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Exploring the Viability of an Organizational Readiness Assessment for Participatory Management Programs in a Passenger Airline Carrier

Al Bellamy
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ABSTRACT

This study attempted to determine the feasibility of conducting an organizational readiness assessment for a participatory management program for maintenance workers within a large passenger airline. Organizational readiness factors consisted of the motivation climate of the department, supervisory behaviors, and the employee's orientation to group problem-solving. The results of a questionnaire study among 73 line maintenance workers revealed that only the group orientation factors predicted employees' willingness to participate in group process improvement programs. However, strong and statistically significant correlations were shown among the willingness to participate variable and employee job satisfaction. The study revealed that employee group orientation moderates the relationships between the independent and criterion factors. Results also revealed that the employee's personality orientation moderates the relationships between the organizational factors and employees' willingness to participate in group process improvement programs.

INTRODUCTION

The use of employee participatory schemes for enhancing organizational effectiveness is becoming more popular in a wide variety of organizations (Lawler, Mohrman, and Ledford, 1992) This approach is being considered within the air carrier environment as a viable method for impacting organizational and cultural change.

In general, employee involvement has been conceptualized as an approach that ameliorates many of the negative consequences of traditional hierarchical forms of management. Participatory structures have been cited as positively affecting worker morale (Steel and Lloyd, 1988), and organizational effectiveness (Macy, Peterson, and Norton, 1989; Lawler, 1986).

The focus of this paper is on the use of employee participatory schemes within the maintenance function of an air carrier.

Participatory processes within these units are particularly salient because of the potential positive impact that they may have for reducing human and work process errors affecting the safety of air carriers (Rasmussen, Duncan, Leplat, 1987; Helmriech, Wilhelm, Klinect and Merritt, 1997). However, we propose that the expected positive outcomes of the lexicon of employee involvement schemes that exist may be undermined by the organization's lack of information concerning its state of readiness for these types of interventions.

More specifically, organizations could possibly improve upon the fecundity of their team process improvement attempts by ascertaining information concerning the employee's perception of these processes prior to their implementation. Employee involvement alone is not a panacea for improving the effectiveness of work processes in organizations.

Knowing the perceptual/attitudinal genome of the workforce prior would facilitate more effective design of the program's structure and implementation. Empirical research indicates that employee participation in decision-making and problem-solving has a minimal influence on job performance and work attitudes (Cotton, Volrath, Froggart, Lengnick-Hall, and Jennings 1988; Wagner, 1994). Perhaps pre-assessment of the organization's readiness for participatory structures is the critical factor that has been missing from employee involvement programs that attempt to affect performance and attitudes.

The purpose of this paper is to describe the results of an organizational readiness survey conducted within a large passenger airline that was contemplating the deployment of a team process improvement program within their maintenance department. Our objective is to determine if organizational readiness factors, consisting of the department's organizational climate (which we refer to as the "motivation climate") supervisory behavior, and the group orientation of the employees, are related to the maintenance worker's willingness to participate in work related group problem-solving improvement (GPI) processes in their department. We also examined the extent to which the organizational readiness factors are correlated with employee job satisfaction.

This paper begins with a discussion of a theoretical framework that we feel is helpful in analyzing and interpreting our data. We then describe the organizational readiness factors incorporated within the present research study.

THEORETICAL FOUNDATION

Expectancy theory (Vroom, 1964; Mitchell, 1974) provides theoretical support to our proposition that the organizational readiness factors will influence the efficacy of team based process improvement programs. Although this is a theory of work motivation, which initially was concerned with predicting work attitudes (for example, job satisfaction) and work performance, the theory is also applicable for analyzing attitudes towards things such as participating in employee involvement programs. According to this theoretical framework, the manner in which employees respond to organizational actions is influenced by:
(1) their perception of whether or not an action or behavior in response to organizational stimuli will lead to various outcomes (referred to as expectancy), and (2) the value that is attached to the predicted outcomes (referred to as valences).

Each of the readiness factors delineated within this study may affect employees' expectancy as to whether or not desirable outcomes (for example, improved work processes) will emerge as a result of their participation in group work improvement processes. Secondly, we are suggesting that the value attached by employees to such processes is influenced by the readiness factors. In short, the theory suggests that the willingness of maintenance workers to participate in group problem-solving efforts would be influenced by their perceptions of previous and existing organizational actions (climate) and the manner in which employees are approached by their supervisor. Both factors are expected to impact employee's perceptions of whether or not something useful will emerge from such efforts. Accordingly, these perceptions may determine the valence that employees' attach to participatory management and process improvement schemes.

Central to the expectancy theory framework is the idea that qualities of the individual affect the expectancy and valences attached to organizational actions. This study examined the extent that the problem-solving orientation of employees moderates the relationships between the organizational readiness factors and the employee's willingness to engage process improvement processes within a work group structure.

We will now give a brief description of each of the variables that will be analyzed within the context of expectancy theory.

ORGANIZATIONAL READINESS FACTORS

The Motivation Climate

Work unit or organizational climate pertains to employees' perceptions of formal and informal reward system expectations of behavioral and organizational outcomes, and perceptions of organizational policies and procedures (Tesluk, Vance & Mathieu, 1999; Schenieder, 1990). Climate is particularly affected by management practices and behaviors as well as intrā and interunit relationships. Within this study, we examined the following factors that can be conceptualized as climate factors that may affect employees' willingness to participate in a process improvement program:

1. The extent that management encourages employees to "think."
2. The extent that management encourages employees to make suggestions regarding ways to improve work processes.
3. The extent that employees perceive that management will take credit for their ideas.
4. The extent that management is perceived listen to employees' ideas concerning work improvements
5. The extent that employees perceive that they have to be careful about publicly discussing their ideas about work improvements
6. The extent that employees perceive that management utilizes the knowledge of the workforce.
7. Employees' perception regarding the efficacy of interunit communications.
8. Employees' perception regarding the efficacy of intraunit communications.

Supervisory Practices

Expectancy theory proposes that the behaviors of supervisors can clarify or stifle channels leading to high employee motivation and performance (House and Mitchell, 1976). Accordingly, they may also influence employees' willingness to be involved in work improvement efforts. This study analyzes two areas of supervisory behavior:

1. The supervisor's reward-punishment orientation
2. The participatory orientation of the supervisor

We suspected that these behaviors could positively or negatively affect employees' willingness to participate in process improvement efforts. The reward-punishment orientation of the supervisor has been shown in previous research to affect the employees' disposition towards work (Keller & Szilagyi, 1978; Sims, 1980; Podsakoff, Todor, Grover, & Huber 1984). This supervisory dimension pertains to the extent that supervisors are oriented toward rewarding employees when they do something positive or not rewarding for good performance but punishing them when they do something wrong. We anticipated a negative correlation between a punishment orientation and willingness to participate in GPI.

The participatory orientation of supervisors pertains to behaviors that reflect the asking of, or consulting with, employees when making work related decisions. Supervisors exhibiting a participatory orientation resemble the participatory nature of group problem-solving processes and are therefore expected to raise both the expectancy levels and valence that employees would attach to GPI. We expect a positive correlation between this factor and GPI.

Employee Orientation Towards Group Problem-Solving

A factor often overlooked by organizations in their attempt to affect change through group problem-solving tactics is the employee's orientation towards group interaction. Oftentimes, the organization takes a hierarchical approach to decentralizing decision-making processes by “demanding” employees to participate in group decision making processes. In short, not all employees have a need to engage in group problem-solving. Some employees may prefer to work alone while others would enjoy working in a group. Either disposition should be seen as affecting the valence that workers would attach to participatory management schemes involving team or group problem solving.

Organizational change is perhaps made less virulent by not taking into consideration the employees’ disposition towards working in process improvement groups. For example, one would suspect that employees’ willingness to participate in GPI would decline with their tendency to work alone.

Problem-Solving Orientation

Problem-solving orientation refers to an individual’s internal needs and preferences that influence the ways in which she/he processes (or perceives) information from their environment. This construct was developed by Carl Jung (1923) and first codified empirically by Meyers-Briggs personality type inventory (1970). According to Jung, there are four dimensions that are involved in information gathering and evaluation: Sensation-Intuitive and Thinking-Feeling. This study is concerned with only one function, the gathering of information, which consists of the bipolar opposites of sensation and intuition. The sensing dimension pertains to an orientation toward structure, organization, details, and a need for what is actual and real. Intuition, on the other hand, relates to an internal preference that looks for possibilities rather than facts and focusing on “the big picture” rather than small details of a problem. In short, a sensation personality type is one who prefers routine and structure whereas intuitives, when solving problems, become impatient with routine details.

The problem-solving orientation of employees may be very significant as a moderator factor within our study, as well as in practice. For example, we would expect that each type would perceive group problem-solving in a different way, which in turn influences the relationships between our criterion factors and the organizational readiness variables.

SPECIFIC RESEARCH QUESTIONS

In attempting to determine the utility of conducting an analysis of how employees’ perceptions of various organizational and interpersonal factors may influence the effectiveness of team based work improvement processes, this study examined the following questions:

1. What is the nature and extent of the correlation between organizational climate factors (as perceived by employees) and the employees’ willingness to participate in process improvement groups?
2. How does the employee’s orientation towards working in groups influence their willingness to participate in process improvement groups?

3. What is the relationship between supervisory behaviors and the employees' willingness to participate in process improvement groups?
4. What is the relationship between each of the organization readiness factors identified within this study and employee job satisfaction?
5. In what ways does a person's problem-solving orientation moderate the relationships between the organizational readiness factors and their willingness to participate in process improvement groups as well as their attitude towards their job?

Although some studies have not shown high correlation between job satisfaction and employee involvement schemes (Wagner, 1994), investigating the nature of this relationship would be a useful indicator to management of how organizational processes are affecting the attitudes of its employees. Subsequently, this type of feedback may be helpful during the planning stages of their work improvement programs.

METHODOLOGY

Sample

Data for this study were collected from 73 employees, randomly selected from the maintenance department of a large commercial airline. The total number of employees within this group is 475. The study also collected information from 9 managers within this department. However, this study will only present information obtained from line maintenance workers.

Measurement

A questionnaire consisting of 55 items was administered to this study's sample group during the summer of 1997. A description of how the variables of this study were measured is as follows:

Criterion Factors: Willingness to Participate and Job Satisfaction

1. Willingness to participate in group process improvement processes was measured by one questionnaire item that stated: "If given the opportunity, I would participate in a process improvement group for this station, if personnel from other departments were included".
This item utilized a Likert type structure consisting of five response choices ranging from strongly disagree to strongly agree.
2. Job Satisfaction was measured by a five-item scale that measured workers' attitudes toward the following job factors:

- The job itself
- Supervision
- Opportunity for promotion
- Pay

Respondents were asked to respond to each of these items in terms of their satisfaction level with each. The items were constructed in a Likert format consisting of five scale points with response categories ranging from strongly disagree to strongly agree.

For analysis purposes, each of the five items were combined to form a job satisfaction scale. Crombach's alpha reliability for this scale (within this particular study) is .70.
Scores for this scale ranged from 4 – 19 with a standard deviation of 3.30. A copy of this scale can be found in Appendix A.

Independent Factors: Organizational readiness variables

Each of the organizational readiness variables was measured by using Likert type items consisting of five scale points with response anchors ranging from strongly disagree to strongly agree. A total of 7 organizational readiness items are reported within this paper. A copy of each of these items is presented within Appendix A.

Moderator factors: Problem-solving orientation

The problem-solving orientation of employees was measured by 6 items selected from the Meyers-Briggs Personality Type Inventory that pertained to the sensation-intuition psychological function. Each of these items consisted of bipolar selections pertaining to the sensing and intuitive functions. For analysis purposes, a value of 1 was given to intuitive choices and a value of 2 was assigned to sensation choices. Each of the items was then added to form a single problem-solving scale. Thus, higher scores reflect a sensation orientation and vice versa. This greatly shortened "version" of the Meyers-Briggs personality inventory was used because the 138 item of the full inventory is simply too large to use in applied research. A comparison was made prior to the study between the resulting personality profile for these dimensions on our modified version and those produced by the Keiersey Temperament Scale (1973), which has been shown to present the same personality profile as the Meyers-Briggs Scale. Our pilot analyses revealed identical profiles on the sensation-intuitive functions for both measurements. Our shortened version revealed an alpha reliability of .74. Scores for this scale ranged from 6 thru 12 with a median of 11. Scores were recoded into two categories to indicate personality type. The intuitive category has scores ranging from 6 thru 9 (n=16). The sensation category is comprised of scores ranging from 10 thru 12 (n=57). A copy of the problem-solving orientation scale is presented in Appendix A.

RESULTS

General Findings

Table 1 reveals that strong and statistically significant correlations exist between the readiness factors and employees' willingness to participate in group improvement processes with the group orientation factors. From a practical viewpoint, this is a very important finding because it strongly suggests the need for management to take more serious consideration of their employees' perceptions regarding group processes before implementing employee involvement programs. This is a variable that is curiously missing in many employee involvement programs. Organizations most commonly insist upon full participation among all employees regardless of their orientation towards groups. Table I reveals that there are very strong and statistically significant correlations between the climate and supervision factors with job satisfaction. Only one of three group orientation factors ("performs well in groups") is correlated with job satisfaction. The relatively strong correlation between the "performs well in groups" factor and job satisfaction, supports the expectancy theory framework that performance impacts job satisfaction as opposed to the idea that job satisfaction "causes" performance. (The other two group orientation factors are not referencing performance).

It is particularly important to point out that job satisfaction is not highly correlated with employees' willingness to participate in group work improvement processes.

The Moderator Influence of Problem-solving Orientations: Motivation Climate Factor

We will now attempt to determine if the problem-solving orientation of employees alter the relationships between the organizational readiness factors and the two criterion variables. If they do alter the correlations, this would suggest to management that this factor (as well as others) should be carefully contemplated within the planning processes of employee participatory schemes.

Tables 2 and 3 illustrate the correlations between the motivation climate factors and the criteria by categories of intuitive and sensation employees, respectively. In comparing the results of the two tables, it is shown that the problem-solving orientation of the employees does not moderate the relationships between willingness to participate and the climate factors. However, important differences are revealed among the job satisfaction and climate factors. The largest difference is found for the variable pertaining to the employee's perception of whether or not management listens to employees' ideas regarding work improvements. While both large and statistically significant correlations are found among both problem-solving types, the relationship is much stronger among intuitives. This may indicate that intuitives place higher valence on this factor than sensations. This proposition is congruent with their propensity (theoretically) towards being "idea" people in comparison to sensations, who are more directed towards detail and order. Thus, the higher correlation shown among this group on this variable could be implying that intuitives are more sensitive to this factor than sensation type employees.

The other substantial correlation difference is found for the communication within the work unit variable. There is virtually no correlation found for intuitives, while sensations exhibit a strong and statistically significant correlation for this variable with job satisfaction.

<u>The Moderator Influence of Problem-solving Orientations: Supervision Factors</u>

The degree to which the problem-solving orientations influence the relationships between willingness to participate and supervision factors is shown in Tables 4 and 5. As can be seen by comparing the two tables, no statistically significant results are shown for this variable. However, in spite of this lack of significance, much stronger correlations are shown among the intuitives, which seems to imply that supervision influences the expectancies associated with participating in work improvement groups among intuitives more than it does among sensation employees.

Examining the correlations among the job satisfaction criteria, we observe very strong and statistically significant correlations only among the sensation employee group. This finding can be understood when seen within the context of Path-Goal theory of leadership (House and Mitchell, 1974) whose basic tenets extend from expectancy theory. According to this theory, a leader's behavior influences work attitudes "..to the degree that the behavior increases subordinate goal attainment and clarifies the paths to these goals."

The supervisory behaviors identified within this analysis can be seen as more path clarifying for sensation employees than for intuitives, since sensation individuals would theoretically have a higher intrinsic need for direction and order than intuitives. In short, higher valance may be attached to supervision as "path clarifying" by sensations than by intuitives who theoretically have less of an internal need for external direction.

<u>The Moderator Influence of Problem-solving Orientations: Group Orientation Factors</u>

The results shown in Table 6 indicate that the problem solving orientation of maintenance employees does indeed moderate the relationship between their willingness to participate in GPI and their group orientation.

Statistically significant correlation between their willingness to participate in GPI and their group problem-solving orientation is found only among the sensation group and these are for the “enjoy working in groups” and “performs well in groups” items. (Although an analysis of variance procedure revealed intuitives exhibiting a higher mean average than sensations on the working alone variable, no statistical significance was shown for this difference). No mean differences were shown for the other two group orientation variables). On the other hand, in comparison to the other readiness factors, the group orientation variables reveal the strongest correlation with the primary criterion. This, is parallel to the findings for the entire sample population. However, these findings are strongest for the sensation subpopulation. In short, the variables “enjoys working in groups” and “performs well in groups” are much better predictors for participating in group work improvement processes among employees with a sensation personality orientation.

DISCUSSION

Overall, the results of this study strongly indicate that conducting research on an organization’s readiness to implement employee involvement type programs prior to implementation would enhance an understanding of many of the social psychological dynamics that exist and that could undermine or support change efforts. Although relatively weak correlations were found between two of the readiness factors and the willingness to participate variables, this study does illustrate very strong correlations between the readiness factors and job satisfaction. This finding in and of itself, is very significant information and should be considered during the planning stages of a participatory management program for improving work processes. The success of any organizational change effort is contingent upon the employee's attitudinal "buy-in" of the program.

The finding that the personality variable moderates many of the relationships within the study points to the importance of conducting organizational assessment systematically. Future research should attempt to include more variables that reference intrinsic characteristics of the employees to determine their influence on various participatory management schemes. From a practical viewpoint, variables that are shown to moderate important correlations would serve as a signal to management for determining how to structure their employee involvement programs. For example, our analyses suggest that supervisory behavior, within the context of employee involvement, is affecting intuitive and sensation-oriented employees differently. The same can be stated in regards to the group orientation factor. This information could be highly useful in designing the content of training programs that are commonly utilized to deploy participatory management programs. It would help change agents to better understand some of the specific problems associated with their work improvement programs. (Bennett, Lehman, & Jamie, 1999; Johnson, 1993; Shandler, 1996). Furthermore, pre-assessment would help to determine the extent to which employee involvement would actually bring about the results intended (Hackman & Wageman, 1995).

Finally, we must keep in mind that the sample population consists of employees who have direct responsibility for maintaining the safety of the airlines. As such, the improvement of work processes through group processes is extremely salient within this industry and should be highly valued. This exponentially magnifies the importance of management taking a strategic and purposeful approach to change efforts related to team based process improvement programs.

Table 1
Correlation Matrix For All Variables For Entire Sample Population

N=73

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Willingness to participate	___	.																
2 Job Satisfaction	,169	___																
3 Encourage to suggest	.059	.540**	___															
4 Interunit communication	.047	.-.266**.	-.216*	___														
5 Intraunit communication	-.033	-.366**	-.355**	.410**	___													
6 Listen to ideas	-.007	.588**	.432**	-.284**	-.261*	___												
7 Encourage to think	.183	.631**	.471**	-.337**	-.378**	.457**	___											
8 Utilizes ideas	.098	.450**	.370**	- .278**	-.280**	.524**	.383**	___										
9 Takes credit for ideas	-.001	-.381**	-.293**	.375**	.349**	.423**	-.513**	-.297**	___									
10Careful about ideas	.076	-.334**	-.319**	.007	.205*	-.503**	-.259**	-.048	.345**	___								
11 Enjoy working alone	-.210*	-.096	.100	-,247*	-.079	.192*	.015	.021	-.257*	-.081	___							
12 Enjoy group work	.487**	.020	.095	.111	.061	-.085	-.048	.029	.049	-.058	-.231*	___						
13 Performs well in grou ps	.353**	.353**	.023	.333**	.049	-.098	-.104	-.079	.285**	-.043	-.327**	.399**	___					
14 Punishment orientation	-.084	-.548**	-.522**	-.296**	.364	-.383**	-.414**	-.290**	.451**	.412**	-.202*	.040	.245*	___				
15 Recognition	-.042	.515**	.601**	.394**	-.322	.408**	.413**	.441**	-.461**	-.228*	.156	-.024	.-199*	-.705**	___			
16 Directive super.	-.106	-.387**	-.304**	.105	.043	-.179	-.246*	-.193**	.287**	.267*	-.019	.072	.184*	.428**	-.374**	___		
17 Consultative	.017	.495**	.505**	-.117	-.156	.495**	.350**	.349**	-.318**	-.184*	.066	.136	-.117	-.527**	.623**	-.414**	___	
18 Asks for ideas	.046	.574**	.595**	-.358**	-.288**	.447**	.423**	.434**	-.329**	-178	.178	.111	-.049	-.605**	.723**	-.309**	.757*	___
19 Problem orientation	.042	-.060	-.129	-.112	-.031	-.010	.051	-.252*	-.020	.168	-.180	-.193*	-.062	-.028	-.118	-.059	-.224*	-.237*

___

Table 2
Correlations Between Climate Factors and Criterions by Intuitive Problem-Solving Function

n=16

	1	2	3	4	5	6	7	8	9	10
1. Willingness to participate	___									
2. Job satisfaction	. 275	___								
3. Encourages to suggest	.207	-.515*	___							
4. Interunit communication	-.037	494*	298	___						
5. Intraunit communication	-054	017	039	530*	___					
6. Listen to ideas	.152	.772**	.515	-.306	-.047	___				
7. Encourages to think	.335	.722**	.733**	-.601**	-.044	.706**	___			
8. Utilizes ideas	-.323	.055	.435*	.068	.041	.355	.140	___		
9. Takes credit for ideas	.104	-.685**	-.424	.569*	.304	-582**	-.472*	-.286	___	
10. Careful about ideas	.283	-.268	-.104	.093	-.046	-.247	-.179	-.049	.284	___

*p≤.05 two-tailed
**p≤.01 two-tailed

Table 3
Correlations Between Climate Factors and Criterions by Sensation Problem-Solving Function

n=57

	1	2	3	4	5	6	7	8	9	10
1 Willingness to participate	___									
2 Job satisfaction	.148	___								
3 Encourages to suggest	.106	.561**	___							
4 Interunit communication	-.019	-.338**	-.311**	___						
5 Intraunit communication	.074	-.304**	-.354**	.368**	___					
6 Listen to ideas	-.035	.467**	.409**	-.241*	-.340**	___				
7 Encourages to think	.`129	.677**	.447**	-.348**	-.488**	.462**	___			
8 Utilizes ideas	.217	.531**	.345**	-.366**	-.372**	.425**	.486**	___		
9 Takes credit for ideas	-.033	-.354**	-.272*	.328**	. 418**	-.509**	.534**	-.311**	___	
10Careful about ideas	-.189	-.379**	-.438**	.270*	.044	-.404**	-.266*	-.068	-.437	___

*p≤.05 two-tailed
**p≤.01 two-tailed

Table 4
Correlations Between Climate Factors and Criterions by Intuition Problem-Solving Function

n=16

	1	2	3	4	5	6	7
1 Willingness to participate	___						
2 Job satisfaction	.275	___					
3 Punishment orientation	-.363	-.349	___				
4 Gives recognition	-.286	.123	-.510*	___			
5 Tells	-.119	-.351	.501*	-.331	___		
6 Consults	-.218	.399	-.241*	.502*	-.595**	___	
7 Asks for ideas	-.016	.358	-.534*	.752**	-.503*	.672**	___

*p≤.05 two-tailed
**p≤.01 two-tailed

Table 5
Correlations Between Climate Factors and Criterions by Sensation Problem-Solving Function

N=57

	1	2	3	4	5	6	7
1 Willingness to participate	___						
2 Job satisfaction	.148	___					
3 Punishment orientation	-.014	-.591**	___				
4 Gives Recognition	.017	.576**	-.745**	___			
5 Tells	-.087	-.398**	.413**	-.389**	___		
6 Consults	.106	.519**	-.601**	.649**	-.595**	___	
7 Asks for ideas	.095	.623**	-.654**	.711**	-.503*	.654**	___

*p≤.05 two-tailed
**p≤.01 two-tailed

Table 6

Correlations Between Group Orientation Factors and Criterions by Intuitive and Sensation Problem-Solving Functions

	Intuitives n=16					Sensations n=57				
	1	2	3	4	5	1	2	3	4	5
1. Willingness to participate	___					___				
2. Job satisfaction	.275	___				.148	___			
3. Enjoys working alone	-.226	-.087	___			-.175	-.122	___		
4. Enjoys working in groups	.303	.027	-.251	___		.559**	-.006	-.260*	___	
5. Performs well in groups	.047	-.048	-.172	.676**	___	.417**	.006	.359**	.363*	___

*p≤.05 two-tailed
**p≤.01 two-tailed

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APPENDIX A

1 = Strongly disagree 2 = Disagree 3 = Neither disagree or agree 4 =Agree 5 = Strongly agree

Criterion Factor

If given the opportunity, I would participate in a process improvement group for this company.

Job Satisfaction

I am satisfied with my job.

I am satisfied with my supervisor.

I am satisfied with my pay.

I am satisfied with the opportunity for promotion associated with this job.

Motivation Climate Factors

Communication within my department needs to be improved.

Communication between departments needs to be improved.

People around here are encouraged to “think”.

Management encourages employees to make suggestions about how to improve work in this department.

Management takes credit for employees ideas

Management will listen to your ideas.

Management fully utilizes the knowledge of its employees.

You have to be careful about talking about new ideas around here; someone may use

them and take the credit for them.

Supervision Factors

My supervisor is more apt to punish you when you do something wrong than praise you when you do something right.

My supervisor will give you recognition for good performance.

My supervisor consults the workers before making a major decision that will affect the work unit.

My supervisor asks for my ideas on how to do things around here.

My supervisor often tells people what to do rather than ask them their opinions.

Group Orientation Factors

I perform well in groups.

I perform better working alone than with a team of people.

I enjoy work in problem-solving groups.

Problem-Solving Orientation

I usually get on better with:
a. Imaginative people
b. Realistic people

Are you more attracted to:
a. A person with a quick mind, or
b. A practical person with a lot of common sense.

When you have a special job to do, do you like to:
a. Organize it carefully before you start, or
b. Find out what is necessary as you go along

If I were a teacher, I would rather teach:
a. Courses involving theory
b. Fact courses

I get more annoyed at:
a. Fancy theories
b. People who do not like theories

Is it higher praise to say someone has:
a. Vision, or
b. Common sense

Teaching the Pilots of the New Millennium: Adult Cooperative Education in Aviation Education

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ABSTRACT

Aviation is a very dynamic field that requires great dedication on the part of those who choose professional flying for their careers. Students must acquire a great amount of knowledge to include technical data, procedural information, social skills and more. There is much for the potential aviator to learn; sometimes it seems overwhelming to the initiate.

One means of learning this vast amount of information involves the technique of cooperative education. The mixing of adult educational techniques and cooperative learning may be particularly useful in aviation. Using cooperative education in acquiring the required knowledge can teach them discipline and social skills required in surviving today's active aviation environment.

The challenge then, becomes one for the college-level aviation instructor. This paper addresses techniques for teaching potential pilots the fundamentals required for the job based on adult and cooperative educational techniques.

INTRODUCTION

According to Telfer & Moore (1997), there are three approaches to learning. These include surface learning, deep learning, and achievement.

Surface learners are dependent on rote learning and tend to acquire only minimal knowledge. These learners tend to be anxious over what they have learned and accomplish only the minimal work necessary. Deep learners, on the other hand, have grasped the concept that learning is a means to understanding, which gives meaning to what they have learned. The highest learners, the achieving learners, are those who do very well. These learners tend to be very competitive, with egos that can only be satiated by a higher standard of learning.

In aviation, student pilots must achieve a level of learning that will allow them to solve problems from a well-defined knowledge base while interacting with others. Motivation plays a very important part of the equation.

Training the students, then, becomes a question of increasing their knowledge base with meaningful activities that will allow interaction among the students. To this end, the instructor needs to develop learning exercises that will challenge the students in small groups. Such exercises can include team competition regarding knowledge of regulations, aerodynamics, meteorology, navigational exercises, and more.

Cooperative Training in the Classroom

Cooperative education in the classroom is the idea of teamwork in a practical sense. Students must realize that in order to succeed, they have to be willing to work in a team environment. From personal observation and discussion with students, this is an idea older students are apt to more readily accept than their younger peers. These older students include those returning to school from a tour of duty in the military, or those who have been in the business world working to save money for school.

Johnson, et al. (1991) points out the five elements of cooperative learning in the classroom. The first is the idea of positive interdependence. To establish positive interdependence, an instructor must assign tasks requiring students to work together toward a common goal. Within the task, each student becomes responsible for a portion of the assignment, and must depend on the others of the group to do their work as well. In the end, each student will learn to trust one another and realize a decrease in their individual workloads.

The second element includes the idea of face-to-face interaction. Working together will enhance the sense of trust and camaraderie among those involved in a project.

The third element is that of individual accountability. Each student within the group must be able to count on others of the group to carry his or her load.

The fourth element is the development of social skills. Working in a group will train students to work well with others, express their ideas, lead when appropriate and follow when acting as part of the team.

The last element of cooperative learning is that of group processing. The idea of group processing is that of the group maintaining its identity as a group, and the continuance of further development and use of the social skills needed for additional growth.

The Nature of Aviation Training

Airline aviation can be a very harsh and demanding field desired by many young high school graduates enrolling in collegiate aviation programs at the start of the new millennium. While many 17- and 18-year old high school graduates find the airline industry attractive, many are ignorant of the skills required to accomplish their goals. The new students are also independent from home for the first time, away from their parents and other constraints of their family situations. As college freshmen, they desire treatment as adults, but are at times unable to stay focused on simple tasks. These new students are an independent lot, still trying to figure out what they have to do in order to progress through their academics. Some are still learning some of the most basic concepts of life, one of which is the idea that "divided we fall, united we stand" (Johnson, Johnson, & Smith, 1991).

The challenge for aviation professors is teaching young students in a manner the students find palatable. In order to do this, treating new students as young adults is the key. One problem with teaching recent high school graduates is that some are still in the mindset of pedagogical learning. Many perceive that some higher authority dictates what they must learn; a few have come to the realization that learning is something pleasant giving them a true thirst for knowledge, particularly aviation knowledge.

Many colleges and universities still hold learning to be a competitive and individualistic endeavor. In some disciplines, this is true. Cooperative education, however, is more suited to the aviation industry because pilots will be dealing with others throughout their entire careers – specifically, through Crew Resource Management (CRM). In this context, they need to develop the social skills that will allow them to interact in a positive way with flight crewmembers, air traffic controllers, operational dispatchers, and others. When they learn together, student aviators will acquire more information and skills in a shorter time while enhancing social skills and developing teamwork skills, all of which are important for successful candidates in the airline industry.

While the freshman or sophomore college student is in an aviation class addressing their interests in flying, they enter college and aviation training with learned educational habits they must overcome. In other words, they have to learn how to seek knowledge and become less dependent on professors to supply information. According to Knowles (1990), adult learning is “a process of active inquiry, not passive reception.” Unfortunately, some of the secondary school systems in the United States tend to develop and foster attitudes towards "passive reception" (Knowles, 1990).

This passive reception conditioning of students by the secondary school system reinforces the idea or attitude of the individuals that they are merely students. From discussions with younger students who entered college straight from high school, many feel as if they had to go to college because of others’ expectations. A number of students enroll in college driven by parental influences rather than personal internal desires to seek knowledge. Consequently these students are not truly ready for school; more importantly, they have not developed the techniques for learning on their own. Therefore, common perception holds these students are dependent on professors, teachers, instructors, and others for more than standard guidance in their learning.

In his work titled, "Aviation education and adult learning: an integrated learning model," Karp (1998) points out “adults are voluntary, practical learners who pursue education for its use to them.” More mature college students may have come to this realization. Some of the younger set, however, has yet to make this distinction in their educational lives.

One way to foster independent learning in younger college students is by introducing them to peer pressure through cooperative learning techniques. “When adults teach and learn in one another’s company, they find themselves engaging in a challenging, passionate, and creative activity.” (Brookfield, 1986.) In the aviation field, students find themselves attracted by activities that are already "challenging and passionate." From discussions with active flight instructors, the problem with younger students is that what they view as challenging and passionate is the actual stick and rudder work in the airplane. As with many who have preceded them, they quickly determine that learning the fundamentals and required regulatory knowledge to survive in the National Airspace System can be boring.

Unfortunately, in the aviation field the fundamentals and required knowledge comprise a large amount of information. To some, the amount of information is daunting, almost to the point of exasperation. The essential aviation knowledge can be so intimidating that many new students start their training, only to drop out in a very short time.

Students who drop out typically have not matured enough to understand that they alone are responsible for seeking out knowledge. These students also tend to think as children rather than as adults. They tend to be singularly competitive rather than team players. Students who resist team projects and peer learning do not understand that by way of cooperative learning, they can increase their knowledge far beyond their individual capabilities while doing so in a much shorter time. By working in a team and sharing the workload, students can increase their comprehension more than they are able "solo." The result is they can reach their educational goals more thoroughly and quickly (Johnson, et al. 1991).

<u>Attitudes Toward Learning</u>

The major difference between the

methods by which an immature student thinks compared to the more mature student lies in their attitudes toward learning. As noted above, the undeveloped student still thinks in terms of the subject matter that he or she must learn as dictated. This results in a natural resistance on their part to acquiring the requisite subject matter knowledge. On the other hand, fully developed learners realize the need for the knowledge and are self-directed toward attainment of their educational goals.

In teamwork, or in an atmosphere of cooperative learning on an adult level, the more advanced students will help the undeveloped students along in the learning process. In so doing, they in turn reinforce their own learning. This idea of teamwork or cooperative education on the part of the students is very important in the aviation field.

Although it is a cliché, pilots must learn the knowledge of their chosen profession as if their lives depend on it. For in fact, their lives and the lives of others truly do depend on how well they learn the cognitive information required of aviators. To this, the learner must add the eye-hand coordination essential for the safe operation of an aircraft.

As Johnson, et al. (1991) point out the use of cooperative learning techniques in the classroom, coupled with a reduction in competition, will aid students in learning a greater amount of information in more depth. Specifically, as Johnson's group writes, "More efficient and effective exchange and processing of information take place in cooperative than in competitive or individualistic situations."

While students of aviation are competitive in nature and will eventually be competing against one another later in the industry, they will have to learn to work with others. In the cockpit, students will become team players from the standpoint that they will work within a crewed environment. In that environment, competition is undesirable and tends to inhibit safety. Consequently, part of the aviation training pilots should undergo during training must include the cooperative aspects of team membership.

<u>Cooperative Aviation Education</u>

Using cooperative learning techniques in the classroom has benefits and disadvantages. Some students are naturally resistant to working in a team environment, preferring to work alone. From discussions with students, the reasons offered most often include a fear of having their grade depend on the work of another. Consequently, the instructor must design the evaluation process to assuage student concerns regarding their lack of control over their final grade.

One of the first issues at the beginning of a term is assigning students to learning teams (Kohlruss & Moren, 1998). The instructor must accomplish this task in a manner to create groups of strong and weak personalities. If left to the students, they will naturally create cliques of their friends. This will result in a polarized class of strong groups and weak, rather than diverse groups.

This grouping may be somewhat acceptable, but in the areas of developing social skills and working with relative strangers, the instructor must assign students randomly into groups of differing social, educational, and ethnic backgrounds (Kohlruss, et al. 1998). In aviation, this is important in refining a potential pilot's abilities to work well in a demanding environment with others.

The question then is one of assigning students to teams in a random manner. There are many techniques for this; the class can be counted off in the number of groups which would have all the one's on the first team, all the two's, and so on. This technique does not guarantee student assignment into teams of diversity. In other words, all the females in the class could end up on one team by accident, a situation depriving others the opportunity to work with women in aviation (Kohlruss, et al. 1998).

Another technique for dividing the class into teams would include such ideas as using the last number of the student's identification number; drawing team numbers from a hat; using student mailbox numbers and dividing them into groups such as the lower third, middle third, and upper third (Kohlruss, et al. 1998). Only the professor's imagination limits the procedure for dividing the class into teams.

One approach to assuring diversity and assigning individuals with strong personalities to teams including those with weaker personalities is through personal observation and questionnaires. At the beginning of the term, the professor can administer the questionnaire to determine who has strengths in leadership and experience in aviation and who does not. By waiting and observing the class for two or three periods, he or she can then determine who are the leaders and followers. The instructor can then manipulate assignments as necessary (Kohlruss, et al. 1998).

Specific Aviation Exercises

The process of teaching all of the information required to work as a professional pilot is extensive. Traditional classroom technique will not allow students to acquire all the required knowledge in one conventional term. Therefore, the key to helping students grasp all the information possible is by cooperative learning.

By assigning the students projects in teams, they can share the learning and the workload and attain higher degrees of learning. The means to accomplishing this goal is through group assignments that are simpler in the beginning of the term and become more complex toward the end.

For a typical commercial/multi-engine class, Appendix A illustrates a typical first exercise. Broken into groups of three to six, students work on the project as a team. Within the group, one individual will emerge as a natural leader/manager and begin delegating responsibility to others in completing the different areas of the assignment. This individual takes charge as the captain with the others of the group responding as crewmembers. This may be appropriate for the first exercise, but in later exercises, others in the group must also act in leadership roles. To this end, the instructor may have to apply some direction to the group dynamics.

The typical first exercise is a cross-country flight planning task. As illustrated by Example Exercise 1 of Appendix A, the drill is simple and straightforward. It provides students the direction required to apply knowledge already acquired to a problem. The students have to reference aspects of commercial aviation regulations, multi-engine flying, and other problems pertinent to carrying out the flight in a safe manner.

As the course progresses through the term, the exercises become more complex, as illustrated in Example Exercise 2 of Appendix B. As teams, the students must solve problems related to the exercise, taking into consideration the possible outcomes of specific scenarios.

Throughout the term, the students deal with more complex issues of high-altitude and turbine operations. They must now apply the introductory information gained in solving the cross-country training exercise and indeed, delve into more information on their own.

Evaluation and Assigning Grades

One problem with cooperative education is determining grades for individuals and teams within the class. Many in education feel as though testing is contrary to the learning process (Dean, 1994). While a few educators may feel as though testing is not necessary, there are many more line captains and other aviators who will demand new aviators not only be tested, but also meet predetermined minimum scores.

In his book, Designing Instruction for Adult Learners, Dean (1994) gives five reasons for the necessity of evaluation. These include enhancing the self-awareness of the student; increasing student self-esteem; development of communicational skills; determining future learning requirements; and finally, the question of certification and credentials.

In determining student grades, professors must consider the level of individual participation in group projects and assignments. A system of peer evaluation may be helpful in this regard, but the instructor or professor must realize a bias may become a part of the peer evaluation process paralleling the popularity of certain individuals within the group.

Evaluation of students is necessary for several reasons. Dean (1994) classified seven domains for evaluation. These include:

1. Learner's reactions to the learning experience.
2. Information.
3. Problem-solving skills.
4. Psychomotor skills.
5. Affective factors such as attitudes, values, and feelings.
6. Personal growth and development.
7. Changes in the organization or community.

In the business of flying airplanes, the cognitive domain is very consequential. The required knowledge is a phenomenal amount and must be available for recall -- no matter the situation. There will be times during an aviator's career that the stress of an emergency may prevent him or her from being able to recall and use the information properly.

Another important area that will interest line captains, training officers, and other management is the problem-solving skills of the newly certified pilot. This is a field that is as significant as the psychomotor, or stick-and-rudder abilities of the new pilot.

Finally, every potential employer of the next generation of pilots will be interested in the values and attitudes of the recently licensed. If a new pilot has unsafe habits or attitudes that result in dangerous practices, chances are minimal in the hiring or further re-training of the individual.

Potential employers of recently certified aviators will be interested in the aviator's total cognitive knowledge, abilities, and flying skills. In short, they will want to know if the students know their business, are capable of solving problems, are safety conscious, and have stick-and-rudder skills.

The job of the aviation professor then, is to make the learning fun, assure each student gains the required knowledge, and then by way of assigning grades, advise future employers the degree to which the students have learned their lessons.

Studwell (1992) identified nine important teaching principles in teaching adult students. At the top of the list are knowing the student, relating their experience to the learning, and accounting theory to actual practice.

Today's aviation students are very intelligent and motivated, but for different reasons. Some seek the high paying airline positions while others simply want to learn how to fly. As Studwell suggests, you have to know the individual student and be able to deal with each on a one-to-one basis. What motivates one may not necessarily motivate another.

The key then is providing worthwhile common learning activities for all to share in. By knowing the students as well as possible, the common denominator can be determined. Then the facilitator can develop plans consisting of meaningful group exercises in which cooperative learning for the group can take place.

Studwell goes on to say instructors must arrange an environment conducive to learning. Within this environment, they should use different formats and teaching techniques to enhance student learning.

