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Acknowledgments

I would like to acknowledge the several authors who submitted manuscripts for presentation at the 1994 Fall meeting of the University Aviation Association, and subsequent publication in this volume. Three times as many papers as last year were received on a wide range of subjects, a sign of increased interest, or increased expectations of aviation educators, or perhaps both. In any event, it was a welcome task to receive, review, and select four papers for presentation this year. Authors of selected papers are commended for their efforts, and we look forward to the opportunity to see even more papers next year.

Thanks go to the panel of reviewers who take the time to evaluate each submission, comment, and make recommendations on acceptance to the editor. This "blind" review process is vital to the credibility of our presentations, and to the improvement of professional writing among our peers.

Special thanks also go to Mrs. Lyn Bubb, staff assistant in the Department of Aviation Studies at Florida Institute of Technology, for her assistance in receiving submissions, responding to inquiries, and preparing papers for publication.

Ballard M. Barker, Ph.D., A.A.E.
Chair, UAA Publications Committee
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Table of Contents

Page

Why Aren't We Teaching Aeronautical Decision Making?

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Abstract

Fifteen years of aviation research into the causes of human performance errors in aviation provided a basis for the current study. Detailed analyses of human performance error accidents produced the conclusion that approximately half of these accidents were decision related. Since traditional pilot training stressed aeronautical knowledge and flying skills while relying on experience to teach and practice decision making, an obvious question was: Can we teach decision making as a way to accelerate the normal learning based on experience and to reduce these accidents? This paper attempts to answer that question and to provide guidelines for both future research and the next generation of aeronautical decision making training materials.

Introduction

Extensive research and empirical testing in aeronautical decision making (ADM) produced a series of fifteen Federal Aviation Administration (FAA) manuals and reports on ADM (1986-1988) as shown in Table 1. These ADM training manuals covered the range of pilots from student private candidates to instrument-commercial pilots and crew resource management for multi-pilot operators, as well as reports devoted to helicopter pilots, emergency medical service (EMS) pilots, and natural resource pilots. In addition, ADM reports were developed for EMS operator risk management, hospital administrator ADM and air traffic controller decision making.

The work described in this paper was initiated in October 1990 with a Phase I study which investigated the differences between novice and expert pilot decision making from an information processing perspective (Adams & Ericsson, 1992). The Phase I report correlated the development of expert decision making with pilot training and experience, and reviewed accident scenarios which exemplified those processes.

Extensive experimental validations and empirical testing in both civil and military operational environments have documented that accident rate reductions of about 50% can be seen when comparing pilot groups with and without decision making training. Although it is difficult to accurately assess the impact of these manuals throughout aviation, significant reductions in human performance error (HPE) accidents have been demonstrated in the specific aviation applications shown in Table 2 which shows the worldwide civil and military safety improvements along with earlier FAA experimental results. The U.S. Air Force data reported by Diehl (1991) as shown in Table 2 and the U.S. Navy data (Alkov, 1991) further substantiate the validity and worth of the FAA research and ADM training.

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Table 1
Summary of ADM Training Materials

Report Number	Title
FAA/PM-86/41	ADM for Student and Private Pilots
FAA/PM-86/42	ADM for Commercial Pilots
FAA/PM-86/43	ADM for Instrument Pilots
FAA/PM-86/44	ADM Instructor Guide for Student and Private Pilots
FAA/PM-86/45	ADM for Helicopter Pilots
FAA/PM-86/46	ADM - Cockpit Resource Management
FAA/DS-88-5	Air Ambulance Helicopter Pilots-Learning from Past Mistakes
FAA/DS-88-6	Air Ambulance Helicopter Pilots-Situational Awareness Exercises
FAA/DS-88-7	Risk Management for Air Ambulance Helicopter Operators
FAA/DS-88-8	ADM for Air Ambulance Hospital Administrators
AC 60-22	ADM Advisory Circular
unassigned	Air Traffic Controller Decision Making Training Materials
unassigned	ADM Techniques for the Practical Test Guide
unassigned	Back to Basics Introduction to ADM
TE01P12	ADM for Natural Resource Pilots

Table 2
ADM Successes

Data sources	HPE reductions (%)
10 Experimental validations	8 - 46
World-wide civil helicopters (Bell 206)	
All HPE accidents	36
Weather related accidents	72
U.S. civil helicopters	
Bell 206 All HPE Accidents	48
Largest civil operator	54
U.S. military	
Air Force MAC transport crews	51
Navy helicopters	28
Navy airplanes (A-6 & EA-6)	81

This basic research defined judgment as: "the ability to stay on top of and control the flight situation, and the motivation to assure safety through timely decisions." ADM identified hazardous attitudes in flight operations and provided pilots with a self-assessment test with which to judge their own abilities. The method stressed situational awareness and a structured approach to decision making to enhance the pilot's application of conventional flight training, knowledge, skill and experience. The methods taught to accomplish good decision making stressed serial, deductive reasoning in a checklist form using the DECIDE model (Detect, Estimate, Choose, Identify, Do, Evaluate). This method is useful to novices, but not necessarily representative of the more advanced decision making abilities used by expert pilots.

The specific shortcomings of this approach included (a) the great difficulty in carrying out the linear analysis under conditions of time pressure, (b) the difficulty in applying it to problems with incomplete information or ambiguous data, and (c) that it was not representative of documented differences between novice and expert decision makers in other fields (Chi & Glaser, 1988).

All of these shortcomings lead the industry to come back to the FAA with a request for additional training material for use in training of novice pilots and for use in both initial and recurrency training with more experienced pilots.

Expert Decision Making (EDM)

Developing EDM training involves unraveling the relationships between cognition (how pilots think in operational situations) and training. Conventional pilot training has been based upon a foundation of skill-based, rule-based and knowledge-based tasks. That is, pilots are taught conceptual knowledge; flying procedures; and, basic pilot skills, while leaving the development of decision making to the realm of experience. The novice pilot, therefore, is expected to learn aerodynamics, airplane performance, electrical and hydraulic systems, Federal Aviation Regulations, etc. He is then trained in aircraft control and operation for both normal and emergency situations. This training includes procedures development for preflight, takeoff, cruise, approach and landing phases of flight. Through this training, the novice develops and improves his basic psychomotor abilities and hones his flying skills.

At this stage, decision making is only taught informally through training session debriefs, hangar flying, analyses of other pilots' experiences and the limited flight experience gained in preparation for an airman certification test. After successfully passing the test, the novice pilot is expected to cautiously begin developing good decision making and judgment skills as he gains experience. Because of the emphasis of aviation on procedure oriented training, both in developing flying skills and in decision making skills, training lays the foundation for the development of more sophisticated decision making as experience is gained.

Common characteristics of expert decision making have been observed in the fields of mathematics, physics, medicine, music, sports and aviation (Ericsson, 1991). In fact, individuals with expert thinking ability have been identified as a new personality type. First the classic Type A and B personalities were identified, individuals who respond dramatically differently to stressful situations. Then the Type T or thrill-seeking personalities, those who seek out the "edge-of-the-envelope" and enjoy the challenge of overcoming dangerous situations was recognized. Now psychologists have identified the Type C personality style as chaos changing individuals who are expert problem solvers. Type C individuals have a tolerance for ambiguity, can see solutions in unfamiliar and information lean environments, and develop action plans even in time compressed situations (Buffington, 1989).

