fraught with unexpected problems, unanticipated issues, and unresolved conflicts that may appear to greatly interfere with learning. However, as Clark (1999) pointed out, these experiences actually becoming part of the learning itself.

Considerations in Establishment of an Internship Program

Prior to establishing an internship program, consideration should be given to whether the internship experience is a requirement for students. Although this presents the problem of arranging an adequate supply of internships for the students, Cook et al. (2004) stated that "if the university's mission is to graduate well-rounded individuals, the internship experience possibly should be an academic requirement rather than an option" (p. 185).

However, Ferguson (1998) believes that "not every student should qualify for an internship, nor should every company be used as an internship site" (p. 23). Additionally, Posey et al. (1988) stated that an internship requirement could potentially place an undue financial strain on some students and prohibit them from completing their degree. However, Flouris and Gibson (2002) feel that additional internship experiences should be added to the curriculum so that "students will have a more realistic view of upcoming career and workload responsibilities [among other issues]". (p. 38)

Whether considered mandatory or optional, those organizations taking the admirable first step in establishing an internship program, as well as aviation programs considering offering internships, should consider a number of issues unique to this form of experiential learning in an effort to avoid having a poor intern experience and minimize any chance of unrealized expectations. For instance, Posey, Carlisle, & Smellie (1988) remind firms that (a) directing an intern takes time and energy, (b) interns usually lack actual hands-on experience, and (c) an organization must set reasonable expectations for what an intern can produce in a short time. Additionally, high-quality internships generally (a) encourage contact between faculty and students, (b) develop cooperation among students, (c) expose students to numerous active learning techniques, (d) provide for prompt, ongoing feedback regarding performance, (e) allow students to spend allocated times on multiple tasks as they strive to achieve high expectations, and (f) help students learn to respect diverse talents and ways of learning (Jones, 2002).

As a result of a study conducted by Dixon et al. (2005), various recommendations were presented in an effort to enhance the internship and the affective organizational commitment of interns. First, employers should provide challenging jobs, as opposed to routine tasks. Challenging jobs communicate to interns that they are capable and valuable; thus, the interns will be more willing to commit to the organization. Challenging jobs will prevent intern comments such as, "75% of my internship involved working in the mail room. I don't feel that I learned a thing stuffing mailboxes" (Ruiz, 2004b, p. 53). Next, organizations may want to review the manner in which supervisor-intern relationships are structured. A clear chain of command and regular interaction with the supervisor leads to greater affective organizational commitment. Lastly, educators need to work closely with the sponsoring organizations to ensure that jobs are both challenging and well supervised.

In an effort to assist academic programs that include an internship component, Diambra, Cole-Zakrzewski, and Booher (2004) presented several recommendations based on research conducted. First, since students find internships highly enjoyable and valuable, a significant amount of academic program resources should accompany this learning experience. Second, internship coordinators and instructors must ensure that sufficient planning, as well as structure, supervision, monitoring, and opportunities for ongoing reflection, are provided to students during the internship experience.

Lastly, the internship program should be evaluated annually, if possible. Reviewing a program's purpose and objectives will, according to Ferguson (1998), allow ways in which to improve a program and enable the internship to better meet its goals. Important in this evaluation is seeking input from students and site supervisors.

Role of Internships in Collegiate Aviation

Internships are currently a widely utilized form of experiential learning for students in collegiate aviation. In fact, of the UAA institutions surveyed, 79.6 percent (n=39) report they offer internships for their aviation students. These many internship opportunities give students the invaluable experience of working for a particular airline, airport, fixed base operator, or aviation consulting firm, for instance, while earning academic credit and supplementing their formal education. Of the UAA institutions surveyed, 89.7 percent (n=35) award academic credit for successfully completing an aviation internship. For a typical internship, those programs on a semester hour basis award three credit hours (n=17) or six credit hours (n=8). Programs on quarter hours, usually award two quarter hours per internship. Prather (1999) noted that, "Individuals no longer may be able to enter the field [of airport management] with sufficient education alone. Experience is now a necessity and for those recently graduated, this experience may seem impossible to obtain" (p. 54). If it were not, that is, for internships.

Thiesse et al. (1992) summarize the purpose and benefits of an aviation internship program:

> One way in which a continuous stream of qualified, enthusiastic, and well-motivated employee candidates can be attracted to an FBO or airport is through an internship arrangement with a university or community college that has an aviation degree program. Internships are an important part of most of these degree programs because they 'build a bridge' between the degree-oriented academic world and the employment-oriented real world. Such programs are also recognition of the fact that college courses and licensing are only one part of the task of education. On-the-job training in the industry itself adds the finishing touch to university/community college aviation degree graduates that makes them more employable. (p. 254)

Many agree that internships provide the critical transition for students as they depart academia and enter into industry. In addition, internships establish the necessary base for employment upon graduation. In a survey of former interns, Gibala and Stuhldreher (2001) discovered that 100 percent recommended mandatory internships as part of the academic experience. Additionally, according to Flouris and Gibson (2002), "many students do not have a reasonable understanding of the workload levels they face in aviation management positions" (p. 35). Thus, the internship experience would provide insight into this area.

Although internships are a popular component in the education experience for many aviation students, some are quick to criticize internships. According to Ferguson (1998), critics claim that faculty often create activities that are unrelated to the fieldwork experience. Additionally, the critics claim that such activities do not accurately evaluate student performance, especially when most students receive an "A". With 55.3 percent (n=21) of responding UAA institutional members granting a letter grade for the internship experience, this is valid concern. As Ruiz (2004a) states, "In order for experiential education to pass the traditional academic muster of the faculty, substantiation of its intellectual benefit is a must" (p. 90). How do those in higher education assess the benefits of internships to ensure that various enhancements to student learning have occurred?

Assessment of Internships

Historically, assessment of student learning was conducted by the professor. The professor required certain tasks to be successfully completed and then measured the performance on these tasks against certain educational outcomes. Academic grades were then assigned to enable students to determine how well they met the objectives. In experiential learning, however, there appear to be additional ways to measure student learning. First, however, a unique and appropriate assessment strategy should be designed.