For the student, there should be some form of feedback to the instructor regarding the course, the subject matter, and teaching. Additionally, resources for learning must be readily at hand. The easier it is for the students to physically acquire the material, the more learning will take place (Studwell, 1992).

Another important point Studwell brings up is developing and maintaining contact with the student, other than academically. In many instances, how students interact with their instructors, peers, and others can influence their success or failure in an aviation academic program. A professor who facilitates, rather than taking on the traditional role of a teacher, is necessary for the students' realization of "a state of self-actualization or to become fully functioning persons," according to Brookfield (1986).

An important element brought up by Brookfield, supporting Studwell's recommendations, is that the instructor must have a genuine concern for his or her students. Brookfield also mentions that teachers must be experts in their fields and capable of relating theory to practice.

Those facilitating student learning must also be confident in their teaching abilities while providing a positive environment in which learning can take place. Additionally, Brookfield relates that instructors and teachers must be open-minded toward the ideas and concepts of the students. They should also be able to help direct students to additional learning beyond the objectives of the curriculum.

Brookfield (1986) makes the argument for professors helping their students learn rather than being "didactic instructors who know all the answers." To this end, Brookfield cites Tough (1979) in the description of the characteristics shared by successful teachers. These characteristics include 1) being a warm and caring person; 2) respecting the student's self-direction; 3) treating the learners as their equals; and 4) having an open-minded attitude.

Practical Recommendations

The first and most important is to know the student. In the cockpit, this is very easy. One-on-one training allows personalities to mesh easily allowing strangers to become friends in short order. In the aviation classroom, however, it is a different story. Getting to know the students is dependent on other factors such as the size of the class. Secondly, the instructor must develop learning experiences that will interest all students in the class. Identifying and applying a common interest among the group can do this.

Another consideration identified by Studwell is making the environment conducive to learning. Many instructors do not have an input regarding the physical aspects of the class other than perhaps the thermostat in the classroom, but they do have a say in the manner in which the class is conducted. In other words, each student should feel comfortable enough to speak his or her mind.

Another important aspect a professor or instructor must accomplish is that of communication. The students should feel comfortable enough to discuss the class freely and there has to be genuine communication between instructor and student.

Finally, as noted by Brookfield above, instructors should help their students learn. The professor who deals with students on an equal level will go further in helping students learn than one who exudes an air of superiority. Essentially, this requires the instructor not to judge each student, but to teach each student.

Many aspire to the characteristics described above. (Some facilitators are good, and some professors are not.) An instructor, a professor, a lecturer, and the teacher -- all are names applied to those charged with the duty of helping others learn. Despite the name, the job of teaching is the most important component helping people learn. The key to being successful in helping students learn is treating them as you would like to be treated.

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APPENDIX A. EXAMPLE EXERCISE 1

Mod I Exercise

PA-44 Seminole

Pilot	185
Front passenger	144
Rear passenger	198
Baggage	60
Fuel	as required

For weight and balance data, use Seminole N1234X

Departure point: Naples, FL
Destination: Savannah, GA

Departure time: This Wednesday, February 3, 1999 at 0800 local, use actual weather observations and forecasts for flight planning.

Prepare full flight plan, with regards to a commercial operation.

Prepare full flight log, including weight and balance data to the destination including fuel stops if necessary.

Due date: Monday, February 8

APPENDIX B. EXAMPLE EXERCISE 2

Team Leader:
Member:
Member:
Member:
Member:

High Altitude Cross Country Exercise
Houston Hobby to Reno International

Please use the copy command to replicate this page on a Word format and then answer the questions. Remember this is a team effort and the answers should reflect the consensus of the team, not just one member.

Upon completion of the answer sheet, *please staple* it to the nav log and turn in the complete package on Thursday or Friday as appropriate.

1. What did your team determine to be the gross weight at departure?

2. What did your team determine to be the total moment at departure?

3. What did your team determine to be the center-of-gravity at departure?

4. What route did you choose to get around the weather?

5. What was the maximum allowable fuel on departure?

6. What was your arrival time at Reno (local and Zulu)?

7. What was the total mileage along your chosen route?

8. What was the average ground speed along the first leg?

9. What was the average ground speed along the second leg?

10. What was the ETE for the first leg?

11. What was the ETE for the second leg?

12. What was total time for the trip including a 0+45 refueling stop?
13. If you had a rapid decompression at exactly 2 hours and 20 minutes into the trip on the first leg of the trip, what action would you take? (Not airplane specific, generic actions only.)

14. What kind of approach would you expect for landing at Reno?
15. What is the landing distance going to be at Reno and what are some of the considerations you will take into account?

The Transfer of Flight Training Procedures From an Advanced Airline Flight Simulator to the Classroom

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ABSTRACT

The current shortfall of aviation professionals has led employers to hire low-time, less experienced aviators to fill cockpit positions. Accordingly, the improved effectiveness and capacity of flight training programs has become a national priority. Collegiate aviation programs, in particular, are faced with resource constraints that mandate optimum use of available flight training devices. This paper suggests the use of off-the-shelf video teleconferencing technology to transmit certain aspects of flight training, such as systems operations and normal procedures, between the classroom and an advanced flight simulator or training device. Instruction that is normally limited to two or three students can now be given to a much larger audience and yet remain interactive. Limited sampling of student performance following flight simulator video teleconferencing sessions reflects the promise of this medium as a useful complement to other aviation training methodologies. This paper is not meant to be a formal research paper, but rather an overview of an innovative teaching technology that could lead to further study.

INTRODUCTION

As the costs and limitations of training aircraft operations have escalated, attention has shifted to flight simulation as a means of reducing in-flight costs while avoiding the impact of actual weather, maintenance, and safety-of-flight concerns. Flight simulation devices have provided a useful adjunct to flight training programs for a number of years. With the advent of hydraulically actuated six-axis motion systems and modern day/night visual simulations, modern flight simulation systems provide a level of training that approaches an actual in-flight experience. The technology, however, is fragile and expensive. The cost of advanced airline flight simulators and supporting infrastructure frequently exceeds that of the actual aircraft they simulate. These costs are especially prohibitive for a collegiate aviation training program.

Cognitive pre-training for flight duties includes any activity that prepares the student for experiential psychomotor training. Such activity can include a wide variety of observed, interactive or hands-on educational formats. High fidelity simulation systems are used to realistically duplicate actual in-flight conditions and provide significant cognitive pre-training to minimize orientation time associated with initial inflight operations. The level of realism associated with the most sophisticated flight simulators has prompted the FAA to certify their use for continuing training and evaluation in place of actual aircraft. Many authors have reported on research to validate transfer of training levels associated with flight simulation (i.e. Taylor, Lintern, and Koonce, 1993; Lintern, 1992; Thomson, 1989; Caro, 1988; Wood and Gerlach, 1973). Additional research has evaluated the benefit of video and motion enhancements to flight simulation devices (Lintern, 1992; Martin & Cataneo, 1980; Martin & Wang, 1978; Prophet & Boyd, 1970; Gerathewohl, 1969).

Although higher levels of physical and visual fidelity support the effective transfer of training between the flight training device and actual aircraft, past research indicates that simpler systems are equally effective in many areas of flight training. Thomson (1989) notes that cockpit orientation and procedural familiarization procedures can be effectively trained with simple cockpit procedures trainers (CPTs). CPTs provide an orientation to the location of instrument displays, switches, and controls for the depicted aircraft.

Although such devices do not provide external views and tactile cues to students, they are effectively used to practice procedures for normal and emergency systems operations. These trainers may be accurate cockpit recreations or less sophisticated wood constructions with photographic panel depictions and movable switches. Transfer of training from these systems is dependent on repetition for cognitive mastery.

Although such devices have utility, research by Brecke, Gerlach and Schmid (1976) indicates that the receipt of repetitive cues during CPT training, without systematic instructional support, may negatively affect transfer of training. Subjects who received repetitive current cues scored an average of seventeen percent lower in training effectiveness than those who received lower repetitions and systematic cues. In addition, those subjected to repetitive training reported significantly negative attitudes towards that training methodology. Repetitive aviation training formats have utility, but other options are needed to provide systematic cognitive cues.

Recent advances in computer technology offer a variety of innovations for flight education training. Modern airline crew training operations provide trainees with self-study CDs that present a comprehensive and extremely realistic depiction of aircraft systems and operations. This training medium is only limited by computer access and allows trainees to manipulate systems to more fully understand normal and abnormal operations. Some flight training schools use inexpensive computer flight-training packages that incorporate an external stick, rudder, throttle quadrant, and comm/nav radio panel for effective flight simulation. Although psychomotor depiction in such systems is limited, the orientation value is obvious and measurable.

Many authors (Mitchell, 2000; Taylor, Lintern, Hulin et al, 1999; Koonce, 1998) have reported on the effective use of computer-based training (CBT) for generic motor skill applications and general systems training. In addition, part-task trainers have proven to be effective for mastery of aircraft components such as radar and flight management systems. Part-task trainers are especially useful in the study of complex aircraft instrumentation that is normally operated independently from flight control systems (Goettl, 1996).

Flight simulators with higher physical and visual fidelity would seem to provide better transfer of training for tasks that require the most complex motor skill and visual coordination. More austere training aids, however, can have a key role in flight training while reducing the utilization rates and costs associated with advanced airline flight simulators.

A state-of-the-art advanced airline flight simulator presents opportunities for repetition and orientation desired in a procedures trainer while providing the psychomotor responses that effectively simulate actual in-flight conditions. A flight simulator session normally includes a prebrief by an instructor to review systems operations, switch locations, and procedures. The prebrief is followed by a two to four hour simulator experience that permits the crewmembers to visually and tactilely experience the designated flight operations from their assigned positions. After the flight, a post-flight session is conducted to review student performance and suggest areas for improvement.

Initial flight qualification training for aircrew members may include as much as 10 to 30 hours of flight simulator time conducted over a relatively short training interval. In addition, periodic refresher and upgrade training are conducted for aircrews each year. Some collegiate flight training programs are able to provide their students with the same number of hours of advanced flight simulator training as their professional contemporaries. However, such collegiate training is usually spread over an extended school year period of many weeks. Integrating student academic schedules with flight simulator availability presents a particularly difficult problem for collegiate flight program managers. If the flight student group is large, and flight simulator sustainability is dependent on outside users, the problem is magnified.

Each year, the four-year undergraduate flight program at Purdue University prepares approximately seventy freshman students to begin commercial aircrew duties upon graduation. The last two years of education for these students are focused on advanced aircraft operations. Significant classroom activity is oriented to the transition from general aviation aircraft to complex turboprop/turbojet aircraft. Classroom instruction and flight simulator activity support training in multi-engine corporate and airline aircraft.

Purdue operates two Boeing 727 flight simulators that are comparable to those used by major airlines. Both simulators are expensive to maintain and are annually certified by the FAA. Each week, upper division flight students receive a two-hour simulator period supplemented by four to six hours of classroom systems and procedures instruction. Simulator student utilization rates currently approach 50 hours per week for each simulator. Airline flight training personnel also use the simulators for up to 60 hours per week to evaluate potential hires and conduct new-hire and recurrent proficiency training. Additional simulator utility is limited by periodic and recurring maintenance.

Effective classroom instruction complements flight simulator activity. Kemp (1985) states that significant interaction between the learner and educational media is key to effective instruction and learning. Active participation enhances the learning process. Teachers and instructional designers should select media that will require opportunities for the student to engage in the learning process (Heinch, Molenda, and Russell, 1993). To bridge the gap between classroom lectures and flight simulator training, the authors have designed an interactive video transmission system to bring the advanced flight simulator experience into the classroom. Such interactive video serves as a logical step to introduce aircraft systems and procedures. Using this format, a large number of students can experience high fidelity simulation within the classroom. This interactive environment addresses individual learning styles while meeting the instructor's need for flexibility. In addition, preparation time for flight simulator sessions is reduced.

SIMULATOR TELECONFERENCING

The authors use a basic video conferencing system to transmit images between the flight simulator and classroom. Initial setup of this system includes the establishment of electrical and network connectivity within the flight simulator. Broadcast transmission between the flight simulator and classroom locations is accomplished through predetermined network paths that are initialized within a video conferencing unit. At the heart of the transmission system is the Polycom Viewstation, a relatively small, portable, video conferencing unit with an embedded web server. The unit can be mounted on a tripod, installed in a fixed position, or placed on a podium. In the flight simulator, the Polycom unit is placed on a tripod behind the pilot stations and can be remotely controlled to view all instrument panels. The Polycom unit is connected to a small video monitor in the flight simulator, which provides a split screen presentation of simulator images and the classroom audience. Finally, a remote microphone/ speaker unit is strategically placed in the simulator to facilitate conversation between the classroom and the simulator. In the classroom, a second Polycom unit transmits images of the student audience to the simulator and a multimedia projection system is used to project simulator images on a large screen. Instructors at both locations can remotely operate either camera unit. The cost for two Polycom units and supporting accessories used in this project was less than $10,000.

For operational flexibility and security, Polycom components are not permanently installed in either the flight simulator or the classroom. Polycom components are lightweight and easily transported. Operation of the Polycom system in any location is limited only by the ease with which electrical power and network connectivity can be established. Setup of the system is simple and takes less than five minutes. When connectivity has been established, the classroom and simulator instructors act in concert to lead the class through a preplanned instructional scenario. Interaction between the instructor stationed at the flight simulator and individual students, although not experimentally verified, seems to enhance classroom participation and the level of training transfer. The number of training scenarios possible is limited only by the instructor's imagination. Typical Polycom scenarios could include: a cockpit instrument orientation, systems operations under normal and/or emergency conditions, normal procedures training, and crew resource management orientation. In addition, a "walk-through" of upcoming simulator activity could greatly reduce the pre-brief and orientation time required during the actual simulator training period.

A typical 30-minute Polycom session might focus on normal and abnormal engine starting problems for a jet aircraft. Students would be provided with a handout at the start of class that outlines information related to the topic. The instructor would control the Polycom unit in the flight simulator to view the overhead starter panel, the throttle quadrant, and the engine instrument panel. Questions are typically asked of the audience by the instructor in the simulator to draw student attention to appropriate aspects of the starting system. Students may be asked to direct the starting sequence. Abnormal operations are encountered and students are asked for appropriate measures to return to normal operations. At frequent intervals during the presentation, students are encouraged to interact with the instructor in the simulator to better understand the systems operation being discussed. The Polycom methodology has been used to date with engine starting procedures, fuel system management, flight engineer systems operations, and electrical systems operations. In each case, student feedback was very favorable and subsequent simulator performance, as evaluated by assigned simulator instructors, indicated improved levels of training. To attain further value from this medium, classroom Polycom sessions have been recorded on a VCR. Sessions can be reviewed for lesson improvement, use by students who missed the class, or in a distance education format.

METHODOLOGY/EVALUATION

The innovative simulator transmission process is still in its infancy and beta testing of the concept still in progress. Each Polycom session is evaluated by students and participating instructors. Students provide feedback through written evaluation forms using a Likert rating scale and/or verbal debriefings after each session. Feedback to date has been very favorable. After the first Polycom presentation, 20 of the 60 students rated the session as outstanding, 37 students as good, 2 students as fair, and 1 as poor. Students indicated they especially liked the interactive nature of the presentation while observing actual flight simulator activity. After the initial sessions, a few students criticized the uneven lighting in the simulator that was projected through the classroom projection system. In response, additional lighting was placed in the simulator prior to the next presentation. After the last Polycom session, 32 of the 61 students rated the overall presentation as excellent, 28 students rated it as good, and 1 student rated it as fair. No students scored it as poor or not worthwhile. Students suggested that instructors provide a written subject matter outline with each presentation, improve camera resolution for better focus, and slow down the flow of information in particularly complex areas. A majority of students suggested that more of this medium be included in future instruction.

In addition to student feedback, input was solicited from advanced airline flight simulator instructors regarding actual student performance following Polycom sessions on fuel system and APU operations. The survey instrument posed five questions regarding student performance, using a Likert rating scale. Simulator instructors reported that 81 percent of 68 enrolled students needed little or no help in operating the addressed systems and 19 percent needed some assistance. No students were observed to be unable to accomplish the subject systems' operations. Finally, the Polycom academic instructor team completed independent, written evaluations immediately following each Polycom presentation. These evaluations were reviewed to highlight improvement opportunities for future presentations.

Limitations of the Polycom Viewstation medium revealed to date include: minimal low light capability, an inability to quickly focus on new objects in the simulator, equipment expense, local area network connectivity, two instructor requirement, and ensuring concurrent simulator availability during the scheduled academic class period. Despite these limitations, students and instructors alike have enjoyed and benefited from the process. Evaluation of this medium is ongoing and seems to support findings by Caro (1988) that visually mediated learning systems can be highly effective, if discriminatory cues are provided in response to appropriate stimuli. Thomson (1989) notes that increased levels of feedback during flight simulator training sessions are associated with higher levels of training transfer. Future research with the Polycom system should reveal the impact of video teleconferencing on this aspect of flight training and suggest opportunities for aviation distance education.

CONCLUSION

The Polycom system provides an effective, flexible alternative to aspects of expensive flight simulation systems. The initial purchase and maintenance costs of this interactive medium are relatively small when compared with those of advanced flight simulation systems. Although the Polycom will not replace flight simulator aspects such as tactile-focused cognitive pre-training, it provides an effective supporting mechanism for the acquisition of visual cues and training reinforcement. The objective of this project was not formal research but rather to initially evaluate this technology. Subsequent investigation may reveal additional cognitive pre-training opportunities. Payne (1982) suggests that the transfer of training value of any cognitive pre-training system (such as the Polycom) hinges on many factors, including instructor consistency/ability, student level of understanding, and the particular task under evaluation. Future research into Polycom methodologies should carefully consider bias associated with these factors.

Students learn new material in different ways and those learning styles may change as students progress through college. Quilty (1996) suggests that instructors should employ a variety of instructional methods to address the wide variety of cognitive biases and learning styles present in the typical classroom. The Polycom system provides collegiate aviation programs with another method to enhance transfer of training. In addition, the Polycom system has potential applications for other laboratory environments, especially those where space or safety considerations limit the size of the participant student group. The authors believe that the Polycom or similar technology can be used to effectively bridge the training gap between the classroom and a flight simulator or training device. Such technology may be extremely useful in collegiate aviation's quest to meet the airline industry's need for sufficient numbers of high quality, professional pilots.

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The Impact of Ground Schools in a Collegiate Aviation Program on FAA Written Exam Scores

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ABSTRACT

This is a longitudinal study, tracing student FAA written exam test scores in a collegiate environment. The exams surveyed were administered in the War Eagle CATS testing center located at Auburn University from January 1, 1999 to December 31, 2000. The purpose of the study was to test the significance of ground schools offered at Auburn University on FAA written exam test scores. In addition, it examined the difference on test scores of Auburn students versus non-Auburn University students. The independent variable was set as the group corresponding to each FAA test ground school. The dependent variable was student performance based on each corresponding FAA written exam score. Statistical analysis revealed that there is no significance on the impact of the independent to the dependent variable, or the impact of ground schools on FAA written test performance is not significant.

INTRODUCTION

In theory, ground schools have the purpose of preparing students for FAA written exams in addition to teaching them the necessary knowledge to undertake the responsibilities of various tasks in aviation operations that correspond to the rating or license they seek. There has been a lot of discussion in collegiate aviation environments on the usefulness of ground schools as pedagogical tools. Are ground schools supposed to adhere to the expanded role of teaching students multidimensional aviation knowledge, which is fitting to a university environment? Or, are ground schools designed to teach students the skills they need to score well on their FAA written exams? Are both abovementioned goals compatible? Can they be achieved at the same time and in an effective manner? The above are valid questions that collegiate aviation programs address as they design syllabi and curricula.

To answer the above questions in an empirical way, we designed a study, which is based on scores collected by the War Eagle CATS Testing Center located at Auburn University. The study is a longitudinal one. It included scores over a period of two years, from January 1, 1999 to December 31, 2000. The origin of the data collection was somewhat arbitrary as January 1, 1999 was the date that we started keeping comprehensive records of test scores at the Center as we came up with the idea of the study. By December 31 2000 we had a large enough sample in each of the test categories we analyze in this paper to proceed with the statistical analysis in a way that valid results can be extracted.

To test our hypothesis, we collected results in two categories, which became our independent variables:
Category 1: Ground School (y_1) versus non-ground school (y_2) attendee exam takers.
Category 2: Auburn University student (y_1) versus non-Auburn university student exam takers (y_2).

Our dependent variables (x) fell into 6 categories, each of them corresponding to the exam score on a specific FAA written exam.

x_1 = Private Pilot Written
x_2= Instrument Rating Written
x_3 = Commercial Pilot Written
x_4 = Flight Instructor Written
x_5 = Advanced Ground Instructor Written
x_6 = Fundamentals of Instructing Written

As the sample sizes for ground school versus non-ground school attendees were different, to produce a valid comparison we used the sampling distribution of $x_1 - x_2$ to develop an interval estimate of the difference between the two sample means. The sampling distribution of $x_1 - x_2$ has the following properties:

$E(x_1 - x_2) = \mu_1 - \mu_2$

As part of our study, to evaluate the differences between our two groups within each category (C1/G1-y_1: Exam takers who have taken a ground school and C1/G2-y_2: Exam takers who have not taken a ground school and C2/G1-y_1: Auburn University Students and C2/G2-y_2 non-Auburn University students) in terms of their test scores in the standardized FAA exam, we have collected and analyzed the data described above. The FAA written scores are a major factor in assessing any significant differences on the effectiveness of the ground schools. The means of the two groups are as follows:

μ_1 = the mean examination scores for the population of individuals in Group 1
(Category 1 and Category 2)
μ_2 = the mean examination scores for the population of individuals in Group 2
(Category 1 and Category 2)

We begin with the tentative assumption of no difference in the quality of the two groups in each category. Hence, in terms of the mean examination scores, the null hypothesis is that $\mu_1 - \mu_2 = 0$. If sample evidence leads to the rejection of this hypothesis, we will conclude that the mean examination scores differ for the two populations. This conclusion indicates a quality differential between the two groups, which may be attributed to whether they have attended or have not attended a ground school. The null and alternative hypothesis for both groups are written as follows:

Ho1: $\mu_1 - \mu_2 = 0$ and Ho2: $\mu_1 - \mu_2 = 0$
Ha1: $\mu_1 - \mu_2 = 0$ and Ha2: $\mu_1 - \mu_2 = 0$

Following the conventional hypothesis testing procedure, we make the tentative assumption that Ho is true. Using the difference between the sample means as the point estimator of the difference between the population means, we consider the sampling distribution of $x_1 - x_2$ when Ho is true. As the sample size is large (n>30) the sampling distribution can be approximated by a normal probability distribution. The following test statistic is used for the approximation:

$$Z = \frac{(x_1 - x_2) - (\mu_1 - \mu_2)}{\sqrt{\sigma^2_1/n_1 + \sigma^2_2/n_2}}$$

The value of z given by the above formula can be interpreted as the number of standard deviations $x_1 - x_2$ is from the value of $\mu_1 - \mu_2$ specified in Ho. The rejection rule is:
Reject Ho if $z < -1.96$ or if $z > +1.96$

PRIVATE PILOT WRITTEN

The analysis of Private Pilot Written Exam scores yielded a result that favors Auburn University students who take the written exam on their own versus students that take the exam as part of the private pilot ground school series. Additionally, non-Auburn University students achieved higher scores than Auburn University students. In analyzing the data it was important to look at both the mean and distribution of exam scores.

Category	Mean Score
Auburn Students	84.0
Students in AU Ground School	83.5
Students not in AU Ground School	86.3
Non AU Student	85.1

According to the mean score analysis the difference between ground school students and non ground school students is 2.8 percent. The next step was to review the distributions of the four categories in order to determine whether the results of the mean analysis test are due to outliers. Additionally, a distribution of the data sets will yield the median values. The results of the distribution are in the Appendix, Table 1.

The results of the distribution analysis show a wider range of scores for ground school students than non-ground school students. Also, the medians of the distributions are higher and closer than the averages. The median difference between ground school students and non-ground school students is only 1 percent. This means that the upper halves of test takers are similarly distributed. The chart above shows the score ranges. The non-ground school students have a narrow interquartile range and overall narrow distribution. The ground school students have a considerably wider distribution. The chart also reveals the presence of outliers. There are two outliers in the ground school class, and only one in the non-ground school class. However, these outliers are moderate, and after recalculating the data without them, the outliers were proven to have little impact on the results. The calculated z scores for both Ha1 and Ha2 show that the alternative hypothesis is both cases have to be rejected, so we can conclude that:

1. There is no significant difference between Auburn University student versus non-university student exam takers on their private pilot FAA written exam scores.
2. There is no significant statistical difference between ground school versus non-ground school attendee exam takers on their FAA private pilot exam scores.

The above statement may lead us to believe that attending ground schools has no impact on FAA written exam performance as far as the private pilot written is concerned.

INSTRUMENT RATING WRITTEN

The results from the written exam scores favored non-Auburn University students over Auburn University students by a wide margin. The difference between Auburn students who are enrolled in ground school and those who are not was small, but in favor of the non-ground school students. Both a mean and a distribution analysis were performed to compare the different categories.

Category	Mean Score
Auburn Students	81.7
Students in AU Ground School	81.5
Students not in AU Ground School	82.8
Non AU Student	89.8

The difference between non-Auburn University students and Auburn University students is 8.1 percent in favor of the non-Auburn students. This gap is larger than any other exam analyzed. The difference between ground and non-ground students is 1.3 percent, which follows the overall pattern seen on all the exams analyzed. The next step was to perform a distribution analysis. The results of the distribution analysis are charted in the Appendix, Table 2.

The results indicated that the distribution differences are wider than the mean differences. The non-Auburn students outperformed all Auburn students by a median difference of 10.5 percent. Furthermore, the 1st quartile score (83.25 percent) of non-Auburn test takers is higher than the median score for Auburn students (82 percent). This means that three fourths of the non-Auburn student test takers did better than half of the Auburn students.

One important change noted from the distribution analysis is that the median scores for non-ground and ground students are equal, with a value of 82 percent. This means that there is little difference between the expected scores of ground school and non-ground school students. The calculated z scores for both Ha1 and Ha2 show that the alternative hypothesis is both cases have to be rejected so we can conclude that:

1. There is no significant difference between Auburn University student versus non-university student exam takers on their instrument rating FAA written exam scores.
2. There is no significant statistical difference between ground school versus non-ground school attendee exam takers on their FAA instrument rating exam scores.

The above statement may lead us to believe that attending ground schools has no impact on FAA written exam performance as far as the instrument rating written is concerned.

COMMERCIAL PILOT WRITTEN

The disparity between Commercial Written Exam scores was slight. Overall, the non-students performed better than Auburn University students. The difference was small between test scores for students enrolled in the ground instruction course versus those who were not. To analyze the test results, both a mean and a distribution analysis were performed.

Category	Mean Score
Auburn Students	89.1
Students in AU Ground School	88.8
Students not in AU Ground School	89.9
Non AU Student	92.6

As seen in the table, the non-students scored an average score 3.5 percent higher than Auburn students. The difference between ground school and non-ground school students was 1.1 percent, which follows the trend witnessed on other exams. Next a distribution analysis was conducted to identify any outliers or distribution trends that would better explain the results. The distributions are in the Appendix, Table 3.

The distribution analysis shows that non-students performed better than the mean analysis stated. The median test score for non-students is 96 percent, which is considerably higher than the mean of 92.6 percent. The reason for the disparity is the extreme outlier that is present on the boxplot (Appendix, Table 3). The median difference between non-students to students is 5.5 percent, which is a wider gap than the mean analysis yielded. The median difference between ground school and non-ground school students is small, one percent, and is in favor of the non-ground school students. This difference is similar to differences noted on all other exams analyzed. The calculated z scores for both Ha1 and Ha2 show that the alternative hypothesis is both cases have to be rejected, so we can conclude that:

1. There is no significant difference between Auburn University student versus non-university student exam takers on their commercial pilot FAA written exam scores.
2. There is no significant statistical difference between ground school versus non-ground school attendee exam takers on their FAA commercial pilot exam scores.

The above statement may lead us to believe that attending ground schools has no impact on FAA written exam performance as far as the commercial pilot written is concerned.

FUNDAMENTALS OF INSTRUCTING WRITTEN

The results for the Fundamentals of Flight Instructing Exam favor the non-ground school students over the ground school students. Additionally, the non-student test takers achieved better scores than Auburn University Students. These results are similar to results noted on the other exams. The means are shown below.

The mean difference between student test takers was present, but slight with a 2.6 percent difference. Non-Auburn University

Students did very well on this exam, with an average score of 96.4 percent. Next, the distributions were analyzed. The results are in the Appendix Table 4. As expected from the average scores, the non-students had a very narrow distribution, but did have a

Category	Mean Score
Auburn Students	91.5
Students in AU Ground School	90.9
Students not in AU Ground School	93.5
Non AU Student	96.4

surprising two outliers.

The main point that the box plots bring up is the presence of extreme outliers, especially the score of 50 percent by one of the ground school students (Appendix, Table 4). When that outlier is removed the average for ground students is raised to a 92.7 percent, which means that the two groups are not as far apart as the mean analysis suggests. The other point of interest is the length of the tail for ground students. The tail is longer, meaning that the lower 25 percent of test takers scored within a wide range, which skewed the results achieved by the upper 75 percent. Overall, this exam exemplifies the results achieved on other exams. The calculated z scores for both Ha1 and Ha2 show that the alternative hypothesis is both cases have to be rejected so we can conclude that:

1. There is no significant difference between Auburn University student versus non-university student exam takers on their fundamentals of instructing FAA written exam scores.
2. There is no significant statistical difference between ground school versus non-ground school attendee exam takers on their FAA fundamentals of instructing exam scores.

The above statement may lead us to believe that attending ground schools has no impact on FAA written exam performance as far as the fundamentals of instructing written is concerned.

FLIGHT INSTRUCTOR WRITTEN

The difference between test takers was slight, but still in favor of the students taking the exam while not enrolled in a ground school. As seen in the mean analysis summary below, the Auburn Students without ground school achieved higher exam scores than all other categories. The non-student test takers did worse, which warranted further inspection. The number of non-student test takers was small and one score was considerably lower than the rest, which brought the average down.

Category	Mean Score
Auburn Students	87.6
Students in AU Ground School	85.9
Students not in AU Ground School	90.9
Non AU Student	87.4

As seen above, the students without ground school achieved scores 5 percent higher than students in ground school. The next step was to examine the distributions of the data, which are in the Appendix, Table 5. The difference between student groups held up, but the difference between non-students and non-ground students disappeared, as the medians are equal.

The distributions offer more explanation for the results. The Non-Auburn Student category did well, but the lower 50 percent brought the average down considerably. The students not in ground school have a narrow distribution without outliers. The differences that exist for this exam follow the others with the exception of the mean score difference of non-student test takers, which was explained by the one low score that brought the average down. The calculated z scores for both Ha1 and Ha2 show that the alternative hypothesis is both cases have to be rejected so we can conclude that:

1. There is no significant difference between Auburn University student versus non-university student exam takers on their flight instructor FAA written exam scores.
2. There is no significant statistical difference between ground school versus non-ground school attendee exam takers on their FAA flight instructor exam scores.

The above statement may lead us to believe that attending ground schools has no impact on FAA written exam performance as far as the flight instructor written is concerned.

ADVANCED GROUND INSTRUCTOR WRITTEN

The Advanced Ground Instructor Exam scores were largely in favor of non-Auburn students. When Auburn University students were compared to non-Auburn students, the students taking the exam as part of a ground school class did considerably poorer than those who did not. The following analysis breaks the scores down for the mean and distribution (for the distribution see Appendix, Table 6).

Category	Mean Score
Auburn Students	85.2
Students in AU Ground School	81.8
Students not in AU Ground School	91
Non AU Student	94

The mean scores are heavily in favor of non-students and students not in ground school. Students taking this test on their own scored, on average, 9.2 percent higher than students who attended a ground school. Before taking the mean difference too far, it is important to examine the distributions. The distributions are listed in the Appendix, Table 6.

The quartile ranges and the medians give more insight into the characteristics of the data. The medians between ground and non-ground school students are only 6.5 percent apart, which is considerably closer than the mean analysis indicated. The box plots (Table 6, Appendix) further demonstrate the effect of a wide lower quartile range. The wide interquartile range and extended lower whisker on the ground school plot shows that the lower half of ground school test takers were considerably more spread out than the lower half of the non-ground school test takers. It should be noted that out of tests chosen for analysis this one had the fewest scores to analyze, with a total of 43 tests taken. Because of the small number a few low scores may significantly skew the results. The calculated z scores for both Ha1 and Ha2 show that the alternative hypothesis is both cases have to be rejected, so we can conclude that:

1. There is no significant difference between Auburn University student versus non-university student exam takers on their advanced ground instructor FAA written exam scores.
2. There is no significant statistical difference between ground school versus non-ground school attendee exam takers on their FAA advanced instructor exam scores.

The above statement may lead us to believe that attending ground schools has no impact on FAA written exam performance as far as the advanced ground instructor written is concerned.

CONCLUSION

The data analysis for each exam reveals that there is no statistical significance in the impact of ground schools on the FAA test scores of a sample of test takers at War Eagle CATS Testing Center located at Auburn University. Our data analysis also shows that there is no statistical significance in the impact of being a University student (Auburn University) on the FAA test scores of a sample of test takers at War Eagle Testing Center. The study only looked at a period of two years, from January 1 1999 to December 31 2000. Several conclusions may be drawn from the above analysis that have to do with the effectiveness of ground schools in preparing students for FAA written exams. More in-depth, careful and comprehensive studies need to be conducted before such conclusions are drawn. We in no way claim that the findings of our analysis are universally applicable.

APPENDIX

Table 1

Private Pilot Written Results

	Auburn Students	In AU Ground School	Not in AU Ground School	Non AU Student
First Quartile	78.00	78.00	82.50	78.50
Median	86.00	86.00	87.00	88.00
Third Quartile	92.00	90.00	93.00	94.50
Interquartile Range	14.00	12.00	10.50	16.00
Mean	84	83.5	86.3	85.1
Moderate Outliers (Δ)	1	2	1	0
Extreme Outliers (▲)	0	0	0	0

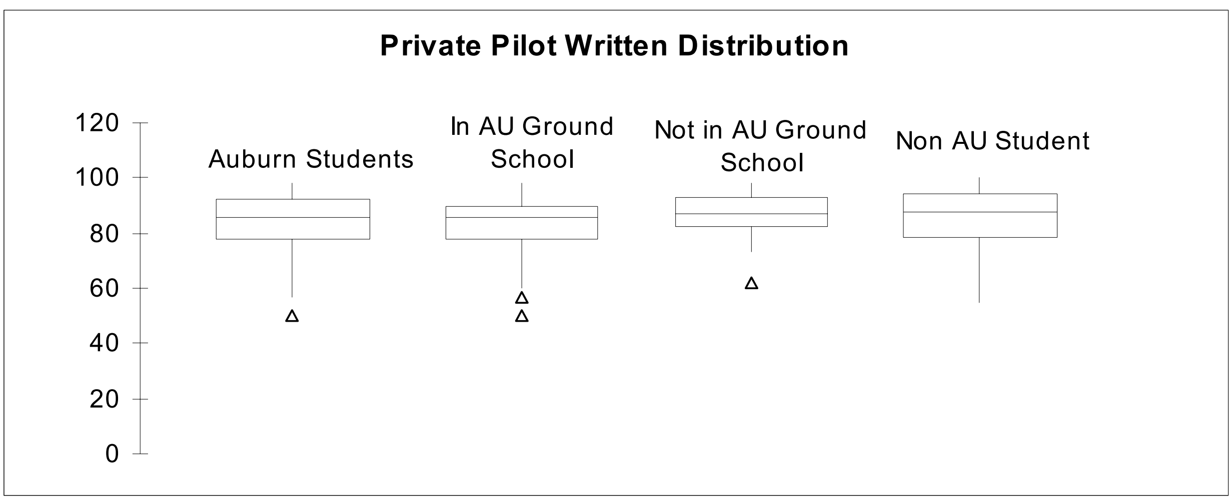


Table 2

Instrument Rating Written Results

	Auburn Students	In AU Ground School	Not in AU Ground School	Non AU Student
First Quartile	75.00	73.00	78.00	83.25
Median	82.00	82.00	82.00	92.50
Third Quartile	90.00	90.00	88.50	97.25
Interquartile Range	15.00	17.00	10.50	14.00
Mean	81.7	81.5	82.8	89.8
Moderate Outliers (Δ)	2	0	0	0
Extreme Outliers (▲)	0	0	0	0

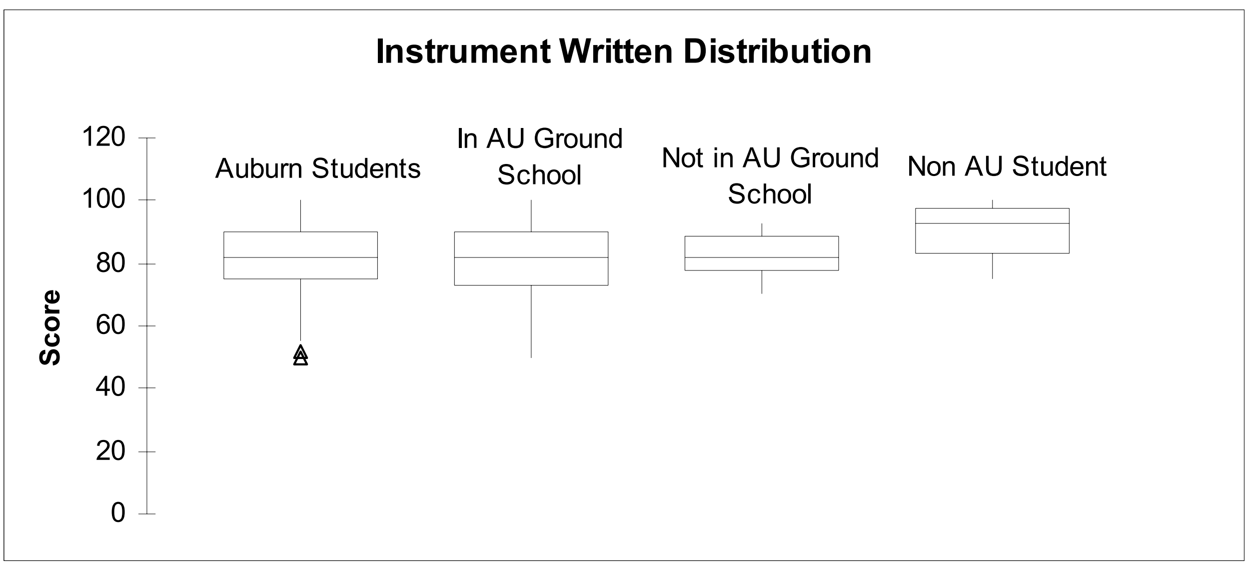


Table 3

<u>Commercial Pilot Written Results</u>

	Auburn Students	In AU Ground School	Not in AU Ground School	Non AU Student
First Quartile	85.0000	85.0000	89.2500	92.5000
Median	90.5000	89.5000	91.5000	96.0000
Third Quartile	94.0000	93.0000	94.7500	97.0000
Interquartile Range	9.0000	8.0000	5.5000	4.5000
Mean	89.1	88.8	89.9	92.6
Moderate Outliers (∆)	0	0	1	0
Extreme Outliers (▲)	0	0	1	1

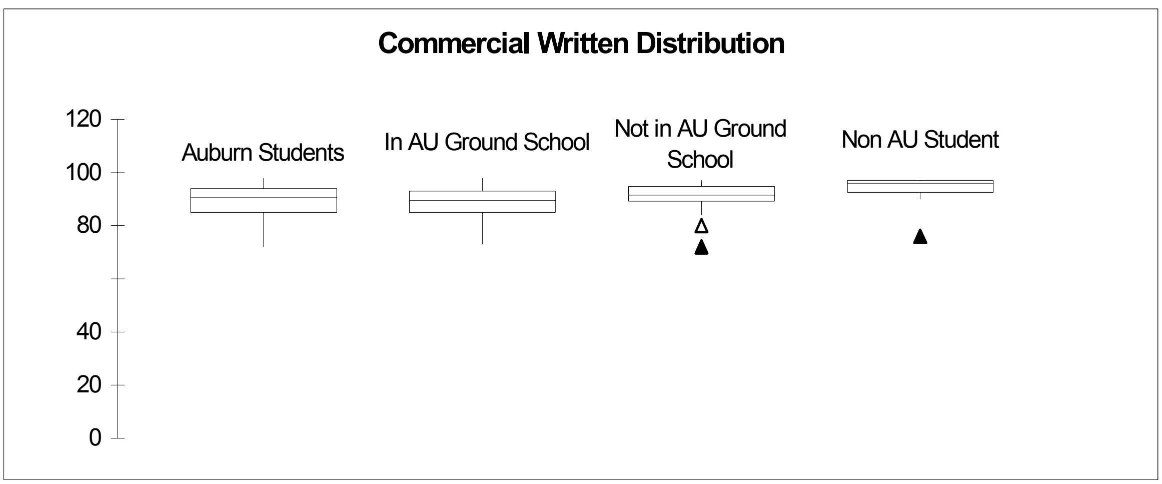


Table 4

Fundamentals of Instructing Written Results

	Auburn Students	In AU Ground School	Not in AU Ground School	Non AU Student
First Quartile	87.0	87.0	90.5	98.0
Median	94.0	94.0	96.0	98.0
Third Quartile	98.0	98.0	98.0	100.0
Interquartile Range	11.0	11.0	7.5	2.0
Mean	91.5	90.9	93.5	96.4
Moderate Outliers (Δ)	0	0	0	0
Extreme Outliers (▲)	1	1	0	2