The most dramatic examples of how Type C pilots and crews apply their expert thinking skills have occurred in several airline accidents listed Table 3.

Table 3
Expertise in Action

Date	Location	Airline	Aircraft	Type
7-19-89	Sioux City	United	DC-10-10	Engine failure
2-24-89	Honolulu	United	B-747-122	Cargo door
4-25-88	Maui	Aloha	B-737-200	Fuselage
7-23-83	Gimli	Air Canada	B-767	Fuel starvation
6-02-83	Cincinnati	Air Canada	DC-9-32	Cabin fire

The catastrophic engine failure and subsequent total failure of the triply redundant flight control system of a United Air Lines DC-10 (Flight 232), the failure of a cargo door and explosive decompression of another United B-747 (Flight 811), and the fuselage separation of an Aloha Air Lines B-737 (Flight 243) are three prime examples of abnormal situations in which Type C problem solving abilities were used to overcome chaotic situations for which there were no specified procedures, no previous simulator training, and certainly no past experience. The event histories of these accidents were analyzed during Phase I of this project to provide specific examples of how expert pilots think (Adams & Ericsson, 1992). For ease of reference, the expert pilot decision making process demonstrated by Captain Al Haynes of United Flight 232 will be reviewed here.

In a speech on January 26, 1991, Captain Haynes reported that the transition from a normal, uneventful takeoff and climb to 37,000 feet to a "nearly uncontrollable" aircraft occurred in about 15 seconds. His first response was reverting to basic airmanship skills (i.e., figuring out how to fly the airplane). His ingrained training in crew resource management was evident by (a) his immediate decision to use the abilities of a check airman to operate the throttles and maintain heading with differential thrust, (b) his utilization of the second officer for damage assessment, (c) his concern for he passengers and coordination with the flight attendant and, (d) his professional communication with the air traffic controller. (Haynes, 1991)

Captain Haynes' behavior clearly show the expert pilot's ability to assimilate data and impressions quickly, formulate a solution, and carry it out while maintaining mental composure under extreme time pressures. However, even with complete utilization of his expertise and all available personnel, pitch oscillations (60 second phugoids) and roll reversals (from 4-28 degrees of bank) were as stable an approach as the aircraft could make. Nonetheless, Captain Haynes reported that he was always "confident of getting the aircraft on the ground." This expert thinking -- knowing what to do and when to do it -- and the taming of a chaotic situation is the real mark of the Type C decision maker. After the accident, Captain Haynes stated that five factors were instrumental in his ability to land the aircraft and save as many lives as he did. They were luck, communications, preparation, execution and cooperation.

The focus of this report is on the preparation and execution aspects of how expert pilots think. Since the way these tasks are performed in practice strongly affects how they will be performed during an emergency, these areas offer the greatest potential for improved training. The factors and processes involved in these two critical decision making areas include: **S**ensing, **O**rganizing, **A**nalyzing and **R**esponding to the cues and contexts of the situation. The Type C behavior documented by Captain Haynes, his crew and the crews of the other "aviation saves" is referred to herein as Cognitive SOARing to recognize the special level of expertise required for abnormal emergencies.

Cognitive SOARing: Sensing, Organizing, Analyzing and Responding

The study of cognition over the past 40 years has identified the importance of four systems used in thinking, or "information processing." Basically, the human information processing system includes (a) the sensory systems (visual, auditory, seat-of-the-pants, etc.), (b) the memory systems (long term, short term and sensory memory), (c) the processor, and (d) the response systems (motor events, communications, etc.). These four systems incorporate the basic characteristic concepts which contribute to the individual's cognitive **SOAR**ing capabilities.

Sensing is the first preparation step involved in decision making. Pilots vary in the way they perceive (recognize and sort) information from the cues and context of a situation. Sensory memory provides enough retention to allow a reasoned response to each situation. The basic characteristic of sensory memory that is important for pilots to be aware of is that a lot of information is "sensed" or received, but only a small amount is "attended to." Dedicated time spent focusing on individual cues and responding is time taken away from situation monitoring or passive situation assessment.

Since the amount of time pilots spend actively attending to sensory inputs versus passively monitoring the cues and context of a situation varies directly with knowledge, training, experience and currency, each of these elements impact the pilots ability to respond in a timely fashion to specific situations. Consequently, attention is one of the differentiators which can be used to identify experts vs. novices. Attention training can, therefore, provide the first part of a program designed to lessen the reliance on experience as the only means of attaining expert performance.

Organizing involves filtering, prioritizing and structuring sensed information. During this step, short term and long term memory resources are used to identify the most important information and develop an understanding of the situation or problem. This understanding is formulated into a group of related facts, data, results and procedures, that is, a pattern which characterizes the current situation and can be used to retrieve related information from short and long term memory. Although the novice and expert pilot have equal capability for cognitive processing, novices typically use lots of search and processing time in a less focused and more general manner. The outstanding performance of experts is derived from how their knowledge is structured in short and long term memory for retrieval, pattern recognition and inference. Memory training should be the second part of an EDM program.

Short term memory and long term memory should not be thought of as different places pilots "put" facts or procedures. Rather, the differences in these two memory systems are based upon the "operational readiness" of the knowledge at any given time. Short term memory provides active, usable chunks of information in a state of readiness to be used. The precise content, organization and usability of each chunk is tied directly to exposure and practice. Therefore, pilot training and especially decision-making training could benefit by re-examining the criticality of information chunking and train novice pilots earlier in the necessary short term memory skills.

Long term memory provides stored information including factual, procedural, experiential, and emotional knowledge. Pilots have stored this knowledge in related groups or schema and must reactivate it based upon the specific situation. Reactivation can be initiated by the cues (mental or physical), the context of a situation (normal or emergency procedure) and the pilot's abilities to make associations between current and previous patterns. Long term memory, then, depends on the pilot's ability to respond to new demands for information through his abilities of recognition and recall.

Analyzing (or information processing and evaluation) is the third critical step in pilot thinking. This step relies on the type of knowledge stored and how it can be retrieved. Once again, expert pilots have developed superior long term memory organizational capabilities which facilitate recognition and recall. Experts use schema, pattern recognition, associative reasoning, elaborations and inferences to interpret the cues and context of a new situation based upon their related knowledge. This expert capability manifests itself in the ability to intuitively respond to patterns without decomposing them into component features or problem elements. An example of these abilities would be the expert's ability to respond to loss of an engine on takeoff without consciously "thinking through" the engine out procedure. This understanding occurs effortlessly due to the expert's knowledge structure.

The expert's ability to fast access their schema (concepts or patterns) of aviation knowledge is expedited by the associations with cues and context of new situations which stimulate the recall process. Although the associations (or concept elaborations) are predominantly based upon experience today, training aimed at replicating this ability is not an unreasonable goal. In addition to the elaborations, the expert's ability to use inferences to aid reconstruction of similar problems and solutions could also comprise part of this training.

