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COLLEGIATE AVIATION REVIEW

Richard O. Fanjoy, Ph.D., Editor
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Cover Image: This photograph, taken February 14th, 2004, shows a Boeing 747 taxiing, over an access bridge to runway 34, at Macau International Airport in China. Reprinted with permission.

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Richard O. Fanjoy, Editor

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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.

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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 2008 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.

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>
> 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.
>
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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.

TABLE OF CONTENTS

The Effect of Pre-Testing in a Private Pilot Fundamentals Class

Wendy S. Beckman
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ABSTRACT

The positive effect of pre-testing in an Introduction to Aerospace class at Middle Tennessee State University (MTSU) has been previously documented and published. The purpose of this study was to apply the same study methodology to a different group of students, those who were enrolled in the Private Pilot Fundamentals class at MTSU in the spring of 2007. One section of the course was given a pre-test at the beginning of each unit of study, while another section was given a list of learning objectives for each unit. The subsequent unit post-test performance of each class was analyzed. Based on the results, pre-testing was found to be a useful learning aid for students in terms of subsequent post-test performance. However, it was not as helpful for the Private Pilot Fundamentals students as it was for the Introduction to Aerospace students in the previous study.

INTRODUCTION

During the last ten to fifteen years, K-12 education has embraced and experienced success with the concept of student pre-testing. In that environment, pre-tests are typically used to determine if students have the prerequisite skills needed for the upcoming unit of instruction, or to what extent students have already achieved the objectives of the planned instruction (Linn & Miller, 2005). While these functions are equally applicable in higher education, there are other benefits as well. In the collegiate environment, the pre-testing methodology has not been widely utilized, but from the literature available, the additional value of pre-testing for college students seems to lie in clearly laying out the expectations of what students are to learn and demonstrating the amount of learning that is taking place (Vocational Instructional Materials Lab, 1998).

A review of the literature on pre-testing in the collegiate environment reveals a limited number of publications, found in disparate disciplines. What is interesting is that each of these articles reported success in the classroom using pre-testing concepts, even though they were implemented in a variety of ways. Shepard (2001, p. 1091) found that assessing prior knowledge and experience not only improved her teaching, but also drew students into the habit of reflecting on their own knowledge. She states:

> After all, what safer time to admit what you do not know than at the start of an instructional activity? What better way to demonstrate to students that assessment (knowing what you know and what you do not know) helps learning?

In science education, Liggett-Fox (1997, p. 29) found that pre-testing can assist students in laying aside their previous misconceptions about a topic:

> …too often we don't investigate what misconceptions our students have. Even if we find out what beliefs our students have, we assume that giving them the "correct" information will make them abandon their misconceptions and adopt the new information. We need to understand that students form misconceptions based on their experiences. As a result, our students do not have any motivation to give up their closely held beliefs because their misconceptions seem to work…

By having questions scored "incorrect" on a pre-test, she found that her students were more interested in finding out why they missed the question, leading them to consider the possibility that their basic premises were incorrect.

A chemistry professor (Ochs, 1998, p. 401 & 403) found that the benefit of pre-testing in his upper level course was to have students realize what they did not know about fundamental chemistry, which in turn made them more receptive to continued chemical education. He reported that:

> Having given such tests for three years now, I can report that the benefits exceeded expectations. Not only do most students now attend to fundamental chemical ideas, but also the entire approach to the course is much more positive.... in previous years, without the pre-test, students were listless, and few took notes in the first day lecture. By contrast, after the quiz, the response to the first lecture was entirely different: the students were deadly silent, all took copious notes and they listened intently. A further benefit was that many overcame their timidity in asking even simple questions. This approach can make students aware of what they don't know and provide an impetus to deepen their understanding of basic concepts.

One theme that ran through the literature was the critical importance of being clear regarding the objectives of the course. The act of preparing pre-tests, whether for an entire course or a particular unit, acted as an impetus for faculty to become very clear in their own minds of the important objectives of the course. An education professor (Bernauer, 1998, p. 26) commented:

> The decision to develop a measurement-driven method resulted from my growing awareness that instead of teaching the most important knowledge, skills, and attitudes that my students needed to attain, I had fallen victim to the trap of trying to "cover the material." I decided, therefore, that it was necessary, first, to identify critical learning goals, and then, based on these goals, to develop assessment items to guide my teaching, student learning, and the evaluation of student achievement.

Further findings to this effect were indicated by Stiggins (1994) who found that the most serious impediment to improving education was not the quality of either instruction or assessment, but rather the failure of instructors to identify clearly what were the most important objectives for learning. Angelo and Cross (1993, p. 8) put it simply: "Before faculty can assess how well their students are learning, they must identify and clarify what they are trying to teach." Additionally, given that most students will study primarily what they perceive they will be tested on, it is imperative that faculty ask the right questions in assessment situations (Resnick & Resnick, 1992). Consequently, it is critical to first identify an achievable set of the most important curricular goals, and then to ensure that objectives, instruction, and assessment items each align with these goals (Bernauer, 1998).

In an attempt to see if these widely dispersed experiences with pre-testing in the collegiate environment had merit for aviation students, in 2006 a study was conducted using two different sections of the Introduction to Aerospace course at Middle Tennessee State University (Beckman, 2008). In the study, one section of Introduction to Aerospace students was given a detailed set of learning objectives at the beginning of each unit of study. The other section of the course was administered a pre-test at the beginning of each unit. The results of this study indicated that there was a statistically significant difference in mean post-test scores between the class that received learning objectives and the class which experienced pre-testing before each unit. The performance on each unit test was compared, and in each case the pre-test class mean score was significantly higher than the mean score of the class which was distributed learning objectives. The final exam scores for the class which was administered pre-tests were also significantly higher than the class which received learning objectives, pointing towards the possibility that the students were not only better prepared for the initial unit tests, but that the knowledge stayed with them for a longer time.

STATEMENT OF THE PROBLEM

Given the success experienced in the previous study of the Introduction to Aerospace class, it was felt worthwhile to replicate the study with a different group of students, and in a different course. As in the previous study, two sections of a particular course, this time Private Pilot Fundamentals, were utilized. One section received learning objectives for each unit, while the other section experienced a pre-test for each unit. The learning objectives distributed were more than a "study guide" for a particular test, as these objectives were handed out at the beginning of each unit and students were encouraged to track their progress in mastering the objectives as the class moved through the unit. The pre-tests developed for each unit acted to operationalize the learning objectives for the students. The unit post-tests for the class were developed from the learning objectives for the unit, and were not identical to the pre-tests. In Table 1, a short list of representative examples of both learning objectives and pre-test questions from each unit can be seen.

Table 1. *Comparison of Learning Objectives and Pre-Test Questions*

Examples of Learning Objectives from Each Unit	**Examples of Pre-test Questions from Each Unit**
Unit One	
• Be able to discuss lift from both Newton's and Bernoulli's perspectives	• Explain how Bernoulli's principle describes the lift generated by an airfoil
• Be able to discuss fuel system components of a piston-powered aircraft	• What is the purpose of an aircraft mixture control?
Unit Two	
• Be able to correctly interpret the information depicted on a sectional chart	• Determine the frequency on which to contact Chattanooga Approach Control if approaching from the north
• Be able to describe the depictions of and /or requirements of Class A, B, C, D, E, and G airspace	• What class airspace exists at 3000 feet MSL directly over the Nashville International Airport, and what are the requirements of this airspace in terms of communication, equipment, and weather minimums?
Unit Three	
• Be able to explain the particular hazards a thunderstorm can present to an aircraft	• Describe the hazards present for aircraft in a microburst.
• Be able to correctly decode and interpret PIREPS	• Given a particular PIREP, at what altitude were the bases and tops of the reported broken layer?
Unit Four	
• Be able to determine aircraft takeoff distance	• Determine the takeoff distance over a 50 foot obstacle for a DA-40, given a pressure altitude of 2000 feet, a temperature of 12° C, a weight of 2250 pounds, and a 8 knot headwind.
• Be able to determine magnetic heading for a given cross country flight	• Given a cross country from MBT to HSV, with winds at the cruising altitude reported as 240° at 18 knots, determine the magnetic heading for this flight

RESEARCH METHODOLOGY

During the spring 2007 semester, two sections of the Private Pilot Fundamentals course at MTSU were used to compare the effectiveness of the two methods. The first section was designated the "Pre-test class," and comprised a population of 17 students. The second section, designated the "Learning Objectives class," consisted of 21 students. There was no student attrition in the Pre-test class, while the attrition rate for the Learning Objectives class was 4.76% (one student). The test grades of the student who withdrew before the completion of the term were not used in the study. The demographics of the two classes were very similar, with the Pre-test class having a minority percentage of 12%, a female percentage of 0%, and 71% of the students classified as freshmen. The Learning Objectives class had a minority percentage of 4%, a female percentage of 4%, and 76% of the students classified as freshmen.

It was important to determine that the two classes were not significantly different in terms of academic ability before starting the study. Since pre-testing both groups at the start of the semester would have defeated the purpose of this study, it was not possible to utilize this typical methodology. Instead, the cumulative college GPA's of the students in each class were examined at the start of the semester, and a two sample t-test was performed to determine if there was a significant difference between these GPA's. The Pre-testing class had a mean GPA of 2.671 (σ=.5966) while the Learning Objectives class had a mean GPA of 2.495 (σ=.6352). The t-test revealed that there was not a significant difference in these GPA's, $t(36) = .8692$, $p<0.05$, so both groups of students were equally adept academically.

The Private Pilot Fundamentals course supports the first semester of combined Private/Instrument flight training at the MTSU flight school. The first unit of the class is dedicated to basic aerodynamics and aircraft systems; the second unit to airspace, charts, the airport environment, and communications; the third unit to meteorology, interpreting pilot weather resources, and aircraft performance; and the fourth unit to cross country flight planning, Federal Aviation Regulations, and physiology. Thus, the course is divided into four separate units, and after each unit there is a post-test.

In order to compare the effectiveness of the two methods of instruction, the Learning Objectives class was given a list of specific learning objectives for each unit on the day of class we started into that particular unit. The Pre-test class was administered a pre-test on the day of class we began each unit, with each pre-test question corresponding to a particular learning objective. These pre-tests were scored, recorded, and returned to the student. Besides this difference, the two sections of the class were given identical treatments, i.e., they were taught in the same manner, and by the same instructor. The results of students in both sections on the unit post-tests were subsequently recorded, for use in determining which method of instruction was more effective. The null hypothesis for the study was: There is no difference between the post-test scores of the Private Pilot Fundamentals students being given a pre-test prior to each unit of study and the class of Private Pilot Fundamentals students being given a list of unit learning objectives prior to each unit of study.

DATA ANALYSIS

The data from each of the two classes was first analyzed at a macroscopic level, using a per-student cumulative test average over all four unit tests. As can be seen by Figure 1 and Figure 2, the student test results were approximately normally distributed in each case.

A two sample t-test assuming unequal variances was used to determine the t values at the .05 level of significance. This test revealed a significant difference between the overall test averages of the two classes, $t(34) = 1.768$, $p<0.05$. The results of this t-test may be seen in Table 2.

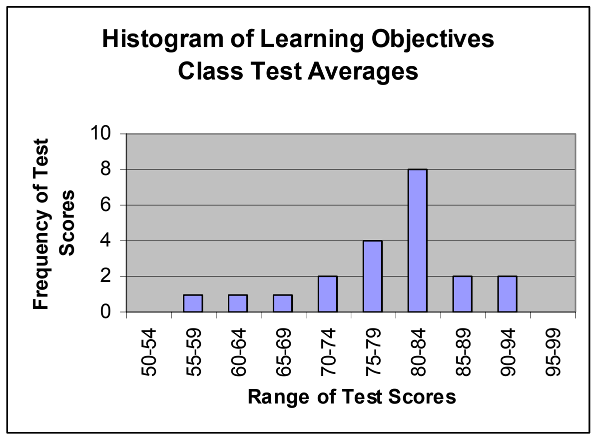

Figure 1. Learning Objectives

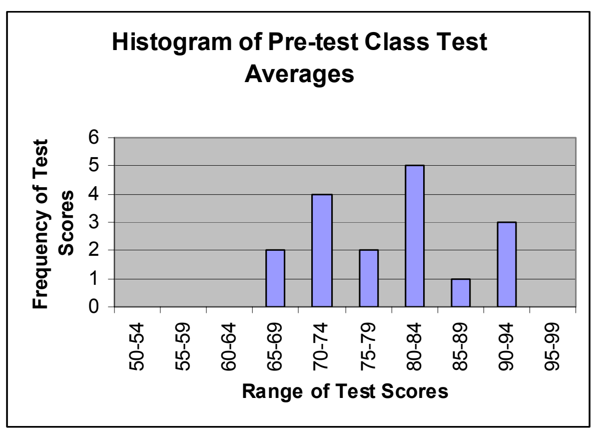

Figure 2. Pre-test Averages

Table 2. *Comparison of the Two Classes' Overall Unit Test Averages*

t-Test: Two-Sample Assuming Unequal Variances		
	Pre-test Class	*Learning Objectives Class*
Mean	79.5735	74.5119
Variance	78.0528	75.7030
T Stat	1.7680	
T Critical two-tail	1.6883	

Next, a comparison of student performance on each of the four individual unit tests was conducted, to determine if the pre-testing procedure had an impact in each particular unit. The descriptive statistics and the results of the two sample t-tests for each unit may be seen in Tables 3-6. In Table 3, it can be seen that there was a significant difference between the test one scores of the two classes, $t\ (36) = 1.7440$, $p < 0.05$. In Table 4 and Table 5, it can be seen that there was not a significant difference between the test two and test three scores of the two classes. In Table 6 it can be seen that there was a significant difference between the test four scores of the two classes, $t\ (36) = 2.6345$, $p<0.05$, with this being the largest difference of the four tests.

Table 3. *Comparison of Test One Scores*

t-Test: Two-Sample Assuming Unequal Variances		
	Pre-test Class	*Learning Objectives Class*
Mean	79.6471	73.9524
Variance	96.6176	104.5476
T Stat	1.7440	
T Critical two-tail	1.6883	

Table 4 *Comparison of Test Two Scores*

t-Test: Two-Sample Assuming Unequal Variances		
	Pre-test Class	*Learning Objectives Class*
Mean	79.0588	77.9048
Variance	91.5588	79.9905
T Stat	.3806	
T Critical two-tail	1.6883	

Table 5. *Comparison of Test Three Scores*

t-Test: Two-Sample Assuming Unequal Variances		
	Pre-test Class	*Learning Objectives Class*
Mean	78.7647	76.2857
Variance	148.5662	99.3143
T Stat	.6755	
T Critical two-tail	1.6883	

Table 6. *Comparison of Test Four Scores*

t-Test: Two-Sample Assuming Unequal Variances		
	Pre-test Class	*Learning Objectives Class*
Mean	80.8236	69.9048
Variance	141.6544	185.4905
T Stat	2.6354	
T Critical two-tail	1.6883	

It was also interesting to compare the amount of gain in scores from pre-test to post-test for the Pre-test class, which of course, was not possible for the Learning Objectives class. As can be seen in Table 7, the class had an overall pre-test mean of 48.65, as compared to an overall post-test mean of 79.57, representing a gain of around 31 points. If performance on each of the individual unit pre-tests and post-tests are compared, an average gain of approximately 30 points is seen on the first test, with average gains of 27 points, 33 points, and 30 points seen on the second, third, and fourth tests, respectively. An analysis of pre-test versus post-test scores was evaluated for the Pre-test class, to verify that there was indeed significant impact from the instruction students received. At $t\ (27) = 7.6673$, $p<0.05$, there was a significant difference between the average pre-test and post-test scores, as seen in Table 7.

Table 7. *Comparison of Pre-test Class Pre-test and Post-test Results*

t-Test: Two-Sample Assuming Unequal Variances		
	Average Post-test Scores	*Average Pre-test Scores*
Mean	79.5735	48.6471
Variance	78.0528	198.5317
T Stat	7.6673	
T Critical two-tail	2.0518	

While this result was obviously expected, it is mentioned here because the amount of improvement seemed to have a psychological impact on the class. This phenomenon was also experienced when the study was done with students in the Introduction to Aerospace course (Beckman, 2008). Although the students' graded pre-tests were simply returned to them with no further mention made of the event, the students were very interested in seeing "how much they had learned" in a particular unit. It seems students are motivated by the fact that they are "getting something" out of the class.

DISCUSSION

The analysis of data revealed that with regards to the cumulative average of the unit tests grades, the Pre-test class performed significantly better than the Learning Objectives class. However, there were mixed results regarding the difference between the Learning Objectives class and the Pre-test class in their performance on each specific unit test. On test one and test four, the Pre-test class did significantly better, while on test two and three the difference in performance was not significant. These mixed results are in contrast to the earlier study done with the Introduction to Aerospace course, in which there was a significant difference between the Learning Objectives class and the Pre-test class in their performance on every unit test (Beckman, 2008).

There are at least two possible reasons why the pre-test procedure did not have as much impact on the Private Pilot Fundamental class. First, a smaller percentage of the Private Pilot students (74%) were freshmen when they took the course, compared with the Introduction to Aerospace students when they took their course (90% freshmen). Since a greater percentage of the Private Pilot Fundamentals students had been in the collegiate environment for more than two semesters, it is likely they had become accustomed to university-level test expectations, and did not need the assistance of a pre-test to operationalize those expectations. Second, since there are test guides published for Private Pilot FAA knowledge test questions, students in both sections of the course had access to those questions for test preparation. It is important to note that the primary purpose of this course is not to teach the Private Pilot knowledge test questions, but instead to provide students the aeronautical knowledge to be safe and effective Private Pilots. As such, no class time is spent reviewing specific FAA knowledge test questions. However, 20-25% of the questions on each unit test are modeled after the FAA Private Pilot knowledge test questions relevant to the topics covered in the unit, as a method of compelling the students to begin preparing for the FAA knowledge test they will eventually need to complete. The fact that knowledge test questions are included on the unit tests is communicated clearly to the students at the beginning of the course. Thus, all students could have had exposure, prior to the post-test, of 20-25% of the test material, if they chose to study the published FAA knowledge test questions related to the topics in that unit.

CONCLUSIONS

While the results of this study were not as compelling as those found previously with the Introduction to Aerospace class, there was still a significant difference in the average unit test scores achieved by the section of Private Pilot Fundamentals that experienced pre-testing. However, while the mean of each unit test was higher for the Pre-testing class, it was only statistically significant for unit test one and unit test four. As mentioned in the Discussion section, this seems to indicate that pre-testing is more helpful for classes in which a large majority of students are freshmen. In addition, for classes in which some percentage of unit test questions are from a particular FAA knowledge test question bank, the advantage of pre-testing is not as great since those questions are available for student use. However, taking a pre-test involves active instead of passive learning, so for those students whose learning style leans toward active, pre-testing may still be beneficial. In addition, the psychological benefit of seeing how much is being learned can aid students in seeing the value of a course, and therefore increase motivation.

The largest problem identified with conducting a class using pre-tests is that the instructor has to be very clear regarding their objectives at the outset of each unit. Since the specific learning objectives for this course had already been developed, it was not too difficult to develop pre-test assessment items from these objectives. Had the objectives not existed, it would have been impossible to develop appropriate assessment items without first developing the learning objectives.

Another difficulty is developing numerous high-quality test questions on a specific topic. Since different questions need to be used on the pre-tests and post-tests, a large bank of questions must be developed. This is somewhat more difficult and time consuming than just creating the usual post-test assessments. An additional concern was the amount of class time it would take to conduct the pre-tests. In reality, most students did not know enough about the topics to spend much time working on the pre-tests. In addition, learning was taking place in the pre-test situation; it was just a different type of learning than customarily experienced. Through the pre-tests, students were able to identify the areas of upcoming study which they had either not yet been exposed to or had not yet understood in a very hands-on manner.

One other identified disadvantage of pre-testing is that there probably is not as much "peripheral" student learning as there is in classes without pre-testing. There are obviously any number of topics that do not rank as "most important" to an instructor, but that may in fact be an area of interest to a particular student. Had students not been given a pre-test (or even the list of learning objectives, for that matter) and therefore realized the instructor did not consider a particular area important, a student may have investigated a topic of interest to them in more depth. Ultimately, at this level class, it seems appropriate for students to concentrate on the areas that an instructor has determined are most important. At upper class or higher levels of coursework, this approach would not be as beneficial, as students need to learn to investigate and learn more independently.

Finally, it should be noted that the number of students in this study was obviously small, and the study should be replicated with both Private Pilot Fundamental courses and Introduction to Aerospace courses in the future to determine if the time and effort spent in developing both pre-test and post-test assessments is worth the subsequent gain in student learning. Based on the results so far, it appears that pre-testing was more helpful for students in Introduction to Aerospace classes than for Private Pilot Fundamentals students. However, pre-testing does appear to provide a slightly more effective means of communicating the objectives of a course to students than distributing learning objectives.

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Working While in School:
Analysis of Aviation Students and Employment

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ABSTRACT

College costs are rising faster than inflation; when coupled with rising flight training costs, students are paying a high price for their aviation education. This study analyzed the effect that working has on an aviation student. A survey of aviation students (n=793) suggests that by working more than 10 hours a week, a student's GPA is likely to decrease. The study also revealed differences in the amount of time that students work when compared to year in school and receipt of financial aid. No variance was found between the different aviation majors and the amount of work reported. Students, faculty and administrators in aviation programs need to understand the overall effects of students' working while pursuing an aviation degree.

INTRODUCTION

The cost of a college degree is on the rise. Over the last five years the average increase in tuition charged at a public four-year institution rose 51% (The College Board, 2007). A recent report published by the Department of Education cited cost and affordability of higher education as a rising concern and notes "the seemingly inexorable increase in college costs, which have outpaced inflation for the past two decades and have made affordability an ever-growing worry for students, families, and policymakers" (Commission on the Future of Higher Education, 2007, P. 2). When the cost of tuition is coupled with other student fees such as flight training at an aviation college, the effect is exacerbated; and it is the students who have to bear the burden.

Most flight schools charge an additional fee for flight training. Depending on the certificates and ratings achieved the cost can range from an additional $20,000 to as much as $60,000 above and beyond the typical costs for attending college. These fees are on the rise due to several factors which include the price of aviation-grade fuel being at a record high, increased insurance premiums, and the need to retain qualified flight instructors with corresponding higher wages (Decker, 2007).

The ability to pay for these rising costs becomes an area of concern for students and their families. Many students seek employment while in school to help offset the cost of their education. Does this outside work come with its own cost affecting student success while at college?

REVIEW OF THE LITERATURE

The National Center for Education Statistics' (NCES) report *Postsecondary Financing Strategies: How Undergraduates Combine Work, Borrowing, and Attendance* (1998), states that nearly three out of four students work while attending college. The act of working while attending college has both positive and negative results for students.

The obvious positive impact of working while in school is to make money to help pay for college expenses. King and Bannon (2002) found that nearly 84% of working students identify themselves as working to help pay for college expenses. Research (King & Bannon, 2002; Kulm & Cramer, 2006; NCES, 1998) also suggests that working part-time (less than 20 hours a week) has a positive impact on student persistence.

The negative aspects of working while in college manifest themselves primarily in academic achievement and persistence to complete a degree. King and Bannon (2002) found that students working more than 25 hours a week were twice as likely to report that work had a negative effect on their academic experience. It was found that too much work limited course offerings, class choice, and negatively impacted the student's grades (King & Bannon, 2002). Similarly, Svanum and Bigatti (2006) found that the more a student worked, the less effort was put into the course, thus resulting in a lower academic grade. Kulm and Cramer (2006) found that students who were employed while at college were less likely to engage in extra-curricular activities.

Students engaged in a flight related major have the additional financial burden of flight costs added to their overall college expenses. Beckman and Barber (2007) found that financial constraints were the leading cause for students transferring out of a professional flight focused degree program. This same study also revealed no significant difference existed in the average number of hours worked by a student in the professional flight program than in any other aviation major (Beckman & Barber, 2007). This study expands upon the research related to the effects of student employment in a high cost field of aviation by answering the following research questions:

1.) What percentage of students work while pursuing an aviation related degree?

2.) Does this vary by year in school, specific aviation major sought, and receipt of financial aid?

3.) What effect does working have on academic achievement and extra-curricular involvement?

METHODOLOGY

Participants

During the 2007-2008 academic year a survey was administered to 793 college students attending a four-year public institution and majoring in an aviation related degree program. The institution offers six different majors in aviation including: Professional Flight, Air Traffic Control, Flight Education, Aviation Systems Management, Airport Management and Aviation Management.

The subjects were chosen based upon their enrollment in aviation classes. All flight classes and certain "gateway" classes within the aviation department were selected for survey participation. The "gateway" classes were classes where the greatest department-wide permeation could be achieved while restricting subject overlap.

Table 1. *Selected Demographic Data*

Demographic
Year in School
Major
GPA
Work status
Hours worked per week
Financial Aid

Materials

The survey was constructed by a committee of individuals who had a diverse set of subject matter expertise, including those with domain relevant experience and those with survey building experience and training. The resultant survey was administered in several sections. One section recorded demographic information, including those areas listed in Table 1. The survey was approved by the institution's review board since it involved the questioning of human subjects.

Students were given the survey via an online survey tool. Each student was able to access the website through their leased laptop from the university. The website required no extra software installation and was accessible through any type of web browser.

Procedures

A research assistant visited each selected classroom to recruit student participants, answer any questions, and direct students to the survey website. The classroom visit and subsequent survey took around 20 minutes to complete. In order to ensure anonymity, each participant selected an individually-printed random number from a box. The random number was later matched to an official roster of numbers generated by computer. This procedure ensured that each participant was indeed a student while maintaining anonymity. All survey respondents who did not enter a correct random number were stricken from the dataset (31 surveys).

RESULTS

Only sixty-percent of the survey respondents reported they worked while in school; this result is 15% less than the nationally reported statistics (NCES, 1998). Several additional analyses were conducted to determine whether the percentages of students who worked varied with the following factors: year in school, aviation major, financial aid and extra-curricular activities. Table 2 lists the findings from these analyses.

Table 2. *Chi-square Analysis for Hours Worked*

Variable	n	df	χ^2
Year in School	791	15	153.13**
Aviation major	672	25	26.29
Financial aid	790	5	27.55**
Extra-curricular	789	5	12.61*

*p < .05. **p < .01

The statistical analysis revealed that three of the four variables had significant differences when compared against the hours students worked; these variables were: year in school, receipt of financial aid, and involvement in student organizations (extra-curricular activities).

The year in school had a significant effect on the hours worked by students. The chi-square analysis showed that senior students reported working more hours than expected with an expected count of 35.6 at 21-30 hours and an observed count of 54. The expected count at 31-40 hours for a senior was 13.5 with an observed of 24. On the other end of the spectrum were the freshmen who reported working less than expected (11-20 hours with expected 49.2 and observed 25; 21-30 hours expected 29.2, observed 5).

There were a significantly higher percentage of students who neither worked nor received financial aid (14.05% observed versus 10.76% expected). Finally, there was a greater likelihood of finding students who worked and were also involved in student organizations. Kulm and Cramer (2006) found that students who worked were less likely to be involved with extra-curricular than non-working students. The finding from this study contradicts this previous research.