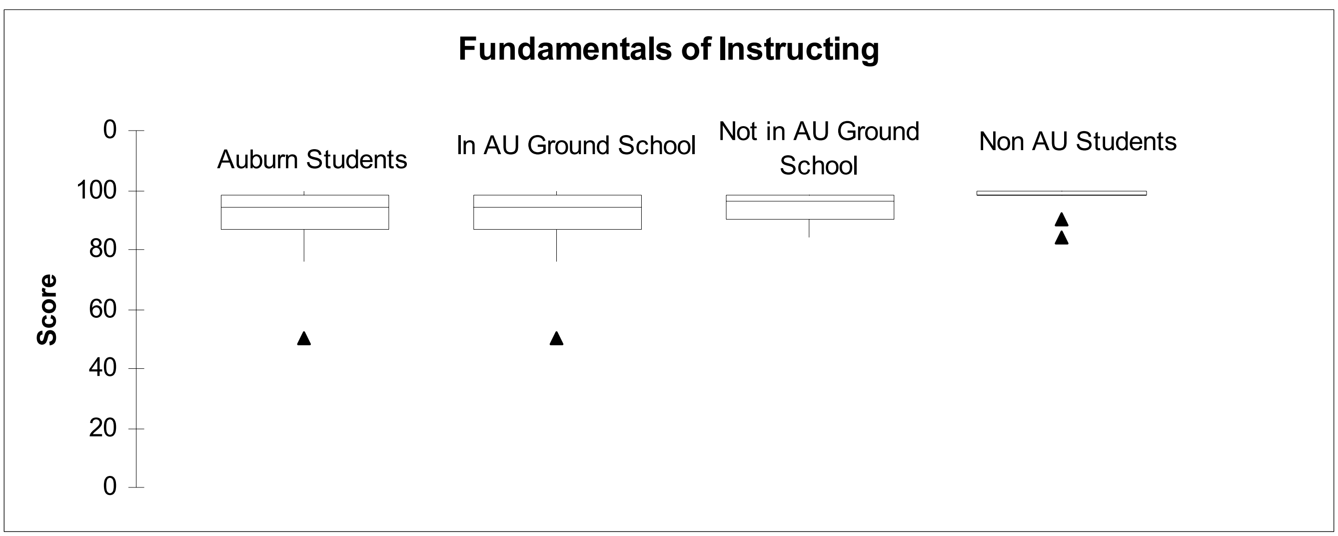


Table 5

Flight Instructor Written Results

	Auburn Students	In AU Ground School	Not in AU Ground School	Non AU Student
First Quartile	81.3	80.0	89.0	83.0
Median	89.0	87.5	92.0	92.0
Third Quartile	92.8	91.5	92.8	94.0
Interquartile Range	11.5	11.5	3.8	11.0
Mean	87.6	85.9	90.9	87.4
Moderate Outliers (Δ)	0	0	0	0
Extreme Outliers (▲)	0	0	0	0

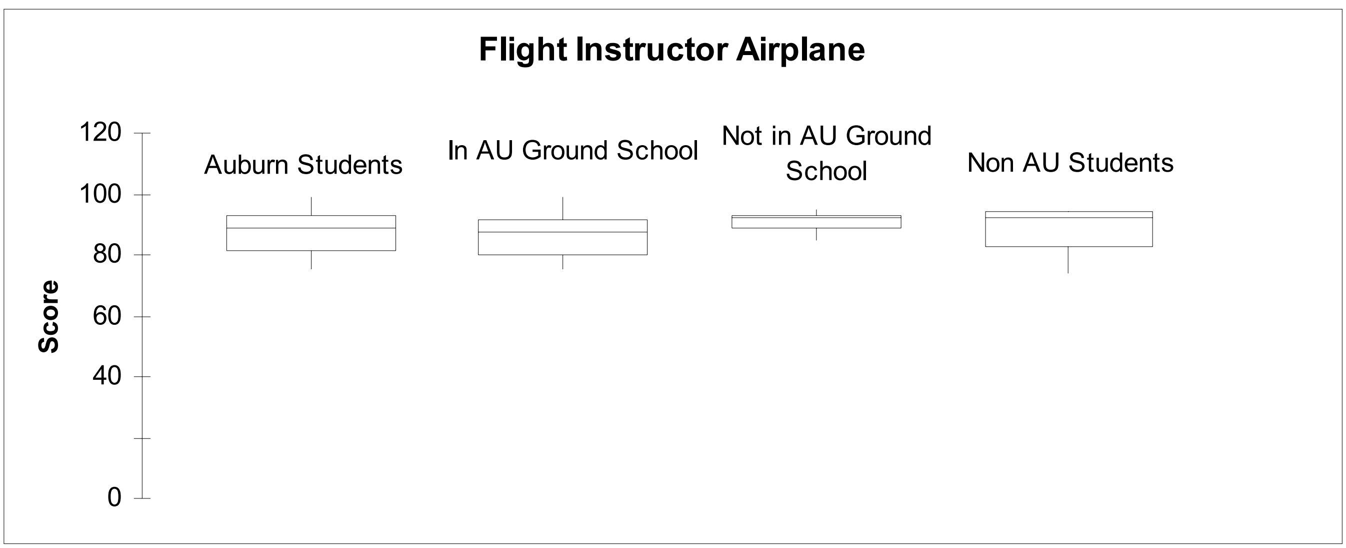
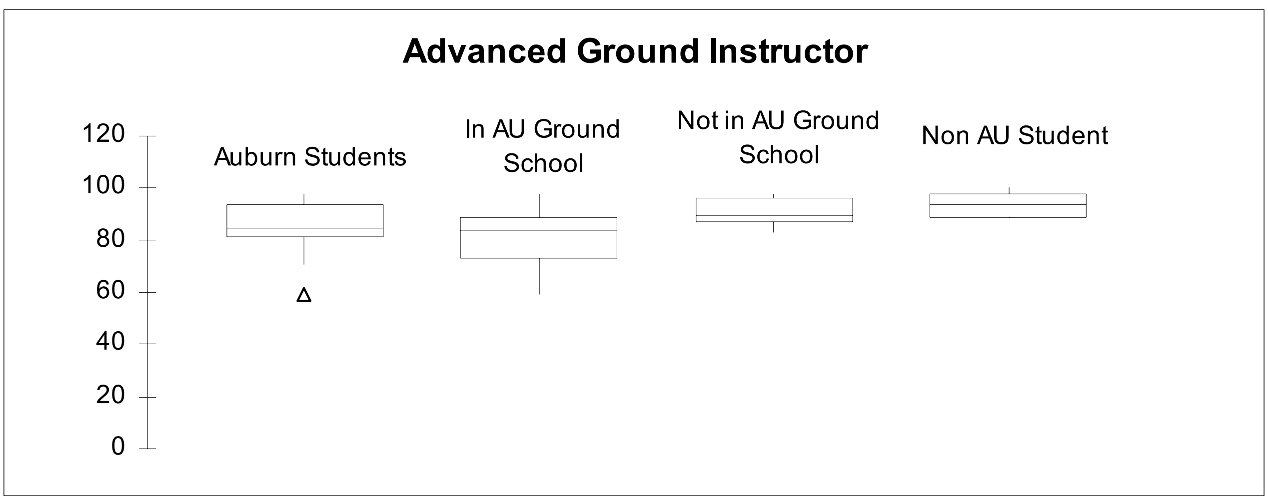


Table 6

Advanced Ground Instructor Written Results

	Auburn Students	In AU Ground School	Not in AU Ground School	Non AU Student
First Quartile	81.5	73.0	87.0	89.0
Median	85.0	83.5	90.0	94.0
Third Quartile	93.5	89.0	96.0	98.0
Interquartile Range	12	16	9	9
Mean	85.2	81.8	91	94
Moderate Outliers (Δ)	1	0	0	0
Extreme Outliers (▲)	0	0	0	0



The Learning Styles of College Aviation Students

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ABSTRACT

This study investigated the learning styles of collegiate aviation students. The results of this investigation were compared to the learning styles of qualified pilots in the United States Air Force, as identified in a previous study. Using the Kolb Learning Style Inventory, the objectives were to identify the learning styles of collegiate aviation students, determine if there was a difference in learning style among the grade levels of the college students, and to note the similarities and/or differences in learning styles between the collegiate aviation students and the United States Air Force pilots. The demographic survey used in the previous study was tailored to reflect the disparity of experiences between college students and active pilots in the United States Air Force. The population for this study consisted of students enrolled in the aviation programs at Oklahoma State University-Stillwater campus, Oklahoma State University-Tulsa campus, and Southeastern Oklahoma State University on the Durant campus and at Tinker Air Force Base.

Using the results of this study to identify a preferred learning style among college aviation students can provide information about the students' cognitive mapping. This mapping can be used as a tool so that courses can be more effectively designed. Modifications to this main theme can then be made for those students who have different learning styles. An ideal learning style, due to the predictive nature of Kolb's Learning Style Inventory, can also identify aviation students as a discrete group from other degree programs on campus.

INTRODUCTION

Due to the importance of learning styles, Oklahoma legislators and educators are examining a program called Oklahoma Schools Attuned. Their goal is to train teachers to recognize and utilize the student's learning strengths (Levine, 2000). The concept of learning styles covers a broad spectrum of mental and physical processes. Learning styles focus on how a student learns, as opposed to the subject matter. Many people think of the physiological components of learning and approach the subject as a study of visual, auditory, tactile, and kinesthetic learners. Levine (2000) quotes Rita Dunn, professor of education and director of the Center for the Study of Learning and Teaching Styles at St. John's University, stating, "Without taking stock of our own learning style, many of us try to produce through our weaknesses" (pg. D-5). In this study, our goal was to identify the predominant cognitive learning style of college aviation students to provide a basis to extend this concept to these students.

Schmeck (1988) attributes learning style development to a process of positive reinforcement during early learning situations. Continued success with a specific learning style, and the positive feelings of achievement this success brings, lead to a preference for a specific style, even when other styles may be more appropriate for specific subject matter. This process of transference from previous experiences is part of the experiential learning cycle.

Kolb (1984) breaks the cycle into four distinct steps: (a) concrete experience, or the ability to become involved " . . . fully, openly, and without bias in new experience . . .", (b) reflective observation, or the ability " . . . to reflect on and observe . . . experiences from many perspectives . . .", (c) abstract conceptualization, or the ability to " . . . create concepts that integrate . . . observations into logically sound theories . . .", and (d) active experimentation, or the ability to ". . . use these theories to make decisions and solve problems . . ." (p. 30). The process of acquiring knowledge becomes a spiral in which the learner moves from one step in the learning process to the next, building continuously on previous experiences.

Kolb (1984) describes the four basic steps in this cycle by using two sets of opposing choices: Vicarious experience and abstract conceptualization, which actively opposes participating in the event through concrete experience. The internalized reflective observation is opposed by the externalized active experimentation. The dichotomy between the abstract and the concrete thinker has entered the popular culture with the images of a concrete thinking, pocket protector wearing, left-brained engineer and the longhaired, abstract-thinking artist coming readily to mind. The reflectively observing introvert and the actively experimenting extrovert are also readily identifiable as personalities. These dichotomies make up Kolb's Learning Styles.

Kolb (1984, 1993) applies the concept of preferred learning styles to these two dichotomies to identify four different styles. The accommodator is a concrete-thinking extrovert who combines concrete experience and active experimentation, while the diverger is a concrete-thinking introvert combining concrete experience and reflective observation. On the opposite side of the scale are the converger, an abstract-thinking extrovert combining abstract conceptualization and active experimentation; and the assimilator, the abstract-thinking introvert combining abstract conceptualization and reflective observation.

The Kolb Learning Style Inventory (LSI), developed in 1976, was revised in 1985, and 1993 to identify where in the learning cycle an individual's preferences fall. To complete the LSI, the subject ranks four possible endings for 12 sentence stems. This forced-ranking, where each ending identifies one of the four steps in the learning cycle, produces a score between 12 and 48 for each mode of learning. Two combination scores are derived to identify a preferred location along each of the two learning dichotomies: abstract/concrete and active/reflective. Subtracting the concrete experience score from the abstract conceptualization score and subtracting the reflective observation score from the active experimentation score, provides these two combination scores. Plotting these two combination scores on a learning-style grid will identify which quadrant best describes the preferred learning style of the subject (Kolb 1985,1993).

In addition to being revised twice since its development in 1976, Kolb's LSI has been validated over the years in such studies as a comparison of learning styles of high school and college students (Matthews

& Hamby, 1995) and a cross-cultural comparison between Western and Asian learners (Auyeng & Sands, 1995). The LSI also is relatively easy to understand and administer. With only 12 forced-choice responses to complete, the instrument is quickly answered.

A survey of pilots in the United States Air Force (USAF) using Kolb's Learning Style Inventory and a demographic survey form was performed (Kanske, 1998/1999). In addition to describing an individual's primary learning style, the LSI displays some predictive ability. Because of the specialization of undergraduate degree programs, it is possible to " . . . expect to see relations between people's learning style and the early training they received in an educational specialty or discipline . . ." (Kolb, 1984, p.85). Kolb reports significant results for undergraduate education as a predictor of learning style, showing degrees in the arts going to divergers, degrees in the physical sciences going to convergers, and degrees in the social sciences going to assimilators.

The study of USAF pilots indicated no variation in learning style based upon undergraduate degree, with no significant variation in learning style when sorted for this factor. The converger style was identified as the preferred learning style among USAF pilots. The intent of the current study was to describe the learning styles of pilots within a common educational discipline, collegiate aviation students, using the methodology for determining learning styles developed in the study of USAF pilots. The research question was designed to determine if there was some point during college where this learning style becomes dominant, or if the learning styles of college aviation students and pilots in the United States Air Force are totally unrelated to each other.

The identification of a preferred learning style among college aviation students provides a focus for course design; allowing developers to design for the learning preference of the student population. Modifications to this main theme can then be adjusted to fit the needs of those students who have different learning styles. A preferred learning style, due to the predictive nature of Kolb's Learning Style Inventory, can also identify aviation students as a discrete group from other degree programs on campus.

METHODOLOGY

The population for this study consisted of students enrolled in the aviation programs at Oklahoma State University-Stillwater campus, Oklahoma State University-Tulsa campus, and Southeastern Oklahoma State University on the Durant campus, and at Tinker Air Force Base. Kolb's Learning Style Inventory was used as the survey instrument. The demographic survey form was modified to account for the collegiate experience as opposed to the active military experience.

Surveys were distributed to students during the Fall 2000 semester at Oklahoma State University-Stillwater, and during the Spring 2001 semester at Oklahoma State University-Tulsa, Southeastern Oklahoma State University at Durant, and Tinker Air Force Base. Survey packages, including a cover letter, the demographic form, and the Learning Style Inventory, were distributed, and collected, by classroom instructors and at the flight facilities for each location.

RESULTS AND ANALYSIS

Responses were received from 74 students at Oklahoma State University-Stillwater, (61.6% response) 56 students at Oklahoma State University-Tulsa (46.7% response), 41 students at Southeastern

Oklahoma State University-Durant (31.5% response), and 16 students from Tinker Air Force Base (32% response). The grade level breakdown of this group of students is shown in Table 1. The limited number of lower division students from Tulsa is a result of a cooperative education program with Tulsa Community College. Southeastern Oklahoma State University-Tinker students are primarily upper division. Lower division courses for Tinker Air Force students are obtained from either a local junior college or schools previously attended and are transferred into the Southeastern Oklahoma State University program. Some responses were unusable, due to errors such as no demographic data, missing responses on the Learning Style Inventory, and responses on the Learning Style Inventory with violated scoring criteria. Only useable survey responses are included in Table 1.

Table 1

Responses by Grade Level and School

	School				
	SOSU **Durant**	OSU Stillwater	SOSU **Tinker AFB**	OSU Tulsa	Totals
Grade					
Freshman	8	16	0	1	25
Sophomore	7	14	2	2	25
Junior	10	23	5	23	61
Senior	11	15	2	15	43
Graduate Student	0	2	7	12	21
Totals	36	70	16	53	175

LEARNING STYLE ANALYSIS

Instruments were scored using the methods outlined in the Learning-Style Inventory Self-Scoring Inventory and Interpretation Booklet (Kolb, 1993). This method produced scores for concrete experience, reflective observation, abstract conceptualization, and active experimentation for each subject. From these four raw scores, two combination scores, abstract conceptualization minus concrete experience (AC-CE) and active experimentation minus reflective observation (AE-RO), were derived. The final step in the analysis is to plot the intersection of the two combination scores on a grid using AE-RO as the X-axis and AC-CE as the Y-axis. The quadrant on the grid in which the intersection falls was used to define the subjects' learning style.

The predominant learning style

displayed by the college students, using this scoring method, was assimilator, with 62 students. This represents 36.7 percent of the surveys with valid learning styles. The diverger learning style was least represented among the responding students with only 26 students, 15.4 percent. The accommodator style was the second most prominent with 39 students or 23.1 percent, followed by the converger style with 42 students and 24.9 percent. These results are shown in Table 2.

Table 3 summarizes the learning styles of the study group, broken down by grade level. Among the freshman class, 25.0 percent were divergers, 33.3 percent accommodators, 20.8 percent convergers, and 20.8 percent assimilators. Convergers and assimilators represented 77.8 percent of the sophomore class, and the remaining 22.2 percent were accommodators or divergers. The junior class had 64.3 percent convergers/assimilators and 35.7 percent accommodators/divergers, while the senior class had 61.0 percent convergers/assimilators and 39.0 percent accommodators/divergers. Finally, 66.7 percent of graduate students were convergers/assimilators and only 33.3 percent were accommodators/divergers.

The results for group learning styles derived with the calculations of AE-RO and AC-CE used to define learning styles are shown in Table 5. Means for the total sample of AE-RO equal 4.56 and AC-CE equal 5.82 plot in the assimilator style. Freshmen, with an AE-RO of 5.58 and an AC-CE of 2.41 plot in the diverger style. The sophomores' AE-RO of 6.00 and AC-CE of 10.56 plots in the converger style. An AE-RO of 6.30 and AC-CE of 5.63 for juniors also plots in the converger style. Means of 2.49 for AE-RO and 6.27 for AC-CE plot in the assimilator style for seniors. Finally, graduate students plot in the assimilator style with means for AE-RO of 1.19 and AC-CE of 5.29.

ANALYSIS AND CONCLUSIONS

The overall look at the learning styles of the students surveyed was similar to the results of the U.S. Air Force pilot study. Perhaps most striking is the similarity in the percentages of respondents with either the assimilator or converger learning styles. These two groups made up 67.8 percent of the U.S. Air Force study group (Kanske, 1998/1999) and 61.5 percent of the college study group.

The Kolb learning style inventory, for a random population, will produce an equal distribution among the four learning styles. The total sample of this study showed a significant deviation ($p<0.0013$) from equal distribution with a tendency toward abstract-conceptualization. The distribution of freshman learning styles matches that of a random population. At the sophomore level, a strong distribution ($p<0.09$) toward assimilator and converger was observed. The small sample size for the sophomores is a cause for concern, and future data must be obtained before this distribution can be considered truly significant. Junior level student responses skewed toward converger and assimilator ($p<0.11$). Assimilator was the dominant style among seniors at 41% with $p<0.11$ and graduate students at 52% ($p<0.036$).

College aviation students start out with a random population distribution of learning styles, but migrate toward the assimilator or converger style. These styles of learning remain the dominant styles throughout the aviation experience. Since all U.S. Air Force pilots are required to have a college degree, they closely match the graduate student classification of this study. It should be noted that the Air Force study (Kanske, 1998/1999) percentage (67.8%) closely matches the 66.7% result for graduate students from this study.

Martin (2000) found a shift in style

after the sophomore year, and suggested that this shift deserved further study. This study found the shift to occur even earlier, after the freshman year. This growing body of data recognizes a shift in learning style as aviation students progress through their education. Why this happens is, as yet, unanswered.

In an effort to answer this question, we consider this the first step in a multi-year study of aviation students. By tracking the learning styles of aviation students, we hope to determine if there are changes of individual learning styles, or if individuals with "non-predominant learning styles" tend to self eliminate from aviation programs.

Table 2

Style by school

Learning Style	School: OSU Stillwater	OSU Tulsa	SOSU Durant	SOSU Tinker AFB	Totals
Diverger	12	9	4	1	26
Accommodator	15	8	11	5	39
Converger	18	14	7	3	42
Assimilator	21	21	14	6	62
Totals	66	52	36	15	169

Table 3

Style by current standing (percentage)

Learning Style	Current Standing: Freshman	Sophomore	Junior	Senior	Graduate Student	Total
Diverger	25.0	5.6	12.5	19.5	14.3	15.4
Accommodator	33.3	16.7	23.2	19.5	19.0	23.1
Converger	20.8	33.3	33.9	19.5	14.3	24.9
Assimilator	20.8	44.4	30.4	41.5	52.4	36.7
Diverger + Accommodator	58.3	22.2	35.7	39.0	33.3	38.5
Converger + Assimilator	41.7	77.8	64.3	61.0	66.7	61.5

Table 4

Style by current standing (frequency)

	Current Standing					
Learning Style	Freshman	Sophomore	Junior	Senior	Graduate Student	Totals
Diverger	6	1	7	8	3	25
Accommodator	8	3	13	8	4	36
Converger	5	6	19	8	3	41
Assimilator	5	8	17	17	11	58
Totals	24	18	56	41	21	160

Table 5

Mean Values for:

Active Experimentation minus Reflective Observation (AE-RO) and
Abstract Conceptualization minus Concrete Experience (AC-CE)

	Current Standing					
Scale	Freshman	Sophomore	Junior	Senior	Graduate Student	Overall Mean
Active Experimentation minus Reflective Observation (AE-RO)	5.58	6.00	6.30	2.48	1.19	4.56
Abstract Conceptualization minus Concrete Experience (AC-CE)	2.41	10.56	5.63	6.27	5.28	5.82

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The Need for Airport Funding

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ABSTRACT

As a major component of the aviation industry, airports today rely on huge amounts of capital to keep the avenues of air transportation open. The Airport and Airways Development Act of 1970 became effective in May 1970 and provided a major source of airport capital improvement funding. However, since this law was passed airport capital needs have grown well beyond the capabilities of the federal government to fund them. Airports face a different financial market than their industry contemporaries; due in part to the regulated public environment, the uniqueness of airport revenue generation and debt markets. The need for airport funding will be explained by exploring the basics of airport operating costs, capital costs and revenue generation. An investigation of capital finance strategies will bring the conclusion.

BACKGROUND ON THE NEED FOR AIRPORT FUNDING

Revenue generation in the airport business is derived from a broad base. Depending upon the size of an individual airport's operation, key users, and the infrastructure supporting that airport, major revenue sources may vary considerably. Besides deriving a portion of their revenue stream from airlines and other aviation users, airports collect revenues from a large contingency of non-aviation related concessions. These income sources flow from charges to businesses that use the airport for their own economic purposes and revenue streams. Some of these include rents for parking areas, restaurants, gift shops, rental car agencies, hotels, and industrial parks located on airport grounds. In some cases, airports collect a portion of a business' gross revenue as compensation, over and above standard rates (Wells, p 213).

The U.S. airport system is a unique breed of a capitalist structure. The Deregulation Act of 1978 removed barriers of entry and exit for airlines, permitting airlines to refine and change existing pre-deregulation route structures. Ease of entry and exit left some airports bewildered as former lifetime tenants vacated the premises. While deregulation changed the airlines' operating environment, a concomitant change occurred in the airport environment (Kaps, 235). A new era of revenue generation and bottom line results was ushered in and thrust upon the airport manager.

As with most businesses, an airport must rely on its ability to attract capital to remain viable. An airport's ability to obtain capital, other than through revenue generation, comes from either the debt or quasi-equity markets, with one major exception. Equity markets do not exist "per se" in airport terminology. This is so because, until recently, private capital had not been infused into the system. The funding of airports has been, and basically remains, a public general fund consideration. If an analogy can be drawn between stockholders of a corporation and citizens of a locale where an airport is located, airport stockholders are the citizens of the community or communities served by the airport. Rather than receive dividends in the form of money for their equity holdings, airport viability and community embellishment are the citizen's investment returns (Kaps, p. 234). As the vast majority of airports in America are publicly owned (municipalities, government, etc.) private investment has not been a consideration. Instead, federal, state and/or municipal moneys work as a traditional equity infusion of non-private industry. Should there be a return on this investment, it does not become the province of the stockholders, but rather, an increase to the general fund, which is ultimately, a benefit to the citizenry.

Air travel has been and remains one of the fastest growing global industries. Forecasts predict U.S. commercial aviation will see robust growth in the coming decades, with international air travel to and from the U.S. growing by almost 1½ times the rate of domestic traffic (U.S. DOT). Airport planners around the world have found it virtually impossible to keep pace with the growing number of passengers and the demand for additional facilities. Airport capacity problems arise in virtually every developed country in the world. In the United States, according to Whitlock (1992), the system has surpassed capacity in many areas and projections are that patronage will grow even faster in the next decade. In 1995, in a speech before the Aviation Management Society of Southern Illinois University Carbondale, the Administrator of the Federal Aviation Administration (FAA) predicted air travel in the U.S. would increase by 60% in the next ten years (Hinson). Airports around the world will be faced with accommodating as many as 1 billion passengers annually by the year 2008 (U.S. DOT). This projection requires new and existing airport capacity and the concomitant ability to fund this growth.

The need for airport funding in the United States is driven by the users of the system; the scheduled airlines, general aviation, and military. The National Plan of Integrated Airport Systems (NPIAS) 1990-1999 (February 1991) estimated the total cost of Federal, State, Local, and Private airport development to be $40.544 billion. This estimate, prepared by the Federal Aviation Administration, includes the total cost of all projects eligible for federal support under the Airport Improvement Program, or AIP. This estimate included $6.153 billion for new airports, including $4.742 billion for new primary airports such as the Denver International Airport opened in February 1995. The FAA estimate for the DIA project was $2.4 billion. Since DIA's total cost has come in at over $4.0 billion, there’s a serious estimate shortfall. Other costs estimated for the other primary airports in the NPIAS (Austin, TX; Chicago, IL; Lake Havasu, AZ; San Diego, CA, etc.) were for nominal planning and land acquisition costs. They did not include development costs. It should be noted that the new primary airport construction estimates amount to less than a fourth of the total costs estimated for the NPIAS from 1990 to 1999. The National Plan of Integrated Airport Systems 1998- 2002 (March 1999) estimates the total cost of Federal, State, Local, and Private airport development to be $35.093 billion. The $5.451 billion dollar cost reduction from the 1990-1999 NPIAS report is due to the fact that no new hub airports are currently being built in the U.S.

Another aspect of domestic need for airport finance is the huge costs involved in reconstructing or expanding the existing airport system. For example, several airports around the nation are actively planning to add additional runways to their current layouts as a way to add more airport capacity without building all-new airport sites (GAO/RCED 98-129). Examples of such airports are Dallas-Ft. Worth International (DFW), and St. Louis Lambert International (STL). STL is in the process of planning to add a third east-west runway, for which preliminary Federal Aviation Administration approval was granted in December 1997. When these plans are finalized, the need for additional airport funding will be acute because these airports are all planning multi-billion dollar projects.

In the United States, rules, regulation, politics, and public outcry can inhibit funding abilities and goal accomplishments. Justifying the expenditure of amounts of money greater than some countries entire Gross National Product, can prove exceedingly difficult. A definitive need, as well as a plan that ensures financial integrity, is necessary before the public, as well as private entities, will consider backing airport requirements.

Internal Airport Funding Sources

The ability of an airport to finance itself, both operationally and for capital projects, has a lot to do with whether it is served by an airline. Airlines, and their passengers, provide a regular, daily flow of revenue to the airport based on the scheduled service that is provided by the airlines. Airlines lease facilities, rent space, pay for fuel, etc. Passengers rent cars, pay car parking fees, purchase items from concessionaires, etc. All of this airline-related activity generates revenue for the airport operator (Jenkins).

The activity at a general aviation airport is unscheduled, which causes the flow of revenue to be relatively unpredictable. There are some critical, and highly utilized, general aviation airports, particularly in major metropolitan areas. However, without airline service, general aviation airports are missing a key ingredient for airport funding -a consistent source of daily revenue. In addition, general aviation airports are ineligible for the Passenger Facility Charge (PFC) revenue, which is also derived from airline passenger volume (FAR 158). Consequently, airport finance options for general aviation airports are somewhat more limited than their commercial service counterparts. Many very small general-aviation airports are almost totally dependent upon Airport Improvement Program (AIP) funding for capital development, due to their lack of local funding options.

Cash Flow Considerations

Before an airport operating body can consider expansion or replacement plans, it must first consider how the costs of its daily operations are paid. Key operating cost categories are:

1. Salaries of airport employees, including management/ administration, operations, maintenance, and, where applicable, security, police, airport rescue/fire fighting, etc.
2. Airport Utilities, including the operation of any on-airport plants, sub stations, etc.
3. Equipment costs, including mowers, snow removal vehicles, airfield maintenance/operations vehicles and, where applicable, airport police cars, airport security vehicles and airport rescue/fire fighting trucks
4. Materials costs, including paint, building material items, snow removal salt, fuel spill clean up agents, lighting items, etc.; and,
5. Other costs that pertain to specific airports, such as airport owned and operated air traffic

control towers or aircraft fueling facilities.

In order to finance these operating costs, airports must consider a wide range of revenue generation possibilities for their airport, including:

1. Airfield or airside user charges. These are charges related to the use of runways, taxiways, ramps, hangars, and any other airport facilities on the operational side of the airport. Examples of such charges are aircraft landing fees (by weight, by aircraft type, by common fee for all, etc), aviation gas/jet fuel charges or fuel flowage fees, hangar rentals, aircraft parking/storage fees, etc.
2. Concessionaire fees. These are landside lease or rental charges which companies wishing to operate at the airport must pay to use the terminal, the fixed base operator building or any other on-airport building. Companies providing services such as airlines, air taxi/charter operators, flight schools, aircraft fueling, car rental, food service, business services, banking services, gift shopping, newspapers, can all expect to pay such charges. Charges can be assessed in terms of space used on the airport or in terms of units of business or sales volume or some combination thereof.
3. Local tax revenues. These can be general-purpose municipal taxes allocated to the airport by a city or county council. They can also be taxes assessed directly for the airport by an airport authority or district based on the assessed valuation in the area covered by the taxing units' voter-approved boundaries.
4. Agricultural fees. These are fees collected from farming and harvesting crops on airport owned lands by farmers. This is a special form of concession or lease fee.
5. Industrial Park Fees. Many airports have encouraged the development of non-aeronautical airport land use in such uses as industrial parks as a way to add revenue streams as well as a way to provide compatible land uses near runways. This is also a special form of concession or lease fees.
6. Mineral or mining fees. These are fees collected by the airport for oil, gas, or minerals pumped or mined from beneath the airport. This can be an important source of income in certain parts of the nation. (Kaps)

At air carrier served airports, the major tenants are the scheduled airlines. By means of rates and charges, these tenants are key to funding the operating and capital needs of airline served airports.

A major consideration to be made by airport personnel at airline-served airports in forecasting their projected revenues is how to suitably charge the airlines. Because such charges impact heavily on the airport's revenue stream, it is important to be both fair to the airline as well as to gain sufficient revenue to both operate the airport and have the ability to make interrelated major purchases.

Setting Rates and Charges

There are two major techniques used by airports to set airline rates and charges. These are the compensatory and the residual methods of ratemaking. Each method has a variety of subdivisions and approaches to their usage. The most prominent are the standard/commercial compensatory plans, the cost-center residual plan, and airport-airline system residual methods. Each of these has their own advantages and disadvantages as the following discussion shows.

Standard Compensatory

This approach to rate-making considers airlines as the ultimate user of the terminal and all other facilities of the airport. Rates and charges are calculated so the airport fully covers the airlines' share of operation and capital costs of the entire facility. These costs are only those necessary to operate the airport as a landing and take off location. Costs incurred by the airport for the maintenance of public areas and concessionaires, such as parking areas, etc., are excluded from charges to the airline. In this case, should Air Atlantis fly into XYZ airport and be the only carrier operating out of that airport, the entire costs of the airport and its operation, exclusive of non-airline necessary operations, would be borne by Air Atlantis. The airport, under this arrangement, must ensure that the profits made from its non-airline operations exceed the non-airline costs. Otherwise, a profit situation will not inure to the airport.

Commercial Compensatory

Under this method of ratemaking, all costs are calculated by charging the airlines, the concessionaires, and all rent paying tenants pro-rata for concession space and public-area costs. Airline costs excluding those for maintenance of public and concession areas in the standard compensatory, are included under this method. Under both the standard and the commercial compensatory methods, the airport assumes the risk associated with vacant rental space, but can, and often times does, receive a portion of the concessionaires' gross revenues.

Cost Center Residual

The Cost Center Residual approach to rate setting establishes a cost center mentality. It allocates the cost of operating an airport to a particular area, as opposed to an all-encompassing approach of the entire operation. In other words, accounts are established for operational areas such as terminal, ground transportation, airfield, parking, staging areas, and other buildings and grounds operations. Rates and charges, particularly airlines' charges are set to recover the costs of this cost center. Charges are based on the usage of this area and any offset or credit that may be received due to non-airline revenue generated by the area. The net costs are then pro-rated to the airline or airlines involved.

Airport/Airline System Residual

This is an all-encompassing assumption of airport financial risk by the airlines. Under this arrangement, the airlines pay landing fees large enough to ensure that the airport breaks even. Under residual methods, the airlines primarily assume financial risk of airport operations. Because long-term leases may run twenty or thirty years, an airline may subject itself to pay costs of undefined future facilities. Generally, as quid pro quo for their financial solvency, an airline obtains lease arrangements satisfactory to their market share. Oftentimes, these arrangements create majority-in-interest clauses in their lease agreements, whereby airlines obtain sufficient influence to gain control over airport financial and investment decisions. Majority in interest arrangements may go so far as to permit the airline(s) to review, approve, and/or veto airport capital projects.

Much consternation exists over the establishment of airport fees. In recent court cases, an airport's right to set rates and charges through a compensatory method has been affirmed. In 1995, Congress established new rate, fee, and charge guidelines. Code of Federal Regulation Title 14 Part 302 highlights that:

- rates established must be "fair and reasonable"
- rates may not unjustly discriminate against aeronautical users or other groups
- rates must be set so that the airport is financially self-sustaining as possible, and
- airport revenues must be expended for aeronautical facilities within that airport.

Once the method of cost allocation is determined, the airport director must determine the difference from anticipated revenues and the cost of operation. Under traditional accounting methods, revenue minus expense equals profit or loss. However, under the airport equation, revenue minus expense equals either costs covered, or an inability to cover costs. If costs are covered, revisions to scheduling or scope of proposed master projects might have to be made to keep the tight balance of costs to expenditures. In the alternative, where revenues do not cover airport costs, a short fall exists. When a short fall is either experienced or anticipated, a break-even need is created. This need creates the necessity for airports to seek other arrangements to secure required capital.

Federal Airport Funding Sources

Obtaining funds over and above the traditional revenue sources to support an airport's capital improvement needs generally falls into two categories: grants or debt. Grants are the receipt of money conferred by a fund for the purpose known to the conferring fund. The exceptional benefit of having a grant conferred is that fulfillment of the duty associated with such grant acts as payment of the principal amount conferred. In other words, free money. The debt market, on the other hand, confers money to the borrower but expects to have the principal returned, with a return of interest. Before going to the debt markets for additional funding, all avenues of "free" money should be exhausted. The avenue of approach should then be grants, other possibilities, and then the debt markets. According to Federal Aviation Regulation Part 151, airports have one additional pre-debt option after the grant route has been exhausted. The Passenger Facility Charge (PFC), which is regulated under Federal Aviation Regulation Part 158, may provide additional sources of revenue. Each of these areas will be briefly discussed.

Because the national infrastructure is dedicated to the support of the transportation system, particularly the air transportation system, the federal government has historically been the provider of airport developmental funds. This funding is provided primarily through the Airport Improvement Program (AIP). The Airport and Airway Improvement Act of 1982 established the AIP.

The Airport and Airway Trust Fund

The Airport and Airway Trust Fund supports the nation’s aviation infrastructure, begun as part of the Airport and Airway Development Act of 1970. Zorn (1990) indicates the purpose of the fund was to support capital development of the nations’ air transportation system and support part of the Federal Aviation Administration's operating and maintenance costs.

The Trust Fund relies on user fees and taxes assessed on those who use the air system for development of its funding mechanism. Fund revenues are derived from:

- Taxes levied on all domestic airline tickets (8%, to drop to 7.5% in FY 2000)
- Ticket tax at rural airports (7.5%)
- Flight segment tax ($2.25, to raise to $3.00 in FY 2003)
- Tax on "frequent flyer" awards (7.5%)
- Taxes levied on all freight airway bills (6.25%)
- International departure taxes assessed per passenger ($12.00)
- International arrival taxes assessed per passenger ($12.00)
- General Aviation gasoline taxes (19.3 cents per gallon)
- General Aviation jet fuel (21.8 cents per gallon)
- Commercial and jet fuel tax (4.3 cents per gallon)

Source: Budget of the United States Government FY 2000 Congressional Research Service

The principal advantage of the user approach to generating the trust funds is that it provides predictable and increasing sources of income, commensurate with need. This permits more effective and long range planning. It has been estimated that in fiscal year 1996, airline ticket purchases alone contributed in excess of $5.0 billion to the fund. Despite this staggering amount, more could probably have been collected had it not been for the government shutdown during the Democratic and Republican debates over balancing the federal budget. Because of an oversight the Trust Fund fees were not extended into early fiscal 1997 and were not collected by the airline community. This provided windfall fares for the traveling public and a competitive edge for some airlines, but it did little for the fund itself. Early 1997 provided Congress the opportunity to reestablish the user charge and trust fund approach, which it did (U.S. House).

The Airport Improvement Program (AIP)

The Airport and Airway Improvement Act of 1982 established the Airport Improvement Program. Its funds, derived from the Airport and Airway Trust Fund, are used for four general purposes; airport planning, airport development, airport capacity enhancement, and noise compatibility programs (PL 100-223). According to the Department of Transportation, Office of Airport Planning and Programming guidelines, the following have been established for AIP funds:

1) **Airport Planning** - Funds received for airport planning may include grants for integrated airport systems addressing the current and future air transportation needs of a region as a whole. Individual airport planning needs can be funded for the current and future needs established through the airport master plan for aviation requirements, facility requirements & compatibility with environmental and community goals.
2) **Airport Development** - Grants issued in this area may include funds for repair and improvement construction on airport grounds, which excludes routine maintenance. Additionally, the following may be included: land acquisition, improvement and repair of navigational aids, terminal building construction, development and repair of roadways, runways and taxiways, and site preparation. Specifically

excluded is the construction of hangars, customer automobile parking areas, terminal art objects, decorative landscaping and building improvements not related to the safety of persons on the airport grounds.

3) **Airport Capacity Enhancement and Preservation** - Funds may be used for projects that significantly enhance or preserve airport capacity. Consideration for these types of funds rests on the airport's desire to improve upon these areas and the project's cost and benefit, the project's effect on overall national air transportation system capacity, and the financial commitment of the airport sponsor to preserve or enhance airport capacity. Rationale and commitment would be evidenced by the airport master plan.
4) **Noise Compatibility Programs -** The 1982 Airport and Airway Improvement Act contained a provision to make funds available for noise compatibility planning and to carry out noise compatibility programs as authorized by the Aviation Safety and Noise Abatement Act of 1979. The specificity of this program is contained in FAR Part 150. Owners and operators of a public-use airport and/or local governments/ communities adjacent to an airport are eligible for such funds.

Fund Eligibility

To be eligible for AIP funding the airport must be a part of the National Plan of Integrate Airport Systems (NPIAS). According to Wells (2000, p 86), the criteria for inclusion in the NPIAS are minimally restrictive. The principal ones are:

- the airport has at least ten based aircraft,
- it can be at least a 30 minute drive from the nearest existing or proposed airport currently in the NPIAS system
- there is an eligible sponsor willing to undertake ownership and development of the airport.

