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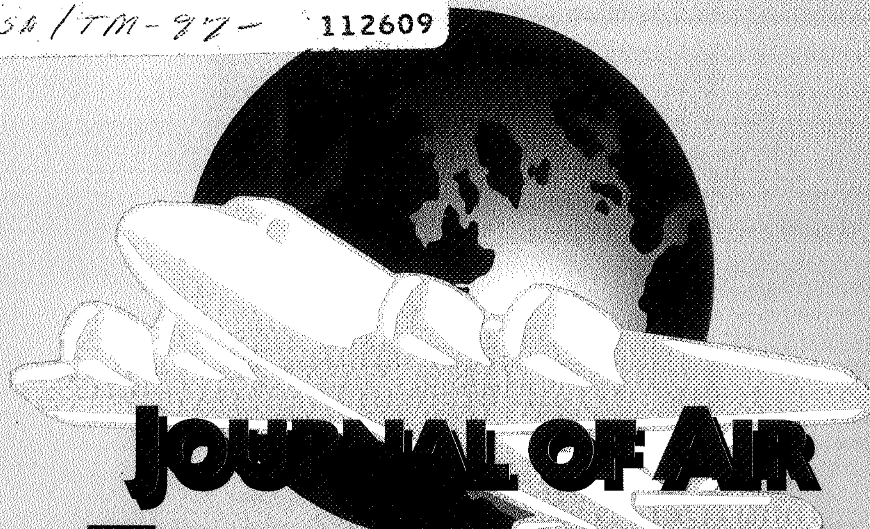

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Dedicated to the memory of

Dr. Larry Truitt,

Editorial Board Member,

contributing author,

and friend.

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Culture and Workplace Communications: A Comparison of the Technical Communications Practices of Japanese and U.S. Aerospace Engineers and Scientists

21 P.

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ABSTRACT

The advent of global markets elevates the role and importance of culture as a mitigating factor in the diffusion of knowledge and technology and in product and process innovation. This is especially true in the large commercial aircraft (LCA) sector where the production and market aspects are becoming increasingly international. As firms expand beyond their national borders, using such methods as risk-sharing partnerships, joint ventures, outsourcing, and alliances, they have to contend with national and corporate cultures. Our focus is on Japan, a program participant in the production of the Boeing Company's 777. The aspects of Japanese culture and workplace communications will be examined: 1.) the influence of Japanese culture on the diffusion of knowledge and technology in aerospace at the national and international levels; 2.) those cultural determinants-the propensity to work together, a willingness to subsume individual interests to a greater good, and an emphasis on consensual decision making-that have a direct bearing on the ability of Japanese firms to form alliances and compete in international markets; 3.) and those cultural determinants thought to influence the information-seeking behaviors and workplace communication practices of Japanese aerospace engineers and scientists. In this article, we report selective results from a survey of Japanese and U.S. aerospace engineers and scientists that focused on workplace communications. Data are presented for the following topics: importance of and time spent communicating information, collaborative writing, need for an undergraduate course in technical communication, use of libraries, use and importance of electronic (computer) networks, and the use and importance of foreign and domestically produced technical reports.

INTRODUCTION

The technological advancements and achievements made by post-World War II Japan are nothing short of extraordinary. The Japanese economic miracle, as it is often called, remains the focus of scholars and policymakers. Indeed, the number of essays, articles, studies, dissertations, and books dealing with Japan is voluminous and shows no signs of abatement. A review of the available literature and research indicates the following: Japanese public policy (e.g., economic, industrial, and technological) is focused, consistent, pragmatic, and adaptive, and it recognizes that knowledge and technological leadership are critical to national economic performance. Unlike those policies in the U.S., Japanese technological policies incorporate many diffusion-like features identified by Branscomb (1993). Chief among these are the capacity to adjust to technological change across the entire industry structure and the effective diffusion of imported and domestically produced knowledge and technology. Of particular importance is the role played by the Ministry of International Trade and Industry (MITI), the leading state actor in the Japanese economy. MITI maintains close and continual contact with industry, fosters industrial collaboration and the diffusion of knowledge among firms, and uses industry associations and advisory committees to review and endorse technology projects an d policies. As a matter of national policy, MITI nurtures the development of such knowledge-intensive industries as aircraft manufacturing as sources of knowledge that can be adapted to other industries. It fosters research collaborations, alliances, and linkages as a means of accessing and importing (external) knowledge and technology.

Innovation, a catalyst for growth, can be divided into three types-organizational, product, and technological. Organizational innovation in Japan has been achieved by streamlining the structure of t he company, wisely managing the enterprise, and organizing the production and distribution systems to optimize marketing and export goals. Product innovation in Japan involves the manufacture of goods that reflect customer requirements and are readily adaptable to changes in consumer behavior and spending. Technological innovation in Japan involves the importation, absorption, adaptation, and development of new knowledge and technology to produce new products, processes, or services and to improve existing ones (Herbig, 1995). Technological innovation in Japan, as distinguished from that in the United States, is characterized by, among other things, globalization and international networks and international collaboration. It is also distinguished from that in the United States by its culture and patent system and the use and management of knowledge and technology.

Japanese companies are exceptional innovators. Japanese firms, have been described as knowledge companies that are constantly importing and creating knowledge, diffusing it throughout the organization, and quickly embodying it in new and existing products, processes, or services. The firms efforts are assisted by a (national) system of innovation that stimulates research and development (R&D), promotes technological innovation, and excels at taking knowledge and technology from around the world and using them to develop and improve products, processes, or services. Westney (1993) states that a widespread consensus has emerged on some key characteristics of the technological behavior of Japanese firms, when compared to those in the United States: (a) shorter (product) development time cycles; (b) more effective design for manufacturability; (c) more incremental product, process, and service improvement; (d) innovation dominated by large, rather than small firms; (e) a stronger propensity to competitive matching of products and processes; (f) a greater propensity for interfirm collaboration in developing and diffusing technology; (g) a higher propensity to patent; (h) weakness in science-based industries; and (i) more effective identification and acquisition of external knowledge and technology on a global scale.

Finally, the diffusion of knowledge and technology is encouraged by the fact that Japanese industries and firms have developed cooperative vertical, and sometimes horizontal, relationships. The keiretsu, a group of cooperative, and often subcontracting, firms is an example. A long-term, semi-fixed relationship between users and suppliers and among affiliated firms, subcontractors, vendors, and others enables the participants to share knowledge and technology related to product and process innovation. The long-term transaction involved in such relationships includes not only an economic component, but also a social one comprised of trust, loyalty, and power. Moreover, the importation, absorption, diffusion, and application of knowledge and technology are facilitated by a number of determinants in the Japanese culture, a point on which we elaborate in the background section of this article.

BACKGROUND

Cultural, ontological, and epistemological principles are thought to influence the organization and diffusion of knowledge in a society. A variety of cultural determinants is responsible for the unique position that knowledge holds in Japanese society. Although the Japanese attitude toward science and the organization of knowledge assumes similar organizational and phenomenal forms as in Western countries, the attitude is based on different cultural principles. Here are two examples. First, in the U.S., the results of science that are paid for with public (i.e., taxpayer) money are considered to be public knowledge. Hence, scientific knowledge is published and made accessible to any and all for critical assessment. Science in Japan is formed not as public knowledge but as corporate knowledge; knowledge belongs first to the corporation; it is acquired and developed, organized, and used chiefly within the corporation as insider knowledge. Thus, knowledge is neither individual nor public property. Furthermore, in Japan, knowledge is a commodity and possessing knowledge is a privilege. Second, the U.S. and Japanese patent systems are shaped by fundamentally different purposes. Whereas the American system protects individuals, the Japanese system balances individual rights with broader social and industrial interests. In the United States, the patent system exists to provide an incentive for innovation by rewarding an individual inventor with the right to exclude others from using or copying his or her invention. That reward is made in exchange for a full, complete, and enabling disclosure of the invention to the public. In contrast, in Japan a family philosophy exists. The Japanese system focuses more on the goal of promoting Japanese industry and technological development by diffusing patent information through Japanese industry. An innovation does not exist merely for the inventor or inventing firm but for the benefit of the country as a whole. The entire Japanese patent system is aimed at avoiding conflict and promoting cooperation through cross-licensing.

Next, we review seven cultural determinants: (a) group think versus individual expression; (b) differences in high-context and low-context communications; (c) attitudes about contractual agreements; (d) the influence of religion on Japanese culture; (e) traditional mental telepathy and apparent versus real messages as communications norms; (f) surface/bottomline messages; and (g) the Japanese preference for informal (oral) communications over formal (written) communications. Although our review provides useful insights into understanding how culture affects the organization and diffusion of knowledge in Japan, our review is not exhaustive. Missing from this discussion, for example, is the influence of linguistics and non-verbal communication.

Group Think Versus Individual Expression

Perhaps the most striking feature that distinguishes the organization and diffusion of knowledge in Japan from that of Westerners is the concept of group think based on hierarchy. Ford and Honeycutt (1992) trace the existence of a hierarchical structure to Confucianism that was brought from China to Japan during the fifth century. Confucianism teaches that "the need for submission to elders an d those of superior position in the group" is a prerequisite of a society (p. 31). Group think is an extension of the holism in society that provides a basis for corporate decision making (McNamara and Hayashi, 1994). Individualism, which is cherished in the West, is not considered a virtue in Japanese society. The Japanese expression, "the nail that stands up will be pounded down," exemplifies the clear distaste for individualism that most Westerners note as one of the distinct features of Japanese unwritten codes (Maher and Wong, 1994; Buckett, 1991). In considering the role of the individual in society, Nakane (1972) asserts that an individual is defined by an attribute that makes up a frame. A group or a frame is formed when individuals share common attributes. Thus, the individual has meaning only within the context of a group. The notion of collectivism is ubiquitous from private to public, from family to corporate organizations, and from local to national levels. The emphasis on harmony among individuals in groups mirrors "the communal ethic of Shinto" (Maher and Wong, 1994); it is assumed that the homogeneous nature of Japanese society makes it possible to carry out group think.

High Context/Low Context Communication

Hall and Hall (1987) define a high context (HC) communication as one in which most of the information is already in the person, while very little is in the coded, explicit, transmitted part of the message. A low context (LC) communication is just the opposite; that is, the mass of the information is vested in the explicit code. Japan has never been invaded by another nation. Thus, a homogeneous and isolated Japanese society could afford to foster HC communication in which almost everyone understands the beliefs, principles, and assumptions about how to go about interacting with people (McNamara and Hayashi, 1994). Conversely, the United States is a heterogeneous, LC society in which a melting pot approach to communication is the norm. In a society whose citizens have diverse national and ethnic backgrounds, it is inevitable that everything communicated to others has to be explicit. Assumptions also have to be explained because there is no single set of beliefs or rules of conduct governing society. Therefore, "explicit digital and verbal communication is an essential element in Western, and especially American, culture" (McNamara and Hayashi, 1994). It is worth mentioning that there is always a danger in classifying everything in dichotomous fashion. For example, Inaba (1988) argues that Hall and Hall's (1987) classification of Japanese and U.S. citizens as HC and LC respectively may be shortsighted, for it excludes nonverbal behavior. However, the literature supports Hall and Hall's (1987) assertions about Japanese and U.S. communications norms.

Contractual Agreements

The concept of a contractual agreement is foreign to the Japanese. Nakane (1972) states that "any sense of contract is completely lacking in the Japanese, and to hope for any change along the lines of a contractual relationship is almost useless" (p. 80). The influence of common law may provide the foundation of contractual agreements that are so important in the United States. Goldman (1994) suggests that it is so important for Japanese to acknowledge other people based on ningensei or "human beingness" that there is no room for logic or rules to be laid out. Ohsumi (1995) also stresses the fact that U.S. society is based on rules, but Japanese society has low regard for rules. The Japanese preference to do without contracts and rules may be related to such cultural attributes as group think and HC. In Japanese society, it is assumed that everyone communicates under the same pre-existing set of beliefs; therefore, there is no need to spell out explicitly what is expected or to establish written rules.

The Influence of Religion

In Japan, religious beliefs are assumed to be an integral part of an individual's history. Although Japanese society is experiencing a noticeable decline in religious affiliation, religious ritual, symbolism, and attitude continue to play an important role among the Japanese people (Maher and Wong, 1994). The Japanese are deeply influenced by ideas and concepts coming from animism, Buddhism, Confucianism, Shinto, Taoism, and Zen. Elements of Confucianism, Buddhism, and Shinto continue to affect the daily lives of the Japanese although the trend toward secularism noted recently in the West actually began almost three centuries ago in Japan (Reischauer and Jansen, 1995). The strong work ethic and an emphasis on harmony come from Confucianism. Matsuda (1991) correlates the ideas of group actions, shared responsibility, harmony, and a strong loyalty to the group with Buddhism, which teaches that everything in nature has life, and therefore one's life is a part of nature. Shinto has been the official national religion since the Meiji Restoration of 1868. Originating from Buddhism, Shinto evolved as a set of beliefs associated with the foundation myths of Japan and with the cult of imperial ancestors. Shinto focused attention within a Japan that was becoming more nationalistic and "eventually came to seek a new unity under symbolic imperial rule" (Reischauer and Jansen, 1995, p. 209).

Traditional Mental Telepathy: Ishin-denshin and Haragei

As a homogeneous society, Japan has nurtured its people to communicate according to the principle of Ishin-denshin or "if it is in one heart, it will be transmitted to another heart" (Kato and Kato, 1992). In essence, a message should be conveyed to a receiver without using many words because both parties are capable of understanding each other wordlessly. Gudykunst and Nishida (1993) de scribe Inshin-denshin as "traditional mental telepathy" (p. 150), for it assumes that a transmitted message will be understood by a receiver. Inshin-denshin is closely related to another Japanese concept haragei, literally meaning "belly language." Haragei can be understood as "the center of abdominal respiration that is in charge of ki, which is the mind and the body that acts almost like air that is inhaled and exhaled by a person" (Lebra, 1993, p. 65).

Surface/Bottomline Messages (Tatemae/Honne)

Human relationships in Japan have two sides, tatemae and honne. "Tatemae is front face or what is presented and honne is true feelings privately held" (Hall and Hall, 1987). "Honne is what a person really wants to do, and tatemae is his submission to moral obligation" (Gudykunst and Nishida, 1993). The Japanese have two modes of communication; tatemae is a formal communication and honne is the language of the heart (Kato and Kato, 1992). Tatemae usually is exchanged during business hours and honne surfaces outside office hours. The meanings of tatemae and honne are closely associated with what Ford and Honeycutt (1992) call "surface or appearance versus result or bottomline" (p. 29). The same concepts can be thought of as "the apparent versus real" (Maher and Wong, 1994). The Japanese tend to place greater importance on process than the results (Ford and Honeycutt). Thus, such seemingly meaningless rituals as an exchange of business cards and conversations without much essence in tatemae mode can be viewed as a way of showing respect for each other.

Preference for Informal Communication

The literature establishes that the Japanese rely heavily on informal communication (Kato and Kato, 1992). Personal contact or "knowing who" is extremely important. Of course, informal communication is very important in the U.S., but for the Japanese, informal communication has some peculiar features. For example, "the old boys' network provides links to practically every board room, laboratory, and factory in Japan" (Cutler, 1989). This network is based on alumni networks of major colleges and universities that actually connect academia, government, and industry. Kokubo (1992) notes that "researchers make courtesy calls on university professors, who serve as middlemen to relay information to their networks of alumni" (p. 34). In addition to relying on colleges and universities, the Japanese extend their networking capability through such various people links as professional societies, consulting groups, collaborative work groups, and professional and technical conferences and meetings (Cutler, 1989).

Information gathering through informal contacts is central to the idea of Japanese competitive intelligence. Kokubo (1992) states that "competitive intelligence consists of: (a) gathering technical information, (b) distributing the acquired information to 'linking agents,' and (c) analyzing and arranging information for decisionmaking" (p. 35). In Japanese business and industry, each project has a champion who works with staff members in the technology information office and patent department, senior researchers, and information professionals (e.g., librarians). Japanese managers at all levels are expected to gather, disseminate, and utilize the latest information available through the company grapevine and from industry-wide conferences and trade shows, zaibatsu groups or clubs, and business, professional, and technical societies (Kokubo, 1992).

METHODS AND SAMPLE DEMOGRAPHICS

This research was conducted as a Phase 4 activity of the NASA/DOD Aerospace Knowledge Diffusion Research Project (Pinelli, Kennedy, & Barclay, 1991). Phase 4 of the project focuses on the diffusion of knowledge and technology at the national and international levels and the cultural, political, and social factors that influence diffusion.

Mail (self-reported) Japanese-language questionnaires were sent to 13 Japanese aerospace engineers and scientists in academia and industry (in Japan) who have collaborated with the project team in other Phase 4 activities and understood the objectives of the study. We asked our colleagues to identify appropriate subjects to include on the questionnaires. A total of 94 surveys were completed during March-June 1994. We used the 340 surveys completed in

1992 by U.S. aerospace engineers and scientists at the NASA Ames and Langley Research Centers as our baseline for comparison with all Phase 4 survey data. For the complete methodology and results of the Japanese/U.S. study see Pinelli, Barclay, and Kennedy (1994).

A t-test (for interval data) was used to estimate if the observed differences between Japanese and U.S. aerospace engineers and scientists are statistically significant. A significant test result (p .05) indicates that there is only a 5 percent probability that the observed difference between the two responses can be attributed to chance. A significant result is therefore interpreted as evidence that a difference between the responses of the two groups of respondents on the factors or variables in question are influenced by (or vary systematically with) cultural differences between the two groups.

Finally, every research design and methodology has its weakness. Ours is no different. The fact that neither the Japanese nor the U.S. samples were randomly drawn lessens the generalizability of the results. The fact that the U.S. sample was composed of government-affiliated aerospace engineers and scientists working almost entirely in research also lessens the generalizability of the data.

Demographic Findings

The professional duties of the 94 Japanese aerospace engineers and scientists in this study are equally divided among design/development, research, and teaching/academic responsibilities. Most work in academia or government and very few work in industry. All of their U.S. counterparts work in government and most perform research duties. The Japanese respondents reported an average of 15 years of professional work experience, and the U.S. respondents reported an average of 17 years of professional work experience.

In terms of education, 45 percent of the Japanese respondents held master's degrees and 32 percent held doctorates; 95 percent of them were educated as engineers and 100 percent perform engineering duties. Among the U.S. respondents, 46 percent held master's degrees and 27 percent held doctorates; 80 percent were educated as engineers and 17 percent as scientists. In terms of their current duties, 69 percent of the U.S. respondents performed engineering duties and 27 percent performed science duties. Eighty-nine percent of the Japanese respondents reported membership in a professional/technical society, and 78 percent of the U.S. respondents were members of a professional/technical society. Because personal contacts are very important for the Japanese, it is reasonable to speculate that Japanese join such professional/technical societies to get to know the right people, to exchange information, and ultimately to work on projects jointly.

Language Fluency

Japanese respondents reported proficiency in reading and speaking English whereas the U.S. respondents reported little proficiency in reading and speaking

Japanese (Table 1). The study of the English language is compulsory in Japan beginning in the seventh grade, and proficiency in a third language is compulsory in colleges and universities in Japan, giving the Japanese "a major linguistic advantage over their U.S. counterparts" (Grayson, 1984, p. 216). German was the third most popular third language among the Japanese respondents. The preference for German as a third language may be attributed to the fact that German systems influenced the modernization of Japan during and after the Meiji Restoration. The Japanese Constitution, parliament, and judicial systems that were created closely resembled those of German systems during the Bismarck era (Sansom, 1950). Among the U.S. engineers and scientists, 5 percent reported proficiency in speaking Japanese and 3 percent reported proficiency in reading Japanese. French and German ranked second and third in terms of speaking (22 and 15 percent respectively) and reading proficiency (32 and 21 percent respectively) among the U.S. respondents.

Table 1
Language Fluency of Japanese and U.S. Aerospace Engineers and Scientists

Language	*% Read*	*% Speak*	*Read Ability*[a]	*Speak Ability*[a]
	Japan (n = 94)			
English	100	99	3.8	3.0
French	30	22	1.7	1.6
German	71	40	1.7	1.6
Japanese[b]	100	100	—	—
Russian	18	10	1.3	1.6
	U.S. (n = 340)			
English[b]	100	100	—	—
French	32	22	1.7	1.6
German	21	15	1.7	1.6
Japanese	3	5	1.7	1.7
Russian	6	5	1.6	1.5

[a]A 5-point scale was used to measure ability with 1 being passable and 5 being fluently; hence, the higher the average (mean) the greater the ability of survey respondents to speak/read the language.