The one variable that displayed no significant differences in regard to hours worked was declared aviation major. Similar to other research (Beckman & Barber, 2007), it was found that no significant difference existed in the hours students worked for different aviation majors. Table 3 indicates the hours worked by major where there were at least five students reporting in the hour category.

Hours worked by students were divided into six separate groups (see Table 4). Mean Grade Point Averages (GPAs) grouped by hours worked per week are also reported in Table 4. A one-way Analysis of Variance (ANOVA) (see Table 5) revealed a significant difference between groups $F(5, 588) = 3.35$, $p = .005$. Post hoc analysis using Tukey's HSD revealed significant differences between those students who work between one to ten hours per week ($M = 3.43$, $SD = .39$) and those working between eleven to twenty and twenty-one to thirty hours ($M = 3.32$, $SD = .39$ and $M = 3.25$, $SD = .40$, respectively).

The results of this survey indicate that students who work between 1-10 hours a week have a significantly higher GPA than the other groups. This finding coincides with previous research (King & Brannon, 2002) stating that part-time work can create a positive impact on academic performance, and that too much work can have negative effect on performance.

Table 3. *Percentage of Hours Worked by Major (With cells greater than n=5)*

Major	Hours worked per week					
	0	1-10	11-20	21-30	31-40	40+
Professional Flight	35.8	15.8	25.1	15.5	5.0	2.8
Helicopter	52.6	14.0	15.8	12.3	*	*
Air Traffic Control	39.7	9.3	23.8	16.6	8.6	*
Aviation Management	55.8	*	23.3	*	*	*
Airport Management	33.3	*	*	*	*	*

*n<5 Note. All cells in Aircraft Systems Management major were less than 5

Table 4. *Mean Grade Point Averages based upon Hours Worked*

Hours worked per week	Mean GPA	Standard deviation	Sample size
Zero (did not work)	3.33	.41	179
1-10	3.43	.39	87
11-20	3.32	.39	165
21-30	3.25	.40	105
31-40	3.20	.37	41
40 or more	3.17	.42	17

Table 5. *Analysis of Variance for Hours Worked and Grade Point Average*

	Sum of Squares	df	Mean Square	F
Between Groups	2.65	5	.531	3.35*
Within Groups	93.24	588	.159	
Total	95.89	593		

*p<.01

RECOMMENDATIONS AND CONCLUSIONS

The findings have numerous implications for students, faculty and administrators involved with collegiate aviation programs. Due to rising costs, some of today's students need to work to afford attending college. Despite the need to work, students should be made aware of what effect it may have on their academic achievement and ultimately their ability to persist in school. When choosing a job, students should seek out employers who are sensitive to student needs. Students should also seek out alternative methods of funding such as scholarships, which can help alleviate some of the financial pressure placed on them.

Faculty should understand and be made aware that many students sitting in their classes are putting in over 50 hour weeks when combining school, work and flying. If the faculty have a voice in disseminating departmental scholarships or other merit-based awards, academic achievement as represented by GPA should not be the only consideration. A student working full-time will more likely have a lower GPA as a result. When advising aviation students, faculty should encourage the student to seek employment in an area that will help them succeed in their career aspirations.

Aviation department administrators need to understand that students are sacrificing time and energy that could be devoted to study by working to afford their education. Anything that can be done to help curb the costs students incur while pursuing an aviation degree should be analyzed. Administrators should also make it a priority to secure more aviation student scholarships that can be awarded to help offset the cost of college. While procuring additional monies for scholarships, information on the rising costs to students, and the student's need to work, must be explained to potential benefactors.

This research revealed numerous other areas that are in need of further study. Although national research (NCES, 1998) reports that three out of four students work while attending college, this survey of strictly aviation students found that only three out of five students are employed during the academic year. Further research in this area could help determine if this is a specific institutional phenomena or if it holds true in most collegiate aviation programs.

This research unveiled many other questions that could be further studied by using either a quantitative or qualitative approach. Since aviation can be classified as a high cost program, why do fewer students work while attending school compared to the national data? Also, since flight is the most costly major, why is there no difference in hours worked between flight and non-flight aviation majors? Why do upperclassmen work more than freshman students? Why do working aviation students tend to participate more in extra-curricular activities?

Other areas that can be studied which branch off of the original research intent of this study, include a more detailed analysis of financial aid and scholarship programs in aviation education. Are aviation students leaving college with a significant amount of debt incurred through financial aid? What types of successful scholarship programs exist, and how is equitable distribution of the monies awarded in collegiate aviation programs?

A better understanding of students' financial sensitivity will ensure that programs provide the highest level of aviation education at the most reasonable cost to the students. In doing this, not only will our students graduate with the skills and knowledge needed to be successful in the aviation industry, they will have less financial pressures placed on them while attending school.

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Flight and Ground Safety: Comparing Teaching and Business Practices

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ABSTRACT

This study investigates how UAA affiliated aviation programs safety course content compares to the safety programs and concerns of the airline industry. Airlines have experienced very few flight safety accidents and incidents during the past five years. During the same period airline employees have experienced ground related injuries at a very high rate compared to other industries. The research concludes that UAA educational programs should be reviewed to ensure adequate attention is being given to ground safety topics.

INTRODUCTION

Background

Business concern for producing safe products and services in the United States has increased with the growth of litigation. The aerospace industry is no exception to this, and since the industry places its customers in the potentially hazardous environment of flight, it is particularly concerned and heavily invested in minimizing customer risk and projecting of an image of totally safe operations.

University aviation programs have long recognized this driving concern within the aerospace industry and generally provide one or more safety courses for their students. The nature of these courses in the sense of what areas of safety they discuss is a common discussion item among faculty that teach these courses, raising the question of what should be taught to best support the needs of the industry that will hire their students.

Multiple safety topics might be included within a safety course or curriculum. For example, industrial safety, traffic safety, flight line safety, airport environment safety, hazardous materials safety, maintenance safety, flight operations safety, crew resource management, aviation physiology, systems safety, OSHA, and safety program management topic could be discussed.

The authors' anecdotal review of UAA presentations, articles and committee actives leads to the perception that the significant majority of discussion and writing in academia is about is directed toward flight safety and little or none involves ground safety or any of the other topics listed above. Yet, the Air Transportation Association (ATA), the professional group representing 18 major airlines (ATA, 2007a), has separate committees for flight and ground safety (ATA, 2007b). The ATA defines flight safety and ground safety by the hazards that affect safety in each area. The ATA flight safety committee and the ground safety committee divide their activities as shown below (ATA, personal communication, January 12, 2007):

<u>Flight Safety</u>

- Issues Involving the Operation of Aircraft when Intent for Flight Exists
- Flight Accident/Incident Investigations,
- Runway Incursions,
- Rejected Takeoffs,
- Turbulence Injuries
- Wildlife Strikes.

<u>Ground Safety</u>

- Issues Involving Ground Damage to Aircraft
- Injury to Personnel Involved In Ground Servicing, Maintenance, Towing/Taxi for Purposes Other than Revenue Flight
- Human Factors,
- Operation/Safe Driving,
- Ergonomics,
- Materials Safety Data Sheets,
- Dg/HAZMAT,
- Marshalling,
- Taxi Signals,
- Ramp Operations During Inclement Weather,

- Ground Accident/Incident Investigation, and Inadvertent Emergency Exit Operations,
- Passenger Loading Bridge Events,
- Hazard Awareness,
- Personal Safety,
- OSHA Requirements,
- Environmentally-Sensitive Ops in the AOA.

Some readers may argue that safety is safety and flight and ground safety should not be considered separately. Others may argue there are some differences but much overlap. Another group of individuals may say safety is divided into various categories such as maintenance safety, industrial safety, etc., and each area must be addressed. Our position is to accept the practice of the ATA which has two functional areas for aviation safety.

The purpose of this study is to determine how UAA affiliated aviation programs safety course content compared to the safety programs and concerns of the airline industry. To do this the authors addressed these seven research questions:

1. Using the subtopic areas of the ATA definitions of flight and ground safety, what is the amount of emphasis placed on ground and flight safety in UAA affiliate safety courses?
2. In which areas of safety do airline managers place emphasis?
3. What is the balance between ground and flight safety topics in aviation publications and research?
4. What is the balance between ground and flight safety activity in ATA member airlines?
5. What percentage of UAA affiliated aviation schools has a safety course?
6. What textbooks are used for these courses?
7. What is the balance between ground and flight safety accidents/incidents incurred by ATA member airlines?

Definitions

Safety – The lack of hazards that can produce injury or death of a person or significant damage or destruction of other resources.

Safety Program – Actions taken by some entity to create safety.

Limitations

This discussion is limited to the University Aviation Association (UAA) member schools that offer a four-year bachelor degree in aviation management as identified by Phillips (2004) and to the United States based member airlines of the Air Transport Association. Both the UAA and ATA represent the major players in their respective industry of aviation education and aviation operations. Civilian and military aviation and practices of non-US based schools and airlines are excluded.

LITERATURE REVIEW

The literature review was conducted in three phases. Phase one reviewed the top three journals in aviation education. Phase two reviewed the text books commonly used in aviation education. Phase three reviewed public records to determine the extent of accidents and injuries in the flight and ground environment.

Journal Review

Johnson, Gibson, Hamilton and Hanna (2006) identify the three most important peer-reviewed journals in aviation education. They are the *Collegiate Aviation Review*, *Journal of Aviation/Aerospace Education & Research*, and the *Journal of Air Transportation.* The review of these journals indicates to what degree flight and ground safety are the subject of published articles and if any prior investigation was made of the issue addressed in this study. The most recent five-year time period, 2002 through 2006, was selected as an arbitrary standard. During this period we located 19 articles dealing with safety. Fourteen articles concern flight safety, three ground safety, and one system safety. A brief summary of these articles is provided below.

Flight Safety Articles

Kirton (2004) indirectly describes in-flight safety as a means of avoiding “traffic conflict.” “Traffic conflict” is defined as “…any situation involving another aircraft in the pattern that required either pilot to maneuver to avoid a midair collision” (p.17). This definition implies “in-flight” safety as an activity that is completed in order to escape an in-flight mishap. Patrick Ross (2004) discussed the need for checklists during all aspects of flight. Checklist usage can reduce the chances for accidents/incidents. Ross describes "in-flight" safety as performing necessary checklists and avoiding conflict resulting from improper usage. According to Adams (2005), "flight safety" is generalized to mean ground and in-flight safety. No references to ground accidents are mentioned in the article. Adams specifically mentions the 1956 midair collision over the Grand Canyon involving a DC-7 and Super Constellation. Olson and Austin (2005) make no distinction between ground and in-flight safety; however, safety in general is categorized as the reduction of flight accidents/incidents.

Young, Fanjoy and Suckow (2006) see "safety" as perfecting in-flight activities including situational awareness, manual flying skills and automated cockpits. In Campbell-Laird's (2006) article on phraseology and communication in collegiate flight training programs, flight safety is measured by the rate of accidents and incidents, and no other mention of safety was made. Flouris, and Reyes, (2006) indicated that airline safety performance is determined by rate of accidents and incidents. There was no distinction between ground accidents/incidents and in-flight accidents/incidents, rather the article concentrates on in-flight safety. Witiw, Lanier and Crooks (2003), targeted pilot decision-making in adverse weather conditions, specifically, decisions regarding additional weather information obtained en route. Although not specifically mentioned, the article concentrated on in-flight safety (pilot decision-making and situational awareness) according to the ATA.

Cocklin (2004) discussed checklists and in-flight safety with emphasis on in-flight emergencies. Gill (2004) offers a definition of safety by Lowrance (1976), "…a judgment of the acceptability of risk, and risk, in turn, as a measure of the probability and severity of harm to human health" (p. 44). Gill (2004) concludes that according to Helmreich and Meritt (2001) "The findings of this study support the notion that safety is somewhat subjective and therefore difficult to conceptualize, as it varies in different environments." Gill (2004) states that violations of safety are considered in-flight safety as defined by the Air Transport Association. Finger and Piers (2005) define safety performance (in-flight safety) as the rate of accidents and incidents. Finally, Lee, Fanjoy and Dillman (2005), focus on flight safety not ground safety and discuss pilots' aeronautical decision-making (ADM), situational awareness, and training experience.

Ground Safety Articles.

McNamara, Thom and Thompson (2004) state that being safe on the ramp encompasses ground safety. They conclude that the lack of ground safety related to accidents like ValuJet Flight 592, Alaska Airlines Flight 261, TWA Flight 800 and Air Midwest Flight 5481 "…alerted the air transportation industry that non-flight operation does play a significant role in today's aviation safety. As a result, the task of eliminating non-flight errors cannot be overemphasized" (p. 33). Rhoades, Reynolds, Waguespack Jr. and Williams (2005) state ground safety, specifically airline ground safety, is discussed as line maintenance and its quality of service. This is the basis of maintenance resource management (MRM) programs.

System Safety Articles

System safety involves general programs or practices which may be applied to ground or flight safety problems. According to Lee and Weitzel (2005), in-flight safety is described as accidents/incidents having resulted in fatalities and the subsequent investigation. Hansen and Pitts (2005) discuss system safety as related to the Mercury space program and NASA history. Their article indicates system safety is comparable to in-flight safety as they both focus on preventive accident measures.

In summary, the preponderance of research published in the top peer-reviewed journals in aviation education addresses flight safety or ground safety issues impacting flight worthiness. To validate this finding, the authors did a quick search of the FAA database (FAA, n.d.). This review revealed 8420 documents on ground safety as compared to 33,400 documents on flight safety. Clearly, the safety emphasis in the aviation industry has been on flight safety with only 20-25% of journal articles and other literature addressing ground safety topics.

Text Book Review

The three most common text books used in safety education in aviation management programs in UAA member schools are (1) *The Fundamentals of Occupational Safety and Health* by Friend and Kohn (2006), (2) *Commercial Aviation Safety* by Wells and Rodrigues (2004), and (3) *Aviation Safety Programs: A Management Handbook* by Woods (2003). Some programs use self-developed materials and other resources to support their curricula. The following paragraphs briefly discuss the primary resources.

The basic concepts of safety are extremely well presented by Friend and Kohn (2003). While this book is intended to introduce the student to Occupational Safety and Health concepts, it does a tremendous job of introducing general ideas and practices applied to all safety areas. It takes the reader from safety legislation and applicable laws such as worker compensation and the Occupational Safety and Health Act, through all of the programs and concepts dealing with ground safety, accident causation and investigation, hazardous material safety, and industrial safety. It also includes chapters on workplace violence and terrorism. It is well written, easy to read and could be a foundation resource in any safety education program, including aviation safety programs. While this textbook is very inclusive, it does not specifically discuss aviation safety concerns such as maintenance, flight line, or flight safety.

Wells and Rodrigues (2004) have produced a textbook that applies many of the concepts discussed by Friend and Kohn (2003) to aviation safety. It expands federal safety program information to include the FAA and NTSB and covers rulemaking by the FAA, EPA, and OSHA. It adds to the University of Southern California's "Four-M" accident causation model discussed by Friend and Kohn by discussing the effect of mission to potential cause elements and also introduces the management causation model developed by James Reason. It then turns to factors that directly affect aviation safety programs such as human factors, air traffic control, aircraft safety systems, airport safety, and airline safety. This text lives up to its title by limiting its comments to commercial--primarily airline--aviation safety programs. Little information is provided on maintenance safety issues but some information is provided on flight line safety. While many of the concepts and practices discussed are applicable to general aviation the book does not address small aircraft, corporate, or contract aviation.

Richard Wood (2003) has produced a practical handbook for aviation managers and safety personnel to use. It is in reality not a textbook but, as titled, a handbook to be used in the day-to-day efforts of aviation managers. Wood, a working expert in aviation safety (p. iii), presents a very practical approach to introducing aviation students to the concept of aviation safety and practices commonly used in this field. It is written by and takes pains to cover the key ideas discussed by Wells and Rodrigues, and Friend and Kohn. The book introduces the impact of safety on economics, basic concepts, terms, programmatic elements, and risk management. It discusses the human element of aviation safety and the elements of a solid safety program including reporting and distribution systems, inspection and safety education programs, and other information leading up to a sample aviation safety program. The book provides a series of checklists that safety personnel can use to achieve their program. Wood goes through a lot of information in easy to read short chapters always from the perspective of one who lived what he recommends.

Public Records

Federal law requires those who operate airplanes to provide the NTSB notification of "…aviation accidents and certain incidents. An *accident* is defined as an occurrence associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage" (NTSB, 2007, Para. 1). Figure 1 shows the number of fatalities and serious injuries occurred by U.S. commercial airlines (FAA Part 121 carriers) for each of the most recent five years. Flight crew injuries are not included. The ATA position on this record was stated at a 2005 U. S. Senate Hearing on Aviation Safety, "Without question, scheduled air service is incredibly safe, and our goal is to build on that safety record" (Barimo, 2005). Neither the FAA or the NTSB provide a summary of injuries beyond fatalities and serious injuries that occur to passengers and or crew members engaged in commercial aviation.

Year	Passenger Fatalities	Passenger Serious Injuries	Total Passenger Enplanements (millions)	Million Passenger Enplanements per Passenger Fatality
2002	0	11	619	No Fatalities
2003	19	10	654	34.4
2004	11	3	711	64.6
2005	18	2	743	41.3
2006	47	4	750	16.0

Figure 1. NTSB report of Passenger Injuries and Injury Rates

The Occupational Safety and Health Administration, under the Department of Labor, is responsible for assuring "the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health" (OSHA, 2007, p. 1). The Administration is concerned with workplace safety for 115 million workers at 7 million worksites. Worker injuries are viewed from the perspective of number of incidents of injuries and the number of cases in which an injury caused the employee to miss at least some time away from work. The latter is called by some individuals in industry a lost-time-injury or "LTI." OSHA reports LTI's as a rate of injuries per 100 full-time workers. By using this rate of injuries, comparison may be made between industries and companies with differing employee populations. The calculation considers a full-time worker an individual expected to work 40 hours per week, for 50 weeks or a total of 2000 hours per year (Bureau of Labor Statistics, 2006).

Commercial airlines fall within the North American Industry Classification System (NAICS) category 4811 - "Scheduled Air Transportation." According to the U.S. Census Bureau (2007), the description of this category is:

> This industry group comprises establishments primarily engaged in providing air transportation of passengers and/or cargo over regular routes and on regular schedules. Establishments in this industry operate flights even if partially loaded. Establishments primarily engaged in providing scheduled air transportation of mail on a contract basis are included in this industry (p. 1).

Figure 2 indicates that for the last three years Scheduled Air Transportation has essentially the worst lost-time-injury record in the nation among all industries. (Data has not been published for 2006.) Based on this report a representative record for an airline with 50,000 employees might have experienced 2,800 lost-time injuries during 2005 (5000 x 5.6 injuries per 100 employees = 2,800 injuries).

Imagine Southwest's Midway Airport station manager's perplexity last December when "Wrestling suitcases on and off planes got so grueling for Southwest Airlines' 350 ramp workers in Chicago that by Christmas season one-fourth of them were reporting on-the-job injuries" (Trottman & Carey, 2007). The station operation must have been impacted by this 25% injury rate!

In 2005 and 2006, OSHA sent letters to the 14,000 workplaces with the highest occupational injury and illness rates "… urging the employers to take action to remove hazards causing the high rates." These locations "had 6.0 or more injuries or illnesses which resulted in days away from work, restricted work, or job transfer. The national average is 2.5." (OSHA, 2005; 2006). (Injuries reported are for 100 equivalent workers.) Of these 14,000 companies, 131 airline workplaces are included in 2005 and 129 in 2006. A workplace may be a single station or large department within the airline. (The airline workplaces may be understated because overnight carriers DHL, FedEx and UPS are not included in these summary numbers.)

Year	Ratio of Lost-time Injuries per 100 Workers	National Ranking
2005	5.6	Second (worst)
2004	5.5	First (worst)
2003	6.2	First (worst)

Figure 2. Bureau of Labor Statistics reports of lost-time-injuries for Scheduled Air Transportation (NAICS 4811)

The public record indicates that the airlines have an exemplary record of operating aircraft but a less than desirable record of employee injuries associated with the activities required to run the airline. The ATA and perhaps the public find the flight safety record is acceptable; the ground safety record appears not to be.

METHODOLOGY

In addition to the literature review, new data gathering for this study involved two steps:

1. Survey the instructors of safety courses taught at UAA aviation management schools. The intent of the survey is to learn what percent of each safety class is directed toward flight and to ground safety. A survey instrument is included in Appendix A. Forty-eight surveys were mailed and 31 (65%) were returned.
2. Survey the head safety officer for airline members of the ATA. The survey instrument is included in Appendix B. The intent is to determine the emphasis on flight versus ground safety in safety committee meetings and the annual management appraisal process of key categories of airline managers. Nineteen surveys were mailed and eight (42%) were returned. In both cases a cover letter described the purpose of the survey and the explanatory information about surveys required by our organization's research department.

SURVEY RESULTS

Teaching Practices

Appendix C portrays the information reported on the surveys. Effort in the classroom is 53% directed toward flight safety, 30% ground safety and 17% toward other categories such as security, NTSB procedures, and a management viewpoint of safety. Part of the emphasis on flight safety may be that three of the safety courses are titled "flight safety."

Airline Practices

Six of the eight responding airlines indicated the existence of a system-level cross functional safety committee. The percent of dialog on flight and ground safety varied and is shown in Figure 3.

Airline System Safety Committee Dialog

% Flight Topics	% Ground Topics
75	25
70	30
60	40
50	50
40	60
30	70

Figure 3. Airline Safety Concerns

The variance is apparently based on company practice and not associated with the size of the carrier. The two largest legacy carriers which responded are at each end of the spectrum.

Five carriers reported cross functional safety committees at their larger station. A cargo carrier reported 50% discussion about flight safety and 50% on ground safety. The other four carriers report 20% to 0% about flight safety. The emphasis is clearly on ground safety.

All carriers report the existence of a safety component in the annual objectives of managers in operational positions. Figure 4 displays the spread of emphasis.

Type of Airline	Flight Operations Mgrs		Maintenance Mgrs		Station Operations Mgrs		Onboard Service Mgrs	
	Flight	**Ground**	**Flight**	**Ground**	**Flight**	**Ground**	**Flight**	**Ground**
Major	95	5	80	20	5	95	75	25
Major	90	10	60	40	40	60	90	10
Major	90	10	70	30	20	80	80	20
Major	Not reported		Not reported		Not reported		Not reported	
Cargo	70	30	30	70	10	90	Not applicable	
Cargo	100	0	50	50	25	75	Not applicable	
Cargo	100	0	50	50	10	90	Not applicable	
Regional	50	50	50	50	20	80	50	50

Figure 4. Extent Flight and/or Ground Safety Emphasized in Managers' Annual Objectives—shown as a percentage.

CONCLUSION AND RECOMMENDATIONS

The literature review and survey results point to the following conclusions:

1. The amount of emphasis placed on ground and flight safety in UAA affiliate safety courses leans steeply to flight safety issues and programs. Fifty-three percent of the reporting schools offered flight safety content in their safety courses, 30% offered ground safety content, and 17% offered related safety topics.
2. Operational airline managers tend to have a safety component in their annual evaluation. The predominant emphasis among ground and flight safety depends on the manager's functional area. As shown in Figure 4, flight operations, maintenance, and on-board service managers were graded primarily in flight safety areas while the station managers were graded primarily in ground safety areas.
3. The balance between flight safety topics in aviation publications and research was approximately 5 to 1 in favor of flight safety topics.
4. At a system level slightly more emphasis is placed on flight than ground safety, but airline system safety committees place at least 25% of their emphasis on ground safety. At a large station level the key emphasis is clearly on ground safety.
5. All of UAA affiliated aviation schools that responded to our survey have some sort of a safety course.
6. The most popular textbooks used for UAA affiliated courses are (1) *The Fundamentals of Occupational Safety and Health* by Friend and Kohn, (2) *Commercial Aviation* safety by Wells and Rodrigues, and (3) *Aviation Safety Programs: A Management Handbook* by Wood. The literature available to support college-level safety courses dealing with ground safety topics is limited.
7. ATA member airlines have exemplary flight safety records and yet have among the highest rate of lost-time occupational injuries reported by OSHA.

These conclusions lead to the following recommendations:

1. While a comparison of airline safety interests and aviation school safety course content seems to be balanced, aviation schools should consider adjusting course content to provide students an overview of ground safety topics as well as flight safety topics.
2. Textbooks written for safety courses need to deal more with flight line, maintenance, and hazardous materials safety.
3. Academic researchers in aviation should be encouraged to study and publish information pertaining to ground safety issues.

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APPENDIX A

Teaching Practices Survey…Aviation Safety Class

If you teach several different "safety" classes address your answers to the basic or first level class.

1	Do you teach a "safety" course?	(circle) Yes No
2	What is the designation and title of the class? (i.e. AMM 360 – Safety management):	
3	The course is valued at how many credit hours?	(circle) 1 2 3 4 other
4	Provide the author, title and edition of the main textbook for your class:	
5	What percentage of class discussion, reading and assignments applies to "**flight** safety"? This includes: • Operation of aircraft with the intent for or actual flight • Injury to people during flight or intent to fly (i.e. taxi). • Investigation of **flight** related accidents or incidents • Runway incursions • Rejected take-offs • Turbulence • Wildlife strikes of aircraft	"**Flight** safety" involves approximately **_____%** of class activity and effort.
6	What percentage of class discussion, reading and assignments applies to "**ground** safety"? This includes: • Damage to aircraft when not involved in flight or intent for flight • Injury to people involved in ground servicing, maintenance, fueling • Investigation of **ground** related accidents or incidents • Personal safety • Hazard awareness • Hazardous materials • Safe driving • Materials Safety Data Sheets • Ramp (ground) operations in inclement weather	"**Ground** safety" involves approximately **_____%** of class activity and effort
7	If the above two answers do not total 100% what is/are the other main topic or topics discussed in your safety class?	
8	At which college or university do you teach?	