Additionally, to qualify for AIP funding, an airport must be of the public-use variety and be characterized by one of the following criteria:

- it must have a minimum of 2,500 enplanements each year,
- it must serve the general aviation community or
- it must be designated a Reliever airport

Fund Allocation

There are more than 13,000 airports in the U.S. but only 3,304 are eligible for Federal funding under the Airport Improvement Program (AIP). Money for this program is distributed by formulas that are set forth in the law. The law divides AIP money into two broad categories: entitlement funds and discretionary funds. Entitlement funds are further divided into four sub-categories. They are:

- Primary airport entitlements;
- Cargo airport entitlements;
- State entitlements; and
- Alaskan airport entitlements.

<u>Primary airports.</u> If a public airport has commercial air service with at least 10,000 passenger boardings per year, it is considered a primary airport. These airports are entitled to receive AIP money each year in accordance with the following formula:

- $7.80 for each of the first 50,000 passengers boarded;
- $5.20 for each of the next 50,000 passengers boarded there;
- $2.60 for each of the next 400,000 passengers boarded; and
- 50 cents for each additional passenger boarded.

Regardless of the number of passengers boarded, the minimum entitlement is targeted to be $500,000 per year and no primary airport is entitled to more than $22 million per year (US House).

To receive AIP money, an airport must have a project, such as runway repair or addition, terminal extension or upgrade, or noise abatement project that is eligible for AIP funding under the law. An airport can retain the right to receive its entitlement money for 3 years. Entitlement money deferred to a later year is referred to as carryover entitlements.

Cargo entitlement. Cargo service airports are served by cargo-only (freighter) aircraft. These airports are entitled to share in a potential AIP distribution that equals 2.5% of total AIP funds. A cargo service airport shares in this available funding in the proportion to which the total weight of cargo-only aircraft operations are to the total weight of such aircraft at all other airports. No airport may receive more than 8% of the 2.5% total available AIP funds. Currently, there are 102 airports that qualify for this entitlement.

State entitlement/general aviation. The States, territories, and possessions share a potential distribution that is equal to 18.5% of total AIP funds. Each State's individual share of this distribution is based on a formula that takes into account the population and land area of the State. Money from this entitlement goes to general aviation airports (airports used by private planes) and to airports with less than 10,000 passengers per year.

General aviation airports seeking AIP money from this entitlement usually apply directly to the FAA. The FAA then decides which airports will receive appropriated funds. Nine States (Illinois, Michigan, Missouri, New Jersey, North Carolina, Pennsylvania, Tennessee, Texas, and Wisconsin) participate in the State Block Grant program. Under this program, the FAA gives the State aviation agency complete responsibility to manage its AIP allocation and the State, not the FAA, decides which general aviation airports will receive it (GAO/RCED 96-86).

Alaska entitlement. By law, Alaskan airports are entitled to receive at least the same amount of money they received in 1980. This year, they will receive about $10.5 million. The $10.5 million is in addition to whatever those airports receive under the above entitlements.

Discretionary Funds

The second category of funds designated for congressional "pet" projects are called Discretionary or Set Aside funds. Discretionary Funds consist of residual funds remaining after the aforementioned entitlements. They are available to any airport sponsor according to congressional mandated requirements deemed necessary for the furtherance of the aviation community. However, discretionary funds are subject to two set-asides.

Noise set-aside. The law sets aside 31% of this discretionary fund for noise projects. These could include such things as buying property for a noise buffer or soundproofing buildings.

Military Airports Program. Under the Military Airport Program, the FAA selects 12 current or former military airports to share in a set-aside that is equal to 4% of the discretionary fund. The purpose of this program is to increase overall system capacity by promoting joint civilian-military use of military airports or by converting former military airports to civilian use. Airports currently in the military airport program (MAP) are Myrtle, Laredo, Smyrna, Pease/Portsmouth, SanBernadino/ Norton, Austin-Bergstrom/Mueller, Homestead AFB, Millington/Memphis, Williams AFB in Arizona, Alexandria/ England AFB in Louisiana, Rickenbacker/ Columbus, and Sawyer AFB (FAA, PFC Branch).

After the entitlements and set-asides are funded, the remaining money is at the discretion of the FAA. This is often referred to as pure discretionary AIP money. Even here, however, there are restrictions. The law requires that 75% of this discretionary money be spent on airport projects that will enhance capacity, safety, or security, or reduce noise.

Minimum discretionary. Until recently, total AIP funding had been declining. At the same time, FAA has been issuing letters of intent (LOIs) to several airports. An LOI is a commitment to pay a certain amount of AIP money to an airport over a specified number of years in order to fund large costly projects. These commitments are predominantly funded from the discretionary portion of AIP. This year, $159.5 million is committed to LOIs issued by the FAA.

The LOI is important to large, long-term airport development as the commitment of the federal government can help the airport sponsor obtain other types of funding, exclusive of the AIP monies. A cause for concern with LOI's is there can be substantial commitments made to LOI's nationally by the FAA. Such commitments would have top priority in the annual allocation of AIP funds to the detriment of other categories of AIP projects (Wells, p. 220).

In the past, when overall AIP program declined, much of the fund was allocated to entitlements and set-asides. This left little discretionary money and prompted concerns that the FAA would be unable to meet its LOI commitments or attend to other important projects (Kaps, 236).

As a consequence, the law now mandates the discretionary fund have at least $148 million per year plus the amount needed to fund outstanding letters of intent issued. If the entitlement and set-aside formulas do not leave such amounts in the discretionary fund, all entitlements and set-asides must be cut by a proportionate amount. In the past, this has resulted in across the board cuts in entitlements and set asides of as much as 23% to ensure the minimum discretionary fund. As a corollary to the minimum discretionary fund, the law further states that if total AIP funding is high enough such that the discretionary fund is more than the statutory minimum, any amount in that fund above the minimum would be divided 1/3 to general aviation airports, 1/3 to military airports, and 1/3 to noise abatement programs (PL 104-264).

Nothing in the funding process is automatic. Irrespective of an airports' need and/or eligibility for funds, the operator must submit an application to the Federal Aviation Administration. Additionally, even if an airport is eligible for set-aside or discretionary money, it must submit an application for FAA review.

The AIP program is not a free ride. Just because an airport is eligible for funding does not mean that its request will be either honored or filled to the degree of total funds required. Applicants for grants must show that they are active partners in the proposed venture by having available capital of 10% to 25% of a projects' cost. This advanced requirement must be in place before the FAA begins to open its checkbook.

WHERE THE MONEY GOES

According to the FAA, during the fiscal years between 1982 and 1996, the AIP money was spent as follows:

- 52.76% for runways; taxiways; and aprons;
- 11.2% on noise control projects;
- 7.82% for land purchases;
- 6.03% on safety and security;
- 5.2% on buildings;
- 4.78% on airport roads; and
- the remainder on miscellaneous projects such as lighting and planning.

From the standpoint of airport size, according the General Accounting Office (GAO) Annual Reports of Accomplishments Under the Airport Improvement Program, in 1996, AIP money was distributed as follows:

- 25% to the 2,764 general aviation airports;
- 24% to the 29 large hub airports;
- 17% to the 42 medium hub airports;
- 16% to the 70 small hub airports; and
- 19% to the 272 non-hub airports.

It should be noted that the reference to hubs here and elsewhere refers to the number of passengers at that airport. It has nothing to do with an airline using an airport as a connecting complex. More specifically:

- Large hubs are airports that enplane more than 1% of the total annual enplanements in the U.S. (more than 6.4 million passengers per year) and include such airports as Chicago, Atlanta, Baltimore, and Tampa;
- Medium hubs are those that enplane more than .25% but less than 1% of annual enplanements in the U.S. (1.6 to 6.3 million passengers) and include such airports as, Cleveland, Providence, Tulsa, and Portland, Oregon.
- Small hubs enplane more than .05% but less than .25% of annual enplanements (324,000 to 1.6 million passengers) and include Buffalo, Norfolk, Birmingham, and Green Bay.
- Non-hubs enplane more than 10,000 passengers but less than .05% of U.S. annual enplanements and include Akron, Moline, Topeka, and Visalia.

Table 1 indicates the amount of money provided by AIP for the select airport projects. Should the revenue stream of the airport not provide the additional capital to venture into the AIP arena, funds from other sources may become a necessity**.**

Since the flow of funds from AIP has been anything but stable, (See Table 2), it is important for airports to have other sources of funds for capital development. As noted in Table 2, there has been a discrepancy between Congressional Authorization of AIP and actual appropriations passed each year. There was a $700,000,000 gap in these figures in recent years, which has been reversed in fiscal year 1998. Still, the $1.7 billion authorized in FY 1998 does not address the tremendous airport capital improvement need identified in the NPIAS. This is especially true for Non-Passenger Facility Charge, "AIP dependent" airports. Such airports have been heavily impacted by changes in AIP funding established by Congress in the early 1990's.

PASSENGER FACILITY CHARGES (PFCs)

In 1990, Congress passed the Aviation Safety and Capacity Expansion

Act. A portion of this Act established ability on the part of publicly owned commercial service airports to assess airport user charges on passengers utilizing their facilities. Passenger Facility Charges or PFC's, as they became known, are intended to supplement AIP by providing more money for runways, taxiways, terminals, gates and other airport improvements.

PFC's, The Reliable Revenue Stream

Those airports eligible to assess PFC's are permitted through the federal aviation administrator (FAR Part 158.5) to assess a charge of $1 to $3 on all domestic or international passengers enplaned at an eligible airport. If a medium or large hub airport charges a PFC, it must forego up to 50% of its AIP entitlement. The foregone entitlements go into a special small airport fund to be distributed as follows:

- 50 % to non-hub airports;
- 25% to general aviation airports
- 12.5% to small hub airports; and
- 12.5% to the discretionary fund

(House Subcommittee)

Recent legislation has increased the upper limit of PFC's to $4.00 or $4.50 with justification; however, this is still considered a special circumstance situation. Approval of a PFC above $3.00 also has the required loss of 75% of all AIP entitlements due the requesting airport. No airport may charge a PFC of more than $3 per passenger except through the aforementioned process; no passenger has to pay more than $12 in PFC's per round-trip regardless of the number of airports through which the passenger connects. Finally, no airport can charge a PFC until FAA approves it (FAA PFC Branch).

These fees are collected by the airlines, travel agents and any other airline ticket issuing office at the time of travel purchase. There are 322 airports authorized to collect Passenger Facility Charges under FAR Part 158 as of March 1, 2001 and 296 approved airports are actually collecting money (House Subcommittee).

According to the FAA Passenger Facility Branch Office, $1.55 billion in PFC funds were actually collected in CY 2000 and used as follows:

- 19% for airside projects such as runways, taxi-ways and safety related projects;
- 34% for landside projects, primarily terminal buildings;
- 30% to pay interest on bonds;
- 7% for noise abatement projects; and
- 11% for roads.

The FAA has approved virtually all airports seeking PFC revenue streams. Originally established to address definitive projects requiring additional capital, virtually all airport projects have been declared eligible for PFC funding without regard to either the need or cost-effectiveness of the project (Delgado). Thus far the lone exception has been Austin/Bergstrom TX. The statutory requirement for fund usage is contained in FAR Part 158.15 that enumerates the requirements for usage and eligibility for PFC funds. In order to be eligible, a project must fall under one of the following:

1. It must preserve or enhance safety, security, or capacity of the National Air transportation system.
2. It must reduce noise or its impacts resulting from the airports' operations, or
3. It must facilitate competition amongst air carriers.

Uses of PFC Funds

Presently, PFC revenues provide the nation's eligible airports with approximately $1.551 billion in additional funding money. This money, because it is not tied to airline terminal usage or majority in interest clauses, strengthens an airport's ability to make spending decisions without the influence of participating airlines.

Within the confines of the three prescriptions outlined above for PFC usage, PFC funds can finance an entire project or can be used to pay debt or related expenses for bonds issued to fund an eligible project. Interestingly, PFC revenue may be used to meet the percentage requirement or airport share of projects funded under the Airport Improvement Plan (AIP).

Since 1992, PFC funding has grown to over $1.5 billion per year for airport construction projects. As reported by the FAA's PFC Branch (2001), this funding has grown as follows since initial approval:

1992	$0.085 Billion
1993	$0.485 Billion
1994	$0.849 Billion
1995	$1.046 Billion
1996	$1.113 Billion
1997	$1.222 Billion
1998	$1.448 Billion
1999	$1.514 Billion
2000	$1.551 Billion

However, the controversy remains regarding the appropriate use of PFC funds. Several attempts have been made to take the Trust Fund off the unified budget to prevent it from being caught in the political game of masking the national deficit.

Politics of Funding

Leaders of the airport industry have recommended that an AIP minimum funding level of $2 billion annually be set and maintained. That level has been accomplished with the most recent funding appropriation, known as AIR 21. Though signed into law by President Clinton, there has already been information released that full authorization of the appropriation levels designated by AIR 21 are in jeopardy

There are too many examples of airports that have sought to build projects more driven by local politics, than by a desire to enhance safety or capacity. After all, of the current $29.1 billion authorized for PFC collection, only $4.9 billion is earmarked for safety and capacity projects such as runways, taxiways, aprons, and lighting (FAA, PFC Branch).

Bonds

After funding options such as AIP grants, PFC's, and other federal sources have been exhausted, airports and/or municipalities usually finance the costs of capital improvements through the issuance of debt. The vast majority of such debt is in the form of bonds. Bonds in the airport venue are operative and technically similar to bonds issued by a corporation. The major difference is the way bonds are backed, the taxability of such instruments, and the methods of responsibility for repayment.

Airport bonds come in a variety of types. The most common are General Airport Revenue Bonds (GARB's), General Obligation Bonds, Self-Liquidating General Obligation Bonds, and Revenue Bonds. Since these are only titles, it is important to recognize that most bonds work similarly and only the method of repayment, interest rates, maturity dates, usage purposes and responsibility for repayment may differ.

Face value, percentage payment, yield, yield to maturity, etc. are all the same.

Markets for Airport Bonds

Airports raise literally billions of dollars annually in the debt/bond markets. This is not a new phenomenon. The first Airport Revenue Bond in the United States was issued for $2.5 million in 1945 by the city of Miami, Florida. It was backed and was to be repaid by the proceeds of revenues from the now Miami International Airport. During the 1950s, the city of Chicago, in seeking finances for improvement of O'Hare International, took an historic step in revenue bond underwriting. In that momentous issue, the O'Hare Agreement, airlines operating into the airport agreed to back repayment. The airlines pledged that should O'Hare airport income fall short of repayment capabilities, the airlines would make up the difference by paying larger landing fees (Wells, p 223).

Airport bonds are primarily a municipal undertaking that is exempt from taxes; the buyer or owner of such bonds is not obligated to pay any taxes, either federal or state, on interest obtained through holding such debt instruments. To purchasers in high income tax brackets this tax-free instrument can provide income security without elevating them to increased tax brackets. It may permit he bondholders to obtain greater earnings than those investments paying higher returns but requiring a percentage to be paid to the Internal Revenue Service.

The tax-exempt status of municipal bond issues makes funding less expensive than other debt instruments. The rationale, because the tax-exempt nature of the bond saves investors tax money, the bonds can be issued at lower interest rates than normal debt instruments. Predictably, the vast majority of airport debt capital is raised in the tax-exempt bond market (Kaps, 245).

An interesting element to airport bonds is that since their inception, not one bond has defaulted. This, unfortunately, cannot be said for bonds issued in the corporate world.

Types of Airport Bonding Issues

General Obligation Bonds - States and municipalities issue general obligation bonds. Sometimes other subdivisions of states and municipalities have authority to issue this type of debt instrument. All bonds are agreements to pay a specific amount of money borrowed (IOU) at a certain time (maturity) with periodic (usually yearly) payments of interest. General obligation bonds are the responsibility of the citizenry of a particular locality to repay the amount borrowed including interest. The repayment to bondholders is secured by the full faith, credit, and taxing power of the issuing government agency. Thus, to have permission to undertake such a debt funding measure, the community usually must approve by vote any potential bond issues, or community indebtedness.

Although general obligation bonds may be utilized for airport construction and improvements, many compete with other local necessities for improvement and building of such programs as schools, roads, and other essential public works. This minimizes their usage as defined airport issues.

Because general obligation bonds are backed by a community guarantee to repay them at maturity, they are generally issued at lower interest rates than competing methods of securing debt. Because of this advantage, some states have set by statute the maximum amounts of general obligation debt that a municipality may incur.

Self-Liquidating General Obligation Bonds - Self-liquidating general obligation bonds are secured by the full faith and credit of the taxing power of the local citizenry, just as are general obligation bonds. The difference, however, is that cash flow from the project being financed is adequate to repay the amount of debt plus the costs to operate the project. Because of this ability to repay, the debt is not legally considered a part of the community's limitation as set for the general obligation bond. A strange anomaly occurs here, however. Since the project's performance and ultimate risk lie with the local government, who is appointed by the community, the community bears the ultimate responsibility for repayment. Due to this convoluted method of risk application, the self-liquidating general obligation bond method of funding means a higher rate of interest than the general obligation bond.

Revenue Bonds - One may imply that the terminology "revenue bond" means that they are issued to obtain revenue. In part, that is exactly what their purpose is, but that would be a misnomer for the intent of the word revenue in this case. “Revenue”, in this instance, applies to the way the bond is to be repaid. Repayment of bond indebtedness is payable solely from the revenue derived from the operation of the facility, road or other project that was constructed or acquired with the bond proceeds. Funding with revenue bonds provides an opportunity to obtain airport improvements without directly burdening the taxpayer.

Some examples of revenue bonds are those issued to finance and build major highways. Generally, such highways turn to toll roads where fees are collected to repay the debt. Oftentimes when the debt is repaid the toll is extinguished and the highway becomes free to all. Similarly, revenue bonds may be issued to build a new airport terminal. The operational revenue received by the terminal acts as the catalyst for repayment.

General Airport Revenue Bonds (GARB's) - General Airport Revenue Bonds are secured solely by the operation of the airport and are not backed by any additional governmental subsidy or tax levy. In short, the citizenry of the community is not responsible for the debt service or payback of the borrowed amount. That responsibility is solely that of the airport authority.

In addition to GARB's, airports may issue a hybrid bond, or special facility bonds. Such bonds are designed to address one particular undertaking resembling an Industrial Development Bond (IDB). These may be issued to finance some specific facility, such as a new hangar or gate jet way installation, on behalf of some specific carrier. The carrier in turn directly secures the debt.

Bond Ratings

The methodology of getting bonds to market is almost the same as bonds in the corporate venue. Investment bankers also specialize in the airport bond market and their approach does not vary considerably.

The U.S. Internal Revenue Tax Code grants bonds issued to finance improvements at municipally owned airports tax exempt status. This allows bonds issued for these purposes, whether they are general obligation, revenue, general airport revenue bonds, or some other derivation to borrow at lower interest rates than corporate bonds. The precise level of the interest associated with these bonds is a direct function of the bond rating.

As with bond ratings for corporate issues, airport bonds are rated by either Standard & Poor's or Moody's according to investment quality. In the airport bonds market, ratings vary between the top and medium grades issued by the rating agencies. A medium grade means that rating firms see the investment as carrying a measure of speculative risk. General obligation bonds usually draw the best ratings. Under this form of security, ratings are determined by the economic vigor of the issuing municipality. Because of this, the airport has no influence on the general obligation rating. Since Revenue bonds are directly tied to the airport, they draw ratings according to the airport's financial vitality and fiscal responsibility.

Credit analysts rank airport bonds according to a variety of factors. These include financial and operational comparables, the nature of airline rates and charges, local economic base, the airport's current financial situation, the strength of the airport management cadre, and the airport layout.

Financial and Operation Comparables - In terms of airport ratio analysis, bond rating agencies will evaluate a series of different ratios that address the vitality of airport operations. Some of these may consist of:

- Debt per enplaned originating passenger
- Debt per enplaned transfer passenger
- Ratio of Originating and Departing Passenger to transfer Passengers
- Percentage of traffic generated by the primary carriers serving the airport
- Annual traffic increases
- Debt Service coverage
- Revenue per enplaned passenger
- Concessionaire revenue per enplaned passenger
- Demographics of metropolitan area

Rates and Charges to Airlines - Since these charges generate the major portion of an airport's revenue, they are strongly considered in the rating methodology. The type of rate-setting (discussed earlier) employed by the airport can give the bond rating agency a birds-eye view of the airport's control over its spending decisions. As airport revenues are the sole backing for GARB's and other revenue bonds, the nature of the airport's ability to control these revenues has considerable impact on a bond rating.

Economic Base of the Community - Demand for air transportation is a function of the economic characteristics of the community served by the airport. Airports located in areas insulated from economic hardships or those in economically boom locations may receive higher bond ratings than those in depressed communities.

Current Financial Situation - All interest rates, from IOUs to bond issues, are predicated on the risk involved in the transaction. The higher the risk of having the money returned the higher the interest rate to borrow. Conversely, the greater the possibility of having the money returned the lower the charge for that money. To discern risk, you only need to look at the way and method an airport or city operates and maintains its financial house. Ratios, similar to those considered under Generally Accepted Accounting Procedures (GAAP) should provide means of determining risk.

Strength of Management Team - Traditional management values should prove beneficial to the airport seeking funding ratings. Analysts review both the managerial and administrative performance of airport operators in determining rating outcomes. Evidence of success of sound management techniques in the areas of planning, operating, controlling and directing the airport environment are a plus factor towards ratings.

Airport Layout - The landside and airside arrangements and setup can have a significant impact on the rating agency determination. An example of an airport layout that may engender a decision on the part of a rater to provide superior analysis would be one where all the concessionaire facilities are located in the main terminal, away from the connecting or transferring passenger. This may indicate a less than opportunistic ability on the part of the operator to achieve profit maximization.

Whatever methodology of determining bond ratings, and ultimately interest rates on bond issues, is employed, a finalized rating will eventually develop. In this setting, the ratios deemed worthy of consideration are listed as Best Grade, High Grade, Upper Medium Grade, and Medium Grade. A description of each is:

1. Best Grade: Strong capacity to pay both interest and principal with the lowest degree of risk to the bondholder
2. High Grade: Also have a strong capacity to return both principal and interest but are judged just a little less exciting than the Best Grade.
3. Upper Medium Grade: Usually are well protected in relationship to their ability to return both principal and interest but are susceptible to the potential fluctuations in Grade economy, etc.
4. Medium Grade: The protection is deemed at the time of rating; however, the presence of Grade speculative elements could impact upon the ability to pay interest or principal should economic conditions change.

Source: Moody's Bond Record, October 1996; Standard & Poor's Rating Guide, New York, McGraw-Hill, 1995

Any grading below these would be very questionable and costly to the seeker of funds.

CONCLUSIONS

When the federal government released the airlines from its control, it changed not only the marketplace for airlines but also the entire aviation industry. One of the greatest impacts was to airports and the funding of airport growth.

Although the use of municipally issued bonds dates back to 1945, the pervasive use of bonds did not begin until after the federal deregulation of the airlines. Today, airport managers know as much about issuing the various types of bonds as do Fiscal Officers of major municipalities. In some cases, airports are forced to compete with other municipal entities for necessary bond issues to fund the expansion required to serve their community. In other cases, the airport has the necessary capitalization clout to issue their own bonds, known as GARBs. Whether issuing their own bonds or depending on the local citizenry to fund expansion, finding dependable revenue sources with which to back the bonds has become a major function in airport management.

The search for reliable funding led to the advent of PFC's. The resistance of airlines to user fees charged by airports caused the argument to end up in court. Eventually Congress passed legislation approving PFC's in particular circumstances; however, to date, only one request for PFC authorization has been denied. PFC's have allowed some airports necessary growth funding but the most common method of funding airport growth is still through

Federal appropriation found in the Airport Improvement Program (AIP).

AIP funding has gone through several metamorphoses since its advent in 1946, but remains, to date, the single most common method of funding growth at public airports. Competition for federal dollars has become a political quagmire that has only served to elongate the process and reduce the effectiveness of the AIP. Using the revenues garnered from the various taxes and fees assessed through the Airport and Airway Trust Fund to offset general ledger shortfalls on the federal general budget has caused AIP to be constantly under funded and consistently inadequate for the aviation infrastructure growth necessary to keep pace with the airline industry the infrastructure serves.

However unreliable the federal funding process gets, the greatest impact of airline deregulation has been at the local airport level. The contractual relationship dynamic between airport and airline has set seemingly industrial allies against each other in an effort to produce revenue and profit for both. The ability of airlines to enter and leave passenger markets at will has shortened the contractual agreement times between airport and airline, thus shortening the duration of the revenue streams produced by that airline. For multi-airline served airports this is not as problematic as when a single airline is the only service at a more remote airport.

Regardless of airport size, when the funds required to pay for capacity enhancement and infrastructure maintenance are not available, safety and confidence in a highly efficient system of transportation is compromised. Although an aviation industry problem on the surface, the need for adequate, reliable airport funding has never been more important for the entire transportation industry than now. Supporting a free marketplace for airlines and general aviation through the use of constricted public monies that are doled out through political patronage and one-up-man-ship is at best challenging, at worst destructive.

Table 1 Percentage of Project Monies Provided by AIP

Project Type	Large Primary Category of Airports	All Other Categories of Airports
Airport Planning	75%	90%
Airport Development	75%	90%
Noise Compatibility Programs	80%	90%
Terminal development (relievers and hub airports)	75%	75%
Terminal development (commercial, non-primary airports)		85%
Terminal development (military airport programs)		90%

Source: Kaps, Robert W. (2000) Fiscal Aspects of Aviation Management, SIU Press, Carbondale, IL, 252)

Table 2 - AIP Funding, 1982-1998

Fiscal Year	Authorization (millions)	Appropriations (millions)
1982	$ 450.0	$ 450.0
1983	800.0	804.5
1984	993.5	800.0
1985	987.0	925.0
1986	1,017.0	885.0
1987	1,017.0	1,025.0
1988	1,700.0	1,268.7
1989	1,700.0	1,400.0
1990	1,700.0	1,425.0
1991	1,800.0	1,800.0
1992	1,900.0	1,900.0
1993	2,050.0	1,800.0
1994	2,105.5	1,694.0
1995	2,161.0	1,450.0
1996	2,161.0	1,450.0
1997	2,161.0	1,460.0
1998	1,740.0	1,700.0

Source: FAA (1996), Aviation forecast 1997-2002 (Washington, D.C.: GAO); Jenkins Darryl (ed.), (1995), The handbook of airline economics (New York: McGraw Hill), 111.

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Retaining Women in Collegiate Aviation by Implementing Learning Style Considerations

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ABSTRACT

Women are clearly underrepresented in aviation. Research must be accomplished to determine which factors influence women, once they have indicated a serious interest in an aviation career, to stay in collegiate aviation programs or to leave. Addressing the issue of women's retention in aviation is one way to help address the growing commercial pilot shortage, while moving toward gender equity in this critical, national industry. Projected shortages in the commercial pilot population, coupled with the low representation of women in career pilot positions, suggest that aviation education and training institutions should re-examine the structure and organization of the aviation knowledge transfer process. Classroom enhancements could improve education methods to make them more efficient from the perspectives of increased knowledge retention, improved application to broader subjects, and reduced loss to attrition of viable pilot candidates to enter the commercial pilot workforce. This study examines how aviation education can best serve the aviation student's learning style needs. The study looks at learning style theory, from the viewpoint of the wide diversity of aviation learners who are dominantly visual, auditory, or hands-on, tactile, or kinesthetic learners, and how women's learning styles are pivotal to their success and retention in collegiate aviation. By exploring how people learn best, and then providing those learners with the tools to maximize their dominant learning styles, the next generation of pilots, both women and men, should be better prepared to enter the aviation industry and help reduce the projected commercial pilot shortages.

BACKGROUND

The number of working women has tripled since the mid-1940's (Naisbitt & Aburdene, 1990). Yet women continue to remain underrepresented in the aviation field. Despite governmental and industry policies which encourage women to join the aviation industry, women constitute less than 6% of all FAA licensed pilots. The small number of women entering careers in aviation is evidenced in collegiate aviation where enrollment and retention of women remain low (Turney, Karp, Green, & Sitler, 1999). Recent studies indicate that women are underrepresented in aerospace engineering, as well as aviation in general (Bowen & Mathis, 1991).

In parallel with the low number of women in aviation, there is a critical shortage of commercial airline pilots. A congressional-directed United States Department of Transportation Federal Advisory Committee study in 1993 projected a shortage of qualified airline pilots that could impact the future availability of commercial air transportation in the United States. This study indicated that expansion of airline capacity, in combination with retirements from the airline pilot force and a reduced pool of former military pilots, would result in a national shortage of qualified pilots through 2010, and beyond, unless positive actions were taken (United States Department of Transportation Federal Advisory Committee, 1993, pp. vii-xxiii, Appendix D, Table 1 and Table 4).

While extensive research has been conducted to improve aviation flight training and simulation (Green, 1998), little has been done to improve the classroom component of aviation education (Karp, 1996). The pertinent commercial pilot supply issue to consider is that of the depth and quality of aviation academic education, as well as the flight training, of those future airline pilots. Because of the increasing sophistication of modern aircraft and high technology equipment, this topic underscores a need to examine, and restructure where necessary, the training options for potential airline pilots. Any academic program must ensure that the aviation education process involves an in-depth, effective transfer of knowledge across a broad spectrum of aviation subjects. When considering aviation education, the academic component of the flight training plays an important role in providing the knowledge base for a new pilot. This academic education has the potential to build an exceptionally solid foundation for ensuring the high standard of technical and flying knowledge needed for future airline pilots.

Gender also plays an important role in learning success in the aviation classroom or on the flight line. Research has shown that women do not learn the same as men (Turney, 1995). For example, while men often prefer debate-like situations in which they pursue knowledge, women most frequently like to share and learn by interacting with each other (Tannen, 1990). Additionally, females often are very participatory in their learning styles, while men tend to be more independent (Emanuel & Potter, 1992). Women also need to master an entire concept before moving on to new information. They require a “big picture” approach to learning (Stuart, 1999). Aviation curriculum development and delivery should take into consideration those learning styles that are unique to both men and women, in order to maximize their retention, and success, in the aviation career field.

In developing educational programs, it is important to know how people learn the best, and why they succeed. Because of the depth and complexity of the subject matter, aviation academic instructors must present the course material in ways that satisfy the different needs and styles of the aviation learners. Likewise, each student must understand her or his learning style and maintain more focused attention to the information when it is being presented in a teaching style that is not easily compatible with their learning style.

This paper on dominant learning styles is part of a larger research effort by the authors on “Maximizing retention of women students enrolled in collegiate aviation programs.” This overall research is funded by grants from the Department of Education, Fund for Improvement of Post-Secondary Education (FIPSE) and the

Alfred P. Sloan Foundation. In this larger, three-year study, the researchers are currently collecting data to determine what factors influence the retention of women in collegiate aviation programs. The research is focused on determining factors that influence the decisions of women to either complete or drop out of aviation programs, and then to identify potential modifications to aviation education in the collegiate setting that could improve the retention of women aviation students and enhance their preparation for careers in commercial air transportation.

LEARNING STYLE RESEARCH

The implementation of learning style considerations in aviation education should play an important role in this model to improve the retention of women in aviation.

Learning Style Theory

Learning style theory, that is, the way people learn best, is of considerable importance in developing and delivering aviation academic programs. One model suggests that there are three recognized primary, or dominant, learning styles: First, *visual learners*, who learn best by reading or looking at pictures. Second, *auditory, or aural, learners*, who learn best by listening. And third, *hands-on, tactile, or kinesthetic learners*, who need to use their hands or whole body to learn (Filipczak, 1995). If knowledge transfer is to take place within the entire classroom population, then all of these dominant learning styles should be addressed in the academic environment.

In this study, a learning style assessment instrument (Appendix A) was administered to 390 collegiate aviation students (195 women and 195 men) from representative aviation students of university and college members of the University Aviation Association (UAA) from around the country. This instrument was part of the larger research administered for the overall effort of "Maximizing retention of women students enrolled in collegiate aviation programs." The individual university and college aviation faculty representatives who assisted in the data collection distributed the surveys to <u>all</u> of their female aviation students and an equal number of their male aviation students.

Results of Learning Style Research

<u>Women Respondents</u>

Of the 195 women respondents, 112 (57.4%) were either dominant hands-on learners, or an equal combination of hands-on and visual and/or auditory learners (Table 1).

Learning Style	Number	Percentage
Visual (dominant)	62	31.8%
Auditory (dominant)	15	7.7%
Hands-On (dominant)	87	44.6%
Visual/Auditory (equal dominance)	6	3.1%
Auditory/Hands-On (equal dominance)	7	3.6%
Visual/Hands-On (equal dominance)	15	7.7%
Visual/Auditory/ Hands-On (equal)	3	1.5%
Total	195	100%

Table 1. Dominate learning styles of women respondents (n=195)

<u>Men Respondents</u>

Of the 195 men respondents, 118 (60.5%) were either dominant hands-on learners, or an equal combination of hands-on and visual and/or auditory learners (Table 2).

<u>Comparison of Women and Men Respondents</u>

Comparing the results of the women and men respondents, a picture becomes apparent that women and men in collegiate aviation are very similar in their dominant learning styles. For example, 44.6% of the women indicated that they were dominantly hands-on learners, compared to 45.1% of the men respondents.

Learning Style	Number	Percentage
Visual **(dominant)**	**56**	**28.7%**
Auditory **(dominant)**	**15**	**7.7%**
Hands-On **(dominant)**	**88**	**45.1%**
Visual/Auditory **(equal dominance)**	**6**	**3.1%**
Auditory/Hands-On **(equal dominance)**	**10**	**5.1%**
Visual/Hands-On **(equal dominance)**	**14**	**7.2%**
Visual/Auditory/ Hands-On **(equal)**	**6**	**3.1%**
Total	**195**	**100%**

Table 2. Dominate learning styles of men respondents (n=195)

A quantitative analysis was performed comparing male and female learning styles (without consideration of equal dominance). For this analysis, each respondent was considered to have a percentage of responses in each of the three categories. Percentages were used because males tended to give more responses than females and so accurate analysis required the use of proportions.

A two-sided unpaired t-test was used to compare the male and female responses for each of the three learning styles. The resulting p-values for the visual and hands-on responses showed no significant result at any reasonable significance level. The responses in these two categories were clearly very close. The auditory p-value was .18, which does not show significance at a reasonable level (.05 or .10). However, this does suggest the possibility that males are slightly less auditory than females.

Composite of Women and Men Respondents

Of the total of 390 women and men respondents, 221 (56.7%) were either **dominant** hands-on learners, or an equal combination of hands-on and visual and/or auditory learners (Table 3).

Learning Style	Number	Percentage
Visual **(dominant)**	**118**	**30.3%**
Auditory **(dominant)**	**30**	**7.7%**
Hands-On **(dominant)**	**175**	**44.9%**
Visual/Auditory **(equal dominance)**	**12**	**3.1%**
Auditory/Hands-On **(equal dominance)**	**17**	**4.3%**
Visual/Hands-On **(equal dominance)**	**29**	**7.4%%**
Visual/Auditory/ Hands-On **(equal)**	**9**	**2.3%**
Total	**390**	**100%**

Table 3. Dominant learning styles of both women and men respondents (n=390)

Comparison of Women and Men Respondents to a Previous Study

A combination of the women and men together (Table 3) can be used to compare this study's findings with a previous study to validate the consistency of the results. In an earlier study (Karp, 2000), when examining the learning style assessments over a two-year period of a composite of 117 respondents, from private pilots to F-16 pilots, the research (Table 4) indicated that 58.1% of the pilots were either dominantly hands-on learners, or an equal combination of hands-on and visual and/or auditory learners. When comparing this 58.1% (n=117) to the combined women and men results of 58.9% of this current study (n=390), or the women only results of 57.4% (n=195), a parallel propensity surfaces: Individuals in collegiate aviation, whether they are women or men, are very dominantly hands-on learners and need that "tactile" connection to process and retain knowledge.

Learning Style	Number	Percentage
Visual **(dominant)**	**38**	**32.5%**
Auditory **(dominant)**	**8**	**6.8%**
Hands-On **(dominant)**	**52**	**44.4%**
Visual/Auditory **(equal dominance)**	**3**	**2.6%**
Auditory/Hands-On **(equal dominance)**	**0**	**0**
Visual/Hands-On **(equal dominance)**	**16**	**13.7%**
Visual/Auditory/ Hands-On **(equal)**	**0**	**0**
Total	**117**	**100%**

Table 4 Dominant learning styles of both women and men respondents in previous study (n=117)

Evaluation of Results

In spite of this majority of pilots being predominantly either hands-on or an equal combination of hands-on and visual and/or auditory learners, research indicates that most classroom environments are auditory in nature, with visual supplementation, and very little, if any, hands-on learning applications (Karp, 2000).

Computer-Based Training

A valuable tool to assist in hands-on learning, in connection with the classroom, is computer-based training, to include the use of PC-based flight simulator programs. With the increased access to computer-based tutoring programs, students are moving away from passive reception of information to more active engagement in the acquisition of knowledge (Kozma & Johnston, 1991). Computer programs for tutoring technical subjects can be particularly useful in aviation education. Computer-Based Training (CBT) programs can be used extensively for pre-class preparation, as well as post-class review and immediate reinforcement. CBT programs allow the student to accomplish self-paced learning in a non-threatening environment. In addition to supporting the CBT programs, the same basic computer equipment can be augmented with a control yoke and throttles to be used with personal computer-based flight simulator programs. These personal computer-based flight simulator programs are relatively low-cost training vehicles that can be easily and effectively integrated into an aviation education curriculum. They are well suited as an educational bridge between the basic, traditional aviation classroom and the advanced, high technology aviation flight environment (Karp, 1996). However, the key is that personal computer-based training with interactive flight simulator programs helps provide the educational components in multiple learning styles, thereby meeting more individuals' learning needs than are provided by classroom lecture alone.

Sitler (1998) identified a series of things instructor pilots should know about women so that they can support retention of women pilots. Some of her many examples underscore issues highlighted in this study on learning styles. While Sitler's research indicated that women appear to be slower than men to grasp some subjects, such as aerodynamics, women are alternatively quicker than men to grasp instrument flight and once they learn an established procedure, they rarely vary it. In this example, by using computer based training and PC-based simulator programs in connection with the classroom environment to be able to "visualize" the effects of aerodynamic factors while making control inputs on a PC-based flight simulator, women's strengths of quickly learning to fly instruments and using set procedures could be used to overcome initial knowledge transfer difficulties through this immediate hands-on application vehicle.

RECOMMENDATIONS

1. Educators should administer to all aviation students a "quick and easy-to-take" learning style assessment instrument (similar to Appendix A), to help them identify, for themselves, their own dominant learning style. The educator should then facilitate a discussion with the learners on how they might maximize their dominant learning style in day-to-day learning situations (by using an aid similar to Appendix B). A side finding of the earlier research of the 117 aviation students from a wide range of pilots was that most respondents thought that everyone learned about the same and were surprised at the differences among their classmates. Similarly, the same observation was made for instructors; many instructors taught in the style that they, themselves, learned best, without thinking about potential differences for their students.

2. Educators should present their aviation curriculum using all three learning style environments (visual, auditory, and hands-on) so that *all students* have the best opportunity to reinforce the material using their dominant learning style(s). Employing PC-based training, including PC-based flight simulator programs, immediately following the classroom experience, is an excellent reinforcing vehicle to provide the hands-on learning opportunities that are critically needed by a large number of both women and men aviation students.

CONCLUSION

This paper addresses aviation educational enhancements through the implementation of learning style theory, including gender specific differences and the inclusion of personal computer-based flight simulator programs, to help retain more women in aviation programs by providing a "comfortable, reinforcing" learning environment that aligns with their own learning style. The emphasis on the use of PC-based flight simulator programs is not aimed at reducing flight training or corresponding simulator training, but is rather focused on providing immediate, hands-on application following each academic class. Providing immediate, hands-on application is directed toward on improving understanding and long-term retention of the subject matter, as well as increasing knowledge application across a broader spectrum. By presenting the classroom academic components so as to also accommodate hands-on learners, in addition to the historical presentation of the material in visual and auditory formats, more students (both male and female) should be able to maximize their learning potential because their specific learning needs will be addressed. For individuals who are not learning the subject matter fast enough because their learning style needs are not being met, presenting the material in visual, auditory, and hands-on formats should lead to increased student retention in aviation, if all other factors remain constant.