In designing an appropriate assessment strategy, the following questions from Holland (2001, p. 54) should be answered: "(a) What is the purpose of my assessment, (b) Who wants or needs the assessment information, (c) What resources are available to support assessment, (d) Who will conduct the assessment, and (e) How can I ensure the results are used?" In answering these questions, Holland (2001) reminds the reader that "a comprehensive assessment design, introduced at the earliest stages of a collaborative endeavor . . . not only measures the impacts of the learning activity, but helps to enrich and sustain the underlying partnership itself" (p. 53). Effective assessment strategies generate the evidence necessary to sustain internal and external support for experiential learning programs. Assessment can also "identify problem areas where improvement is needed, illuminate key issues and challenges, compare and contrast strategies and actions, and document successes that warrant celebration" (Holland, 2001, p. 53).

Ferguson (1998) proposes four key factors that must be considered when developing evaluation criteria. First, the internship coordinator and the on-site supervisor must develop meaningful assignments and projects that require the student to demonstrate written and verbal communication skills, as well as professional knowledge gained on the job. These items could then be placed in a professional portfolio. Second, a balance must be maintained between keeping the student busy and not overburdening the student. Third, the on-site supervisor could be involved in the intern's evaluation by, for instance, completing a questionnaire that assesses specific criteria such as timeliness, cooperation, and work, in addition to normal performance evaluations. Lastly, as part of grading, faculty with expertise in specific areas should be responsible for evaluating assignments in those specific areas. To reduce grade inflation, faculty should strive to develop quality written assignments. Conversely, implementing a pass-fail system may be appropriate. Cook et al. (2004) suggest that interns should receive a pass/fail grade for their academic credit, rather than a letter grade. Interestingly, the students these researchers surveyed also agreed with this premise.

Since one of the primary goals of the internship is to enable students to become more self-directed in their own learning, the use of self-assessment is beneficial. Some intern programs allow the students to assess themselves "by analyzing their ability to use an array of group skills, work with others to solve real problems, perceive and respond appropriately to different cultures, operate from a personal working definition of leadership, and form an understanding of the needs of a pluralistic democracy" (Jones, 2002, p. 68).

Alm (1996) admitted that academic quality can be a significant issue with internships. As a result, she proposes the use of student journals to improve the academic quality of internships. The goal of journal writing, she explains, is to help students connect classroom knowledge with knowledge gained through the internship. Keep in mind, however, that journal writing, although beneficial, may seem daunting to students who are required to create new meaning and understanding for themselves. Students can get started by asking themselves open-ended questions about their internship experience or reflecting on significant events or challenges encountered. Faculty also have a role to play during the internship by reviewing and commenting on journals, providing encouragement and focus, and helping the student to integrate the internship with previous classroom experience. Lastly, grading criteria should relate to the purpose of the journal writing assignment, that is, to help students reflect on their internship experiences.

An additional assessment tool, more commonly utilized in medical residency training, is peer assessment. In a study conducted by Thomas, Gebo, and Hellmann (1999), it was discovered that peer review is both reliable and feasible, provides somewhat different information (especially in areas of humanistic and professional behaviors) than faculty assessments, and is acceptable to residents. Granted, the use of peer assessment is not without difficulties, especially if only one intern is working at a particular location.

In an effort to create performance-based assessment specifically for service learning projects in Minnesota secondary schools, Cairn and Cairn (1999) utilized journal writing, self-assessment, research papers, observation during site visits by an instructor, and evaluation of performance by agency supervisors. They are quick to point out that journals are the most common form of assessment for service learning, in particular. "Depending on course objectives," explained Cairn and Cairn (1999, p. 67), "instructors may weigh the relevance of journal entries, the quality of writing, the accuracy of observations, the depth of understanding of the host agency, and the student's ability to reflect on and improve his or her performance."

In discussing the assessment of community health internships, Gibala and Stuhldreher (2001) focus on a journal and major project. The journal is a weekly log that details the student's work. The internship site supervisor also contributes to this journal by evaluating the intern's performance in (a) the ability to develop effective working relationships with staff, (b) acceptance of supervision and constructive criticism, (c) effective communication with clients and peers, and (d) capacity to relate learning to new experiences. The major project is intended to demonstrate mastery of skills and abilities of an entry-level community health professional.

At the Business Department of Queensborough Community College in New York, the internship experience is recognized by a three credit-hour course. This course has several requirements which must be met by interns. The intern supervisor is responsible for ensuring the student works a minimum number of hours and evaluating the intern's work performance. Additionally, daily log sheets are required to be turned in on a weekly basis. These logs record the various tasks performed and problems encountered on the job. Further, three seminar workshops are held during the semester and attendance of interns is mandatory. In the seminar, students are expected to complete writing assignments each week that includes journals and observation notes. These observations then provide for rich discussion and analysis as students interact and share about various intern experiences. Interns are also required to complete a final project. Lastly, students having successfully completed an internship submit a final report detailing the internship experience (Jones, 2002; Moriber, 1999).

In the American Association of Airport Executives (AAAE) *Airport Management Internship Program Guide*, assessment methods include testing, supervisor evaluation, journal writing, and a required final project. First, the guide recommends take-home tests to be administered by each of the departments in which the intern is assigned. Incorrectly answered questions on these written tests must then be resubmitted correctly prior to moving to the next department. Second, the guide recommends evaluation by supervisors. These evaluations conducted both verbally and in writing, should be conducted by the appropriate departmental supervisor on a quarterly basis. Third, journal writing is recommended as a means to enhance the intern's experience, and provide a means for supervisors to gauge the intern's thoughts on the experience thus far. Lastly, the objective of the final project should be to promote accountability, self-discipline, and forward thinking on the part of the intern. All of the intern's experiences may assist in the creation of this final project, which should then be presented to staff (AAAE, n.d.). These and other areas are evaluated utilizing the Internship Evaluation Sheet and the associated performance elements (Appendix B).