APPENDIX B

Airline Practices Survey…Safety Administration

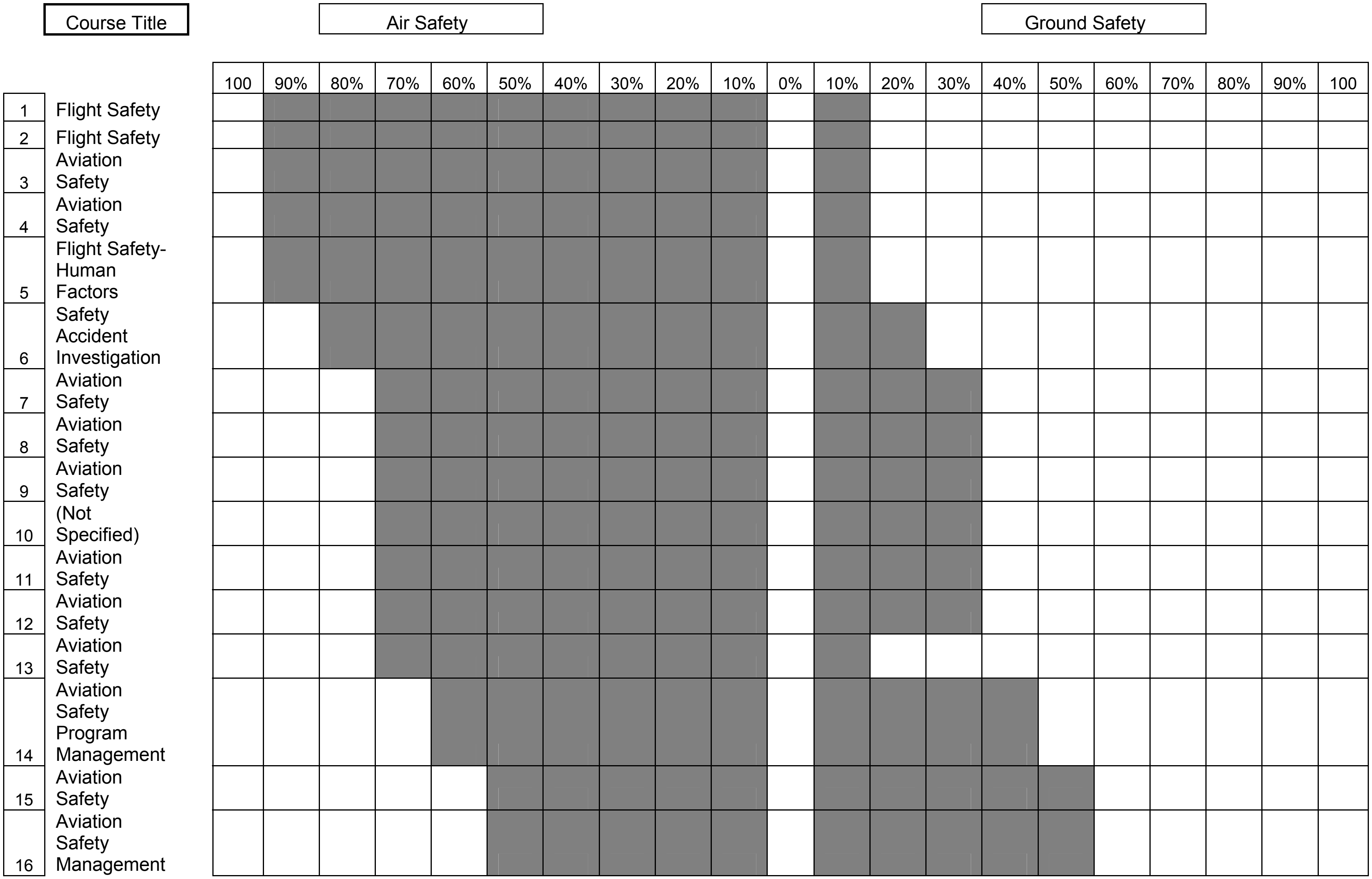
Please answer these questions and return this sheet in the envelope provided.

1	What is the name of your airline?	
2a	Do you have a **system-level** cross functional safety committee? (circle)	Yes No
2b	If you answered yes, indicate the approximate percent of committee dialog on **flight** versus **ground** safety. *"Flight" and "ground" safety are defined below.*	______% flight ______% ground
3a	Do you have cross functional safety committees at your **larger stations?**	Yes No
3b	If you answered yes, indicate the approximate percent of committee dialog on **flight** versus **ground** safety.	______% flight ______% ground
4a	Do the annual objectives for managers in operational positions have some portion allocated for performance in the safety area? If "yes" answer parts b-e.	Yes No
4b	For managers in the **flight operations department** what percent of their safety objective is for flight safety and what percent for ground safety?	______% flight ______% ground
4c	For managers in the **maintenance department** what percent of their safety objective is for flight safety and what percent for ground safety?	______% flight ______% ground
4d	For managers in **station operations** (i.e. customer service, ramp operations, and cargo operations) what percent of their safety objective is for flight safety and what percent for ground safety?	______% flight ______% ground
4e	For managers in the **onboard/in-flight service department** what percent of their safety objective is for flight safety and what percent for ground safety?	______% flight ______% ground
5	From your 2006 ***OSHA 300A Summary of Work Related Injuries and Illnesses*** report, column H, what is the total number of "lost time" injuries?	

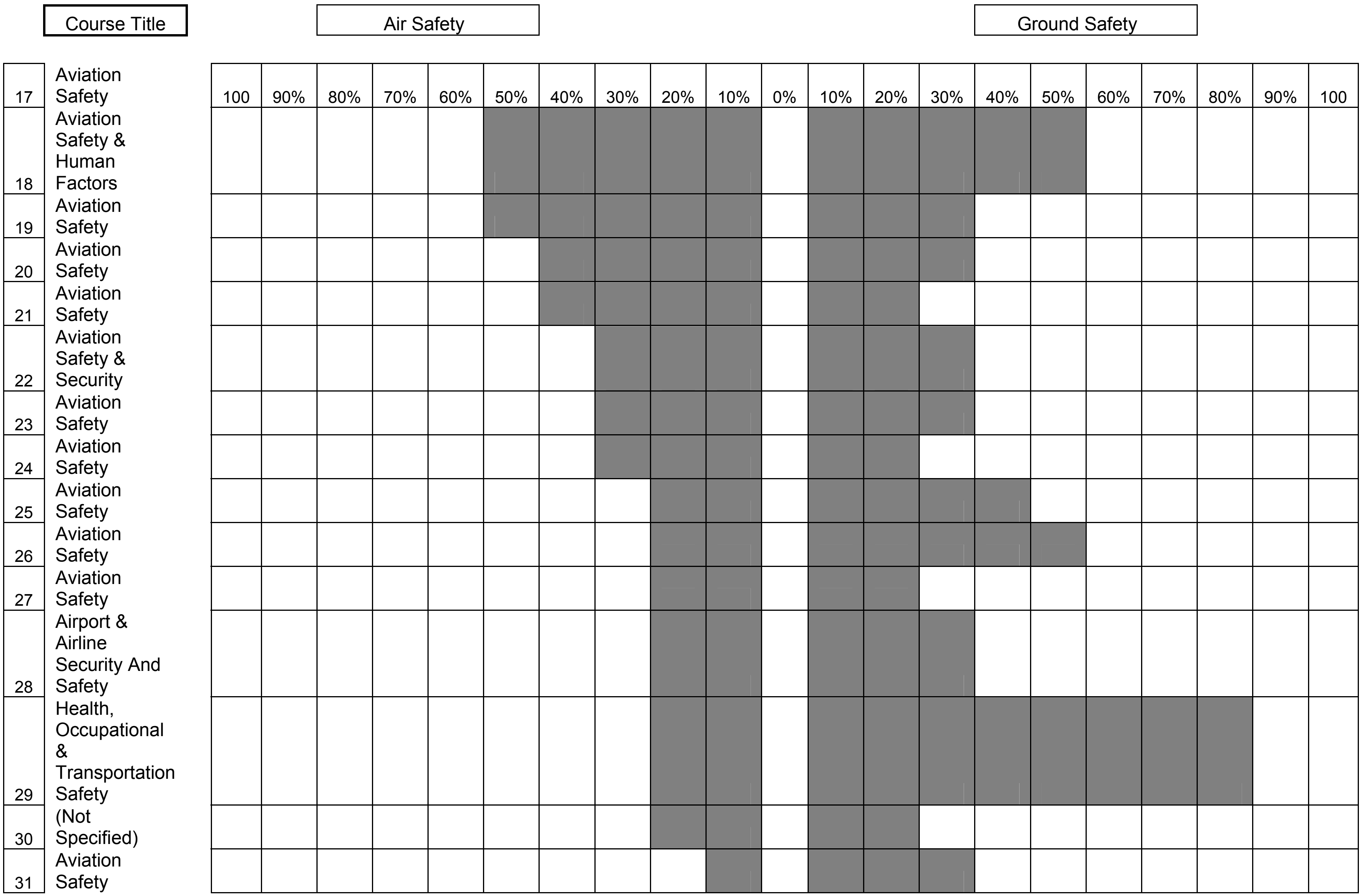
Flight safety involves activities such as:	**Ground** safety involves activities such as:
• Operation of aircraft with the intent for or actual flight	• Damage to aircraft when not involved in flight or intent for flight
• Injury to people during flight or intent to fly (i.e. taxi)	• Injury to people involved in ground servicing, maintenance, fueling
• Investigation of **flight** related accidents or incidents	• Investigation of **ground** related accidents or incidents
• Runway incursions	• Personal safety
• Rejected take-offs	• Hazard awareness
• Turbulence	• Hazardous materials
• Wildlife strikes of aircraft	• Safe driving
	• Materials Safety Data Sheets
	• Ramp (ground) operations in inclement

APPENDIX C - 1

Teaching Practices - page 1



Teaching Practices - page 2



APPENDIX
C-2

Subjects Taught Other Than Flight and/or Ground Safety

	Course Title	Percent of Course %	Subject
1	Flight Safety		
2	Flight Safety		
3	Aviation Safety		
4	Aviation Safety		
5	Flight Safety-Human Factors		
6	Safety Accident Investigation		
7	Aviation Safety		
8	Aviation Safety		
9	Aviation Safety		
10	(Not Specified)		
11	Aviation Safety		
12	Aviation Safety		
13	Aviation Safety	20	litigation, NTSB procedures
14	Aviation Safety Program Management		
15	Aviation Safety		
16	Aviation Safety Management		
17	Aviation Safety		
18	Aviation Safety & Human Factors		
19	Aviation Safety	20	pilot health
20	Aviation Safety	30	decision making, models, reporting systems, etc.
21	Aviation Safety	40	employee motivation, safety from management viewpoint
22	Aviation Safety & Security	40	security
23	Aviation Safety	40	regulatory framework, NTSB, etc.
24	Aviation Safety	50	safety systems, security, NTSB, etc.
25	Aviation Safety	40	general systems safety
26	Aviation Safety	30	safety from management viewpoint
27	Aviation Safety	60	safety management systems; risk management
28	Airport & Airline Security And Safety	50	security & terrorism
29	Health, Occupational & Transportation Safety		
30	(Not Specified)	60	accident theory, organizational communications, etc.
31	Aviation Safety	60	organization impact/human error

Very Light Jets: Requirements for Pilot Qualification and Collegiate Aviation's Role

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ABSTRACT

This study examined how senior flight operations staff at Very Light Jet (VLJ) air taxi and manufacturing companies determine pilot experience levels, training, education and qualifications for their current and future flight operations. Additionally, this study examined how collegiate aviation may address the pilot training and education needs of the VLJ industry. Senior flight operations staffs at two VLJ air taxi operators and three VLJ manufacturers were interviewed regarding these issues. Results indicated that current pilot supply for commercial operations in VLJ aircraft were being met by pilots leaving regional airline operations and also from promotion within respective respondents' current air taxi operations. Innovative mentoring programs designed for single-pilot VLJ commercial operations were not being routinely utilized in favor of the more traditional Captain and First Officer roles for gaining flight experience and advancement. Another operational implication for the traditional two-pilot crew versus single-pilot was to meet particular customer insurance requirements for multi-pilot crews. Respondents valued collegiate aviation's past preparation of industry pilots and offered suggestions in adjusting curriculum away from traditional rote systems training to one of cockpit management. Results indicated that while there was no immediate need for formal relationships between VLJ industry and collegiate aviation, respondents were open to the idea of future collaboration.

INTRODUCTION

Very Light Jets (VLJs) are being introduced to the aviation industry at an increasing rate. Because of the potential entry of VLJs over the next eight to ten years, there is some concern that these high performance jet aircraft, with advanced cockpit avionics, integrated automation features, and single-pilot operation, are particularly sensitive to the need for high-quality training, selection and qualifying of pilots. The introduction of the VLJ into the commercial aviation industry will bring both new opportunities and demands to flight training and education. Applying what the industry has learned from the past, an innovative pilot selection, training, and qualifying process must be identified to ensure an orderly and safe transition for those who become commercial operators of this next generation of aircraft.

In this paper, we present a preliminary qualitative study for identifying initial pilot operating experience, qualifications, and training requirements, as determined by emerging commercial VLJ business operators and manufacturers. While federal regulators and aviation insurance companies have established initial minimum pilot requirements for VLJ commercial operation, it was the goal of this study to determine how VLJ business operators and manufacturers view these requirements in their actual operations.

This study was an Institutional Research Board (IRB) approved survey of VLJ flight operations staff that may provide insight to determine pilot experience levels, training, education and qualifications for their current and future flight operations and how collegiate aviation may address some of these concerns. Flight operations staff at VLJ air taxi companies included chief pilots and flight operations managers. Flight operations staff at VLJ manufacturers included flight staff within customer flight support, flight training, and flight testing. The purpose, literature review, methodology, findings, and conclusions of this study are presented in the following sections.

PURPOSE OF THE STUDY

The purpose of this study was to ascertain how commercial VLJ business operators and manufacturers view pilot selection, training and operational experience processes unique to VLJ single-pilot commercial operations. Additionally, this study investigated the role collegiate aviation could possibly play in preparing pilots for this emerging section of the aviation industry.

LITERATURE REVIEW

Very Light Jets are being introduced to the industry at an increasing rate. According to Honeywell's 2007 Business Aviation Outlook, the forecast is that approximately 5000 VLJs will be produced between the years of 2007 and 2016 (Government Accountability Office, 2007). In this same GAO report, PMI Media predicts the production of VLJs to exceed 7,000 aircraft during the same time period. The report also cited the Federal Aviation Administration's (FAA) own estimates for that time period include the production of approximately 6,000 VLJs. Strait (2007) reports that manufacturers of VLJs have accepted advanced sales of nearly 3,000 aircraft.

Forecasts indicate that these trends will continue for the foreseeable future (Brown, 2007; Cobb, Thomas, & Cobb, 2007). Research in the area of VLJs has followed several avenues. Early works by Trani, Baik, Swingle, and Senanu (2003) and Trani et al. (2005) were concerned with developing systems dynamics models for small jet aircraft integration into the airspace system and other socio-economic factors based on the introduction of VLJs. Cobb, Thomas, and Cobb (2007), reported on issues related to the direct and indirect market impact of VLJ aircraft. Additional work by Prather and Hawkins (2007), and Bonnefoy and Hansman (2007), dealt with the impact of VLJs on general aviation airports and the National Airspace System.

Few researchers have addressed the problems of hiring, training and qualifying commercial VLJ pilots. In a study by Burian (2007), the author analyzed accident and incident reports which offered implications for training future VLJ pilots. Significant problem areas identified in that study included poor crew/single pilot resource management, low currency, inadequate preflight planning, avionics use difficulties, and cognitive performance issues. In a separate study, the National Business Aviation Association (NBAA) Safety Committee developed a training outline that represents the minimum curriculum necessary to satisfy a very light jet transition-training program (NBAA, 2007). The NBAA Safety Committee identified the following unique potential problems for inclusion in VLJ pilot training as wake turbulence encounters, convective weather encounters, microburst/ windshear encounters, clear air turbulence/jet stream core or boundary encounters, high-altitude upset, mountain wave encounters, inadequate knowledge of high-altitude weather, physiological effect of high-altitude operations, jet blast damage, low-fuel arrivals, incorrect/less than optimum cruise altitude selection, inadequate preparation for high-rate/high speed climbs, inadequate crosswind takeoff/landing preparation, inadequate LAHSO preparation, VLJs misunderstood by ATC, single pilot adherence to checklists, FMS programming and autoflight versus manual flight control, inadequate exercise of command, recognizing single pilot red flags, lack of pilot self-evaluations, and winter operations.

After initial training and education, traditional commercial pilot career progression most often included multi-crew pilot experiences where the pilot's development progressed through stages of advancement from Second Officer to First Officer, and finally to Captain as pilot-in-command (PIC) at most airlines, charter fleets, and corporate flight departments. With single-pilot certification for VLJ operations, an innovative view of pilot training and advancement must be considered. One consideration for VLJ pilot development is incorporating the role of a mentor pilot. The NBAA Safety Committee advocates mentor pilot programs to supplement VLJ pilot transition training (NBAA, 2007). These mentor pilot programs will match very experienced pilots with VLJ transitioning pilots.

VLJ manufacturers and aviation insurance companies generally support the concept of mentor pilot relationships in order to gain acceptance by the professional flying community, and the FAA, and overcome the problem of insurability of VLJ pilots (Cobb, Thomas, & Cobb, 2007). Research in the area of mentoring has followed several avenues. Schneier, MacCoy, and Burchman (1988) view mentoring as developing a relationship to transfer skill and knowledge, and having the mentor act as a model of effective behavior. This model could be applied to provide initial operating experience for pilots in single-pilot operations. Additional work by Geroy, Bray, and Venneberg (2005), adopted a characterization of mentoring as the supporting of learning and development of individuals seeking personal and professional growth, where these mentoring efforts meet both individual and organizational needs. Results of a study by DeMik (2007), stressed the critical role of mentoring as a strategic need within human resource development that fosters an environment for performance improvement.

METHODOLOGY

The researchers initially reviewed VLJ flight operations within seven companies: four of the first commercial operators of VLJ aircraft and the three leading VLJ manufacturers. The research was designed to identify each organization's experiences with pilot training and identify similarities and differences among them. It was also the intent of this study to determine if collegiate aviation could play a key role in preparing pilots for positions within this segment of the industry.

A review of the literature discussed in the previous section revealed key issues that may lead to unique potential problems for professional VLJ pilot training such as poor crew/single-pilot resource management, low currency, avionics use difficulties, single-pilot adherence to checklists, and recognizing single-pilot red flags (Burian, 2007; NBAA, 2007). Due to the infancy of commercial single-pilot VLJ operations, none of the literature, however, addresses the actual commercial operation of single-pilot VLJ aircraft. A defining feature of this study is the opportunity for the operations staff at these companies to express their personal experiences in this innovative aviation business regarding hiring, training and providing initial operating experience for their pilots.

Theoretical Framework

The theoretical framework we chose for this study was narrative inquiry. Our initial telephone survey, as established in appendix A, proved to be ineffective. Flight operations staff personnel were hesitant to provide survey information. However, they chose instead to provide in-depth conversation as opposed to staying on script to complete the survey. Since we had incomplete responses to the initial survey, no data analysis to the survey was provided in this article. Because of the in-depth discussion, the researchers continued the research as a narrative inquiry approach.

Using interviews, discussions, and an exploration of past experiences, this method allowed VLJ operations staff to convey their experience in this field in narrative form. The participants were encouraged to consider and discuss compelling and controversial issues in commercial VLJ operations through narrative expression. Their accounts provide a depth of ownership needed to explore important issues in aviation, in a way that previous VLJ studies have not considered. Hearing each staff member tell his or her experiences in VLJ pilot qualifying provides an initial understanding of what was missing in the literature regarding this new field - an understanding of the initial pilot operating experience, qualifications, and training requirements as determined by commercial VLJ business operators and manufacturers in actual operations.

A qualitative study provides a rich, comprehensive description as evidence of the experience of the participants, as opposed to calculating statistics drawn from large samples of participants (Patton, 2002). Patton also suggests that the perceptions, beliefs, and attitudes of the participants are the target of a qualitative study. The researchers do not judge the data; instead, the data is merely presented for its descriptive value and analyzed for assumptions and commonalities. A theory emerges gradually through data collection, accompanied by the researchers' continual reflection of the data. An examination of the experiences of VLJ staff regarding distinctive issues affecting pilot qualifying may be most effectively researched through a qualitative study.

A qualitative study of the experiences of VLJ staff in actual operations, in the form of a narrative inquiry, may enhance current literature on VLJ pilot qualifying through the impact of the participants' narratives. We felt that this perspective could provide a provocative method for our research in a field that is just now emerging. The value of this research lies in its ability to shed light on the curricular issues of commercial VLJ pilot initial operating experience, training requirements, and the role of collegiate aviation.

Research Questions

The guiding research questions for this study were:

1. What minimum pilot qualifications will VLJ air taxi operators require of pilots in order to be hired to fly their VLJ's?
2. What role can collegiate aviation programs play in preparing pilots to fly VLJs in the air taxi market?
3. What minimum time will be required with a mentor pilot prior to a new hire pilot being released to fly single-pilot in a VLJ in air taxi operations?
4. From which segment of the industry do you believe pilots will emerge for the air taxi market?

Population

The following sections describe the participants used in our study, the data collection, and data analysis process. The seven companies initially identified for this study represent the majority of the emerging VLJ field to have actual flight operational experience with commercial VLJ flight operations. Two companies, Linear Air and Pogo Jet, Inc., were later excluded from this research as they had not yet started VLJ operations. When the seven companies were first identified, these two companies were to have had VLJ operations; however, they experienced some delay in their start-up.

Since the study is a narrative inquiry and the participants' voices are central to the understandings that develop in the inquiry, we will provide a brief description of each participant before we discuss data collection. Participants were operations staff members at emerging commercial VLJ business operators and manufacturers. The following is a brief narrative on each of the five companies that had operational experience with VLJs at the time of our inquiry.

DayJet. DayJet has worked to change the way on-demand air travel works. They were the first air-taxi operator to offer accessible air travel on a per-seat basis using VLJs. Based on the premise that time is valuable, DayJet allows business travelers the freedom to set their own terms for on-demand jet service. Employing a 100% all-digital operation, DayJet is able to run a large-scale on-demand service on a per-seat basis without publishing flight schedules. In July 2002, DayJet signed a five-year agreement for the purchase of more than 1,000 Eclipse 500 jet aircraft. To date, DayJets operates approximately 65 Eclipse 500 VLJs (DayJet, 2008).

HondaJet The HondaJet fulfills one of Honda's longstanding dreams to advance mobility through personal aviation. Honda's focus is on their customers and the harnessing of advanced technologies to provide new and better mobility for people. The Honda Aircraft Company has received more than 110 orders for the $3.65 million HondaJet, with first deliveries scheduled for 2010. On Wednesday, June 27, 2007, Honda Aircraft Company broke ground for their future world headquarters in Greensboro, N.C (HondaJet, 2008).

Imagine Air. ImagineAir is also changing the way air taxi service works by offering innovative on-demand personal air transportation service for people traveling for both business and pleasure. Their point-to-point service, between regional airports in the Southeast, is at a cost similar to those of the large commercial air carriers and lower than that of the traditional private charters. Currently equipped with five Cirrus Aircraft, ImagineAir is expanding its fleet to include three Eclipse 500 Very Light Jets, extending its service area throughout the United States and neighboring destinations (Imagine Air, 2008).

Cessna Aircraft Company. The Cessna Aircraft Company has been a leader in the general aviation piston and light/medium jet aircraft markets since 1927, having produced more than 100,000 piston-powered airplanes and another 2,000 Citation jets. The Citation Mustang, announced in 2002, was designed to fill a void in the light turbine aircraft market and meet the needs of tomorrow's aviation environment. The six-place Citation Mustang received full FAA type certification on September 8, 2006. Cessna currently has over 500 orders for the Citation Mustang (Cessna, 2008).

Eclipse Aviation. Eclipse Aviation was founded in 1998 with the goal of bringing the word "personal" into the aviation market. Their innovative approach to business designs, certifying, and manufacturing of the Eclipse 500 VLJ is part of the current transformation in the transportation industry. To date, Eclipse has orders for approximately 2,400 Eclipse 500 VLJ's. Full FAA type certification was achieved on September 30, 2006 (Eclipse, 2008).

Data Collection

A telephone survey (attached as appendix A) was developed to initiate dialog and determine emerging commercial VLJ operators' and manufacturers' attitudes and experiences regard-ing hiring, training and providing initial operating experience for their pilots. This method of data collection was selected because of some proven advantages it has over other methods. According to Dillman and Salant (1994), this method results in higher response rate which is especially important with a small population such as this one. Additionally, the data can be collected faster which is a key factor in a rapidly changing industry such as aviation.

Representatives of seven VLJ companies were telephoned and surveyed. Two of the seven companies were excluded from the research inquiry as they had not yet begun VLJ operations. The telephone calls were placed during normal business hours during the weekday.

Five of the seven companies provided data for this study, yielding a 71% response rate. As stated in the theoretical framework section of this article, our initial telephone survey proved to be ineffective. Flight operations staff personnel were hesitant to provide survey information. However, they provided in-depth conversation which is represented in our findings below.

FINDINGS

Pilot Requirements

A guiding question was posed inquiring about minimum pilot qualifications. Experience and sound decision-making abilities are two key points that emerged when asked this question. Meeting pilot-in-command (PIC) FAR 135 IFR minimums established by the Federal Aviation Regulations were cited by the respondents who were operating VLJ's. Additionally, flight times between 300 – 500 hours total time were given as minimums for crew members to operate as traditional first officers while gaining the requirements to meet established PIC minimums. One respondent stated these flight times may come down, over time, with the acceptance of future *ab initio* training and mentoring programs.

Hiring VLJ Pilots

The question was posed to the respondents as to if they are or anticipate having trouble hiring pilots. With a widely held belief that the aviation industry is or will shortly be experienceing a pilot shortage, it is interesting to note that results of this inquiry did not support that belief. In fact, 100% of the respondents stated that they are not currently experiencing difficulty in hiring pilots nor do they believe their segment of the industry will experience this problem in the near future.

Recruiting and Retaining Pilots

A commonly shared belief among the respondents was that regional jet airline pilots who are looking to improve their lifestyle will be attracted to the VLJ air taxi market. Overall, respondents felt that this transition would be very smooth from the aircraft they are flying and their experience is highly desirable. Another incentive to leave their present positions is believed to be the volatility of the air carrier industry, and particularly the pay and working conditions at the regional jet airline level. With this shift occurring, one challenge that was identified was how to retain pilots who make this transition. It is a common practice for pilots to want to fly a larger aircraft and this may be a reason for them to seek employment with another company. The respondents felt that while there may currently be a shortage of pilots in foreign markets, the incentives linked to current domestic VLJ operations, will insulate them from what occurs in other segments of the industry.

Mentoring

When questioned about mentoring programs as an aid in providing operating experience for pilots, the companies responded with mixed enthusiasm. It is seen as a viable option for a training regime; however, the model actually being adopted is the more traditional air charter and air carrier two-man crew concept. Single-pilot VLJ commercial operations with mentoring programs were not being routinely utilized in favor of the more traditional Captain and First Officer roles for gaining flight experience and advancement. Another operational implication for the traditional two-pilot crew versus single-pilot was to meet particular customer insurance requirements for multi-pilot crews. Respondents felt that this may change if it is proven that through innovative training and mentoring, a safe operation can be conducted with a sole pilot; however, this is yet to be determined.