Responding is the most critical step of the EDM process. This step requires that the pilot take some action to alter or control the situation and then monitor the effectiveness of that action. Responding involves the use of conceptual and procedural knowledge. Since aviation training is highly procedural both in developing flying skills (psychomotor) and in problem solving for normal and emergency situations, pilots are provided the foundation for more sophisticated problem solving using production rules. Production rules consist of conceptual knowledge combined with general problem solving procedures (i.e., heuristics, algorithms, working backward from a goal, etc.) to create new, problem specific procedures. This ability marks the early beginnings of how expert pilots think. As these rules are used more and more often, and applied to many situations, they result in autonomous generation of specialized production rules which often use forward inferencing to progress from the initial problem toward a solution or goal.

The captain of the UAL Flight 232 (used as an example of successful decision making and problem solving in chaotic, multiple failures) expressed the opinion that preparation and execution were critical factors involved in his decision making and problem solving. For this analysis the preparation factor was limited to the cognitive aspects of **S**ensing and **O**rganizing information. The EXECUTION factor was similarly limited to the cognitive aspects of **A**nalyzing and **R**esponding to the needs of the situation.

Conclusions

This paper has presented a unique view of how pilots think based upon expertise, information processing and problem solving processes. This analysis of the mental aspects of preparation and execution lead to the coining of the term cognitive SOARing for the "taming of the chaotic situation" demonstrated in several of the recent air carrier accident "saves." This type of problem solving behavior has been recognized and identified in the psychology field as Type C behavior where solutions are developed under time pressured, information lean, ambiguous circumstances. Successful training of Type C problem solving behavior has been demonstrated in other fields. The transfer of this training to aviation offers potential enhanced decision making training for pilots and should be addressed in future research. The following general conclusions can be drawn from the analysis presented:

1. Aeronautical decision making can be taught both in a classroom and a simulator environment. The principles and concepts of ADM have been accepted and used by a wide variety of civil and military aircraft users performing a multitude of missions. All formalized ADM training implemented to date improves safety through significant reductions in human performance error accident rates.

2. Expert cognitive performance is characterized by rapid access to a well organized body of conceptual and procedural knowledge. This is a modifiable information structure based upon knowledge that is experienced. This experience allows the perception of large meaningful patterns in familiar and new situations which help the expert match goals to task demands. This means they can respond creatively or with opportunistic solutions based upon a global perception of the meaningful relationships in a situation.

3. Experienced pilots have exhibited expert cognitive performance through keen, quick, confident decisions and almost a direct perception of the proper course of action. These decisions which occur so rapidly it appears to be a cognitive process and behavioral resultant based upon

insight or intuition. This intuitive performance is based upon: experience (cognitive and sensory, internal and external); the cues and context of the situation; and, the experts ability to identify causal relationships in a situation.

4. Experience or training that is intended to be used for the development of expert pilot cognitive processing development must insure the perception of the essential psychophysiological elements of the problem. The appropriateness of the experience will be critical to the subjective associations and stored knowledge patterns that will be used in new situations.

References

Adams, R. J. & Ericsson, K. A. (1992). Introduction to Cognitive Processes of Expert Pilots. Federal Aviation Administration, Washington, D. C., Report No. DOT/FAA/RD-92/12, (pp. 10-18).

Alkov, Robert A. (1991). U. S. Navy Aircrew Coordination Training - A Progress Report. U. S. Naval Safety Center for the Sixth International Symposium on Aviation Psychology, The Ohio State University, April 1991.

Buffington, P. W. (1989). No Problem! SKY, pp. 93-97 June.

Chi, M. T. H., Glaser, R., & Farr M. J. (eds.) (1988). On the Nature of Expertise. Hillsdale, NJ: Lawrence Erlbaum Associates.

Diehl, A. E. (1991) . The Effectiveness of Training Programs for Preventing Aircrew Error. U. S. Air Force Inspection and Safety Center for the Sixth International Symposium on Aviation Psychology, The Ohio State University.

Ericsson, K. A. (1991). Toward a General Theory of Expertise. Cambridge University Press, New York, New York. (pp. 20, 64-171).

Firestein, R. L. & McCowan, R. J. (1988). Creative Problem Solving and Communication Behavior in Small Groups. Creativity Research Journal,1,

Haynes, A., (1991). Sioux City, Iowa, United Airlines Flight 232. Speech presented at the Helicopter Association International Annual Meeting, Los Angeles, CA.

Hunt, Lynn M., (1991). Information Processing in Ab Initio Pilot Training. Paper presented at the Sixth International Symposium on Aviation Psychology. The Ohio State University, Columbus, Ohio.

Le Poncin, Monique, (1990). Brain Fitness. Ballantine Books, a division of Random House Inc., New York.

Aviation Distance Learning: An Initial Case Study

of

Intent, Implementation, and Evaluation

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Abstract

The concept of distance learning is not a new concept in education but is somewhat innovative in collegiate aviation programs. The following study involved an evaluation of the examination performance of 70 students in three different aviation classes; one class met in a traditional classroom and two in a distance learning setting. A statistical comparison of the examination scores of all these students found no significant difference and in several cases, slightly elevated test scores by the distance learning students.

Introduction

Distance learning is increasing in popularity and is acknowledged to have many advantages. These advantages include improved cost-effectiveness when addressing the needs of far-flung learners, reduced needs for classroom facilities, and opportunities to communicate with a wider circle of students and teachers (Pearlstein, 1993).

Embry-Riddle Aeronautical University (ERAU), involved in serving aviation through education, is particularly well positioned to maximize these benefits through its offering of degree programs at more than 100 locations throughout the continental United States, Alaska, Hawaii and Europe. In addition, the university also provides undergraduate and graduate degree programs and courses through independent study to students not served by a designated resident center. With this delivery infrastructure already in place, along with a history of successful experience, it seemed appropriate to take advantage of the new telecommunications technologies -- specifically distance learning -- as a way to reach more students and to address a broader range of instructional goals in aviation education. The idea of audio-taped lectures supplemented with notes and texts was first introduced a number of years ago, and served to bring the program to a point where distance education was an endeavor that comprised a significant percentage of the overall university activity.

The initial effort to chart a new course for the future focused on obtaining information and assistance, where possible, from others already heavily involved in telecommunications. These included a group of pioneering institutions involved in the Annenberg/CPB Project's New Pathways to a Degree Project (1993). As a part of this project there are seven New Pathways colleges, universities, and statewide consortia which are using different combinations of technologies and strategies to offer degree programs to underserved populations. These educational initiatives are one of the primary sources of information for the Annenberg Foundation's "Going the Distance: A

Handbook for Developing Distance Degree Programs." The initial evaluation of the Annenberg efforts reveals one central issue: The specific technologies are less important to the success of the program than are the "people variables," the factors that allow faculty and students alike to function effectively within these new environments.

Other invaluable sources of guidance in "distance learning" come from the Association of Commonwealth Universities, the International Council for Distance Education, the Canadian Association for Continuing University Education, and the Ontario Universities Registrars' Association. Additionally, a United States consortium of four regional, legislative compacts is now in place between groups of states in the West, the South, New England, and the Midwest that facilitate the sharing of resources. What is new is the means by which these states are able to share their resources and avoid unnecessary duplication of costly degree programs.

Aviation education is still on the threshold of significant use of distance learning because the number of institutions that offer complete degree programs is still relatively small. Further, the technologies undergirding distance learning are constantly evolving; that which are taken for granted today was revolutionary ten years ago, and what can now only be dreamt of will be commonplace in another decade.