One manner of assessment that is widely utilized is the portfolio method. This method was successfully utilized by the Education faculty at the University of Wisconsin-Oshkosh to evaluate student learning via internships. First, faculty collaborated with students to determine the specific outcomes that were important. Faculty also discussed with students what types of evidence would be collected to demonstrate student growth toward these outcomes. Students then worked with faculty to generate criteria for judging the evidence. In this instance, the criteria included assessments of (a) quantity of portfolio items, (b) level of creativity, (c) level of reflection,

(d) appropriateness of evidence, (e) usefulness of ideas to future teaching and learning contexts, (f) self-initiation section, (g) quality of change, (h) variety of activities and evidence, (i) organization, and (j) time and effort invested (Jones, 2002). During the internship, students decided which evidence to include in their portfolios and were also asked to reflect on samples of their work. In this instance, students typically discussed how their perceptions had changed as a result of the internship, what was being learned on the job, and what particular challenges they were facing. The actual assessment and grading of the internship experiences was accomplished via three different and distinct strategies. The first method involved a self-evaluation by students of their portfolios according to negotiated criteria. The professor (or internship coordinator) then reviewed the self-evaluation and negotiated with students prior to reaching a final grade. A second method involved the instructor retaining full control over the grading process and assigning a grade based on previously established criteria. Thirdly, two other professors were involved in assigning ratings to the portfolios, which were then reviewed by the main professor, who met with the student and determined a final grade for the portfolio. (Jones, 2002).

Current Aviation Internship Assessment Practices

Of the 52 institutions responding to the survey conducted as part of this study, 41 reported that they offer internships to their aviation students. Of these 41 programs, it is clear the vast majority place responsibility for assessing the intern on both the employer (intern provider) and faculty (intern coordinator). Interestingly, five programs also allow for some type of self-assessment by the student.

What forms of assessment are currently in use by these programs? The top three include (a) completion of internship, (b) intern on-the-job performance, and (c) intern final report. Other forms of assessment utilized by these programs include (a) journal writing, (b) weekly reports, (c) major project, (d) critical incident logs, (e) portfolio, (f) assessment of learning objectives, (g) mid-term report, and (h) oral presentation to students and faculty (see Figure 1). Regardless of which assessment tools are used, it would seem that the available assessment tools are as unique as the internship programs they are designed to assess. Interestingly, the assessment of internships and the problems therein, is not a new challenge for higher education. As a matter of fact, an article written almost 30 years ago states that "if internships are to receive academic recognition there must be more involved than just a work experience" (Creek & Thompson, 1977, p. 178).

RECOMMENDATIONS

Indeed, for institutions offering academic credit for internships, the assessment of the quality of learning that takes place at a worksite is a significant issue for higher education. While some of the strategies presented above may or may not be appropriate in certain situations, it appears that the student benefits from a multi-method approach to assessment. First, the plan for assessment should provide substantial initiative for the intern to self-assess rather than requiring the intern to assume a passive role in being assessed. Whether this includes journals, weekly reports, or critical incident logs, students should be encouraged to reflect on key issues experienced during the internship and reflectively evaluate their internship experience. Second, requiring the intern to complete a final report summarizing the overall internship experience, as well as a critique of their own performance, allows the intern to reflect on those learning outcomes they have achieved and the manner in which those outcomes were reached. Third, the use of portfolios provides a wonderful opportunity to assess the intern's development and progress on a regular basis. Further, a well-developed portfolio may serve as a useful reference once the former intern begins a job search. In the portfolio, the internship coordinator may find reports or proposals prepared by the student, as well as supervisor evaluations. Fourth, the intern's on-site supervisor should prepare evaluations of the intern's performance, including thoughts on the intern's strengths and weaknesses and areas of possible improvement.

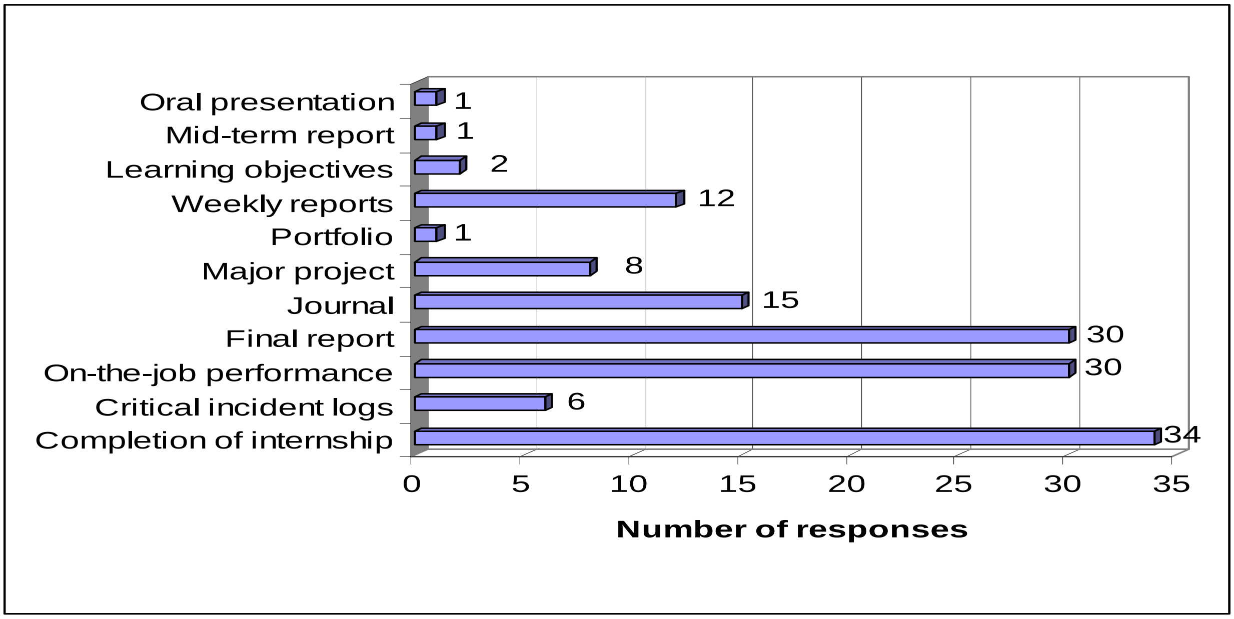

Figure 1. Aviation Internship Assessment Methods
Note: Respondents could select more than one assessment practice; thus, total numbers do not reflect number of respondents.