Collegiate Aviation's Role

The respondents were questioned about glass cockpit training, placing simulators at universities, forming formal partnerships with universities and the value of collegiate aviation programs in developing courses for small single-pilot jet operations. The good news in this area of the study is that the respondents believe that collegiate aviation is properly preparing pilots for the market place. It had been hoped that this research would uncover a need for a more formal bridge program to be developed between the VLJ operators and collegiate aviation programs. This was not the case. Respondents were in general open to the idea of training being developed that would lead to pilots graduating from an aviation program and entering their segment of the market place. However, without a shortage of pilots, the companies currently are able to hire more seasoned pilots and therefore did not see an immediate need for a formal partnership with university flight programs. That being said, there was a resounding call for glass cockpit training and advanced flight deck technology training. A general focus on jet aircraft training instead of the more traditional model of piston-engine general aviation training is also seen as more beneficial in transitioning students successfully into the VLJ market place. The FAA-Industry Training Standards (FITS) program and other scenario-based flight training programs were also identified as a means to provide higher quality training. In a synopsis, it was stated that rote systems training is no longer as important as it once was, and that university programs need to focus their curriculum on 'managing' the cockpit. This shift is from one where pilots were expected to know systems, to one where their ability to analyze a situation and make a correct decision, is more valued.

CONCLUSIONS

The purpose of this study was to ascertain how commercial VLJ business operators and manufacturers view pilot selection, training, and operational experience processes unique to VLJ single-pilot commercial operations. Additionally, this study investigated the role collegiate aviation could possibly play in supplying pilots for this emerging section of the aviation industry. The findings of this study indicated that current pilot supply for commercial operations in VLJ aircraft were being met by pilots leaving regional airline operations and also from promotion within current air taxi operations. Innovative mentoring programs offered for single-pilot VLJ commercial operations were not being used in favor of more traditional Captain and First Officer roles for gaining flight experience and advancement. Another operational implication for the traditional two-pilot crew versus single-pilot was to meet particular customer insurance requirements for multi-pilot crews. With regard to the role of collegiate aviation within the emerging VLJ industry, respondents valued collegiate aviation's past preparation of industry pilots and offered suggestions in adjusting curriculum away from traditional systems training to one of flight deck management. Results also indicated that while there was no immediate need for formal relationships between VLJ industry and collegiate aviation, respondents were open to the idea of future collaboration.

Research on pilot qualification and collegiate aviation's role regarding VLJ flight operations could continue in several directions. First, other aspects of VLJ pilot training and qualifying may be affected through the growth of VLJ operations. Second, longer-term studies that compare the effectiveness of mentoring programs versus traditional advancement from First Officer to Captain may change attitudes and regulations for single-pilot operations for VLJ aircraft and therefore provide safe and efficient use of VLJ aircraft in commercial operations. Third, and perhaps most fascinating as the VLJ markets grow, studies could explore how collegiate aviation might have a more active role in VLJ pilot education. This role may be enhanced through housing VLJ simulators on campus in partnership with VLJ operators and manufacturers, developing formal bridge programs, researching the advantages or disadvantages of mentoring versus advancement through multi-crew operations, and overall formal partnerships with the VLJ industry.

In conclusion, the results of this study provide some initial insights into emerging VLJ flight operations. This research and other research to follow will contribute to knowledge of the disadvantages - and possible advantages - of the establishment of mentoring programs for single-pilot VLJ flight operations. The mixed results of this study suggest that we have much more to learn about VLJ pilot selection, training, operational experience processes, and the role of collegiate aviation for this emerging segment of the industry.

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APPENDIX A

Very Light Jets: Pilot Qualifications and Collegiate Aviation's Role

1.) Pilot Qualifications Hiring Criteria

Mark the degree to which you would emphasize the importance of each category of flight experience for VLJ pilot interviewees.

Pilots interviewing with time in	Low Emphasis	Moderate Emphasis	High Emphasis
Single-Engine Recip Aircraft			
Single-engine turbo-prop or pressurized single engine aircraft			
Turbo-prop or left seat Cabin Class Twin			
Left seat of a previous jet			

2.) Mentoring

With regard to the following four categories of new hire pilots, what would you consider to be the targeted minimum and maximum operating time with a mentor pilot prior to release to fly single-pilot VLJ operations?

Pilot Transitioning From	No Mentor Time	Desired Minimum Mentor Time	Desired Maximum Mentor Time
Single- Engine Recip Aircraft			
Single-engine turbo-prop or pressurized single engine aircraft			
Turbo-prop or left seat Cabin Class Twin			
Left seat of a previous jet			

3.) What group of the industry do you believe your pilots will come from?

Industry Experience	Absolutely Not	Possibly, based upon?	Most Likely
Part 91			
Part 135 Operators			
Part 121 Operations			
Military			
Straight out of Collegiate Aviation Program			

4.) Collegiate Aviations Role

Mark the degree to which you believe collegiate aviation could play a role in training pilots to meet your future needs

Collegiate Aviation Role	No	Would be considered	Yes
Developing courses for small single-pilot jet operations			
Glass Cockpit Training			
Establish partnerships with Collegiate Aviation Programs			
Sharing the cost of training i.e. Purchasing simulators to be located at a University etc.			

Other ways that collegiate aviation could help meet your need for qualified pilots…

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Aviation Management: A Discipline in Crisis?

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ABSTRACT

This article presents a detailed description of the key attributes of undergraduate aviation management programs. This exploratory research provides insight into key program issues in a manner designed to stimulate meaningful dialogue among aviation management faculty based on a study of 56 collegiate aviation baccalaureate programs. This investigation resulted in a taxonomy of aviation management curricula that examines: (1) breadth of curriculum, (2) science foundation, and (3) curriculum structure. Research results show that two primary dimensions emerged. The first is an operational vs. business processing oriented dimension. The second is a functional vs. asset understanding oriented curricula. The findings reveal that most programs are clustered around operational process–asset understanding. The authors advocate a need for increased business management oriented curricula focused by industry perspective and participation.

INTRODUCTION

Aviation programs and their faculty face a unique challenge. Representatives of aviation programs are charged with producing highly trained and educated students ready to make an immediate, positive impact on the aviation industry upon graduation. How to best accomplish this task is up for debate. Many feel it is imperative that the student possess all of the professional and operational skills and techniques that have traditionally been the focus of professional flight programs. While technical pilot capabilities remain important, industry increasingly expects faculty to prepare graduates for broader and more general business, management, and other non-flight related positions within a growing air transportation industry (Erickson, 2006).

The practitioner driven shift to a broad industry focus is good news for aviation faculty members who see "aviation" as an emerging discipline that is a core transportation mode in today's time-definite global transport oriented economy (Adrangi, Chow, & Raffiee, 1997; Erickson, 2006; Taylor & Jackson, 2000). This shift has generated increased demand for students who understand the nature of the global economy and the importance of transportation in servicing this type of economy (Golicic, Bobbitt, Frankel, & Clinton, 2004). This shift has created advocates of aviation programs characterized by a managerially focused aviation curriculum model designed to prepare students for managerial roles in the aviation industry. These managerial roles are geared towards preparing students for emerging opportunities in the aviation industry. For example, the rapidly growing $40 billion annual industry segment that is focused on after market service support to airlines provides students with high quality, management oriented jobs in the aviation industry. This industry segment has been created by entrepreneurs with business and managerial acumen who have in effect created a new industry segment by realizing there is greater profit potential selling things to the airlines than actually running an airline (Flint, 2007).

The apparent shift in skill sets required by industry practitioners has created debate among faculty in many aviation programs. How academic aviation programs handle the industry driven shift is uncertain, but likely to have a significant impact on the future of collegiate aviation programs and their students. As a result, aviation accreditation authorities, faculty, deans, and industry practitioners all appear to be considering the implications of a shift away from a technical training focused curriculum model toward a broader based educational initiative.

Some aviation faculty members argue a shift to a broader based educational curriculum model could dilute the operational content surrounding aviation as a profession (Phillips, Ruiz, & Mehta, 2006). These faculty members tend to remain committed to a curriculum focused on the professional skills and techniques associated with the traditional professional pilot. Conversely, other aviation faculty members are embracing a new paradigm where the aviation industry is the backbone of a global time-definite transportation economy requiring young professionals with managerial capabilities beyond the cockpit (Engler, 2007; Fabey, 2007). These faculty members believe in a curricula focused on educating students to have broad business based skills that prepare them for an eventual upper-level management position within the aviation industry.

It appears a challenge faces academic collegiate aviation programs as they attempt to respond to economic shifts and a growing divergence in paradigm views (Kavanagh, 1994; Kuhn, 1996; Meredith, Raturi, Amoako-Gyampah, & Kaplan, 1989). This article provides a method to better understand if this transition is causing a crisis in the aviation discipline and, if so, the nature or severity of the crisis. To more deeply analyze this, the investigation provides an aggregate level taxonomy of four-year collegiate aviation management curricula based on the content built into various curricula models and the relative weight of that content in various curricula. This analysis provides insight into the dominant orientation of aviation baccalaureate programs across 56 collegiate aviation programs. As a baccalaureate degree program each deals with some element of aviation. Some of the programs are broad based and oriented toward management of the aviation industry; others are more narrowly focused on the management of aviation technology or flight.

Understanding the dominant orientation of programs designed to educate future aviation related managers will assist decision makers tasked with performing academic program reviews as they prepare their programs, and their graduates, for success in the aviation industry of the future (Wergin, 2003). As with other disciplines (Burrell & Morgan, 1979; Hunt, 1992) understanding the dominant orientation of a discipline provides a foundation for meaningful dialogue to better understand emerging and divergent views of a discipline. To accomplish this, our investigation relies on exploratory content analysis (Randall & Defee, 2008) to aggregate the US aviation curriculum and generate an understanding of the nature of the discipline’s shift. Results of this methodology provide readers with information on where the curricula of aviation programs originated and where programs stand currently. Perhaps more importantly the results allow for meaningful dialogue and an insightful projection about the future of aviation programs and their curricula. The results of the analysis and projection should provide insight into logical questions such as how aviation curricula should be modified to meet the demands of industry.

BACKGROUND AND LITERATURE REVIEW

In their research on industry’s view of the weaknesses of aviation management graduates, Phillips, Ruiz, and Mehta (2006) reported “The student’s aviation knowledge is excellent. This is their greatest strength [however]. . . . graduates must also possess a much greater knowledge of the aviation industry and its business practices. Respondents of our research indicate that technical expertise alone does not ensure success in the aviation industry.” The debate over how to prioritize content of an aviation curriculum model is nothing new to the field. From a pedagogical perspective a baccalaureate curriculum which best prepares graduates for success in the aviation industry should logically evolve along with the aviation industry (Quilty, 2004, p. 63). However, academicians and practitioners alike frequently differ on the direction of industry and how to effectively integrate industry evolution into the curricula models of various aviation programs. In his recent critique of aviation management programs, Phillips (2004) cited the difficulty in defining “aviation management” as a discipline, based on his analysis of 117 UAA member institutions, and he noted “flight and aviation management programs are linked much like conjoined-twins. The degree to which the programs are linked may put too much emphasis on the technical aspects of aviation at the expense of the management aspects.” (p. 47).

Early on, the University Aviation Association (UAA) was recognized as the primary agency to ascertain the key areas of content and relative importance of content by which collegiate aviation management curriculum could best serve the industry (Fairbairn, 1987). Aviation educators, however, do not share a common understanding about the criteria to best evaluate aviation management programs, particularly as they face new industry dynamics (Clark, 2006; Phillips, 2004). For example, two studies conducted in 1989 and 1995 each surveyed airport managers on curriculum needed for an airport management career. These studies yielded little agreement when compared to UAA curriculum guidelines during the period of the studies (Kaps, 1995). Other articles highlighted competing views in the evolutionary and diverging nature of aviation management curricula. While many studies have a restricted focus on specific skill-based professional career tracks, such as airport management, air traffic control, etc., consensus has emerged on the substantive content, three categories seem to capture this content: (1) specific industry knowledge, (2) writing, speaking, and interpersonal communication, and (3) personal behavior related to work ethic and initiative (Phillips et al., 2006).

This evolution is not lost on the Aviation Accreditation Board International (AABI) the international accrediting agency for collegiate aviation programs. AABI has elected to base its future program accreditation evaluation criteria on measurable program outcomes. These measures focus on decision making capabilities, analytical capabilities, managerial acumen, and even communication skills. This is a sharp contrast to past accreditation criteria that have focused on the measurement of metrics such as curriculum contact hours, library facilities, technical skills, faculty credentials, and training methods.

The shift in focus of the accreditation criteria is considerable and is likely to undergo some scrutiny by member institutions seeking a definition of a common core aviation curriculum from which to benchmark their programs. Given this transition, an exploratory analysis is an important step as the academy properly prepares for, and responds to, the evolutionary processes confronting the discipline. A primary goal of our research is to aggregate and evaluate data from 56 collegiate aviation management programs to provide input into what categories and dimensions the "core" curriculum content is based and illustrate where the discipline is currently positioned.

Articulating and developing a common understanding can aid individual programs as they rationally determine their distinctive characteristics and determine their key differentiating qualities. Additionally, a common understanding of the current state of aviation management program curricula can also help to highlight areas that justify additional development or consideration. The investigation is oriented towards greater understanding of the following six research questions.

RESEARCH QUESTIONS

1. What are the substantive focus areas of the various collegiate 4 year aviation management curricula?
2. What is the intellectual objective of the various curricula?
3. What is the scope of knowledge the current curricula expects to impart to the student?
4. For what element or segments of the industry are these curricula preparing the graduates?
5. What elements or segments of the industry do aviation faculty members and their respective curricula intend to prepare graduates for today? In the future?
6. Is there a growing divergence in the conceptualization of the proper collegiate aviation curricula among academicians?

As aviation programs move forward re-evaluating themselves in preparation for new AABI accreditation criteria, a logical self critique is necessary to understand the needs of students and industry. Does the compilation of the individual programs curricula based skills and knowledge intentionally, or unintentionally, define each program? Additionally, by aggregating the key content areas of all collegiate aviation programs, the results may provide a broad typology of skills that aviation educators have intentionally, or unintentionally, defined as meeting the demands of industry and students. The method employed proposes such aggregation.

METHOD AND ANALYSIS

To accomplish this, a web based content analysis was used to reveal the characteristics and dimensions of the aggregate level curricula of US based aviation programs. Harvesting content from institutional descriptions of courses and programs has proven to be an effective means of providing strong research results (An, 2007). Doing so provides meaningful insight into what jobs, skills, professions, and industries the US based aviation management curriculum is preparing our students for upon graduation. 56 collegiate baccalaureate aviation programs spread across five distinctly different types of colleges were examined (UAA, 2007). The sample was generated based on the overall list of all aviation related programs (graduate, 4-year, 2-year, and technical) as identified by UAA. As shown in table 1, while the course content is similar, the courses are taught in various colleges within the university such as engineering, business, education, or liberal arts. How did this variation occur and does it impact the discipline? Does the location of the baccalaureate aviation program within the university environment impact whether the goal is to educate professionals for the management of engineering, science and technology, business, or education? Alternatively, do the curricula educate aviation students based upon a somewhat consistent curriculum model that simply "ended up" in various schools or is the variety of course work vastly different depending on location within the university?

Table 1: *Benchmark Collegiate Four-Year Programs*

College of Engineering (4)	Hampton, Ohio, San Jose, Tennessee State
College level Unit (Aeronautics, Aviation) (12)	Daniel Webster, Dowling, Embry, Everglades, Florida Institute of Technology, Florida Memorial, Middle Georgia, Rocky Mountain, Tarlington State, U of Illinois Urbana-Champaign, Minnesota Crookston, Western Michigan
Colleges of Science and Technology (18)	Arizona State, Baylor, Bowling Green State, Eastern Michigan, Elizabeth City, Fairmont College, Indiana State, Kansas State at Salina, Kent State, Lewis U, Liberty U, Middle Tennessee, Parks, Purdue, St Cloud U, U of Alaska Anchorage, U of Central Missouri, U of North Dakota
College of Business (12)	Auburn, Delaware State, Delta State, Eastern Kentucky, Henderson State, Jacksonville U, Lynn U, Ohio State, Southeastern Oklahoma, U of Maryland Eastern Shore, U of Nebraska Kearney, Westminster
College of Education and Liberal Arts (10)	Central Washington, Louisiana Tech, Metropolitan State, Minnesota State, Oklahoma State, South Dakota State, Southern Illinois Carbondale, U of Dubuque, U of Nebraska Omaha, U of Oklahoma

Source: UAA, and individual websites

As shown in table 2, the colleges and universities included in this study offer a total of 174 aviation-related four-year degree programs. The purpose of our research is to better understand the underlying content of these programs. As a result, this is a timely research program aimed at better understanding the wide disparity of aviation management programs as the academy begins to consider new AABI outcomes-based accreditation criteria.

This investigation uses content analysis to define and generate a typology of aviation curriculum models and to determine the core content and intended outcomes at an aggregate level. Research on communication has shown content analysis to be an effective means to generate understanding (Kassarjian, 1977; Spears, 2001; Stafford, Spears, & Chung-kue, 2003). Content analysis effectively examines intended messages based upon frequency of discrete written content provided by a person or organization (An, 2007; Kassarjian, 1977; Spears, 2001). Content analysis provides a way of understanding an entity's "apparent" intent with respect to an apparent "audience" (Kassarjian, 1977) therefore content analysis was considered to be the appropriate method considering the goals of our research.

Table 2: *Aviation Management (Business, or Technology) Related Four Year Degrees Key Word in the Degree*

1. Management	46
2. Flight	40
3. Science	27
4. Technology	13
5. Maintenance	12
6. Administration	9
7. Air Traffic Control	6
8. Aeronautics	4
9. Operations	3
10. Logistics	2
11. Security	2
12. Agricultural	1
13. Aviation education	2
14. Aviation Engineering	1
15. Business Aviation	1
16. Corporate and general aviation	1
17. Homeland Security	1
18. Human factors	1
Total	174

SAMPLING AND UNIT OF ANALYSIS

The sample for this investigation was chosen from the baccalaureate collegiate aviation programs of the University Aviation Association (UAA). Information on each aviation program was gathered from their respective program website. Both course descriptions associated with each program and the text posted on the website describing each program was used in the analysis phase of the research method. Increasingly websites are used by organizations to project strategic content toward intended customers (An, 2007). The use of web-based corporate messages provided an effective source of data to obtain content for later aggregation and analysis. Using a web-based method overcomes the notorious "low response rate" associated with survey research (Dillman, 2000); we generated a "100% response" from the sampled firms' websites. Websites have been used in similar content based analytical investigations of intended value proposition with great success (Randall & Defee, 2008).

The data collection and investigation process consisted of a multi-step approach to data reduction. Our ability to "count" search words within each category allows specific, weighted, curricula elements to be placed within a broad taxonomy. For instance "global air transportation" was identified as a word element within the business process category at the industry level. Yet the relatively sparse usage of the term suggests the element is not a robust and frequent dimension when measured across curricula (Glaser & Strauss, 1967).

In another example descriptive of the methodology the term "airframe" was found 89 times. There were also numerous related descriptive words such as wing, air foil, engine, etc. These words represent a common category of nouns that deal with a technical understanding of assets central to the aviation industry. As a result, these words are placed in a Technical Understanding Category. In a final example there were also several descriptive words dealing with airlines, air-cargo, air taxi, etc., that appeared to be more focused on a broader understanding of Business Processes.

DATA PREPARATION

Each of these program specific text files were then individually imported into a qualitative software program known as Max Qualitative Data Analysis (MAXQDA). The investigation focused on the use of the quantitative tools to support data reduction and categorization of aviation program curricula (Lewins & Silver, 2006). The initial content count generated 9,934 distinct words in 56 texts. These texts are based upon the individual program's website. The software tool was then used in an iterative process to reduce the data to a final key word list of 1,800 descriptive words and their frequency.

Two researchers independently began the coding of key terms into sub-categories. During this process each of the key terms were linked back to their original website content in order to affirm contextual understanding. These steps allowed us to evaluate the aviation related intent of each term. The initial context-linked catalog of key terms was culled, and aggregated, to include only words that contained aviation, education, technological, business or supply chain specific meaning. This resulted in a refined “short list” of 100 words. These words fell along two broad categories based upon context and frequency. These two broad categories of constructs emerged that were associated with the 56 baccalaureate aviation curricula models evaluated.

CATEGORIZATION AND DIMENSION

The software tool was then used to index each of the 100 key words so that a link back to the original text was constructed. The researchers then independently generated categories associated with these key descriptive words. This step resulted in broad content categories associated with the words and their frequency. These results were harmonized based upon discussion, agreement and common understanding. The result was categories of aggregated content with frequency based dimensions (Charmaz, 2006). For instance, “process” arose as a highly weighted variable. Analysis revealed that “process” exhibited a strong dimension in the content analysis. At one edge “process” was associated with operational or flying processes while at the other edge, “process” was associated with business or management processes.

Figure 1 provides an aggregate level curricula map that gives a spatial representation of the content analysis. The research indicates the two broad categories with dimensions associated with collegiate aviation programs. The X axis deals with the intellectual objectives of the program; how the students are being trained or educated to think and act. The second broad category or dimension is the assimilation of knowledge; the content of knowledge intended to be absorbed by the student.

The “intellectual objective” category and dimension is aimed at affecting the manner and ability with which the students think and solve problems. The right end of the X axis deals with the ability of the student to perform operational level activities that require procedural skill and understanding. This tends towards such activities as flying, tower operations, dispatch, etc. The left side of the X axis deals with the ability of the students to perform business processes such as management, administration, cost benefit analysis, decision making, etc. The assimilation of knowledge category and dimension deals with the type of knowledge and to what affect that knowledge is intended. Over this is laid an oval which represents the preponderance of weight for the aggregate level curriculum. That is, while individual courses and programs may well fall outside the oval, at the aggregate, this is the area where the baccalaureate programs educate and train their students. This oval is based upon a subjective yet empirically informed assessment of categories, word elements, and word weights.

This research provides a glimpse into the core categories of knowledge and learning suggested by the aggregate curricula, the weight programs put on these variables, where the preponderance of programs currently reside along each axis and dimension, and those outliers. Such taxonomy moves closer to identifying the intersections of flight skill, knowledge, course content, and cognitive development. Our investigation uncovers the characteristics and dimensions of the aggregate level curricula of US based aviation programs. This investigation identifies a set of benchmarks that, when interpreted in light of an institution's mission and culture, can aid in optimizing experiences for students. The second goal, to help all aviation management programs to lay legitimate claim to the status of “an exceptional program” serving industry needs, is achieved.

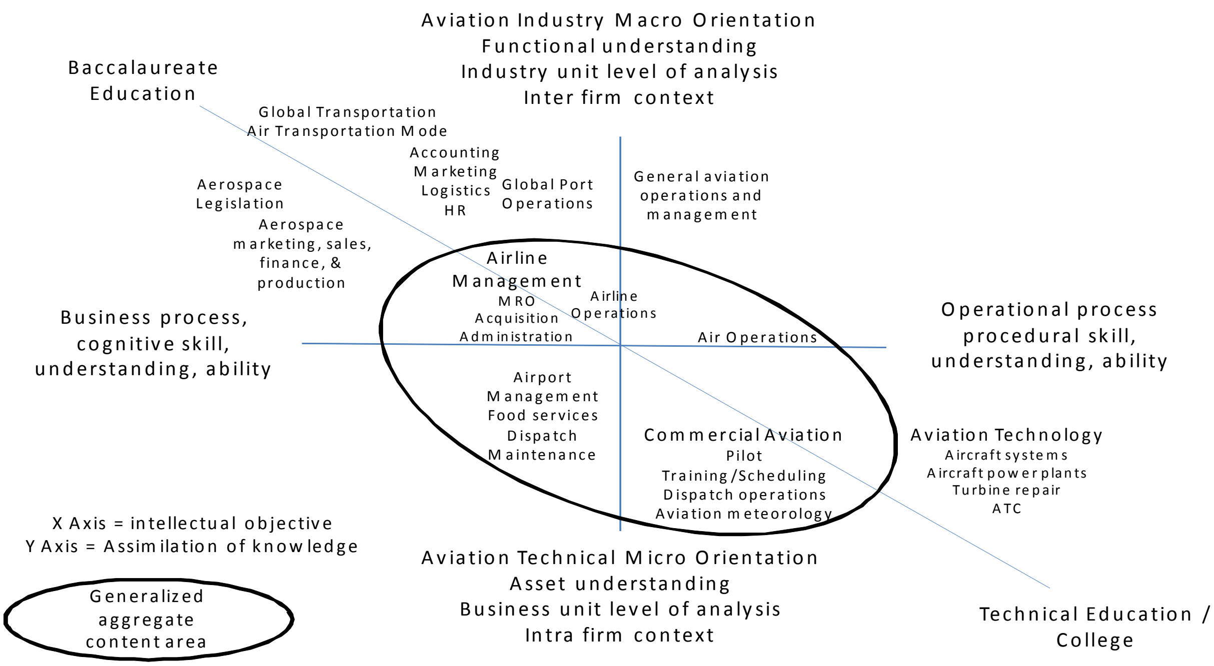

Figure 1: Taxonomy of Collegiate Aviation Curricula

A Proposed Aviation Management Curriculum Model

"Benchmarking" facilitates and enhances active engagement of key players and stakeholders (Haworth & Conrad, 1997). The proposed framework provides program dimension to support such benchmarking efforts in light of a shifting focus in aviation curricula. The results of our research provide a taxonomy model (See Figures 1 and 2) from which individual programs can judge their content and positioning.

Administrators depend on benchmarks to compare their institution's program quality, content and position with that of other peer institutions. In addition, administrators also use benchmarks to support a program in developing a distinctive mission. This is particularly important to collegiate aviation programs where oftentimes each program is perceived as an anomaly among academic colleges' alignment of traditional disciplines. The benchmarking information is also valuable for students since the information enables them to make well informed choices when considering matriculation in a program.

The three assessment areas for aviation curriculum are based on: (1) breadth of curriculum, (2) science foundation, and (3) curriculum structure. These proposed evaluation criteria characteristics range from *marginal* to *exceptional*. It is our hope that using the taxonomy of the aggregate level baseline curriculum provided here, our discipline can enhance the evaluative process of collegiate aviation education programs.

Implications: Characteristics of an "Exceptional" Aviation Management Program?

Table 3 provides a benchmarking framework based upon this analysis. In the recommended benchmarks, we employ the term *exceptional* to refer to the characteristics of an aviation management program that makes exceptional contributions to how well students learn about and are prepared for the demands of the broad elements of the aviation *industry*. We designate the next level of program function as *effective* which represents making an above-average, appropriate and positive contribution to student learning. An *average* benchmark meets, but does not exceed an adequate contribution. In contrast, characteristics that are *marginal* are counterproductive to an overall collegiate educational mission aimed at preparation for the aviation industry.

Table 3: Recommended Benchmarks for Assessing Aviation Management Programs

Achievement Level:	Marginal	Adequate	Effective	Exceptional
Breadth of curriculum	Limited focus based on tradition & faculty interests	Limited breadth beyond faculty interests	Broad curriculum reflecting scope of profession	Broad curriculum: students evaluating & integrating facets of aviation management
Science foundation	Limited scientific orientation dependent on individual faculty member(s)	Non-systematic science orientation encouraged by faculty administration	Curriculum built on scientific foundation echoed throughout the curriculum	Science-based curriculum requiring students' demonstration of scientific method
Curriculum structure	no specific structure; determined solely by student interests	Core requirements but no attention to sequence & development of skills	Sequences a broad base of core requirements; may entail an integrating capstone experience	Sequenced to achieve growing student cognition of the discipline & requisite managerial skills for aviation industry

Source: Adapted from Dunn et all (2007, p. 665)

These benchmarks should aid in highlighting problems and may help to redirect a program's efforts toward renewal and revitalization of purpose and pedagogy. Such evaluation may point to the need for a critical reassessment of a program's educational goals *if the program's advocates so desire*. The labels are appropriate for formative assessment in contrast to summative assessment, and provide a multidimensional method for evaluating a department's progress toward mastery of the quality benchmarks aimed towards the emerging demands of the aviation industry. Thus, *average* and *marginal* should be viewed as relative labels that aid self critical program evolution.