In this paper the authors are attempting to bring together a discussion of the issues and challenges involved in implementing one specific kind of distance learning technology. As an example of such an effort, the instructional delivery system, an overview of several separate classes of students receiving differing instructional treatments, and a statistical comparison of the performance of those students on various evaluation instruments will be discussed.

Instructional Delivery System

The two ERAU instructional delivery systems for this study were the traditional on-campus lecture format and videotapes of each class. The class members in the on-campus class were graduate students and the videotapes were used by off-campus graduate students enrolled in the course in a distance learning setting. The video tape of the class was made during the regular scheduled class period. The studio classroom in which the on-campus class met was equipped with two television monitors and three television cameras. Two cameras were operated by technicians and the third camera, a document camera, was operated by the instructor at the teaching podium. Mixing and final editing of the videotapes was done ex post facto.

Student Profiles

The student subjects for this study were three classes of students enrolled in MAS 602 - Air Transportation, a required core class in the Master of Aeronautical Science degree of ERAU in Daytona Beach, FL. The first set of subjects (n=16) was the class that was present in the distance learning studio/classroom on campus and is referred to as the On-Campus Students (ONC). The second set (n = 27) and the third set (n = 27) of subjects are those students enrolled in the distance learning segment of the study. These subjects sets are referred to respectively as distance Learning - Summer 1993 Students (DL-S) and as Distance Learning - Fall 1993 Students (DL-F) since that is the academic term in which the students enrolled.

The distance learning students were located in 22 states in the U.S. and in nine foreign countries and all completed the academic segment of the course by watching the videotapes of the ONC students. These students completed all the same assignments as the on-campus students but interacted with the instructor and other students in the distance learning class on the Telenet computer bulletin board system (BBS); this group of students took a proctored mid-term and final examination which were graded by the same on-campus instructor.

Discussion

Table 1 contains the age and the undergraduate grade point average (UGPA) of all students by group. Although the DL-S and the DL-F groups were somewhat older than the ONC students, an ANOVA for difference

Table 1
Subjects' Age and Undergraduate Grade Point Average (UGPA)

Subjects	Age	UGPA
ONC		
Mean	31.09	2.76
SD	8.46	.42
Number	11	15
DL-S		
Mean	35.68	3.04
S D	5.67	.47
Number	25	17
DL-F		
Mean	36.00	2.95
S D	7.07	.57
Number	27	17

in age of the subjects at $p < .05$ indicated no significant difference, F (2, 60) = 2.225 with a critical value of 3.13. With respect to UGPA at $p < .05$, there was no significant difference, F (2, 46) = 1.321 with a critical value of 3.18. Since there were a very small number of females in comparison to males, no gender comparisons were made.

Table 2 contains a comparison of the numerical averages scored by all students on the written assignments for the course, the mid-term and final examinations, and the final course average. The written assignments consisted of an analysis and evaluation of a current aviation journal (a critique); there were two critiques assigned during the term. The purpose of this assignment was to give the student an opportunity to engage in library research, critical thought, and scholarly writing. The distance learning students uploaded the assignment to the central BBS computer and the instructor downloaded the file and graded the assignment. The examinations were sent from the main campus to the student's designated proctor and then returned to the main campus for grading. The results of all evaluations were sent to the student by private electronic mail (E-mail).

Table 2
Subjects' Test Scores and Final Course Average

Subjects	Critique 1	Critique 2	Test Scores Mid-term	Final	Average
ONC					
Mean	87.81	88.28	83.38	88.79	86.74
SD	6.25	6.56	11.47	7.34	5.70
Number	16	16	16	16	16
DL-S					
Mean	88.89	89.35	87.48	85.84	87.32
SD	5.98	4.98	7.45	7.15	4.28
Number	27	27	27	27	27
DL-F					
Mean	89.72	90.00	87.70	90.44	89.34
SD	4.82	4.55	6.93	1.90	3.24
Number	27	27	27	27	27

The difference in scores of the subjects on the first written assignment, Critique 1, at $p < .05$ was not significant, $F\ (2, 67) = .5829$ with a critical value of 3.13. For Critique 2, the difference in scores of the subjects on the second written assignment, at $p < .05$ was also not significant, $F\ (2, 67) = .3900$ with a critical value of 3.13. It should be noted (see Table 2) that the distance learning students scored somewhat higher on each assignment.

The difference in scores of the subjects on the mid-term examination at $p < .05$ was not significant, $F\ (2, 67) = 1.576$ with a critical value of 3.13. On the final examination, the difference in scores of the subjects at $p < .05$ was considered significant, $F\ (2, 67) = 4.367$ with a critical value of 3.13. Casual inspection of the data in Table 2 indicates that the DL-S students had the lowest examination average (85.84) while the DL-F students had the highest average (90.44). However, it appears that the difference in variance between the groups, from 3.61 for the DL-F students to 53.87 for ONC students, may have been a contributing factor for the significant F value. With respect to the final class average, the difference in scores of the subjects on class average at $p < .05$ was not significant, $F\ (2, 67) = 2.338$ with a critical value of 3.13.

Conclusions

Summarizing the data, it appears that there is no significant difference in the learning that takes place (as measured by examination scores, written assignment, and class average) between students in a traditional, instructor-oriented, lecture-style class and those individuals that receive instruction in a distance learning setting. Such a finding is consistent with results obtained by Carl and Densmore (1988) who found that "no differences were found between . . . sections but differences in performance on some measures were found" (p. 90). The same study indicated that ". . . given the same course materials and videoconferencing system, student receiving the course at distance . . . can be expected to perform as well as students receiving the instruction in a normal classroom setting" (p. 91).

When considering the fact that most of the numerical scores for the distance learning students were slightly elevated over those of the on-campus students, a possible explanation of this phenomena might be the fact that the distance learning students are more mature (or motivated). While measurement of such maturity is difficult, extremely subjective, and beyond the scope of this study, it is a factor that might be considered and could be the subject of additional research. Perhaps, such a difference, if present, might cause the distance learning students to stay on task more effectively, complete the required reading assignments more readily, better organize their study habits, and even value the educational experience more.

However, the implications for distance learning to become more of a fixture in the educational arena, particularly in aviation settings are clear. With few aviation related programs available except at widely scattered locations (particularly at the graduate level), no longer must the securing of an advanced aviation degree be a logistics challenge above all. The days of an effective educational experience being solely place and time dependent are just about over. A previously inaccessible student can now be part of any educational event; the classroom boundaries have become limitless. Granted, the physical presence of all participants is probably best, but such proximity is not the only way. Perhaps the words of John Sperling, founder and chairman of the board of the University of Phoenix (a leader in on-line education) capture the essence of the distance learning challenge best. Sperling (Lewis and Hedegaard, 1993) stated "As we move to meet the educational needs of working adults in a mobile society, our conception of the university must extend beyond place and embrace process. An adult university cannot be campus bound, rather its borders must be defined by the lives of its students. . ." (p. 68).

References

Annenberg/CPB Project - PBS Adult Learning Service (1992). Going the distance: A handbook for developing distance degree programs. Bethesda, MD: Toby Levine Communications.

Carl, D. R.& Densmore, B. (1988). Introductory accounting on distance university education via television (DUET): A comparative evaluation. Canadian Journal of Educational Communication, 17 (2), 81 - 94.