The retention of women in aviation programs is a particularly important factor to consider in meeting future commercial pilot requirements. While women constitute only a small percentage of the commercial pilot force, they comprise a large resource pool from which the commercial aviation industry can draw. In order to retain the best people in aviation programs, aviation academic providers must design their academic curriculum and delivery vehicles to meet their students' specific learning styles, whether they are women or men. The investment in time for curriculum development to include all learning styles in an integrated aviation education program should pay high dividends in expanding the aviation learners' knowledge base and enhancing their flexibility to address new situations, while increasing the retention of women in collegiate aviation programs.

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Appendix A

PERSONAL CHARACTERISTICS

Directions: Circle the phrases that you think best reflect your personal characteristics. Circle as many phrases as you feel are applicable.

Observe rather than talks or acts

Organized in approach to tasks

Like to read

Usually a good speller

Memorize by seeing pictures or graphics

Not easily distracted

Find verbal instruction difficult

Have good handwriting

Remember faces

Use advanced planning

Doodle

Quiet by nature

Meticulous, neat in appearance

Notice details

Talk to myself aloud

Enjoy talking to others

Easily distracted

Have more difficulty with written directions

Like to be read to

Memorize steps in a sequence

Enjoy music

Whisper to myself while reading

Remember names

Easily distracted by noises

Hum or sing

Outgoing by nature

Enjoy listening activities

Enjoy programs where a speaker tells stories

In motion most of the time

Like to touch people when talking to them

Like to handle objects

Tap pencil or foot while studying

Enjoy doing activities

Reading is not a priority

Usually a poor speller

Like to solve problems by physically working through them

Will try new things

Use hands when talking

Express emotions thorough physical means

Dress for comfort

Outgoing by nature

Like working with hands

Adapted by Dr. Merrill R. Karp, Arizona State University, from instrument by Jan R. Amstutz, Director, Intensive English Language Center, California State University, as presented to “Aviation Communication: A Multi-Cultural Forum Symposium,” April 11, 1997, Embry-Riddle Aeronautical University, Prescott, AZ.

APPENDIX B

Suggested Aids for Learning Styles

Directions: Add each individual column of the "Personal Characteristics" assessment instrument. The first column indicates characteristics of "visual learners," the second column indicates characteristics of "auditory learners," and the third column reflects characteristics of "hands-on, tactile, or kinesthetic learners." The column with the highest number of annotated occurrences reflects the most dominant learning style; the column with the second most occurrences reflects the second most dominant learning style, etc. There is a possibility that two or even three of the columns are the same. If so, then those styles are equally dominant. The following aids may be helpful to enhance your particular dominant learning style, or to strengthen a weaker one. Some of the suggestions are the same for more than one learning style, but for different learning and processing reasons.

Visual

Form pictures in your mind

Take notes in class

Use notebooks to summarize notes after class

Draw/use drawings

Use charts or graphs

Use maps

Watch lips move in front of mirror while speaking

Use study cards

Use photographs and pictures

Watch TV

Watch videos

Use color codes

Use acronyms, visual chains, and
Mind maps

Auditory

Use video and audiotapes

Watch TV

Speak/listen to speakers

Make up rhymes/poems

Read aloud

Talk to self

Repeat things orally

Use rhythmic sounds

Have discussions with classmates

Listen carefully

Use oral directions

Sound out words

Say words in syllables

Use word links, like rhymes, poems, lyrics

Hands-on/Kinesthetic

Physically "do" the task

Practice by repeated motion

Pace/walk as you study

Take a lot of notes in class

Write down thoughts during day-to-day activities

Write on surface with finger if paper is not available

Write lists repeatedly

Role-play

Think or practice while exercising

Associate feelings with concept/information

Stretch/move in chair

Watch lips move in front of mirror while going over lessons

Adapted by Dr. Merrill R. Karp, Arizona State University, from instrument by Jan R. Amstutz, Director, Intensive English Language Center, California State University, as presented to "Aviation Communication: A Multi-Cultural Forum Symposium," April 11, 1997, Embry-Riddle Aeronautical University, Prescott, AZ.

The Future and Potential of Non-Steady Flow Devices in Advanced Propulsion Designs

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ABSTRACT

Conventional aircraft powerplants generate a propulsive force through the application of a relatively constant fluidic flow. In non-steady flow propulsion, an unevenness of fluidic pressure is developed and purposefully controlled with the objective of producing thrust. This paper reviews basic non-steady flow concepts and presents potential applications for emerging technologies.

INTRODUCTION

Some unsteadiness is characteristic of any propulsive flow. However, in non-steady flow propulsion, an unevenness of fluidic pressure is developed and purposefully controlled with the objective of producing thrust. A non-steady flow device may be component or power plant. Examples include internal- and external-combustion wave engines, valved and valveless pulse jets and wave rotors.

In comparison to steady flow devices, such as turbojets and propellers, those operating on the principle of non-steady flow potentially offer several advantages. According to Foa (1960):

> ...the lowest entropy rise in combustion, for any given heat input and initial temperature, is obtained with non-steady modes, and that these modes also make possible the alternate exposure of moving parts to hot and cold gases, thereby permitting the use of higher peak temperatures. Thus, as far as the effect of combustion alone is concerned, non-steady modes appear capable of producing a higher cycle efficiency and a higher air specific impulse than could be produced by the best steady modes. [Further,] ..... non-steady thrust augmenters, which are wave exchangers, are believed to be potentially more efficient than any steady-flow thrust augmenter with the exception of the propeller. (p. 345)

The idea of using non-steady flows in the production of thrust is not new. Conceptualization of non-steady flow power plant designs date to approximately the beginning of the twentieth century, and proposals for gas turbines and jet engines based on non-steady combustion apparently preceded the straight-through, steady flow design of currently-produced turbomachines (Foa, 1960). By 1910, G. Marconnet had devised and patented a propulsion device that many consider the archetypical pulse jet (French patent number 412,478). Non-steady flow devices are of many designs, some more practically applicable than others. Despite certain inherent advantages (discussed below) and the fact that non-steady flow power plants were first proposed approximately a century ago, most of these designs remain, as yet, more theoretical than practical.

Reasons for lag in the development and application of non-steady flow devices are manifold, but the preeminent cause is that technology has not yet evolved to reduce certain losses inherent in non-steady flows. For example, Foa (1960) states that, with one exception (when the exhaust velocity is a square-wave function of time), "...supersonic diffuser losses are generally higher in pulsating than in steady flow...", and he also cites losses attributed to inefficiencies in non-steady exhaust flows (p. 345). Much remains to be improved, resolved or even fully understood. Areas requiring further research include wave propagation, shock, heat and viscous losses within wave rotor passages, mixing of nonuniform flow fields, leakage between wave rotor ports and passages, and mixing at gas/gas interfaces (Welch, Jones, & Paxson, 1997).

PULSE JETS

The pulse jet generates a series of pressure pulses (or waves) to produce a directed propulsive jet. Several variations of the pulse combustor are possible. Timnat (1996) identified four, categorized according to the method employed to control the combustion processes and resulting pressure pulses: (a) mechanically valved, (b) rotary valved, (c) aerodynamically valved, also referred to as a valveless design, and (d) a valveless flow rectifier system.

Although the pulse jet was patented in 1910 and a number of desirable attributes are characteristic of this engine (e.g., simplicity of construction and operation, improved combustion intensity, reduced NO_x emissions, less smoke, and the potential for high cycle efficiencies), the pulse jet has generally not proven a viable means of propulsion–the notable exception being the pulse-jet-powered V-1 "buzz bomb" designed by the Germans for use during the Second World War. The high noise level associated with pulsed combustion remains problematic. This notwithstanding, Georgia Tech engineers have been working to develop pulse-jet-powered micro air vehicles, weighing only four ounces and having a wingspan of about six inches. Potential missions for such an aircraft include search and rescue operations, reconnaissance and near-earth remote sensing. "The favored concept for propulsion [of the micro air vehicle] is a pulse jet...which has no moving parts, and could also provide air for lift and flight control" (Nordwall, 1997, p. 70). The advantages associated with pulsed combustion remain attractive and efforts to refine and develop this non-steady flow device continue.

WAVE ROTORS

The Concept of Pressure Exchange

Non-steady flow propulsive devises frequently rely on the principle of "pressure exchange." "'Pressure exchange' is sometimes defined as the compression of a fluid from a pressure P_A to a pressure P_B at the expense of the expansion of another fluid from the pressure P_B to the pressure P_A" (Foa, 1960, p. 223). Put in a more simplistic way: Pressure exchange may be defined as the process by which one expanding fluid applies a compressive force to another; in this process, compressing fluid pressure rises in proportion to the diminishment of pressure in that which expands.

General Description

Gas turbines operate on the principle of the Brayton cycle, an idealized thermodynamic model used to describe power development in a gas turbine engine. The Brayton cycle consists of the following events: (a) compression of the working fluid (gas), (b) addition of heat while maintaining gas constant pressure, (c) expansion of the gas in the turbine, and (d) heat rejection as exhaust. The higher the constant pressure at which heat is added, the more efficient the engine operates, producing higher specific power (SP) and lower specific fuel consumption (SFC)[ii]. Thus, there is a drive in the gas turbine industry toward higher pressure ratio engines. However desirable, an increase in an engine's pressure ratio produces two undesirable side-effects that set constraints on power plant performance and design.

With the increase in compression necessary to boost pressures in the gas turbine comes an increase in operating temperatures. These temperatures, however, can be no higher than today's metallurgy and material technology will allow–if the temperature is too high, things begin to melt. From the days of the Whittle and von Ohain turbines, researches have focused on improving component cooling and developing materials (alloys, ceramics, composites) tolerant of elevated temperatures with the objective of producing higher pressure ratios in gas turbines for better performance. More recently evolved strategies include the use of thermal barrier coating.

A second side-effect of higher pressure ratios is that, as pressures go up, component sizes go down. Now, initially smaller component size may seem like a desirable attribute, producing smaller, lighter power plants, but consider the following. Small components are far more susceptible to performance degradation due to very close operating tolerances. A 10 mil spacing between rotor and casing is likely not excessive for a big blade at the front of the compressor, but that same clearance for a small blade at the rear will have a huge impact on performance. To achieve very close tolerance during manufacture and maintain these during operation increases costs. To sustain small clearances over an engine's service life is difficult, and likely increases engine complexity, requiring refinements in some systems, such as electronic engine control, and the addition of others, such as active clearance control. Consequently, the development of more efficient turbomachinery has lagged as the result not only of the inability to increase combustion temperatures beyond a certain thermal limit, but also due to a threshold on the design size of components. The wave rotor may provide the means of overcoming these limitations.

Wave rotors are devices that use unsteady waves to exchange fluidic energy through the compression and expansion of air in a single, internal flow machine. The wave rotor consists of a bank of elongated tubes or passages assembled on a rotating

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[ii] These ratios measure the efficiency of air-breathing power plants and are useful in comparing the efficiency of one engine to that of another. Specific Power (SP) is defined here as the net shaft power or thrust the engine produces as compared to the mass flow of air taken into the power plant. SFC is the ratio of pounds of fuel burned per hour for each pound of thrust produced by the engine. A decrease in the rate of fuel consumption for a given power output, reduces (improves) the Specific Fuel Consumption (SFC) ratio. In other words, the lower the SFC ratio, the lower the fuel flow rate for a given power output and the more fuel efficient the engine.

cylinder. In current designs for turbomachinery topping cycle applications, these tubular passages are generally trapezoidal in cross section. As the cylinder, or drum, rotates inside its housing, each tubular passage periodically aligns with an inlet port to fill with air. The force of an unsteady pressure wave compresses the air, which exhausts from the tube as the opposite end aligns with an outlet port. In one rotational cycle of the drum, these waves propagate from one end of the tube to the other. Wave rotor designs may conceivably take any one of several multi-port configurations, with through-flow and reverse-flow variations further diversifying power plant options. “Two-port, four-port and nine-port wave rotors have been evaluated for gas turbine engine topping applications” (Welch, Jones, & Paxson, 1997, p. 469).

The Wave Rotor in Topping and Bottoming Cycles

Turbine engine topping is the process through which it is possible to add heat to combustor gasses, elevating that fluid’s temperature and pressure in comparison to those otherwise experienced, without significantly increasing the temperature of turbomachinery components. The term, “topping” is descriptive of the point in the Brayton Thermodynamic Cycle where the wave rotor functions to improve turbomachinery performance–that is, at the top, in the high pressure area between the last stage of compression and the combustor. Consider the following quote, attributable to Daniel E. Paxson, NASA engineer whose contributions to propulsion include substantial wave rotor research:

A typical aircraft gas turbine performs this cycle [the Brayton Cycle] using several shafts. The fan say, and first few compressor stages (the compression and expansion process are accomplished over multiple stages) are physically connected to a low pressure turbine (e.g. expander) in the rear of the machine. On another shaft, spinning completely independently, are the latter (high) stages of the compressor and the first (high pressure) stages of the turbine. Generally, the inner spool or shaft spins much faster than the outer spool. This has to do with aerodynamic properties of the airfoils making up the compressor and turbine stages. If it spins faster, it is more efficient. The inner shaft is, of course, thermodynamically balanced. That is, the shaft work generated by the turbine exactly balances that required by the high- pressure compressor. Sitting on top of all of this is the combustor, which adds heat to the compressed flow and delivers it to the turbine. The whole purpose of this inner shaft is to raise the pressure of the working fluid before heat is added. The shaft power from the low-pressure turbine drives the fan and the lower compression stages and whatever energy is left over can be expanded through a nozzle to get jet thrust.

> This inner shaft system of compressor and turbine is essentially a topping cycle...[The wave rotor] acts like a third shaft, compressing and expanding in a balanced manner. The difference is that it achieves the cycle using gasdynamic waves instead of airfoils... (personal communication with Michael Most, April 22, 1998)

Despite considerable recent researches on the application of the wave rotor in topping cycles (NASA, General Electric and Rolls-Royce have all tested wave rotors for use in turboshaft and turbofan power plants), use of this technology in a bottoming cycle is not new. The term “bottoming cycle” refers to placement of the wave rotor at the bottom, or low pressure portion of the thermodynamic cycle. Since they initially compress the working fluid, any supercharger/turbocharger operates as a bottoming cycle machine. In a turbocharger, the compressor is driven by a turbine which expands the exhaust gases. Just as in the topping cycle, the shaft work provided by the turbine is exactly that required by the compressor. Since a wave rotor is just a matched gasdynamic compressor and turbine, it can perform equally well as either a topping or bottoming cycle device. When used in the bottoming cycle, the spinning of a wave rotor by connecting it to a car engine (say, driven through a belt/pulley system) is only for valving purposes, and therefore consumes very little power. As a turbocharger, the wave rotor provides no thermodynamic advantages over conventional turbochargers. It does, however, offer very fast response time (i.e., does not suffer the droop or lag that a turbocharger experiences as it bootstraps itself), relative simplicity in terms of manufacture and some potential pollution reduction due to an inherent egr feature of the wave cycle.

The idea of using wave rotors as an integral component in power plant design dates to the early 1940's. Wave rotor bottoming cycle compressors for locomotive diesel engines have been available since 1947. In the 1950's wave rotors were touted as a viable alternative to conventional turbochargers in the improvement of aircraft piston engine performance (Taussig, 1984). More recently in Europe, Mazda sold automobile engines with wave rotor turbochargers. Today, research into the application of wave rotor bottoming cycle technology continues as "Caterpillar Inc. is currently investigating wave rotor turbochargers for diesel-powered machinery..." (Paxson, personal communication with Michael Most April 22, 1998).

Four-Port, Through-Flow Wave Rotor Topping

Among conceivable configurations are two-, three-, four-, eight- and nine-port wave rotors. Another design option is to direct the working fluid through the rotor in either a reverse-flow or through-flow passage/port design. Although offering the potential advantage of increased capacity in comparison to the through-flow wave rotor, the reverse flow design has serious limitations. If the four-port, reverse-flow wave rotor has a single cycle per revolution, one end of the rotor (compressor inlet) remains relatively cool while the other (turbine outlet) becomes heated. Further, a buffer layer of air remains in the passages unless each reverse-flow cycle is followed by an opposite-flow, "mirror-image" cycle. "In this approach, a passage would experience two four-port, reverse-flow cycles, one the mirror image of the other, as it rotates past eight ports in one rotor revolution" (Welch, Jones, & Paxson, 1997, p. 470). The four-port, reverse-flow rotor is therefore complex, requiring twice the housing ports and associated ducting.

Of all possible wave rotor configurations, the four-port, through-flow design is the preeminently logical choice for immediate development, since it most readily adapts to topping current-technology turbomachines. Using a through-flow, four-port wave rotor to produce a topping cycle, air from the turbine's compressor is ported into the wave rotor through one of two input ports. (The other input port directs air from the combustor to the rotor.) The air flows into the rotor passages to be compressed by a series of compression or shock waves. This compressed air exits the housing through one of two outlet ports to flow to the turbine's combustion chamber. (The other outlet port leads to the engine's turbine section.) Heated from combustion in the burner, the air is returned to the wave rotor and directed into the tubular passages through the second inlet duct. This heated airflow returning to the wave rotor introduces a shock wave which propagates axially to further compress the air traversing the passage en route from the compressor to the combustor. As the drum continues to rotate, the inlet from the combustor closes, trapping the air in the passage at a very high pressure. With further rotation, the passage opens into the port leading to the engine's turbine section. Since, while traversing the tubular passages, air first compresses, then expands, the wave rotor combines, in a single machine, the functions of both compressor and turbine.

Use of the wave rotor for turbine engine topping is particularly attractive because this nonsteady flow device possesses an inherent self-cooling feature (Welch, Jones, & Paxson, 1997):

> In general, the wave rotor passages are alternately exposed to cold and hot gases at [high] frequencies...and, therefore, the rotor assumes a constant temperature, which is significantly lower than the peak gas temperature in the rotor. This self-cooling feature enables topping in turbine-inlet-temperature-limited engines; that is, the wave rotor topping increases the pressure and temperature at which heat is added in the burner without increasing the temperature of the turbomachinery components. (p. 469)

According to NASA researchers at Lewis Research Center, when incorporated into a small power plant (5 lbm/s) the mean wave rotor passage wall temperature is approximately 360° Centigrade below combustor discharge pressure. Because wave rotor designs inherently operate cooler, increased pressure ratios and combustion temperatures result, with a corresponding potential for significantly improved power plant performance (Wilson & Paxson, 1995):

> ...By using a wave rotor topping cycle, combustion temperatures greater than the turbine inlet temperature can be used, since the gas leaving the combustor is cooled in the expansion before being sent to the turbine. Also, since the rotor is washed alternately by cool inlet air and hot combustion gas, it is self-cooled, and attains a steady state temperature significantly lower than the combustion temperature. By increasing the overall cycle pressure ratio, and allowing higher combustion temperatures, the wave rotor topping cycle offers a potential route to higher engine efficiency. (p. 1)

By using a wave rotor in turbomachinery topping cycles, the pressure and temperature at which heat is added in the combustor increases without elevating the temperature of engine components. This results in higher pressure ratios, and consequently, increased specific performance and decreased specific fuel consumption without substantially increasing turbomachinery temperatures.

Technological Promise of Wave Rotor Design

Many advantages accrue in the use of the wave rotor to produce a topping cycle for gas turbine engines, including high efficiencies, quick response and installation flexibility. Consider the following. excerpted from Taussig (1984):

> .....the compression - and - exhaust process is accomplished by gas-dynamic waves and not by the motion of any solid pistons or by the rotor wheel, so that no change in solid-body inertia is required for it to respond quickly to load changes. Since there is no analog to turbine blade tip leakage in the wave rotor, the component efficiency of this device is comparatively high for small engines. For the same reason, the wave rotor need not have a small shaft diameter. Therefore, it can be mounted either coaxially with the lower pressure spools, or at right angles as in the eccentric configuration. (p. 61)

In comparison to conventional turbomachinery, wave rotor component stresses are reduced due to a much lower spin rate, and the blade stresses imposed on conventional axial-flow compressors do not exist. Wave rotors have the potential to dramatically improve performance in terms of specific power and specific fuel consumption without significantly increasing power plant size.

When used in a topping cycle, wave rotor designs inherently operate cooler, allowing increased power plant pressure ratios and combustion temperatures for improved performance. Increased pressure ratios reduce NO_x (oxides of nitrogen) emissions, improve specific power and decrease thrust specific fuel consumption. Research at NASA's Lewis Research Center in Cleveland, Ohio suggests that, in comparison to large turbofan power plants, small (400 to 600 shp) and intermediate (3000 to 4000 shp) turboshaft engines will benefit the most from wave rotor technology (Welch, Jones, & Paxson, 1995):

> ...the specific power enhancement of the small and intermediate turboshaft engines is +21% (i.e., increased by 21% of baseline SP [specific power] and +19%, respectively, and the SFC levels are reduced (enhanced) by 17% and 16% respectively...The large turbofan [80,000 to 100,000 lbs. of thrust] wave rotor performance is severely penalized by 21% (core flow) cooling bleed. The penalized wave rotor pressure ratio...leads to SFC reduction of 3% and SP enhancement of 3%. These modest improvements might suggest discounting wave rotor-topping in the large high bypass turbofans... (p. 5)

CONCLUSION

In writing this article, the authors have not intended to produce an empirical study. Rather, it was our goal to give the reader perspective on a topic of significance to aviation and insight into a technology that is both emerging and unfamiliar to many. We elected to achieve this goal through an historical, informational account of non-steady flow propulsion and a look at the promise of future powerplant applications. As technology continues to evolve, realizing the potential of wave rotors for topping gas turbines becomes more likely. At some point, it may even be possible to construct a radically different engine where, in a single power plant, the internal combustion wave rotor performs the functions of compressor, combustor and turbine---a wave engine.

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Using the Job Characteristics Model to Measure the Motivating Potential of Flightdeck Positions

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ABSTRACT

This paper explores the potential of using the Job Characteristics Model (JCM) for analyzing flightdeck positions. The JCM has been successfully used to study a variety of job designs and the effects prescribed treatments have on the job designs. This paper presents an overview of the job characteristics model, discusses the model's critical psychological states and shows how the Job Diagnostic Survey (JDS) can be used to measure the motivating potential of flightdeck positions. The results from our analysis and the model itself will be useful in the design of individualized LOFT (Line Oriented Flight Training) and CRM (Crew Resource Management) LOFT programs. Additionally, the JCM can be used to study the effects of automation, operation type (passenger vs. cargo), tenure as a pilot, and tenure in type on pilot motivation. From a longitudinal perspective, current data collection can serve as baseline measures for studying the aggregate, long-term effects of flightdeck job design changes.

INTRODUCTION

The purpose of this project is to explore the potential of using the Job Characteristics Model (JCM) for analyzing flightdeck positions. The JCM has been successfully used to study a variety of job designs and the effects prescribed treatments have on the job designs (Cheser, 1998; Dodd & Ganster, 1996; Fok et al., 1999; Fok et al., forthcoming; Shafer et al., 1995). This paper presents an overview of the job characteristics model, discusses the model's critical psychological states, and shows how the Job Diagnostic Survey (JDS) can be used to measure the motivating potential of flightdeck positions.

Our research at this stage is an attempt to adapt the JCM and to verify it, empirically, in the flightdeck setting. We are planning to achieve this through the use of statistical analysis of data being collected from representative carriers in the United States. The next stage of this research will focus on verifying the JCM using an international sample. Once the JCM has been verified in the flightdeck setting, there are many potential uses for it, both by airlines and researchers of airline operations. The results from our analysis and the JCM itself will be useful in the design of individualized LOFT and CRM LOFT programs. Additionally, the JCM can be used to study the effects of automation, operation type (passenger vs. cargo), tenure as a pilot, and tenure in type on pilot motivation. From a longitudinal perspective, current data collection can serve as baseline measures for studying the aggregate, long-term effects of flightdeck job design changes.

OVERVIEW OF THE JOB CHARACTERISTICS MODEL

Hackman and Oldham's (1980) Job Characteristics Model (JCM) describes the link between a job's core characteristics, critical psychological states, and outcomes (see Figure 1). Basically, whenever certain core job characteristics are present, they lead to the critical psychological states of experienced meaningfulness of the work, experienced responsibility for the outcomes of the work, and knowledge of the actual results of the work activities. The degrees to which all three of these states are present contribute to the motivating potential score (MPS) of a job. Higher MPS is related to higher outcomes. These outcomes include high internal work motivation, high growth satisfaction, high general job satisfaction, and high work effectiveness.

The proposed relationships in the JCM are moderated by individual differences. For instance, an individual's *knowledge and skill* will affect the model's relationships. High knowledge and skill suggests an individual will perform well. However, low MPS jobs have low *internal* motivating potential. Thus, how well a person performs in a low MPS job will not affect their feelings about his or her work. However, in a high MPS job, good performance will lead to positive feelings and poor performance will lead to negative feelings. Thus in high MPS jobs, a person's knowledge and skill will affect the degree to which they experience positive outcomes from doing their job.

Similarly, an individual's growth-need strength (GNS) and context satisfaction will moderate the model's proposed relationships. GNS is a measure of an individual's desire for higher personal accomplishments, learning, and improved social, economic, and professional status. High GNS individuals are motivated to grow while low GNS individuals may be satisfied when basic physiological and security needs are met.

Context satisfaction refers to an individual's satisfaction with the work context. For instance, individuals who feel they are significantly underpaid or who do not feel well liked and/or respected at work will have low context satisfaction. With individuals that are low on GNS and low on context satisfaction there is no relationship (or a small negative relationship) between MPS and outcomes. When both GNS and context satisfaction are high, there is a strong positive relationship between MPS and outcomes. When only one or the other of GNS and context satisfaction are high, there is a moderate positive relationship between MPS and outcomes (Hackman & Oldham, 1980).

CRITICAL PSYCHOLOGICAL STATES

Five job characteristics have been shown to contribute to the three critical psychological states of meaningfulness, responsibility for outcomes, and knowledge of actual results of the work (Hackman & Lawler, 1971; Hackman and Oldham, 1976; Turner & Lawrence, 1965). Three of the job characteristics contribute to meaningfulness. One of the job characteristics contributes to responsibility for outcomes. Another of the job characteristics contributes to knowledge of actual results of the work. These five job characteristics are discussed below. To illustrate the usefulness of using the JCM for studying flightdeck positions, propositions regarding expected differences based on operations type (passenger or cargo), degree of flightdeck automation (conventional versus glass cockpit), overall flightdeck experience, and in-type flightdeck experience are stated. These flightdeck environment variables are not intended to be a comprehensive list of variables that can affect job satisfaction. These variables are only discussed as examples for the potential uses of the JCM in analyzing flightdeck positions.

Experienced Meaningfulness

The core job characteristics that contribute to the critical psychological state of meaningfulness are skill variety, task identity, and task significance (Hackman & Oldham, 1980). These characteristics are described here.

Skill variety. Skill variety is defined as "the degree to which a job requires a variety of different activities in carrying out the work, involving the use of a number of different skills and talents of the person" (Hackman & Oldham, 1980, pg. 78). It has been shown that performing work that requires a number of skills leads to feelings of meaningfulness in humans. It is not necessary for the work to be considered important or significant in the greater scheme of things. Rather, if the work requires an individual to stretch his or her talent, it will be considered meaningful to the individual. For instance, note the meaningfulness of excellence in sporting activities to the participants. Though being good at golf is not a significant contribution to the world at large, many individuals find meaningfulness in improving their game. Similarly, one does not have to be a commercial airline pilot to experience meaningfulness from piloting an aircraft.

A substantial amount of skill variety is required in flightdeck positions. Technical skills and significant knowledge are required to fly aircraft safely. Additionally, significant motor skills, communication skills, cognitive skills, and people skills are also required. Skill variety may be perceived as increasing as the flightdeck environment becomes more automated. Newer and more advanced avionics and aircraft monitoring and control systems present new challenges to pilots. Alternatively, automated flightdecks may be viewed as decreasing skill variety as they take over more of the flightdeck tasks. It will be interesting to note the change in perceived skill variety as flight experience in general and tenure in a particular flightdeck environment increase. As time goes on and the same tasks are performed day-in and day-out, perceived skill variety may decrease because the individual no longer feels challenged.

Task identity. Task identity is defined as "the degree to which a job requires completion of the whole and identifiable piece of work, that is, doing a job from beginning to end with a visible outcome" (Hackman & Oldham, 1980, pg. 78). As might be expected, workers that perform only a small piece of a large job experience less meaningfulness than workers who perform larger portions of the job. It is more difficult for a worker to identify with the project/product and the benefits it provides to society when he or she only contributed a small portion of the overall task.

There is substantial task identity associated with flightdeck positions. If you define the task as transporting passengers and/or cargo from point A to point B, flightdeck positions are involved from beginning to end. Task identity is expected to be consistent across types of flight operations (passenger or cargo). Additionally, it is unlikely that overall flightdeck experience, and in-type flightdeck experience will significantly affect task identity. However, flightdeck automation may impact task identity. Some individuals may believe that the computers are performing a bulk of the task. Therefore, they may perceive less direct connection to the task.

Task significance. Task significance is defined as "the degree to which the job has a substantial impact on the lives of other people, whether those people are in the immediate organization or in the world at large" (Hackman & Oldham, 1980, p. 79). As stated above, an activity does not have to be significant in the greater scheme of things in order to produce feelings of meaningfulness. However, the degree to which others value the activity will *contribute* to feelings of meaningfulness.

Task significance will likely vary depending on the type of flight operations. Flightdeck positions on large passenger jets will likely be considered highly significant, simply because they affect the lives and safety of a large number of people. While transporting cargo is important and affects a large number of people, human lives are not at significant risk (except for the pilot and crew, of course). Thus, it is likely that cargo pilots will view their positions as less significant than passenger carrying pilots. Likewise, there is likely a positive correlation between perceived task significance and aircraft size as determined by the number of seats. Additionally, we may find that the type of cargo (hazardous vs. non-hazardous, medical vs. non-medical) being carried affects perceptions of task significance. It is unlikely that flightdeck automation, overall flightdeck experience, and in-type flightdeck experience will significantly affect task significance.

Skill variety, task identity, and task significance all contribute to the meaningfulness experienced by the flightdeck professional. However, for a job to have motivating potential, individuals must feel responsible for the outcomes of a task and have knowledge of the outcomes of the task. A job characteristic called "autonomy" affects the responsibility for the outcomes an individual feels and "feedback" affects the knowledge of the actual outcomes.

Autonomy

Autonomy is defined as "the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" (Hackman & Oldham, 1980, p. 79). Jobs with high autonomy afford workers the chance to claim the outcomes, good or bad, as a result of their efforts. Workers who merely follow stringent procedures may view a substantial portion of the outcome as a result of the procedure rather than their efforts.

In the interest of safety, much of the autonomy of flightdeck positions has been removed. While FAA regulations allow pilots to deviate from the regulations in times of emergency, the vast majority of flightdeck work is carried out via established checklists and procedures. Any deviation from these procedures often requires substantial justification. Thus, it is expected that flightdeck positions as a whole will score relatively low on autonomy.

The perceived autonomy of passenger carrying pilots may be lower than for cargo carrying pilots. Scheduled passenger carrying and cargo carrying operations in the United States are subject to the same regulations (FAA Part 121). These regulations include the requirements for the issuance and maintenance of airline operating and fitness certificates. However, passenger operators set stricter company regulations in their Flight Operations Manuals, many of which deal with issues such as passenger handling that are not issues for cargo operators. Thus, pilots flying for passenger operations are subject to increased rules and scrutiny. Additionally, cargo only operations are primarily conducted during the night. Due to the reduced amount of traffic at night, airspace management requirements are not as strict as for day operators (primarily passenger operators). Thus, cargo only pilots have more freedom in picking the routes they fly. This may also contribute to cargo only pilots perceiving a higher degree of autonomy.

The degree of flightdeck automation will likely affect a pilot's perceived autonomy. The more automated the flightdeck becomes, the more tasks that are assumed by the aircraft systems. Thus, pilots may see automated systems as "taking over" their jobs. The perception of autonomy may come down to who has the last word, the pilot or the computer. Boeing designs give the pilot the last word on aircraft operations. That is, the pilot can override the flightdeck automation if he or she deems it necessary. However, Airbus designs give the aircraft systems the final word. If the aircraft computers believe inputs from the pilot(s) would place the aircraft in an unsafe situation, the pilot(s)' commands are overridden. Thus, it will be interesting to see if Boeing pilots report higher levels of autonomy than Airbus pilots.

Job Feedback

Job feedback is defined as "the degree to which carrying out the work activities required by the job provides the individual with direct and clear information about the effectiveness of his or her performance" (Hackman & Oldham, 1980, p. 80). To be internally motivating, a job must provide the worker with knowledge of the outcomes of his or her efforts. Note that the focus here is on feedback from the job itself. Feedback from other people such as managers and/or supervisors does impact the knowledge of outcomes. However, the MPS is a measure of the motivating potential of a *job's* design.

The perception of feedback in flightdeck positions will likely be high. The squeak of the tires on the runway at the intended destination provides immediate and unequivocal evidence of performance success. Likewise, the outcomes of simulator training exercises are quite apparent.

Feedback is not expected to vary with operations type, flightdeck automation, overall flightdeck experience, or in-type flightdeck experience. In all these cases, the feedback from the job itself is unaffected.

THE JOB DIAGNOSTIC SURVEY

Hackman and Oldham (1975 & 1980) created the Job Diagnostic Survey (JDS) to measure the variables and constructs in the JCM. The survey instrument is administered to individual workers and elicits their perceptions of the attributes of their jobs. Responses are recorded on seven point Likert scales.

Sections one and two of the survey ask respondents questions about their current job. The answers to these questions are selectively combined to form measures of the five job characteristics. For example, skill variety is obtained by averaging the score on the following three questions from Sections one and two:

> Section One, #4: How much variety is there in your job? That is, to what extent does the job require you to do many different things at work, using a variety of your skills and talents?

1-------2-------3-------4-------5-------6-------7

Very little, the job requires Moderate variety. Very much; the job requires me to do many different things over and over again. Things using a number of different skills and talents.

> Section Two, #1: How accurate is the following statement in describing your job? *The job requires me to use a number of complex, high level skills. (1 = very inaccurate – 7 = very accurate)*
>
> Section Two, #5: How accurate is the following statement in describing your job? The job is quite simple and repetitive. *(1 = very inaccurate – 7 = very accurate; note that this item is reverse scored to help reduce bias)*

Sections three and five are used to measure the experienced psychological states. Section three asks respondents questions about how they personally feel about their job. Section five asks respondents to indicate how other people in the organization that hold the same job feel about their job. Both sections are used to gain an overall measure of the experienced psychological states rather than from a single perspective. For example, experienced meaningfulness is measured by four questions. They are:

Section Three: How much do you agree with each statement? (1 = disagree strongly – 7 = agree strongly) #4: Most of the things I have to do on this job seem useless or trivial. (reverse scored) #7: The work I do in this job is very meaningful to me.

Section Five: How much do you agree with each statement? (1 = disagree strongly – 7 = agree strongly)
#3: Most people on this job feel that the work is useless or trivial. (reverse scored)
#6: Most people on this job find the work very meaningful.

Sections three and five also contain questions that assess the affective outcomes such as general job satisfaction and internal work motivation.

Section four asks questions about job satisfaction. Some questions are used to assess one of the affective outcomes called growth satisfaction. Other questions obtain measures of context satisfaction such as satisfaction with job security, compensation, co-workers, and supervision.

Sections six and seven measure growth need strength. Section six asks "would like" type questions. Respondents are asked the degree to which they would like to have certain characteristics (respect and fair treatment from their supervisor, job security, friendly co-workers, quick promotions, etc.) present in their jobs. The questions in section seven ask respondents to choose between two types of jobs. The choices respondents make indicate what is more important to them and measures their growth need strength. For example, respondents are forced to choose (on a seven point Likert scale) between "a job with a supervisor who respects you and treats you fairly" and "a job that provides constant opportunities for you to learn new and interesting things." A person that has high GNS would be less worried about being treated fairly and more interested in a job that provides constant opportunities to learn new and interesting things. Another question asks respondents to choose between "a job where there is a real chance of you could be laid off" and "a job with very little chance to do challenging work." A person with high GNS would not be as concerned with job security as much as they would want to avoid a job that is not challenging.

The JDS has been used in a variety of organizations and subjected to many empirical tests (e.g., Renn & Vandenberg, 1995; Fried & Ferris, 1987; Hogan &

Martell, 1987; Cathcart, Goddard, & Youngblood, 1978; Dunham 1976, Dunham, Aldag, & Brief, 1977; Pierce & Dunham, 1978; Stone & Porter, 1977). Our research is an attempt to use the model in the airline industry and to verify it using the same strict empirical testing as has been used to verify it in other industries.

We believe the JCM will fit the flightdeck environment well. The primary uses for the JCM are in jobs that employ high GNS individuals. It is in these settings that the JCM's correlations are strongest. We suspect that individuals who aspire to flightdeck positions have high GNS (our survey will test this). Additionally, the JDS is not job specific and can be used to analyze a variety of jobs. Thus, very few changes to the JDS are needed.

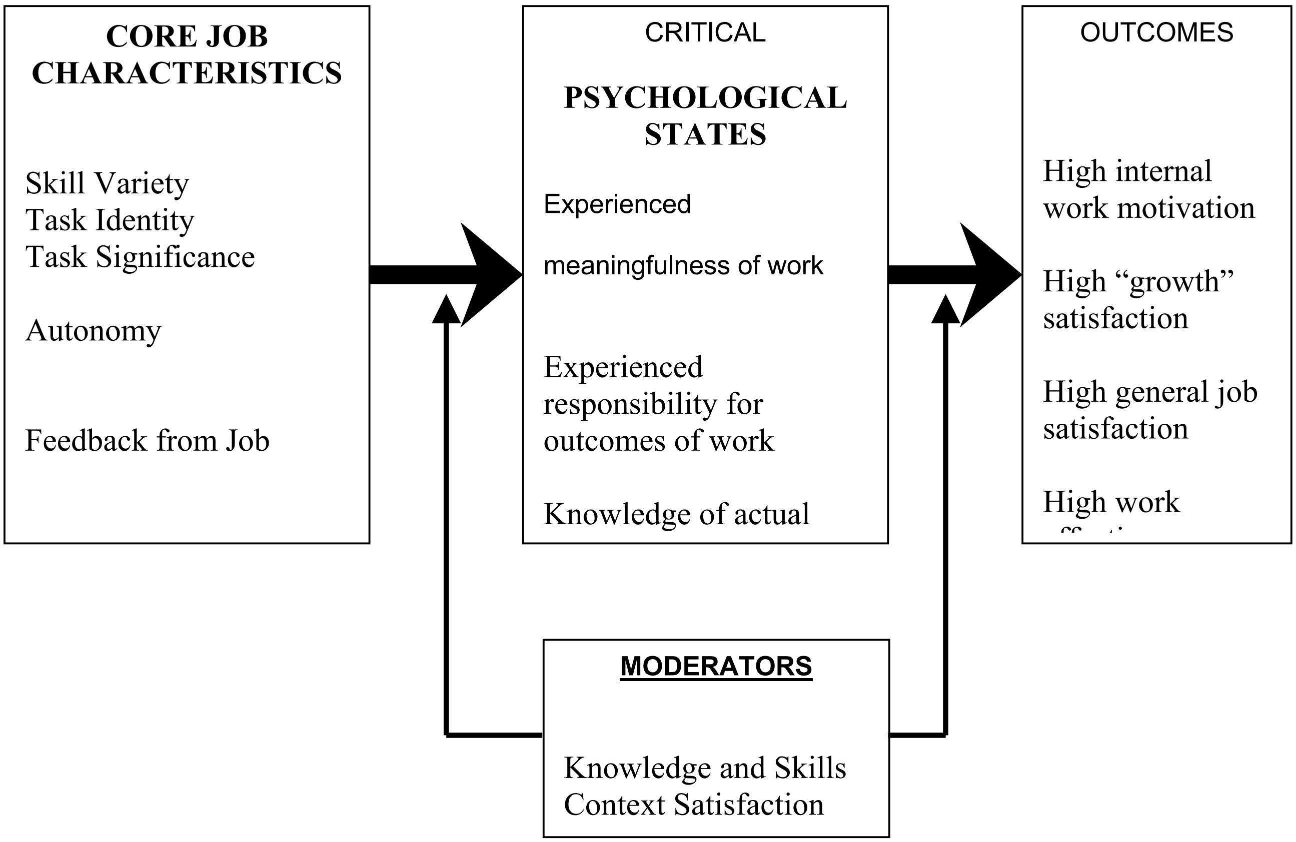
SUMMARY AND FUTURE RESEARCH

We believe using the JCM to study flightdeck positions has considerable potential. The first step is to validate its appropriateness in the flightdeck environment. Data are currently being gathered to do just that. Once this is accomplished, the effects of different variables such as degree of flightdeck automation, operation type, tenure as a pilot, and tenure in type on job satisfaction can be tested. As this research stream progresses, researchers and practitioners will undoubtedly identify other variables and constructs that affect job satisfaction in the flightdeck environment. The results of this research will provide a vehicle for testing their theories.