In some cases, the presence of marginal areas might indicate an intentional program focus on a narrower technical / skill focus. In other cases such evaluation may indicate a lack of well-defined goals within a program based upon historical path dependencies (Bettis & Sze-Sze, 2003; Hunt & Morgan, 1996). Marginal results may indicate a lack of overall program integration. Such lack of a strategic path and goals may lead to neglect of responsibilities, lack of faculty and student engagement, severe resource constraints, or even collegial strife (Avolio & Bass, 1988; Chemers, 1997; House, 1996).

CONCLUSIONS

We have provided a foundation for codification of aviation programs. As discussed earlier there are 56 institutions with aviation-related four-year degrees. These programs reside in five distinct academic colleges. In total, we identified 174 degree programs that appear to involve 18 distinct baccalaureate degrees. In this initial investigation the development of "category" was done by consensus of the aviation researchers conducting the study. The analysis brought forth two broad, multi-dimensional, categories. Our method generated a taxonomic and dimensional analysis with respect to collegiate aviation curriculum.

Based upon our research, our recent contacts with industry, and indications from AABI, we find that there appears to be a growing need for industry based business process educational objectives to be added to aviation management curriculum models. This can be viewed as good news. Aviation has grown beyond its role as a niche program to become more of a central pillar in a time-definite, increasingly global, economy. However the implication is that this economy requires a collegiate aviation student with a view well outside of the cockpit, one ready to employ business based skills to analyze, decide, and act with robust business based acumen.

The aviation discipline is ascending as an important management element in the global economy. For some this is a very exciting time. For others this is cause for concern as in their view, the operational roots may be becoming obscured. There is a stark reality that as we add industry focused courses, other more classical courses might be curtailed or dropped. The question then becomes how, and to what extent, does a program integrate operational content into industry decision making focused courses.

In essence we have a divergence, possibly even a crisis in the aviation curriculum and discipline. Why are there so many programs across so many different colleges? Why is there such disparity in the content of various aviation related majors? It appears that the discipline is struggling to define its core elements and intent.

For those academics and researchers who have moved from the cockpit to the school house, aviation management will always have the essence of flight, the smell of jet fuel, and the allure of a 30,000 foot view. Aviation Management from that perspective appears to be Aviation Operations. For that breed, the collegiate aviation paradigm is centered on the flight aspect of aviation. "Core" content is logically focused on aviation operations such as Air Traffic Control, Meteorology, Airport Operations, Maintenance Operations, Cockpit Resource Management, and Safety. In this, the historical perspective, Aviation Management is Aviation Operations. Classes and research therefore correspond to those areas.

Yet there are others looking closely at the aviation industry from a different perspective. These academicians see a strong industry basis for the discipline. While they too have responded to the allure of aviation whose essence is flight, their backgrounds in logistics, supply chain management, international business, manufacturing, retail, and operations bring into focus a different paradigm of aviation management. They see aviation as the time and distance compressing industry. They see a massive economic sector with increasing importance as consumers demand products and services that are better, faster, and cheaper (Lee, 2004). These industry focused academicians see curriculum content weighted toward the ability to optimize routes as a means of optimizing total cost (LeKashman & Stolle, 1965). These academicians consider a systems dynamic which integrates rail, sea, truck and air into a sophisticated transportation system that effectively serves today's supply chain networks. They find air to be the time and place champion in the intermodal transportation network. For these academicians, meteorology provides content to teach the impact of natural and manmade disaster as a disruption of a global supply chain.

We reflect back on Phillips' statement that "flight and aviation management programs are linked much like conjoined-twins. The degree to which the programs are linked may put too much emphasis on the technical aspects of aviation at the expense of the management aspects." (Phillips, 2004) Can they coexist? Is there a crisis in the Kuhnean (1996) sense? Is Aviation Management an operational discipline oriented toward managing sortie generation? Or is the substantive content of Aviation management aimed at managing the aviation industry? Can both be taught as part of one major? Should they? Are these two different degrees or disciplines? One Flight Operations Management, the other Air Transportation Management? Considering the impending evolution in AABI accreditation criteria and incongruence in orientation as dictated by the results of our research, it might be time we consider how we might avert a crisis or take advantage of a tremendous opportunity in the global economy.

Can those who view the aviation industry from the cockpit peacefully coexist with those who view the aviation industry as a business sector aimed at providing expedited time and place utility? We believe so. We believe our explanation may give mutual understanding to these, at times competing, perspectives. With understanding perhaps comes integration, synthesis, and evolution. Such "crisis" in a discipline may actually be an encouraging growing pain leading to a tremendous opportunity for the discipline. Similar discipline "crises" have occurred in other academic disciplines such as marketing (Hunt, 1992; Kavanagh, 1994), information systems (Burrell & Morgan, 1979), Operations Management (Meredith et al., 1989) and supply chain management (Novack, Rinehart, & Wells, 1992; Stock, 1990) with most believing the end result to be evolution and discipline enhancement.

The challenge to the aviation management academy is to search out those common elements that uniquely identify aviation management as a discipline. Our analysis provides a schema from which to begin this process. The proposed taxonomy will help a program examine its relative position and its offerings. Coupled with a viable model to benchmark quality, we provide a program's faculty and administration an initial tool designed to measure effectiveness in serving aviation industry needs. At the aggregate, once there is understanding of the common curricular elements which reflect the industry's needs, aviation management will advance toward a distinct and robust discipline.

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Developing a System for the Prediction and Management of Aircraft Deicing/Anti-icing Fluids Concentrations in Airport Effluents

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ABSTRACT

Applications of aircraft deicing/anti-icing fluids (AD/AF's) are necessary for safe flight operations during winter storms. However, these compounds have been detected in both ground and surface waters, and field observations have demonstrated the detrimental effects of introducing such substances into the environment. Those who manage the application of these compounds are subject to contradictory, sometimes mutually exclusive, regulations. At approximately 50% of those airports where deicing/anti-icing operations occur, the only means of limiting AD/AF contamination of surface and ground waters while ensuring adequate safety is the cancellation of flights. Decisions made in this dichotomous regulatory environment are often predicated on the costs associated with limiting contaminated effluent discharges. The purpose of this paper is to propose the means to facilitate the decision making process with respect to AD/AF applications and subsequent stormwater discharges by suggesting an initial design paradigm for the development of a spatial decision support system (SDSS) with which managers can model the mechanisms by which aircraft deicing/anti-icing fluids enter surface waters as pollutants. Using the proposed SDSS to model AD/AF effluents, decision makers could better estimate those costs associated with exceeding regulatory guidelines. Further, the ability to generate outcomes within the context of this economic/environmental quid pro quo will provide the manager a range of options with which to make determinations regarding the costs and corresponding implications of the application of AD/AF's. Thus, the SDSS would provide the means with which to explore mitigation opportunities and to reduce the costs of discharging wastewaters containing deicing/anti-icing chemicals.

INTRODUCTION

The Fokker 28-4000 swung into position at the end of LaGuardia's runway 13. Twice before pushback, ground crews had applied a glycol-based fluid, a Type I deicer, to the wings and fuselage of USAir's Flight 405. But with 35 minutes having elapsed since the last application—an interval greater than three times that considered safe—a layer of snow and ice had again accreted on the aircraft's wings. The captain eased the thrust levers forward; the Rolls Royce Speys spooled to full power; Flight 405 began to roll. The landing gear was stiff with cold and the impact of the tires hitting ruts in the packed snow jolted the Fokker's 51 occupants. As the aircraft's momentum increased, the first officer called the V-speeds: V1; then, VR, but 11 knots too early. The additional weight and lift-killing effect of ice on the wings made it impossible to gain much altitude, and the Fokker struggled to leave ground-effect. Abruptly, the left wing stalled and dipped. Its tip scraped the concrete about 4000 feet upwind of the liftoff point. As Flight 405 lost altitude, its wheels bit deeply into the soft earth along the side of the runway. The aircraft struggled back into the air, but the left wing again lost lift and dropped. This time the tip caught a row of lights, then sliced through a building. The Fokker cart-wheeled, breaking-up as it somersaulted over the 15 foot berm that delineated the airport perimeter. The aft fuselage disintegrated in flames. Flight 405 came to rest upside down in the frigid darkness of Bowery Bay. Twenty-seven people died in the icy waters; many drowned while strapped to their seats.

This accident, which occurred just before 9:30 PM on March 23, 1992, underscores the critical nature of the application of deicing fluids to aircraft. The National Transportation Safety Board (NTSB) (1993) attributed probable causes of the accident in part to " . . . the failure of the airline industry and the Federal Aviation Administration to provide flight crews with procedures, requirements and criteria compatible with the departure delays in conditions conducive to airframe icing . . . " (p. 77). The crash of USAir's Flight 405 with the concomitant criticism of the Federal Aviation Administration (FAA) proved a seminal event. It engendered the regulations, promulgated by the FAA, requiring the liberal application of aircraft deicing/anti-icing fluids (AD/AF's) during winter operations (DOT, 1996).

Application of aircraft deicing/anti-icing fluids is governed by the rules and regulations of the Federal Aviation Administration and the Environmental Protection Agency (EPA). These promulgations are often conflicting with diametric or even mutually exclusive goals (Mericas & Wagoner, 1994; DOT, 1996; Betts, 1999). The FAA encourages the liberal application of AD/AF's to prevent the accumulation of ice that causes horrifically fatal crashes. The public strongly endorses and supports this policy (DOT, 1996). The EPA attempts to restrict the use of AD/AF's to prevent the introduction of pollutants into ground and surface waters. The public strongly endorses and supports this policy (Angelo, 1996). Caught in the middle is the airport manager who, under FAA regulations, must provide adequate deicing opportunities to departing flights, and who, under EPA guidelines, must institute and adhere to a plan, a Stormwater Pollution Prevention Plan (SWPPP), for containing and controlling the AD/AF's used to comply with the FAA requirements (EPA, 1992; EPA, 1993; Mericas & Wagoner, 1994; DOT, 1996).

Alternatives to the use of AD/AF's are limited and often neither efficacious nor cost-effective (Mericas & Wagoner, 1994). Similarly, according to Barash, Covington, and Tamulonis (2000), the options for containment, control and processing (e.g., recycling) of spent AD/AF's are few and expensive. Further, these latter technologies are frequently so immature as to be either largely untested or only marginally effective (Mericas & Wagoner, 1994; Barash et al.). Other alternatives, such as canceling flights or closing an airport exist, but are both costly and inconvenient. Shutting-down a major airport causes flights to be diverted and canceled at other airports producing repercussions that reverberate throughout the air traffic system.

Attempts to litigate, legislate, and promulgate away the problems associated with the application of AD/AF's have only served to exacerbate the aforementioned circumstances. The problem is so complex that the EPA preempted its own regulations by stating that, in order to assure adequate deicing of aircraft, it would ignore the discharge of airport waters containing excessive amounts of AD/AF contaminants (DOT, 1996). This abrogation of the agency's congressional mandate lasted only briefly, however, as EPA regulators, becoming alarmed at the amount of deicing fluids that were being used, soon rescinded their rescindment. Abruptly, airlines and airport operators found themselves without regulatory guidance.

Because airlines currently operate to make a profit, and on a very small profit margin at that, decisions regarding the use of AD/AF's are inextricably linked to costs of operation. Of necessity, those managing airport facilities will assess user airlines any unsubsidized costs associated with the control or reduction of AD/AF's in discharges to surface waters (Mericas & Wagoner, 1994; McNerney, 1994). In turn, the airlines will "charge through" any costs to their passengers, and so, it is the consumer who ultimately pays for adherence to the EPA's regulation of airport effluents (Barash et al., 2000). Consequently, the costs associated with improving effluent quality are intrinsic to any decision regarding the reduction of AD/AF's in stormwater discharges and thus significant to airport and airline management as well as the consumer of aviation.

The interrelationship of these disparate and conflicting issues is the reason that Betts (1999) referred to the use of AD/AF's as a "classic environmental problem" (p. 212). How can decision makers, in the context of this confounding regulatory environment and these complex circumstances, make soundly based decisions regarding the singular question: What will be the typical costs of adherence to current and possibly forthcoming EPA regulations governing the release of AD/AF-contaminated effluents into surface waters? The answer to this fundamental question would facilitate the resolution of related, secondary questions, including: What are the economics of canceling flights in comparison to the costs associated with reducing or eliminating effluents containing anti-icing and deicing fluids? Will EPA guidelines, both current and future, necessitate a restriction of flight operations to prevent exceeding AD/AF discharge limits and ensure the quality of ground and surface waters? Which airports are most likely to become non-compliant with their EPA-mandated Stormwater Pollution Prevention Plans and at what costs? To develop insight into questions such as these and provide decision makers with a useful tool with which to better assess and manage the problems associated with AD/AF discharges, a spatial decision support system (SDSS) would be useful. For example, the proposed SDSS could be used to predict an airport's potential for exceeding effluent guidelines and to determine the economic impact of compliance with EPA regulations. Similarly, airport managers could use the proposed spatial decision support system to predict the potential for exceeding its SWPPP, determine current and future costs associated with SWPPP compliance, and, based on these costs, determine alternative strategies to reduce AD/AF discharges to an acceptable level.

SIGNIFICANCE OF THE PROBLEM

The Necessity of AD/AF Applications

During a 14-year period, between 1982 and 1996, aircraft icing caused six accidents that killed 203 people (DOT, 1996). Although the majority of these accidents and over half the fatalities occurred in the decade preceding 1992, it was the crash of USAir's Flight 405 that produced the first substantial criticism of the FAA with respect to its policies regarding the deicing and anti-icing of aircraft. The fact that, during winter airport operations, the application of AD/AF's is critical to flight safety has not escaped the attention of paying passengers. According to a 1996 Department of Transportation (DOT) Report, "Aircraft accidents [have] raised public concern about the safety of aircraft during icing conditions" (p. 1).

In listing probable causes of the Flight 405 crash, the National Transportation Safety Board (1993) criticized the Federal Aviation Administration for its failure " . . . to provide flight crews with procedures, requirements and criteria compatible with the departure delays in conditions conducive to airframe icing . . . " (p. 77). Three years after release of the 1993 NTSB report, the DOT's Office of the Inspector General produced an equally critical indictment of the FAA's failure to meet its obligation to ensure safety of flight. The OIG (1996) stated that the agency's remedial actions and amendments which were implemented in the aftermath of the Flight 405 tragedy " . . . will not eliminate icing-related accidents and incidents" (p. i).

In response to NTSB and DOT criticisms and the public's concern over potentially fatal air crashes, the FAA promulgated, in a regulatory frenzy, the Federal Aviation Regulations (FAR's) currently governing the application of AD/AF's (Barash et al., 2000). These regulations have not only increased the use of deicing/anti-icing fluids, but also made flying safer. This assertion is substantiated by the fact that, since the crash of Flight 405, no fatal airline accidents have been attributed to inadequate application of AD/AF's.

Potential Environmental Impacts

Evidence supporting the contention that excessive AD/AF's are being discharged into U.S. surface waters is abundant. For example, consider the volume of AD/AF's used. Fifty-two million liters or approximately 13,740,000 gallons of AD/AF's are used annually in North America; Worldwide, airlines apply about a half billion gallons of AD/AF's (Cancilla, Martinez, & VanAggelen, 1998). According to Mericas and Wagoner (1994) "The ADF volume required to deice a typical large passenger jet (approximately 3785 L [1000 gal]) has a $CBOD_5$ [five day carbonaceous biochemical oxygen demand] equivalent to the daily domestic wastewater generated by 5000 people" (p. 40).

That surface waters receive much of this AD/AF is unquestionable. Transport Canada estimates that nearly 50% of AD/AF's drain directly into stormwater runoff (Mericas & Wagoner, 1994). The EPA estimates that the annual volume of AD/AF-contaminated stormwater is between 300 million and 1.4 trillion gallons with a yearly average of approximately 7 billion gallons (Barash et al., 2000). Further, of the airports surveyed by the EPA for the *Airport Deicing Operations Summary* (2000), 50% discharged AD/AF-contaminated stormwater directly into surface waters, with no means of mitigating the impact of the effluent on surface waters (Barash et al., 2000). Another 42% discharged AD/AF's into both surface waters and publicly-owned wastewater treatment plants. In total, more than 92% of the airports surveyed discharge AD/AF-contaminated effluents into surface waters. Safferman, Siruvalure, and Foppe (1998) report that "Even if the deicing fluids are diluted 99.9% in storm water or in a receiving stream . . . the uncontrolled release of these compounds can have a severe impact on the environment" (p. 11).

Several large U.S. airports discharge AD/AF's directly into surface waters: Portland International Airport which discharges into the Willamette River through the Columbia Slough; Milwaukee's General Mitchell International Airport from which effluents drain directly into Lake Michigan; Logan International Airport which discharges untreated wastewaters containing AD/AF's directly into Boston Harbor; Baltimore-Washington International Airport from which effluents enter Chesapeake Bay, and; Minneapolis-St. Paul International Airport (where a single carrier, Northwest Airlines typically uses 800,000 gallons of deicing fluid in a single winter) which releases glycol runoff directly into the Minnesota River (Corsi, Booth, & Hall, 2001; Betts, 1999; Guterman, 1999; Angelo, 1996; Bremer, 1993).

According to the EPA (Barash et al., 2000):

> . . . airport deicing operations can result in [negative] environmental impacts. In addition to potential aquatic life and human health impacts from the toxicity of deicing and anti-icing chemicals, the biodegradation of propylene and or ethylene glycol (i.e., the base chemical of deicing fluid) in surface waters . . . can greatly impact water quality, including significant reduction in dissolved oxygen (DO) levels. Reduced DO levels can ultimately lead to fish kills. [Additionally,] . . . fish kills caused by [airport] discharges . . . may [also] be due to . . . the aquatic toxicity of deicing chemicals" (p. 1-2).

A number of field studies support the foregoing statements. For example, tolyltriazoles, an AD/AF additive that has been found in airport ground water, has the potential to be extremely toxic (Betts, 1999; Guterman, 1999; Cancilla et al., 1998). In another study, Koryak, Stafford, Reilly, Hoskin, and Haberman (1998) found that, when introduced into an adjacent watershed, glycol and urea deicers created a strong biochemical oxygen demand (BOD) in the waters, stimulating the growth of dense biological slimes on the streambed. According to these researchers, "Invertebrate communities in waters influenced by airport runoff were severely stressed and . . . [the] fishery of the watershed was also impaired" (p. 287). Turnbull and Bevan (1995) identified similar ecological impacts resulting from the discharge of AD/AF compounds from Newcastle Airport in the Ouseburn, a tributary of the Tyne River in England.

In other articles, Guterman (1999) cites evidence correlating heavy deicing operations at General Mitchell International Airport in Milwaukee with increased aquatic mortality in a stream carrying effluents from the airport to Lake Michigan; Cancilla, Baird, Geis, and Corsi (2003), found that ". . . field and lab studies indicate that additives, other than glycols, used in aircraft deicing fluids can be found in aquatic systems and may be of greater risk than previously believed" (p. 134). According to Jia, Bakken, Breedveld, Aagaard, and Frostegärd (2006), one such additive, benzotriazole, decomposes slowly, retards, through interaction, the degradation of organic substrates found in airport runoffs (e.g., acetate, formate, glycol and toluene), and, as a powerful toxic, impairs the health of soil ecosystems. Empirical evidence compiled during research conducted by Bielefeldt, Illangasekare, and LaPlante (2004) also suggests that glycol, itself, contributes to soil compaction and, consequently, reduces the ability of soils to percolate and filter airport runoff. Thus, the act of deicing aircraft may, in itself, increase the likelihood that aircraft AD/AF chemicals will enter surface waters.

Concerns over the consequences of the discharge of airport effluents containing deicer chemicals have resulted in lawsuits against airports and managing authorities (Betts, 1999; Amicus Journal, 2000). The National Resource Defense Council (NRDC) filed suit against

Chicago's O'Hare where " . . . [managers] had not been sufficiently reporting the use of a . . . deicing chemical called ethylene glycol, which can be harmful, and even deadly . . . " (Amicus Journal, 2000, p. 46; see also Croft, 2000). The US-Civil Aviation Watch, in concert with the NRDC and several other groups, have filed suit against Baltimore-Washington International Airport (BWI) over the discharge of effluents containing AD/AF chemicals (Washington Post, 1998; Croft, 2000). The coalition cited violations of the Clean Water Act and the airport's Storm Water Pollution Prevention Plan.

The implications of these lawsuits with respect to environmental regulations are significant. For example, that certain airports discharge unacceptable quantities of AD/AF's into surface waters, even in excess of that allowed under existing regulations, is implicit in both litigations. A second implication is that airports, being responsible for their own oversight, may not adequately monitor effluents. A third is that airport SWPPP's may have been haphazardly developed, without accountability for the information upon which they were justified. And finally, that regulations are not uniform, varying from one state to another, and, although penalties for noncompliance with existing laws may be costly, enforcement is often uneven and seldom rigorous (Barash et al., 2000; Amicus Journal, 2000).

Economic Impacts

Airports incur capital costs associated with implementation of technologies for the mitigation of AD/AF pollution as well as operating costs for collection, treatment and disposal of AD/AF-contaminated waters. In fact, McNerney (1994) states that " . . . major expenses at airports today are the cost of infrastructure and the mitigation of environmental concerns" (p. 680). Barash et al. (2000) note that ". . . much of the cost of capital improvements [associated with the application of the AD/AF's] are likely to be passed-through to the airlines as higher fees or to the passenger in the form of passenger facility charges (PFCs)" (p. 1-5). The fee an airport assesses an airline to recover the costs of collection, treatment and disposal of contaminated stormwater may be double the cost of the AD/AF fluid, effectively tripling the carrier's cost of deicing an aircraft (Betts, 1999). Generally operating on a narrow margin of profit, airlines, in turn, pass costs through to the passenger in the form of higher ticket prices. Ultimately, therefore, the consumer, the paying passenger, is the one who will likely bear the cost of both the use of deicing fluid, applied to ensure a safe flight, and the expense of preventing environmental degradation.

Airports discharging directly into surface waters are the most likely to be impacted by stricter enforcement of existing EPA guidelines or enactment of more stringent regulations. Because many lack the equipment to store, mix and deliver multi-strength deicing fluids, these facilities are also more likely to use a concentration of chemicals effective in the most severe weather conditions (Barash et al., 2000). Further, such airports are less likely to be in a position to purchase the more sophisticated equipment that reduces the amount of AD/AF applied and make modification to the facility's physical plant to comply with more stringent effluent controls. Thus, these will be the airports most affected by the pressures of stricter enforcement, more stringent EPA guidelines, and the projected increase in demand for air transportation. Airports discharging directly into surface waters will be the most likely to cancel flights to remain compliant with environmental regulations. Under what circumstances will such cancellations be necessary? What are the costs associated with such cancellations? Given that the cancellation of flights reduces airline profits, what mitigation technologies might become economically justifiable in lieu of canceling flights or temporarily closing an airport? These are the questions the proposed SDSS would inform. The answers so derived have the potential to impact the gamut of those engaged in air transportation and commerce, including airport and airline managers and the aviation consumer.

SDSS METHODOLOGY

SDSS Design

The proposed spatial decision support system could be used to model airport AD/AF outfall concentrations, predict the extent of opportunity costs lost through compliance, and suggest which mitigation alternatives are most desirable given the economic outcomes. The SDSS would be based on GIS software, hydrological modeling extensions and scripting to provide a graphical user interface (GUI). Components would include: (1) geographic information system (GIS) software (e.g., Environmental Systems Research Institute's ArcInfo or ArcView programs) to provide management and database storage of spatial (locational) and aspatial (attribute) data; (2) a modeling management and database module (MMDM); (3) a graphical user interface (GUI), manipulated via computer mouse and keyboard, and; (4) the means of generating and displaying outcomes via a monitor and printer. (See Figure 1.)

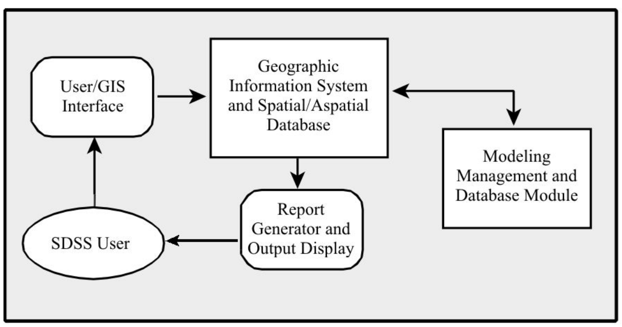

Figure 1. Organization of the proposed SDSS.

SDSS Components and Construction

In its spatial database, the GIS would store the locations of deicing operations and airport slope and terrain attributes. Information regarding the number and volume of AD/AF applications, which would be stored in the aspatial database, could be adjusted according to anticipated weather conditions. Effluent concentrations would be calculated in the MMD module using existing water quality software (e.g., the EPA's BASINS which models discharges from point and non-point sources) and predicted, based on terrain and slope information, at the airport's outfall. The user could enter anticipated conditions to derive outcomes for comparison in determining maximum AD/AF volumes given meteorological variables, number and types of flights and EPA pollutant loading criteria. The assumption would be that FAA and EPA regulations are fixed (at any given time) and that airports strive to achieve conformance to these guidelines. Costs would be computed based on the preceding parameters.

In a publication known as the "Green Book", the Bureau of Transportation Safety (BTS) prints monthly statistics for all large certificated carriers that include measures of capacity (available seat miles), capacity usage (revenue seat miles), enplanements, departures, etc. In its "Blue Book," the BTS provides similar statistics for small certificated, regional and commuter airlines. The BTS also publishes an annual record of airline service to individual airports in the Airport Activity Statistics. Costs incurred by the airlines as the result of AD/AF applications are available from the EPA and the Air Transport Association of America. This data would be useful in determining at what point it will be necessary to cancel flights, the costs of such cancellations and what environmental impact mitigation alternatives may become viable in lieu of reduced or restricted flight operations. Given that many airports have no means of mitigation and discharge effluents directly into surface waters (approximately 50% of those surveyed by the EPA) it is generally accepted that the only alternative to exceeding effluent guidelines at these facilities is the cancellation of flights (Barash et al., 2000). Thus, the opportunity costs associated with flight cancellations would be computed using data available from a variety of sources.