If the geographical location of the internship allows, group conferences or seminars can be held on campus to allow students engaged in internships to share their experiences, learn about issues in other organizational contexts, and solve problems together. This forum provides a convenient opportunity to gauge how much learning is occurring for the students. Lastly, an academic internship coordinator should be assigned at the home institution to monitor the progress of interns, collect materials from both the supervisors and the interns, evaluate the intern's performance, and assign either a letter grade or a pass-fail rating for the student (depending on institutional grading policy). In essence, by assessing the performance and level of experiential learning displayed by interns longitudinally, contextually, and collaboratively, the grade assigned to each intern should be both reasonable and fair.

CONCLUSION

In whatever form, experiential learning is becoming a prominent pedagogy of the 21st century. Students are eager to expand the walls of the traditional classroom and have been doing so via distance learning technologies and experiential education. Although the assessment of experiential learning is a concern for higher education, this should not discourage more aviation academic programs from arranging internships, nor should it discount the amount of learning that takes place during an internship. In fact, as more institutions recognize the importance of a real-world work experience for their students, and faculty, and industry get on board in support of such efforts, the graduates of tomorrow will be ensured success as they transition from the role of a student to that of a well-prepared, and even experienced, member of the workforce.

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APPENDIX A

Internship Assessment Survey

Consent

All UAA institutional members were invited to participate in this study on the use and assessment of internships in collegiate aviation. There are no known risks if you choose to participate, nor will you be penalized if you decide not to participate. There are no rewards (monetary or otherwise) available to those who choose to participate. By completing this on-line survey, you are voluntarily agreeing to participate. Your responses will remain confidential; neither you nor the institution you represent will be identified in the study results. The questionnaire should take no more than 5 minutes to complete.

IRB #07-060

If you have any questions concerning your rights as a research subject, please contact:

Ms. Tara Prairie
Compliance Officer
Middle Tennessee State University
BAS S245
Murfreesboro, TN 37132
615-494-8918
compliance@mtsu.edu

If you have any questions about this study, please contact:

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Thank you for your time!

1. Does your aviation program offer (arrange/coordinate) internships for the aviation students at your institution? *Survey Monkey allowed use of logic, which directed those answering 'Yes' to this question to skip to question three, while those answering 'No' were directed to question 2 only.*

   - ☐ Yes
   - ☐ No

2. Based on your experience and expertise, which of the following methods do you feel are most appropriate for assessing interns? (Check all that apply)

   - ☐ Completion of internship
   - ☐ Critical incident logs
   - ☐ Intern on-the-job performance
   - ☐ Intern final report
   - ☐ Journal writing
   - ☐ Major project
   - ☐ Portfolio method
   - ☐ Weekly reports
   - ☐ Other (please specify)

3. In which of the following segments of the aviation industry do you typically place interns?

   - ☐ Airports
   - ☐ Airlines (incl. scheduled and non-scheduled, cargo, etc.)
   - ☐ FBOs
   - ☐ Governmental aviation agency
   - ☐ Aviation association (AOPA, NBAA, etc)
   - ☐ Other (please specify)

4. Are interns awarded academic credit for successfully completing an aviation internship?

   - ☐ Yes
   - ☐ No

5. For a typical internship, how many credit hours are awarded?

	Quarter hours	Semester hours
1	☐	☐
2	☐	☐
3	☐	☐
4	☐	☐
5	☐	☐
6	☐	☐
7	☐	☐
8	☐	☐
9	☐	☐
More than 9	☐	☐

6. In general, how are students graded upon successful completion of an internship?

- ☐ Pass/Fail
- ☐ Letter grade
- ☐ Satisfactory/Unsatisfactory
- ☐ Other (please specify)

7. Who is responsible for assessing the intern? (Check all that apply)

- ☐ Intern on-site supervisor (employer) assessment
- ☐ Intern coordinator (faculty) assessment
- ☐ Intern (student) self-assessment
- ☐ Other (please specify)

8. Whether your interns are assessed by the employer, internship coordinator, and/or student, which of the following methods are used to assess interns?

- ☐ Completion of internship
- ☐ Critical incident logs
- ☐ Intern on-the-job performance
- ☐ Intern final report
- ☐ Journal writing
- ☐ Major project
- ☐ Portfolio method
- ☐ Weekly reports
- ☐ Other (please specify)

Thank you very much for your time and effort in completing this questionnaire!

Please contact me any comments.