Also important is that this research will provide a benchmark measure of job satisfaction in the flightdeck environment. It will be interesting and instructive to repeat this research annually so that trends in job satisfaction can be monitored. The JDS provides measures of job satisfaction and, perhaps more important, measures of the underlying constructs that affect job satisfaction. The analysis of trends in these latent variables will be necessary in understanding *why* changes in job satisfaction are occurring. This research stream should prove interesting to both practitioners and researchers.

Figure 1.

JOB CHARACTERISTICS MODEL



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Risk Analysis, Pilot Motivation, and Decision-Making: Application of the PAVE Personal Minimums Checklist to Pilot Decision-Making in Three General Aviation Accidents

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ABSTRACT

This paper addresses the relative effects of risk and pilot motivation on decisions made by three general aviation pilots. Using the PAVE (Pilot, Aircraft, environment, External pressures) personal minimums checklist, various risk elements related to the flights and information available to the pilots prior to/during flight are considered. The motivation behind each pilot's decision to go ahead with the flight in spite of adverse conditions is also discussed. Use of the checklist as an in-flight decision-making tool, as well as go/no-go decision-making are considered, and suggestions for further research are offered.

INTRODUCTION

A recent study of general aviation aircraft accidents occurring in 1996 by the National Transportation Safety Board (NTSB, 1999) indicates that 83% of all fatal general aviation accidents that year were attributable to pilot performance. A number of those accidents were due to such events as encounters with weather (13.4 %), loss of aircraft control (31.4 %), and collision with terrain (11.2%) (NTSB, 1999). Such occurrences are often a result of poor decision-making on the part of the pilot-in-command. Many agencies and organizations within the aviation industry offer programs and literature aimed at teaching pilots to recognize their own tendencies to make poor decisions. The combined efforts of the Federal Aviation Administration (FAA) and various aviation-oriented organizations have resulted in the creation of many training aids aimed at improving pilot decision-making skills.

In 1987, the FAA published a series of manuals pertaining to aeronautical decision-making (ADM). These publications present ADM concepts (e.g., hazardous attitudes, risk elements) for training purposes, and were the results of twelve years of research, testing, and development (FAA, 1991). In the manual for student and private pilots, the FAA (1987) defines ADM as "the ability to search for and establish the relevance of all available information regarding a flying situation, to specify alternative courses of action, and to determine expected outcomes from each alternative."

The motivation is to choose and authoritatively execute a suitable course of action within the time frame permitted by the situation. The word "suitable" means an alternative consistent with societal norms, and "action" includes no action, some action, or action to seek more information. (p.4)

The manual recognizes that the ability to make good decisions is affected by stress. Both physiological and psychological stresses impair decision-making by dividing the pilot's attention between flight duties and distractions. It also identifies five categories of risk factors that pilots should consider when contemplating flight.

In 1996, Kirkbride, Jensen, Chubb,

and Hunter published a personal minimums tool to aid a pilot in risk evaluation when making a go/no-go decision. It identifies six categories of risk factors, similar to those in the FAA's manual. Further collaboration between the FAA, The Ohio State University, and King Schools resulted in the PAVE (Pilot, Aircraft, environment, External pressures) personal minimums checklist pamphlet, available through the FAA (1996). This checklist (see Appendix) is to be tailored to a specific pilot's needs based on experience, certification, skill, and knowledge level. In many cases, only the minimum requirements for a flight operation (in terms of pilot certification, weather conditions, etc.) are stipulated in the regulations or aircraft manual. Less experienced pilots may wish to set more conservative minimums for themselves until they gain more familiarity with the flight environment. For example, while a flight may be legally conducted under visual flight rules with only one to three miles of visibility, depending on the operation (General Operating & Flight Rules, 2001), a new pilot may not feel comfortable with a visibility of less than five miles or more. The PAVE checklist is designed to allow the pilot to devise a personal set of minimums to be referred to prior to flight. The checklist can be filled out at any time, allowing the pilot to think about each element without the pressure of an imminent flight. A 1998 study sponsored by the FAA's Office of Aviation Medicine (OAM) (Jensen, Guilkey, & Hunter, 1998) found that, within the limitations of the study, pilots believe such training aids to be helpful in making the go/no-go decision.

The purpose of this paper is two-fold. First, using the PAVE go/no-go decision-making tool to gauge the risks associated with the flights, it discusses the effects of motivation on decisions made by three general aviation pilots. Second, it suggests the effectiveness of the PAVE checklist as an in-flight as well as pre-flight decision-making tool.

ACCIDENT SUMMARIES

The three accidents chosen for this study occurred in 1996. Summaries of the three accidents are available on the NTSB's website, www.ntsb.gov. In each of the three accidents, the pilot-in-command (PIC) made a decision to either initiate or continue flight in spite of evidence that such a decision was not wise.

Accident 1

According to the final report adopted by the NTSB (1997), the aircraft departed Half Moon Bay, CA, on the morning of April 10, 1996, on the first leg of what was to be an attempt to set a world record for the youngest pilot to fly across the United States. Aboard the aircraft were an instructor pilot acting as PIC, the seven-year-old pilot-trainee, and one passenger, the father of the pilot-trainee. The trip was to last seven days, with stops planned around visits to relatives and several public events. On the evening of April 10th, the aircraft landed at Cheyenne, WY, its final destination for the day. Takeoff the next morning was initially planned for 0615 local time in order to depart the area before an advancing storm front arrived (NTSB, 1997).

On the morning of April 11th, media reporters interviewed both the PIC and pilot trainee prior to the flight. At 0813 local time, the PIC called for taxi instructions. At 0820, he was cleared for takeoff on a special visual flight rules (VFR) clearance as rain associated with the approaching storms had reduced tower visibility to 2 3/4 miles. After takeoff, the aircraft turned right toward an easterly heading. As the aircraft rolled out of the turn, witnesses said it suddenly descended into the ground in an almost vertical attitude (NTSB, 1997).

The final accident report was adopted by the NTSB almost one year after the accident. Upon conclusion of the investigation, the NTSB (1997) determined that:

1. The probable cause of this accident was the pilot in command's improper decision to take off into deteriorating weather conditions (including turbulence, gusty winds, and an advancing thunderstorm and associated precipitation) when the airplane was overweight and when the density altitude was higher that he was accustomed to, resulting in a stall caused by failure to maintain airspeed. (p. 53)
2. A tightly scheduled flight itinerary and the pressures of media commitments were listed as contributing factors.

Accident 2

On June 12, 1996, the pilot and her husband flew from Augusta, ME, to Bowling Green, OH, with an en route fuel stop at Cortland, NY (NTSB, 1996a). The pilot was in the process of moving from Augusta to Bar Harbor, ME, and the purpose of the flight was to pick up a family member who would help with the move. On June 13, 1996, the pilot and her two passengers departed Bowling Green, OH, and arrived again at Cortland, NY, for fuel that afternoon. The accident flight was to be the final leg of the return to Augusta, ME.

The pilot initially contacted the Buffalo Flight Service Station (FSS) at 1910 local time for a weather briefing and learned of a line of thunderstorms between Cortland, NY, and her destination, Augusta, ME. Subsequent calls placed by the pilot to the FSS at 2216 and 0035 local time indicated that the storms were still present. At 0134, the pilot filed an IFR flight plan with the FSS and, at 0223, requested her IFR clearance. She was given a clearance with a 0245 void time. The flight departed the Cortland County Airport at about 0240 and flew into rising terrain north of the departure end of Runway 6 (NTSB, 1996a).

The NTSB determined that the cause of the accident was "the pilot [sic] failure to maintain directional control of the airplane which resulted in the airplane striking trees. Contributing factors were the pilot's spatial disorientation, dark night conditions, fog, and the pilot's self-induced pressure to reach the destination" (1996b).

Accident 3

On August 2, 1996, the pilot and a passenger departed Friday Harbor, WA, for Medford, OR, so the pilot could manage a bowling tournament scheduled to occur at his place of business (NTSB, 1996c). Several phone calls placed to the Seattle FSS indicated that VFR conditions would not remain through the next morning, so the pilot faced the decision of flying home that night before the weather moved in or waiting two days. The pilot opted to fly home that night, but upon contacting Seattle FSS at 0041 local time in flight to open his flight plan, he learned that conditions along his route of flight had deteriorated much more quickly than had been anticipated. He opted to continue to see what the weather really looked like. Approximately 40 minutes later, radar indicated that the aircraft entered a descending left turn at a high groundspeed and descent rate. Seattle Approach Control received a broken radio call from the pilot requesting help. The aircraft disappeared from radar, and was found in a residential area in the Purdy, WA area, six miles from the filed flight path (NTSB, 1996c).

The NTSB determined that the cause of the accident was "[t]he noninstrument-rated pilot's continuation of VFR flight into instrument meteorological conditions which led to pilot spatial disorientation and loss of control of the aircraft. Factors were: pilot self-induced pressure, night conditions, low ceilings, and the pilot's lack of total instrument time" (NTSB, 1996d).

METHODOLOGY

The three NTSB aircraft accident reports considered here were selected for analysis based on the existence of a variety of external pressures. First, the PAVE checklist was applied to information available to the pilots to determine specific risk factors associated with each flight. Then, the particular motivating force behind each pilot's decision to proceed with flight was contrasted against those risk factors. Finally, those three cases were compared to a fourth flight in which a decision to discontinue flight was made.

ANALYSIS

Analysis shows that various risk factors existed that should have led the pilots to consider the wisdom of the decisions made. Tables 1 through 4 illustrate the known risk factors as compared to the PAVE checklist; Table 1 compares known pilot information, Table 2, known aircraft information, Table 3, known environment information, and Table 4, known external pressures. In spite of these risks, the motivation to complete flight was strong enough to override any consideration of risk.

PAVE Checklist

<u>Accident 1</u>

<u>Pilot</u>

According to the NTSB (1997), while the PIC was properly certified for the flight, his lack of sleep during the three days prior to the trip led to fatigue. He also had limited experience operating out of high density altitude airports such as Cheyenne (NTSB, 1997). As indicated previously, the PIC may have encountered both physiological and psychological stresses. The April 10 departure from Half Moon Bay Airport occurred at 0700 local time. Neither the PIC nor the pilot trainee had received much sleep the night prior to the flight. Such fatigue, while not identified as a contributing factor in the accident, is recognized as having an adverse effect on decision-making (NTSB, 1997). The very nature of the trip, with the tight schedule and all of the media attention, would have placed psychological stress on the PIC. The NTSB (1997) did recognize this as being a factor in the accident. Evidence of the effects of this stress on the PIC's abilities comes from videotapes of the aircraft prior to takeoff and from testimony from the air traffic controller on duty. According to the report, the PIC:

> . . . started the airplane engine while the nosewheel was still chocked; requested a taxi clearance without having obtained the ATIS [automatic terminal information service]; read back a radio frequency incorrectly; accepted a radio frequency that he could not dial on his radio; failed to acknowledge, as requested, the weather information provided by the controller; asked "are we going the right way"; failed to stop at the end of the runway; and used incorrect phraseology when he requested a "special IFR [instrument flight rules]" clearance. (NTSB, 1997, p. 41)

At the time of the accident, ADM was not a required aeronautical knowledge area for certification. However, it should be noted that the PIC of the accident flight had completed an FAA approved flight instructor refresher course, including a one-hour section on weather and a one-hour section on human factors in aeronautical decision-making, in the month prior to the accident (NTSB, 1997).

Aircraft

The accident aircraft was a 1975 Cessna 177B. While the aircraft carried adequate fuel and the pilot was familiar with the aircraft, the aircraft performance data appear to have been ignored to an extent (see Table 2). Given the nature and length of the trip, extra equipment was loaded on the plane, including suitcases of clothing, a video camera and film, and food and beverages (NTSB, 1997). The aircraft was found to be overweight by 96 pounds at takeoff, and estimated to be 84 pounds overweight at the time of impact (NTSB, 1997). An increase in aircraft weight will increase stall speed, decrease climb performance, and increase takeoff distances (Hurt, 1965). Consideration of these facts, along with the environmental conditions existing at the time, should have also led the PIC to consider delaying takeoff.

Environment

The environment that existed at the time of the accident, with approaching thunderstorms, was not conducive to visual flight in a light aircraft. The April 11th flight from Cheyenne was originally to have departed at 0615 local time to avoid the approaching weather system. However, the PIC did not leave the hotel until 0622 and the pilot trainee and her father did not leave until 0714. At 0801, the PIC placed a call to the Casper, WY, Automated Flight Service Station (AFSS). The AFSS briefer indicated deteriorating weather conditions due to thunderstorms just west of the airport with no significant improvement for a while. When the aircraft began its takeoff roll at 0820, the storm system was closing in, with two lightning strikes recorded at the time of takeoff, .5 and 1.2 miles west of the airport (NTSB, 1997).

External pressures

The external pressures associated with this flight included a record setting attempt with a full itinerary and scheduled media obligations. The trip was to begin on April 10, 1996, at Half Moon Bay and return to Half Moon Bay on April 17 with overnight stays in Cheyenne, WY, Ft. Wayne, IN, Falmouth, MA, Clinton, MD, Lakeland, FL, Houston, TX, and Sedona, AZ. The Massachusetts and Texas stopovers coincided with visits to relatives, and the Florida stopover coincided with the annual Sun 'n Fun fly-in. There were also 15 planned intermediate fuel stops. In an interview with NTSB investigators, the father of a boy who had previously set a 'youngest pilot record' stated that during their record trip "there were media people waiting at nearly every stop. . .they were distracting, irritating, asked the same questions all the time, and became a major distraction from flying duties" (NTSB, 1997, p.32). There is evidence that such media distractions affected both the accident flight and another flight previous to the record attempt. There were interviews with media the evening before and the morning of the accident flight, and papers found in the shirt pocket of the pilot trainee's father indicated several subsequent scheduled media interviews, "including one scheduled for the evening of the accident in Ft. Wayne, Indiana, and another for the next evening in Massachusetts" (NTSB, 1997, p. 25). In a previous orientation flight with media representatives, it was reported that the preflight engine runup was neglected and that a door on the aircraft was discovered to be open in flight (NTSB, 1997).

Beginning with the planning stage of the flight, it is obvious that the plan for the trip was too tight to take into consideration any unforeseen events (weather, illness, mechanical problems) that might cause a delay. Given the goal of completing the flights before the pilot trainee's eighth birthday on May 5th, it would appear that sufficient time existed for the trip to be completed safely. A conscious decision during the planning phase to sacrifice the intended schedule in response to adverse conditions could have prevented the accident. While there is evidence that the PIC discussed the possibility of flight delays with another pilot, his wife, and a friend, there is no confirmation that these possibilities were seriously discussed with others, including the pilot trainee or her family (NTSB, 1997).

Accident 2

Pilot

According to the NTSB (1996a), the pilot of the accident aircraft held a commercial pilot certificate with airplane single- and multi-engine land and instrument ratings and a flight instructor certificate with airplane single-engine land and instrument airplane ratings. The addition of the multi-engine rating to her commercial certificate is the last known flight review and instrument proficiency check she received. Her recent instrument flight experience was unknown, so while she was properly certified for the flight, her currency was undetermined.

Inspection of the previous day's activities indicate that this pilot also was probably in a fatigued state when the takeoff was attempted. The June 13 flight departed Bowling Green, OH, in the afternoon and arrived at Cortland, NY, where a fuel purchase was made at 1609 local time. The first call to Buffalo FSS for a weather briefing took place at 1910. At 2001, the pilot and her passengers checked into a local motel and got a 0030 wake-up call on June 14. At 0130, a cab was dispatched to take the pilot and passengers from the motel to the airport. At 0223, the pilot received an IFR clearance from the Buffalo FSS along with a 0245 void time. The aircraft departed the Cortland airport at about 0240 local time (NTSB, 1996a).

Aircraft

The accident aircraft was a 1956 Piper PA-23-150 (NTSB, 1996a). According to witnesses, the pilot experienced difficulty starting the left engine at the Cortland airport on June 12 and difficulty starting both engines at the Bowling Green airport on the afternoon of June 13. Once started, however, the engines appeared to run smoothly. The aircraft had been fueled for the flight, and the NTSB narrative makes no mention of improper weight and balance (1996a). Another pilot reported that on previous occasions, the aircraft had experienced electrical problems, including loss of interior lighting. Also, the instrument panel was not laid out in a "T" arrangement, but all instruments were in the locations they were in when the aircraft was built.

Environment

In each of three phone calls placed to the Buffalo FSS, the pilot was advised of a line of thunderstorms between Cortland, NY, and her destination, Augusta, ME. Automated weather observing system (AWOS) observations prior to and at the time of the flight reported lowering ceilings and visibilities. Between 0001 and 0141 local time, cloud cover dropped from a 300 foot scattered layer to a 100 foot overcast ceiling, and visibility dropped from 1 ¼ miles to less than ¼ mile. The 100 foot ceiling and ¼ mile visibility remained until 0521 local time, almost three hours after the accident (NTSB, 1996a).

Of interest is the existence of an IFR departure procedure and published nonstandard takeoff minima of a 400-foot ceiling and 2 mile visibility (NTSB, 1996a). Nonstandard takeoff minima and departure procedures are published when obstacles exist in the vicinity of the airport. While the Part 91 flight was not required to follow these minima, their existence indicates a need for extra caution during the takeoff phase of flight.

External pressures

The pilot was scheduled by her employer to be on duty at 0900 on June 14 for scenic flights. There were no such flights actually scheduled for that time, and the pilot knew another pilot was available to cover the flight schedule. Also, according to a family member, "the pilot and her husband were under pressure from their current landlord to evacuate their present housing by the end of the day on June 14, 1996" (NTSB, 1996a). Indeed, the purpose of this flight was to return with another family member who would help them with the move. While alternate plans were in place for the pilot's work duties, there is no evidence from the NTSB narrative that alternate plans were discussed with the landlord (1996a).

Accident 3

Pilot

According to the NTSB, the private pilot had been certified 14 months prior to the accident (1996c). He held no instrument rating. His total flight time was 123.5 hours, with 14 hours at night and 3 hours of simulated instrument time. Within the preceding 90 days, he had logged 2 hours at night and no instrument time. He therefore was not certified to continue his flight into the deteriorating weather conditions.

Aircraft

The accident aircraft was a Mooney M20E. According to the NTSB narrative (1996c), an annual inspection had been completed 11 months earlier. The only discrepancy mentioned was the lack of compliance with an airworthiness directive requiring the lubrication of all flight control systems. This non-compliance was not determined to have had an effect on the outcome of this flight, and the aircraft appears to have been otherwise satisfactory for flight.

Environment

The pilot placed three phone calls to the Seattle AFSS at 1354, 1844, and 2235 local time on the evening of August 1, 1996, to inquire about weather conditions forecast for his route of flight the following morning (NTSB, 1996c). Each time he was informed that marginal VFR conditions were expected. He decided to depart Friday Harbor that night instead to complete the flight before conditions deteriorated. Once in flight, he was advised by Seattle AFSS that the weather conditions were worsening at a faster than expected rate. The ceiling at Olympia had dropped to an 800 foot broken layer, and another pilot in flight was reporting difficulty maintaining VFR flight. The pilot of the accident flight opted to continue and flew into an area where the reported ceiling at the time of the accident was a 600 foot overcast layer. The ceiling in this area had been as high as 2,600 feet only 20 minutes earlier (NTSB, 1996c).

External pressures

According to an acquaintance, "the pilot, who owned a bowling alley, was returning to Oregon to run a major bowling tournament at the alley which was scheduled for the day on which the accident occurred" (NTSB, 1996c). Given the option of trying to fly out that night or wait for two days, after the tournament had begun, the pilot chose to fly that night. There is no evidence that the pilot discussed alternate plans with friends or employees concerning the running of the tournament should he not return in time.

Motivation

Jensen, Guilkey, and Hunter "believe that . . . in situations where no one is watching, a commitment will be stronger for personal minimums than it would be for imposed minimums" (1998, p.3). The implication is that sufficient outside pressures weaken the will to abide by these personal minimums. These external pressures quickly become self-induced pressures, as pilots perceive that more is at stake for them personally. A cautionary note in the PAVE checklist warns the pilot that "[t]he more important the trip, the more tendency there is to compromise your personal minimums, and the more important it becomes to have alternate plans" (FAA, The Ohio State University, & King Schools, 1996).

Inspection of Tables 1 through 4 shows that factors related to all four elements raised the overall risk associated with these flights. Yet, in spite of objective information indicating that flight was not wise, three pilots made a go decision. According to Hawkins, "[i]n simple terms, motivation reflects the difference between what a person can do and what he will do" (1987, p. 133). In each of the three accidents presented here, a qualified pilot contacted flight service prior to takeoff for one or more weather briefings. They all filed flight plans for the proposed flights. Two of the three were flight instructors. On the surface, they appear to be good, conscientious pilots.

The common denominator in the three accidents was the presence of an outside/self-induced pressure motivating them to complete a flight. In spite of thunderstorms, a rushed schedule, and an overloaded aircraft, one pilot allowed media commitments to make a decision for him. In spite of poor weather conditions at the departure airport and along the route of flight, one pilot allowed pressure from a landlord to make a decision for her. In spite of worsening weather conditions encountered en route, one pilot allowed a bowling tournament to make a decision for him.

Certain motivations, however, can help to ensure that a pilot will make a good decision when faced with rising risks. Copp (2000) tells of a flight in which the decision was made to not continue with flight in light of worsening weather conditions. In spite of being faced with rental car charges and the hassle of returning both the car and the airplane to their respective home bases over the course of the next week, he opted to land the aircraft and finish the trip on the ground. The presence of his wife and son were the motivating force behind the decision to discontinue flight. Deteriorated weather conditions at his destination validated his decision (Copp, 2000).

CONCLUSION

Use of the PAVE personal minimums checklist as an aid in the go/no-go decision-making process is an important step in preventing accidents such as these. Some minor changes to the checklist might be considered. For example, pilots might consider how many hours they have already flown in the preceding 24 hours when evaluating physical condition. Also, a line about hazardous weather avoidance would be appropriate in the environment section. And, given the strength of self-induced pressures to affect decision-making, it could be argued that the "Importance of Trip" note in the checklist be moved to the front of the checklist where it would be more prominent, at the outset alerting pilots to question their motivation to make a flight.

However, the personal minimums checklist is a valuable decision-making tool beyond the initial go/no-go decision. As conditions change, personal minimums may be exceeded at any time during flight. The checklist appears to be viable as an in-flight decision-making aid when considering whether to continue in flight.

Nonetheless, the checklist is frequently dependent on the subjective self-evaluation of the pilots. While determining the airworthiness of an aircraft or the hazards related to current weather should be a fairly straightforward task, external/self-induced pressures can motivate a pilot to ignore personal limitations or in some other way rationalize a poor decision, either before or during flight. The answer may be to help pilots identify some personal positive motivating factor to consider when faced with a decision. For example, in each accident presented here, there were passengers aboard. A higher sense of responsibility to these passengers might be the motivating factor necessary to help ensure safe decision-making.

As the 1998 study indicated that those pilots surveyed were open to the use of aids in the go/no-go decision-making process, research should continue to focus on how to better deliver instruction regarding the effects of outside pressures and pilot motivation on decision-making and on more effective methods of dissemination and use of materials such as the PAVE checklist. Questions that might be addressed include:

1. Are pilots who are taught the proper use of a formal personal minimums checklist from Day 1 of training more likely to make good decisions, both before and during flight, in spite of external/self-induced pressures?
2. Should check airmen include the personal minimums tool as a part of checkrides, flight reviews, instrument proficiency checks, etc?
3. How do we teach pilots to be more honest with themselves and those around them?

Table 1

Comparison of Pilot to PAVE Checklist

Checklist Item	Accident 1	Accident 2	Accident 3
Experience/ Currency	• 1,484 hours total time • 4.1 hours actual and 4.0 hours simulated instrument in last 12 months	• Recent instrument experience unknown • Had flown into Cortland two days prior	• 3 hours total simulated instrument time ✓ Not instrument rated
Physical Condition	• Eight flights out of high altitude airports in preceding five years ✓ Sleep history: April 7, 7 ½ -8 ½ hours; April 8, 6 ½ hours; April 9, 5 ½ hours; April 10, unknown—hotel check-in 1900, check-out 0622 April 11 • Some food in stomach • No alcohol detected; some acetaminophen detected	✓ Sleep history: June 12, unknown; June 13, unknown—motel check-in 2001, wake-up call 0030 June 14 • No drugs or alcohol detected • Under pressure to move out of current residence	• Sleep history: July 31, unknown; August 1, • No drugs or alcohol detected

Note: Known pilot information taken from Aircraft Accident Report NTSB/AAR-97/02 and NTSB Accident Narratives NYC96FA126 and SEA96FA175. ● = factor not considered to raise risk associated with flight; √ = factor considered to raise risk associated with flight.

Table 2

Comparison of Aircraft to PAVE Checklist

Checklist Item	Accident 1	Accident 2	Accident 3
Fuel Reserves	• Full fuel	• Aircraft fueled prior to takeoff	
Experience in Type	• Pilot owned the accident aircraft	• Approximately 50 hours in accident aircraft	• 46.6 hours in accident aircraft, 43.7 as pilot-in-command
Aircraft Performance	✓ Loaded over gross weight ✓ Mixture not leaned for takeoff; density altitude 6,670 feet • Center of gravity within limits		
Aircraft Equipment	• Adequate/appropriate for flight	✓ Several recent electrical problems including interior lighting failures	

Note: Known aircraft information taken from Aircraft Accident Report NTSB/AAR-97/02 and NTSB Accident Narratives NYC96FA126 and SEA96FA175. ● = factor not considered to raise risk associated with flight; √ = factor considered to raise risk associated with flight.

Table 3

Comparison of Environment to PAVE Checklist

Checklist Item	Accident 1	Accident 2	Accident 3
Airport Conditions	• Crosswind of 18-21 knots • Runway length 6,691 feet	• Wind conditions not reported • Runway length 4300 feet	
Weather	• Briefing obtained from Casper AFSS within hour prior to takeoff ✓ Icing, severe turbulence, and IFR precautions	• Obtained briefings from Buffalo FSS ✓ Thunderstorms reported along intended route ✓ Local weather reported to be 100 feet overcast ceiling, ¼ mile visibility at takeoff	• Obtained briefings from Seattle AFSS • Marginal VFR conditions and rain showers forecast for following morning ✓ Informed of worsening conditions shortly after takeoff
Weather for VFR	✓ Requested special VFR due to visibility		✓ Entered area with 600 foot ceiling about 40 minutes into the flight
Weather For IFR	• Flight to be conducted under VFR	✓ IFR departure procedure (rwy hdg to 2600 before turning) and alternate takeoff minimums (400 foot ceiling and 2 mi visibility)	• Flight to be conducted under VFR

Note: Known environment information taken from Aircraft Accident Report NTSB/AAR-97/02 and NTSB Accident Narratives NYC96FA126 and SEA96FA175. ● = factor not considered to raise risk associated with flight; √ = factor considered to raise risk associated with flight.

Table 4

Comparison of External Pressures to PAVE Checklist

Checklist Item	Accident 1	Accident 2	Accident 3
Trip Planning	✓ Trip to be completed within eight days ✓ Media commitments at most stops	✓ Trip planned to be completed in two days	✓ Trip planned to be completed overnight
Alternate Plans	✓ No alternate plans known to exist or be discussed	• Alternate plans discussed with coworkers ✓ Alternate plans not known to have been discussed with landlord	✓ Alternate plans not known to have been discussed with coworkers
Personal Equipment	• Adequate for flight	• Adequate for flight	• Adequate for flight

Note: Known external pressure information taken from Aircraft Accident Report NTSB/AAR-97/02 and NTSB Accident Narratives NYC96FA126 and SEA96FA175. ● = factor not considered to raise risk associated with flight; √ = factor considered to raise risk associated with flight.

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APPENDIX A
PERSONAL MINIMUMS CHECKLIST

Think…
PILOT
AIRCRAFT
EN**V**IRONMENT
EXTERNAL
PRESSURES

Pilot: ____________________________
Date Revised: _____________________
Reviewed with: ___________________ (if applicable)

FAA-P-8740-56
AFS-810 (1996)

PILOT

Experience/Currency

Takeoffs/landings…………………._______in the last _______ days

Hours in make/model……………… _______ in the last _______ days

Instrument approaches…………….._______ in the last (simulated or actual) _______ days

Instrument flight hours……………. _______ in the last (simulated or actual) _______ days

Terrain and airspace………………. Familiar

Physical Condition

Sleep………………………………________in the last 24 hours

Food and water…………………….in the last _______ hours

Alcohol……………………………. None in the last _________ hours

Drugs or medication……………….None in the last _________ days

Stressful events…………………….None in the last _________ days

Illnesses……………………………None in the last _________ days

____

____

____

____

____

AIRCRAFT

Fuel Reserves (Cross-Country)

VFR Day..…………………………..________ hours

Night…..………………………_________ hours

IFR Day…………………………….________ hours

Night…………………………..________ hours

Experience in Type

Takeoffs/landings…………………..________ in the last
in aircraft type ________ days

Aircraft Performance

Establish that you have additional performance available over that required.

Consider the following:

- Gross weight
- Load distribution
- Density altitude
- Performance charts

Aircraft Equipment

Avionics……………………..familiar with equipment (including autopilot and GPS systems)

COM/NAV………………….equipment appropriate to flight

Charts………………………current

Clothing……………………..suitable for preflight and flight

Survival gear………………..appropriate for flight/terrain

____
____
____
____
____

ENVIRONMENT

Airport Conditions

Crosswind…………..________ % of max POH

Runway length……...________ % more than POH

Weather

Reports and forecasts.…………….….…not more than _______ hours old

Icing conditions…………………..within aircraft/pilot capabilities

Weather for VFR

Ceiling Day……………………________ feet

Night………………….________ feet

Visibility Day…………………________ miles

Night………………..…________ miles

Weather For IFR

Precision Approaches

Ceiling……………….________feet above min.

Visibility…………….________ mile(s) above min.

Non-Precision Approaches

Ceiling……………….________feet above min.

Visibility…………….________mile(s) above min.

Missed Approaches

No more than ……….. ________ before diverting

Takeoff Minimums

Ceiling………………. ________ feet

Visibility……………. ________ mile(s)

____
____
____
____
____

EXTERNAL PRESSURES

Trip Planning

Allowance for delays……………. ________ minutes

Diversion or Cancellation Alternate Plans

Notification of person(s) you are meeting

Passengers briefed on diversion or cancellation plans and alternatives

Modification or cancellation of car rental, restaurant, or hotel reservations

Arrangement of alternative transportation (airline, car, etc.)

Personal Equipment

Credit card and telephone numbers available for alternate plans

Appropriate clothing or personal needs (eye wear, medication…) in the event of an unexpected stay

____
____
____

!Importance of Trip

The more important the trip, the more tendency there is to compromise your personal minimums, and the more important it becomes to have alternate plans.

Your Personal Minimums Checklist---

- An easy-to-use, personal tool, tailored to your level of skill, knowledge, and ability.
- Helps you control and manage risk by identifying even subtle risk factors
- Lets you fly with less stress and less risk

Practice "Conservatism Without Guilt"

Each item provides you with either a space to complete a personal minimum or a checklist item to think about. Spend some quiet time completing each blank and consider other items that apply to your personal minimums. Give yourself permission to choose higher minimums than those specified in the regulations, aircraft flight manuals, or other rules.

How To Use Your Checklist

Use this checklist just as you would one for your aircraft. Carry the checklist in your flight kit. Use it at home as you start planning a flight and again just before you make your final decision to fly.

Be wary if you have an item that's marginal in any single risk factor category. But if you have items in more than one category, you may be headed for trouble.

If you have marginal items in two or more risk factors/categories, don't go!

Periodically review and revise your checklist as your personal circumstances change, such as your proficiency, currency, or training. You should never make your mini-mums less restrictive unless a significant positive event has occurred. However, it is okay to make your minimums more restrictive at any time. Never make your minimums less restrictive when you are planning a specific flight, or else external pressures will influence you.

Have a fun and safe flight!

FEDERAL AVIATION ADMINISTRATION AVIATION SAFETY PROGRAMS
THE OHIO STATE UNIVERSITY KING SCHOOLS

Evaluation and Action: Sustaining Excellence in Collegiate Aviation Distance Education

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ABSTRACT

This study assesses the role of the evaluation process in sustaining and developing quality distance education programs in collegiate aviation. Distance education encompasses distance learning and distributive learning as well as e-learning and multiple method crossover delivery that includes some form of electronic delivery. The research explores the sanctioned position of evaluation procedures and their practical application in the outcomes assessment process within collegiate aviation distance education programs as compared to traditional delivery methods. Additionally, the study investigates the criteria for determining outcomes assessment based on establishing methods for interpolating contact hours, applied testing, and gauging learning. The methodological approach includes a literature review and a survey instrument implemented by semi-structured phone interviews. The gathered data are based on a review of accredited graduate and undergraduate collegiate aviation distance programs. The findings demonstrate that evaluation is an underutilized method for sustaining and ensuring a high-level academic product is delivered via distance education. The lack of consistent terminology for classifying and measuring distance education, and more specifically, the meaning of quality, further complicate this. Further research is recommended in order to reach a consensus on defining vocabulary of distance education elements and the role and application of evaluation. Additionally, the recommendations provide guidance in modifying the curriculum for achieving consistent results commensurate with accreditation standards.

INTRODUCTION

The evaluation process continues to be an integral part of sustaining and developing quality distance education programs in collegiate aviation. As technology turns education into a global event, the learning process is less restricted to a traditional classroom setting. For the purpose of this study, distance education consisted of distance learning and/or distributive learning that occurred through any form of e-learning or multiple method crossover delivery, which included any type of electronic delivery. This encompasses online teaching and learning, as well as academic support and student support services that were fully or partially electronically delivered (Eaton, 2000).

Students and teachers communicate and learn via distance education programs cropping up across the United States and the world at an ever increasing rate. While the opportunity to learn was at an all-time high, the possibility of failure was just as great. Aviation programs were selected for this study due to their limited number and the congruency of their programs. The basis for this study came from prior surveys conducted to discover in the collegiate aviation community which schools were involved in distance education (Bowen, Freeman, Scarpellini & Schaffart, 2000). This study explored the sanctioned position of evaluation procedures and their practical application in the outcomes assessment process within collegiate aviation distance education programs as compared to traditional delivery methods. Additionally, the study investigated the criteria for determining outcomes assessment based on establishing methods for interpolating contact hours, applied testing, and gauging learning.

This study was based on the assumption that the same standards for on-campus courses applied to distance education courses since the U.S. Department of Education notes no need for different standards (U.S. DE, 1999). Furthermore, the relative newness and unfamiliarity of distance education limited the amount of established program maintenance evaluation. Distance education providers lacked a consistent vocabulary to be able to organize and compare different aspects of the program from one school to the next (Wolf & Johnstone, 1999). The lack of vocabulary uniformity restricted the classification and measurement of distance education, especially in the area of quality definition.

The primary goal of this study is to determine which schools are involved in delivering collegiate aviation distance education or who are planning to do so in the near future. By determining the appropriate respondents, the research examined the role of evaluation in ensuring quality delivery and outcomes-based assessment in collegiate aviation. The respondents contributed information through a semi-structured phone interview that allowed for snowballing to determine other applicable participants. The questionnaire established the status of program evaluation at each location.

The methodological approach highlighted the survey method that was supported by an extensive literature review. This combination enabled valid and reliable data collection (Wiggins & Stevens, 1999). A literature review within the Contextual Knowledge Framework section of this research examined recently published material relating to evaluation and accreditation of distance education programs as well as benchmarks in this method of delivery. Information from the World Wide Web was used in comparison with related dissertations and scholarly articles. Searches were conducted using key words as well as exploring the links provided by the websites of leaders in distance learning within the educational and industry areas. The review findings also explored how other disciplines dealt with the same concern. This broad overview of standards and accreditation measures narrowed the focus to the progress and development of evaluation procedures in collegiate aviation distance education.

Distance education is a relatively new form of learning delivery. The research findings of this study support recommendations that may enhance effective delivery and distance education outcomes overall. As more institutions become involved with providing degree programs through electronic delivery, the problem of inadequate follow-up evaluation will widen if not addressed now. While the accreditation process attended to evaluation for accreditation purposes, the distance education administrators needed to adopt a proactive stance in order to ensure evaluation continued to focus on the needs of their students and faculty. Recommendations for regular evaluation and assessment by both the student and the instructor were supported by the research (Eaton, 2000). By supporting greater focus on continuity of communication throughout the program, curriculum may need to be modified. These changes, while still commensurate with accreditation standards, will improve the outcomes consistency.

DISCUSSION

Contextual Knowledge Framework

Distance education sparked a deluge of literature (Eaton, 2001b; Bowen, Scarpellini, Fink & Freeman, 2001). The articles extolling the virtues and vices of distance learning confuse the subject when trying to sort between educational opportunities and moneymaking schemes. An extensive search of web resources covering accreditation and evaluation of distance education programs, coupled with a review of dissertations and scholarly articles, formed the crux of this study. The primary source of standards and expectations was the Council for Higher Education Accreditation (CHEA), the national coordinating body for national, regional, and specialized accreditation. According to Judith Eaton, current CHEA president, the organization offered its own recommendations as well as guidance to researchers and educators alike. The organization tracked enrollments, new providers, faculty role, and quality review to examine how accreditors and external reviewers assure quality in distance education (Eaton, 2000). Additionally, The Western Cooperative Education Telecommunications' (WCET) *Principles of Good Practice for Electronically Offered Academic Degree and Certificate Programs* formed the foundation for the distance learning practices applied by the eight regional accrediting commissions (Eaton, 2000).

Distance education appears to have brought new challenges to the accreditation process. Recent CHEA findings determined that traditional accreditation procedures might not be as appropriate for ascertaining the quality of distance learning. CHEA proposed the emergence of competency-based review focused on student outcomes (Eaton, 2001b). According to Eaton, student outcomes referred to ". . . what students learn, what students achieve, and how they perform, whether full-time or part-time, degree-bound or engaged in ongoing education" (p.1). While traditional core academic values remained at the center of distance education, different measures worked more effectively in assessing quality learning.

The outcomes-based standard has been presented as a measure that minimizes the limitations of distance learning. Due to its flexibility, this standard can be more open to external quality review through accreditation and may present a more accurate picture of the learning experience (Eaton, 2001b). In 1998, CHEA and the National Center for Higher Education Management Systems (NCHEMS) initiated and tested an unconventional accreditation standards and review method. They worked in conjunction with Western Governors University (WGU) who ultimately directed the Competency Standards Project program. This alternative approach differed in four principal areas with the customary institutional review. These areas include concentrating principally on teaching and learning, greater dependence on existing teaching and learning information, stressing outcomes over capacity and processes, and providing team decision-making added structure (Eaton, 2001b). The Competency Standards Project found a distinct and recognizable correlation between institutional quality to student achievement. A key step ". . . is to develop the standards that address consequences—outcomes, results, competencies—in physical space or cyberspace" (Eaton, 2001a, p. 8).

As distance education slowly established standards, it must work doubly hard to maintain them. According to

Carnevale (2001), the American Federation of Teachers requested that colleges not only acknowledged, but also assumed the standards and collective-bargaining agreements to protect the quality of distance education. This included not only content and technical support standards, but faculty training for online teaching as well (American Federation, 2000). These AFT programs addressed all aspects of the learning process to maintain and attract a receptive student body. In a survey of students enrolled in a distance education program conducted at the University of Nebraska at Omaha, Krzycki (1998) found student satisfaction was directly linked to the student-faculty interaction. This exchange ranked higher than any other aspect of the program.

The teacher-student relationship must be established early and maintained through timely feedback. According to Eaton (2000), all too often instructors were thrust online without the proper training or time to manage this new and important connection. Distance education presented a challenge for teachers, as they were faced with a new kind of delivery system. Regular evaluation by the student and instructor allowed effective monitoring so instructors were able to correct their situation as needed. Different delivery techniques were necessary to facilitate learning in distance education (Burnham, 1994). In a study of graduate students by Scott-Fredericks (1997), the online experience required students to pass through stages of understanding to become skilled learners in computer-mediated communication. The progression involved causal and intervening conditions that included ". . . the need for direction, support, and level of dependence on the instructor" (p.1). As a result, the instructor played a key role in the students' mastery of the learning process.

The demand for access to higher education has steadily increased in recent decades due to changes in the economic and social structure (Bowen, et al, 2001). Rapid advances in technology have fueled the growth as it widens education's accessibility. With the number of people seeking higher education rising, key issues concerning information technology have been identified as content, delivery, and infrastructure (Green, 1999). This included not only the extent of the topic matter delivered, but also the different types of delivery used, including discussion boards and on-line lectures. All of these elements combined within a predetermined framework to ease in standardization and continuity. Technology made education accessible; it does not produce learning without the appropriate inputs and outputs by both the instructor and the student.