The term, "pollutant loading," refers to the concentration of pollutants in a volume of water. The EPA developed pollutant loading criteria as a preliminary step to the promulgation of effluent guidelines regulating the discharge of airport wastewaters containing AD/AF's. Although numerous sources (e.g., leaking equipment, spills and aircraft runoff) may contribute to the total pollutant load, the EPA discounted these as relatively minor when compared to the de-icing pads where AD/AF's are applied. Consequently, the EPA ". . . developed pollutant loading estimates for the industry based solely on estimates of the average volume of fluid sprayed and considered all other sources of ADF discharges to be negligible" (Barash et al., 2000, p. 11-2). The proposed SDSS would rely upon published EPA pollutant loading criteria to determine AD/AF concentration limits in airport effluents. The concentration of AD/AF's in the airport's outfall would provide the means of determining under what conditions and circumstances an airport's SWPPP limits would be reached.

Additional data available from the EPA would also be used in designing the SDSS. For example, at airports where the deicing and anti-icing runoff is not contained, AD/AF's enter the environment following application to aircraft and paved airport surfaces such as runways, roadways, taxiways and gate areas. Barash et al. (2000) assert that " . . . approximately 80% of the Type I deicing fluids that are applied to aircraft fall to the pavement" (p. 10-1). Using this value, the SDSS would be capable of computing AD/AF pollutant loading based on amount of fluids applied, airport terrain and surface types between the point of application and the effluent outfall.

Unless authorized by a National Pollutant Discharge Elimination System (NPDES) permit, point source discharges of pollutants to navigable waters are expressly prohibited by the 1972 amendments to the Federal Water Pollution Control Act (also referred to as the Clean Water Act or CWA). The EPA (1993) defines a point source as: " . . . any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, . . ." from which pollutants are or may be discharged (p. 52). NPDES Stormwater Discharge Permit regulations require that airports conducting airport surface and/or aircraft deicing/anti-icing operations must obtain a stormwater discharge permit. These airports and/or airlines " . . . must apply for a storm water discharge permit for locations where deicing chemicals are applied . . . [including] but . . . not limited to, runways, taxiways, ramps and areas used for the deicing of airplanes" (EPA, 1992, p. 11). These permits establish effluent limitations for various pollutants and require that airports monitor discharges to detect excessive levels of pollutants. Most often airports monitor BOD_5 and/or glycols (Barash et al., 2000). Therefore, in order to make meaningful comparisons to the levels prescribed in EPA guidelines and more specifically, a given airport's SWPPP, the SDSS would be designed to predict point source AD/AF pollution based on topology, precipitation, volume of AD/AF's applied, number and types of flights with respect to EPA-developed pollutant loading criteria in terms of BOD_5 and/or glycols. The determination of the point at which maximum allowable AD/AF concentration is reached at the outfalls would provide the basis for deriving the opportunity costs of flight cancellations and evaluating mitigation options.

CONCLUSION

The current operational environment is complex. Airport managers are obligated under FAA regulations to provide adequate AD/AF facilities for winter operations while constrained by EPA guidelines restricting the concentration of AD/AF's in airport effluents. Airport and airline managers are driven to generate profits, but burdened with the costs of environmental mitigation. That significant quantities of AD/AF's are entering surface waters is indisputable.

Expectations are that glycol will continue to be the primary constituent of AD/AF's, and further, that these fluids will be in use for the deicing and anti-icing of aircraft for the foreseeable future (Mericas & Wagoner, 1994). Current trends and forecasts suggest that, unless factors alter significantly, increasing amounts of aircraft deicing and anti-icing fluids will flow into surface waters (Angelo, 1996; Rusten, Wien, & Skjefstad, 1996; Betts, 1999). EPA data indicate that deicer usage has significantly increased over the last two decades, and projections suggest that air travel will continue to increase. Correlating to FAA predictions of increased air traffic is the expectation that quantities of glycol-based AD/AF's applied to aircraft will also become greater (Mericas & Wagoner, 1994; Rusten et al., 1996). Larger aircraft (e.g., the Airbus A380) will require still greater quantities of AD/AF's to safely fly in wintry precipitation. With this in mind consider: "The [AD/AF] fluid required to deice one 747 is equivalent to the daily effluent from 5,000 homes . . . " (Angelo, 1996, p. 10). And, even as the pressures to increase AD/AF usage become greater, the EPA is considering issuance of more stringent guidelines.

Given that mitigation of environmental pollution is a major expense at airports, McNerney (1994) notes that a GIS " . . . can provide significant improvements to the way airport management . . . [is] conducted today" (p. 681). The purpose of this proposal has been to suggest the design of a GIS-based SDSS for the purpose of determining the opportunity costs associated with airport deicing operations. The ability to project costs associated with AD/AF applications would also be useful in exploring various mitigation strategies.

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Stakeholder Perceptions of Specialized Accreditation by the Aviation Accreditation Board International: Part Two – Aviation Students and Industry Employers

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ABSTRACT

In an effort to understand the current status of specialized accreditation in collegiate aviation and the reasons why so few aviation programs are accredited by the Aviation Accreditation Board International (AABI), a comprehensive study was undertaken to determine the perceptions held by the following four stakeholders of collegiate aviation regarding specialized accreditation by AABI: administrators of both AABI accredited and non-AABI accredited aviation programs, collegiate aviation program students, and aviation industry employers. This article is the second in a series of three reporting the results of this nationwide study, and presents the perceptions of collegiate aviation students and aviation industry employers. Recommendations specific to part two of this nationwide study include: (a) Collegiate aviation students should become better informed about AABI and the current accreditation status of the program they attend; and (b) Aviation industry employers should be willing to collaborate with AABI on developing quality aviation graduates via the AABI Industry-Educator Forum and consider placing an emphasis on hiring graduates of AABI accredited programs.

INTRODUCTION

Today, three types of accreditation exist. First, the eight regional accreditation agencies in six regions together accredit approximately 3,000 institutions enrolling close to 14 million students. National accreditation is usually sought by trade, business, and technical schools in the for-profit sector. Eleven national agencies collectively accredit approximately 3,500 institutions enrolling 4.75 million students. The third type of accreditation is specialized. The specialized agencies accredit individual schools or programs within larger colleges and universities. This form of accreditation has today grown into 48 specialized accrediting organizations recognized by the Council for Higher Education Accreditation (Council for Higher Education Accreditation [CHEA], 2007). Generally, specialized accreditors require the program or school to be part of a regionally or nationally accredited institution. In that sense, specialized accreditation of specific academic programs serves as an added sense of prestige for an already accredited institution (CHEA, 2006; Wellman, 2003).

The field of specialized accreditation in the U.S. is quite diverse. For instance, the Council for Higher Education Accreditation recognizes 48 specialized accrediting organizations that accredit programs in at least 43 different academic fields, including audiology, aviation, computer science, forestry, nursing, social work education, and veterinary medicine.

Interestingly, although most of these academic fields only have one specialized accrediting organization (similar to aviation), several fields (such as business, nursing, and teacher education) are covered by two organizations. This may be understandable, as these academic fields are quite popular and contain the number of programs that can support additional specialized accrediting organizations (CHEA, 2006).

Although formal specialized accreditation has been in existence in the U.S. for over 100 years, specialized accreditation in the field of collegiate aviation is a relatively recent phenomenon. Since the first four non-engineering aviation programs were accredited by the Council on Aviation Accreditation (CAA) in 1992, a larger number of aviation programs have sought and obtained specialized accreditation through the newly renamed Aviation Accreditation Board International (AABI). However, even though there are currently 78 AABI accredited programs at 26 institutions of higher learning, only 26 percent of UAA member institutions have AABI accredited programs. Considering that there are at least 13 non-engineering collegiate aviation programs in the U.S. that are not institutional members of the UAA and many more worldwide, the actual percentage of institutions worldwide with AABI accredited programs is less than 26 percent.

This paper, second in a series of three, presents abbreviated findings of a nationwide study that investigated stakeholder perceptions of AABI and AABI accreditation. Although the first article in this series presented a thorough literature review of the topic and examined the perceptions of AABI among collegiate aviation administrators, this article examines the perceptions of collegiate aviation students and industry employers. Understanding these perceptions will likely assist the Aviation Accreditation Board International in strategically planning for the future by implementing measures to better meet the needs of collegiate aviation programs worldwide.

METHODOLOGY

Research Design

This study utilized a non-experimental, mixed method research design, with both quantitative and qualitative attributes. The research design is a "mixed method" design in that both qualitative and quantitative data were gathered via cross-sectional surveys. Quantitative and qualitative data were collected via close-ended items and open-ended items on each questionnaire. In essence, this study is considered a descriptive study with data collection via cross-sectional surveys. Plainly, a "descriptive study simply describes a phenomenon" (McMillan (2004, p. 176). [For further detail regarding the research design, the reader is encouraged to review *Stakeholder Perceptions of Specialized Accreditation by the Aviation Accreditation Board International: Part One - Collegiate Aviation Administrators.*]

INSTRUMENT DESIGN

Survey of Aviation Program Students on AABI Issues

To understand the role AABI accreditation plays in decisions made by students regarding the institution they choose to attend and in their general awareness of AABI, a questionnaire entitled "Survey of Aviation Program Students on AABI Issues" was developed. This questionnaire was quite brief, containing only 10 items. The first item contained a checklist with 12 categories. Four items contained Likert scales, three items had several categories from which to choose, one item was a ten-point scale, and one was open-ended.

Survey of Aviation Industry Employers on AABI Issues

A questionnaire entitled "Survey of Aviation Industry Employers on AABI Issues" was designed to gather perceptions from aviation industry employers on their level of awareness of AABI and the manner of emphasis they place on hiring graduates of AABI accredited programs. The brief questionnaire contained nine items, of which five were Likert-scale items, one was a 10 point scale, two had several categories from which to choose, and one was open-ended.

Validity and Reliability of Measurement

As explained by Alreck and Settle (1995, p. 58), "a measurement of any kind is valid to the degree it measures all of that and only that which it's supposed to measure." Face validity of the questionnaires was enhanced by informally allowing persons not involved in the study to review the questionnaires for accuracy and ease of completion, resulting in several revisions to the questionnaires. Content validity was enhanced by allowing a group of experts to review each of the questionnaires (Gay & Airasian, 2000). This group of experts consisted of one member of the University Aviation Association (UAA), one member of the Aviation Accreditation Board International (AABI), and the researcher's supervisory committee chair. This jury was presented with an overview of the study and the purpose of the questionnaires. In adapting Litwack's (1986) method, each juror was asked to rate each question on a three-point scale of importance: 1-'important'; 2-'important but requires revision'; 3-'not important'. Items rated by two out of three jurors as 'important' or 'important but requires revision', were included in the questionnaire. In addition to the ranking of items on a scale of importance, constructive comments were also received, resulting in additional questionnaire refinement.

In addition to a focus on validity, reliability was also addressed. Reliability, as explained by Alreck and Settle (1995, p. 58), means "freedom from random error." A fundamental test of reliability is that of repeatability (Alreck & Settle, 1995). This survey was administered only once, as lack of resources and time did not allow for extensive test-retest methodology. However, McMillan (2004) explains that reliability of an instrument can be measured in terms of internal consistency via the Cronbach alpha, appropriate for instruments in which there is no right or wrong answer to each item. As seen in Table 1, the Cronbach's reliability coefficients for the two questionnaires were 0.479 and 0.855. As McMillan (2004) states, reliability coefficients of 0.65 are acceptable for measuring noncognitive traits, whereas studies of groups can tolerate a lower reliability, sometimes as low as 0.50 in exploratory research. Further, as suggested by McMillan, additional efforts were implemented to minimize the lower than desired internal consistency of this questionnaire. First, with each of these questionnaires, there were standard conditions of data collection, in which each of the four groups were provided the same directions. Also, the instruments were appropriate in reading level and language of the subjects. Lastly, the questionnaires were brief, thus not experiencing the problems associated with lengthy questionnaires.

Table 1. *Questionnaire Reliability*

Instrument	Cronbach Alpha
Survey of Aviation Program Students on AABI Issues	0.479
Survey of Aviation Industry Employers on AABI Issues	0.855

In a final effort to address issues of validity and reliability, as well as pre-test the operation of each questionnaire, a pilot study was conducted. A main goal of this pilot study was to determine if the questionnaires were easily understood and could be completed within a reasonable time period. The pilot study consisted of five members randomly selected from each of the sample populations. Responses received from each group closely matched responses collected from each group during the full study.

STUDY POPULATIONS

Aviation Program Students

The questionnaire aimed at aviation students was designed to determine, specifically, what effect AABI accreditation had on the decision made by the student as to which aviation program and institution to attend. The survey population for this questionnaire consisted of the total number of aviation students enrolled at all of the 112 institutions offering non-engineering aviation academic programs nationwide (UAA, 2003). Determining the sample frame for this large survey population was not very feasible. The sample frame, therefore, consisted of the student membership list of the UAA, and the sample included each of these 98 students. Due to the broad aviation focus of this organization, the membership list contains students from many of the institutions with aviation programs and contains a good cross-section of various aviation majors. Although it cannot be precisely specified, coverage error, unfortunately, was relatively high with this approach. Due to the size of the population and the lack of a comprehensive list which included each of the population units, there was little way to provide for each unit in the population of having a known, non-zero chance of being included in the sample. That said, however, coverage error was reduced by ensuring that the UAA student membership list did not contain non-members of the population. Per UAA objectives, the student membership is composed of current aviation students. Further, the decision was made that an amount of coverage error was acceptable, as no feasible alternatives for surveying this population existed. Lastly, sampling error was also high due to the ability to only collect information from the subset of aviation students who are also UAA student members. Although all UAA student members were surveyed, this was only a small fraction of current aviation students nationwide. As the total population size of collegiate aviation students is unknown, the actual sampling error could not be calculated with any precision. Any sampling error was minimized due to the broad cross-section of students and institutions represented by the UAA student membership list.

Aviation Industry Employers

Clearly, the group of aviation industry employers is another extremely large survey population. The various segments of the aviation industry hiring recent aviation graduates include national and regional airlines, cargo carriers, government agencies, airports, fixed base operators, and consulting firms. Surveying the entire survey population would have been prohibitive. Thus, the sample frame consisted of the membership lists of the following aviation industry trade groups: American Association of Airport Executives (720 airport members and 591 corporate members), Air Transport Association (18 airline members), National Air Transportation Association (2,000 associate members), and the National Business Aviation Association (6,000 corporate and associate members). A simple random sample of members from each of these groups was contacted. Although a suggested sample size for each of these groups would normally range from 20 to 907 (depending on the membership size), limited resources prevented the selection of such a large sample size. Further, it was decided not to use a modified stratified sampling approach, as the percentage of members of these organizations do not necessarily represent a higher percentage of companies hiring aviation graduates. Thus, a simpler method involved randomly selecting 40 corporate members from each of these four organizations (with the exception of the entire 18 Air Transportation Association members), resulting in a total sample size of 138 industry employers. The questionnaire was then directed to the Director of Human Resources (or central hiring office) of each organization. Although it cannot be precisely specified, coverage error was high with this approach, simply because of the large size of the survey population. However, a cross-section of groups representing the major aspects of the aviation industry was sampled, thus minimizing coverage error to the extent possible. As with any survey in which a subset of the population is surveyed, sampling error also resulted with this survey of aviation industry employers. However, as the total size of the population is not known, sampling error could not be precisely specified. Yet, efforts such as selecting a range of aviation industry trade groups and use of random sampling from each of these groups was used to minimize sampling error to the extent possible.

SURVEY PROCEDURES

The implementation of the questionnaires designed for this survey project closely adhered to Dillman's (2000) Tailored Design Method. Specifically, three contacts were made via first-class mail, while the fourth and fifth contacts were made via e-mail and fax, respectively. Each of these five contacts was utilized for the purpose of increasing survey response rate. As Dillman (2000, p. 149) explains, "Multiple contacts have been shown to be more effective than any other technique for increasing response to surveys by mail." The first contact was made with recipients on June 22, 2007, and the final contact was made on July 30, 2007.

DATA ANALYSIS

As detailed in part one of this study, both quantitative and qualitative data were collected as a result of implementing the non-experimental mixed method research design. The majority of quantitative data collected during this research study involved nominal and ordinal data. As a result, non-parametric statistical analyses were heavily relied upon in analyzing this quantitative data. SPSS version 15.0 and Microsoft Excel were the statistical analysis software used to analyze quantitative data collected during this study. Specifically, the chi-square test for goodness of fit was utilized to analyze nominal data. The Likert-scale ordinal data were analyzed using simple frequency distributions.

To analyze the qualitative data collected during this study, content analysis via a manual coding effort was employed. After comments were separated into the theme categories based on their general intent, the number of responses in each theme category was then counted numerically to allow general conclusions to be drawn from the qualitative data.

FINDINGS

Although the nationwide study included 11 research questions, part two of this study presents the abbreviated findings of only two research questions. It is these questions that could only be addressed by aviation students and industry employers.

Research Question 8: Does a preference exist among students regarding the factors considered influential on a student's decision as to which institution and aviation program to attend?

To collect data associated with this research question, a 12-item categorical scale was developed and incorporated into the "Survey of Aviation Program Students on AABI Issues." The scale resulted in nominal data being collected. Therefore, the chi-square goodness of fit test was appropriate in analyzing if preferences existed among students regarding the factors considered influential as to which institution and aviation program to attend. The null hypothesis was stated as follows:

> **H_0**: No preference exists among students regarding the factors considered influential on a student's decision as to which institution and aviation program to attend.

Upon analysis of the data, the students showed significant preferences among the 12 items when selecting which institution and aviation program to attend, χ^2 (10, n = 149) = 58.819, $p<0.05$. With a critical region beginning at 18.31 at the 95 percent confidence interval, the decision was made to reject H_0. Therefore, at the 0.05 level of significance, the data provide sufficient evidence to conclude that there is a significant preference among students regarding the items they considered when selecting which institution and aviation program to attend. It should be noted that although 35 students answered the question, they could select as many of the 12 categories as they desired, thus the total observed n = 149.

Based on frequency of responses, students most considered location (65.7 percent), cost (62.9 percent), reputation of the institution or aviation program (60 percent), financial aid/scholarships (57.1 percent), and aviation training facilities (57.1 percent). Only three respondents indicated that AABI accreditation status played a role in their decision making process.

Table 2. *Chi square Frequency Data*

	Observed frequencies	Expected frequencies
Aviation training facilities	20	13.5
AABI accreditation status	3	13.5
Cost	22	13.5
Family member's alma mater	1	13.5
Financial aid/scholarships	20	13.5
Friends attending	6	13.5
Institutional accreditation status	15	13.5
Location	23	13.5
Particular professor	1	13.5
Reputation of institution or aviation program	21	13.5
Specific academic program	17	13.5

Additionally, qualitative data that addressed this research question was collected by presenting students with the following open-ended item: "Please share any further thoughts you may have on the AABI and the role of AABI accreditation in your education and future career opportunities. A total of 15 responses were received, which were analyzed using content analysis. This resulted in the responses being categorized into five theme categories (see Table 3).

Table 3. *Number of Responses by Students*

Theme	**Number of Responses**
Lack of awareness	7
Appreciative of higher standards	4
Positive effect on career opportunities	2
No effect on career opportunities	2
Higher quality program	2

As shown, the category with the most responses can be titled, “Lack of awareness of AABI.” As one student expressed, “When I was a high school student looking at colleges, AABI certification wasn’t even something I thought of. When I was applying and interviewing for positions the topic never came up either.” Thus, the qualitative data seems to support the quantitative data in this regard.

<u>Research Question 9: Among aviation industry employers, what beliefs are most widely held regarding AABI accreditation?</u>

In an effort to answer this research question, four closed-ended items and one open-ended item were developed and included on the “Survey of Aviation Industry Employers on AABI Issues.” As the four Likert-scale items obtained ordinal data from one group, the number of responses was analyzed. Participants were asked to indicate their level of agreement or disagreement with each of the four following statements.

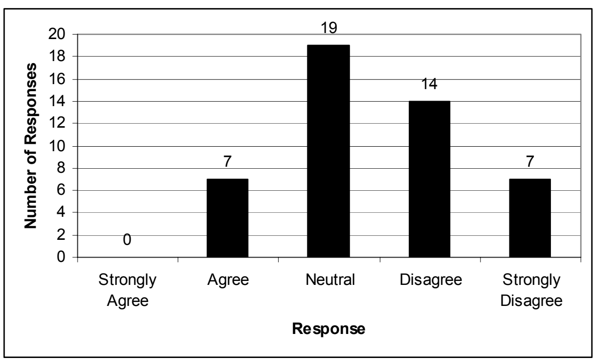

Figure 1. The AABI Should Better Market Itself to our Industry

As indicated, respondents tended to disagree with this statement. Although 14.9 percent agreed with the statement, 40.4 percent were neutral.

When presented with the statement, “Our organization prefers to hire graduates of AABI accredited programs,” 63.8 percent of respondents were neutral, indicating neither agreement nor disagreement. Almost 30 percent disagreed with this statement.

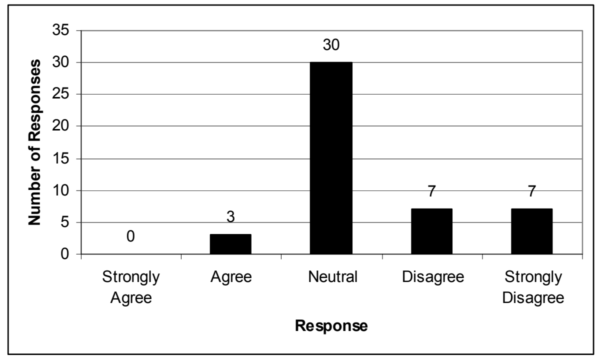

Figure 2. Our Organization Prefers to Hire Graduates of AABI Accredited Programs

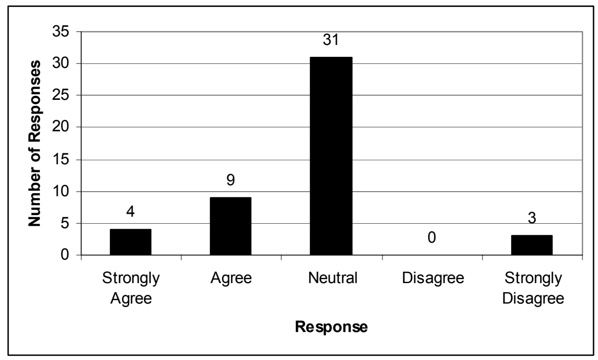

Figure 3. It would be beneficial to our industry if more Collegiate Aviation Programs became accredited by the AABI

Similar to the item above, this item also garnered a high proportion of neutral responses. Indeed, 66 percent of respondents indicated a position of neutrality on this statement. However, almost 30 percent tended to agree that it would be beneficial if more collegiate aviation programs became accredited by the AABI.

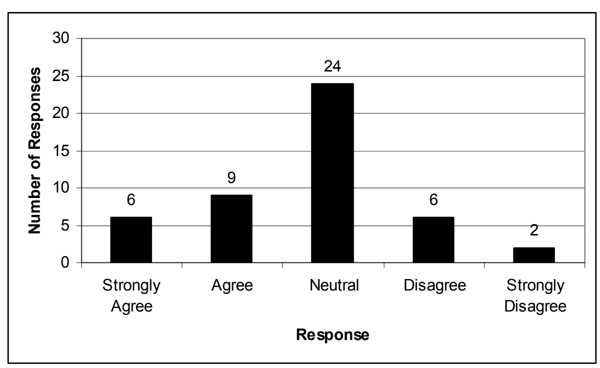

Figure 4. Our Industry does not realize any Direct or Indirect Benefits from the AABI and its Efforts

This last item aimed at discovering whether industry perceived any benefits from the AABI and its efforts. As with the items previously discussed, the majority of responses to this item were neutral. However, there was also some agreement (32 percent) and disagreement (17.1 percent) with this statement.

Additionally, employers were invited to respond to the following statement: "Please share any additional thoughts you may have on AABI accreditation and the hiring of recent college graduates by the aviation industry." A total of 17 responses were received, which were then analyzed using content analysis. These responses were then categorized into five general themes. The number of responses in each of the theme categories is shown in Table 4.

Table 4. *Number of Responses by Industry*

Theme	Number of Responses
Lack of awareness	8
No benefits to industry	2
Positive benefits to industry	1
More industry contact needed	1
Better marketing needed	1

The themed category with the most responses refers to lack of awareness of AABI. Apparently, aviation industry employers did not widely hold beliefs about AABI, as they generally knew very little about the organization and its impact on their industry.

DISCUSSION

The findings reveal that the majority of current aviation students responding to the survey are not even aware of AABI, don't know whether or not the program they currently attend is accredited by AABI, and share that the AABI accreditation status of aviation programs had no effect on their decision making process of which institution to attend. Indeed, only three student respondents indicated that AABI accreditation status played a role in their decision making process as to which institution to attend. Furthermore, students do not consider the AABI accreditation status of a program in deciding which institution to attend. Is this because of a lack of awareness of AABI? Quite possibly, as 60 percent of responding students indicate a lack of awareness of AABI. Additionally, of the qualitative responses received by students, the theme category with the most responses is entitled, "Lack of awareness." These findings seem to support statements made by administrators of non-AABI accredited programs regarding the fact that neither students nor parents have ever asked if their program was accredited. However, these findings challenge assumptions previously made by academia and AABI. For instance, administrators of AABI accredited programs point to their AABI accreditation status as important in marketing and attracting high quality students.

Another significant finding of this study involves aviation industry employers. In particular, the vast majority of aviation industry employers are not aware of AABI, do not consider the AABI accreditation status of a program when hiring graduates of collegiate aviation programs, and see little benefit in AABI's efforts. As a result, previous assumptions held by academia and AABI that industry not only realizes the value of AABI accreditation, but prefers graduates of AABI accredited programs, are not accurate. Interestingly, however, some level of industry is aware of the benefits of specialized accreditation in general, and of AABI accreditation in particular. Thus, it would seem that if AABI better marketed itself to industry (a point that 45 percent of AABI accredited programs and 37.2 percent of non-AABI accredited programs agreed with), industry would begin to see the benefits of AABI accreditation, subsequently improving industry's perceived value of AABI accreditation.

CONCLUSION

This study was designed to investigate why so few collegiate aviation programs were accredited by AABI, considering the perspectives of both students of these programs and potential employers of the graduates of these programs. As a result, and in light of the findings of this study, recommendations are presented in the context of these two groups of stakeholders, as well as AABI.

Collegiate Aviation Students

1. Educate yourself about the purpose of specialized accreditation and the role of AABI, in order to decide if attending an accredited program is beneficial to your education and future career.

Aviation Industry Employers

1. Acquire an increased awareness of the purpose of specialized accreditation and the role of AABI, in order to decide if an emphasis should be placed by your company on hiring graduates of AABI accredited programs.
2. For those employers placing an emphasis on AABI accreditation, consider industry's role in providing input to collegiate aviation education via the AABI Industry/Educator Forum.

Aviation Accreditation Board International (AABI)

1. Develop a comprehensive marketing program aimed toward the stakeholders of collegiate aviation, with specific emphasis on aviation industry employers, as well as future and current collegiate aviation students.
2. Consider whether the Industry-Educator Forum has sufficient industry support and adequately reflects industry concerns.