[b]This is the native language for these respondents.

PRESENTATION OF THE DATA

Data are presented for the following topics: importance of and time spent communicating technical information, collaborative writing, need for an undergraduate course in technical communications, use of libraries, the use and importance of electronic (computer) networks, and the use and importance of foreign and domestically produced technical reports.

Importance of and Time Spent Communicating Information

Japanese and U.S. aerospace engineers and scientists were asked a series of questions regarding (1) the importance of the ability to communicate technical information effectively, (2) change over the past five years in the amount of time spent communicating information, and (3) change in the amount of time spent communicating information as a function of professional (career) advancement. About 1 percent and 8 percent of the Japanese and U.S. respondents indicated that the ability to communicate information effectively was unimportant. About 95 percent and 91 percent of the Japanese and U.S. respondents reported that the ability to communicate information effectively was important. About 60 percent and 26 percent of the Japanese respondents indicated that over the past 5 years, the amount of time they spent communicating in formation had increased or had stayed the same. About 70 percent and 24 percent of the U.S. respondents reported that over the past five years the amount of time they spent communicating information had increased or had stayed the same. About 35 percent of the Japanese and about 65 percent of the U.S. respondents reported that as they have advanced professionally, the amount of time they spent communicating information had increased. About 34 percent of the Japanese and about 26 percent of the U.S. respondents indicated that the amount of time had stayed the same.

Survey respondents were asked to report the number of hours they spent each week producing (i.e., written and oral) and communicating information and the number of hours they spent each week working with information (i.e., writing and orally) received from others (Table 2). Data appearing in Table 2 indicate that the Japanese aerospace engineers and scientists in this study devoted significantly more hours each week than did their U.S. counterparts to preparing written communication. Conversely, U.S. respondents spent more hours each week communicating information orally than did their Japanese counterparts.

Table 2
Time Spent Each Week Communicating Information by Japanese and U.S. Aerospace Engineers and Scientists

Activity	*Japan Hours*	*U.S. Hours*
Producing written materials	11.3 (Median 10.0)	8.3** (Median 6.0)
Communicating information orally	4.6 (Median 4.0)	8.7** (Median 8.0)
Working with written information received from others	6.5 (Median 5.0)	7.7* (Median 5.0)
Receiving information orally from others	3.5 (Median 2.0)	6.3* (Median 5.0)

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

Similarly, the U.S. respondents spent significantly more hours each week working with written communications received from others. Likewise, the U.S. respondents devoted significantly more hours receiving information orally from others than did their Japanese counterparts.

Collaborative Writing

The process of collaborative writing was examined as part of this study. Survey participants were asked whether they wrote alone or as part of a group (Table 3). Approximately 21 percent of the Japanese respondents and 15 percent of the U.S. respondents wrote alone. Although a higher percentage of the U.S. respondents than the Japanese respondents wrote with a group of two to five people or with a group of five or more people, writing appears to be a collaborative process for both groups.

Japanese and U.S. aerospace engineers and scientists were asked to assess the influence of group participation on writing productivity (Table 4). Only 35 percent of the Japanese respondents and 32 percent of the U.S. respondents indicated that group writing is more productive than writing alone. Eighteen percent of the Japanese respondents and 32 percent of the U.S. respondents found that group writing is about as productive as writing alone, and 26 percent of the Japanese respondents and 20 percent of the U.S. respondents found that writing in a group is less productive than writing alone. Of the respondents who did not write alone, 48 percent of the Japanese group and 47 percent of the U.S. group worked with the same group when producing written technical communications (Table 5). The average number of people in the Japanese group was 5.11, and the average number of people in the U.S. group was 3.21. Thirty-one percent of the Japanese respondents worked in an average number of 3.10 groups, each group containing an average of 3.14 people. Forty percent of the U.S. respondents

Table 3
Collaborative Writing Practices of Japanese and U.S. Aerospace Engineers and Scientists

Collaborative Practices	*Percent of Writing Time*	*Percent Who Use the Practice*	*(n)*
		Japan	
Alone	70.1	21	(20)
With one other person	*12.8	57	(54)
With a group of two to five people	14.9	53	(50)
With a group five or more people	2.2	11	(10)
		U.S.	
Alone	61.1	15	(50)
With one other person	20.7	72	(246)
With a group of two to five people	15.6	61	(208)
With a group five or more people	2.1	14	(47)

*Percentages do not total 100.

Table 4
Opinions of the Influence of Group Participation on Writing Productivity

Opinion	Japan *% Agree*	Japan *(n)*	U.S. *% Agree*	U.S. *(n)*
A group is more productive than writing alone	35	(33)	32	(110)
A group is about as productive as writing alone	18	(17)	31	(107)
A group is less productive than writing alone	26	(24)	20	(68)
I only write alone	21	(20)	15	(50)

worked in an average number of 2.82 groups, each group containing an average of 3.03 people.

An Undergraduate Course in Technical Communication

Japanese and U.S. participants were asked their opinions regarding the desirability of undergraduate aerospace engineering and science students taking a course in technical communications. Approximately 72 percent of the Japanese respondents and 96 percent of the U.S. participants indicated that aerospace engineering and science students should take such a course. Approximately 44

Table 5
Number of Groups and Group Size of Collaborative Writing Practices of Japanese and U.S. Aerospace Engineers and Scientists

Groups and Group Size	Japan *%*	Japan *(n)*	U.S. *%*	U.S. *(n)*
Worked with same group				
Yes	48	(45)	47	(161)
No	31	(29)	38	(129)
I only write alone	21	(20)	15	(50)
		(n)		(n)
Number of people in groups				
Mean (Average)	5.11	(45)	3.21*	(161)
Median	3.00	(45)	3.00	(161)
Number of groups				
Mean (Average)	3.10	(29)	2.82*	(129)
Median	3.00	(29)	3.00	(129)
Number of people in each group				
Mean (Average)	3.14	(29)	3.03	(129)
Median	3.00	(29)	3.00	(129)

*$p < .05$.

percent of the Japanese participants and about 90 percent of the U.S. participants indicated that the course should be taken for credit (Table 6).

The Japanese and U.S. participants who thought that undergraduate aerospace engineering and science students should take a course in technical communications were asked how the course should be offered. About 19 percent of the Japanese respondents indicated that the course should be taken as part of a required course, about 43 percent thought the course should be taken as part of an elective course, none thought it should be taken as a separate course, about 10 percent did not have an opinion, but only 28 percent of the Japanese respondents indicated that undergraduate aerospace engineering and science students should not have to take a course in technical communications/writing.

About 82 percent of the U.S. respondents indicated that the course should be taken as part of a required course, about 12 percent thought the course should be taken as part of an elective course, none thought it should be taken as a separate course, about 2 percent did not have an opinion, but only 4 percent of the U.S. respondents indicated that undergraduate aerospace engineering and science students should not have to take a course in technical communications/writing. A simple majority of the U.S. respondents (51 percent) indicated that the technical communications/writing instruction should be taken as a separate course, while only 21 percent of the Japanese respondents indicated that the technical communications/writing instruction should be taken as a separate course.

Table 6
Need for an Undergraduate Course in Technical Communications for Aerospace Engineering and Science Students

	Japan		*U.S.*	
Options	*%*	*(n)*	*%*	*(n)*
Taken for credit	44	(41)	90	(259)
Not taken for credit	15	(14)	4	(11)
Don't know	13	(12)	2	(6)
Should not have to take course in technical communications	28	(27)	4	(11)

Use of Libraries

Almost all of the respondents indicated that their organization has a library. Unlike the U.S. participants (9 percent), about 43 percent of the Japanese respondents indicated that the library was located in the building where they worked. About 55 percent of the Japanese and 88 percent of the U.S. respondents indicated that the library was outside the building in which they worked but was located nearby. For 52 percent of the Japanese group, the library was located one kilometer or less from where they worked. For about 81 percent of the U.S. respondents, the library was located one mile or less from where they worked.

Respondents were asked to indicate the number of times they had visited their organization's library in the past six months (Table 7). Overall and statistically, the Japanese respondents used their organization's library more than their U.S. counterparts did. The average use rate for Japanese respondents was 20.9 during the past six months compared to 9.2 for the U.S. respondents. The median six-month use rates for the two groups were 10.0 and 4.0, respectively.

Table 7
Use of the Organization's Library in Past 6 Months by Japanese and U.S. Aerospace Engineers and Scientists

	Japan		U.S.	
Number of Visits	%	(n)	%	(n)
0	12	(11)	11	(37)
1-5	16	(15)	43	(145)
6-10	29	(27)	21	(72)
11-25	19	(18)	14	(49)
26-50	16	(15)	7	(22)
51 or more	6	(6)	1	(4)
Does not have a library	2	(2)	3	(11)
Mean	20.9		9.2*	
Median	10.0		4.0	

*p < .05

Respondents were also asked to rate the importance of their organization's library (Table 8). Importance was measured on a five-point scale with one being not at all important and five being very important. A majority of both groups indicated that their organization's library was important to performing their present professional duties. About 73 percent of the Japanese aerospace engineers and scientists indicated that their organization's library was important or very important to performing their present professional duties. About 68 percent of the U.S. aerospace engineers and scientists indicated that their organization's

Table 8
Importance of the Organization's Library to Japanese and U.S. Aerospace Engineers and Scientists

	Japan		U.S.	
Rating	%	(n)	%	(n)
Very important	47.9	(45)	68.2	(232)
Neither important nor unimportant	42.6	(40)	15.6	(53)
Very unimportant	7.4	(7)	12.9	(44)
Do not have a library	2.1	(2)	3.2	(11)
Mean	4.2		4.0	
Median	4.0		4.0	

library was important or very important to performing their present professional duties. Approximately 7 percent of the Japanese respondents and approximately 13 percent of the U.S. respondents indicated that their organization's library was very unimportant to performing their present professional duties.

Use and Importance of Electronic (Computer) Networks

Survey participants were asked if they use electronic (computer) networks at their workplace in performing their present duties.

Approximately 55 percent of the Japanese respondents use electronic networks, and about 45 percent either do not use (30 percent) or do not have access to (15 percent) electronic networks (Table 9). About 89 percent of the U.S. respondents use electronic networks in performing their present duties and about 12 percent either do not use (9 percent) or do not have access to (3 percent) electronic networks. Statistically, U.S. respondents made greater use of electronic (computer) networks than did their Japanese counterparts.

Table 9
Use of Electronic (Computer) Networks by Japanese and U.S. Aerospace Engineers and Scientists

	Japan		*U.S.*	
Percentage of a 40-hour Work Week	*%*	*(n)*	*%*	*(n)*
0	4	(4)	1	(4)
1-25	50	(47)	53	(180)
26-50	1	(1)	17	(57)
51-75	0	(0)	8	(26)
76-99	0	(0)	9	(30)
100	0	(0)	1	(5)
Do not use or have access to electronic networks	45	(42)	12	(38)
Mean		4.2		30.1*
Median		1.5		20.0

*$p < .05$.

Respondents were also asked to rate the importance of electronic networks in performing their present duties (Table 10). Importance was measured on a five-point scale with one being not at all important and five being very important. Statistically, U.S. respondents rated electronic networks more important than did their Japanese counterparts. More Japanese (18.1 percent) than U.S. respondents (11.2 percent) indicated that electronic (computer) networks were neither important nor unimportant in performing their present professional duties.

Table 10
Importance of Electronic (Computer) Networks to Japanese and U.S. Aerospace Engineers and Scientists

	Japan		U.S.	
Rating	*%*	*(n)*	*%*	*(n)*
Very important	34.1	(32)	65.0	(221)
Neither important nor unimportant	18.1	(17)	11.2	(38)
Very unimportant	3.2	(3)	7.6	(43)
Do not use or have access to electronic networks	44.7	(42)	16.2	(38)
Mean	3.8		4.1*	

*p < .05.

Use and Importance of Foreign and Domestically Produced Technical Reports

To better understand the transborder migration of scientific and technical information (STI) via the technical report, survey participants were asked about their use of foreign and domestically produced technical reports (Table 11) and the importance of these reports in performing their professional duties (Table 12). Both groups make great use of their own technical reports (87 percent of the Japanese respondents use NAL reports and 97 percent of the U.S. group use NASA technical reports). In addition to their own reports, the Japanese respondents use NASA (89 percent); AGARD (60 percent); German DFVLR, DLR, and MBB (53 percent); and British ARC and RAE (48 percent) technical reports.

Table 11
Foreign and Domestically Produced Technical Reports Used by Japanese and U.S. Aerospace Engineers and Scientists

	Japan		U.S.	
Report	*%*	*(n)*	*%*	*(n)*
NATO AGARD*	59.6	(56)	82.2	(236)
British ARC and RAE	47.9	(45)	54.0	(155)
ESA	24.5	(23)	5.9	(17)
Indian NAL	3.2	(3)	6.3	(18)
French ONERA	39.4	(37)	41.1	(118)
German DFVLR, DLR, and MBB	53.2	(50)	36.2	(104)
Japanese NAL	87.2	(82)	11.5	(33)
Russian TsAGI	2.1	(2)	8.4	(24)
Dutch NLR	23.4	(22)	19.9	(57)
U.S. NASA	89.4	(84)	96.5	(277)

*Advisory Group for Aerospace Research and Development.

In addition to their own reports, the U.S. group uses AGARD (82 percent) and British ARC and RAE (54 percent) technical reports. Neither group makes great use of Indian NAL, Dutch NLR, ESA, or Russian TsAGI technical reports. Survey participants were also asked about their access to these technical report series. Overall, the U.S. group appears to have better access to foreign technical reports than do their Japanese counterparts. Both groups have about equal access to NASA technical reports.

Table 12
Importance of Foreign and Domestically Produced Technical Reports to Japanese and U.S. Aerospace Engineers and Scientists

	Japan		*U.S.*	
Report	*Rating*[a]	*(n)*	*Rating*[a]	*(n)*
NATO AGARD	3.67	(85)	3.42	(282)
British ARC and RAE	3.12	(85)	2.89	(266)
ESA	2.78	(79)	1.44*	(242)
Indian NAL	2.02	(52)	1.40*	(241)
French ONERA	2.97	(79)	2.25*	(257)
German DFVLR, DLR, and MBB	3.15	(84)	2.20*	(247)
Japanese NAL	3.94	(93)	1.63*	(239)
Russian TsAGI	2.23	(43)	1.60*	(231)
Dutch NLR	2.65	(60)	1.81*	(246)
U.S. NASA	4.46	(92)	4.26	(285)

[a]A 5-point scale was used to measure importance with 1 being the lowest possible importance and 5 being the highest possible importance. Hence, the higher the average (mean) the greater the importance of the report series.

*$p < .05$.

Technical report importance was measured on a five-point scale with one being not at all important and five being very important. Both groups were asked to rate the importance of selected foreign and domestic technical reports in performing their present professional duties. The average (mean) importance ratings are shown in Table 12. The Japanese respondents rated U.S. NASA reports as most important (4.46), followed by NATO AGARD (3.67), and German DFVLR, DLR, and MBB reports (3.15). The U.S. group rated NASA reports most important (4.26), followed by NATO AGARD (3.42) and British ARC and RAE reports (2.89).

Discussion

Given the limited purposes of this study, the overall response rates, and the research design, no claims are made regarding the extent to which the attributes of the respondents in the studies accurately reflect the attributes of the populations being studied. A much more rigorous research design and methodology and larger samples would be needed before any claims could be made. Nevertheless, the findings do permit the formulation of the following general statements regarding the technical communications practices of the Japanese and U.S. aerospace engineers and scientists who participated in this study.

1. The ability to communicate technical information effectively is important to Japanese and U.S. aerospace engineers and scientists.
2. The Japanese engineers and scientists possess greater language fluency (i.e., reading and speaking) than their U.S. counterparts.
3. Statistically, U.S. aerospace engineers and scientists spent more time (e.g., hours each week) communicating information, orally and in writing, to others than did their Japanese counterparts.
4. Statistically, U.S. aerospace engineers and scientists spent more time (i.e., hours each week) working with written information received from others and receiving information orally from others than did their Japanese counterparts.
5. More Japanese respondents write alone than do their U.S. counterparts. Of those Japanese respondents who write with others, the average number of persons per group, the average number of groups, and the average number of people in each group exceeded the number in each category for their U.S. counterparts.
6. Both Japanese and U.S. respondents indicated that aerospace engineering and science students should take a course in technical communications. Both groups of respondents indicated that the course should be taken for academic credit.
7. Statistically, Japanese aerospace engineers and scientists had used a library more times in the past six months than did their U.S. counterparts. Both groups of respondents reported that a library is important to performing their present professional duties.
8. Statistically, U.S. aerospace engineers and scientists made greater use of electronic (computer) networks in performing their professional duties than did their Japanese counterparts. Statistically, the U.S. aerospace engineers and scientists in this study rated electronic (computer) networks more important in performing their present professional duties than their Japanese counterparts rated them.
9. U.S. and Japanese respondents made the greatest use of NASA technical reports and rank them highest in terms of importance in performing their professional duties. Both groups make extensive use of (and consider important) NATO, AGARD technical reports.

CONCLUDING REMARKS

Communicating with people with whom one does not share the same culture and native language creates significant challenges in a technical environment.

Nowhere is this more apparent than between Japan and the U.S., two major industrialized nations that are engaged in a number of collaborative as well as competitive business ventures in high technology fields. Perry notes that "when East meets West, the biggest abnormality is in communications," (1990, p. 53) and he attributes most communication problems to differences in culture and language. Although expanding telecommunications networks are rapidly bridging geographic distances, cultural differences among nations that are involved in collaborative business ventures may actually be contributing to a "new era of cultural confrontations and value conflicts" (Koizumi, 1990, p. 220).

The aerospace industry provides an excellent platform for investigating the influence of cultural differences on technical communication, for Japanese and U.S. manufacturers have enjoyed collaborative relationships since the end of World War II. After the Japanese aircraft industry was destroyed by the U.S. occupation forces, it gradually rebuilt itself by producing U.S. military aircraft (F-86s and F-15s) under the Japanese/U.S. Mutual Defense Assistance Agreement. During the 1960s and early 1970s, Japanese firms were subcontractors for major U.S. commercial aircraft firms, but by the 1980s, the Japanese producers had begun to play an active role in all phases of the production and sales of the new aircraft (Mowery & Rosenberg, 1985).

Japan and the United States continue to participate as active members of multinational collaborative efforts in the aerospace industry, and joint ventures between Japan and the United States are expected to flourish in commercial aerospace engineering throughout the 1990s. Through such collaborative projects, the Japanese aircraft industry is expected to transform itself from a supporting player with the West to a true joint venture member contributing its own talent (Mowery & Rosenberg, 1985). However, much of the success or failure of these collaborative projects may depend on the ability of the individual participants to communicate effectively and to identify and bridge the communication gaps created by cultural differences.

The 1980s witnessed an expansion of international commerce in terms of multinational production and joint manufacturing ventures. This is especially true in aerospace and the production of large commercial aircraft. This expansion has triggered interest in understanding the role of language and culture in the success of such ventures. Although a considerable body of knowledge about employee management practices has been developed, very little is known about how language and culture affect communication practices and information-seeking behaviors of engineers and scientists and how language and culture influence production, transfer, and use of scientific and technical information. Although the results of this study add to the knowledge base, they are more exploratory than conclusive and should be followed up with a larger study that will render results that are generalizable and can be used by managers and information developers and providers. A better understanding of and exposure to foreign language, culture, and business practices by Japanese and U.S. aerospace engineers and scientists can be an important step toward successful collaboration and may help create a level playing field for competition.

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NASA and Ethics: Training and Practice

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ABSTRACT

This paper is about the National Aeronautics and Space Administration (NASA) and the practice of professional ethics. It has been eleven years (Jan 28, 1986) since the Challenger accident and the past decade has been a time of investigation, assessment, and finger-pointing, as well as a time for introspection and internal reform. While there has been a lot of rhetoric about ethical commitments at NASA there has also been a dearth of empirically-based knowledge about what NASA and its various contractors are doing about professional ethics and what decisionmaking criteria are being used. It has also been a decade of cost-cutting and personnel cut-backs. One has to wonder what, in all this time, NASA has done to create an ethical climate in which events like the Challenger accident are less likely to happen.