Lewis, C. T., & Hedegaard, T. (1993). Online education: Issues and some answers. Technological Horizons in Education, 20 (9), 69-71.

Lumsden, B. A. (1986). Administrative Issues in Distance Education. Waterloo, Ontario: University of Waterloo Teaching Resources and Continuing Education.

Pearlstein, R. B. (November/December 1993). Keep-your-distance learning. Performance & Instruction. 32 (10), 8 & 9.

A Comparison of Personality Characteristics Between

University Aviation Students and Airline Pilots

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Abstract

This study represents the first phase of a multiphase project to develop a model for selecting and assessing professional pilot applicants into a university aviation flight program. Using the NEO-PI, the present study compares the personality characteristics of freshmen enrolled in the introductory aviation course with students in a third-year flight courses (persistors), and pilots employed by a major U.S. carrier. Significant differences were found between students in the freshman and junior courses, between make and female students, and between students and the line pilots. Significant correlations were found between grade point averages and scores on the NEO-PI.

Introduction

With the decreasing number of pilots being produced by a down-sized military and a declining general aviation sector, the U.S. airline industry will be looking to other sources of qualified pilots. Certainly as we approach the next decade, collegiate aviation programs will increasingly be called upon to educate the future pilot population. It is also likely that this educational shift will be accompanied by a reevaluation of the methods presently used for pilot selection and training.

Pilot selection procedures in the airline industry have traditionally emphasized psychomotor and technical skills. Personality assessment has been used primarily to screen out undesirable candidates rather than to select optimal candidates. For example, the U.S. airline industry has relied on clinical personality assessment tools, such as the Minnesota Multiphasic Personality Inventory (MMPI). While these instruments may be appropriate for the clinical diagnosis required for therapy, most pilot applicants do not suffer from behavioral disorders.

The authors believe a better approach would be the use of a personality instrument that discriminates within the normal range of behavior--one that reveals information about critical work-related traits and can, in turn, be linked to academic and operational performance. Especially significant to this theoretical foundation is the evidence indicating that the effectiveness of airline crews is a product of not only technical skills and attitudes, but also the more stable personality traits of the crew members (Chidester, Helmreich, Gregorich & Geis, 1991; Hormann & Maschke, 1993).

The NEO Personality Inventory

The NEO-PI was developed to operationalize the five-factor model of personality. Factors are defined by groups of intercorrelated traits. Specific traits are referred to as facets and each cluster of facets is termed a domain. The NEO-PI has five domain scales: Neuroticism, Extroversion, Openness, Agreeableness, and Conscientiousness. Within each domain there are six facet scales, as listed below:

1. Neuroticism: Anxiety, Angry Hostility, Altruism, Self-Consciousness, Modesty, Vulnerability.
2. Extraversion: Warmth, Gregariousness, Assertiveness, Activity, Excitement-Seeking, Positive Emotions.
3. Openness: Fantasy, Aesthetics, Feelings, Actions, Ideas, Values.
4. Agreeablesness: Trust, Straightforwardness, Altruism, Compliance, Modesty, Tender-Mindedness.
5. Conscientiousness: Competence, Order, Dutifulness, Achievement Striving, Self-Discipline, Deliberation.

The NEO-PI personality inventory was selected for use in this study because of the focus on normal behavioral traits and the predictive value of several NEO scales with occupational performance (Barrick and Mount, 1991).

Purpose of the Study

This study represents the first phase of a multiphase project to develop a model to select professional pilot applicants into a university aviation flight program. The research presented here has two objectives. The first is to determine if the personality profile of freshmen enrolled in an introductory aviation course is significantly different from the personality profile of persistors, those students enrolled in third-year flight courses. The second objective is to determine if there are any significant differences between the university students and a selected sample of 20 pilots employed by a major U.S. carrier.

The researchers were also interested in analyzing differences in the student population based on demographic factors, such as gender and degree objective, and examining the relationship between personality dimensions and academic success.

Method

The self-report version of the Revised NEO Personality Inventory (NEO-PI-R) was administered to 142 students who were enrolled in four-year aviation degree programs at a U.S. university. The degree programs included professional pilot, aviation maintenance management, aircraft maintenance engineering technology, and aviation technical management. The first student group was comprised of 92 aviation majors enrolled in the freshman introductory aviation course. Of this group, the majority--69 students--were professional pilot majors. The second student group was comprised of 50 professional pilot majors enrolled in one of three third-year (junior) flight courses. The third group in this study was a selected sample of 20 pilots employed by a major U.S. carrier.

Results

The scores of the 142 aviation students were plotted on the NEO profile form to get a general sense of these students relative to the normative groups by gender. Male and female scores were plotted on the corresponding profile sheet. Both male and female students were higher than the normative group on Extraversion. This can be accounted for primarily by the higher score on Excitement Seeking facet of this dimension for both groups. Interestingly, in the Conscientiousness domain, both male and female students scored slightly lower on the Dutifulness facet than the normative group and the males also scored lower in the Self-Discipline facet in this domain.

The t-test for independent samples was used to compare the scores of students enrolled in the freshman course with students enrolled in the junior flight courses. We have used the term persistors to describe the latter group since these students have persisted in their academic career. As can be seen in Table 1, significant differences were found in three domains: Neuroticism, Extraversion, and Conscientiousness. The greatest differences were found in the Neuroticism domain. Students enrolled in the freshman course are more prone to feelings of guilt and sadness (Depression), inferiority (Self-Consciousness), and less able to cope with stress (Vulnerability) than students enrolled in the junior course. The persistors were significantly more forceful and dominant (Assertiveness) and feel more capable and effective (Competence) than the first-year students.

Table 1
Comparison of Students in a Freshman Course with Students in Junior Courses on NEO-PI Scales

Domain/Facet	Freshman (n= 92)	Junior (n= 50)
Neuroticism **	88.5	77.7
Depression **	15.6	11.9
Self-Consciousness **	16.2	13.5
Vulnerability **	11.0	8.3
Extraversion *	119.0	126.1
Assertiveness **	16.9	19.2
Competence **	21.1	23.0

* <.05 ** <.01

NOTE: In all the tables presented in this paper, domain scales are distinguished from facet scales by capital letters.

When the professional pilot majors enrolled in both the freshman and junior courses were compared, the only significant differences were in the Neuroticism domain. As Table 2 indicates, the persistors scored lower on the Depression, Self-Consciousness, and Vulnerability scales.

Table 2
Comparison of Pilot Majors in Freshman Courses With Pilot Majors in Junior Courses on NEO-PI Scales

Domain/Facet	Freshman (N= 61)	Junior (N= 50)
Neuroticism *	87.2	77.7
Depression **	15.3	11.9
Self-Consciousness *	15.8	13.5
Vulnerability **	10.6	8.3

* <.05 ** <.01

While there were only 23 non-pilot majors in the sample, the scores between the professional pilot and non-pilot majors were compared. This comparison is presented in Table 3. The non-pilot majors were more self-conscious and, interestingly, their scores suggested this group is less friendly and affectionate, less assertive, and less likely to experience positive emotions than the pilot group.