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Appendix B

(Adapted from the AAAE Airport Management Internship Program Guide)

Airport Management Internship Program

Internship Evaluation Sheet

Date: ____________________

Evaluation #______________

Intern Name: ___________________________________ IDPP Supervisor Name: ________________________________

Program Training Activities Accomplished including Job Duties [Completed by IDPP Supervisor]
(Evaluation of the training programs completed during this evaluation period)

Significant Accomplishments [Completed by IDPP Supervisor]
(Evaluation of any special accomplishments or duties undertaken above and beyond the call of duty)

Overall Performance of duties and Responsibilities [Completed by IDPP Supervisor]
(Evaluation of the intern should be based on the normal standard of performance at the Arapahoe County Public Airport Authority. Identify the performance and deficiencies noted)

Self-Management

Work Processes & Results

Teamwork

Innovation & Change

Development

Communication

Customer Service

Sign upon completion evaluation

Intern: ____ Date: _________

Chief Operations Officer ____ Date: _________

Performance Elements

Self-Management

- Punctuality & regular work attendance
- Efficient, effective use of work time, equipment, and resources
- Working in a safe manner
- Proper use and maintenance of equipment
- Seeking and assuming additional responsibilities as appropriate
- Exhibiting integrity and honesty
- Treating others with respect and dignity
- Giving and accepting constructive feedback
- Working effectively in a diverse work environment
- Focusing on the situation, issue, or behavior rather than on the person
- Other ____________

Work Processes & Results

- Providing products and services that consistently meet or exceed the needs and expectations of customers
- Using customer satisfaction as a key measure of quality
- Using appropriate problem solving methods to improve processes
- Collecting and evaluating relevant information to make decisions
- Using good judgment
- Setting and adhering to priorities
- Meeting productive standards, deadlines, and work schedules
- Accurate and timely work with minimal supervision
- Achieving results
- Pursuing efficiency and economy in the use of resources
- Informing supervisor or others of problems, identifying issues, and alternative solutions
- Other____________

Teamwork

- Supporting and focusing on the vision, mission, and goals of the organization and team
- Understanding the benefits of teamwork
- Cooperating with and offering assistance to others
- Recognizing the contributions of others
- Viewing the success of the organization and team as more important that individual achievements
- Contributing to the development, cohesion and productivity of the team
- Appropriately sharing information internally and externally
- Supporting teamwork and cooperation through open and honest communication
- Other___________

Innovation & Change

- Being creative and innovative when contributing to organizational and individual objectives
- Receptivity to new ideas and adaptability to new situations
- Avoiding being overly defensive; willingness to explore different options
- Taking calculated risks
- Seeking and acting on opportunities to improve, streamline, re-invent work processes
- Helping others to overcome resistance to change
- Other ___________

Development

- Participating in opportunities to enhance knowledge and skills that are identified and offered by the organization or the evaluator
- Self-initiative in developing or upgrading knowledge and skills
- Applying new knowledge or skills squired from developmental opportunities
- Helping others learn new systems, processes, and programs
- Learning to use technology effectively, as appropriate
- Other ___________

Communication

- Participating in meetings in an active, cooperative, and courteous manner
- Orally communicating effectively on a one-to-one basis and in small groups
- Making effective oral presentations before groups
- Writing clearly and succinctly
- Avoiding "bureaucratese" whenever possible in written and oral communications
- Demonstrating understanding and empathy with the listener or reader
- Being responsive and timely to emails, phone messages, and mail
- Other ___________

Customer Service

Understanding and being responsive to customers' objectives and needs

Sensitivity to public attitudes and concerns

Being accessible, timely, and responsive in dealing with customers

Handling customer inquires and complaints promptly and courteously

When possible, going the extra mile to satisfy customer needs and expectations

Other ___________

Organization and Funding of Intercollegiate Flight Teams

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ABSTRACT

Fifteen flight teams were surveyed at the 2006 National Intercollegiate Flying Association's (NIFA) national flight competition at The Ohio State University. The purpose of the survey was to (a) gain insight into how teams are organized, how much they practice, and how they are funded; (b) correlate this information with overall team rankings at nationals to determine the key characteristics of a top performing team; and (c) to gather ideas and share them with other NIFA teams. Key characteristics of surveyed teams that placed in the top quartile included (in order of their correlation with overall ranking): multiple flight practices per week; three or more ground practices per week; the school absorbed all flight costs; and one or more paid coaches. Methods of fundraising were found to include: washing airplanes, washing cars, selling logo-items, selling donuts, walk-a-thons, and penny-a-pound flights.

INTRODUCTION

Flight competitions between colleges date back to 1919 with the start of the Intercollegiate Flying Association. The follow-on to this, the National Intercollegiate Flying Club (NIFC) was formed sometime around 1930. Competitions resumed after World War II in 1946, under the current name of National Collegiate Flying Association (NIFA). The current organization, NIFA, Inc. was incorporated in 1972 (Hemphill, 2007).

Other aviation associations have supported the intercollegiate flight competitions, in particular the University Aviation Association (UAA) and The Ninety Nines. In the 1950's, NIFA was governed by an ad hoc committee of UAA prior to its being turned over to the NIFA Council in 1996 (UAA, 2007). The Ninety Nines women pilot organization has helped with judging and funding events since 1948 (The Ninety Nines, 2007) and continues to strongly support NIFA today.

NIFA consists of member teams from post-secondary schools that compete in flight competitions. Today, NIFA is made up of 79 member schools (NIFA, 2006a) in eleven geographic regions. Currently there are no member schools in Region XI, the Northwest United States. The Mission Statement of NIFA is:

> The National Intercollegiate Flying Association was formed for the purposes of developing and advancing aviation education; to promote, encourage and foster safety in aviation; to promote and foster communications and cooperation between aviation students, educators, educational institutions and the aviation industry; and to provide an arena for collegiate aviation competition. (NIFA, 2007a)

Competitions

Each year, schools meet in regional flight competitions, referred to as SAFECONs which stands for Safety And Flight Evaluation Conference (Shreve, 1982). Within a region, schools take turns volunteering to host the regional competition. In general, the top three schools from each regional are invited to the national competition (NIFA, 2006b).

At a SAFECON, teams compete in a variety of flight events and ground events that test their knowledge and flying skills against other schools. Flight competition events include accuracy landings, cross country planning and navigation, and message drop. Ground events include written exams that test aeronautical knowledge, computational ability, and aircraft recognition skills, and other events that test instrument flying ability in a ground training device, and thoroughness in aircraft preflight on an actual aircraft. The national competition includes additional events. Points are awarded to teams based on member's performance. Flight events count twice as much as ground events (NIFA, 2006b). Regional SAFECONs typically last for four days and National SAFECON last six days plus travel days and on-site practice days for each competition.