In a review of distance education research, Merisotis and Phipps (1999) reported that the majority of findings detected little difference in learning outcomes for students participating through distance education as opposed to the traditional classroom. They studied research investigating student outcomes, student attitudes, and overall student satisfaction. However, their analysis was limited by the lack of reliable research covering the topic, particularly when considering the possible exclusion of dropouts from distance learning studies. Distance education required skill sets beyond the reach of many distance learners. While technology opened the door of education to countless people, it could not eliminate the human factor without significant loss of quality (Merisotis & Phipps, 1999). Essentially people still need the interaction and exchange between other people in order to fully learn and grow. If all learning could be done straight from books, traditional classrooms would have closed long ago. Technology facilitated the learning delivery; it did not replace the need for active faculty involvement in ensuring that learning and understanding occur.

Establishing a consistent vocabulary to refer to distance education and its components would help in building a strong foundation for evaluation and comparison. The current confusion surrounding terminology caused problems for potential students, professional educators, and the general public (Wolf & Johnstone, 1999). While it was not necessary to label every aspect of distance education, Wolf and Johnstone suggested a set of frameworks that aligned as closely as possible with traditional higher education usage. Areas to consider included institutional taxonomy and frameworks for electronic course configurations.

Performance indicators need to be connected to decisions relating to program development, enrollment management, and/or allocation of resources. The *U.S. News & World Report* standing system provides useful indicators because they are widely accepted for ranking graduate schools in terms of market choice. The findings correlate highly with the rating conducted by the National Academy of Sciences (O'Neal, Bensimon, Diamond & Moore, 1999).

The American Federation of Teachers (AFT) took an active role in distance education. After issuing its first report in 1996, the organization released regular follow-up reports dealing with a variety of distance education issues ranging from workload to cost, and to educational quality. Last year, the AFT produced *Distance Education: Guidelines for Good Practice* that compiled the findings from a survey of 200 practitioners of distance education in post-secondary institutions (AFT, 2000). The study's focus was on collegiate distance education in credit-bearing degree courses at either of the following levels: graduate, four-year, or two-year. While the study may have been limited to these groups, the results had a broader applicability to other forms of distance education.

The AFT guidelines touched on key areas of education delivery. As opposed to using broad generalizations, the paper attempted to provide specific action steps to promote a high level of interchange between educators and students. The AFT program was broken down into 14 inter-connected steps that detailed the teacher-student distance education experience. Foremost was the affirmation that *faculty must retain academic control*. Keeping teaching and research faculty involved in the curriculum development superseded the use of curriculum specialists. To this end, the faculty needed to be " . . .appointed and evaluated through traditional processes involving the faculty and the department" (AFT, 2000, p.7). Evaluation continued to be a prominent feature throughout the guidelines as they touched on special requirements of teaching at a distance, which were course design potentials, student understanding, personal interaction, and subject, student and coursework assessment. Additionally, by proposing the creation of a national information clearinghouse and a program of targeted research, the AFT (2000) recommended federal government involvement in the evaluation of distance education. The high standards associated with these developments were established and evaluated by regional and specialized accreditation agencies. The level of achievement should be the same for students whether they were taught in a traditional classroom or electronically (WICHE, 1999).

<u>Accreditation Boards for Various Professions</u>

In a review of the websites for a range of professional accreditation boards, distance education was given only minor attention. The Accreditation Board for Engineering and Technology, Inc. (ABET) certifies programs related to engineering and technology. Currently, they do not differentiate between traditional and distance delivery methods or assessments. A large portion of the programs ABET evaluated required onsite laboratory practice that is ill-suited to distance techniques. When possible, distance delivery was worked into various components of more applicable programs. Likewise, the American Psychological Association (APA) has been slow to address the potential of employing distance education techniques. The accreditation standards created in 1996 did not reflect an inclination to acknowledge or pursue evaluation of this area. Most accreditation boards were more amenable to exploring the potential of distance education than ABET and APA.

The National Association of Schools of Public Affairs and Administration (NASPAA) took a proactive stance on distance education, as reflected in its website. In 1995 and 1996, NASPAA conducted surveys concerning the development and implementation of related distance education programs. The second survey noted an increase in distance education programs in the course of one year up to 38% indicating they offered distance education programs (NASPAA, 1998). Additionally, the students, faculty and institutions involved with the distance education programs reported an overall positive effect as a result of the interaction.

Collegiate Aviation Programs

The Council on Aviation Accreditation (CAA) in July 1997 organized an Ad hoc Committee on Distance Education to study distance education accreditation issues (Bowen, et al, 2000). The committee compiled information relevant to aviation distance education accreditation. The Ad hoc Committee on Distance Education conceded, "…it is evident that a struggle exists to define this rapidly changing issue. An emerging common thread is the conveyance that standards are not exempted for curricula delivered via technology. However, interpretation of standards to accommodate unique and innovative systems for distributed learning is necessary" (Ad hoc, 1998, p. 1). In response to the needs of the committee, a survey was constructed to explore the nationwide issues and implications of distance education and distributive learning among aviation professionals (Bowen, et al, 2000). The survey found that "Distance education is becoming an increasingly significant issue in aviation education, as its role is expanding in education as a whole" (p.23). By instituting standards now, it would be easier to ensure the quality of distance programs as they continue to develop.

The significance of measuring student responses was also recognized as an important aspect of the distance education evaluation process (Bowen, et al, 1999). In this study, the Teaching Analysis By Students (TABS) evaluation was administered to students enrolled in computer-mediated aviation courses at the University of Nebraska at Omaha (Bowen, et al, 1999). Additionally, the instructor, who was the same for both computer-mediated aviation courses, completed a self-evaluation. The study found student evaluations, when used in combination with the instructors' self-evaluation, supplied important data in terms of the educational experience. The data could be acutely insightful in terms of distance education effectiveness measurement when gathered midterm and near the completion of a course. TABS data, in conjunction with additional contextual research collected on and by the instructor, identified particular teaching strengths, isolated teaching problems, and developed improvement strategies to combat these problems (University of Massachusetts School of Education, 1974-1975). Distance education was more successful when developed in combination with a system of evaluation that provided midterm feedback (Bowen, Scarpellini & Vlaseck, 1999). Researchers found that as student satisfaction intensified, the attrition rates decreased and achievement rose.

<u>Regional Accrediting Bodies</u>

The Commission of Secondary Schools (CSS), comprising six regional accrediting bodies, presented a nearly unified view of distance education program accreditation. Of the six regional accrediting bodies, only the Middle States Association of Schools and Colleges failed to address the role of distance education as an aspect in the accreditation process in its accreditation literature on its website (CSS, 2001). The other accrediting bodies encompassed by CSS included the New England Association of Schools and Colleges, the North Central Association Commission of Schools, the Northwest Association of Schools and Colleges, the Southern Association of Colleges and Schools, and the Western Association of Schools and Colleges. This commission managed the accreditation process for accrediting college and university degree programs.

While the Middle States Association of Schools and Colleges offered no opinion on distance education, the New England Association of Schools and Colleges (NEAS&C) recently adapted its process to include the accreditation of academic degree and certificate programs offered through distance education. NEAS&C policy acted in conjunction with its standards for accreditation (NEAS&C, 1998). NEAS&C "…endeavors to enhance the quality of teaching. It encourages experimentation with methods to improve instruction" (Commission on Secondary Schools, 1998, p. 9).

The Northwest Association of Colleges and Schools (NACS) integrated distance learning within its standards for continuing education and special learning activities. The 1996 *Accreditation Handbook*, produced by the Commission of Colleges of the NACS, offered basic provisions for the distance education methods. Distance education held a minor role with little influence on the total accreditation process.

The Southern Association of Colleges and Schools (SACS) proffered distance education a more detailed position within its accreditation standards than most of the other regional accrediting groups. In the *Criteria for Accreditation*, composed by the Commission on Colleges in 1998, several sections addressed the role of distance education in delivering learning opportunities.

The North Central Association (NCA) volunteered no definite statement regarding the accreditation position for distance education programs. The general guidelines of the *Criteria for Accreditation* did not specifically mention or contain distance education, but "…their generality ensures that accreditation decisions focus on the particulars of each institution's own purposes, rather than on trying to make institutions fit into a pre-established mold" (North Central Association, 1998, p. 2). When assessing accreditation for distance education program quality, NCA evaluated every program on an individual basis.

The Western Association of Schools and Colleges (WASC) led the way in addressing accreditation of distance education. The WASC continues to cultivate the process. In a *Policy Statement on Distributive Learning and Technology-Mediated Instruction*, "WASC intends for its role in assuring institutional quality to be supportive of innovation and creativity. Distance education and technology-mediated instruction have already generated considerable creative approaches to teaching and learning" (Western Association, 1998, p. 1). To ensure the public of distance education program's quality standards, WASC asserted " . . . the accreditation process will continue to focus on the overall quality of an institution. Although there are many similar issues, distance education does raise quality issues that are distinctive from those relevant to on-campus programs" (p. 1).

Federal Government Assessment and Programs

The U.S. Department of Education's (U.S.DE) accreditation guidelines treated distance education as a method of delivery, not an independent program. For that reason, "…we [U.S.DE] will observe and evaluate, as part of our regular review of an agency for initial or continued recognition, the agency's compliance with the criteria for recognition, including the agency's compliance in accrediting distance education programs and institutions" (U.S.DE, 1999, p. 56614). Regulations did not vary for distance education.

Under Title IV of the *Higher Education Amendment of 1998*, two programs were created to increase the scope of students served by distance education. First, the Distance Education Demonstration Program waived distinct statutory and regulatory requirements for student aid in relation to distance education, thus modifying financial aid distribution parameters (University of Continuing Education Association, 1999). Additionally, Congress appropriated $10 million for the Learning Anytime Anywhere Partnership (LAAP). The LAAP offered "... competitive grants to increase student access to high-quality, technology-mediated learning opportunities that are not limited by the constraints of time and place" (Lekander, 1999, p. 1). The Fund for the Improvement of Post-secondary Education (FIPSE) controlled the program. Technology-mediated distance learning was recognized as a significant resource enhancing the lifelong learning on a national level.

METHODOLOGICAL APPROACH PROCESS

Research Questions

To determine the status of the evaluation process in collegiate aviation distance education, a thorough literature review was performed. Based on the information from this framework of knowledge, a survey instrument was constructed that further addressed the research hypotheses posed by this study.

This study examined the following questions:

1. Does the current evaluation process successfully combine outcomes assessment to ensure quality learning occurs in collegiate aviation distance education courses?
2. Does the process of accrediting collegiate aviation programs reflect the needs of the new e-learning environment as seen by distance education providers?

Higher education is a dynamic entity reflecting the changing needs of society. Technological advances, in addition to shifting demographics, have a significant impact on the direction of higher education as it determines the role of e-learning in collegiate aviation (Eaton, 2001a). Efforts to assure quality in delivery and learning can be reflected in higher education's efforts to determine the needs and requirements of standard or nonstandard evaluation procedures.

Participants

This study rests on the foundation laid by two previous research projects. The first white paper explored the accreditation standards applied to distance education programs throughout various disciplines as well as national and regional accrediting bodies that compose the Commission of Secondary Schools (Bowen, et al, 2000). The second research component attempted to develop an accurate database of aviation education programs in the United States. Participants for this group came from educational institutions listed in the Collegiate Aviation Guide: Reference Guide of Collegiate Aviation Programs. The guide only lists colleges and universities that offer aviation courses or majors, but provides no information about distance education. Therefore, a survey was distributed via mail to each institution questioning its current and future involvement in collegiate aviation distance education (Bowen, et al., 2001). The Distance Education Aviation Program (DEAP) Survey established the increasing role of distance education in serving aviation students. The flexibility of distance education is especially appealing for aviation students already employed in the industry. Such programs are able to fit into their dynamic time and location schedules as well as reflect the requirements of an ever-changing industry. Additionally, the need for program standards and assessment was seen as a key issue for the success of further distance programs (Bowen, et al, 2001).

Participants from the current study were selected primarily based on the DEAP responses for the 2000 study. Respondents who indicated participation in a distance education aviation program were also questioned about their program's evaluation criteria process. Since the database of aviation education programs does not currently include a distance education modifier, the snowballing technique was used to determine participants in the study. "Snowball refers to the process of accumulation as each located subject suggests other subjects" (Babbie, 1999, p.174). Snowballing was implemented to aid in the location of additional members of the target population who will provide information for locating other members of the same population.

SURVEY

Survey development.

A comprehensive development process (see Figure 1) was used to create the survey for this study. Research questions can be more accurately explored through a survey than a questionnaire (Wiggins & Stevens, 1999). According to Wiggins and Stevens, survey questions can focus on broader issues and are not constrained by an individual premise. Since limited definite information is known about collegiate aviation distance education evaluation, the survey allows for a wider scope to acquire data. The content was generated from additional literature and an examination of prior surveys of similar study groups. The questionnaire underwent a multi-step analysis consisting of aviation content expert review and survey technique expert review. Individuals were termed experts based on their role in the industry and proven record through publications. The resulting feedback was incorporated into the questionnaire and then further examined by a test group based on an estimated 10% of the study group. The end result was the Program Evaluation for Aviation Distance Education Questionnaire (PEADEQ).

Survey design.

PEADEQ (see Appendix A) is

primarily a structured phone interview guide that contains several unstructured questions at the end. The unstructured portion of the survey encouraged the snowballing effect and thus leads to additional suitable participants. The intent of the survey was to present an accurate cross-sectional design of the selected group of collegiate institutions offering distance education aviation programs. "Cross-sectional designs provide a portrait of a group during one time period" (Fink, 1995a, p.49). This account of the current state of the programs helps to gauge the development of evaluation measures, as well as the potential for use. All phone interviews took place within a one-week period at approximately mid-term to remove the likelihood of end-of-term or beginning-of-term confusion and to assure that all programs were surveyed at approximately the same time in the academic year. While there is a slight incongruity for universities on the quarter system, the limitation is recognized without significant effect on the results of the study.

The author drafted the PEADEQ survey to quantitatively and qualitatively investigate the status of assessment within collegiate aviation distance education programs. The semi-structured interview guide took approximately five to ten minutes to complete. As this is self-reported data, it is expected that the participants provide to the " . . .best of his or her ability information on the areas of interest" (Hedrick, Bickman & Rog, 1993, p. 70). An introductory statement is included to ensure all respondents have the same definition of distance learning (see Appendix A). "The introductory statement describes the survey and attempts to enlist participant cooperation" (Frey & Oishi, 1999, p.43). An eligibility screen that determines the suitability of potential respondents follows this section. The actual questions round out the interview script.

The questionnaire consists of five parts, including an unstructured closure section where participants are asked exploratory questions to assist in the snowballing technique (Fink, 1995a). The questions are a combination of yes/no questions used in conjunction with items answered on a Likert-scale with ordinal measurement pattern options ranging from *strongly agree* to *strongly disagree* and a *don't know* option (Fink, 1995b). Several of the sections contain split-questions that aid in reducing the complexity of the question area (Frey & Oishi, 1995). Therefore, respondents are not asked questions that are not relevant to their program.

All information that was to be read aloud to the respondents was in bold print to facilitate accuracy and consistency in the interviewing process (Frey & Oishi, 1995). Interviewer instructions are in plain italicized text to help further distinguish them from questions. Based on the relatively small sample size, the author conducted all of the interviews. With only one interviewer, environmental and outside bias are held to a minimal level.

Unit of Analysis

The unit of analysis for this study is based at the institutional level. One representative from each applicable institution was interviewed. The individual, from each institution, was selected based on accessibility and ability to respond to questions based on a general knowledge of the distance education program. The positions of the individuals surveyed ranged from the departmental secretary to the director of the program. Since the survey is based on the use of assessment and evaluation techniques on the aviation distance education program overall, it would be inadvisable to consider the results on a course-by-course basis.

Validation

The survey was revised based on the input of established experts in the fields of both aviation education and distance education. “A design is internally valid if it is free from nonrandom error or bias” (Fink, 1995a, p.56). Additionally, in an effort to reduce response error and increase clarity, a pretest was conducted using distance education programs without an aviation component. Based on n=26, three universities were used in the pre-test validation process. According to Frey & Oishi (1995), “Not only should pretesting be conducted on members of the relevant population, the instrument should also be pretested on interviewers and coders” (p.108). The survey design was modified based on responses from the pretest group as well as interviewer reaction. The changes improved the flow of the survey, resulting in increased clarity and ease of response.

RESEARCH OUTCOMES

Distance education has undergone a metamorphosis in response to the increased advancements in technological delivery. Many aspects of distance education, such as quality delivery and effective student learning, are complicated to define and measure. The accrediting institutions acceded that guidelines must be developed that attend to both traditional delivery and distance education. Evaluation was an essential aspect of these guidelines and should focus not just on course delivery and course content, but also on actual student learning and faculty feedback. Consideration of these factors will assist in the development of more effective evaluation guidelines that support high-quality distance education.

Based on the findings of the literature review, evidence illustrated the growing role distance education was beginning to play in education as a whole, and in particular collegiate aviation. CHEA spearheaded progressive research to examine the limitations and opportunities presented by e-learning and outcomes-based evaluation procedures. While some educators continued to resist the advent of e-learning, the AFT was making every effort to protect the quality of all education through promoting faculty training to include online teaching as well (AFT, 2000). Likewise, the CAA took a proactive stance in making certain the distance programs that were part of its sphere of influence upheld quality standards. By examining the pitfalls encountered by other fields of study, professionals creating and delivering collegiate aviation distance education were attempting to circumvent these issues. Regular and timely evaluations procedures were a key element in prolonging the success of traditional learning as well as e-learning (Bowen, 1999).

The regional and national accrediting bodies and the collegiate aviation programs were at similar levels of development regarding distance education. The number of universities offering e-learning opportunities was growing every day (CHEA, 2001). However, they were still in the minority. The governing bodies recognized the change as real and imminent. As a result, numerous studies investigating the subtle and obvious similarities and differences offered insight and perspective to address the concerns of the students and the instructors alike (NCA, 1998).

The accreditation boards for various professions outside of aviation took a mixed view of distance education. While the difficulty of conducting a laboratory class online was obvious, there were other currently unrecognized uses for employing various aspects of e-learning into the engineering and hard science environment (ABET). Several of the professional boards failed to recognize the possible benefits of incorporating e-learning, but based on findings studying similar areas, this was likely to change.

Survey Outcomes

The survey results further corroborated these findings. From an original population of n=26, 24 universities were surveyed. Two additional universities in the U.S. were identified as possible providers of aviation distance education courses (See Appendix B), but were not available when contacted for the survey. Finding administrators of distance education programs was limited by the flexible nature of the media. In contrast to traditional courses, instructors in e-learning were not bound to the office facility. A survey conducted via e-mail, as opposed to the telephone, may have been a more appropriate tool for this method of survey. When possible, follow-up contact was made via e-mail. The primary limitations to be considered for this study were that there were relatively few schools involved in delivering aviation-specific courses via distance education. While the nature of the content does not limit the applicability to distance learning, some schools found some Federal Aviation Administration (FAA) requirements restrictive. Additionally respondents may not have been completely objective in their analysis of their evaluation status for the program considered. These shortcomings were addressed and partially compensated for by the other areas of analysis.

At the time of this study, 14 U.S. universities verified that they engaged in aviation distance education. An additional 3 universities were believed to offer collegiate aviation distance education programs based on responses from snowballing and website crosscheck. Also, 10 other universities offering collegiate aviation programs were surveyed. These schools provided distance delivery, but there were no aviation offerings in this area. While distance delivery was indeed an option all universities were exploring, based on the survey responses, e-learning was not a method they took lightly in view of the difficulty other departments and programs have had with the delivery method.

Based on survey indicators, universities offering aviation courses via distance education played an active role in exploring the possible options of distance delivery and e-learning. Additionally, all programs quickly pointed out the complex nature of the evaluation issue when framing the e-learning environment. According to the results from PEADEQ, the universities' planning process for developing distance education courses and programs showed a similar flow (see Figure 2). Typically the universities determined if there was a need for an e-learning program based on student and faculty interest and the curriculum requirements. If the need was established, the institution developed a program to meet the mutual needs and to fulfill the necessary outcomes. The program was implemented and usually reviewed as part of the regional accreditation process. Throughout the process, student and instructor evaluation occurred and outcomes were measured. The information from these evaluations was then fed back into the program. While the current program may have been of high quality, constant monitoring occurred to make sure it continued to be true.

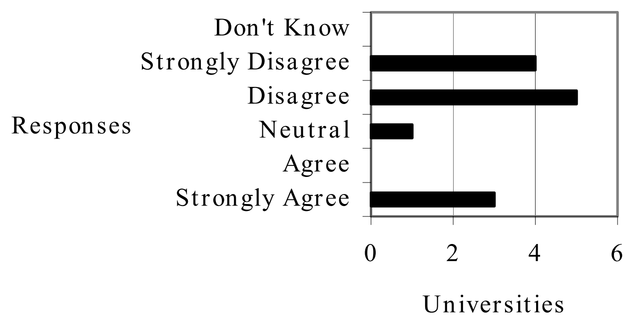
There was no easy fit or simple standard that addressed the multiple needs of the e-learning student or instructor. Several of the universities were stepping back and conducting comprehensive studies of distance education before adding courses or proceeding with their programs. The advent of new technology made many of the advances in e-learning possible.

Unfortunately, technology proved to be a major stumbling block both in the essence of conducting the course and then integrating it into the evaluation process.

Comments from the PEADEQ participants revealed chronic problems with establishing the necessary technical support and training to sustain distance education courses. The frustration at investing considerable time and effort into a program that could be outdated tomorrow by the introduction of new technology was particularly difficult to combat. Technology was a program's greatest ally and most formidable foe when difficulties appeared. While many of the respondents had plans in progress for creating aviation distance education courses, they were approaching the delivery method cautiously. The resources needed to launch such a program weighed heavily not only in funding, but also faculty time and cooperation. Considerable upfront time was cited as a major concern for introducing a quality program. Not all curriculums were found to be suitable for e-learning.

A broad range of aviation distance education programs exists in the U.S. Additional courses and exchanges occurred with international partners to increase the depth of learning and experience for aviation students. Undergraduate and graduate degrees, as well as certificates, could be earned all or partially via e-learning. See Appendix C for a complete listing of degrees. Increasingly, entirely online programs were offered that never require a student to come to campus (See Table 1). In some cases graduate degrees were available entirely online, while undergraduate degrees were not. Of the universities already offering aviation courses via distance, 10 of the 14 schools plan on expanding the distance education program, with only 1 school voicing strong disagreement with expansion.

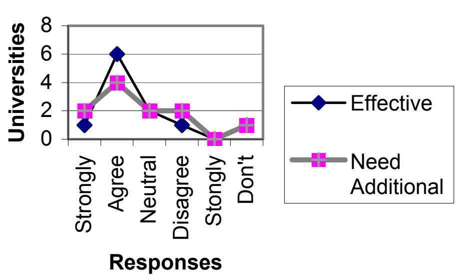
Table 1. Entire Program Can Be Completed via Distance Learning



Universities offered varying amounts of distance courses that would count toward an aviation degree. This study included non-aviation courses, as well as actual aviation courses, that enabled a student to pursue some form of aviation degree from the associate through the bachelor and graduate level. Courses counting toward various certificates, such as private pilot or air operations management, were included. Of the six programs offering only 1-5 distinct courses throughout the year, plans were in progress to increase the depth of their distance opportunities in all but one case. Additionally, three universities offered 11-20 distinct courses via distance delivery annually. The remaining schools fell singly into each of the course offering categories of 5-10, 21-30, 31-40, and more than 50 distinct courses annually.

Evaluation is a key factor in maintaining the viability of not only the course, but also the entire e-learning program. Universities are experimenting with different types of evaluation procedures to ensure the quality of learning delivered meets expectations and industry standards. The majority of the programs use student evaluations as at least one aspect of the evaluation process. Aviation courses taught to meet FAA requirements have the additional evaluation advantage of the official FAA certification process to confirm effective learning occurred. The measuring of student outcomes met with mixed results depending in part on the type of course taught. Several schools used FAA testing to measure the success of student learning. This was typically done in conjunction with other measures such as tests of communication skills and regular quizzes to assess learning throughout the term. Four of the schools mentioned faculty response and evaluation to determine the student outcomes. In only one case were learning outcomes established for each course with every aspect of the delivery tied into standardized outcomes across distance learning. In section three of the survey, universities were queried as to whether the current evaluation process was effective for maintaining quality standards as well as if additional procedures were necessary to assess the quality of the distance program. Although the respondents replied favorably regarding their current evaluation process, many thought additional procedures were necessary for assessing the distance education experience. One respondent agreed somewhat to both questions and is not included in the responses for Figure 3 pictured below.

Figure 3. Quality Evaluation Procedures for Distance Program



This study discovered that nearly half of the schools with aviation distance education used the same evaluation processes to assess distance delivery as the traditional method. The other universities expressed concern for using the same measures and recommended at least a variation in the mechanism to account for, at the very least, the technological component to distance delivery. Often questions on student surveys were geared toward e-learning, but the questionnaire remained comparative. One university said, "The best distance education depends more on measurement of student outcomes…need multiple methods of student outcomes such as a portfolio and testing." This line of questioning found an overall lack of continuity between the schools in distance delivery. Most implied they were close to having the proper procedures in place, but they were not quite there.

The final aspect of the survey dealt with accreditation familiarity, including the role the Council on Aviation Accreditation (CAA) plays in the accrediting process. Both programs with aviation distance programs and without such programs were included in the testing population. All the questions in this section were based on the Likert scale, ranging from strongly agree, agree, neutral, disagree, strongly disagree, to don't know. All but a couple of respondents either strongly agreed or agreed to being familiar with regional accreditation programs as well as the role of CAA in the accreditation process. However, both groups were nearly split on knowledge of CAA's involvement in distance education accreditation. The responses divided further when they were asked about what standard should be applied to e-learning. Three questions (see Figure 4) covered this area and included options from using the same standards as for traditional classroom, separate standards for e-learning, or an open-ended outcomes-based assessment. The responses are broken down by universities with aviation distance education courses in series 1 and those with only aviation courses in series 2.

Even though many of the respondents shied away from the traditional standards for distance education, they were not opposed to them entirely. The traditional methods could still be applied, just not fully or singly. Since a different medium was being used, standards needed to reflect that without lowering the amount of learning that needed to occur. The terms *outcomes-oriented* and *open-ended outcomes* met with some skepticism, as they were so loosely defined. According to PEADEQ results, most acknowledged that, “Student learning was the key factor more so than how they were able to get there.” Figuring out how to get there seems to be the problem.

IMPLICATIONS FOR THE NEXT STAGE

The findings result in the provision of recommendations to better the evaluation process of aviation distance education courses. Additional assessment will provide guidance in modifying the curriculum for enhanced achievement. While accreditation standards provide some guidance for developing and implementing distance education courses in relation to the traditional courses, the standards are not responsive to the changing needs, opportunities, and limitations of e-learning.

Programs that may be considered pioneers in aviation distance education, due to their relative longevity, recognize the constantly shifting framework surrounding distance education. They have an active role in the development of standards and principles. For all of their enthusiasm and experience, they remain concerned about actual specifications and potential limitations placed on distance education. See Appendix D for a full listing of comments from both sets of survey participants.

Evaluation procedures are either formally or informally in place to regularly assess the quality of aviation distance education programs throughout the nation. Assessment is a required part of an accredited program. Determining the viability and usability of the information provided by these processes is another matter entirely. Additional procedures need to be established that recognize the unique nature of distance delivery. This factor must be worked into the evaluation process in order to accurately and fairly assess the program and make the necessary changes. While student learning may be the same, the delivery makes a big difference in measuring the quality of the learning experience.

Figure 1. Survey Design Process

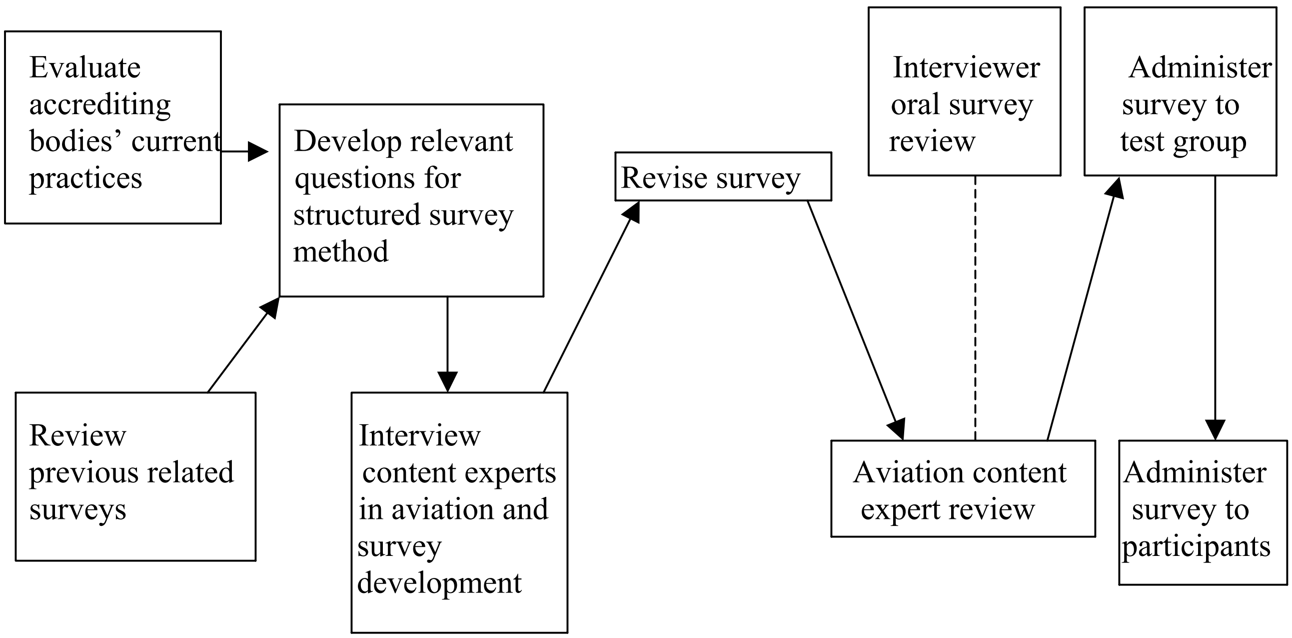


Figure 2. Program Development in Distance Education

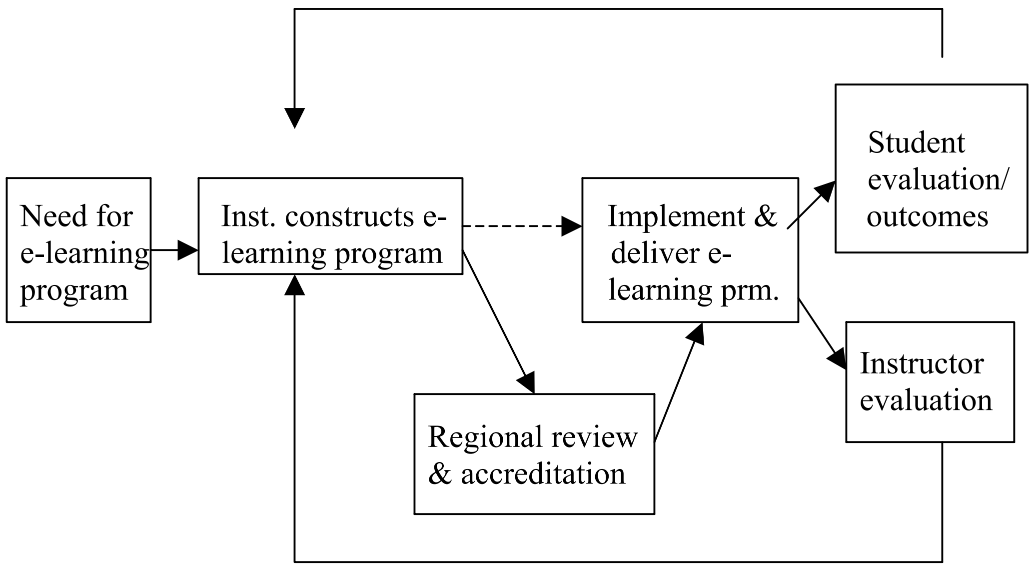
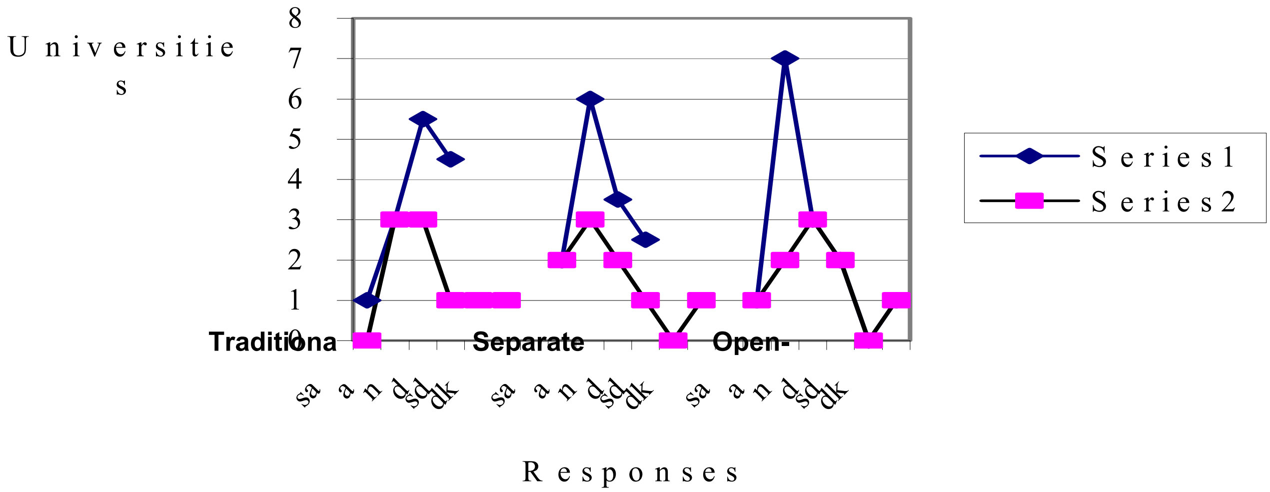


Figure 4. Standards Applied to E-learning in Terms of CAA Evaluation



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APPENDIX A

Program Evaluation for Aviation Distance Education Questionnaire (PEADEQ)

Institution: __________________ Contact Name: ______________ Phone: ___________ Date: ______________

For the purpose of this survey, please consider distance education to consist of distance learning and/or distributive learning that occurs through any form of e-learning or multiple method crossover delivery which includes any type of electronic delivery. This encompasses online teaching and learning, as well as academic support and student support services that are fully or partially electronically delivered.

This survey is being conducted by the University of Nebraska at Omaha Aviation Institute and supported by the Council on Aviation Accreditation Ad hoc Committee on Distance Education.

SCOPE OF PROGRAM

- **Does your institution offer any courses via distance delivery?** (1)

  Y/N

Answer NO

- **When does your institution plan to offer distance education courses?** (1na)

Next term **Next year** **Within 5 years** **Never**

- **What methods might institution use? (i.e. technological add to existing courses)** (1nb)

E-mail *Web page* *Video Conference* *Other* _________

Go to ADDITIONAL SOURCES SECTION

Answer YES—Continue

- **Do you offer aviation courses via distance education?** (2)

  Y/N

Answer NO

- **Your institution plans to offer aviation courses via distance in the next year.** (2na)

  Strongly Agree ***Agree*** ***Neutral*** ***Disagree*** ***Strongly Disagree*** ***Don't Know***

- **Your institution plans to offer aviation courses via distance at some other time in the future.** (2nb)

Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree* *Don't Know*

➢ **Your institution plans on expanding the distance education program.** (2nc)

Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree* *Don't Know*

➢ **Why haven't you implemented aviation courses via distance learning?** (2nd)

Lack of interest *Lack of funds* *Plans in progress* *Other* ______________

Go to ADDITIONAL SOURCES SECTION

Answer YES

➢ **How many aviation courses do you offer via distance?** (2ya)

1-5 *5-10* *11-20* *21-30* *31-40* *41-50*

➢ **What kind of degrees or certificates can a student earn via distance coursework?** (2yb)

Undergraduate *Graduate* *Other*

➢ **How is it (are they) titled?**

➢ **A student can complete the entire degree program via distance learning.** (2yc)

Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree* *Don't Know*

➢ **The institution is planning on expanding the distance education program.** (2yd)

Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree* *Don't Know*

QUALITY MONITORING

➢ **Do you have an evaluation process in place?** (3) ______________

________ ***Y/N***

Answer NO

➢ Why not? **(3na)**

Time constraints *Budget constraints* *Faculty resistance* *Other* ___________

- How do you assess the quality of your program? **(3nb)**

Questionnaire *Word of mouth* *Student success rates* *Other* ___________

- The institution is planning on implementing an evaluation process. **(3nc*)***

Strongly Agree *Agree* *Neutral* *Disagree* *Strongly Disagree* *Don't Know*

- The process used to assess distance programs differs from the process used to assess traditional programs.

(3nd) *Strongly Agree* *Agree* *Neutral* *Disagree* *Strongly Disagree* *Don't Know*

- How is it different and/or similar? **(3ne)**

Answer YES

- **What does the process consist of?** (3ya)

- **How often do you evaluate the programs?** (3yb)

Every term ***Twice a year*** ***Annually*** ***Other*** ___________

- **What additional procedures, if any, are used to evaluate the distance programs?** (3yc)

- **How do you measure outcomes?** (3yd)

Student evaluations ***Student response/success*** ***Faculty response*** ***Other*** ___________

- **The current evaluation process is effective for maintaining quality standards.** (3ye)

Strongly Agree Agree Neutral DisagreeStrongly Disagree Don't Know

- **Additional procedures are necessary to assess the quality of the distance program.** (3yf)

Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

- **The distance program's evaluation process is identical to evaluation process for the traditional programs.** (3yg)

  Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

- **How is it different?** (3yh)

- **How is it similar?** (3yi)

ADDITIONAL SOURCES SECTION

- *Do you know of any other universities that offer aviation courses via distance education?* ***(4)*** Y/N

Answer NO—Go to CLOSURE SECTION

Answer YES—Continue

- **Which universities does this include?** (4ya)

ACCREDITATION FAMILIARITY

- **I am familiar with regional accreditation programs.** (a4a)

  Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

- **I am familiar with the role the Council on Aviation Accreditation plays in the accreditation process.** (a4b)

  Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

➢ **I am aware that the Council is engaged in distance education accreditation** (a4c)

Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

➢ **Existing standards for traditional classrooms should be applied to e-learning.** (a4d)

Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

➢ **The Council should have separate standards for E-learning.** (a4e)

Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

➢ **Rather than specific standards, an open-ended outcomes based assessment should be used for CAA evaluation.** (a4f)

Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know

➢ **Which accreditation standard does your program follow (check all that apply)?** (a4g)

Regional Collegiate Aviation Association Other ________________

CLOSURE SECTION

➢ **Is there anything you would like to add that I may have missed?** (5)

➢ **What would you like to know about this study?** (6).

Appendix B

Universities Offering Aviation Courses via Distance Delivery

Arizona State University; Mesa, CA
California State University-Los Angeles; Los Angeles, CA
College of Aeronautics; Flushing, NY
Delta State University; Cleveland, MS
Eastern Michigan University; Ypsilanti, MI
Embry-Riddle Aeronautical University-Ext. Campus
Indiana State University, Terre Haute, IN
Louisiana Tech University; Ruston, LA
Mercer County Community College; Trenton, NJ
Metro State College of Denver; Denver, CO
Naugatuck Valley Community Technical College; Woodbury, CT
Northwestern Michigan College; Raverse City, MI
Thomas Edison State College*; Trenton, NJ
University of Nebraska-Kearney; Kearney, NE
University of Nebraska-Omaha; Omaha, NE
University of North Dakota*; Grand Forks, ND
University of Utah*; Salt Lake City, UT

*Did not respond to survey

Appendix C

Degrees/Certificate Titles Earned Via Distance Education per PEADEQ

Associate Degrees
Aircraft Turbine Engine
Aviation Business
Aviation Customer Relations
Aviation Science Aviation Technology
Applied Sciences in Customer Relations
Applied Sciences & Flight Technology
Applied Sciences & Technology
Arts in Aviation Management
General Flight

Bachelor of Arts
Aviation Business Degree
Business Management & Aviation
General Studies in Aviation Studies

Bachelor of Science
Aviation Management
Aviation Technology
Management of Technical Operations
Professional Aeronautical Science
Professional Aeronautics
Professional Aviation

Master Degrees
Aeronautical Science
Business Administration
Commercial Aviation
Liberal Studies with Aviation Concentration
Public Administration with Aviation Concentration
Urban Studies with Aviation Concentration

Doctoral Degrees
Education Administration with Aviation Focus
Public Administration with Aviation Concentration

Certificates
Air Operations Management
Private Pilot Ground
Instrument, Pilot Ground
Commercial Pilot Ground
Certified Flight Instructor Ground

Appendix D

5 Is there anything you would like to add I may have missed?

Schools with no aviation distance education

- Graduate programs are a source for distance education, but no approval needed; in traditional degree have an accreditation standard and a body to look at quality of program; establish a program for distance education graduate study.
- Haven't figured out how to handle requirements of FAR Part 141; think we will reexamine when university works through bugs of distance education already in place.
- Not off hand.
- No separate standards yet. Traditionally based, but think through what's happening with different delivery methods it will. Difficult to determine quality. Distance quality issues include determining quality via e-learning is a tough quality to measure. Quality of e vs. traditional in terms of certain subject matter and ability to deliver it. Certain subjects lend themselves well, some don't. Like mixed mode option where there's the best compromise to meet people's schedules. Believe in it as much as possible. We want to take advantage of the opportunity of distance delivery without giving up quality. Depends so much on people. Time involved at front end of course is tremendous. Accreditation should address the front end of course to get at what's behind the course.