Table 3
Comparison of flight majors with non-flight majors on NEO-PI scales

Domain/Facet	Flight (n= 111)	Non-Flight (n= 23)
Self-Consciousness *	14.8	16.9
Extraversion *	123.9	113.1
Warmth *	23.2	21.0
Assertiveness *	18.4	16.0
Positive Emotions *	21.0	18.9

* <.05

The authors were also interested in the differences in scores based on gender. As Table 4 illustrates, the female aviation students are significantly more anxious than their male counterparts and more prone to feelings of guilt, hopelessness, and loneliness. However, these women also have a deeper appreciation for art and beauty (Aesthetics), are more willing to try different activities or new experiences (Actions), and more readily reexamine social, political, and religious values (Values) than the male students.

Table 4
Comparison of Male Students with Female Students on the NEO-PI Scales

Domain/Facet	Males (n= 116)	Females (n= 23)
Anxiety *	15.6	17.9
Depression *	13.8	16.3
Openness *	111.5	120.6
Aesthetics *	16.3	19.0
Actions *	16.3	18.0
Values **	19.9	22.6
Agreeableness *	113.5	122.0
Straightforwardness *	18.2	20.3
Tender Mindedness *	19.2	21.3

* <.05 ** <.01

In addition, there were significant differences between the male and female students in the Agreeableness domain. The significantly low scores on the Straightforwardness facet suggest that male students are more willing to manipulate others through flattery, craftiness, or deception than are female students. The lower scores on the Tender-Mindedness facet indicate that the male students are both more hardheaded and hardhearted than the female students.

Because there is some evidence to suggest that a relationship exists between academic and occupational success and the traits associated with Openness (McCrae, 1987) and traits associated with Conscientiousness (McCrae & Costa, 1987), the correlations between the grade point average of the persistors and the NEO-PI scales were analyzed. The results of this analysis are presented in Table 5. All correlation coefficients are presented in the table, but the probability levels are presented for only those coefficients significant at the .05 level.

Table 5
Correlations Between Grade Point Averages of Persistors on NEO-PI scales

Domain/Facet	r
Depression	-.29 (p=.038)
Impulsiveness	-.38 (p=.007)
Aesthetics	-.34 (p=.017)
Trust	.29 (p=.042)
Straightforwardness	.32 (p=.025)
Conscientiousness	.44 (p=.001)
Competence	.44 (p=.001)
Order	.28 (p=.048)
Dutifulness	.33 (p=.020)
Achievement Striving	.38 (p=.007)
Self-Discipline	.29 (p=.041)
Deliberation	.40 (p=.004)

The highest correlations--in number and significance--are between grade point average and the Conscientiousness domain and all six facets within this domain: Competence, Order, Dutifulness, Achievement Striving, Self-Discipline, and Deliberation. Moderately high positive correlations were also found between grade point average and both Trust and Straightforwardness in the Agreeableness domain. There are moderately high negative correlations between two facets in the Neuroticism domain, Depression and Impulsiveness, and the Aesthetics facet in Openness.

The t-test for independent samples was used to compare the scores of the students who were professional pilot majors with the airline pilots. As can be seen in Table 6, there were significant differences between these groups in the Neuroticism domain and in all six facets in this domain, the students scoring higher than the pilots on Anxiety, Angry Hostility, Depression, Self-Consciousness, Impulsiveness, and Vulnerability. The students also scored significantly higher on the Excitement-Seeking facet in the Extraversion domain. The students also scored significantly lower on the Agreeableness dimension and on Trust, Straightforwardness, and Compliance in that domain. They were significantly lower on Conscientiousness and five of the six facets in that domain: Competence, Dutifulness, Achievement Striving, Self-Discipline and Deliberation.

Table 6
Comparison of Pilot Majors and Airline Pilots

Domain/Facet	Students (n= 111)	Pilots (n= 20)
Neuroticism **	82.9	57.3
Anxiety **	16.0	10.8
Angry Hostility **	13.2	8.7
Depression **	13.8	7.9
Self-Conscious **	17.8	11.2
Impulsiveness **	15.7	13.0
Vulnerability **	9.6	5.7
Excitement-Seek **	22.1	18.0
Agreeableness *	115.6	125.9
Trust **	19.1	22.9
Strtforwardness **	18.9	21.8
Compliance **	17.1	19.8
Conscientiousness **	120.0	139.9
Competence **	22.2	25.6
Dutifulness **	21.4	25.4
AchStriving **	20.7	23.2
Self-Discipline **	19.7	24.6
Deliberation **	17.0	20.8

* <.05 ** <.01

Conclusions and Discussion

Overall, the aviation students included in the study scored higher on Excitement-Seeking than the normative group. Professional Pilot majors who had persisted to their junior year of course work scored lower on Neuroticism and on the Depression, Self-Consciousness, and Vulnerability facets within that domain than students in the freshman course. The female students scored higher on Anxiety and Depression, higher on Openness and several facets within that domain, and higher on both Straightforwardness and Tender-Mindedness than the male students.

Barrick and Mount's (1991) meta-analysis of 117 criterion-related validity studies examined the relation of the five personality factors to job proficiency, training proficiency, and personnel data for a wide range of occupational groups. Since the ultimate goal of our larger research project is to be able to better predict the academic and occupational success of pilot candidates, Barrick and Mount's findings provide an interesting comparison.

Barrick and Mount found the Conscientiousness dimension to be a consistently valid predictor of training proficiency and job proficiency across the wide range of occupational groups included in their study. Our research supports their findings--grade point average was highly correlated with the Conscientiousness domain and with all six facets within this domain.

Another finding in Barrick and Mount's meta-analysis was that Openness to Experience was a valid predictor of training proficiency but not job proficiency. They theorize that individuals with high scores on this dimension have a more positive attitude toward learning experiences. It is also this dimension which has the highest correlation of any of the personality dimensions with measures of cognitive ability (McCrae & Costa, 1987). It is interesting, then, that in the present study there is little relation between grade point average and the Openness domain or any of the facets within Openness. More surprising, with the exception of Values, the relationships are negative.

Extraversion was also found to be a predictor of training proficiency. This scale, Barrick and Mount suggest, may in fact differentiate between active and passive learners. While in the present study the correlations between Extraversion and grade point average were relatively low, it is worth noting that the persistors scored significantly higher on Extraversion than the students enrolled in the freshman course.

This study has potentially important implications for pilot selection and training. First, our findings support the notion that there is a strong relationship between the Conscientiousness personality dimension and academic success, as measured by grade point average. Second, the finding that persistors scored significantly higher on Extraversion than students enrolled in the freshman course may also provide additional insight into the personality dimensions associated with academic success. Another intriguing finding is the significant differences between the students and airline pilots. More research is needed to explain these differences.

References

Barrick, M. P., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. Personnel Psychology, 44, 1-26.

Chidester, T., Helmreich, R., Gregorich, S., & Geis, C. (1991). Pilot personality and crew coordination: Implications for training and selection. The International Journal of Aviation Psychology, 1, 25-44.

Hormann, H. & Maschke, P. (1993). Personality scales as predictors for job success of airline pilots. In R. Jensen (Ed.), Proceedings of the Seventh Annual Symposium on Aviation Psychology. Columbus, Ohio: Ohio State University.

McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience', Journal of Personality and Social Psychology, 52, 1258-1265.

McCrae, R. R., & Costa, P. T. Jr. (1987). Validation of the five-factor model of personality across instruments and observers. Journal of Personality and Social Psychology, 52, 81-90.