In the fall of 1995, as a part of competition for a mini-grant from NASA, a request for funding to complete an ethical profile of the space agency was submitted. This paper contributes to knowledge about NASA and ethics by reporting on the results of the first year of research which was spent in doing a comprehensive literature and web-site review along with phone interviews and e-mail correspondence with NASA ethics officers. The goal of this first year was to see what ethics activity has been documented and to ascertain what work is being done to raise the ethical question with NASA.

Questions for which answers were sought include:

1. What is NASA now doing regarding ethics?
2. What training is being provided? By whom? For whom?
3. Are the answers to these questions different at different NASA installations?

The next section of this paper describes the information discovery process. The section following it summarizes the literature and interviews, then discusses implications. Tentative answers to the research questions are supplied, along with a summary and conclusions.

INFORMATION DISCOVERY PROCESS

The first step toward discovering information about NASA's administrative ethics practices was a comprehensive literature review. The second step was to search the Internet for web sites related to NASA and ethics. Identified NASA officials were then contacted by e-mail. The next part of this section describes the search for relevant literature. The one following it explains the Internet search and the use of e-mail as a part of the data gathering which occurred.

This research was funded in part with a grant from NASA.

Literature Review

The literature review about NASA and ethics practices utilized both computerized and bound databases. Computer databases searched were the Public Affairs Information Service (PAIS), First Search, Uncover, and InfoTrac General Periodical Index. Paper indices searched were the Reader's Guide (1995-September 1996), the New York Times Index (1994-July 1996), the Washington Post Index (1994-August 1996), and United States Government Documents. Key word pairs chosen for the initial search were: NASA and ethics, government and ethics, NASA and morals.

Searches of key words NASA and ethics uncovered two articles in the PAIS, one in the InfoTrac Index, one in the Uncover index and one in the First Search databases. Compared to over 2,000 articles referencing key words government and ethics, this suggests very little research dedicated to ethics and NASA. When key words NASA and morals were run, First Search's twenty-eight million record collection returned no articles, while PAIS reflected five articles and InfoTrac showed two. Number of articles about NASA and ethics, by database are shown in Table 1.

Table 1
Number of Articles about NASA and Ethics

	FirstSearch	*Genisys*	*InfoTtrac*	*PAIS*	*Uncover*
NASA* and Ethics	2	0	1	2	1

*"National Aeronautics and Space Administration" also searched to arrive at hit numbers.

The disappointingly small number of articles found under the above named pairs of key words led to computer searches under a host of other key words thought to address dimensions of ethics, including: ethics and space, science and ethics, NASA and human resources, NASA and management, NASA and plan*, NASA and policy, NASA and strategic plan, NASA and standards, NASA and risk management, NASA and corruption, NASA and finance, NASA and conflict of interest, NASA and decision, and NASA and whistle blowing. These search combinations identified many more articles. The most prolific categories are illustrated in Table 2. These results suggest the literature about NASA focuses on finance, policy, planning and management.

Paper indices do not allow for key word pairs, so similar categories were researched, and redirections were followed to other topics. Because of the broad classifications, numbers found were not recorded and only those articles which appeared applicable to the topic of NASA and ethics were reviewed.

All material found prior to February, 1995 was read and summarized in an annotated bibliography (Russell and Bruce, 1996). Additional material, through September, 1996, is cited in this article.

Table 2
Sources of Articles about NASA Practices

	FirstSearch	*Genisys*	*InfoTrac*	*PAIS*	*Uncover*
NASA* and Finances	1		149	25	0
NASA and Management	18	8	154	16	30
NASA and Policy	106	0	118	68	16
NASA and Plan	17	73	0	31	27

*"National Aeronautics and Space Administration" searched as well as NASA.

Most striking in this research was the meager amount of scholarly literature devoted to NASA and ethics and the tenacity required to uncover it. The comprehensive, year-long search yielded only three scholarly books (Hoban, 1989, 1993, and Vaughan, 1996) and nine academic journal articles confined to three journals: Journal of Business Ethics, Public Administration Review, and Space Policy. Most of what has been written about NASA is found in popular and trade magazines and newspapers.

After searching scholarly databases, the inquiry moved to the World Wide Web in an attempt to identify specific persons who might be knowledgeable about NASA and the practice of ethics. The next paragraphs describe that search.

World Wide Web Search

Specifically, for this paper, fifteen NASA related web sites were identified. All were searched for employees with the word ethics in their title or job descriptions. When ethics identified no one, the phrase employee development was searched. When neither of these returned a candidate, as a last resort, an e-mail was sent to the person listed as responsible for the human resources section of a web site. The e-mail request is shown in Figure 1.

Each web site was searched for mission statements, value statements and codes of ethics. Searches on the key words Ethics and Values resulted in security-forbidden messages on these sites. A search of the NASA Headquarters web site revealed one ethics course associated with contract management. It is offered as a part of the Project Managêment Development Process for NASA employees on the management career track.

Eleven installations were queried via the World Wide Web. Four did not respond. Of the seven which did respond, five installations gave usable information, though not all gave the same amount. Table 3 lists the installations and the titles of the officers to whom an e-mail message was sent. Table 4 identifies the installations which provided information.

This section has described the information search process. The next section summarizes the available literature about NASA and ethics. The one following it summarizes the Internet correspondence.

Figure 1
Message to NASA Web Sites

I am a graduate fellow working on a project funded by the Nebraska Space Grant Consortium. Professor Willa Bruce, of University of Nebraska at Omaha's Department of Public Administration, is my faculty mentor for this paper on administrative ethics as it is practiced and promoted within NASA.

We have completed an extensive literature review and now ask your assistance. After sampling what's been written about NASA, we need a direct response from ____________ Center to these questions:

1. What is NASA now doing regarding ethics?
2. What training is being provided? By whom? For whom?

Could you please answer these questions at your earliest convenience or forward this e-mail to someone who can? We are working under a very tight deadline, with a call for papers the end of October, so a response by October 7 would be greatly appreciated.

If you need any further clarification, I invite you to e-mail me, call me or Dr. Bruce at UNO (402) 554-2664.

Thank you very much for your help. We look forward to hearing from you.

Very truly yours,

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Table 3
NASA Installations and Title of Officials Contacted

NASA Headquarters	Associate General Counsel & NASA Ethics Official Chief Counsel Other - Title unknown
Ames Research Center	Human Resources - Ethics Director
Dryden Flight Research Center	Associate Director
Goddard Flight Research Center	Assistant Chief Chief Counsel
Jet Propulsion Lab	Manager of Business Ethics Other - Title unknown
Johnson Space Center	Chief Legal Counsel
Kennedy Space Center	Associate Counsel
Langley Research Center	Employee Development Specialist
Lewis Research Center	Chief of Personnel
Marshall Space Flight Center	Employee Development Specialist
Stennis Space Center	Employee Development Specialist

Table 4
NASA Installations and Titles of Officials which Provided Information on Ethics Activities

NASA Headquarters	Spokesperson - Title unknown
Dryden Flight Research Center	Associate Director
Goddard Flight Research Center	Assistant Chief Chief Counsel
Jet Propulsion Lab	Manager of Business Ethics
Stennis Space Center	Spokesperson - Title unknown

NASA and Ethics: A Review of the Literature

The literature review revealed that the bulk of the published material about NASA and ethics was written in response to the Challenger disaster or to analyze changes implemented in reaction to the Challenger incident. As discussed above, much of it is in the popular press, rather than in scholarly journals. Available government documents primarily deal with investigations following Challenger, particularly those of the Augustine Commission and the Rogers Commission. Also reviewed was the Office of Government Ethics Standards of Ethical Conduct (5 CFR Part 2635) and supplemental regulations (5 CFR Part 6901) in book form (1992) and on cd-rom (1995). These minimalist legal guidelines apply to all federal employees and are not NASA specific, though, as will be discussed later, are relied upon by NASA officials as ethical standards.

Perhaps the showiest of the articles deal with corruption and NASA. The public demands more responsibility and accountability to prevent production of billion dollar telescopes that do not work (Wade, 1993) and $200,000 toothbrush holders (Asker, 1996). They are outraged by NASA floor checks revealing 43 percent of third shift workers reading newspapers, playing cards and sleeping (Hearing, 1992). FBI stings (Cartwright, 1996) and investigations of top contractors regarding bribes, kickbacks, mischarging, false statements and accepting gratuities (Hearing 1992) make the headlines.

Beyond Challenger, however, the greatest interest in and about NASA is neither ethics nor corruption, but costs. One scholar calls for contract penalty provisions to discourage contractors from accepting risks because that appears more cost-effective (Aller, 1989). The high expense of considering all possible abort schemes and safety factors is discussed in both the popular press and a scholarly book (Rees, 1989)(Kramer, 1990). Scientists and engineers protest financial constraints and deplore that NASA's visibility leaves them no room for errors—experiments must work the first time (Stine, 1993).

NASA has been accused of exercising poor judgement by scholars and journalists alike. It has been accused of relying too heavily on subjective judgement in choosing problems to focus on (Marshall, 1988), promising more than it can deliver and having no priorities (Katz, 1993), and of having an addiction to big ticket projects (Shafritz, 1992). An article in Science charges that NASA uses hype to keep both Congress and the public supportive of budget requests (Flam, 1993). An editorial in Aviation Week and Space Technology accuses NASA of chasing headlines (Heartburn, 1992) while Hines, in the Progressive (1994) calls the whole manned space flight program the wrong stuff.

NASA is also described as a victim of maltreatment by Congress and the public. The agency is financially punished for efficiency reforms, gets no credit for its successes (Asker, 1995), and is accused of poor judgement in setting up a centralized decision structure that critics fear could foster a repeat of the Challenger disaster (Asker, 1996).

A Rockwell representative who advocates decentralization and contracting for services suggests that NASA will only let go when they have "triple redundancy — when you have a checker checking a checker checking a checker" (Chandler, 1996, p. F1+), yet others think that "Given the aging (shuttle) hardware and the need for additional maintenance, more rather than fewer inspections are warranted" (Covault, 1996, p. 23). NASA must continually deal with the issue of whether releasing a data relay satellite is worth dying for (Easterbrook, 1991) and the reality that there is a crisis of confidence where the space agency is concerned (Kramer, 1990).

NASA budget battles are legion. Articles weigh the advantages and disadvantages of contracting for services (Anselmo, 1996b, 1996c) and blame interdependency of all NASA programs for NASA's budget problems (Mann, 1988). Senator Howell Heflin, (1990) advocates for NASA and asks Congress to give NASA enough money to do their job, though NASA's can-do spirit has been undermined by leadership squabbles, low morale, and the prospect of extended delays for cherished projects (Corrigan, 1996). The Office of Management and Budget (OMB) has designated NASA's financial systems as high risk and top contractors have been investigated for bribes, kickbacks and mischarging (Hearing, 1992).

Organizational scholars studied NASA in the wake of the Challenger disaster. Shafritz (1992) argues that NASA is disadvantaged by the civil service merit system in the acquiring and retention of high quality personnel, while Levine (1992) notes that NASA's decentralized structure extracts a price in overlapping responsibilities, redundancies, and competition. Lawbaugh (1992) believes that NASA's place in the discretionary segment of the federal budget causes it to be shortchanged. Challenges to managing NASA in the 1990s were identified by GAO as contract management and monitoring, facilities maintenance, and information management (US GAO, 1993).

Following the Challenger accident, NASA's culture became one of "backbiting, infighting, and finger pointing" (McGinley and Burrough, 1986, p. 1). McCurdy (1989, 1992) argues for a cultural shift to one with an ethos of excellence, great personal dedication, unwavering self-scrutiny and constructive questioning. Vaughan in a massive historical analysis of the Challenger, contends that NASA has a deviant culture and that:

> The cause of disaster was a mistake embedded in the banality of organizational life and facilitated by a climate of scarcity and competition, an unprecedented, uncertain technology, incrementalism, patterns of information, routinization, organizational and interorganizational structures, and a complex culture. (1996, p. xiv)

Very little available literature on NASA deals specifically with ethics, though clearly issues about expenditures, hype, deviance, and mismanagement are at the heart of an ethics question. One wonders to what extent ethics is addressed at all by the space agency. Marshall (1989), in writing about issues in NASA program and project management, argues that there is no substitute for ethical behavior and technical integrity and managers must be prepared to make tough decisions and stick by them, but does not record what NASA's ethical practices are.

Russell Boisjoly addresses individual and organizational responsibility at NASA, and raises the question of whether "existing ethical theories adequately address problems posed by new technology, new forms of organization, and evolving social systems" (1989, p. 218). In looking at the Challenger incident, Boisjoly concludes that NASA's bureaucratic structure undermined personal responsibility and accountability.

What is strikingly absent from writing about NASA and ethics is a recognition that ethical issues permeate daily organizational life. Regarding the space agency, it is as though the Challenger incident has been the only ethical quandary at NASA worth analysis. One doubts that this is the case.

This section has reported on a comprehensive literature search regarding NASA and what NASA is doing with regard to ethics. The next section presents the result of web site investigation and ethics officer responses to inquiries about NASA and ethics.

EXPLORING NASA'S ADMINISTRATIVE ETHICS PRACTICES

Since the literature search was unable to determine much about NASA and ethics, and lacking funds for site visits or surveys, the researchers turned to the Internet to continue the search for answers to the questions:

1. What is NASA now doing regarding ethics?

2. What training is being provided? By whom? For whom?

3. Are the answers to these questions different at different NASA installations?

What follows is a report of how these questions were answered by the ethics officials at NASA Headquarters and ten installations across the country. After each question is a description of how it was answered.

What is NASA now doing regarding ethics?

Answers to this question as received from each responding installation are summarized below. After the account of responses from each installation, a summary and interpretation is provided.

NASA Headquarters. The spokesperson from NASA Headquarters stated that NASA complies with the Office of Government Ethics regulations, including post employment issues personnel matters, EEO, and others. This response was almost verbatim with the NASA Chief Counsel's web page which reads "...ethics functions include counseling employees and Center management officials regarding 'The Standards of Ethical Conduct for Employees of the Executive Branch,' and the NASA supplement thereto, and include but are not limited to outside employment activities, financial conflict-of-interest issues, post-Government employment matters, and review of public and confidential financial interest reports and resolution of issues arising from the review" (NASA Headquarter's Web Page).

The Chief Counsel for each Center is the alternate ethics official, and those offices are staffed to handle questions and ethics issues, and are not just responsible for training. In-house ethics officers are in those Centers' legal offices.

Dryden Flight Research Center. The Associate Director of the Dryden Flight Research Center suggested that NASA headquarters could better answer the request "since the question is oriented toward overall NASA policy."

Goddard Flight Research Center. The Assistant Chief responded first, saying he had referred the questions to the Chief Counsel who "handles ethics training here." An e-mail was sent to the Chief Counsel whose response is similar to that of NASA Headquarters: "NASA employees are subject to the Standards of Ethical Conduct (5 CFR Part 2635), along with supplemental regulations (5 CFR Part 6901), and must file Public or Private Financial Disclosure Reports (5 CFR Part 2634), subject to post employment restrictions in (5 CFR 2637)." He also stated that NASA designates attorneys as ethics officials, whose duties are to "provide advice and guidance to employees and management." The 2,000 civil service employees are required to file financial disclosure reports annually. The Chief Counsel's office reviews them for potential financial conflicts, contacting any employee with potential financial conflicts verbally, followed by a written cautionary letter.

Outside activities of employees also require approval from the Chief Counsel's office, to avoid possible criminal violations of the law. His office also "provides voluntary general counseling to anyone who may have a question." He noted they provide many written opinions for employees regarding post employment restrictions, covering both general restrictions and specific situations.

For guidance, they turn to NASA Headquarters and the Office of Government Ethics (OGE). The position of senior ethics attorney in the Office of General Counsel will be filled shortly. That position is responsible for "providing general guidance to the General Counsel and NASA field center legal staffs . . . as well as agencies which may be appropriate or necessary."

Jet Propulsion Lab. The Manager of Business Ethics at the Jet Propulsion Lab (JPL) responded by telephone. He explained that JPL is not considered a center, but is actually a Federally Funded Research and Development Laboratory, funded primarily by NASA and operated by Caltech. Bearing this separation from NASA-proper in mind, he did not know what NASA is doing regarding ethics, and said "to the best of my knowledge there is no ethics network within NASA," other than that at JPL.

As part of the on-going dialogue, the Manager of Business Ethics began his own line of inquiry. He discovered that the NASA phone book does not list the word ethics, and ethics officers for the various centers are not listed as ethics officers within the phone book. When asked if JPL's ethics program was developed due to NASA or Caltech, he noted that Caltech does not have an ethics program other than JPL's, and that JPL has a much more extensive program than the NASA Centers.

Kennedy Space Center. No one at the Kennedy Space Center responded to e-mail inquiries, but the Kennedy Space Center web site (http://www.pao.ksc.nasa.gov) did contain an article about standards of conduct which listed considerations for answering an ethical question. They are listed below. However, on July 31, 1997, the list was no longer present.

a. Is this right?
b. How will others see it?
c. Am I being consistent?
d. Should I explain?
e. Am I beyond reproach?
f. Would my action be 'good press'?

Stennis Space Center. Stennis Space Center's designated agency ethics official (DAEO) is responsible for "reviewing financial disclosure reports, maintenance of ethics education and training programs, and monitoring administrative actions and sanctions." The DAEO counsels employees regarding ethics standards and programs, as well as post-employment issues, and conducts the annual ethics training required under 5 CFR 2639.704 (c) to individuals covered under 5 CFR 2638.704 (b). All NASA employees receive copies of Standards of Ethical Conduct for Employees of the Executive Branch.

Answering the Question. Thus, in answer to the question about what NASA is now doing regarding ethics, one must conclude that NASA is not doing much beyond the minimum required by law. NASA employees, like other federal workers, are monitored for outside employment activities, financial conflict-of-interest, post-Government employment matters, financial interest reports and resolution of issues arising from the monitoring.

There has been a continuing debate in the ethics community since the late 1940s about which is the most effective way to insure that public administrators behave ethically. Known as the Friedrich-Finer debate, it was summarized by Finer as follows:

> My chief difference with Professor Friedrich was and is my insistence upon distinguishing responsibility as an arrangement of correction and punishment even up to dismissal both of politicians and officials, while he believed and believes in reliance upon responsibility as a sense of responsibility, largely unsanctioned, except by deference or loyalty to professional standards. (1941, p. 335)

At NASA, the debate appears not even acknowledged. Rather, NASA simply complies with the federally legislated ethics code, adhering to the letter of the law, rather than fostering dialogue about values and morals.

The next question dealt with the kinds of ethics training that NASA provides. Responses to that question are summarized in the following section.

What training is being provided? By whom? For whom?

Answers to this question as received from each responding installation are summarized below. After the account of responses from each installation, a summary and interpretation is provided.

NASA Headquarters. Each NASA Center has a designated ethics official who is mandated to do the requisite OGE ethics training which consists of one hour per year per employee on the requirements of 5 CFR Part 2635 and supplemental regulations 5 CFR Part 6901. These one-hour sessions can be in the format of lectures on the Standards of Conduct, films, or question and answer discussions. Content can vary from year-to-year. Some Centers contract this out, e.g. Johnson Space Center and, possibly, Marshall Space Flight Center. Langley has contracted out but may not at this time. The Chief Counsel for each Center is the alternate ethics official, and those offices are staffed to handle questions and ethics issues, and are not just responsible for training. In-house ethics officers are in those Centers' legal offices.

Goddard Flight Research Center. Goddard specifically implemented its requirements with mandatory annual training of 2,000 of its more than 3,000 civil service employees, where an attorney conducts an hour-long lecture and questions and answers session.

Jet Propulsion Lab. JPL is doing quite a bit of training. JPL ethics training over the past five years has been directed toward managers and supervisors, but in July 1996 they began to train rank and file employees, targeting July 1997 to have most trained. The training for new hires and employment development is done mostly through case studies.

The manager sent a copy of JPL's Ethics Handbook and JPL's 1996 Annual Ethics Refresher Training materials. The packet includes viewgraphs used in training programs, case studies, other training tools and ethics newsletters. Of particular interest are an Ethics Training Map, indicating the specific training paths for new hires, all employees, administrative aids, and management, and a map, entitled The Ethics Process tracing every step of a report to the Ethics Office. The accompanying cover letter commented on an idea inspired by the original e-mail - developing a round-table ethics training program for all NASA Centers. This idea will be explored further with JPL.

Johnson Space Center. Believed to contract out for training. No information received from JSC.

Langley Research Center. Believed to contract out for training. No information received from LRC.

Marshall Space Flight Center. Believed to contract out for training. No information received from MSFC.