It is likely that the findings highlighted in this paper are somewhat surprising to AABI and administrators of AABI accredited programs. Since AABI accreditation (and any accreditation, for that matter) is a voluntary process, programs must see benefits that outweigh the costs of pursuing such accreditation. The cost-benefit equation may now be cast in a different light as a result of these findings. Indeed, if aviation students know little about AABI and do not consider AABI accreditation when choosing which institution to attend, and aviation industry employers are unaware of AABI and don't prefer hiring graduates of AABI accredited programs, the demand for AABI accredited programs likely only springs from within academia. Although this is not detrimental, it does raise additional questions regarding the real benefits of AABI accreditation. After all, if students don't care about it, and industry doesn't prefer it, why would non-AABI accredited programs feel the need to pursue AABI accreditation?

It is believed that students and industry benefit from specialized accreditation in collegiate aviation, whether they realize it or not. However, AABI must consider these findings as they endeavor to accredit more programs in the years to come. For if the benefits of AABI accreditation are called into question, it will make it difficult for AABI to maintain success in the specialized accreditation arena within collegiate aviation throughout the world.

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A Comparison of the Success of Native and Transfer Private Pilots at Southern Illinois University Carbondale

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ABSTRACT

This study seeks differences in the degree completion and time-to-degree of native versus transfer private pilots along with transfer private pilots required to take proficiency training versus those who did not take proficiency training before beginning the aviation flight program at Southern Illinois University Carbondale (SIUC). An ex-post facto descriptive study of 338 flight students that began commercial pilot training between the fall 1998 through the summer 2003 semesters measured completion or exit from the SIUC flight program. The study population was determined from the Student Information System and the data on degree completion and time-to-degree was gathered from the students' flight training records. Chi-squares were used to determine significance ($p<.05$) in degree completion percentages and t-tests were used to determine days-to-degree significance ($p<.05$). The study concludes that there are no significant differences between native and transfer or proficiency and direct-entry private pilots at SIUC.

INTRODUCTION

Currently, to enter the flight program at Southern Illinois University Carbondale (SIUC), students must apply to the Aviation Flight Program in addition to applying to the university. Students can enter the Aviation Flight Program with or without their private pilot's license. Currently, if students already possess a private pilot's license, they begin by taking the Private Pilot Transition Course, which is a 10-14 flight hour refresher/evaluation course. Once this course is successfully completed, they can proceed directly into instrument training and receive university credit for their private pilot's license. If higher certificates are held, entrants will only be given credit for their private pilot's license. Students that begin without a private pilot's license take Primary Flight I and Primary Flight II. Once these two courses are completed, the students receive their private pilot's license. The students will then take three courses beginning with their instrument training and time building towards their commercial certificate. After this training is complete, they take a course to receive their commercial certificate and then take the last course to obtain their multi-engine rating.

Prior to the creation of the Private Pilot Transition Course in the fall of 2005, the flight department's policy varied yearly either requiring transfer private pilots to take proficiency training before beginning instrument training or allowing them to enter directly into the initial instrument training course. From the fall 1998 semester to the spring 2001 semester, most private pilot transfers were required to take up to ten hours of proficiency training before beginning instrument training. Some exceptions to this policy were allowed if the transfer students had previously taken their private pilot check ride with an Assistant Professor Emeritus from the flight program. From the summer of 2001 until summer of 2003, private pilot transfer students began training by enrolling directly into the initial instrument training course. From the fall of 2003 until the summer of 2005, private pilot transfer students were required to take Primary Flight II before beginning instrument training.

Private Pilot Certificate status upon program entry into the Aviation Flight Program may affect student retention, degree completion and time-to-degree. Student retention and degree completion are two major issues facing any academic program. These issues can effect students' decisions as to where to receive their training and administrative decisions about program funding.

If students start flight training in their sophomore or junior year or spend extra time in their earlier flight courses, they may complete their Bachelor of Science in Aviation Management before their Associate of Applied Science in Aviation Flight. In this case, students may not be willing to stay at the university when they could finish their flight training elsewhere. If students enter the flight program with their private pilot's certification, they may be able to complete their degree faster because they can bypass the private pilot training. However, transfer students generally come from an unknown training background and may have issues assimilating to the program.

One of the major issues facing the future of commercial aviation is the demand for quality trained airline pilots. In the past, the major airlines relied heavily on military trained pilots. With the military downsizing in the last three decades, there are fewer military trained pilots available, leaving the void to be filled with civilian trained pilots. (Hansen & Oster, 1997)

A university's key to balancing the high demand for quality pilots is efficiency. If completion rates or the time-to-degree can be improved, more students can be trained without increasing instructional staff or enlarging the aircraft fleet. Efficiency can be achieved by reviewing current practices and making adjustments to the program's structure that will help the program survive into the future.

RESEARCH QUESTIONS

1. Is there a difference in the successful completion of instrument flight training between students who earn their private pilot's license at the university and those who complete their private pilot training elsewhere?
2. Is there a difference in the successful completion of multi-engine training between students who earn their private pilot's license at the university and those who complete their private pilot training elsewhere?
3. Is there a difference in days-to-degree between students that complete their private pilot's license at the university and those who complete their private pilot training elsewhere?
4. Is there a difference in the successful completion of instrument flight training between transfer private pilots who enter directly into instrument training and those whom must take proficiency or evaluation training?
5. Is there a difference in the successful completion of multi-engine training between transfer private pilots who enter directly into instrument training and those whom must take proficiency or evaluation training?
6. Is there a difference in days-to-degree between transfer private pilots who enter directly into instrument training and those whom must take proficiency or evaluation training?

BACKGROUND

FAA Part 61 Versus 141 Training

According to the Federal Aviation Regulations, when students receive training for any type of pilot certificate or rating, they have the choice of pursuing their training through two types of flight schools: Part 61 or Part 141. SIUC is a Part 141 flight school. Private pilots that transfer to the university may come from either a Part 61 or a Part 141 flight schools. A Part 141 school has an Air Agency Certificate issued by the FAA and may be authorized to give their students practical exams. As of 2003, there were 506 FAA Part 141 certificated pilot schools in the United States (U.S. Department of Transportation, 2003). At a Part 141 school the FAA approves all lessons, whereas a Part 61 school requires pilots to cover general subject areas and meet a minimum number of flight hours. No matter which part program students train under, they receive the same pilot certificates. The difference between Part 61 and Part 141 flight schools is in the structure of the training.

The FAA's *Airplane Flying Handbook* explains the requirements and some benefits of Part 141 certificated schools:

> The school must operate in accordance with an established curriculum, which includes a training course outline (TCO) approved by the FAA. The TCO must contain student enrollment prerequisites, detailed description of each lesson including standards and objectives, expected accomplishments and standards for each stage of training, and a description of the checks and tests used to measure a student's accomplishments. FAA-approved pilot school certificates

> must be renewed every 2 years. Renewal is contingent upon proof of continued high quality instruction and a minimum level of instructional activity. (U.S. Department of Transportation, 2004, pp. 1-4 & 1-5)

The *Airplane Flying Handbook* also states that most pilot schools are Part 61 and that “many of these non-certificated schools provide excellent training that meets or exceeds the standards required of FAA-approved pilot schools” (p. 1-4). The handbook states that the flight instructors at both types of schools must meet the same certification and renewal standards and that, “any training program is dependent upon the quality of the ground and flight instruction a student pilot receives” (p. 1-4).

An article on the Student Pilot Network website (*Part 61 Versus Part 141*, 2002) stated that Part 61 is the flexible choice of pilot training compared to Part 141 as the structured choice. The article claimed that Part 61 schools can be very motivating and enjoyable, but if the training is poorly organized, it may take longer to complete; whereas, Part 141 schools are more structured because they must adhere to more regulations that guarantee coverage of specific subject areas and require more stage check rides during training. The article concluded that the quality of training depends more on the quality of the instructor and the student/instructor relationship than whether the training is done in a Part 141 or 61 environment (*Part 61 Versus Part 141*, 2002).

In a discussion forum following the previous article on the Student Pilot Network, John C. Boylls a designated pilot examiner, who was awarded the FAA Western-Pacific Region Flight Instructor of the Year in 1998 and has formerly developed training courses for the King Schools, gave his opinion on Part 61 and Part 141. Boylls believes that Part 141 school does not necessarily guarantee better training and that it depends upon the management of the flight school and their integrity. He also noted one downside to Part 141 schools is that instructors usually come from the schools where they were trained, keeping those schools isolated from outside ideas (*Part 61 Versus Part 141*, 2002).

METHODS AND PROCEDURES

Study Population and Sampling Procedures

The study population includes all aviation flight students at Southern Illinois University Carbondale that began instrument training between the fall 1998 semester and the summer 2003 semester. Using the information gathered by the Student Information System (SIS) at the university, the course lists revealed that 338 flight students were enrolled in the beginning instrument training course over the study’s time period. Upon further review, two students enrolled in the course twice, making 336 students in the population. Using archival data, information was found on all 336 students. For the purpose of this study, a native student will be defined as a student that received his/her private pilot’s license at the university. A transfer student will be defined as a student that received his/her private pilot’s license anywhere other than the university. A direct-entry transfer student will be defined as a transfer flight student that entered instrument training without any proficiency training or testing. A proficiency transfer student will be defined as a transfer flight student that was required to complete proficiency training or testing at the university before entering instrument training.

Limitations of the Study

The study cannot determine the quality or location of private pilot training that students receive outside of SIUC or the reasons for students leaving the program prior to instrument rating or degree completion. The study cannot determine the amount of previous flight training; the study can only determine if the student has a private pilot’s license prior to program acceptance. Days-to-degree will not take into consideration weekends or breaks in training in which the student does not fly.

Data was collected on all students that began instrument training over a five-year period from the fall 1998 semester to the summer 2003 semester. The end date of 2003 was selected to allow students at least three years to complete the A.A.S. degree. Students who enroll in instrument training and fail to complete the A.A.S. degree or reach the instrument training course will be counted as incomplete. The length of time-to-degree completion will be measured in days from the first day of flight or ground training in the initial instrument training course until the day that multi engine training is completed. The completion of multi engine training was used to determine degree completion since it is the last flight course in the sequence of flight courses needed to attain the associate degree.

Measures

The data concerning the location of private pilot training, start date and completion date was gathered from SIS and the students' progress charts (training records). The flight department's semester report of student training was also referred to in the case of missing progress charts. The semester report is an administrative document that lists the course start date and pass/fail/withdrawal date of flight students.

Data Analysis

Descriptive statistics were used to describe the study population. Frequency counts and percentages of completion were utilized to analyze certificate status at enrollment and entry method into the flight program. Descriptive statistics were also used to determine days-to-degree for students that completed the program.

Inferential statistics were used to test the research questions. Chi-square was used to test for significant differences between native and transfer students' completion of instrument training and multi-engine training. A t-test of independent samples was used to determine significant differences in days-to-degree of native and transfer students. Chi-square was also used to test for significant differences between direct and proficiency transfer students' completion of instrument training and multi-engine training. A t-test of independent samples was used to determine significant differences in days-to-degree of direct and proficiency transfer students.

RESULTS

Treatment of Data

The data was imported into SPSS 11 for Windows (Statistical Procedures for the Social Sciences) to assist in analyzing the data. SPSS was used to calculate descriptive statistics such as frequencies, completion percentages, standard deviations and days-to-degree. The program was also used to calculate chi-squares and t-tests for independent samples.

The first eight tables use descriptive statistics to explain the study's population. The last six tables use chi-squares and t-tests to test for significance at the .05 level.

Presentation of Data

Table 1 displays the study population separated by native and transfer private pilots. Semesters of enrollment are listed in chronological order, with native pilots referring to pilots that completed their private pilot training at SIUC and transfer pilots being pilots that completed their training elsewhere. For the study population, there were 336 students that began instrument training during the identified period, of which 202 were native and 134 were transfer private pilots. From year-to-year, the highest student enrollments in the initial instrument training course were in the fall semesters. Normally, there was a higher native student enrollment than transfer student enrollment in this course with the exceptions of summer 2000, fall 2000, summer 2001 and fall 2001.

Table 2 displays the instrument training completion rate of native and transfer students by semester. Native students had a 67% rate of completion with 136 of the 202 students completing instrument training. Transfer students had a slightly higher rate of completion at 70% with 94 of the 134 students completing instrument training.

Table 3 displays multi-engine training completion rate of native and transfer students by semester. There was a 49% completion rate for native students with 97 of the 202 students completing their multi-engine training. Transfer students in this course had a slightly higher rate of completion at 54%, with 72 of the 134 students completing the course. When the data was collected, there were four students either still active in or waiting to begin multi-engine training. The four students were subtracted from the total enrolled after the completion percentages were calculated.

Table 1. *Number of Native and Transfer Students Enrolled by Semester*

Semester	Native	Transfer	Total
Fall 1998	27	13	40
Spring 1999	20	9	29
Summer 1999	2	2	4
Fall 1999	22	19	41
Spring 2000	19	5	24
Summer 2000	2	4	6
Fall 2000	11	12	23
Spring 2001	17	1	18
Summer 2001	0	3	3
Fall 2001	7	26	33
Spring 2002	19	6	25
Summer 2002	8	7	15
Fall 2002	23	16	39
Spring 2003	21	11	32
Summer 2003	4	0	4
Totals	202	134	336

Table 2. *Instrument Training Completion Rate of Native and Transfer Students by Semester*

Semester	Transfer Status	Enrolled	Completed	% Complete
Fall 1998	Native	27	20	74%
	Transfer	13	9	69%
Spring 1999	Native	20	12	60%
	Transfer	9	5	56%
Summer 1999	Native	2	2	100%
	Transfer	2	2	100%
Fall 1999	Native	22	12	55%
	Transfer	19	13	68%
Spring 2000	Native	19	14	74%
	Transfer	5	5	100%
Summer 2000	Native	2	1	50%
	Transfer	4	3	75%
Fall 2000	Native	11	6	55%
	Transfer	12	5	42%
Spring 2001	Native	17	14	82%
	Transfer	1	1	100%
Summer 2001	Native	0	0	
	Transfer	3	2	67%

Table 2. *Instrument Training Completion Rate of Native and Transfer Students by Semester-Continued*

Semester	Transfer Status	Enrolled	Completed	% Complete
Fall 2001	Native	7	5	71%
	Transfer	26	19	73%
Spring 2002	Native	19	17	89%
	Transfer	6	4	67%
Summer 2002	Native	8	5	63%
	Transfer	7	5	71%
Fall 2002	Native	23	14	61%
	Transfer	16	12	75%
Spring 2003	Native	21	11	52%
	Transfer	11	9	82%
Summer 2003	Native	4	3	75%
	Transfer	0	0	
Totals	Native	202	136	67%
	Transfer	134	94	70%

.Table 3**.** *Multi-Engine Training Completion Rates for Native and Transfer Students*

Semester	Trans Status	Enrolled	Completed	Active	% Complete
Fall 1998	Native	27	11		41%
	Transfer	13	7		54%
Spring 1999	Native	20	8		40%
	Transfer	9	2		22%
Summer 1999	Native	2	2		100%
	Transfer	2	2		100%
Fall 1999	Native	22	5		23%
	Transfer	19	9		47%
Spring 2000	Native	19	12		63%
	Transfer	5	3		60%
Summer 2000	Native	2	1		50%
	Transfer	4	3		75%
Fall 2000	Native	11	6		55%
	Transfer	12	5		42%
Spring 2001	Native	17	11		65%
	Transfer	1	1		100%
Summer 2001	Native	0	0		
	Transfer	3	1		33%

Table 3. *Multi-Engine Training Completion Rates for Native and Transfer Students - Continued*

Semester	Trans Status	Enrolled	Completed	Active	% Complete
Fall 2001	Native	7	4		57%
	Transfer	26	17		65%
Spring 2002	Native	19	12	1	63%
	Transfer	6	3		50%
Summer 2002	Native	8	1		13%
	Transfer	7	4		57%
Fall 2002	Native	23	14		61%
	Transfer	16	9		56%
Spring 2003	Native	21	8	2	38%
	Transfer	11	6	1	55%
Summer 2003	Native	4	2		50%
	Transfer	0	0		
Totals	Native	202	97	3	49%
	Transfer	134	72	1	54%

Table 4 displays mean days-to-degree of native and transfer students by semester. Days-to-degree was chosen as the appropriate measure for flight students due to the aviation flight program's policy, which allows students to begin and complete courses anytime during a semester. Days-to-degree were measured from the date of a student's first lesson in the initial instrument training course, until the date a student completed their multi-engine training graduation check flight. The mean days-to-degree of transfer students was 829, which was 44 days less than the mean of 873 for native students. However, the mean days-to-degree for native students is skewed higher because of the fall 1998 semester when five students took six or more semesters to complete multi-engine training. If the fall 1998 semester was removed from the population, the mean days-to-degree of native students would be 838 days.

Table 4. *Mean Days-to-degree of Native and Transfer Students by Semester*

Semester	Transfer Status	Days-to-degree	Stan. Dev.
Fall 1998	Native	1144	383
	Transfer	892	180
Spring 1999	Native	755	109
	Transfer	682	74
Summer 1999	Native	953	50
	Transfer	668	33
Fall 1999	Native	965	251
	Transfer	851	276
Spring 2000	Native	854	253
	Transfer	940	261
Summer 2000	Native	665	
	Transfer	771	128
Fall 2000	Native	941	204
	Transfer	967	276

Table 4. *Mean Days-to-degree of Native and Transfer Students by Semester- Continued*			
Semester	Transfer Status	Days-to-degree	Stan. Dev.
Spring 2001	Native	709	99
	Transfer	850	
Summer 2001	Native		
	Transfer	1032	
Fall 2001	Native	664	157
	Transfer	841	116
Spring 2002	Native	921	215
	Transfer	624	142
Summer 2002	Native	1239	
	Transfer	745	262
Fall 2002	Native	839	239
	Transfer	809	148
Spring 2003	Native	842	163
	Transfer	795	81
Summer 2003	Native	785	88
	Transfer		
Totals	Native	873	251
	Transfer	829	185

Table 5 displays the number of proficiency and direct-entry transfer private pilots by semester. Proficiency students are transfer students that took some form of screening training and/or a check ride prior to beginning instrument training, whereas direct-entry students enrolled immediately in instrument training upon admission to the flight program. The study population consists of a total of 78 direct-entry students and 56 proficiency students. Between the spring 1999 semester and fall 2002 semester, there was a proficiency requirement, but nine students had the requirement waived because these students had their private pilot check ride with an Assistant Professor Emeritus from the flight program.

Table 6 displays the instrument training completion rates of proficiency and direct-entry transfer students. Direct-entry transfer students had an instrument training completion rate of 74%, while proficiency students had a 64% completion rate.

Table 7 displays multi-engine training completion rates of proficiency and direct-entry transfer students. Direct-entry students had a 57% completion rate, whereas proficiency students had a 50% completion rate. There was one direct-entry transfer student that was still active in the flight program when the data was gathered. The completion percentage was calculated by subtracting the active student from the total enrolled. If this student were to complete or fail, the completion percentage would be affected by less than 1%.

Table 8 displays mean days-to-degree for proficiency and direct-entry transfer students. The number of days-to-degree was measured from the date of the first lesson in the initial instrument training course until the date the multi-engine graduation check flight was completed. Direct-entry students used 831 mean days-to-degree compared to 825 days for proficiency students. Proficiency training is not included in the days-to-degree calculation. This may account for proficiency students taking fewer than six days. If any remedial training was required for direct-entry students, it would have to be completed in the initial instrument training course.

Research Question One

Is there a difference in the successful completion of instrument flight training between students who earn their private pilot's license at the university and those who complete their private pilot training elsewhere?

Table 5. *Number of Proficiency and Direct-Entry Transfer Students by Semester*

Semester	Direct	Proficiency	Total
Fall 1998	0	13	13
Spring 1999	3	6	9
Summer 1999	0	2	2
Fall 1999	3	16	19
Spring 2000	1	4	5
Summer 2000	1	3	4
Fall 2000	1	11	12
Spring 2001	0	1	1
Summer 2001	3	0	3
Fall 2001	26	0	26
Spring 2002	6	0	6
Summer 2002	7	0	7
Fall 2002	16	0	16
Spring 2003	11	0	11
Summer 2003	0	0	0
Totals	78	56	134

Table 6. *Instrument Training Completion Rates for Proficiency and Direct-Entry Transfer Students*

Type of Entry	Total Enrolled	Completed	% Completed
Direct	78	58	74%
Proficiency	56	36	64%
Total	134	94	

Table 7. *Multi-Engine Training Completion Rates for Proficiency and Direct-Entry Transfer Students*

Type of Entry	Total Enrolled	Completed	Active	% Completed
Direct	78	44	1	57%
Proficiency	56	28	0	50%
Total	134	72	1	

Table 8. *Mean Days-to-degree for Proficiency and Direct-Entry Transfer Students*

Type of Entry	Days-to-degree	Completed	Standard Deviation
Direct	831	44	165
Proficiency	825	28	216

Table 9. *Chi-Square for Instrument Training Completion by Transfer Status*

Transfer Status	Count	Completed	Incomplete	Total
Native	Observed	134	67	201
	Expected	137	64	201
Transfer	Observed	95	40	135
	Expected	92	43	135
Chi-Square	0.51		Sig.	3.84

$p < .05$

In Table 9, the observed and expected instrument training completion frequencies of native and transfer private pilots in the flight program were compared using chi-square. Chi-square was calculated to be 0.51, which is less than 3.84 that is required to be significant (p<.05). Therefore, there is no statistically significant difference in instrument training completion rates between native and transfer private pilots in the flight program.

Research Question Two

Is there a difference in the successful completion of multi-engine training between students who earn their private pilot's license at the university and those who complete their private pilot training elsewhere?

Table 10. *Chi-Square for Multi-Engine Training Completion by Transfer Status*

Transfer Status	Count	Completed	Incomplete	Total
Native	Observed	96	103	199
	Expected	101	98	199
Transfer	Observed	73	61	134
	Expected	68	66	134
Chi-Square	1.246		Sig.	3.84

$p < .05$

In Table 10, the observed and expected multi-engine training completion frequencies of native and transfer private pilots in the flight program were compared using chi-square. Chi-square was calculated to be 1.246, which is less than 3.84 that is required to be significant (p<.05). Therefore, there is no statistically significant difference in multi-engine training completion rates between native and transfer private pilots in the flight program.

Research Question Three

Is there a difference in days-to-degree between students that complete their private pilot's license at the university and those who complete their private pilot training elsewhere?

Table 11.**.***T-Test for Days-to-degree by Transfer Status*

Transfer Status	N	Mean	SD
Native	96	875.5	251.5
Transfer	73	826.5	184.6
Total	169		
t	1.401	Sig.	1.96
Df	167		

$p < .05$

Days-to-degree was chosen as the measure of time-to-degree due to students' ability to enroll, begin and end flight courses at anytime during a semester. In Table 11, a t-test of independent samples was used to determine significant differences in days-to-degree of native and transfer students. A value of 1.401 was calculated for t, which is less than the t value of 1.96 required for significance (p<.05). Therefore, there is no statistically significant difference in days-to-degree between native and transfer private pilots in the flight program.

Research Question Four

Is there a difference in the successful completion of instrument flight training between transfer private pilots who enter directly into instrument training and those whom must take proficiency or evaluation training?

Table 12. *Chi-Square for Instrument Training Completion for Transfer Private Pilots by Type of Entry*

Type of Entry	Count	Completed	Incomplete	Total
Direct	Observed	58	20	78
	Expected	54.7	23.3	78
Proficiency	Observed	36	20	56
	Expected	39.3	16.7	56
Chi-Square	1.58		Sig.	3.84

$p < .05$

In Table 12, the observed and expected instrument training completion frequencies of direct-entry and proficiency transfer private pilots in the flight program were compared using chi-square. Chi-square was calculated to be 1.58, which is less than 3.84 that is required to be significant ($p<.05$). Therefore, there is no statistically significant difference in instrument training completion rates between direct-entry and proficiency transfer private pilots in the flight program.

Research Question Five

Is there a difference in the successful completion of multi-engine training between transfer private pilots who enter directly into instrument training and those whom must take proficiency or evaluation training?

Table 13. *Chi-Square for Multi-Engine Training Transfer Private Pilots by Type of Entry*

Type of Entry	Count	Completed	Incomplete	Total
Direct	Observed	44	33	77
	Expected	41.7	35.3	77
Proficiency	Observed	28	28	56
	Expected	30.3	25.7	56
Chi-Square	0.666		Sig.	3.84

$p < .05$

In Table 13, the observed and expected multi-engine training completion frequencies of direct-entry and proficiency transfer private pilots in the flight program were compared using chi-square. Chi-square was calculated to be 0.666, which is less than 3.84 that is required to be significant ($p<.05$). Therefore, there is no statistically significant difference in multi-engine training completion rates between direct-entry and proficiency transfer private pilots in the flight program.

Research Question Six

Is there a difference in days-to-degree between transfer private pilots who enter directly into instrument training and those whom must take proficiency or evaluation training?

In Table 14, a t-test of independent samples was used to determine significant differences in days-to-degree of direct-entry and proficiency transfer students in the flight program. A value of 0.136 was calculated for t, which is less than the t value of 1.96 required for significance ($p<.05$). Therefore, there is no statistically significant difference in days-to-degree between direct-entry and proficiency transfer students in the flight program.

Table 14. *T-Test of Days-to-degree for Transfer Private Pilots by Type of Entry*

Type of Entry	N	Mean	SD
Direct	44	831	164.7
Proficiency	28	824.9	216.2
Total	72		
t	0.136	Sig.	1.96
Df	70		

$p < .05$

DISCUSSION

The purpose of this study was to research factors concerning transfer and native student's successful completion of the Aviation Flight Degree. The topic of native and transfer private pilots was chosen due to the lack of similar research in collegiate aviation. Federal Aviation Regulation Parts 61 and 141 schools were discussed to show different training environments from which transfer private pilots could come. The U.S. military has had many versions of initial pilot training, ranging from civilian training to complete in-house training, both of which exhibited little difference in the completion rates.

Data for this study was collected on a population of 336 aviation flight students that began instrument training between the fall 1998 and summer 2003 semesters. The data shows that there is no significant difference between native and transfer private pilots as well as no significant differences between direct-entry and proficiency transfer private pilots in the flight program.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the data analysis, the following conclusions may be drawn: When comparing days-to-degree, instrument rating completion and degree completion, there were no statistically significant differences between native and transfer private pilots for the study's time period. A pilot's transfer status does not appear to be a good indicator of student success in the Aviation Flight Program.

When comparing days-to-degree, instrument rating completion and degree completion, there were no statistically significant differences between transfer private pilots that directly entered instrument training and those required to pass an evaluation or receive proficiency training. For the study's time period, proficiency training and testing do not appear to be a good indicator of student success in the Aviation Flight Program.

Based on the results of this study and the findings, the following recommendations can be made: Future research should be conducted on the effectiveness of the current Private Pilot Transition Course as a transitioning tool for transfer private pilots in the flight program. Further research should be conducted on factors that effect program completion and time-to-degree for collegiate aviation flight students.