Airport Privatization: False Panacea?

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Abstract

This paper describes the recent history of airport privatization, presents the arguments for and against airport privatization, and assesses the prospects for airport privatization in the United States. The traditional role of government in aviation was challenged during the 1970s with passage of the Airline Deregulation Act, which terminated 40 years of federal economic regulation of commercial airlines. Many economists and policy analysts have argued that airline deregulation did not go far enough, and that the federal government should have also introduced competition into the airport industry. Calls for greater reliance on the private sector in aviation infrastructure development gained momentum in the 1980s that has continued into the 1990s. The authors conclude that, given the complex goals that public administrators must balance, coupled with the risks involved in total privatization, the prudent course of action is to seek less extreme solutions for the problems facing airports today. In this regard, privatization models that have combined elements of the market approach with a public administration approach would seem to represent the models worth replicating.

Introduction

The concept of privatization is as old as capitalism itself, with intellectual roots in the free market theories of Adam Smith. Historically, government has played a limited role in America, an effect of its liberal, capitalist traditions. However, exceptions have been made to this general rule for activities considered too important to be subjected to market controls or for activities that markets could not, or would not, undertake. The ownership and operation of airports is one such activity. The role of aviation has been considered to be so vital to society, in general, and to commerce, in particular, that it has always been characterized by high levels of government involvement. Moreover, the substantial capital costs associated with land acquisition and construction of airport facilities, coupled with the long payback period, have resulted in government ownership of virtually all of the nation's largest airports as well as many small and medium-size airports. This paper examines the recent history of airport privatization, presents the arguments for and against privatization, and assesses the prospects for privatization of airports in the United States from the public administration perspective.

The traditional role of government in aviation was challenged during the 1970s with passage of the Airline Deregulation Act, which terminated 40 years of federal economic regulation of commercial airlines. Many free market economists have argued that airline deregulation did not go far enough and that the government should have introduced competition into the airport industry as well. During the 1980s, and into the 1990s, calls for greater reliance on the private sector in the development and operation aviation infrastructure gained momentum. The support of the Reagan and Bush administrations provided impetus to the movement toward airport privatization (Gesell, 1994). The most radical advocates of the privatization movement call for the outright sale of publicly owned airports to private enterprises. Other supporters of airport privatization propose less extreme measures such as long term leases and/or contracting out to private firms for the provision of particular airport services or functions.

The sale of publicly owned enterprises has occurred frequently in Western Europe, the former planned economies of Eastern Europe and the former Soviet Union, and in the developing world. The most notable sale of state-owned airports occurred in 1987 when the British Airports Authority (BAA), which consisted of seven United Kingdom airports, was sold to the public (Gomez-Ibanez and Meyer, 1993). Airport privatization on this scale has not yet been attempted in the United States. However, many proposals to sell publicly owned airports have surfaced in recent years. For example, local officials have proposed to sell or lease Los Angeles International Airport, Albany County Airport, and Peoria County Airport (Poole and Snyder, 1992). The FAA, citing federal grant agreements that prohibit the diversion of airport revenues, has vetoed these plans so far on the ground that the transfer of airport revenues to off-airport uses is illegal.

The Privatization Debate

The main argument for privatization is efficiency. It is widely believed that the private sector is inherently more efficient than the public sector because private enterprises are better equipped and more motivated than their public sector counterparts to be cost conscious and customer oriented (Gomez-Ibanez and Meyer, 1993). Privatization advocates argue that efficiency translates into lower costs to the public because private firms have a more flexible procurement process. Advocates of privatization also suggest that private firms would not be as constrained as public organizations with respect to the myriad of government requirements that often delay planning and construction schedules, mandate detailed contracting procedures, and increase paperwork. Purchasing managers in a privatized airport would not be bound by the bureaucratic procurement system that exists in the United States. However, it is important to note that the public procurement system was designed to encourage equity and to prevent corruption and favoritism, with little concern for efficiency.

According to privatization proponents, efficiency would also be enhanced because private operators have more flexibility in personnel management than public administrators. Private managers can hire and fire more easily and are not constrained by civil service pay scales or other administrative rules and procedures (AAAE/ARDF, 1992). Advocates also argue for privatization on the ground that the private sector can build facilities cheaper and faster than government. Indeed, the Alliance Airport in Ft. Worth, which was planned and completed in less than two years, provides strong evidence to support this claim.

The 1987 BAA privatization experiment, which resulted in the creation of the newly privatized BAA, is perhaps the major success in airport privatization. BAA has demonstrated the ability to earn profits, which grew 49% to 285 million pounds in 1993 (Coleman, 1994). An examination of its revenue streams reveals that a significant proportion of its operating income comes from innovative retailing and leisure activities rather than traditional airport activities such as landing fees. Privatization appears to have transformed the BAA from an inefficient monopoly into a lean, efficient, and customer-oriented private company that is earning substantial profits. A few smaller scale airport privatization experiments have met with success in other areas of the world. For example, Mexico City's new international terminal and Toronto's Terminal 3 at Pearson International Airport were both constructed and are owned and operated by private consortiums. The BAA and these other smaller cases provide evidence to support the efficiency case.

However, critics of airport privatization question the degree to which privatization enhances efficiency. They claim that privatizing airports does little to increase economic efficiency since most economic activities undertaken at public airports have always been provided by commercial airlines and other private vendors. Furthermore, some of the efficiency gains claimed for privatization of the BAA, such as the expansion of on-airport retailing activities, may be largely due to transfers from off-airport businesses. A strong case can be made that many airport gains in such activities as airport restaurants, hotels, and retailing may come at the expense of off-airport enterprises, rather than representing any net gain to society (Gomez-Ibanez & Meyer, 1993).

Moreover, any efficiency advantages that privatized airports might have over public airports are often thwarted by political realities. For example, political constraints have limited the privatized BAA from implementing pricing and other incentives to promote the more efficient use of existing airfield and terminal investments. Prior to privatization, the BAA stated that aviation charges would be set to cover long-run marginal costs; that is, the incremental costs of landing an additional aircraft or processing an additional passenger. However, in setting landing fees to achieve economic efficiency, the BAA would have had to impose large increases on airlines. Imposing such increases has proven to be politically untenable. Thus, while there is evidence that privatization offers the potential for increased efficiency, the experience of the BAA indicates that much of what is advertised as gains in efficiency is actually a result of transfers from off-airport businesses to private enterprises located on the airport (Gomez-Ibanez & Meyer, 1993).

A second argument posited by advocates of privatization is that it taps an alternative new source of funds necessary to finance airport infrastructure for governments in fiscal distress. Some experts suggest that there is a pool of equity investors with a willingness to accept higher risks than the typical municipal bond investor and that this pool of equity investors can be a ready source of capital for airport infrastructure projects (AAAE/ARDF, 1992).

This argument is open to debate. Public entities in the United States are able to secure investment capital by issuing tax-exempt securities in the municipal bond market. In the case of airports, the standard practice is to issue revenue bonds that are secured by the stream of revenues that flow from the enterprise. An airport's size, as measured by passenger enplanements, volume of cargo, or general aviation activity has historically been an important determinant of its financial performance. In the case of publicly owned airports in the United States, only large and medium sized airports that are generally in good to excellent financial condition are attractive candidates for privatization. For example, in 1993 Atlanta Hartsfield International Airport generated $39.7 million in net income (Atlanta, 1993). Most large and medium size commercial airports in the United States are able to obtain financing at a lower cost of capital because of their tax exempt status. On the other hand, the income of the majority of small commercial service airports and for small general aviation airports is inadequate to support the issuance of revenue-backed airport bonds. Indeed, many of these airports fail to cover even their operating costs. Therefore, the argument that privatization leads to increased investment in airport infrastructure is limited.