Stennis Space Center. The respondent from Stennis also noted that "each center is responsible for providing annual ethics training to those employees who (sic) are in positions most exposed to situations requiring good ethical judgment." Stennis has a DAEO who conducts the annual ethics training required under 5 CFR 2639.704 (c) to individuals covered under 5 CFR 2638.704 (b).

Answering the Question. Thus in answer to the question about ethics training at NASA, one can conclude that, with the exception of the Jet Propulsion Lab, NASA officials are focusing only on the requirements of 5 CFR Part 2635, Standards of Ethical Conduct for Employees of the Executive Branch and its mandate to provide one hour of ethics training per employee per year. Table 5 shows the issues addressed in the eighty-page informal computer-generated manual and the percentage of pages used to deal with each topic.

Only JPL has a strong ethics training program that appears to deal with issues of moral judgement, as well as legislated and OGE mandates. That JPL is interested in expanding their ethics networks initiating a series of ethics roundtable discussions has been an unanticipated outcome of this research that bodes well for the future of ethical reflection among NASA employees.

The JPL model is important for the future of NASA. Recent research (Bruce, 1996) on the value of education for ethics clearly indicates that education about

Table 5
Standards of Ethical Conduct for Employees of the Executive Branch
Topics Covered by Percentage of Pages

Topic	*Percent of Pages which Address Topic*
Gifts	25 %
Outside Activities	22 %
Conflicting Financial Interests	12 %
Seeking Other Employment	10 %
Impartially Performing Official Duties	10 %
General	09 %
Misuse of Position	08 %
Related Statutory Authorities	04 %

values and moral decision making makes a difference in the ethical climate of a jurisdiction. Education increases the ability to define corrupt acts and the willingness to report them. It fosters the feeling that whistle-blowing is safe, and the belief that action will be taken when reports are made. Education affects values as well as attitudes. Complying with law and regulations is certainly essential, but it is insufficient.

Do answers differ at different NASA installations?

The final question asked if there is a difference in ethics climate or education among the different NASA installation. Responses to that question have been included in the discussions above, so what follows is a summary and interpretation.

Answering the Question. Little difference in ethics climate or education was found among the NASA installations included in this study. Only JPL goes beyond the letter of the law. Thus, conclusions in this study can be said to be reflective of NASA as a whole.

SUMMARY AND CONCLUSIONS

The results of the review of literature for this study and the initial contacts with NASA ethics officers indicate little regard for ethics at NASA. This means that NASA uses a low road, bureaucratic approach to what constitutes ethical behavior, with emphasis on financial conduct and risk management rather than upon morals and values. The letter of the law is clearly followed. One wonders, however, if following 5 CFR Part 2635 and/or the line of inquiry listed in the Kennedy Center's "Standards of Conduct" would have prevented the Challenger disaster (OGE, 1995). One suspects not. This emphasis on bureaucratic ethics is not designed to provide moral guidance. Worse it does not, in the eyes of many constitute a bonafide ethics program.

After a study of government employees that spanned several years, Brumback argues:

> A government program that does nothing more than keep behavior legal, while no small accomplishment, would not be a bonafide ethics program. It would be more of a law enforcement program. Laws and regulations are not the answer to keeping behavior above the bottom line of ethics. (1991, p. 354)

The kinds of projects under NASA's jurisdiction are too challenging to be handled without ethical deliberation. They are filled with moral dilemmas and many value-laden areas. The following citations are illustrative. NASA searches for the origin of life, uses animals in experimentation (Lawler, 1995, 1996), and provides complex whistle blowing programs for pilots to report hazards (Manningham, 1994). The Hubble telescope question states the quandary NASA employees must face every day: what is an acceptable, informed risk (Chaisson, 1995). Presidential policy spelled out the answer for the space shuttle: humans should not be sent on missions that do not require that risk (Anselmo, 1996a). The fact is NASA is accountable for the loss of life (Hearing, 1993). These are burdensome responsibilities.

What are the implications of these activities? The literature contains some answers, as indicated below. Risk loss controls based on scientific method are called for, as is leadership to carry the ethical burden (Katz, 1993). NASA employees must weigh the expense of considering all possible abort schemes (Rees, 1989) against meeting impending deadlines (McKenna, 1996). The pressures of meeting these launch deadlines may cause people to be unable to do simple cause-effect reasoning (Lighthall, 1991), yet even after the lesson of the Challenger tragedy, directors have been forced out for refusing to approve launches based on safety concerns (Urquhart, 1991). In other words, the responsibilities and possible repercussions of NASA activities are awesome.

The reader will remember that at NASA ethics activities are not awesome, nor are they directed toward dealing with moral and life affecting decisions. Rather, they consist of one hour of ethics training per employee per year and counseling when needed on the following: outside employment activities, financial conflict-of-interest issues, post-Government employment matters, and review of public and confidential financial interest reports and resolution of issues arising from the review.

Despite the weightiness of NASA employee responsibilities, there is no apparent place to turn for moral counsel. Help on the tough, life affecting choices that permeate space agency activities does not appear to be available. Rather, NASA ethics guidelines seem to be minimalist and insufficient.

Based on the research for this article, one must conclude that a changed approach to ethics is needed at NASA. Its one-hour-of-training-per-employee-per-year program should be expanded and supplemented. Officials need to think about deterring problems, as well as detecting or ignoring them. Discussion about ethics at NASA needs to permeate the agency and include citizens who can bring concern for the public interest, social equity, and personal interest into the bureaucratic milieu. NASA needs responsive and responsible decisionmakers who are able to define the ethical dimensions of a problem and to identify and respond to an ethic of public service as well as one of risk management. Where ethics at the space agency is concerned, to abide by the law is absolutely necessary, but it is woefully insufficient.

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Safety Concerns of Startup Airlines

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ABSTRACT

Startup airlines which do not have sufficient capital are forced to acquire older aircraft and contract out maintenance, crew training, and operation management. These factors can contribute to the poorly supervised practices as illustrated in this case study of the crash of a ValuJet DC-9 on May 11, 1996. The areas of focus are aircraft age, maintenance, safety record, cargo handling, and crew resource management.

INTRODUCTION

This is a case study of a new airline company. This study details the demise of ValuJet flight 592. On May 11, 1996, a routine scheduled flight, with an experienced crew plummeted to the ground. One hundred ten people died in this crash.

In October 1993, ValuJet Airline was created with the use of only two aircraft. The airline has scheduled flights from Atlanta to Florida. When the airline started many analysts thought that it would not be able to compete with the major airlines. ValuJet has been able to compete by keeping costs low. They do this by having a ticketless system, no full meals, no first class, and a leisurely employee dress code. ValuJet has three different series of aircraft: the MD-80, DC9-30 and DC9-20. Within these series the airline flies three different models of the MD-80, two different models of the DC9-30 and two of the DC9-20.

According to ValuJet, "To put it less enigmatically, ValuJet's ValuFares can be as low as they are (from $39 on many routes) because ValuJet's operating costs are among the lowest in the industry." Due to these cost cutting techniques the average one way fare is seventy-nine (79) dollars. In ValuJet's words, "ValuJet has been able to make a profit with less than half of the flight being full. All the mentioned cost cutting techniques enabled ValuJet to be the most successful startup company to date in the airline history."

This case study will focus on five areas of the airline operation that may have contributed to the demise of flight 592:

> the excessive age of the aircraft, the maintenance practices performed on the aircraft, the safety aspects of the airline, the cargo the aircraft was carrying and the flight crew of the aircraft. In addition to these areas other airlines handling these duties are also reviewed.

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Initial Air Traffic Control Training At Tartu Aviation College

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ABSTRACT

A well developed air traffic control training system is vitally important for guaranteeing flight safety and the efficient provision of air traffic control services. This article provides an overview of the development of an initial air traffic control training program at Tartu Aviation College. Lessons learned from the first two classes of students provide the basis for future improvements in the training program.

INTRODUCTION

A well developed air traffic control training system is vitally important for guaranteeing flight safety and efficient provisions of air traffic services (ATS). The following is an overview of initial air traffic control (ATC) training at Tartu Aviation College. The program includes descriptions of the training design and preparation, training process, development and future prospects.

HISTORICAL BACKGROUND

After the break-up of the Soviet Union and the Aeroflot structures in the beginning of 1990s, it was essential for independent Estonia to establish its own aviation system including air traffic control services. During the Soviet era, air traffic control services were provided by Aeroflot and airforce. The procedures were different from western procedures and the technical equipment inadequate. This situation had a negative influence on flight safety and air transportation efficiency.

The Estonian Civil Aviation Administration (CAA) was established in 1990 and was given the responsibility for providing air traffic services (ATS). The situation concerning personnel, during those days, was complicated. All air traffic controllers were former employees of Aeroflot who had received their training at Soviet training centers according to Soviet standards. There were no Estonians working in air traffic services before April 1994, when three Estonian air traffic controllers graduated from ANS Institute of Finnish CAA.

TRAINING NEED

A training program was needed to establish an independent and well functioning air traffic control service system in Estonia. This training was necessary to guarantee that a sufficient number of well trained and local ATS personnel would be placed in the system.

There was a need for advanced training to upgrade the knowledge and skills of employees already working in the system. International inbound and outbound traffic from Estonia and the opening of new ATC routes for overflying traffic reinforced the need for English training. The training need involved the following ATS units: Tallinn Air Control Center; controlled aerodromes in Tallinn, Kardla and Kuressaare; and AFIS aerodromes in Tartu and Parnu.

To accomplish the tasks in a cost-effective way it was decided to establish a local training system. Tartu Aviation College was established in 1993 and its first major project was to create a local ATS training system.

DESIGNING OF TRAINING PROCESS

The first step in ATS training was developing the ATC I/1994 course. The preparations for this course began in 1993. I was appointed to be responsible for the ATS training at Tartu. At this time, I was in Finland together with my Estonian colleagues. We decided to build up the initial training system according to the Finnish pattern we were already familiar with. We believed that a system similar to this one would be effective at Tartu. It was decided that the initial ATC training should consist of the following parts: theory, familiarization practice, aerodrome control training, non-radar approach control and on-the-job training (OJT).

We decided practical flying experience was essential in training an air traffic controller. This training allows the controller to understand the situation the aircraft is in and when to avoid giving clearances when a pilot is unable to comply. Speaking from my own experience, after practical flying of approximately 50 hours it was much easier to understand the situation in the air as an air traffic controller. However, taking into account the situation in Estonia it was unrealistic to set the practical flying experience as a prerequisite for the training. Also, due to the limited financial resources, it was impossible to give all students private pilot training within the framework of ATC training.

We compromised by giving the students private pilot ground school and 15 hours of practical flying as a beginning phase before ATC training. The objective of practical flying was to show the students different phases of flying, starting with local visual flight rules (VFR) flights and ending with instrument approaches. This amount of flight training will help prepare students for the initial ATC training.

DESIGNING AND CREATING TECHNICAL EQUIPMENT

Before we started training we had to design and prepare all the equipment necessary for the training process, the materials for theoretical studies and simulators for practical training. However, beside the International Civil Aviation Organization (ICAO) documents and some Estonian regulations, most materials for the theoretical training were missing at that time. The problem with using these materials during initial training is that they are too dry and complicated for students who do not have experience in aviation.

We began to create special study materials to make training more effective and convenient for students. During this stage we were faced with a big problem; many of the rules and regulations necessary in air traffic services in Estonia were missing. Therefore we had to present new rules and procedures to the CAA for approval to accomplish the training according to international standards. The need for training and training materials sped up the improvement of the already existing system. During the development of training materials we often used the materials we had received during our own studies from Finland. Simulators had to be built in order to accomplish practical training at the college.

The most urgent need was to create an aerodrome control simulator and non-radar approach simulators. However, there were principal questions to be resolved before we could do this: What should the technical level of the simulators be? Should we buy the simulators or should we build them ourselves? What kind of airspace should we use for simulation?

We decided to build a table-top version of the aerodrome control simulator, which consists of tower and airport layout including all basic equipment necessary for air traffic control. We also decided to use real Tallinn airspace for simulation. The main reason for choosing this alternative was because it was not cost effective to purchase high-tech equipment with our limited resources.

My own training experience assures that there are advantages to using a simple table-top simulator. Pilots do not need special training for using this equipment and it is possible to keep a larger group of students active at the same time. If the time comes when we need more sophisticated simulators for advanced training, we can work with Finland as a cooperative partner. Finns have one of the best simulator complexes in the world. The reason for using Tallinn airport and airspace instead of artificial airspace is that the air traffic control in Estonia is centered to Tallinn. For training purposes we simplified some procedures and created exercises where aerodrome control and approach control are combined into one unit like it is at smaller airports in Estonia. During the exercise designing stage we faced the same problem as when developing the training materials: many areas were not exactly regulated or were missing totally.

We decided to build the non-radar approach and area control simulator ourselves. The technical solution of this simulator is not complicated. Only the radio and telephone systems for aerodrome control simulator were purchased from the Swedish ATS Academy.

We also have a radar simulator at the college, which we purchased later under a BITS project via Sweden from the Canadian company ATS Aerospace Inc. This simulator is PC based and consists of one controller position and two pilot positions. It is technically possible to expand the simulator into a network of four working positions. The simulator includes necessary software for creating a huge variety of different exercises. We have prepared a package of exercises for initial radar training based on Estonian airspace.

FOREIGN CO-OPERATION PARTNERS

Throughout the working process at Tartu Aviation College we have had good and fruitful relations with colleagues from abroad. It is vitally important for a young system to obtain information from other countries, analyze it, pick up all useful details and avoid the mistakes others have experienced during their development. There is no need to reinventing the wheel. The main task is to find out how to use the wheel in the most efficient way in our existing situation.

Our first cooperative partners were from ANS Institute of Finnish CAA. My first Estonian colleagues and I received our training in Finland and we know the Finnish system and the people working there well. In order to trust your cooperative partners, it is very important to know them in advance. The Finns have been our closest cooperation partners. The cooperation partnership has covered the following areas: consultancy, participation of Finnish instructors in practical training at Tartu and on-the-job training in Finland.

Our second cooperative partner in ATS training is the Swedish ATS Academy. In 1995 the BITS (at present SIDA) project became active and it included many sub-projects such as instructor training, participation of Swedish instructors in practical training at Tartu, on-the-job training for Estonian students in Sweden and the delivery of a radar simulator.

In summer 1995, we had a Canadian consultant from CESO working at the college for almost two months to improve our existing ATS training system. As a result of that project we changed our existing system to make it more effective. We also received a great deal of useful information about the implementation of radar training. In addition we have had contacts with colleagues from Denmark, the U.S.A., Great Britain, France, Lithuania and Latvia.

RECRUITMENT AND SELECTION OF STUDENTS

A well designed recruitment and selection system is one of the most important prerequisites for successful training. There are certain requirements for the applicants of ATS training. They should at least have a secondary education, good English speaking skills, good health, be between 19 and 30 years old and they should be citizens of Estonia. Besides these formal requirements applicants must also assume a strong will to study and work in the field of aviation.

The selection process consists of three parts. First the students have to pass oral and written examinations in English. The second step is a psychological test with the objective to find out if a person is suitable to work in ATS. It is evident that a person carrying out the operational work in ATS should have certain abilities like good spatial orientation, capability to perform different tasks at the same time, etc. To examine all these abilities thoroughly, a testing system has been created. Much of the work in this field has been done by Professor Luuk and his colleagues from University of Tartu. The testing also includes an interview conducted by ATS instructors and external experts. The last step is a medical examination according to ICAO standards.

The main problem during the recruitment and selection process has been the lack of applicants. For the first ATC course, ATC I /1994, we accepted 17 students from 60 applicants. In Finland the number of applicants for a group of approximately the same size was ten times larger. The reasons for the small number of applicants in Estonia are that ATS specialties are not well known in the society and the salaries are relatively much lower than in other countries. The fact that the training begins at an academically nontraditional time (in February) has also had a slight influence on the number of applicants.

The other problem we face quite often is the applicants' insufficient knowledge of English. This problem is created by the uneven English teaching levels at secondary schools. However, we can increase the number of English lessons and make the language studies more intense throughout the training period during college.

TRAINING PROCESS

The following analysis and conclusions are based on experiences from two domestic ATC courses: ATC I/1994 and ATC II/1995.

Both courses allowed the same amount of practical flying in the beginning of the training session. This proved to be a necessary part in training making further studies easier and motivating the students. Fifteen hours of practical flying is sufficient if the program is built up in a logical way, but the more the students can fly, the better. The problem we faced with the first ATC course dealt with the students learning the wrong radiotelephony material during the practical flying. A former Aeroflot employee was not precise during his instruction. The students adopted incorrect phrases and it took some time during the practical training to correct them.

The theory phase of training after flying contains all subjects necessary for an air traffic controller. Students are expected to pass written examinations by at least 70 percent. However, the instructors feel this phase is too dry and boring because it contains only theory. Test results have confirmed this feeling.

The familiarization practice after the theory period is necessary because it illustrates how ATS systems and operations at different airports are organized. Both ATC classes had a chance to visit our neighboring countries. Besides the main objective, these visits gave our students good language practice and motivation for further studies.

The aerodrome control phase consists of theory and practical training. The theory is mainly the review of ATS procedures. The practical training consists of 25 simulator exercises. Simulator exercises are divided into different groups depending on the content. At the beginning of this phase the instructors give a great deal of assistance to the students with the expectation that at the end the students will be ready to perform the exercises without external help.

These exercises are randomly evaluated, except for the last three exercises which are always evaluated. We do not inform students which exercises will be evaluated in order to avoid unnecessary stress. However, the students usually guess which exercises are evaluated. The evaluation itself takes place according to special rules. A certain amount of points will be subtracted for each mistake. The students receive two different marks: one for ATC procedures and general performance and the other for radiotelephony. This evaluation shows that the working load and the amount of exercises has been suitable for the students during the training phase.

The next phase in training is usually the most difficult for students. During non-radar approach control, students cannot see the aircraft and are responsible for additional separation of aircraft in a much larger area of responsibility. The non-radar approach phase contains the same elements as the aerodrome control phase, only the theory part lasts longer. In the beginning of the practical training there are six exercises where tower and approach are combined. In the second half of practical training we have two exercises where both units, tower and approach, work at the same time like in real life. This gives an excellent experience with cooperation and is a good review of tower duties.

We have found that the non-radar approach phase is difficult for students. Quite often instructors feel the students understand only at the very end of the training phase. A solution to this problem is to increase the number of exercises during the practical training.

During the practical training phases we have had instructors from Finland and, for the second ATC course, instructors also from Sweden, working together with Estonian instructors. The reason for this was lack of local instructors, however I think this type of international cooperation is beneficial to everyone. The students receive a wider view of possible working methods, as well as good language practice. The instructors also gain new experience.

For the second ATC course we added an extra training phase before on-the-job training, the introduction to radar control. The objective of this phase is to give the students a basic knowledge about radar control and to enable them to cooperate with the ATC units using radar during the on-the-job training. This phase consists of shortened theory and two introductory simulator exercises. The technical side of radar equipment is almost excluded. The feedback of this introduction has been positive and we consider this training phase an important step before the on-the-job training phase.

The main problem with on-the-job training in Estonia is the lack of airports. The only suitable airport for OJT is Tallinn. At smaller airports the traffic load is so low that the students will forget what they have studied in the simulator. However, it is impossible to accommodate all the students at Estonian airports during OJT. The solution to this problem is the use of foreign airports. The students of the first ATC course received OJT at the following Estonian and Finnish airports: Tallinn, Kuressaare, Turku, Vaasa and Rovaniemi. The students of the second ATC course also had the chance to receive their training at Swedish airports such as Gothenburg/Landvetter, Jonkoping and Stockholm/Arlanda.

After OJT, the students graduate and are able to apply for work at aerodrome control units and at combined aerodrome control and approach control units.

The success rate for ATC I/1994 was 76 percent and for ATC II/1995 88 percent. From the graduates of ATC I/1994, 92 percent are working in air traffic services. For ATC II/1995 this figure is unavailable because the students have just graduated.

TRAINING OF FOREIGN STUDENTS

In summer 1996, we had a group of 12 Lithuanian ATC students at our college. The objective was to provide aerodrome control practical training for the group. The training consisted of seven exercises and a study visit to Tallinn ATS center. Three Estonian instructors participated in the training which lasted for two weeks. The general impression of the training period was very good. All of the students were highly motivated and eager to study and they all reached the training objectives.

We hope the cooperation with Lithuania will continue and we are able to provide training for other foreign customers. The instructors and the equipment are ready for additional customers.