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Study of Flight School Pilot Incident Data: Implication for Educators

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ABSTRACT

Flight training presents some of the most dangerous times in a pilots flying career. Lack of experience, decision-making abilities and youth can create a recipe for a potential disaster. The majority of pilots complete their training at an established flight school. A collegiate aviation department or a Fixed Base Operator can operate these flight schools. In both situations, there are associated risk factors.

This study was completed to identify aircraft incidents that occurred with pilots who were piloting flight school aircraft and to thereby identify possible training weaknesses. The researcher utilized the Federal Aviation Administration (FAA), Aviation Safety Information Analysis and Sharing (ASIAS), Accident/Incident Data System (AIDS) to obtain 397 aircraft incidents that occurred at flight schools from January 1978 to July 2007. The incidents were broken down based on the highest pilot certificate held by the pilot; incident categories were established, and then incidents were tabulated in order to generate descriptive statistics. Meaningful data was derived under each of the pilot certificates and recommendations were made to improve safety.

INTRODUCTION

According to Green (2001) "Aviation is a high-risk activity" (p. 101). This case study was completed to identify the risk exposure for flight school pilots by analyzing associated aircraft incidents. A study completed by Chappell (1997) stated, "The premier value of incident knowledge is its potential role in preventing accidents" (p. 149). Therefore, implementation of the findings of this study could prevent substantial damage to an aircraft and or serious injury to the occupants. By reviewing these incidents, risk can be exposed and specific actions can be taken to tailor training to prevent or reduce their occurrence.

Students rely upon educators to use their expertise to take all possible measures to reduce the risk that are inherent with flight. A proper method in which to accomplish this according to Green (2001, p. 101) as reported in the AOPA Nall Report (1997) is to "…gain knowledge about the risks and take proactive steps to control them" (p. 2). Knowledge can be gained by researching aircraft incidents associated with flight school pilots and educators can thus use training to attempt to improve safety.

Problem Statement

The AOPA Nall Report (2006) documents that "The total number of General Aviation (GA) accidents is relatively low, but remains significantly higher than the airlines", (p. 4). This need for improvement in GA safety establishes the basis for this study. Furthermore, pilots who are in training are especially vulnerable because of their lack of experience. Thus, by identifying aircraft incidents, proactive steps can be taken to arrest a problem prior to a more serious event such as an accident occurring. The two questions that were developed to guide this research are as follows:

1. What aircraft incidents do flight school pilots most frequently report?
2. What methods can be adopted to improve safety at flight schools when studying the most frequently reported flight school pilot incidents?

RISK IDENTIFICATION

Accident Data

One common method used to identify safety problems is accident data. By reviewing the results of a breakdown in a safety system, changes can be made to prevent further mishaps from occurring. This is a useful way in which to identify weak areas and shore them up through strengthening curriculum and other accident prevention methods. It also is the only way to collect data on certain events. For example, a typical accident scenario occurs when a non-instrument rated pilot flies into Instrument

Meteorological Conditions (IMC), and subsequently, loses control of the aircraft. The scenario is a familiar one usually resulting in a fatality. Therefore, accident data in some flight regimes is the only data available. Another danger can arise when a pilot loses control during a takeoff. These low altitude mistakes leave little time to recover and, thus, an accident occurs. If the pilot does recover, then neither an accident nor incident would have occurred, and no data would be available. This is important to note since incident data has limitations and cannot warn us in all areas that present danger. Therefore, understanding that incident data is not all-inclusive when considering the hazards associated with flight is important. Undoubtedly, there is value in studying accident data but in order for this data to exist; a serious event must take place. Incident data allows us to see trends that could lead to an accident before they occur.

Incident Data

Incident data is commonly used as a way to identify risk associated with flight. This methodology has a distinct advantage over accident data in that it identifies a weakness in the safety system prior to a complete failure of the system. Incident data was used to determine the most commonly reported incidents that are being committed by flight school pilots. Analyzing incident data provides the means to identify areas for improvement. As stated by Chappell (1997) "Proper use of incident data can provide unique insights into safety issues for which follow-up laboratory research can be conducted" (p. 152). Additionally, by identifying these areas, educators can raise awareness and allocate additional training resources in order to eliminate or reduce the likelihood of an accident. Utilizing incident data is a valid way in which to determine what could be changed to prevent reoccurrence of a type of incident and possibly prevent an accident.

Shared Responsibility

Although the pilot in command has ultimate responsibility for the safety of a flight, it is without a doubt a shared responsibility of many individuals. Consider that the aircraft mechanics, airport inspectors, and certified flight instructors are just some of the individuals who can play a positive role in breaking the incident or accident chain. There are, in fact, many individuals who have the ability to prevent a mishap before it occurs (Gill, 2004). A variety of studies have clearly established that there are many contributing factors when an accident occurs. A study completed by Lu, Pretzak and Wetmore (2006, p. 121), found the following non-flight groupings could contribute to an air carrier accident.

1. Flight operations
2. Ground crew
3. Turbulence
4. Maintenance
5. Foreign Object Damage
6. Flight Attendant
7. Air Traffic Control
8. Manufacturer
9. Passenger
10. Federal Aviation Administration

These individuals and organizations can also play a role in preventing incidents.

Mattson, Petrin, and Young (2001), found that in the early years of accident investigation, the pilot or an air traffic controller was typically cited as the cause of an accident instead of looking past the initial facts and determining an underlying root cause. This superficial type of investigation creates more of a blame mentality than one that is focused upon discovering the root causes of an incident/accident and eliminating them. For example, if a pilot was slow to recognize a system failure in an aircraft and take corrective action in time to prevent an incident, would it be prudent to blame only the pilot? Could a more in-depth investigation uncover an underlying deficiency such as an organization that took a blasé stance toward safety? Lu, Pretzak and Wetmore (2005) found that "the aviation safety net consists of flight crews, maintenance personnel, air traffic controllers, airplane dispatchers, flight attendants, ramp agents, airport security, and related professionals" (p. 138). This suggests that safety is the responsibility of more than just the pilot in command of the aircraft at the time of a mishap.

Research completed by Mattson, Petrin and Young (2001) found that "A major challenge to accident investigators is the analysis of factors that may have caused a chain of events reverberating all the way through the organization to the individual" (pg. 39). Once again, research suggests that there is a correlation between an aircraft mishap and, not only the pilot, but a myriad of individuals including educators.

SAFETY CULTURE

Culture is defined by Pidgeon and O'Leary (1994) "…as the set of beliefs, norms, attitudes, roles, and social and technical practices within an organization which are concerned with minimizing the exposure of individuals, both within and outside an organization, considered to be dangerous" (p. 32). The individuals who are in a position to establish these criteria create a flight school culture. This includes faculty, certified flight instructors, and other flight school employees.

An effective safety culture should permeate throughout an organization. This has been publicized by Pidgeon and O'Leary (1994, p. 33) where they documented the ways in which safety should be infused into an organization.

1. Strategic management level
2. Distributed attitudes of care and concern throughout an organization
3. Appropriate norms and rules for handling hazards
4. On going reflection upon safety practice

Safety culture is not only a responsibility of an aviation department but is a shared responsibility of many levels in a university. An organization's culture can be a deterrent or a contributor to an incident/accident. As found by Pidgeon and O'Leary (1994) "… under the general heading of human factors, wider organizational factors have only recently been clearly identified as contributing significantly to accident causation, and hence as a topic of concern for both aviation safety researchers and practitioners" (p. 21). Thus, the culture of a flight school has implications when considering safety. Early airmail operations would be a case in point. With an attitude of completing a flight regardless of the risk, pilots were forced into adverse weather conditions to their own demise. Additionally, consider that investigations at the National Aeronautics and Space Administration (NASA) conducted after the shuttle accidents were focused on analyzing the organization in order to identify contributing factors (Pidgeon & O'Leary, 1994).

Safety Audit

Safety deficiencies within organizations may not be as easy to find and correct as they once were. However, that does not mean that they do not exist. Obvious deficiencies are eliminated or minimized in the early years of an organization. The remaining safety deficiencies are more difficult to detect. Fortunately, there are trained professionals who can assist in this area. There are a variety of organizations that will conduct an audit for a flight school. One such safety audit is performed by experienced educators on behalf of the University Aviation Association (UAA). These safety experts all have experience with flight schools and in a variety of aviation positions.

Instructional Methods

Educators act as guardians of those who desire to follow in their footsteps. Therefore, the findings of Dillman, Lee, and Petrin (2003) are relevant "Concrete measurements and detailed observations are required to determine where there are weaknesses in the safety culture so that appropriate remedies can be devised" (p. 93). The structure of a course, educator's attitudes, and methods used to convey concepts all influence a students understanding of what is normative behavior when piloting an aircraft.

An educator's personal experiences can be useful in teaching safety. However, it is important to be aware of what is implied when recalling personal narratives to impressionable students. For example, proudly interjecting flying stories for the sole purpose of establishing one's own prowess in an aircraft could lead students to believe that risk taking is a rite of passage. However, properly framed as an "I'll never do that again" story provides valuable first hand experience that can lead students to a greater understanding. Students not only hear the message but also pick up on body language. Thus, educators need to evaluate the manner in which they are delivering their personal narratives.

Instructional design and instructional strategies indicate to students an instructor's attitudes towards the importance of course content. Enthusiasm and organized curriculum convey that an instructor believes in the importance of a topic; whereas, yellowed notes brought into a classroom from decades past can be seen as not only dated but lead students to believe that the topic is not worthy of an instructor's best effort. This inference might then manifest itself in a mimicked attitude when the student is studying material or preparing for a flight.

Dillman, Lee, and Petrin (2003) found that "One of the ways that an awareness of a safety culture can be promoted is by placing the idea of safety at the forefront from the beginning of training all the way through the certification process" (p. 93). An effective safety culture can be established if safety is imbedded in the curriculum and espoused by instructors in the collegiate classroom. This can be a very effective deterrent to an incident/accident.

According to Green (2001) "If and how we adapt our educational practices to enhance pilot decision-making will have important implications for aviation safety in the future" (p. 108). Her findings are consistent with the 2006 Nall report where it was reported that accidents could be reduced by "improving aeronautical decision making." Therefore, safety can be strengthened by teaching proper techniques and good decision-making. Good decision-making is challenging to teach, but when accomplished, it provides a powerful force in the prevention of accidents or incidents.

Teaching safety is possible, and no one in the business of educating pilots should shirk their responsibility to make a positive contribution; imbedding safety into their curriculum must be a priority. Consider that Thom and Clariett (2004) found, "Safe behavior like any other behavior is learned through the repetitive interaction of action and consequence" (p. 99). This leaves little doubt that the collegiate aviation classroom provides fertile soil for "safety seeds". Case studies and other instructional strategies can provide a catalyst to assist a student in understanding the relationship between cause and effect.

Flight Schools

Flight schools can be owned and operated by a collegiate aviation program or a fixed based operator. Regardless of which organizational umbrella that they are under, informing all parties concerned about the types of incidents committed by flight school pilots is equally important.

The majority of pilots complete their primary and advanced training at a flight school. The quality of training received at these institutions has safety implications across civil and military flying. It was reported by Green (2001) that "The research demonstrates that pilot attitude toward risk and risk management strategies are established quite early in flight training" (pg. 106). There is truth in the adage that states, "Old habits die hard." It is therefore crucial that sound flight training be given at the earliest stages so that the habits developed are best practices and not poor procedures that lead to an incident.

Flight schools serve a valuable role in preparing pilots to manage the risk associated with flight. The vast majority of airline, military and civilian pilots can trace their flying roots back to one of these establishments. They provide the instructional building blocks upon which many more hours of instruction and experience will be laid. When unsafe practices, attitudes, and theories are imbedded at this early stage, they can contribute to a future aircraft accident. Therefore, it is imperative to identify these bad traits prior to an incident/accident occurring. According to Lee, Fanjoy and Dillman (2005) "Clearly, initial training in a collegiate flight program is one of the most defining stages for future professional pilots" (p. 5). This fact is supported by the 2006 Nall report, "The first 500 hours of a pilot's flying career are the most critical, with 30.9 percent of the total accidents and 30.7 percent of fatal accidents occurring within that timeframe" (p. 16).

Inadequate training or bad habits taught early in a pilot's career can eventually lead to disastrous results. This suggests the need for a mechanism that can be used to determine when an accident might occur. Incident data provides one such mechanism. It is imperative to review this data to glean useful information in order to incorporate best practices into training and break a link in the incident/accident chain.

RESEARCH METHODOLOGY

The researcher utilized the FAA, ASIAS, AIDS database to obtain 408 incidents committed by flight school pilots. The data was then separated by using a coding form that was developed for this study. This categorized the incidents by pilot certificate and type of incident. Once the data was separated it was entered into a Microsoft Excel spreadsheet to generate descriptive statistics. This method of statistically analyzing the data is supported by Chappell, (1997) where she stated, “The most common and often the only valid quantitative analyses of incident data are descriptive, rather than inferential” (p. 163). Additionally, a review of the literature was completed to establish the need for this research and report on relevant studies that frame the need for this study.

This study took the following three-step approach to answer the research questions.

1.) Data concerning flight school incidents was obtained from the FAA, ASIAS, AIDS database and subsequently analyzed.
2.) A literature review was completed to identify other relevant research and to frame this study.
3.) Recommendations were developed to equip educators with a means to prevent an incident before it occurs.

This study utilized a systematic approach in order to provide need-to-know information to educators so that they could fulfill their responsibilities in minimizing risk exposure to flight school pilots.

The data derived by this report has value not only to collegiate educators but also to anyone in the business of training pilots for certificates and ratings. This includes certified flight instructors who provide the training, collegiate aviation instructors, and many others who can provide another safety barrier to prevent an incident/accident from occurring.

Data Collection

The data collected for this research was obtained from the Federal Aviation Administration (FAA), Aviation Safety Information Analysis and Sharing (ASIAS), Accident/Incident Data System (AIDS). This online database is a compilation of several incident-reporting mechanisms including information supplied to the FAA through the accident/incident reporting form 8020-5.

The researcher coded and subsequently analyzed 397 pilot incidents that occurred from January 1978 to July 2007. All of the incidents occurred while pilots were flying in association with a flight school. The research was completed in order to analyze incident types and frequency of occurrence with pilots flying flight school aircraft. Trends and safety issues can be gleaned from the data and steps can be taken to mitigate them.

RESULTS

When interpreting the results of this study, the researcher avoided comparing incidents rates across flight certificates. It would not be accurate to compare the groups across types of incidents since it is unknown how many flight hours each group flew. For example, perhaps the private pilot group flew three times as many hours as commercial pilots during the data collection period and, thus, experienced more landing type incidents. Would it be accurate to say that commercial pilots are less likely to experience a landing type incident as compared to the private pilot group? The frequency of flights of the private pilots would push up the probability of an incident occurring and, without controlling for these factors, accurate interpretation of the data would not occur. Therefore, the results of this study will only analyze the data found within one pilot certificate group and not compare across the groups. It should also be noted that the categories of “Gear None” and “Retract Gear” are not one in the same. “Gear None” is a heading used when the pilot landed without lowering the landing gear while “Retract Gear” describes an incident whereby a pilot inadvertently raised the gear lever while on the ground resulting in the fuselage coming in contact with the runway.

Student Pilot Certificate

When reviewing the incidents reported, the greatest probability for an aircraft incident for student pilots occurs during the landing phase. A review of Figure 1 shows that the two areas with the most incidents are Brake Ground Control (32%) and the Level Off (29%) phase of flight. These two incidents, both associated with landing an aircraft, account for more than half (61%) of all the incidents associated with student pilots. Additionally, the 2006 Nall report documents that, regardless of the pilot certificate held, the landing phase of flight has the highest incidence of accidents (35.3%).

The specific event classified under Brake/Ground Control or Level Off was one of the following:

1. Losing control of the aircraft while in the landing roll out
2. Flaring high resulting in a hard landing
3. Landing on the nose gear before the main gear touched down and losing directional control or causing its failure
4. Landing short of the runway

Pilots usually consider landing the aircraft to be one of the most challenging aspects of flight. The challenge of the maneuver, coupled with the fact that a landing is performed at least once with each flight, accounts for the high rate of incidents in this area. These incidents all occurred between the flare and the roll out. Landing is one of the greatest hurdles to overcome as a novice pilot. Therefore, Certified Flight Instructors should emphasize proper technique, and collegiate faculty should reinforce this training in the classroom. Additionally, special emphasis should be focused on decision-making. Student pilots not only lack technique, but they also have not had the chance to learn from experience and hone their decision-making abilities. This is a premier opportunity for education to play a role in improving the safety of this phase of flight. It also serves as a reminder to Certified Flight Instructor's (CFI's) that they must remain vigilant during this phase of flight. In addition, establishing when the CFI has the aircraft under their control is important. Many of the incident narratives that fell under "brake/ground control" occurred with a CFI and student countering each other on the controls. In some instances, the physical force of the pilot's counter inputs resulted in the breakage of aircraft mechanical parts. These incidents may be reduced by CFI's establishing clear procedures that delineate when they want the student to relinquish control of the aircraft.

If there is any good news surrounding this data, it is that although landings are a significant contributor to incidents and accidents, they are usually not fatal. The 2006 Nall report stated that landings make up 35.3% of accidents, but they only represent 5.0% of overall fatalities.

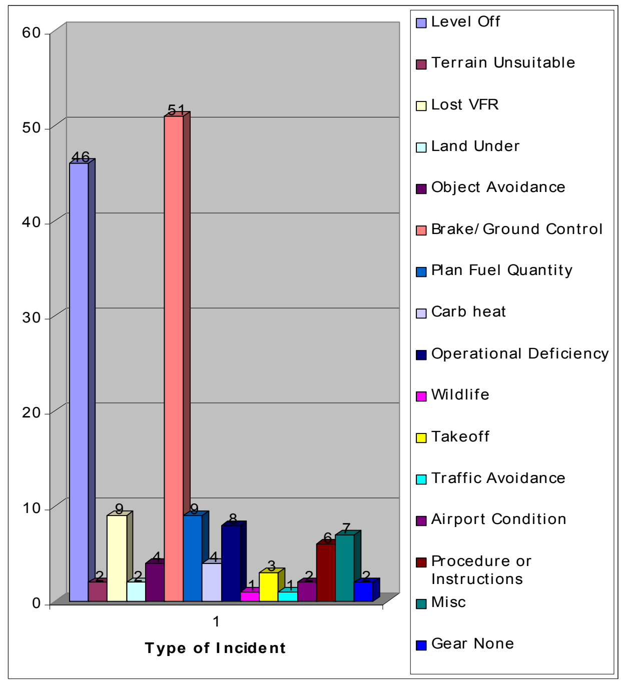

Figure 1. Student Pilot Incident Frequency January 1978 – July 2007.

Private Pilot Certificate Incidents

The data collected indicates that the top three incident areas in this category are Operational Deficiencies (21%), Gear None (14%), Brake Ground Control (12%) and Level Off (11%). It is interesting to note that pilots at this level appear to be gaining mastery of the aircraft with more incidents attributable to mechanical issues with the aircraft.

It should be noted that Operational Deficiencies were the leading reported cause of incidents for Private pilots (21%), Commercial pilots (34%) and Airline Transport pilots (33%). These operational deficiencies cover a wide range of events, but all have commonality in that they all reflect an aircraft system breakdown. It becomes apparent that emergency procedures must be ingrained in a flight school culture so that when a breakdown occurs, the pilot will respond appropriately.

If Gear None (14%), Brake Ground Control (12%) and Level Off (11%) were categorized under a single heading of improper pilot technique, they would account for (37%) of the overall incidents. Moreover, all of the areas except "Operational Deficiency" could be listed under a broad heading of decision-making. This illustrates just how powerful of a role decision making can play in safe piloting. Teaching pilots how to assess the risk and make choices that lead to a safe outcome are paramount in improving flight school safety.

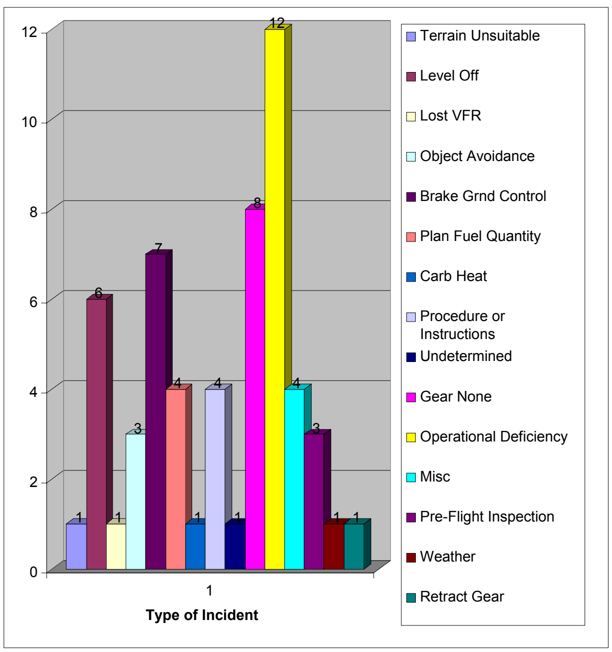

Figure 2. Private Pilot Incident Frequency January 1978 – July 2007

Commercial Pilot Certificate

The top five areas of flight that reported incidents occur are depicted in Figure 3 as Operational Deficiencies (34%), Brake Ground Control (13%), Retract Gear (13%), Level Off (7%) and Gear None (7%).

Nearly one third of all of the incidents that occur are the result of a mechanical issue. At first glance, this seems to be outside of the realm of a pilot's control. However, it remains a possibility that a pilot mismanaged an aircraft system thus leading to a mechanical breakdown. Such would be the case when a pilot thermal shocks the engine, runs the engine at above recommended power settings, or uses improper startup techniques during cold weather operations. The cumulative effect of this abuse may lead to a mechanical breakdown.

The other four areas listed above could be listed as procedural errors. Once again, stressing the importance of checklist and proper procedures could help in reducing these types of incidents.

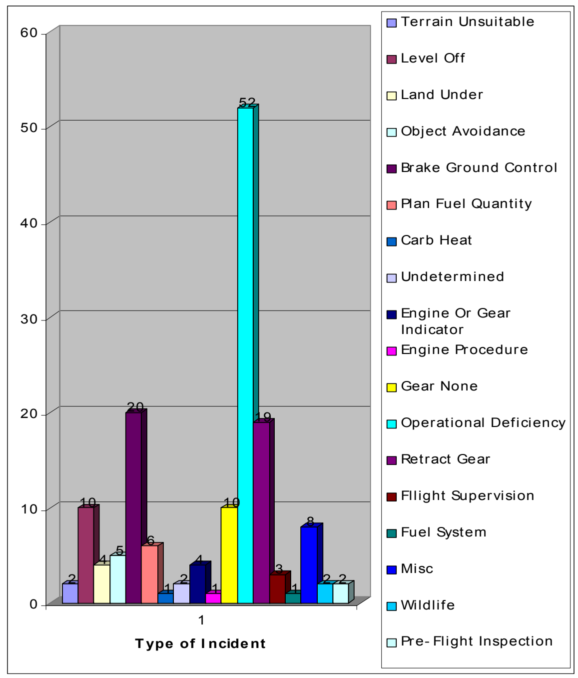

Figure 3. Commercial Pilot Incident Frequency January 1978 – July 2007.

.*Airline Transport Pilot Certificate*

For pilots who held an Airline Transport Certificate the top reported incidents were Operational Deficiencies (33%), Gear None (23%), Retract Gear (8%), Flight Supervision (8%) and Level Off (8%). Once again, Operational Deficiencies account for over one third of the incidents experienced by ATP certificate holders. These pilots are typically beyond the classroom environment and, thus, are somewhat more difficult for a collegiate faculty member to influence.

Gear none was the second most common area of aircraft incident accounting for (23%) of the total. In reading the narratives, it was apparent that in most cases this is a missed item on a checklist. Maintaining a sterile cockpit below a certain altitude or within a certain distance of the airport and stressing the importance of not being complacent may reduce the amount of incidents occurring in this area. Once again, since pilots that hold this certificate are typically beyond the collegiate classroom, early training may be one of the most effective ways in which to safe guard against these incidents occurring.

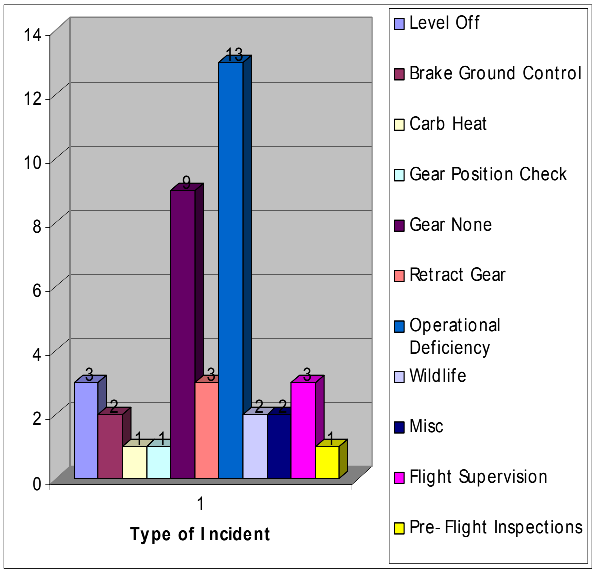

Figure 4. Airline Transport Pilot Incident Frequency January 1978 – July 2007.

IMPLICATIONS FOR EDUCATORS

This study was completed to identify risk associated with flying at a flight school and effectively use training to maximize the safety barrier that effective instruction can provide.

The following are recommendations that were developed from this study and are suggested to reduce the incidents associated with Flight Schools and minimize the possibility of an accident. It is also believed that implementing them will reduce the severity of an incident or accident if it were to occur.

1. Long runways, clear approaches and ARFF equipment all have the ability to stop an incident before it develops into an accident. If possible, pilot training should be conducted at an airport that has a comprehensive safety net in place to minimize the possibility of an accident.
2. Renewed emphases should be placed upon landing technique and proper go around procedures.
3. Certified Flight Instructors and student pilot certificate holders should be made aware of the dangers that the landing phase of flight presents and should assure that best practices are being used to teach this flight maneuver. Collegiate aviation faculty members and CFI's should strive to teach sound decision-making through case based studies, problem based learning, and the use of flight simulators. The ability to identify risk and determine what is an acceptable risk are the most effective deterrents to an incident/accident.
4. Consideration should be given to creating a non-punitive, confidential, incident-reporting program at flight schools so that safety issues can be identified and effectively addressed.
5. Flight school pilots, collegiate faculty members, and all other individuals that play a role in safety should be periodically brought together to address areas of safety concern.
6. Flight schools should consider implementing a safety management system to oversee all aspects of flight school safety.

The primary reason to improve safety is to prevent the loss of life. However, loss of property must also be considered. This cost is not only in equipment replacement but also in rising insurance premiums. Godlewski (2005) quoted Phil Kolczynski, an aviation attorney, as stating "There have been instances where a pilot has gone through the factory training, then after an accident filed suit against the person or school providing the training claiming that it was substandard" (p. 37). Lawsuits are yet another possible vulnerable area for flight schools. The bad publicity from such an event could curb enrollments and in the most dire cases cause university administrators to eliminate an aviation program.

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