Private investors are not the only interests that support privatization. Many cash-strapped local units of government in the United States that own and operate airports support privatization because of the desire to receive the windfall of cash that would be generated by a sale. The sale of BAA raised $2.5 billion for the British treasury. Robert Poole of the Reason Foundation estimates that the net present value of the sale or long-term lease of Los Angeles International (LAX) would earn the city of Los Angeles approximately $1 billion (Poole and Snyder, 1992). That privatization provides a source of much needed cash infusions to local units of government is a point that has validity. The desire to capture the proceeds from the sale of an existing public airport has been a strong factor for motivating many privatization proposals. Local units of government that own and operate airports view these facilities as one of their largest capital investments from which they are not earning any direct return. According to Clifton Moore, Director of Airports for the City of Los Angeles, "the city of Los Angeles never has received five cents return on the work and investment that it has made" (Reason, 1990). Moore's reference is to the legal obligation on the part of the recipients of federal airport grants that all airport revenues be used for airport purposes. These assurances are based on the fear that if municipal governments are allowed to take the proceeds from airports to finance other programs, then airport needs might be neglected. Municipal officials might delay expansion of needed airport capacity because of other pressing needs. These conditions attached to federal airport grants present a legal obstacle that has prevented outright privatization from occurring in the United States to date.

The Public Administration Perspective

There are other weighty arguments for taking a cautious approach to airport privatization. Unlike private managers, who have the profit motive as their primary objective, public administrators are charged with serving the public interest. Although defining the public interest is problematic, it encompasses a range of values and objectives broader than just the pursuit of profit. History is replete with examples of robber barons stripping viable enterprises of their assets through complex financial maneuvers and the use of debt instruments. The experience of the 1980s with leveraged buy-outs demonstrates the dangers of leverage. The possibility of unscrupulous operators controlling one or more of our nation's airports is disturbing. The prospect of a major hub airport filing for bankruptcy protection is cause for alarm. If private firms serve the purpose of pursuing their own private economic gain through vigorous competitive behavior in the marketplace, the government's role is to protect the public interest from damage that the private sector might inflict on society at large (Hart, 1984).

From its early years, aviation has been rightfully considered a "public good." Public goods are characterized by two properties: it is neither feasible nor desirable to ration their use (i.e., to exclude any individual). Because of the monopolistic nature of airports and the positive and negative externalities associated with air transportation, market approaches to airports have often been viewed as inappropriate. Most commercial service airports have long been considered to be natural monopolies. A natural monopoly is an industry in which the most efficient form of organization is a single entity. However, to prevent abuses associated with monopolies, public ownership or government regulation is required. While the risks of monopoly with respect to airports have been challenged in recent years (Snyder and Poole, 1992; Gomez-Ibanez and Meyer, 1992), it remains a concern among many policy analysts and public administrators involved in aviation issues.

Arguments in favor of privatization can also be misleading. While often presented as a panacea, the fact is that relatively few airports in the United States are attractive candidates for privatization. The United States presently has approximately 17,500 landing sites, of which over 12,000 are privately-owned general aviation facilities,leaving only 5,400 publicly-owned facilities. (AOPA, 1993). Together, these two groups of airfields and other landing sites form a nationwide network for conducting commerce and other vital services that can be best supplied by air. At the core of this network are the 3,285 airports subject to federal planning criteria as outlined in the National Plan of Integrated Airport System. Only 486 of these airports operate control towers, which makes service by commercial airlines more likely. Of the commercial service airports, the vast majority of passengers are processed by the top 50 airports, which accounted for well over 80% of the passengers in 1992. Only airports that have a sufficient number of passengers, cargo, or general aviation traffic warrant the interest of private investors. In effect, then, privatization represents a plan to sell off the "crown jewels" of the airport system. Since airports in the United States truly constitute a system, the viability of the system would be threatened if the centerpieces were removed.

Conclusion

The purpose of this paper has been to introduce the concept of airport privatization and to present a balanced view of the arguments for and against privatization. Airports in the United States represent the full range of the airport ownership continuum, from complete government ownership and operation to full private ownership and operation, with a range of mixed arrangements in between. The custom of publicly owned airports entering into leases with private management firms to operate an airport, or contracting out for selected services is well established in the United States. However, total privatization, defined as the outright sale of a publicly-owned airport to a private enterprise, continues to generate considerable opposition. This opposition is well founded in that the arguments for privatization are sometimes overstated. More fundamentally, there are formidable arguments against privatization that arise from the understanding that institutions that serve the public should be organized in a fundamentally different way than private organizations.

The goals of private sector enterprises are easy to identify: profitability, growth, and market share. Public organizations, on the other hand, have more complex missions in their obligation to protect the public interest. Thus, managers of public organizations, unlike CEOs of private firms, are constantly balancing efficiency and productivity goals with goals of equity and equal opportunity. Given the complex goals that public enterprises must balance and the dangers involved in total privatization, the prudent course of action is to seek less radical solutions for the problems facing airports today. In this regard, the systems that have attempted to combine elements of the market approach with a public administration approach would seem to represent the models worth replicating.

References

AAAE/ARDF (1992, April). An airport executive's guide to privatization. A study conducted by the American Association of Airport Executives and the Airport Research and Development Foundation.

AOPA. (1993). Aviation statistics. Aviation USA. Frederick, MD: Aircraft Owners and Pilots Association.

Atlanta Hartsfield International Airport. (1993) Annual Report.

Beer, S. H. (1973, Fall). The modernization of American federalism. Publius: The Journal of Federalism. 3 (1).

Chapman, C. J., & Lees, E. J. (1993, May). Airport privatization....a cure for the crowded skies? Transactional Finance. 5 (2).

Coleman, B. (1994). Mortars don't hurt highflying BAA, resilient operator of London's airports. Wall Street Journal. March 5, 1994.

Gesell, L. E. (1994). Airport privatization (Part I): the rush to deregulate. Paper presented at the 34th Airport Management Short Course, American Association of Airport Executives, Monterey, CA. January 6, 1994.

Gomez-Ibanez, J. A. & Meyer, J. R. (1993). Going private: the international experience with transport privatization. Washington D.C.: The Brookings Institution.

Hart, D. K. (1984, March). The virtuous citizen, the honorable bureaucrat, and public administration. Public Administration Review. 44 (2).

Payson, J. E., & Steckler, S. A. (1992, July). Expanding airport capacity: getting airport capacity off the ground. Los Angeles, CA: Reason Foundation.

Poole, R. W. & Snyder, B. E. (1992, August). Privatizing Los Angeles international airport: analyzing the alternatives. Los Angeles, CA: Reason Foundation.

Reason Foundation (1990, August). Airport privatization: What the record shows. (Policy Insight #124) Los Angles, CA: Author.

Wilson, W. (1887, June). The study of administration. Political Science Quarterly. 2.

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