Teams

The benefits of a NIFA flight team to the school and the team members can be immense. A successful team brings positive attention to the school, motivates students, creates a lasting positive college experience for members, and ultimately could help improve recruiting and other sources of revenue to the school. Flight teams are organized many different ways within school structures. The way the team is organized affects the availability of funds, and the stature and prestige of the team at their school.

Expenses

Participation in NIFA is very expensive for flight teams. During the year, teams practice flight events to the extent they can afford the aircraft costs. For Regional SAFECONs, teams have the expenses of lodging, meals, registration, ground transportation and aircraft expenses. Teams that advance to the national competition have these expenses again at the national level plus the additional expenses of farther travel to the national host school and the longer duration of the national competition. Teams typically incur ten or more nights of lodging as part of national competitions depending on how early the team arrives to practice on-site prior to the start of the SAFECON.

How to fund the flight team's activities and expenses are a major challenge to schools and teams. It is a constant question whether the expense and effort is worth it for the intangible return on investment. Teams are looking for ideas and ways to reduce expenses and generate funds while at the same time performing better in competitions. This, therefore, is the impetuous for this research.

METHODS

At the 2006 NIFA Nationals competition at The Ohio State University airport, 15 of the 28 attending schools were surveyed. The purpose was to (a) gain insight into how different teams are organized, how much they practice, and how they are funded; (b) correlate this information with overall team rankings at nationals to determine the key characteristics of a top performing team; and (c) to gather ideas and share them with other flight teams.

The survey was administered to team coaches or advisors while the teams were in the main hangar at the competition. Table 1 shows how many schools were surveyed from each NIFA region. While the convenience sample is not all inclusive, it is a good cross-section of the teams at the competition. The schools completing the survey represent eight of the ten different regions, and are an even distribution in quartile ranking at the national competition. The schools in the survey include both large and small and both public and private schools.

Table 1. *NIFA Regions Represented in Survey*

NIFA Region	Number of schools in survey
Region 1	2
Region 2	0
Region 3	2
Region 4	0
Region 5	1
Region 6	2
Region 7	2
Region 8	1
Region 9	3
Region 10	2

Table 2 shows how the teams surveyed ranked at the 2006 NIFA national competition. The ranking is based on the total points the team received (NIFA, 2006c). The top quartile includes two large state universities, one private aviation university, and one military academy. The bottom quartile includes two private universities, one community college, and one a public college. The seven schools in the middle were three private schools and four mid-size state universities.

For each variable in the next section, the number of teams scoring in the top and bottom quartile is given along with a Pearson correlation in hopes of giving insight into what does and does not work well.

Table 2. *Overall Ranking of Teams in NIFA 2006 National Competition*

Ranking	Number of Teams in Survey
Top Quartile	4
2nd Quartile	4
3rd Quartile	3
4th Quartile	4

RESULTS

Team Organization

NIFA's requirement to be a member is that "each team must be associated with a regionally accredited institution of higher education" (NIFA, 2006d). Beyond that, teams can be intramural teams, student activity organizations, courses, flying clubs, or some other organization. Table 3 shows how the teams surveyed are organized. The most often cited organization was student-activity organization. Four teams said they did not fit within any formal organizational standing within their school although they were associated with the school. One team required that team members register for, and attend, an elective course that meet three class periods per week.

Table 3. *Team Organizational Structure.*

Organizational Structure	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
Student activity organization	5	2	0
Club	2	0	2
Team	1	1	0
Department organization	1	0	0
Mission Activity	1	1	0
Club and elective course	1	0	0
None	4	0	2

Team Size

Table 4 shows the varying size of the teams. The largest team surveyed had 32 members, while the smallest was 7. Only one school surveyed had a team large enough to limit the size of the team. For the other schools, anyone who wanted was allowed to be on the team. There was a correlation of r = -.42 between the size of the team and the team's overall ranking in the competition. Teams with less than ten members all scored in the bottom quartile.

The larger teams did not bring the entire team to the national competition. Only the host school had more than 20 competitors at nationals.

Coaches and Advisors

NIFA requires that when attending a flight competition, "each team be accompanied by a faculty advisor or other advisor recognized by their institution as the official representative for their team" (NIFA, 2006d). In addition to the advisor, ten teams surveyed have coaches to help the team prepare for competition.

Table 4. *Size of Team*

Size of Team, members	Number of Teams	Numberof teams in top quartile	Number of teams in bottom quartile
7-10	6	0	3
11-15	0	0	0
16-20	3	2	0
21-25	3	1	1
26-30	2	0	0
> 30	1	1	0

There are no NIFA guidelines on who can be a coach, how many coaches there can be on a team, or if coaches can be paid. The survey attempted to determine the number of coaches per team and if those coaches were paid by the school.

Table 5 shows the number of volunteer coaches on a team. Volunteer coach was defined as those whose official work duties do not include the flight team and who coach in their spare time. Coaches are either former team members who have graduated or flight instructors employed by the school. It is not known how much time each coach donated to the team. One large school stated it had ten volunteer coaches "all the time and many others on an occasional basis".

Table 5. *Number of Volunteer Coaches on a Team*

Number of Volunteer coaches other than advisor	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
0	5	1	2
1	3	0	1
2	5	1	1
4	1	1	0
10+	1	1	0

As shown in Table 6, the majority of teams had no paid coaches. Paid coaches were defined as those whose work duties specifically include the flight team and who are compensated by the school for their time with the team. Most paid coaches were employed as flight instructors. It is not known what percent of time each coach worked with the team. Note that three of the four teams that finished in the top quartile had at least one paid coach. The one team with no paid coaches that finished in the top quartile is the school with ten volunteer coaches. There was a correlation of r = -.60 between the number of paid coaches and overall team ranking in competition.