Schools with aviation distance education courses

- Believe that accreditation should occur, but unsure as to the manner. A lot of courses aren't worth the
e-mail--little more than directed reading. A stand-alone course without visuals is useless in this industry. Planning on creating a CD and DVD to accompany courses.
- Currently working to set-up an international program with Lufthansa. JAR standards and language create interesting problems/issues.
- Appreciative of professional bodies that are looking at how distance learning is shaping up. Confident that it will steer us in the right direction. I'd be happy to be involved in helping.
- Accountability; evaluate program on national level and provide publicity for professional status.
- In process of setting standards.
- Look into PictureTel Video Conferencing and moving to online.
- Surveys are slanted and misleading.
- Distance learning is the way of the future. Technology is improving rapidly. When trying to assess D.L. you're assessing the past, not a good indicator about the future. Video stream is a good method.
- Distance education is moving so quickly and changing so rapidly. A couple of people are on top of it at my university with the most advanced library. All we've learned is how much is unknown. I'd be very careful because who's going to do the accreditation? It's a stumbling block when people without technical backgrounds come in and evaluate what they don't know. It's important to take a step back and watch. Asynchronous versus synchronous can make a big difference.

Air Rage: A Policy Research Study

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ABSTRACT

Disruptive passengers are a growing concern to preserve the safety of crew and passengers in the air. A policy research study from 1996 to 2000 reveals a range of air rage incidents and airline policies. The various definitions are presented, as well as the scope of the problem. The causal factors are critical in understanding the root of the problem and in eradicating air rage incidents. The application of the policy research methodology revealed a void in data collection and future research needs such as policy evaluation. Policy makers, collegiate aviation educators, and industry personnel will use these results to inform decision making. This article contributes to the academic literature of air rage as an emerging aviation safety concern.

INTRODUCTION

The problem of disruptive passengers aboard aircraft is not a new phenomenon. One case dates as far back as 1950, when a drunken passenger assaulted the crew on a flight from Alaska (Sheffer, 2000). Recently, however, the problem is becoming a more serious one. "Bad tempers are on display everywhere. The media report incidents of road rage, airplane rage, biker rage, surfer rage, grocery store rage, [and] rage at youth sports activities. Leading social scientists say the nation is in the middle of an anger epidemic that, in its mildest forms, is unsettling and, at its worst, turns deadly" (Peterson, 2000, p. 1A). One flight attendant explained that at 30,000 feet in the air, one cannot simply call a cop or throw an unruly passenger out the door like in a bar. " . . . there is no beefy backup on an airplane, and most of us aren't up there for the physical challenge. Why should we be? We're flight attendants, not Steven Seagal wannabes" (Hester, 1999b, p. 2).

According to the International Transport Workers' Federation (ITF), airlines are obligated to ensure the safety of their passengers and employees (International Transport Workers' Federation [ITF], 2000b). Meanwhile, safety authorities are obligated by law to protect passengers and "ensure the occupational safety of flying staff" (ITF, 2000b, p. 19). Therefore, airlines and regulatory authorities are searching for means to eradicate air rage.

<u>Definitions of Air Rage</u>

It is often said that in order to solve a problem, one must understand it and be able to define it. However, organizations use different definitions of air rage, and unruly and disruptive passengers. The Sussex Police in the United Kingdom (UK) define a disruptive passenger as "Any passenger who, on an aircraft, carries out any action or pursues a course of conduct which is unlawful according to United Kingdom criminal legislation or which may amount to an [offense] under the Air Navigation Order" (Sussex Police, 1998, p. 109). Another definition states, air rage "is disorderly conduct, of any sort, which [jeopardizes] the safe and orderly operation of the aircraft or the well being of any of the occupants and their property. It does not have to be immediately violent, but it does have to be disruptive, threatening, or an [offense]" (Lucas, 1999, p. 1). The first definition explicitly states the actions of the individual must be criminal to be classified as a disruptive passenger. This definition excludes many disruptive incidents on board aircraft that are classified as air rage under other definitions. Meanwhile, the latter definition is more inclusive of a range of disruptions such as verbal abuse and threats.

Other definitions are even more vague. Ron Wilson, a spokesman for the San Francisco Airport, defined air rage as simply "interfering with crew members in the performance of their duties" (ABCNews.com, 2000, p. 2). Whereas, the UK defines disruptive behavior in terms of the Tokyo Convention. "Acts which are [offenses] against criminal law, and acts which, whether or not they are [offenses], may or do [jeopardize] the safety of an aircraft or any passengers or property therein, or [jeopardize] good order and discipline on board" (Vivian, 2000, p. 12). This definition is based on the legal treaty that has been adopted by many countries. Yet, all countries did not adopt the same definition of air rage.

The ITF recognizes the unique circumstances of aviation when it comes to disruptive passengers. An airborne aircraft cruising at 31,000 feet does not lend itself to standard security measures. There is a lack of an escape route and a lack of reinforcements to resolve the situation. Understandably, the ITF gives special attention to acts that occur after the aircraft doors have been closed (ITF, 2000b). The ITF defines disruptive passenger behavior as, "Any [behavior] on board an aircraft which interferes with cabin crew in the conduct of their duties, disrupts the safe operation of an aircraft, or risks the safety of occupants on board an aircraft, excluding the premeditated acts of sabotage or terrorism" (ITF, 2000b, p. 5). The ITF deliberately excludes "premeditated acts of sabotage or terrorism, intended to harm an aircraft and its occupants" as appropriate definitions and legislation already exist to address such incidents (ITF, 2000b, p. 5).

The above definitions do not include acts or assaults that occur on the ground. While these incidents are serious, the laws of the jurisdiction in which they occur cover them. Airport police and other local and national law enforcement have access to respond to these incidents. This is not the case for trans-oceanic flights. However, ground incidents are important to document and report. The ITF states bad behavior on the ground may be a prelude "to disruption in the air, and must be firmly dealt with" (ITF, 2000b, p. 5).

Both the Federal Aviation Administration (FAA) and the Dutch carrier, KLM, use definitions of varying levels. The FAA's levels increase in terms of the seriousness of the incident. KLM's levels vary based on the type of intervention required to resolve the situation. As evidenced by this paper, a single, comprehensive definition of air rage is needed to determine and categorize air rage incidents that are comparable around the globe.

Scope of the Problem

"When pilots are stabbed to death and flight attendants are taken to the hospital in ambulances, the skies are out of control" (Hester, 1999a, p. 1). Disruptive passengers have caused flight delays, emergency landings, diversions, inconveniences to other traveling passengers, psychological traumas, and serious injuries to crew and other passengers (Drudis, 2000). A British Airways policy stated that most airlines are experiencing an increase in the frequency and severity of disruptive passengers at check-in, at the gate, in lounges, and on board the aircraft (Jack, 1997).

"Defective passenger [behavior] ranges from non-compliance with safety instructions . . . to actions amounting to verbal harassment or physical assault directed at staff, passengers or the aircraft" (ITF, 2000d, p. 1). A broad range of documented air rage offenses committed aboard aircraft is included as Appendix A. This is not a comprehensive compilation; rather it illustrates the range of actions that can be categorized as air rage. Knowing the broad range of incidents assists management in developing training programs to prepare employees to diffuse such a variety of situations.

Studies on Air Rage

Two air rage studies were conducted in 1999. NASA conducted a study on commercial air passenger behavior problems using 1998 data reported to the Aviation Safety Reporting System. One hundred and fifty-two reports of air rage incidents were reviewed. Perspectives included those of both the pilots and the cabin attendants. A second study was conducted by the ITF in 1999. The ITF is a UK-based organization representing "5 million members in 136 countries, including approximately 500,000 flight attendants" (Sparaco, 2000, p. 51). The ITF undertook a survey of affiliated unions concerning the disruptive passenger policies of their airlines. Replies represented 64 airlines in 32 countries (ITF, 2000b). The findings from these studies are further discussed below.

Characteristics of Offenders and Flights

There is not a typical unruly passenger, says Ellie Larsen of the Association of Flight Attendants. "There are no boundaries. They could be male or female. They can be young or old. They cut across every social and economic class" (ABCNews.com, 2000, p. 2). The offenders include business fliers, and premium- and coach-paying passengers (ITF, 2000b). While there is no typical air rage offender, statistics from April to October 1999 reveal that offenses were committed by males 75% of the time, while females were less likely to commit an air rage offense, being suspects in only 25% of the incidents (Vivian, 2000). Additionally, in 66% of the incidents, the offenders were 20 to 39 years of age (Vivian, 2000). While these statistics do not profile an offender, they do provide an idea as to the type of offender more likely to commit an offense.

As with offenders, there is no typical flight on which an incident will occur. Incidents occur on scheduled as well as charter operations; on short-, as well as long-haul flights; and on all aircraft types, both wide- and narrow-bodied (ITF, 2000b).

Statistics

According to International Air Transport Association (IATA) figures from a survey, air rage incidents increased fivefold from 1,132 in 1994 to 5,416 in 1997 (James, 2000; ITF, 2000a; ITF, 2000f). In a separate study of incidents from April 1999 to February 2000, approximately 1,100 incidents were reported (Vivian, 2000). The NASA Aviation Safety Reporting System (ASRS), a confidential reporting database for airline crews, reported that unruly passenger incidents increased by approximately 800% (ITF, 2000f). In 1997, 66 incidents were reported. In 1999, 534 incidents were reported. One in four incidents was serious enough to warrant intervention by the flight crew.

The FAA statistics indicate air rage incidents in the U.S. have recently decreased. Table 1 indicates the number of passengers cited by the FAA for assaulting, intimidating, or interfering with an airline crewmember.

Table 1. Citations of air rage by the FAA (Hilkevitch & Taylor, 2000)

Year	Citations by FAA
1995	138
1996	186
1997	307
1998	292
1999	187

"But industry experts say the FAA statistics don't tell the whole story. Officials of the Air Transport Association, which represents 26 domestic carriers, say there were about 4,000 [air rage] incidents last year – counting incidents that fall short of felony offenses" (Topousis, 2000, p. 2). Eighty-four U.S. carriers transported 614 million passengers in 1998, and United Airlines reported 635 incidents of disruptive behavior (Hester, 1999a). Meanwhile, the FAA recorded fewer than 300 incidents on all 84 carriers. Obviously the data collection methods are not accurate (Hester, 1999a). The difference is attributed to the records the FAA collects. "FAA records only those incidents that airlines choose to disclose, the actual number of assaults is seriously underreported" (Hester, 1999a, p. 2).

"Despite tabloid headlines documenting instances of 'air rage', aggressive [behavior] by passengers is thankfully incredibly rare" (Virgin Atlantic, 2000, p. 16). David Fuscus of the ATA explained the number of disruptive passengers is small when compared to the 640 million passengers that will board U.S. air carrier aircraft this year.

STATEMENT OF THE PROBLEM

Air Rage as a Security Problem

Airline and airport security have responded to the increase in air rage incidents. Their job is to secure the airport and flight environments. Therefore, aviation security must respond to the air rage threat. Captain Stephen Luckey of the Air Line Pilots Association stated in his testimony before Congress, "Passenger interference is the most pervasive security problem facing airlines" (Taylor, 1999, p. 8). In the UK, local police have assumed the lead role on committees to monitor interventions, while airport-based security officers in the U.S. have also assumed a coordination role (ITF, 2000b).

Importantly, the threat to the safety of the passengers and aircraft is a security concern, as is the case with terrorism. David Hyde, Safety and Security Director for British Airways, stated, "There can never be any excuse or justification for violence. When you are 35,000 [feet] in the air, violence threatens not only one person but hundreds of lives" (Sherwin, 1999, p. 2). Many are concerned that the increase in air rage incidents will lead to an accident. Sarah Finke, spokesman for a transport union, stated, "It's only a matter of time before a serious accident is caused by one of these instances" (Peterson, 2000, p. 2A). ITF Deputy Secretary General Stewart Howard also emphasized this point. "The issue must be taken seriously. . . . It is a miracle that no accident has occurred yet as a result of air rage" (Sparaco, 2000, p. 51).

The NASA air rage study revealed distractions among flight crews due to unruly passengers. "In 43% of the passenger-related incidents, flight crews experienced some level of distraction from flying duties. . . . In more than half of these distraction incidents, a pilot deviation was the consequence. . . . In 22% of the total study incidents, a flight crew member left the cockpit to assist flight attendants in dealing with an unruly passenger" (National Aeronautics and Space Administration [NASA], 2000, p. 1). Ten percent of the cases resulted in flight crew errors. It also creates a dangerous situation now that aircraft primarily operate with only two members comprising the flight crew. Should one of the members be injured in a scuffle with a passenger, the safety of all on board may be jeopardized. The safety component of the issue is not to be overlooked.

The Causal Factors of Air Rage

Air rage is not limited to one cause. A variety and combination of causes led to the outrageous examples of incidents labeled air rage. All studies agree that alcohol is the greatest contributing factor. In a study by Northwest Airlines, intoxication was the factor in 25% of incidents, seat assignments were 16%, smoking problems were 10%, carry-on luggage disputes were 9%, employee behavior was 8%, and food service was 5%. 'Undetermined' and 'Other' made up 27% (Taylor, 1999).

Alcohol

In NASA's study of passenger misconduct incidents, alcohol intoxication was directly involved in 43% of the incidents (NASA, 2000). However, problems with alcohol should not be allowed to escalate to such a level. In fact, most aviation safety regulations specify that intoxicated persons should not be allowed to board aircraft (ITF, 2000b). Gate agents and cabin crew are charged with denying boarding to persons that appear drunk. This is problematic because it can be difficult to assess a stranger's level of intoxication (Prew, 1997a).

"It is the responsibility of passengers not to be drunk on boarding or to get drunk on the aircraft" (Jack, 1997, p. 28). Yet, the ITF stresses that passengers are not discouraged from drinking, nor are they advised that it is illegal to get drunk before or after boarding the aircraft (ITF, 2000a). The ITF wants staff at airport catering outlets to be educated on the importance of preventing excess drinking as passengers prepare to board flights (ITF, 2000b). The ITF would also like these outlets to have a system by which they can notify carriers in the event that a patron becomes intoxicated.

Excess drinking is a problem on aircraft as the effects of alcohol are increased at altitude. In aircraft, intoxication occurs at a lower level of consumption due to the effects of cabin air pressure on alcohol in the blood (ITF, 2000b). An adult passenger can show impairment at a Blood Alcohol Concentration of only 0.04% at altitude. Therefore, an intoxicated passenger can present definite safety risks on board an aircraft (Prew, 1997a). Where a single drink at the airport is the equivalent of at least two drinks at altitude, passengers that may be sober when boarding the aircraft may be drunk at 30,000 feet (Wise, 2000).

In an effort to combat the problem, some flight attendants want to restrict or cutback the amount of alcohol served. "We're not asking for a ban on alcohol. We're asking for a policy that's a little more realistic," said Dawn Bader, president of the Association of Flight Attendants' United Airlines Council (Valles, 2000, p. 2). But a British Airways spokesman said there were no plans to stop the free drinks and supply. "We have no intention of being a killjoy and punishing our well-behaved passengers" (BBC News, 1998b, p. 3).

Smoking

"Anecdotal evidence suggests that air rage is more common on long-haul flights when passengers have been cooped up in a tight space for hours on end" (BBC News, 1998b, p. 3). Some of these incidents are attributed to 'smoke-starved' passengers. Smoking restrictions onboard aircraft cause frustrated smokers. As expected, flight duration was a factor in incidents involving smoking. Longer flights were more prone to encounter a frustrated smoker that displayed disruptive behavior (Vivian, 2000). German airline pilots even urged their employers to offer nicotine to these smokers in an attempt to avert more incidents of air rage (Loviglio, 1998).

"Frustrated smokers accounted for more than half of the 266 incidents of disruptive passenger behavior recorded by British Airways in 1997" (James, 2000, p. 20). In 1998, British Airways extended its smoking ban to all flights. As smoking is a factor in a high proportion of incidents, the ITF wants smoking policies that are designed with the aim of avoiding disruptive behavior as a central function (ITF, 2000b).

Carry-on Baggage

Statistics indicate 8% of all airline baggage is lost or stolen, causing passengers to carry-on their baggage (Fairechild, 2000). Research suggests cabin baggage issues are implicated in 10% to 15% of disruptive passenger incidents, leading the ITF to call for a uniform regulatory limit on cabin baggage (ITF, 2000b). The ITF hopes this will reduce passenger confusion as to airline carry-on limits no matter which airline the passenger selects.

Management

Some say airline management is to blame for passengers becoming unruly (Fairechild, 2000). "While the airlines are only partly to blame for delays, they are solely responsible for how they handle delays and other factors affecting a passenger's right to safe, fast, polite service and on-time arrival, and for making baggage available within a reasonable time" (North, 1999, p. 87). In other words, disruptive behavior may be a reaction to poor service received from the airline. The ITF survey indicates that poor service, such as delays and overbookings of aircraft, is a great source of aggression against passenger handling staff (ITF, 2000b).

Stress

Stress is a widely recognized contributing factor to the air rage epidemic. A clinical psychology researcher, Jonathon Bricker, stated air rage is a symptom of travel stress (James, 2000). U.S. Senator Harry Reid of Nevada recognized this stress. He introduced Passenger Fairness legislation in July of 2000 in response to the stress airline management causes passengers in order to save money and maximize profits (Reid, 2000). Passengers today do not need to be told the experience is taxing on the nerves.

> " . . the modern airport experience is often an unpleasant one. Passengers endure a succession of difficulties: inadequate parking; confusing check-in procedures; long lines at the check-in counter; more lines at security checkpoints; shrinking airplane seats; insufficient overhead bin space; small in-flight meals if any; and maddening numbers of delays caused by a safe but woefully insufficient Air Traffic Control system" (Hester, 1999a, p. 2)

Sarah Prew (1997a) warns as the stress levels continue to build, the airlines and the entire industry must soothe the problem, not aggravate it.

Expectations

The expectations of passengers have changed as the price of commercial airline travel has become more affordable to many. New customers are flying that have no previous experience in air travel. The gap between expectations of passengers and their actual experience has increased (ITF, 2000b). There should be a correlation between the service an airline claims to offer and what it can in practice deliver. The United Airlines flight cancellations during the summer of 2000 are an example of a difference in expectations. When a gap does occur, unfortunately it is the employees providing customer service that must deal with the passenger dissatisfaction (ITF, 2000b).

Terry Riley, a psychologist and travel-security expert, said a surprising number of first-class passengers end up in rage incidents because they feel more entitled to special treatment in first-class (Topousis, 2000). Their expectations are not aligned with the service they receive. “An executive may not like a flight attendant telling him what they can and can’t do,” said Riley.

Air Quality

The use of recycled air in aircraft cabins is a source of complaints by passengers. Not only is the air of poor quality, but it also contributes to air rage. Dr. Vincent Mark, M.D., stated the “Curtailment of fresh air in airplanes can be causing deficient oxygen in the brain of passengers, and this often makes people act belligerent, even crazy . . . I’m positive about this, and it can be proven with a simple blood test” (Fairechild, 2000, p. 4).

Passenger Traffic and Seating

Another source of air rage is the amount of passenger traffic flying on airlines today. In 1999, the system load factor on U.S. commercial aircraft was 71%. In July of 2000, traffic was at the record-setting level of 80% (“World News Roundup,” 2000). “With 50% more passengers expected to be flying in the U.S. by 2010, an average day will feel like Wednesday before Thanksgiving” (North, 1999, p. 86). The passenger traffic obviously means more seats are filled on the aircraft and there is not enough personal space for travelers.

“Most people require a certain amount of personal space to feel comfortable. For at least five percent of the population, typical coach seats are too narrow and legroom is too restrictive to be comfortable” (Wise, 2000, p. 1). The ITF believes that seat pitch should be regulated to include minimum standards (ITF, 2000b).

Stereotype of Flight Attendants

Finally, the stereotype of flight attendants is also a contributing factor. Some passengers have taken liberties with cabin crewmembers because the advertisements stated the passengers would receive personal, female attention (Taylor, 1999). But flight attendants must be promoted as safety professionals, for in an emergency situation, they must be treated with authority and respect (Taylor, 1999). “Unfortunately, the marketing of aviation very often explicitly undermines this staff role: crew and passenger handling staff are all too often portrayed as compliant service providers, willing and able to meet the individual requirements of passengers” (ITF, 2000b, p. 12).

AIR RAGE POLICY: A METHODOLOGICAL FRAMEWORK

International Agreements and Awareness

Several measures have been taken to combat the problem of air rage, from new legislation to penalties and airline actions. Oftentimes, air rage offenders are difficult to prosecute due to jurisdictional issues. Previously, under the Tokyo Convention, the state of aircraft registry was to assume jurisdiction for hijacking incidents (ITF, 2000b), although most governments felt that air rage, while serious, was not covered under this Convention. The U.S., UK, Australia, and Canada have changed laws in their respective countries to keep jurisdiction from preventing the prosecution of offenders. The four countries amended domestic laws to assume jurisdiction for air rage offenses as the act occurs onboard their registered aircraft and to include foreign inbound flights, provided the next landing is in one of the above four countries (ITF, 2000b; Prew, 1999).

During July of 2000, the ITF undertook a worldwide campaign to raise awareness of the air rage problem faced by flight attendants and other employees. In addition to educating passengers through leaflets at airports, the goal of the campaign was to encourage governments to pass laws increasing enforcement and prosecution of air rage offenses. Additionally, they encouraged governments to sign an international convention by the end of 2003 that would supercede domestic law and be effected in many countries at once. This international treaty would specify the jurisdictions for air rage offenses and close loopholes to ensure their prosecution (ITF, 2000a; Valles, 2000).

Changing Penalty Policies

Due to the jurisdiction problem associated with air rage, penalties for offenses, if any at all, vary depending on the country of prosecution. However, steps taken in the U.S. and UK demonstrate the seriousness with which the problem is treated by the authorities. In the spring of 2000, the U.S. Congress raised the maximum fine for passenger interference with crewmembers from $1,100 to $25,000 after U.S. unions lobbied for the increase. Meanwhile, the disruption of a flight carries a more staggering maximum of 20 years in prison and a $250,000 fine (Valles, 2000). The issue of air rage is treated seriously in England. British Transport Minister, Lord Whitty, said, "Air rage is unacceptable and the [government] has decided to take strong action to ensure the safety of air crew and passengers alike. The safety of airline passengers must not be threatened by the [behavior] of selfish individuals" (Sherwin, 1999, p. 1). In September of 1999, new air rage penalties were established in response to the increase in air rage incidents. A new offense, acting in a disruptive manner, was added to the British Air Navigation Order in response to requests by the airlines. "The airlines argued that there was no measure to cover passengers not directly affecting the safety of an aircraft or causing criminal damage but to disrupting staff" (Sherwin, 1999, p. 1). Offenders are being sentenced to prison, even for first offenses, while comparable offenses committed on the ground would only dictate a suspended sentence or fine (Vivian, 2000).

Airline Prevention Policies

The ITF surveyed 64 airlines in 1999 and discovered only 32% provide air rage training to employees (ITF, 2000b). Some flight attendants criticized the airlines' efforts toward air rage training. One flight attendant said, "Airlines spend a lot of time teaching us how to deal with hijacking or bomb threats, but they do not teach us what to do if someone is violent or drunk" (Topousis, 2000, p. 4). The FAA, the ITF, and Virgin Atlantic believe the airlines' training efforts should be focused on prevention and keeping dangerous passengers off the aircraft (FAA, 1996; Virgin Atlantic, 2000; ITF, 2000b). Virgin Atlantic operates a training program named REACT. The program is based on the foundation that "prevention is better than cure" (Virgin Atlantic, 2000, p. 16). The program trains employees to diffuse situations before they escalate. Additionally, the ITF suggests other areas for staff training. These include: effective communication, de-escalation techniques, passenger restraint and control methods, role-playing, legal parameters within which staff can act, the scope for intervention across different scenarios, 'peace officer' skills, self defense, and management of crowd disturbances (ITF, 2000b).

In a heated air rage scenario, a tangible warning may be presented to an irate passenger in the form of a warning card. These are used increasingly by airlines to emphasize the seriousness of the incident, and to warn the passengers of potential legal action should the situation continue or escalate (ITF, 2000b). First used by British Airways (BA), "such warnings were quickly dubbed a 'yellow card' after the warning a soccer player gets when he is close to being ejected from the game. If handed a 'red card,' the BA passenger knows that he will be greeted by the cops rather than his family when the airplane lands" ("Unruly Passengers Challenge," 1999, p. 62). These straightforward messages in hard copy present the seriousness of the situation to the passenger. Appendix B includes the suggested content of a warning card by the FAA. Warnings, both verbal and written, have proved effective 41% of the time, being most effective in the presence of one's family (Vivian, 2000).

The captain can order the restraint of a disruptive passenger on the plane (British Airways, 1997). Therefore, the ITF states, "All aircraft absolutely must be equipped with restraint devices, such as handcuffs, restraint straps and restraint tape" (ITF, 2000b, p. 16). However, in their survey of 64 airlines, fewer than half, 42%, actually provided restraint equipment. The ITF called this unacceptable and stated it represents a breach of the "carrier's duty of care" to customers and employees (ITF, 2000b, p. 16). The crew must be able to fight back and subdue the unruly passenger. In some instances, they have improvised restraint devices. On one flight, several passengers had to provide their neckties to bind the wrists of one unruly passenger (Topousis, 2000). Another unruly passenger found himself bound to his seat by adhesive tape (Topousis, 2000). New technology in this area includes a body restraint package with which several airlines are experimenting. The device was designed by a former police officer and is thrown over the head and shoulders of the passenger to bind them to the seat (Topousis, 2000). Restraints may sound like a quick and easy fix to a situation of an unruly passenger. They are not. All other options should be exhausted before restraining a passenger. Trying to restrain an unruly passenger is a dangerous undertaking that exposes the crew to greater risk of injury (Prew, 1997b). Some airlines feel this potential danger to crew members is justification for not including restraint devices aboard their aircraft.

One punishment for the air rage offender is imposed by the airlines. This long-term punishment is banning air rage offenders from the airline in the future. Such a ban serves as a deterrent for business fliers that do not always have many air operators from which to choose. Such a ban not only affects their personal life, but their career as well. U.S. carriers, including Northwest, TWA, and United, have implemented policies that ban passengers for life. United Airlines even sends a severance letter from the company informing the banned flier that they are no longer welcome on United Airlines (Hester, 1999a). British airlines have taken an additional step in sharing the information and respecting the lists of fellow airlines. Virgin Atlantic joined Airtours in banning a man for life who attacked a flight attendant with a vodka bottle from traveling on any flight of Virgin Atlantic or Airtours (BBC News, 1998a). Richard Branson, the owner of Virgin Atlantic, and Gordon Bethune, CEO of Continental Airlines, want to compile a worldwide database of offenders that would prevent unruly passengers from being allowed on virtually any airline. "But just how an industry-wide blackballing system would work is unclear" as airlines do not share a common computerized database ("Unruly Passengers Challenge," 1999, p. 62). KLM is exploring a database of offenders that are banned. They must determine whether it is legal for them to record the information about passengers that display unruly behavior. "The internal use of such a list probably does not present a problem, but to build a watertight system KLM must be able to work worldwide with it, and it should also be accessible by third parties such as travel agents. This is more difficult to arrange. . . . Other criteria also need to be established, such as the point at which a passenger is placed on such a list, its security and how long data are retained" (KLM, p. 45).

In an article on unruly passengers, Sarah Prew identifies four areas of focus for the crew when dealing with an unruly passenger. First, deal with the incident as it happens; second, gather evidence; third, determine what the police need to know prior to the aircraft landing; and fourth, know the role of the aircrew on landing (Prew, 1999). Gathering evidence is one step that is commonly known to have failed the crew in a trial. It is important to gather as much evidence as soon as possible. Additionally, witness lists are important to make a case (Prew, 1999). Appendix C lists other tips in collecting evidence.

<u>Application of the Policy Research Method</u>

The application of policy research allows decision makers to improve policies or programs (Haas & Springer, 1998). "More specifically, analysis for policy is called applied policy research" (Bowen & Hansen, 2001, p. 164). Bowen and Hansen introduced the application of the policy research method to aviation applications (Bowen & Hansen, 2000). The authors stated, "policy research occurs at a variety of points in the policy process and is situational in nature" (p. 164). They explained that policy analysis and research is "an appropriate tool in reviewing the outcomes of past policies in an effort to define future . . . policy options" (Bowen & Hansen, 2000, p. 164).

According to Bowen (2001), "the policy research method is a study of evolving policy, utilizing both internal and secondary policy data." While the framework of policy research has been addressed in the scholarly literature as a process that relies on the application of research tools, it has not been operationalized as a tool itself. Bowen introduces the policy research construct to bridge the gap and provide policy researchers with a mechanism to operationalize policy research for the purpose of providing research-derived results. The results are derived from a systematic review, compilation, and synthesis of critical policy information.

Through application at a variety of points in the policy process, policy research was applied to examine the air rage phenomenon. The gap in academic literature on air rage provided an opportunity for a comprehensive policy research study into air rage. The air rage issues presented in this paper were explored through the application of policy research during the period 1996 through 2000. The study allowed the many facets of air rage to be analyzed over a period of time. A thorough review of the air rage epidemic in society reveals policy implementation of both governments and airlines. Analysis of the findings seeks commonalities, differences, and gaps for decision makers to review in the eradication of air rage. Finally, areas for future research in air rage were recorded as well.

FINDING THE SOLUTION TO AIR RAGE

Policy research reveals that different definitions of air rage do not resolve or address the issue of air rage; rather, they confuse it. Applying varying definitions of air rage in different jurisdictions leaves airlines wondering whether or not an incident will be classified as air rage. The jurisdiction in which the plane lands makes the determination of whether or not the incident will be classified as air rage based on the local definition. Vague definitions of air rage are also problematic for the same reason.

The scope of the air rage problem is disputed among airline management, national safety authorities, and cabin and flight crew unions. The exploration of air rage statistics and the range of offenses committed revealed contradictory data. The scope of the problem itself is one that is debatable. NASA and ITF follow-up studies may reveal the impact, if any, of policies implemented by airlines and governments to prevent future air rage incidents. A time-series analysis or other study would provide useful data for policy evaluation.

In addition to the scope of the problem, the causal factors must be determined to prevent future incidents of air rage. Alcohol, smoking, carry-on baggage, management, and other causes were determined to be common factors influencing the air rage environment. The causal factors indicate the rage problems are not limited to aviation, but due to the unique nature of aircraft in flight, the factors must be diffused before one boards an aircraft, if at all possible.

Once the causal factors are known, the problems can be addressed. Measures taken by airlines, governments, and unions were reviewed to see what steps have been taken to combat air rage. Much ground has yet to be covered to prevent air rage offenses; however, policy evaluation studies can be undertaken to see if the measures implemented have influenced a rise or fall in the number of air rage incident reports. But in order to properly determine the scope of the problem, a comprehensive definition must exist so data are reported consistently and are comparable across airlines, organizations, and the globe.

APPLICATION OF POLICY RESEARCH OUTCOMES

The literature reveals the air rage problem is complex and requires more than one solution. First, passengers are voicing their discomfort regarding the ‘sardine seating arrangements’ of the airlines. This resulted in the startup of one airline in particular. JetBlue offers leather seats with more legroom, low fares, and new airplanes. CEO David Neelman said, “With our friendly service and hassle-free technology, we’re going to bring humanity back to air travel” (Edmondson-Jones, 2000, p. 1).

Second, as passengers become increasingly agitated by delayed and canceled flights, complex ticket prices, and crowded airplanes; it becomes more likely that a Passenger Bill of Rights will be passed. Senators John McCain and Ron Wyden proposed an Airline Passenger Fairness Act that specified the rights of passengers when flights are delayed or canceled, including required compensation for passengers, disclosed sales information about flights, and other practices. This legislation was averted when the airlines voluntarily agreed to improve service. Since then, passenger complaints have risen (Reid, 2000; Bowen & Headley, 2001). Senator Reid reintroduced such legislation in July of 2000 and January of 2001. Both pieces of legislation included provisions for passengers to exit aircraft that have been at the gate for more than one hour ("Right to Exit," 2000; Reid, 2001). Reid stated that such a provision would "help prevent 'air rage' incidents when passengers are forced to sit in parked planes for long periods of time" (Reid, 2001).

Third, the gap analysis of the literature reveals a void in the form of a comprehensive air rage database. Aside from an offender database, many are urging the development of a comprehensive air rage incident database. With airlines collecting different pieces of information, statistics are not comparable across airlines and countries. ICAO or IATA should establish a common reporting form with minimum required information to truly gauge the scope of the air rage problem. Data to be collected include associated issues with or causes of inflight violence; trends; factors, such as alcohol; type of incident, such as physical violence, unruly behavior, or verbal abuse; and locations involved; among others. In order for such a worldwide database to succeed, common reporting forms must be used to collect comparable data. Until such a program is implemented, the "understanding and eradication of sky rage will be hampered by inconclusive statistics and the arbitrary interpretations that result" (Hester, 1999a, p. 2). Qantas Airlines appointed a Security Analyst in 1996 to maintain and analyze a database of information on air rage within their airline and from other reports (Bee, 1996). Such a database could be a foundation from which to build.

CLOSING THE FLIGHT PLAN: CONCLUDING OBSERVATIONS

Through the application of the policy research methodological framework, it was revealed that different definitions of air rage are problematic, the scope of the problem is debatable, the causal factors must be addressed, and a void was uncovered in the collection of the air rage data. Policy changes are the likely solution. Due to the gaps revealed, immediate action is required to further close these gaps. Congress, the airlines, and the Department of Transportation must continue to act on behalf of the traveling passenger. The policies implemented to date are initial steps, reacting to the rise in air rage incidents in the 1990s. Collegiate aviation educators can incorporate this material in the curriculum through safety and security courses (Schaaf & Bowen, 2001). Additionally, the faculty can conduct a share of the scholarly research that is desperately needed.

Never before have airplanes been so full, the system so congested, and the unruly passengers so out of hand. Future research in this area will be useful in determining correlations that may or may not exist among variables. Three passengers have been able to break through the cockpit door during violent air rage incidents. As the magnitude and seriousness of the incidents continues to grow, the preventative research must be advancing as well.

ITF Assistant General Secretary Stuart Howard said it is only a matter of time before a serious accident is caused by air rage and there is no reason not to act now to prevent future incidents (ITF, 2000c).

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APPENDIX A

Select Air Rage Incidents That Illustrate the Range of Offenses

1. A passenger took swings at the pilot (Okada, 2000).
2. A crew exceeded 250 knots below 10,000 feet due to a passenger that brandished a knife (NASA, 2000).
3. On final approach, a passenger removed his clothes in the lavatory and set fire to them in an attempt to set fire to the aircraft (NASA, 2000).
4. A passenger sexually assaulted a flight attendant as she tried to serve his meal. A senior company executive was prosecuted for then defecating on a food trolley. (Fairechild, 2000; Prew, 1997a).
5. A crew member needed 18 stitches after being hit with a vodka bottle (ITF, 2000).
6. A passenger grabbed the hair of a female clerk at check-in and banged her head on the counter repeatedly (ITF, 2000).
7. A passenger stormed the cockpit and assaulted a crew member when he was denied alcohol (ITF, 2000).
8. A passenger attacked the pilot and co-pilot intending to crash the plane and had to be subdued by crew members and passengers (ITF, 2000e).
9. A man broke an inside window of a British Airways 747 and crew and passengers had to overpower him (James, 2000).
10. A passenger was arrested after kicking the door on a flight from the United States (James, 2000).
11. "A violent passenger died on board a Hungarian airliner after cabin crew and passengers strapped him to his seat and injected him with tranquilizers. The passenger had been harassing people on board the flight from Bangkok to Budapest, punching the pilot and choking an attendant" (James, 2000, p. 7).
12. A Missouri carpenter broke into the cockpit of an Alaska Airlines flight, lunged for the controls and shouted, 'I'm going to kill you.' Passengers and crew members tackled the man and restrained him until the plane landed (ABCNews.com, July 6, 2000).
13. A female passenger entered the cockpit of an America West jetliner in flight and struck the co-pilot (ABCNews.com, July 6, 2000).
14. A passenger fought with her boyfriend, then threw a can of beer at a flight attendant and bit a pilot on the arm ("Woman Bites Crew," 2000).
15. A female passenger knifed a flight attendant in the neck because that crew member was trying to get the passenger's young daughter to put on her seatbelt for landing (Prew, 1997a).
16. Ian Brown, the former Stone Roses frontman, told a flight attendant he would chop off her hands and then banged on the flight deck door as the pilot landed the plane (BBC News, 1998a).
17. A plane diverted after an unruly passenger refused to stop smoking and became abusive to the flight attendants ("Unruly Smoker," 2000).
18. A woman was arrested after she attacked a Southwest Airlines employee. She "became upset when the employee cut up a credit card presented to buy a ticket. The employee had been alerted by the woman's bank that it was invalid, according to police. The woman lunged at the employee who was behind the counter and fell down. As [the

attacker] stood up, she allegedly grabbed the scissors used to cut up her credit card and threatened the female employee with them" ("Employee Attacked," 2000, p. 17).

19. A Continental Airlines gate agent was slammed to the floor after telling a passenger to wait at the boarding gate. He "sustained three fractures to his cervical, neck and spine area, and may never walk again" (Hester, 1999a, p. 3).
20. Cathay Pacific banned two rock stars for life after they disrupted the flight with drunken and rowdy behavior (Wise, 2000).

APPENDIX B

Warning Card Content Suggested by the FAA

Your behavior appears to be in violation of Federal law. If you fail to control your actions, federal authorities will be notified and requested to meet this flight.

THIS IS A WARNING THAT FEDERAL LAW PROHIBITS THE FOLLOWING:

> Assaults, threats, intimidation or interference with a crewmember in performance of the crewmember's duties aboard an aircraft being operated. 14 CFR 91.11
>
> Disruptive behavior due to alcohol consumption. 14 CFR 121.575
>
> Alcohol-related disturbance created by a passenger
>
> Consumption of an alcoholic beverage unless served by a crewmember
>
> Alcohol service to a passenger who appears to be intoxicated
>
> Failure to follow instructions given by a crewmember regarding compliance with passenger safety regulations such as the following: 14 CFR 121.317
>
>> No smoking in lavatories at any time
>>
>> No smoking when 'NO SMOKING' signs are illuminated
>>
>> Tampering with, disabling or destroying smoke detector installed in any airplane lavatory
>>
>> Requirement to keep seat belt fastened while the 'FASTEN SEAT BELT' sign is lighted
>>
>> Operation of an electronic device when prohibited

An incident report may be filed with the appropriate federal agency if you do not refrain from this behavior. The Federal Aviation Administration provides for fines of up to $10,000. In the case of interference with a crewmember in the performance of crewmember duties, imprisonment for up to twenty years may be imposed in addition to the fine."

Source: FAA, 1997, p. 68

APPENDIX C

Tips on Collecting Air Rage Evidence

There are certain pieces of information that will help the police prior to the aircraft landing. The information includes:

1. Where and when the incident took place.

2. The Incident Type. This is especially important if the offense is an obscure one. In any case, it helps the police to know what they are dealing with prior to meeting the aircraft.

3. How many people are involved in the incident and their gender.

4. The full names and ages of those involved in the incident. This allows the police to do a search on the person before the aircraft lands. It may be that they have a previous conviction that may affect the way the police decide to handle that person.

5. Where the aircraft is going to park at the airport. Although the ground staff determines this, if there is a particularly difficult or violent passenger on-board, for example, the police may decide to request that the aircraft be parked in a remote location.

Source: Prew, 1999

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