FUTURE IMPROVEMENTS IN TRAINING PROCESS

Based on the existing training process, I see two major areas that should be improved. The first need is to combine theoretical studies with the practical training in the earlier stage of training. This will avoid difficulties during the long theory phases and will make the study process more efficient and interesting for students.

The second need is to make the whole training process more flexible. If we know the exact needs of future employers we can prepare students during the initial training phase. However, we should be careful not to delete necessary items from the initial training program, as well as not to overload the students.

These are the two major changes I suggest to improve the initial training system, but there are always hundreds of smaller areas which need polishing on a continual basis to keep the training at a high professional level. Progress in aviation is rapid, air traffic control training should follow, if not be a step ahead of it.

INITIAL AIR TRAFFIC CONTROLLER TRAINING AT TARTU AVIATION COLLEGE

Phase 1	Flight Training Private Pilots Ground School 15 Hours of Flying
Phase 2	General Theory Familiarization Practice at the Airports
Phase 3	Tower Theory Simulation
Phase 4	Non Radar Approach Theory Simulation Introduction to Radar Control Theory Simulation
Phase 5	On-the-job Training Graduation

DISCUSSION

The first area of concern is the age of the equipment. The plane that crashed on May 11, 1996, was purchased new in 1969 by Delta Airlines, traded back to its manufacturer in 1992 and bought by ValuJet in 1993 (Holman, 1996). "ValuJet's fleet is 26.4 years old on average, one of the oldest in the business, twice the age of the major airlines" (Holman, 1996). Some other startups have similarly aging fleets with the next closest one being 23 years (see Appendix A).

The age of ValuJet's DC-9 fleet is not unusual among major airlines that use the planes. Continental, Northwest, Trans World Airlines and USAir all operate dozens of DC-9s with an average age of 24 to 26 years. Instead of spending millions for new aircraft, many airlines choose to upgrade their older fleets. Although critical parts are constantly being replaced, aging airplanes can still pose safety threats.

For example, components such as engine and hydraulic systems may be replaced many times during regular maintenance schedules. An old plane also has other systems, including electrical wiring, that probably has not been replaced. This wiring can break down causing short circuits and fire aboard an aircraft. Older aircraft have their share of mishaps, flight delays, and breakdowns, but nothing as catastrophic as the ValuJet crash.

In most cases, the older aircraft in the inventory of the major airlines were purchased as new aircraft and have been maintained on a scheduled basis throughout their history. The aircraft in ValuJet's inventory were purchased used and are 25 years or more. The maintenance of the aircraft may be unknown.

Airlines purchase old aircraft because of the cost savings. They are inexpensive to buy. The average price of a new jetliner is $25,000,000, considerably more expensive than a 20 year old airplane which may cost $2,000,000. The reason most of the startup airlines aircraft are 20 years old plus is because the majors do not sell them until most of the useful life is gone or the aircraft become too costly to maintain. This is a potentially dangerous situation because the startup airlines purchase these used aircraft at a critical time in their life.

These aircraft need diligent maintenance to keep flying safely, which cost money in parts, labor, and downtime. Maintenance is contrary to the operations of any airline. Startup airlines may not maintain them as closely as a major airline would because they do not have the same cash flow. An aircraft on the ground does not create revenue. Besides the apparent economics, the startup airline may not do their own maintenance. A third party is contracted to do the work. The third party has even less concern with the aircraft. This could possibly lead to short cuts in maintenance. At a time when the aircraft needs more attention, maintenance cannot be jeopardized. ValuJet in mid-1996 operated (eleven) 11 different types of DC-9 aircraft. This contributed to the maintenance problems of ValuJet. Each type of aircraft needs different flight, maintenance, and cargo loading procedures. These procedures could easily be confused with each different type of aircraft.

The contracting out of the aircraft maintenance is the second area of concern to be considered. To maintain low costs, many start-up airlines like ValuJet not only buy used aircraft but also contract with other companies to do the heavy aircraft maintenance work on their jets. This practice is often referred to as outsourcing. The potential for mis-communication is inevitable. Many airlines prefer their own standard operating procedures (SOP) to that of another airline. Poor communication or different SOPs may have led to the May 11, 1996 crash of the ValuJet DC-9 north of Miami.

Different SOPs may have been a factor because maintenance practices of each airline differ. For example, one airline may top off all hydraulic systems and fill all tires with air after each flight. Other airlines may perform these simple maintenance procedures at the end of each day. The later procedure may lead to low quantities of fluids in the hydraulic system and low tire pressures at the end of the day, potentially causing major problems. Outsourcing also stretches the ability of the Federal Aviation Administration (FAA) to inspect and regulate this rapidly changing and growing industry.

The FAA is struggling to monitor an intricate web of contractors that stretches around the world. Internal FAA records show that on several occasions inspectors were concerned about a lack of oversight by ValuJet on its contractors. For example, an inspector found that maintenance was not properly documented by one contractor and that ValuJet lacked procedures to make sure it was done. The FAA also found that ValuJet did not make sure that the companies ValuJet contracted with — including other airlines like Northwest and Carnival — were properly trained using ValuJet's procedures. One company in particular that trained ValuJet pilots did not send to ValuJet records documenting poor performance or poor communication of the ValuJet employees, although this is one requirement of ValuJet.

A draft federal safety report related ValuJet Airline's quality control procedures at its contract maintenance facilities as inadequate five days before the crash of ValuJet Flight 592. The report cited out-of-date manuals, employees who were unfamiliar with various rules and work that were certified as completed when it had not even been started (Holman, 1996).

In one late February incident reported by the FAA, mechanics working for ValuJet in Atlanta used a hammer and a chisel to remove a balky DC-9 engine part being replaced. They did not have a Pratt & Whitney maintenance manual that would have told them a special tool was required for such work. Subsequently, on a flight to New Orleans shortly afterward, the engine lost oil pressure and shut down in flight. An FAA inspector was described as discovering that the chisel apparently had damaged a seal, letting engine oil drain out (Kuttner, 1996).

Sources have recently suggested that one of the FAA's main concerns about ValuJet's maintenance practices is the lack of standardization of its equipment and procedures. This ranges from cockpit and flight crew standardization to a lack of common practices at the various third-party maintenance operations

ValuJet uses. The FAA also cited concern about a corporate culture that is affecting and influencing the ability of aircraft captains to make safety-oriented decisions. The FAA is concerned that ValuJet paid pilots only for each leg of a flight, without any additional pay for extra time flown in the event of diversion and no pay whatsoever in the event a flight turns back. There are currently six firms that do maintenance work for ValuJet. Sabretech is one of the six companies that ValuJet hired to do heavy maintenance. ValuJet also contracted with more than a dozen other companies, including airlines, to work on its planes at various airports. This is cost effective for the airline but the people that are working on the aircraft for these maintenance subcontractors do not have the same level of motivation and feeling of ownership and involvement as the employees of an airline would have toward their own aircraft. If indifference exists, it could lead to skimping on maintenance practices. This may be the reason this plane had so many safety related problems.

Another area of concern is the safety record of ValuJet. ValuJet has been having its ups and downs since it began operating in October 1993 (Holman, 1996). ValuJet, once one of fastest growing companies in the industry has had problems with ongoing safety investigations with the FAA and the National Transportation Safety Board (NTSB). The safety record of ValuJet is of concern to the investigators. ValuJet has been involved in several accidents or incidents. It is this author's understanding that ValuJet had an accident and incident rate four times the industry average (Holman, 1996). Due to these safety concerns about ValuJet, the FAA conducted a seven-day safety investigation of the airline in February.

The aircraft involved in the crash had its share of service problems, nine to be exact. The safety record of the twenty-seven (27) year old plane revealed:

- September 1994, takeoff aborted because of takeoff warning horn and a high temperature warning light,
- May 1994 low oil pressure light caused flight to be aborted,
- May 1995 cabin depressurized in flight, flight was aborted,
- October 1995 aft stair was ajar, caused the flight to be aborted,
- January 3, 1996 engine overheated flight was aborted,
- January 4, 1996 takeoff warning light sounded causing flight abort, and
- January 20,1996, hydraulic pressure low light flight was aborted.

In addition, there were 12 other safety related problems that ValuJet has experienced since it started flying in 1993.

The aircraft had nine reports of service problems since May 1994, including five requiring it to return to the airport after takeoff. Also records show that the airline filed 281 service difficulty reports with the FAA in just three years (Hedges & Cary, 1996). These reports are made voluntarily, and some airlines report them more faithfully than others. Ironically, airlines that routinely submit service reports may have worse safety ratings than the less diligent carriers (Appendix B). The reason for these safety concerns, the FAA feels, is the outsourcing of contracted maintenance. ValuJet has agreed to make a major overhaul of its maintenance practices. ValuJet is also negotiating with several major airlines to take over most, if not all, heavy maintenance on ValuJet's fleet of DC9-30 aircraft (Holman, 1996).

The cargo being carried on the ValuJet Flight 592, is another major area of concern. The issue of the use of outside contractors arises again in this area ValuJet's dispute with Sabretech centers on the oxygen generators. Oxygen generators are connected to the oxygen masks located in the seat backs and are used by passengers if there is a drop in cabin pressure. Federal officials think that these generators could be the cause of the crash.

A generator, an 8 inch long stainless steel container roughly the size of a can of hair spray, produce oxygen by heating chemicals at close to 1,200 degrees Fahrenheit. The outside of the container reaches approximately 500 degrees Fahrenheit. The generators are activated when the firing pin is pulled, usually when a passenger pulls the oxygen mask from an overhead compartment or seat back. Sabretech, which is an FAA authorized maintenance company, removed the generators from ValuJet MD-80 aircraft that were undergoing maintenance.

ValuJet officials said they told the contractor to dispose of the generators. Sabretech said it was given no such order and put them in boxes, mislabeled them "OXY Canisters, Empty," and returned them to ValuJet. ValuJet then loaded the boxes into the cargo hold of flight 592. While the generators are standard equipment on many airplanes they are considered hazardous items when carried as cargo. The cargo hold of the DC-9 aircraft was carrying more than 130 of these generators back to its Atlanta headquarters. This cargo is suspect because of the indication of fire and smoke in the cabin and cockpit that was reported by the crew before the crash.

"ValuJet was not authorized to carry a cargo load of the oxygen generators that have come under suspicion" (Holman, 1996). ValuJet's chief operating officer, Lewis Jordan, gave an explanation on why the canisters were aboard the plane. Mr. Jordan stated, "the airline planned to refill them." This explanation does not seem adequate because other airlines, service companies and the biggest manufacturer of the devices say they do not refill the devices because it is not worth the effort to clean out the depleted chemicals (Matthew L. Wald, May 24). If there were an initiating source, the oxygen generators could enrich the air supply. Potentially enriched air could start a fire, via spontaneous combustion.

A fire that destroyed a DC-10 jumbo jet at Chicago's O'Hare International Airport 10 years ago was blamed on a generator that accidentally began producing oxygen in the cargo hold. While no lives were lost in that accident, the accident caused the FAA to classify the canisters as a hazardous material. When installed, the generators are heavily insulated to protect the plane from damage or fire from the intense heat produced when activated. Experts agree it is virtually impossible for the generators to malfunction, citing tests where the devices have been thrown on the floor and jostled without problems.

These canisters were being shipped without the protective caps that block them from being set off. The generators had been removed from other ValuJet planes by a contractor after their shelf life had expired, but they had not been lit-off or fired, meaning that the oxygen-producing chemical reaction had not been set off (Wald, 1996). The simple step of "firing" the canisters would have changed them from being a hazard capable of staring fires to a chemical compound that can no longer burn or explode.

The oxygen generators were placed on top of three fully inflated aircraft tires that were also being transported in the forward cargo hold of the aircraft. During takeoff these tires or possibly some other cargo shifted, hitting the box containing the oxygen generators. At least one canister was fired off or leaked oxygen causing the generator to heat up, setting off a chain reaction with the canisters in the box. This was confirmed by the discovery of two canister end caps that showed evidence of heat damage. Senator Bob Graham, D-FL, was quoted, "The canisters I saw were all charred and twisted by the heat." The activation of the generators and the heat produced, could have caused the tires to burn and explode.

This assumption is also supported by the traces of heavy soot found on some of the wreckage and by melted parts which confirmed a fire. Aviation experts believe that toxic gases produced by a fire involving the burning rubber of the aircraft tires and the canisters enriching the air supply (an analogy to an oxyacetylene torch where the oxygen enriches the burning mixture) would have killed everyone on board before the plane crashed into the Everglades.

Due to these findings, the NTSB called on the FAA to impose tough curbs on the air transport of such materials. A bipartisan group of congressmen introduced legislation to regulate the air transport of chemical oxygen materials, a suspected cause of the crash of ValuJet flight 592. Under this bill the FAA would be required to comply with the safety board's recommendations. The bill would ban shipments of chemical oxygen generators on passenger and cargo planes and the shipment of oxidizer and oxidizing materials in cargo bays not equipped with fire or smoke detector systems and an automated fire fighting system. The department of transportation has already banned the transport of oxygen generators on passenger carriers for the remainder of the year, pending evaluation of their safety (Holman, 1996).

The final area of concern is the crew of the aircraft. The pilot of the aircraft, Candalyn Kubeck, 35 years old, had been flying since she was 15 years old. She had nearly 9,000 hours of flight time, including 2,100 hours with ValuJet. She was very experienced, very well trained, and very competent. The co-pilot, had 2,000 hours of flight experience. In addition to the pilot and co-pilot there were also three (3) flight attendants on board.

The average age of all ValuJet pilots is 39 years old. The average overall flight time is 7,800 hours. This meets the industry standard experience for airline pilots. ValuJet's pilot training is contracted out to other companies because it is more cost effective. As mentioned before, most of the major airlines do their own training. The fact that ValuJet contracts out their pilot training brings us to the point that a set standard procedure to deal with emergency situations may not be incorporated in this training. Seventy percent of accidents on air carriers are caused by human mistakes. Big airlines have minimized those inevitable mistakes with strong policies, hammered home through training, checklists and prescribed emergency procedures.

The two pilots in the ValuJet DC-9 aircraft had sufficient experience to handle emergency situations. This was confirmed by the investigators who reviewed the cockpit data voice recorder.

As mentioned before, these investigators stated evidence that there might have been an explosion on board. This was followed by the pilot radioing for clearance to return to the airport. Another indication on the cockpit voice recorder was the sound of wind rushing into the cockpit. This is an indication that a window had been opened to help clear the cockpit of smoke. This is a standard procedure all pilots adhere to during emergency situations of this type. This indicates that the crew took prompt action. The crash occurred seven (7) minutes later. Indications were that the crew and/or passengers may have passed out from the smoke. Based on eyewitness reports, the angle that the plane nosedived into the Everglades never varied, indicating that the crew was obviously incapacitated.

CONCLUSION

ValuJet flight 592 was the victim of very bad luck. The oxygen generators that were carried in the cargo forward cargo bay normally would not have caused any problems in this location. The combination of the other cargo located there, and the method in which the generators were stored led to a generator igniting. This heat started burning the rubber on the tires, causing the tires to explode and the fire to spread throughout the forward cargo bay. This, in turn, caused more of the generators to ignite enriching the air supply and causing the fire to spread very fast and ignite other cargo in the hold. The acrid black toxic sooty smoke traveled up the cargo bays fiberglass panels into the cabin.

This sequence happened extremely fast because of the enriched oxygen supply in the air. The passengers and the pilots were incapacitated within ten minutes. The autopilot was turned off because of the emergency turn in progress at the time. The emergency oxygen masks in the cockpit may not have been working so the pilots were not getting the air they needed. When the pilots lost consciousness the plane crashed to the ground.

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APPENDIX A
US MAJORS AGE OF AIRLINERS

	No. of A/C	*Avg. Fleet Age (Feb.1996)*
Carrier:		
Southwest	226	8.3 years
American	664	9.2
American West	93	10.1
Delta	539	11.5
US Air	434	12.3
Continental	299	13.9
Northwest	389	19.1
United	577	21.0
US Startups:		
Reno	24	5.8
Western Pacific	12	10.3
Carnival	23	13.5
Air South	8	22.0
Frontier	7	22.6
Kiwi	16	22.8
Vanguard	8	23.0
ValuJet	40	26.4

APPENDIX B
AN AIR SAFETY REPORT CARD

	Problems per 100,000 Departures	*# of Accidents/ Incidents/Service Reports*
Majors 1993-95		
Northwest Airlines	55.5	0/60/855
Delta Airlines	51.7	7/135/1,364
Continental Airlines	33.3	5/90/394
America West Airlines	30.3	0/11/159
Trans World Airlines	29.1	1/28/209
Alaska Airlines	18.4	0/11/60
USAir	16.2	2/80/328
United Airlines	13.5	3/65/236
American Airlines	9.9	4/118/140
Southwest Airlines	8.8	0/19/137
Group Average	**26.7**	**2.2/61.7/388.2**
Regionals/Commuters		
Comair (Delta Connection)	113.0	0/17/677
Trans States Airlines	62.9	0/11/209
Continental Express	62.1	0/15/420
WestAir	47.4	0/15/206
Great Lakes Aviation	36.7	0/15/127
Piedmont Airlines	31.9	0/5/131
Express Airlines	31.2	2/36/64
Business Express	26.7	0/16/109
Simmons Airlines	22.4	2/19/110
Horizon Air Industries	21.2	1/17/113
Wings West Airlines	21.0	0/10/66
Flagship Airlines	19.8	1/30/111
SkyWest Airlines	14.6	0/12/66
Atlantic Southeast Airlines	6.6	1/6/33
Mesa Airlines	6.3	1/20/45
Group Average	**34.9**	**0.5/16.3/165.8**
Start-Ups 1994-95		
Nations Air Express	57.3	0/0/2
Spirit Airlines	45.0	0/1/4
ValuJet	39.0	2/5/31
Kiwi International Airlines	37.5	0/2/11
Reno Air	35.2	0/4/28
Air South	24.9	0/2/4
Midway Airlines	21.1	0/1/6
Carnival Airlines	19.0	1/3/1
Frontier Airlines	10.0	0/2/0
AirTran Airlines	0	0/0/0
Vanguard Airlines	0	0/0/0
Western Pacific Airlines	0	0/0/0
Group Average	**24.1**	**0.3/1.7/7.3**

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International Airline Quality Measurement

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ABSTRACT

Historically, airline quality has been measured through the use of surveys that ask the consumers to make a comparison between expectations and outcomes. This method was informative but very cumbersome in a rapidly changing environment. This paper outlines the efforts of the consumer researchers to develop a weighted, consumer oriented rating scale for the U.S.A. domestic airline industry as an alternative to survey-based rating scales. The Airline Quality Rating (AQR) approach has been successfully employed in the United States by the major airlines and by the general public. Development considerations are offered for facilitating the adaptation of the AQR's weighted average approach to the world airline industry.

INTRODUCTION

Service quality perceptions are often defined as the difference between what a consumer expects and what they actually perceive as outcome. It is difficult to measure service quality in a consistent and timely way. Being able to assess quality using several relevant factors, having this assessment of quality be comparable across several competitors, and having this quality rating available on a timely basis would be the best of all worlds. Historically differences between expectations and outcomes have been assessed using a survey based approach that asks the consumer to make a comparison between expectations and outcomes at some time during or after an encounter with a service. The SERVQUAL scale developed by Parasuraman, Zeithaml and Berry (1988) incorporates a measurement of consumer expectations before a service encounter with a measurement of that same consumer's perception of outcome after a service encounter. This specific matched response approach, using before and after experience measurements, offers a very rich glimpse into consumer attitudes and advances our thinking about service quality measurement. It is, however, very cumbersome to accomplish and often does not lend itself to the consumption situation at hand.

The bottom line is that with all of our efforts to measure service quality, we have progressed little beyond a survey of opinion approach. There is an alternative that has not been used frequently, but has distinct potential in certain situations: a weighted average. Since the world presents itself as a multivariate problem, we should accommodate this in our assessment efforts where possible. Various factors that a consumer might consider will inevitably have differing levels of importance for each consumer in any final judgement of quality. This suggests a multi-factor approach that must allow for differing importance (weights) for various factors. If constructed with consideration of comparability issues, a weighted average of multiple factors can produce a numerical rating that is comparable across competitors in an industry and across time. In order to achieve these two elusive aspects, however, conditions must be right. Similar data must be available for all those being assessed. Weights for each individual factor must be established and the nature of their impact whether positive or negative must be agreed upon.