Table 6. *Number of Paid Coaches on a Team*

Number of paid coaches, other than advisor	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
0	10	1	4
1	2	1	0
2	2	1	0
3	1	1	0

The number of advisors on the team is shown in Table 7. Advisors held different positions: faculty, flight instructor, dispatcher, adjunct professor, and administrative staff. The advisors were volunteers for all but one team. For three schools, the advisor was also an active coach. One advisor said his time counted equivalent to being on a committee. There was a small correlation (r = -.28) between the number of advisors and the team ranking in competition.

Table 7. *Number of Advisors on a Team*

Number of Advisors not Classified as coaches	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
0	3	1	0
1	8	2	2
2	4	1	2

Table 8 shows the total support from coaches and advisors. The number is individual coaches and advisors, not full-time equivalent. This variable had a correlation of r = -.55 with overall ranking.

Table 8. *Total Number of Advisors and Coaches Helping the Team.*

Number of Advisors not Classified as coaches	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
1	2	0	1
2	3	0	1
3	7	1	2
6	2	2	0
11+	1	1	0

PRACTICE

Flight Event Practice

There are two parameters that related to how much a team practices. One is how often the team practices during the year, defined as the 'practice season', and the other is how much the members fly when during a practice.

The different ways teams organize their practice seasons is shown in Table 9. Only one team practiced year round. The information on the season was not specifically on the survey, but came through comments. Therefore, not all teams answered this question.

Table 9. *Flight Practice Season for Teams*

Flight Practice Season	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
Year round	1	0	0
12-16 weeks prior to event	1	0	0
Beginning of semester until regionals, then January until nationals	2	0	0
6 weeks prior to event	2	1	0
Between regionals and nationals only	1	0	1
Very limited practice time shortly before event *	4	0	3
No answer	4	3	0

*Comments included: "three times total before event", "3 weeks per year", "2hr total before event", "20hr total for team per year"

Table 10. *Structure and Frequency of Flight Event Practice*

Frequency of Flight Practice	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
Any time	1	1	0
Daily starting 6 weeks prior to event	1	1	0
3 times per week	1	1	0
Saturday initially, and then everyday close to even	1	1	0
Saturday plus weekdays	1	0	0
Saturday or Sunday only	4	0	0
No recurring weekly practices	6	0	4

The different ways teams structure their flight practice shown in Table 10. It was clear from the survey that practice makes a difference in competition performance. Surveyed teams in the top quartile practiced flight events multiple times each week. Surveyed teams in the bottom quartile had no regular flight practice.

There were many variations on how much to practice. One team allows less practice time per pilot prior to making cuts for the competitions. Then, as the competition approaches, competitors are allowed more practice time. The schools with very little practice time said they encouraged their students to practice landings during their 'regular' flight lessons. One team that finished in the top quartile wrote the team members had "Unlimited use of Cessna 150. Unlimited use of other aircraft when available [*sic*]. Flyers are expected to fly every day close to competition." Table 11 shows how many hours teams fly per practice.

Table 11. *Typical Flight Hours for Practice*

Flight Hours per Practice	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
3hr/pilot/week	1	0	0
1 hr/pilot/week	1	0	0
0.5hr/pilot/week	1	0	0
6 hour/plane/week	1	0	0
1-2 hr/day	1	1	0
100 hr/year	1	0	0
20 hr/year for team	2	0	2
≤5 hours for team prior to event	4	0	2
Not Given	1	1	0

In order to estimate the total flight practice per team member per year, the variables (a) hours practiced, (b) frequency of practice, (c) practice season, and (d) size of team were combined to determine yearly flight-practice hours per team member. Computing this variable required estimating how many weekends per semester and assuming no practice during Thanksgiving, Christmas, or Spring breaks. For example, a team where each pilot practices once a week for one hour prior to regionals and starting again in January has an estimated 26 total flight-practice hours per year. Table 12 shows the spread of estimated flight-practice hours. There is a correlation of r = -.71 between flight-practice hours and overall ranking.

Ground Event Practice

Table 13 shows how often teams practiced for ground events. One team practiced ground events Saturday & weeknights, and then, close to the event, did two-a-day practices, one in the mornings before classes and another in the evening. There was a correlation of r = -.56 between time for ground event practice and overall ranking.

Table 12. *Estimated Yearly Flight Practice Hours per Member*

Flight Practice Hours per year per member	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
More than 52	4	3	0
Between 27 and 52	2	1	0
Between 14 and 26	1	0	0
Between 1 and 13	2	0	0
<1	5	0	4
Not able to estimate	1	0	0

Table 13. *Frequency of Ground Event Practice.*

Frequency of Ground Event Practice	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
4 or more times/week	2	1	0
3 hours or times/week	7	3	1
1.5 to 2.5 hours/week	4	0	1
1 time every two weeks	1	0	1
5 hr before event	1	0	1

TEAM FUNDING

Flight Time Funding

Flight *practice* funding generally fell into a few categories: (a) the school absorbed the cost, (b) the pilot-flying paid a rental fee, (c) the team paid a rental fee from a team account, (d) the money was donated, or (e) the flight training contractor, Delta Connection, absorbed the cost.

The study did not try to ascertain where school funds came from within the school's budget because coaches and advisors do not have insight into this information. For purposes of this survey, the term "team account" includes a variety of sources such as donations, fund raising by the team, and dues. "Team account" does not include funding from the school, either through student activities or the academic unit.

Table 14 shows the how teams paid for their flight practice and if the team received a discount on the cost of rental aircraft. The table shows that for three out of four teams in the top quartile, the schools paid for the flight practice.

Table 15 shows how teams paid for their flight time at the 2006 competition. Flight time at competition includes travel to-from competition, any practice at the competition and the flying events.