The remainder of this paper outlines the efforts of the consumer researchers to develop a weighted, consumer oriented rating scale for the U.S.A. domestic airline industry as an alternative to survey-based rating scales. Development considerations are offered for facilitating the adaptation of the weighted average approach to the world airline industry.

THE NATURE OF AIRLINE SERVICE QUALITY

There are many possible aspects that could influence the airline consumer's perception of quality at different times in the consumption process. Generally, an airline passenger is concerned with two basic aspects of the airline service: 1) schedule and 2) price. There are other secondary, but important, aspects that a consumer may consider in the ultimate choice of an airline. The basic factors can be used to explain a large majority of consumer use of airline services. At the same time, once the basic concerns are met, the larger, more complex set of concerns begin to dominate the consumer's perception regarding quality of and satisfaction with a particular service experience and ultimately, the choice of a particular airline. Such things as safety, comfort of the seats, in-flight amenities such as food and beverages, attitude of the ground and flight crew, financial stability of the airline, on-time performance of the flights, assurance that bags arrive with the passengers, crowded conditions of the flight, being bumped from the flight, and frequent flyer programs are important to consumers. Problems arise in a consumer's ability to make meaningful sense from the information available regarding these multiple and less obvious factors. Fortunately, the consumer of airline services in the U.S.A. has information available, via the U.S. Department of Transportation monthly Air Travel Consumer Report, regarding service performance on many of these factors for most U.S.A. airlines. Unfortunately, the average consumer is most likely unaware of, or uninterested in this detail of performance and it goes unused in consumer decision making and quality judgements.

All air carriers recognize that customer satisfaction and the perception of quality is important to the consumer that has a choice of air carriers in any market. With multiple carriers providing the same basic service (transportation from point A to point B) the perception of quality held by a consumer has become an important competitive point. To monitor this rather fluid consumer opinion, quality assessment efforts are made periodically by individual airlines and by other consumer interest groups. Generally, these survey based efforts concern themselves with qualitative factors such as comfort, pleasurableness, taste of food, and employee attitude. These are certainly important areas of consumer satisfaction. Subjective opinions are assessed by direct inquiry of the consumer via survey processes, and represent individual and group sample expressions of consumer perceptions regarding the outcome of a service encounter. These are the traditional types of opinion gathering that have proven to be very useful to the airline industry. Elaborate surveying efforts necessary to monitor this type of consumer opinion are cumbersome, but none the less, important. Most of the major airlines operating in the world today already do this type of quality assessment and use the results to effectively manage the quality of service they offer the consumer. This information is most often proprietary and not available to the public or the broader industry for their use in making better choices regarding airline quality.

While information gained by proprietary and industry assessment efforts is invaluable, the predominantly survey-based nature of the efforts causes some concerns as to timeliness and reliability of the results. Survey based opinion gathering as a technique requires accurate questions, unbiased sampling technique, and sizeable amounts of time and money resources to accomplish. In addition, the sheer size of the surveying efforts preclude them from being accomplished on anything but a lengthy repeat-time schedule. Something is needed that allows a glimpse of quality on a regular and timely basis, without sacrificing reliability and validity. The weighted average offers this by combining comparable data with a recognized method for comparing data across industry competitors and across time.

AN EXAMPLE: THE AIRLINE QUALITY RATING (AQR)

Often, an innovative approach is the result of combining basic ideas and existing raw materials with a specific purpose in mind. This is exactly the case with the Airline Quality Rating (AQR). The objective in developing the AQR was to better organize readily available data for the consumer and offer it in a more useful, understandable, and objective form. Developmental procedures involved identifying a substantial list of potential quality factors through extensive literature search; discussions with experts from airline associations, government agencies and U.S.A.-based major airlines; and using a variety of other expert sources. These efforts were aimed at discovering relevant, quantifiable, reliable factors of importance to consumers commonly used in rating the quality of airline service. Factors considered for inclusion had to be quantifiable, to better achieve an objective approach; to be regularly available, to achieve a timely result; and to be commonly available for all airlines, to insure maximum compatibility. In developing the AQR, only the major airlines operating in the U.S.A. were used. A major airline, as defined by the U.S. Department of Transportation, is an airline whose operating revenues for a twelve-month period are $1 billion or more.

The weighted average approach of the AQR allows level ground comparison of quality for the major domestic airlines operating in the U.S.A. The AQR is not consumer opinion based in a traditional sense, but rather it includes distinct performance characteristics that are specifically reflective of the consumers' points of view. The Airline Quality Rating approach focuses on quantitative factors rather than qualitative factors in order to provide a more objective result in assessing service quality levels across all major domestic airlines. The use of quantifiable, readily available data provides an objective starting point for monitoring the quality of service an individual airline might be providing and allows it to be directly compared with other competitors.

The AQR scale is a weighted average of 19 factors that have relevance to consumers when judging the quality of airline services (see Table 1). The factors represent a select group of concerns that were identified through a combination of research and opinion polling. Originally, over 80 factors were identified as potentially relevant for the AQR (Bowen, Headley, & Luedtke, 1991). This initial list was pared down using two criteria: 1) a factor had to be readily obtainable from published data for all airlines being rated; and 2) a factor had to have relevance to consumer concerns regarding quality. Methods used to achieve a reduction in the number of factors included record searches to determine the availability of the data, discussions with experts in the airline industry regarding relevance to consumers, and expert judgement of the research team. In arriving at the final 19 items, a specific opinion survey was made to a group of 65 experts in the field. These experts included representatives of most major airlines, air travel experts, FAA representatives, academic researchers, airline manufacturing and support firms, and individual consumers. The result of this inquiry allowed a final list of critical factors to be identified. During the gathering of opinion from this diverse group, each expert was asked to rate the importance that each individual factor might have to a consumer of airline services using a scale of 0 (no importance) to 10 (great importance). As a result of these opinions and ratings, some factors were excluded from further consideration. The average importance ratings resulting from this process were used as the weights for the various factors in the AQR. Due to the metric nature of the rating scale, the reliability (Cronbach's Alpha) of the scale was found to be 0.87 for the sample of 65 experts surveyed. This suggests that the AQR is reliable as an initial measure-

Table 1
Airline Quality Rating
Factors, Weights, and Impact

Factor	*Weight*	*Impact*
1. Average Age of Fleet	5.85	-
2. Number of Aircraft	4.54	+
3. On-Time	8.63	+
4. Load Factor	6.98	-
5. Pilot Deviations	8.03	-
6. Number of Accidents	8.38	-
7. Frequent Flier Awards	7.35	-
8. Flight Problems*	8.05	-
9. Oversales*	8.03	-
10. Mishandled Baggage*	7.92	-
11. Fares*	7.60	-
12. Customer Service*	7.20	-
13. Refunds*	7.32	-
14. Ticketing/Boarding*	7.08	-
15. Advertising*	6.82	-
16. Credit*	5.94	-
17. Other*	7.34	-
18. Financial Stability	6.52	+
19. Average Seat-Mile Cost	4.49	-

*Data for these factors is drawn from consumer complaints registered with the U.S.A. Department of Transportation and are published monthly in the Air Travel Consumer Report.

ment scale (Headley, Bowen, Lutte 1993). The basic weighted average formula for calculating the Airline Quality Rating is:

$$\text{AQR} = \frac{w1F1 + w2F2 - w3F3 + \ldots w19F19}{w1 + w2 + w3 + \ldots w19}$$

Each factor (F) has a weight (w), ranging from 0 (no importance) to 10 (great importance), that reflects the importance of that factor in the overall AQR. Also, each weight and factor has an associated positive or negative impact in the formula. For instance, the factor includes on-time performance as a positive impact because it is reported in terms of on-time success, suggesting that a higher number is favorable to consumers. The weight for this factor is high (8.63) due to the importance most consumers place on the on-time aspect of airline service. Conversely, the factor that includes number of accidents has a negative impact because it is reported in terms of accidents per hours flown suggesting that a higher number is unfavorable to consumers. The weight for this factor is also high (8.38) since safety is important to all consumers. It is important to remember that weight and impact are independent of each other. Weight reflects importance of the factor in consumer decision-making, while impact reflects whether the factor has a positive or negative influence on the consumer's rating of airline quality. Taken as a whole, the AQR is reflective of critical quality aspects that a consumer of airline services might consider and the impact and weight attached to each factor reflects consumer attitudes.

When all of the factor values and their associated weights are combined for an airline, a single value for each airline is obtained. Due to the use of comparable data, an AQR value can be directly compared among airline competitors for any designated reporting period and across reporting periods. Since factors, weights, and impacts are the same for all, differences in rating scores are attributable to performance difference among airlines across the various factors. As a result, we have an assessment tool that gives accurate comparative readings based on performance rather than subjective opinion.

INTERNATIONAL PERSPECTIVE

The Airline Quality Rating methodology focuses on quantitative factors rather than qualitative factors in order to provide a more objective result in assessing service quality levels across major U.S.A. domestic airlines. The use of quantifiable, readily available performance data provides an objective starting point for monitoring the quality of service that an individual airline might be providing and allows it to be directly compared with other competitors. This same approach can be applied to international airlines provided that comparable data are available.

Europe has its own special problems with consumer airline quality. The European community's top transport official has urged the twelve-member countries to build a single air-traffic control network to replace the strained and outdated patchwork of national systems presently monitoring European skies. European air traffic control snarls and airport capacity restraints have increasingly caused flight departure delays. The Association of European Airlines (AEA) has called for a single, unified air traffic control for Europe. According to the AEA, delays caused by air traffic control problems have cost the European economy as much as $4.2 billion annually (Industry Trends and Statistics, 1990). More landing sites and/or slots are needed. With the opening of eastern Europe, there has already been new cooperative agreements between different countries' carriers.

There has been increased cooperation among European airlines in order to compete more effectively in this fiercely competitive industry. For example, Austrian Airlines, Scandinavian Airlines, and Swissair formed the European Quality Alliance to facilitate efforts in combining handling and ticket operations and in coordinating product development and marketing. These international airlines, especially new entrants and expanding firms, must realize that they must provide quality service to their customers in order to survive in today's market.

In addition, the Asia/Pacific region is one of the fastest growing areas of the world in scheduled air traffic. Although the European share of total world traffic is expected to decline by the year 2000, the Asia/Pacific region is projected to increase substantially by then, with overall growth in world-wide scheduled passenger traffic anticipated as air travel becomes more accessible worldwide (Forecast of Commercial Aviation Activity, 1996). African and South American markets are also seeing rapid growth opportunities emerge. Middle and Near East markets are growing as well and Central American air traffic is maintaining growth similar to North America. This signifies the growing importance of the world aviation community and a growing competitive environment. With all of the competitive forces at play in the global airline industry some basic common quality assessment tool would be very useful to the various governments, competitors, and international airline travelers.

RECOMMENDATIONS FOR A GLOBAL QUALITY ASSESSMENT SYSTEM

It would seem in the best interests of all global competitors and consumers to identify some common, basic performance factors that could be tracked internationally. In today's competitive international airline environment it is imperative that a company does all it can to attract and retain customers. Companies are learning that it is important to monitor customers' needs and wants and then strive to meet them. If an airline fails to provide quality and satisfaction in its services (i.e., passenger satisfaction), it will lose customers to its competitors.

In order to assess quality in the airline industry, there are two types of measurement factors: qualitative and quantitative. The qualitative factors are difficult to measure and are, more or less, how customers "perceive" quality to be. These perceptions can be determined by surveys, focus groups, interviews, etc., but these opinions are difficult to establish on a comparative basis. The weighted average approach offers an alternative way to compare the quality of airlines by using quantitative, regularly available, performance data.

Perhaps the single biggest plus for the weighted average is the ability to efficiently assess quality on a timely basis across competitors. Quality is best understood over time. Consistent performance in a service environment is a valuable asset that can pay dividends in customer satisfaction and customer loyalty. The biggest roadblock to measuring the consistency of quality is the lack of a tool that allows comparable measurements to be taken at reasonable periods. Surveys do this very well in a longer time frame for the more qualitative aspects of the service encounter. We feel that opinion-based approaches and the more objective weighted average approach complement each other and offer alternatives to those interested in assessing airline quality. The weighted average can supply a more regular assessment of the status of an airline's service quality and track the movement of that quality over time on a level playing field for any number of competitors.

Global application of a weighted average quality assessment tool should be given serious consideration as the industry truly becomes a global marketplace.

Basic data that might be useful in an international assessment tool could include on-time performance, denied boardings, canceled flights, schedule frequency, load factor, and safety. The weighted average of relevant quality factors can be easily adapted for use in any setting as long as some basic conditions exist. These conditions are as follows:

> Any data that are to be used in the weighted average must be available for all competitors on a regular basis. This establishes the basis for comparison between players and across time intervals. Data must also be reliable in its development. If the data are not a true reflection of the marketplace, then weighting, or any analysis tool, is manipulating and extending false impressions.
>
> The weights that are attached to factors must be reflective of the actual importance that they have in the competitive environment involved. These weights must be defensible as to their importance and consistent across some specified period of time to insure accurate comparisons.
>
> Impact (+/-) of the various factors must be determined from a consistent perspective. Whether a factor has positive or negative impact can be relative to whether it is taken from a consumer or industry perspective.
>
> The method has its best return when there are numerous factors to be considered. There is a point at which the effort is not worth the return (i.e., too few factors) and also a point where the effort is too complex to have meaning (i.e., many factors). The exact point for either of these circumstances is situationally determined by available data and resources.

CONCLUSION

Because airline operations are similar throughout the world, the weighted average assessment tool is a good fit for rating the airline industry worldwide, as long as certain data are available for each airline. If these data are available, a comprehensive quality-tracking system can be developed for airlines worldwide. The Airline Quality Rating developed in the U.S.A. is a model that can be adapted to a global airline system. Unfortunately, most countries do not have a central reporting agency for airline performance data as in the U.S.A. In order to utilize the weighted average approach on a worldwide basis, several things must happen: (1) there must be standardized data collected and made available for each airline; (2) an information-sharing vehicle must be established to disseminate these data to an interested public; (3) some organization must identify critical data, calculate a quality rating formula and publish the results to an international audience; and (4) the airlines must cooperate with each other, as well as with the agency collecting and publishing the quality rating scores.

With the dynamic environment of today's competitive airline market worldwide, it is vital to utilize every available means to keep flying and flying profitably, while keeping passengers happy. The weighted average quality assessment tool is a comprehensive quality-tracking system that can show airlines how to achieve this goal by better identifying strengths and weaknesses. The Airline

Quality Rating has been successfully employed in the United States by the major airlines and by the general public. Because airline operations are similar throughout the world, this approach can also be used in many countries to enhance the quality of their airlines. The AQR offers a readily available blueprint which is adaptable to a global industry.

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Aviation Education: Perceptions of Airport Consultants

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ABSTRACT

The necessity for advanced training in aviation has prompted a few universities to establish graduate programs in aviation. Although several masters aviation programs are now well established, they do not have a common core curriculum. This article reports the findings of a study designed to learn more about the educational needs of one segment of the aviation industry - the airport consulting business. Airport consultants were first asked to evaluate the relevance of courses offered in an existing MPA program. They were then asked to evaluate sixteen fields of academic study in terms of importance in preparing entry-level employees for a career in airport consulting

INTRODUCTION AND BACKGROUND

Aviation as a field of academic study has undergone dramatic changes in its relatively short history. Aviation education has traditionally had a technical/vocational orientation and the primary mission of aviation faculty at institutions of higher learning was to provide flight and/or maintenance training. However, considerable interest in aviation developed in the academic community over the past two decades and aviation education moved from airfields and maintenance hangers to classrooms on main campuses across America. At the same time, the objective of aviation educators shifted to include instruction in more traditional university areas of study including science, business and public administration, technology, and the social sciences. In the 1960s and 1970s a number of highly regarded bachelors degree aviation programs emerged at several of America's largest and most prestigious universities, indicating that aviation as a field of academic study has matured considerably.

As this evolution in aviation education has taken place, the need for advanced levels of professional preparation has manifested itself, as demonstrated by several recent studies (Baty, 1985; NewMyer, 1987; Johnson and Lehrer, 1995). These and other analyses indicate that there is considerable demand for advanced degrees in aviation from both industry and educational institutions. The necessity for advanced training in aviation prompted a few universities to establish graduate programs in aviation. Several masters aviation programs are now well established and have proven their effectiveness by their success in the placement of graduates in industry and academia. This article reports the findings of a study designed to learn more about the educational needs of one segment of the aviation industry: the airport consulting business.

Despite the rapid maturing of aviation education, it remains a highly balkanized field of study with no common theoretical or conceptual base from which to build a common core curriculum. Aviation programs at both the undergraduate and graduate levels are located in a hodgepodge of academic units. Frequently, aviation programs are free-standing departments housed in Colleges of Technology and/or Applied Sciences, primarily because of their historical technical/vocational orientations. Other colleges and universities offer aviation education as academic units in Colleges of Business Administration or Engineering, usually because one or more of the original aviation program entrepreneur(s) was affiliated with one of these disciplines. This fragmentation of aviation educational programs within the university organizational structure has contributed to the lack of a common theoretical base and core curriculum.

The challenge facing all academic programs is to match industry demand for education with the research and teaching interests and expertise of their faculty. Of course, the scope and content of any aviation program is dictated to a considerable degree by the discipline of the academic unit with which it is connected. Equally important, a program's curriculum will reflect the financial and personnel resources of the aviation department. Clearly, no aviation program can hope to offer a comprehensive curriculum that will meet the needs of all industry segments. Every academic aviation program must periodically reevaluate their long range strategic plan to identify the areas of education in which the department has special strengths and to match these strengths with the needs and opportunities of particular segments of the aviation industry. University faculty are extremely mobile and turnover is a fact of life in universities. As new faculty members join a department they bring with them their own special strengths and expertise, which administrators should take advantage of by incorporating these special competencies into the department's curriculum.

In order to assist administrators and faculty in designing and evaluating aviation curriculum, a number of recent studies have been conducted to assess the needs of industry and the relevance of current curriculum offerings to these needs. Industry studies also are designed to identify additional fields of study that can be introduced to enhance both the appeal and the product of aviation programs in institutions of higher learning (DenBleyker, NewMyer & Troutt-Ervin, 1989; Truitt, Hamman & Palinkas, 1994; Kaps and Widick, 1995; Quilty, 1996). These studies typically have targeted a specific segment or segments of the aviation industry from which to obtain information about their particular needs. Generally, these industry segments are selected because faculty members have a special interest in that area and because the segment is a major employer of program graduates.

As privatization and contracting out has emerged as a popular method of downsizing government at the federal, state, and local levels, the aviation consulting industry has gown appreciably. Thus, this article presents the results of a survey designed to learn the perceptions of professional airport consults regarding the educational requirements for entry-level employment in the consulting industry. The objective is to assist aviation educational administrators and faculties in designing their curriculum to meet the needs of the airport consulting business. A second goal of the study is to provide information to students contemplating a career as an airport consultant. We were interested in identifying the range of skills and knowledge that consulting firms are looking for in prospective employees.

RESEARCH DESIGN AND METHODS

The research project was conducted during the Spring of 1996. The research strategy chosen in this study was a mailed survey to 251 airport consultants throughout the United States and Canada. Respondents included the entire 1995 membership roster of the Airport Consultants Council, the primary professional association for airport consultants. In addition, we identified a number of airport consultants listed in the 1994 World Aviation Directory to serve as respondents.

Many of the members of the Airport Consultants Council are large, integrated consulting firms that offer a wide range of consulting services, including an airport consulting division or department. We attempted to ensure that the questionnaire was completed by a senior member of the airport consulting department by including an indication in the cover letter. However, there was no way to guarantee that this objective was achieved in the case of large, full service consulting firms. Other airport consulting firms in our sample are very narrow in scope and only perform very specialized types of services such as signing/graphics, pavement strength analysis, or communications services. Thus, respondents to our survey included a wide range of firms in terms of the types services they offer, the size of staff, and level of revenues. The single mailing produced 54 usable surveys, for a response rate of 22%.

The Aviation Consulting Business

Airport consultants perform a broad range of specialized services because airports do not have the personnel to perform them. The list of services performed by airport consultants is far too lengthy to report here, but a summary of the major types include planning (system and master planning), engineering, architecture and construction management studies. In addition, consultants perform economic impact studies, a range of environmental impact assessments such as noise, air, and water pollution, and wildlife habitat analyses. Consultants also provide a host of technical services requiring specialized skills such as airside pavement analyses (runway, taxiway, and apron pavement strength), security systems, automated weather systems, electrical and lighting systems, terminal and runway design, and a host of other legal, marketing, and ground transportation analyses. These are just a few examples of the types of services offered by the airport consulting industry. Airports cannot be afford to employ full time personnel with the expertise necessary to conduct the specialized studies that are only needed infrequently.

As pointed out by one reviewer, consultants require specialist skills, not just the generalist skills provided by typical aviation administration courses. We agree with this assessment but we argue that the same is true for most academic disciplines. Universities cannot possibly be expected to provide the very specialized skills necessary to prepare graduates to perform advanced projects. Whether students graduate from law, business administration, or economics programs, they are generally hired as entry-level employees and learn the specialized skills needed on the job from the senior members of the firm. Entry level employees in most management positions serve in a capacity that is similar to an apprenticeship under senior members in order to acquire the skills required by their employers.

Survey Instrument

A survey questionnaire was designed to obtain information regarding the importance of several areas of aviation curriculum. The first section of the survey asked respondents to evaluate the relevance of each of the required courses offered in a typical aviation administration concentration in a Master of Public Administration (MPA) program (see Tables 1 and 2). We wanted to learn how airport consultants perceived the MPA aviation program in terms of relevance to their business. A brochure describing the MPA aviation program was included in the mailing to assist respondents in completing this part of the study. The curriculum described in the brochure consisted of five required core public administration classes and five aviation-specific courses, from which MPA aviation students were required to complete at least three.

The second section of the survey asked respondents to rate sixteen different disciplines and/or fields of study in terms of their importance in preparing entry-level employees for a career in the airport consulting business (see Table 3). The fields of study listed on the survey were selected from a university catalogue and included many areas generally offered by Colleges of Business, Liberal Arts, and Technology/Applied Sciences. The third section of the survey asked respondents to evaluate the importance of twenty-two different areas of general knowledge and skills (see Table 5). For example, we asked airport consultants to rate the applicability of computer modeling, planning, and written communications in preparing students for entry-level employment in the airport consulting business. We also asked respondents to rate the relative importance of several computer software packages which are commonly used in the airport consulting business.

The questionnaire included a section that requested respondents to provide general demographic data including their level of educational attainment, length of employment, professional organization affiliations, previous experience, race, gender, and age. These questions were included in order to learn more about the career track of the "typical" professional in the airport consulting industry as well as to identify the diversity of employees that comprise the industry. The survey also included a series of questions requesting respondents to indicate whether they were aware of the existence of the MPA aviation program that sponsored the survey. Additionally, respondents were asked whether their firm had an existing internship program and whether they would be interested in participating in an internship program with the institution that sponsored the research. Critics can legitimately claim that this series of questions and the inclusion of brochures describing the MPA aviation program and its internship program introduced bias into the study. We acknowledge that this is a valid concern. However, the realities of the sponsoring program's budget and other resource constraints, coupled with the need to establish relationships with the airport consulting industry, dictated that researchers include these questions in the survey. We feel very strongly that the internship component is one of the strengths of our program. At least one respondent voiced the same view of the internship program, commenting that "one can't be effective without real world experience." Moreover, follow-up interviews with several respondents leads us to believe that any effect of these factors on the objectivity of the research is negligible.

Measurement

A Likert-type scale was used for questions regarding relevance and importance of a variety of issues. The categories of the relevance scale included: "Extremely Relevant," "Very Relevant," "Somewhat Relevant," "Little Relevance," "Not Relevant," and "Don't Know," Categories for the importance dimension scale were similar. Ascending values were assigned for the measurement categories, with a rating of 1 equivalent to "Extremely Relevant," and a rating of 5 equivalent to "Not Relevant." A value of 6 was assigned to "Don't Know" and -9 for non-responses. Only values of 1 through 5 were considered in the determination of frequency distributions and descriptive statistics reported below. Although we did not ask open-ended questions on the instrument, several respondents felt so strongly about certain issues that they were compelled to expand upon their responses by writing comments. We report some of these comments since they provide additional insight into how airport consultants perceive academic programs.

Statistical Procedures

A statistical software package, SPSS for Windows, was used to evaluate the survey data. Simple descriptive statistics were calculated for each variable, as well as frequency distributions. After means were calculated for each item in a specific group, the means and corresponding items were reorganized in tabular format. The categories are presented in ascending order, with most importance or relevance categories reported first and least importance or relevance last. The findings of the consultants' survey are reported below in tables of frequency distributions and mean scores for relevance or importance as perceived by the respondents.

FINDINGS

MPA Program Curriculum

The first section asked airport consultants to evaluate the MPA aviation program described in the brochure included in the mailing. Aviation courses were rated higher than the core MPA courses. As shown in Tables 1 and 2, the top three courses were aviation specific courses. Airport consultants rated the Aviation Policy and Planning course highest, with 41% of respondents indicating that they believed this course to be "extremely relevant" and 33% considered it to be "very relevant." These responses translated into a mean score of 1.804 for the Aviation Policy and Planning course (see Table 2). This high rating is not surprising when one considers that much of the work airport consultants do involves planning studies commissioned by airport policy makers. Clearly, the more training and expertise a prospective employee has in the areas of planning and policy making, the more attractive the individual is to his superiors. This finding is supported by follow-up reports from consulting firms that have par-

Table 1
EVALUATION OF PROGRAM CURRICULUM
Responses for Each Category Given in Percentages and (Frequencies)

Courses in Curriculum	*1*	*2*	*3*	*4*	*5*	*n*
Public Sector Management	4% (2)	28% (15)	44% (24)	6% (3)	2% (1)	45
Public Budgeting and Fiscal Management	17% (9)	41% (22)	22% (12)	6% (3)	2% (1)	47
Public Personnel Management	2% (1)	20% (11)	39% (21)	17% (9)	7% (4)	46
Program Analysis and Evaluation	15% (8)	26% (14)	32% (17)	7% (4)	0	43
Organizati on Theory and Behavior	0	13% (7)	57% (31)	19% (5)	4% (2)	45
Aviation Law and Regulation	26% (14)	39% (21)	19% (10)	4% (2)	0	47
Aviation Safety Administration	19% (10)	24% (13)	28% (15)	15% (8)	0	46
Airport Administration	30% (16)	37% (20)	20% (11)	0	0	47
Aviation Policy and Planning	41% (22)	33% (16)	9% (5)	2% (1)	4% (2)	46
International Aviation	11% (6)	37% (20)	32% (17)	6% (3)	2% (1)	47

Note 1: Rating system provided for evaluators follows:
1=Extremely Relevant
2=Very Relevant
3=Somewhat Relevant
4=Little Relevance
5=Not Relevant
6=Don't Know

Note 2: A value of -9 was assigned to surveys in which the respondent failed to mark a category.

Note 3: Only responses 1-5 were used in calculating statistics.

Note 4: Row percentages may not add up to 100% due to rounding.

Table 2
Evaluation of Program Curriculum
Ranking of Mean Ratings

Courses in Curriculum	*Mean Score*
Aviation Policy and Planning	1.804
Airport Administration	1.894
Aviation Law and Regulation	2.000
Public Budgeting and Fiscal Management	2.255
International Aviation	2.426
Aviation Safety Administration	2.457
Program Analysis and Evaluation	2.395
Public Sector Management	2.689
Organization Theory and Behavior	3.044
Public Personnel Management	3.087

Note 1: Rating System provided for evaluators was as follows:
1=Extremely Relevant
2=Very Relevant
3=Somewhat Relevant
4=Little Relevance
5=Not Relevant
6=Don't Know

Note 2: A value of -9 was assigned to surveys in which the respondent failed to mark a category.

Note 3: Only responses 1-5 were used in calculating statistics.

ticipated in the MPA internship program. Despite this high ranking, relatively few aviation programs offer a course in aviation policy.

Consultants ranked the Airport Administration course a very close second in terms of relevance, with 30% of the respondents indicating the course was "extremely relevant" and 37% rating it as being "very relevant." These responses for the airport course translate into a mean rating of 1.894, a statistically insignificant nine one-hundredths of a point behind Aviation Policy and Planning,. We expected airport consultants to rate this course very high since the substantive content of the course deals with the essence of the consulting profession. Most consultants are intimately involved with airport administrators and it is only natural that they would consider such a course highly valuable for prospective employees. Obviously, the more information that students have regarding the functions, duties, and responsibilities of airport administrators the better equipped they will be to produce meaningful work. Not surprisingly, almost every undergraduate and graduate aviation management program in the country has at least one course in airport administration. Aviation Law and Regulation was ranked third in terms of relevance with 35 of 47 respondents assigning it either an "extremely relevant" or "very relevant" rating. As shown in Table 2, these responses translate into a mean score of 2, or "very relevant." The two other aviation courses—International Aviation and Aviation Safety Administration—were perceived by respondents as being somewhat lower in relevance with mean scores of 2.436 and 2.457 respectively. It would be interesting to learn if airport consultants' opinions regarding the relevance of the Safety

Administration course have changed given the increased attention safety has received in the wake of the ValuJet and TWA disasters, both of which occurred after the survey was administered.

The results of this section of the survey indicate a strong support for the aviation courses compared to the core courses in the MPA program consultants were asked to evaluate. Respondents rated Public Budgeting and Fiscal Management as the most important course of the required core public administration courses. This finding is supported by other studies (Truitt, Hamman & Palinkas, 1994; Kaps & Widick, 1995). Consultants generally ranked two other core MPA course—Program Analysis and Evaluation and Public Sector Management—as being relevant to the consulting business with mean scores of 2.395 and 2.689 respectively. Only two out of the ten MPA courses evaluated by respondents—Organization Theory and Behavior and Public Personnel Management—received mean scores greater than 3 (somewhat relevant), indicating that respondents considered them to provide only marginal benefits for a career in the consulting business. More research is required to explain these lower ratings. However, discussions with many alumni reveal that organization theory courses are often seen as being more abstract and less relevant. Similarly, a plausible explanation for the relatively low ranking of the Public Personnel Management course is that airport consultants rarely get involved in studies relating to public sector personnel laws and procedures.

Fields of Study

The next section of the survey asked airport consultants to evaluate sixteen fields of academic study in terms of importance in preparing entry-level employees for a career in the airport consulting business. As shown in Table 3, the field of public administration was ranked highest in importance with 43% of respondents ranking it as being "extremely important" and 30% indicating it was "very important," which translated into a mean score of 1.846 (see Table 4).

The high ranking of the field of public administration is rather surprising since many of the respondents were graduates of business administration, economics, and/or engineering programs. However, as noted previously, a very high percentage of the studies that airport consultants conduct are sponsored by public administrators and presumably the more one understands the field of public administration, the better prepared they will be to do a satisfactory job for their clients. As noted earlier, the inclusion of MPA brochures in the mailing may have introduced bias into the study.

This seems to be partially confirmed by one respondent who indicated that "all of the elements are important but since the curriculum is oriented toward administration, I suspect emphasis would be on elements of study involving money, people, and politics and less on science and engineering." Nevertheless, the high ranking of public administration indicates that airport consultants recognize that the core elements in the field of public administration are important in preparing entry-level students for a career in the airport consulting business.

Table 3
EVALUATION OF FIELDS OF STUDY
Responses for Each Category Given in Percentages and (Frequencies)

Field of Study	*1*	*2*	*3*	*4*	*5*	*n*
Accounting	13% (7)	33% (8)	39% (21)	9% (5)	0	51
Applied Science/Technology	19% (10)	48% (26)	28% (15)	2% (1)	0	52
Computer Science	15% (8)	50% (27)	24% (13)	4% (2)	2% (1)	51
Economics	35% (19)	43% (23	19% (10)	2% (1)	0	53
Engineering	19% (10)	43% (23)	28% (15)	6% (3)	0	51
Finance	0	9% (5)	43% (23)	32% (17)	9% (5)	50
Foreign Language	6% (3)	20% (11)	35% (19)	20% (11)	15% (8)	52
Geography	6% (3)	19% (10)	40% (21)	26% (14)	4% (2)	50
International Relations/Business	6% (3)	25% (13)	48% (26)	17% (9)	2% (1)	52
Law	15% (8)	50% (27)	28% (15)	6% (3)	0	53
Management	20% (11)	42% (23)	24% (13)	7% (4)	2% (1)	52
Marketing	0	9% (5)	48% (26)	26% (14)	9% (5)	50
Political Science	2% (1)	9% (5)	33% (18)	28% (15)	20% (11)	50
Psychology	7% (4)	39% (21)	33% (18)	15% (8)	0	51
Public Administration	43% (23)	30% (16)	20% (11)	4% (2)	0	52
Speech Communication	19% (10)	39% (21)	32% (17)	2% (1)	2% (1)	50

Note 1: Rating system provided for evaluators follows:
1=Extremely Important
2=Very Important
3=Somewhat Important
4=Little Importance
5=Not Important
6=Don't Know

Note 2: A value of -9 was assigned to surveys in which the respondent failed to mark a category.

Note 3: Only responses 1-5 were used in calculating statistics.

Note 4: Row percentages may not add up to 100% due to rounding.

The field of economics was rated by respondents as being second in importance. In a seeming contradiction, the fields of finance and political science were rated lowest in importance in terms of preparation for a career in consulting, with mean scores—3.440 and 3.600 respectively. These results are difficult to explain since they appear to contradict the respondents' ranking of Public Budgeting and Fiscal Management as the most important core MPA public administration course.

One reviewer suggested that the apparent anomalies between the high ranking of economics and the low ranking of finance may be at least partially explained by the high prevalence of economic impact analysis compared to the lower number of consultants that conduct landing fee analysis or municipal bond preparation.

The ranking of public administration as the most important field of study and political science as the least important also seems paradoxical. However, much of this variance probably can be attributed to the relative perceptions and interpretations of public administration and political science. Many consultants deal directly with city managers and airport directors who are professional public

Table 4
EVALUATION OF FIELDS OF STUDY
Ranking of Mean Ratings

Fields of Study	*Mean Score*
Public Administration	1.846
Economics	1.868
Applied Science/Technology	2.135
Engineering	2.216
Computer Science	2.235
Speech and Communications	2.240
Law	2.245
Management	2.250
Accounting	2.471
Psychology	2.588
International Relations/Business	2.846
Geography	3.040
Foreign Language	3.192
Marketing	3.380
Finance	3.440
Political Science	3.600

Note 1: Rating system provided for evaluators was as follows:
1=Extremely Important
2=Very Important
3=Somewhat Important
4=Little Importance
5=Not Important
6=Don't Know

administrators. It follows that consultants view public administrators as professional executives. On the other hand, many individuals regard political science as too abstract. In fact, one respondent indicated that political science was "too theoretical" and gave it a low ranking, presumably on the basis that knowledge of the political process was of little value in preparing entry-level employees for a career in the airport consulting business. Nevertheless, it is puzzling how the same group can rate a course in budgeting and fiscal management and the field of public administration so highly while at the same time rating the fields of finance and political science as being the least important in terms of student career preparation. Obviously, this finding is ambiguous and more information is required to uncover the basis for this apparent contradiction.

Knowledge and Skills

To add to the puzzle, in comparison to the respondents' low regard for the field of political science, airport consultants rated knowledge and skills regarding the Structure and Operations of State/Local Government highest in terms of mean importance for entry level employees (see Table 6). Of the twenty-one items rated by respondents the following categories round out the top five ratings: Operations Research, Written Communications, Oral Communications, and Emergency Management Services. Given that a significant proportion of

Table 5
EVALUATION OF KNOWLEDGE AND SKILLS
Responses for Each Category Given in Percentages and (Frequencies)

Knowledge/Skills	*1*	*2*	*3*	*4*	*5*	*n*
Computer Modeling	32% (17)	41% (22)	20% (11)	2% (1)	0	51
Decision Making	11% (6)	36% (3)	37% (20)	28% (15)	9% (5)	49
Emergency Management Services	43% (23)	32% (17)	9% (5)	11% (6)	0	51
Ethics	13% (7)	46% (25)	28% (15)	6% (3)	0	50
Federal Laws and Regulations	15% (8)	41% (22)	32% (17)	4% (2)	0	49
Financial Planning	19% (10)	46% (25)	24% (13)	4% (2)	2% (1)	51
Forecasting	17% (9)	28% (15)	33% (18)	13% (7)	2% (1)	50
Grants Administration	2% (1)	13% (7)	32% (17)	32% (17)	15% (8)	50
Labor Relations	7% (4)	17% (9)	39% (21)	24% (13)	6% (3)	50
Lease Contract Negotiations	7% (4)	43% (23)	35% (19)	7% (4)	2% (1)	51
Management Information Systems	6% (3)	20% (11)	48% (26)	15% (8)	2% (1)	49
Operations Research	61% (33)	28% (15)	4% (2)	4% (2)	0	52
Oral Communications	39% (21)	39% (21)	17% (9)	0	0	51
Planning	7% (4)	22% (12)	37% (20)	20% (11)	6% (3)	50
Policy Analysis	2% (1)	30% (16)	33% (18)	22% (12)	6% (3)	50
Policy Evaluation	15% (8)	32% (17)	33% (18)	9% (5)	4% (2)	50
Research Methods	4% (2)	20% (11)	44% (24)	17% (9)	7% (4)	50
Security	11% (6)	32% (17)	37% (20)	11% (6)	2% (1)	50
State/Local Laws and Regulations	17% (9)	24% (13)	41% (22)	9% (5)	2% (1)	50
Statistics	4% (2)	19% (10)	60% (32)	7% (4)	4% (2)	50
Structure and Operations of State/Local Government	67% (36)	26% (14)	4% (2)	0	0	52
Written Communication	33% (18)	67% (36)	0	0	0	54

the airport consulting business is related to analyzing airport operations and the decision making and transformation systems associated with operations management, it is not surprising that respondents rated it as being second in importance with 61% rating it as "extremely important" and 28% rating as being "very important," which translates into a mean score of 1.481.

Similarly, given the widespread recognition of the importance of communications, it comes as no surprise that 33% of the respondents rated Written Communications as being "Extremely Important" while the remaining 67% rated it as being "Very Important," a mean score of 1.666. Indeed, every respondent considered written communications to be of great importance, with one respondent marking the category with an asterisk and writing in the margin "most important of all." Another consultant indicated that "too many grads cannot write!" A third respondent felt so strongly about written communications that he marked a new category "vitally important." Of course, one of the most frequent complaints about the American education system is the poor level of writing

Table 6
EVALUATION OF KNOWLEDGE AND SKILLS
Ranking of Mean Ratings

Knowledge and Skills	*Mean Score*
Structure and Operations of State/Local Government	1.346
Operations Research	1.481
Written Communications	1.666
Oral Communications	1.765
Emergency Management Services	1.882
Computer Modeling	1.922
Financial Planning	2.196
Federal Laws and Regulations	2.265
Ethics	2.280
Lease Contract Negotiations	2.510
Forecasting*	2.520
Policy Evaluation*	2.520
State/Local Laws and Regulations*	2.520
Security	2.580
Management Information Systems	2.857
Statistics	2.880
Planning	2.940
Policy Analysis	3.000
Labor Relations**	3.040
Research Methods**	3.040
Decision Making	3.204
Grants Administration	3.480

*Forecasting, Policy Evaluation and State/Local Laws and Regulations have the same mean score.

**Labor Relations and Research Methods have the same mean score.

skills of today's graduates. These results simply confirm the general perception that writing skills are weak and that academic programs at all levels must emphasize the importance of good writing and incorporate more written assignments into their courses.

As shown in Tables 5 and 6 respondents also viewed Oral Communications as being only slightly less significant than written communications with 39% of respondents rating oral communications as being "Extremely Important" another 39% rating it as "Very Important", the remaining 17% rated Oral Communications as being "Somewhat Important." The same respondent that marked a new category for written communications also marked a new category for oral communication—"Super Important."

Rounding out the top five areas of knowledge and skills is emergency management services, which includes a wide range of functions including fire, crash and rescue activities. Of course, each of these activities is extremely important and all require extensive training and practice. Equally important to training is the development of an Airport Emergency Services Manual that clearly defines the duties and responsibilities of emergency personnel. Since new flight and emergency equipment is constantly being introduced, modifications of support facilities and services is an on-going process. This is especially true for crash and rescue services. Thus, knowledge and skill in this specialized area was rated "extremely important" by 43% of the respondents and 36% rated this category as being "very important," for a mean score of 1.882.

Most other knowledge and skill categories also received relatively high rankings by the respondents, making it clear that faculty members who teach airport courses must be prepared to cover a wide range of material. Clearly, the degree of professionalism expected of today's airport executive is reaching new standards and the old perception of the airport manager as a political appointee with a pilots license no longer holds, indeed, if it ever did. Not only must airport managers be good communicators, they must also be well versed in a wide range of areas including state and local government, operations, financial planning, marketing, federal laws and regulations, negotiating leases, security, and ethical issues.