Table 14. *Methods of Funding Flight Practice*

Method of Funding	Rental Cost to Team or Pilot	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
School, either department or college	none	8	3	1
Pilot flying until cuts, then team account	Discount from rental rate	1	1	0
Corporate Donation	No Discount	1	0	0
Pilot flying aircraft	Discount from rental rate	1	0	0
Pilot flying aircraft	No Discount from rental rate	2	0	1
Delta Connection	none	2	0	2

Table 15. *Methods of Funding Flight Time at National Competition*

Method of Funding	Number of Teams	Number of teams in top quartile	Number of teams in bottom quartile
School, either department or college	7	3	0
Team account	2	1	0
Sponsor	1	0	0
Delta Connection	2	0	2
Combination school & team account	2	0	1
Combination school & $200/contestant for nationals	1	0	1

Funding of Hotels, Meals, and Transportation

In addition to flight time, there are many other expenses involved in participating in and attending a flight competition. These other expenses include hotel rooms, ground transportation during the event, meals, VFR and IFR charts, and registration fees. Table 16 summarizes how teams paid for different expenses at national competition.

One school had a very active parent group that helped the team with expenses at competition. For example, different parents sponsored dinner each night while at the competition.

The majority of schools indicated they were trying hard to get donations and sponsorship for the team. The exceptions were two schools that paid 100% and did not expect their team to do any fundraising. Donations ranged from charts donated by the local fixed-based operator (FBO), to one $10,000 sponsorship from a bank, and a “very generous” sponsorship to one school from NetJets. One school emphasized parent donations to the university and then doubled it using employee matching funds where the parents work.

Teams that used fundraising as a source of funding used a variety of methods. Money raised went into a team account. Methods of fundraising included:

- washing planes for flight school (~one plane/week)
- washing planes for local pilots and at fly-ins (one day wash-a-thons)
- washing cars
- selling logo-items in the local pilot store (team runs the pilot shop)
- selling donuts
- walk-a-thons
- penny-a-pound flights

Table 16. *Method of Funding Hotels, Meals, and Transportation at National Competition*

Method of funding	Number of Schools		
	Hotels	Meals	Transportation
School, academic unit or college	4	3	5
Student Activity Funds	1	1	0
Team Account	5	4	5
Combination of school & team account	2	1	2
Contestants	3	5	3
Parents	0	1	0

Table 17 summarizes where teams get their funds, not including funds for aircraft, and an estimate of how much comes from each source. For purposes of the question, "school" includes the academic unit, student activities or other entity at the school. "Donations" include sponsors, and cash or in-kind donations to the team. "Fund raising" includes the team working or selling something in exchange for money. "Student" is team members paying their own money as opposed to raising the money.

All but two teams surveyed used a combination of sources for their funding. Contrary to commonly held beliefs, only two teams (12%) were totally funded by their schools and eight teams (54%) surveyed did no fundraising. There was no meaningful correlation between the source for funds and overall ranking (r = -.13 for school funding, r = -.05 for fundraising).

Size of School

The last variable examined was the size of the school versus overall ranking. The size of the student body was taken from the Carnegie Foundation web site (Carnegie Foundation, 2006). There is a correlation of r = -.44 between the size of the student body and the overall team ranking.

DISCUSSION

In determining where to put resources to improve a team, it would be helpful to summarize how the different variables examined correlate with team ranking. Table 18 summarizes this information.

Table 17. *Source of Funds for Expenses other than Aircraft*

Percent of funding	Number of Schools			
	School	Donations	Fund Raising	Students
100%	2	0	0	0
76-99%	2	1	3	0
51-75%	2	2	0	1
26-50%	3	2	2	0
1-25%	3	4	2	8
0	2	6	8	5
Can't determine	1	0	0	1

Note: The two teams where the members paid their own meals at events did not include this money in the percent of funds coming from students. However, it is believed that this does not affect the table because these two schools paid <25%, and that would not change.

Table 18. *Correlation between Survey Variables and Overall Team Ranking*

Variable	Correlation, r
Total yearly Flight practice hours	-.71
School pays for flight time	-.67
Number of paid coaches	-.60
Frequency of ground practice	-.56
Total number of coaches & advisors	-.55
Size of school	-.44
Size of team	-.42
School funding other than flight time	-.13
Fundraising for other than flight time	-.05

It is satisfying to see that flight practice was the factor with the highest correlation to team performance. However, the amount the top teams practiced was substantial. Team members in the top quartile practiced for flight events, on average, every day.

The question for a school wanting to do better at nationals is how to afford team members practicing for flight events every day? The study showed schools paid the cost of flight time for three out of four teams in the top quartile. The one surveyed team in the top quartile that did not receive financial support from the school is a large public university. Instead, it had exceptional local alumni support with sponsorship and donations to pay the bulk of flight time and help with coaching to offset the lack of school funds.

Other than aircraft cost, the idea that only a big school can do well at nationals or that a team has to receive substantial funding from their school to place well is not substantiated. Teams that had to earn the money for hotels, meals and transportation did just as well as teams that did not have to raise funds.

With respect to team success, the survey showed the importance of having a paid person whose job duties include responsibility for the flight team. A school would be best served to put its funds into a paid position whose duties include coaching, guiding the team in fundraising, obtaining sponsorships, and recruiting volunteer coaches. A job position of team coach provides a continuity and corporate knowledge as the team members gradually change every year. Also, unlike a volunteer coach, a paid coach has a vested interest in the team doing well and the incentive to make the flight team a priority.

CONCLUSION

It is clear from the survey that to do well at NIFA national competitions takes a tremendous commitment both from the team members and the school in terms of both money and time. Hopefully this information is helpful to schools in determining how to organize, fund and support a flight team.

Key characteristics of the teams in the top quartile include:

- All had flight practice multiple times per week.
- All had ground practice three or more times per week.
- Three out of four had the school absorb all costs of the flight time.
- Three out of four had one or more paid coaches whose duties included the flight team.

There are at least two areas where further study could be of benefit. First, this survey did not include all NIFA teams, and in particular did not include any teams from the regional level that did not qualify for nationals or any teams that qualified for nationals but could not afford to attend. An area for following study would be to expand the sample size to include all NIFA teams. Second, it would be beneficial to know how academic units that provide school funds to their teams successfully lobby for and account for the funds in their budget.

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