Computer Software Programs

The next section of the survey asked respondents to rate the relative importance of seven specific computer software packages to their firms' activities. The packages are either directly aviation related or are indirectly used in the airport consulting business. In somewhat of a surprise, the mean importance score for each of the programs indicates that consultants generally place prior expertise in these programs to be of relatively low importance for entry level employees—ranking them as either "somewhat important" or of "little importance." The software package with the highest mean importance was the Integrated Noise Modeling (INM) program, which received a rating of 2.875, a score only slightly higher than the "Somewhat Important" category. The scores of other software programs as shown in Tables 7 and 8 received similarly low scores. This finding is puzzling since we asked several experts in the consulting business to pre-test our questionnaire and they indicated that these software programs were among the most popular programs in the industry. They indicated that these programs were regularly used in the airport consulting business. However, our respondents ranked knowledge and skills of these popular programs relatively low. This confirms our hypothesis that consultants hiring entry level employees are more concerned with more general skills and that the highly technical skills can be taught "on the job."

Following the questions regarding how respondents ranked the importance of specific computer programs to the firm, we asked them to rank the importance of exposure to these types of programs by prospective entry-level employees. The same Likert-type scale was used for the answer categories. On this question the mean importance score was 2.808. Comparing this score to the low ratings of the specific software package programs shows that consultants appear to believe that exposure to these types of programs is perhaps somewhat greater than the expectations for those in the business today. This is another indication of the

Table 7
EVALUATION OF SOFTWARE PROGRAMS
Responses for Each Category Given in Percentages and (Frequencies)

Software Program	*1*	*2*	*3*	*4*	*5*	*n*
Simmod	17% (9)	11% (6)	19% (10)	17% (9)	22% (12)	49
ALPS	4% (2)	15% (8)	26% (14)	19% (10)	19% (10)	44
INM	20% (11)	24% (13)	15% (8)	6% (3)	24% (13)	48
EDMS	7% (4)	15% (8)	17% (9)	15% (8)	26% (14)	43
Economic Impact Model	2% (1)	6% (3)	13% (7)	22% (12)	26% (14)	37
EMME/2	0	4% (2)	7% (4)	11% (6)	32% (17)	29
Construction Management	15% (8)	19% (10)	11% (6)	13% (7)	24% (13)	44

Table 8
EVALUATION OF SOFTWARE PROGRAMS
Responses for Each Category Given in Percentages and (Frequencies)

Software Program	*Mean Score*
INM	2.875
Construction Management	3.159
Simmod	3.196
ALPS	3.409
EDMS	3.465
Economic Impact Model	3.946
EMME/2	4.310

All notes from Table 4 apply.

Additional notes for Tables 7 and 8:
Simmod = Simmod (FAA) - Airspace Simulation
ALPS = Airport Landside Planning System (ALPS)
INM = Integrated Noise Modeling (INM)
EDMS = Emission Dispersion Modeling System (EDMS)

vital importance of computer literacy for the emerging workforce. (See Tables 7 and 8.)

Demographics

The next section of the survey asked a series of questions regarding demographics and professional affiliations of the respondents. All of the airport consultants that returned our questionnaire indicated they had achieved at least a bachelors degree. Forty-four percent had earned a masters degree, while four percent have the doctorate. The overwhelming majority (almost 70%) of airport consults earned their highest degree in either business administration or engineering. Most of today's airport consultants expect entry-level consultants to have received a bachelors degree prior to obtaining employment as a consultant, while 13% indicated that a masters degree is necessary.

The mean length of employment of our respondents in the consulting business was 17.42 years, and on average our respondents had held their current position for a period of 8.23 years. The vast majority (78%) of respondents classified their position as upper management. Sixty-seven percent of the respondents are affiliated with the American Association of Airport Executives (AAAE), while nearly half (48%) are members of the Airport Consultants Council (ACC). As indicated earlier, we surveyed the entire 1995 membership roster of the ACC as well as a number of airport consultants listed in the World Aviation Directory that were not ACC members. Another explanation for the fact that only about one-half of the respondents to the survey are members of the Airport Consultants Council is that many of these firms are large, diversified consulting firms for which airport projects account for a relatively low portion of their business. Thirty-two percent of the respondents indicated they were members of the American Society for Civil Engineers and 40% have earned the professional engineer (PE) certificate. Other individuals indicated that they were members of architectural and/or planning professional organizations, but the numbers were small in comparison to members of engineering and/or airport associations. Airport consulting is a field of growing importance to the aviation industry and our list of respondents represents an ideal group from which the University Aviation Association (UAA) can launch a recruiting effort for new corporate members. After all, one of the primary objectives of UAA is to establish and maintain relationships with key aviation groups. Approximately one-third of those surveyed had previous military experience, and 35% have received private pilot training. In addition, almost one-third of respondents had previous experience in local government. Thirty-two percent had previously been involved with airport management, and thirty percent had experience in the airline industry. The average age of the airport consultant was 49 years, with a range of 22 years to 82 years. It is noteworthy that the group of respondents are predominately Caucasian (87%) and male (92%). This finding comes as no surprise to anyone that has attended a meeting of aviation professional organizations, but it reveals the opportunities for employment for women and other minorities.

CONCLUSIONS

The results from this study provide insights into the perceptions of a sample of airport consultants regarding aviation education and the importance and relevance of various disciplines and fields of study to the consulting industry. It must be stressed that the airport consulting business is only one segment of aviation, a broad and diverse industry. Thus, one must be careful in drawing conclusions about the curriculum and other elements of aviation programs based upon a single segment. However, airport consulting is an important and growing segment and graduates of aviation management programs are increasingly finding employment in this segment. Several conclusions can be drawn from the responses of airport consultants to this survey:

1. Respondents believe that the curriculum of the MPA Aviation Administration Program is adequate preparation for future airport consultants.

2. Airport consultants place the highest degree of importance on state and local government operations.

3. All consultants emphasized the importance of both written and oral communications.

4. Airport consultants rated public administration as the field with the highest mean importance score of all fields of study they were asked to rate.

While airport consultants presently do not place a very high degree of importance on aviation and consulting business type computer software applications, they do recognize that this importance will grow and will more than likely be essential for tomorrow's airport consultants.

It appears that perhaps the most beneficial adjustment any educational institution could make would be to provide their students with a higher degree of exposure to oral communication and written communication skills. The overwhelming response of consultants noting deficiencies in these categories indicates that skills in these areas are vital for future airport consultants. Methods of implementing this increased level of exposure include, but are not limited to: (1) oral presentations in every class; (2) stringent standards applied to the evaluation of all written assignments; and (3) recognition of those performing well in these areas.

As for the exposure to aviation-specific software for graduate students, this task may be more difficult. The acquisition, implementation, upkeep, and training of personnel on such highly specific applications would likely be cost prohibitive. However, students can broaden their base of computer literacy by gaining exposure to as many different types of applications as possible. A broad base of knowledge often enables quicker learning of new applications, regardless of their type.

Perhaps the most important contribution this study makes to aviation as a field of study is that it provides information regarding the importance of various disciplines and areas of knowledge and skills from the perspective of the airport consulting business. As indicated in the references, several similar studies have been conducted that targeted different industry segments to learn about their needs and perceptions of aviation education. As more studies are completed in the future, the field of aviation as an academic endeavor can continue the maturing process and a common theoretical and conceptual base can emerge that will promote the development of a widely-accepted core curriculum for aviation management programs. Individual academic programs can design their programs to meet the needs of particular target segments.

Of course, program development cannot be done haphazardly. Program administrators must match their curriculum with the interests and expertise of their faculty. Likewise, when new faculty members are hired they must be selected based upon the strategic direction of the program. Few aviation programs have the financial or personnel resources to meet the needs of the entire aviation industry. Thus, the prudent way to develop a program with a reputation for excellence is to target specific industry segments in which to specialize. As the graduates of these excellent programs prove themselves in the workplace, the prominence of the university and the program from which they graduated will be enhanced. Ultimately, it is the quality of graduates that establishes the reputation of any academic program. Industry studies such as the one reported in this article simply provide information which can be used to chart a course. The fragmentation of aviation educational programs within the university organizational structure has contributed to the lack of a common theoretical base and core curriculum. As aviation as a field of study continues to mature, it can move toward becoming a discipline and gain the status and respect that established disciplines have come to take for granted.

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Curriculum Design Issues in Developing a Doctor of Philosophy Program in Aeronology

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ABSTRACT

A Ph.D. degree program in the non-engineering aeronautical/aerospace sciences (aeronology) will likely be required in the near future to meet the increasing demands for qualified faculty, administrators, and industry representatives within the aviation/aerospace field. Since there is no known Ph.D. degree program dedicated exclusively to a non-engineering aeronautical/aerospace science discipline worldwide, a study was conducted to design and propose a Ph.D. curriculum model based upon two curriculum models a research/practitioner model and a practitioner model. A survey questionnaire was sent to 105 U.S. University Aviation Association (UAA) institutional members to solicit their professional expertise. The study found that support for each of the two curriculum models was approximately equal although overall support for both models was not overwhelmingly high. However, a majority of the respondents did support several curriculum design attributes in developing a new Ph.D. program. These attributes included a computer science requirement, an oral communication requirement, a core program requirement, and a global education awareness requirement.

INTRODUCTION

In a global economy, new technologies are constantly changing the products and services in the aviation/aerospace industry at phenomenal rates. Today's state of the art equipment seemingly is made obsolete by new and improved technological methods of tomorrow. If American aviation/aerospace employers expect to remain competitive, their employees must remain adept in the face of changing trends in technology. In providing employers with highly skilled graduates, it is imperative that aviation/aerospace programs become equipped with the necessary tools to stay abreast of changing trends in the field and incorporate these changes into their curricula.

Despite technological advances in the aviation/aerospace industry, there is a notable absence of an aviation/aerospace doctoral program in the U.S. and there are no known programs abroad. The benefits of a Ph.D. program in aeronology are numerous. Not only will a newly developed Ph.D. program benefit the aviation/aerospace industry, a new doctoral program in aeronology will provide an

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avenue for collegiate aviation faculty members to advance in teaching excellence, promotion, and tenure, and will increase their ability to procure grant monies. Hirshberg (1992) asserted that keeping faculty current in their field and knowledgeable about the latest teaching and learning (Brady, 1991) techniques and technological changes/innovations is vital for high quality instruction and educational excellence.

BACKGROUND

The impetus for this study was derived from several other studies conducted since 1993 pertaining to non-engineering doctoral programs. A master's thesis, The Feasibility of Developing a Professionally Accredited Non-Engineering Aeronautical/Aerospace Science Doctoral Degree Program in U.S. Universities by Johnson (1993), provided preliminary information by surveying 101 University Aviation Association (UAA) institutional members to determine the feasibility of developing a non-engineering doctoral program by assessing present educational needs and anticipating future needs. Two doctoral dissertations, Perceptions of Aviation Educators Concerning Aviation Practitioner's Concepts of Curricular Needs in an Aviation Doctoral Program: A Modified Delphi by Kaps (1995) and A Doctoral Degree in Aviation Science: The Need, Curriculum Content, and other Considerations as Perceived by Aviation Educators Holding Doctoral Degrees by Beck (1996), provided significant information related to content issues in the development of an aviation doctoral program. Beck's study sought to determine what content areas should be included in an aviation doctoral program and the type of program that should be established as perceived by aviation educators holding a doctoral degree. Recommendations included additional research in examining different approaches to organizing curriculum for a doctoral program in aviation. The purpose of Kaps' study was to identify the perceived content of an aviation doctoral degree by aviation professionals, and to obtain and define any consensus between aviation professionals and educators. Interestingly, findings suggested the possibility that aviation educators may not have a basic understanding of the needs and concerns of aviation practitioners.

Although designing and implementing an effective curriculum provides unique challenges to educators, another salient issue that became readily apparent during the study was the lack of widespread identity concerning the postsecondary aviation/aerospace field. As suggested in an article entitled Aviation Science? Collegiate Aviation? Aeronautics? Aerospace Science? Introducing Aeronology in Resolving Identity Issues by Johnson (1997):

> Identity in the academic setting is of paramount importance and affects many variables. The identity problem creates havoc for educators and students alike. One area affected by identity is student recruitment. Consider a prospective aviation student aspiring to become an airport manager. The student looks at several aviation programs at five institutions and finds the following in the school catalogs: aeronautical

> technology, aerospace science, aeronautical studies, aviation science, airway science, civil aviation, aviation administration, aviation computer science, and aviation maintenance management. In contrast, a prospective psychology student aspiring to become an industrial psychologist will probably be able to identify a specific industrial psychology program under the auspices of the psychology department. (p. 7)

By combining recognized terms to develop a new term that accurately reflects postsecondary aviation as an academic discipline, Johnson (1997) developed the term aeronology for consideration to the academic community, and defined it as "the study of the non-engineering aspects of aviation, aeronautics, and aerospace sciences and technologies" (p. 7). An advantage of using the term aeronology is that it distinguishes the academic study of aviation, aerospace, etc., from the pervasive nature of the field. Perhaps in time, the term aeronology may provide a platform of perceptual stability in the public eye.

METHODOLOGY

Subjects

The population for this study includes all of the U.S. University Aviation Association institutional members. In February 1996, the University Aviation Association membership list indicated there were 105 U.S. institutional members. Each of these institutional members represents a postsecondary institution that offers an aviation/aerospace program. Concerning the subjects, several key assumptions were made during the study: (a) The UAA institutional members were appropriate representatives who are experts in the non-engineering aviation/aerospace sciences; (b) the data generated from the experts can be utilized to design a curriculum for a new Ph.D. program in conjunction with content-based studies in the field; (c) the experts were current in academic matters who were able to understand the present needs and reasonably make assumptions about future needs in aviation/aerospace field; and (d) the experts responded to the questionnaire in a sincere manner using their professional, educational, and experiential expertise.

Research Instrument

The measuring instrument utilized to collect the data was a survey questionnaire developed specifically for the study. The questionnaire was distributed by mail to all 105 U.S. member institutions. A Likert scale was utilized for 20 statements in the questionnaire. This type of scale indicates the extent of agreement or disagreement with a particular statement of an attitude, belief, or judgment (Tuckman, 1988). The Likert-type statements used the scale 1 Strongly Disagree, 2 Disagree, 3 Somewhat Disagree, 4 Somewhat Agree, 5 Agree, and 6 Strongly Agree. The phrase Don't Know (DK) was used in order to provide the respondents a suitable means to answer a statement if it generated confusion, was insufficient, was beyond the area of the respondents' expertise, or simply could not be answered. The phrase No Opinion (N/O) was also included in the questionnaire in case the respondents did not have a belief that reflected the other statements. Although reported in the study, Don't Know (DK) and No Opinion (N/O) responses were excluded in determining significant relationships between variables. Gay (1992) points out that a minimum return rate of approximately 70.0 percent needs to be obtained or the validity of the conclusions will be weak. A usable return rate of 75 responses (71.4 percent) was achieved for the study.

DATA ANALYSIS

Descriptive and inferential statistics were used in the computations. An analysis of the data generated by the survey questionnaires was accomplished using Statistical Package for Social Sciences (SPSS) (1995). Prior to developing tables for the data, a chi-square test was used and it was found that the data were extremely skewed or the expected frequency for many of the cells were less than five. As a result, the cells were collapsed into a 2x2 table and Fisher's Exact Test was performed in order to find any significant relationships (SPSS Reference Guide, 1990) instead of using a chi-square.

Demographics

The survey questionnaire also solicited demographic information from the respondents. Specific characteristics included sex, age, highest degree held, Federal Aviation Administration (FAA) certificates/rating held. The demographic information was collapsed into two categories. Because the degree of agreement statements were combined (e.g., Strongly Disagree with Somewhat Agree), prudence in interpreting the data is recommended. Rounding errors for the data should also be considered.

Of the 75 respondents, 32 (42.7 percent) possessed a master's degree as the highest degree held, 59 (78.7 percent) were employed at a public institution, and 34 (45.4 percent) held a faculty position as a tenured assistant, associate, or full professor. Seventy-four members (98.7 percent) were male and 31 members (41.3 percent) were 51-60 years of age. In the respondents' highest degree field of study, education (all areas) was the most prevalent at 32 members (42.7 percent) followed by aeronautical studies/aviation at eight members (10.6 percent) respectively.

Significant Relationships

The data from Strongly Disagree to Somewhat Agree designations (1-4) were collapsed together while the data from Agree and Strongly Agree (5-6) were placed together to collectively form the dependent variable. The following section illustrates ten significant relationships in tabular form found between the Likert-type statements and the demographic information.

The data in Table 1 show that a significant relationship exists between the degree of agreement and disagreement and the respondents' highest degree obtained. Twenty-nine out of 46 individuals (63.0 percent) with either an associate's, bachelor's, or master's degree agreed or strongly agreed with a requirement for professional certification requirements before applicants are admitted into the Ph.D. program. Only nine out of 28 individuals (32.1 percent) with the doctorate or other degree agreed or strongly agreed to professional certification requirements for admitted applicants.

Table 1
UAA Member Opinions about Certification Requirements for Admission to a Ph.D. Program in Aeronology by Highest Degree Held

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have professional certification requirements before applicants are admitted into the Ph.D. program.

Statement	*Associate's, Bachelor's and Master's Degree*		*Doctorate and Other*		*p-value for Fisher's Exact Test*
	#	*%*	*#*	*%*	
Strongly Disagree-Somewhat Agree	17	37.0	19	67.9	
Agree/Strongly Agree	29	63.0	9	32.1	
Total	46	62.2	28	37.9	.016*

*p <.05.

In Table 2, a significant relationship exists between the degree of agreement and disagreement and the highest degree obtained by respondents in their views of a prescribed work experience requirement. Twenty-six out of 45 individuals (57.8 percent) with either an associate's, bachelor's, or master's degree agreed or strongly agreed with a work experience requirement before applicants are admitted into the doctoral program. Eight out of 28 individuals (28.6 percent) with the doctorate or other degree agreed or strongly agreed to prescribed work experience requirement for prospective applicants.

Table 2
UAA Member Opinions About Minimum Work Experience Requirement for Admission to a Ph.D. Program in Aeronology by Highest Degree Held

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have a minimum amount of relevant work experience as an admission requirement for prospective doctoral students.

Statement	*Associate, Bachelor's and Master's Degree*		*Doctorate and Other*		*p-value for Fisher's Exact Test*
	#	*%*	*#*	*%*	
Strongly Disagree-Somewhat Agree	19	42.2	20	71.4	
Agree/Strongly Agree	26	57.8	8	28.6	
Total	45	62.2	28	37.9	.018*

*p <.05.

Table 3 shows a significant relationship between the degree of agreement and disagreement and the highest degree obtained by respondents in their responses to incorporating a practitioner-based model in the curriculum of a newly developed Ph.D. program. The practitioner-based model seemed to have been favored by individuals without a doctorate degree. Twenty-one out of 36 individuals (58.3 percent) with either an associate's, bachelor's, or master's degree agreed or strongly agreed with a practitioner-based model. Only eight out of 26 individuals (30.8 percent) with the doctorate or other degree agreed or strongly agreed to the incorporation of a practitioner-based model in the curriculum.

Table 3
UAA Members Opinions About Incorporating a Practitioner-Based Model in a Ph.D. Program in Aeronology by Highest Degree Held

A successful non-engineering Ph.D. program in aeronautical/aerospace science should incorporate a practitioner-based model in the curriculum.

Statement	*Associate, Bachelor's and Master's Degree*		*Doctorate and Other*		*p-value for Fisher's Exact Test*
	#	%	#	%	
Strongly Disagree-Somewhat Agree	15	41.7	18	69.2	
Agree/Strongly Agree	21	58.3	8	30.8	
Total	36	58.1	26	41.9	.041*

*p <.05.

In Table 4, there is a significant relationship between the degree of agreement and disagreement and the license status of the respondents in their views of a master's degree requirement. Forty-one out of 61 individuals (67.2 percent) with one or more licenses agreed or strongly agreed with a master's degree requirement. Only two out of nine individuals (22.2 percent) without any licenses agreed or strongly agreed. Caution is advised in interpreting the results as only nine respondents do not have any licenses compared with 61 respondents who have one or more FAA licenses.

Table 4
UAA Member Opinions about Master's Degree Requirements for Admission to a Ph.D. Program in Aeronology by FAA Licenses Held

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have a requirement for students to obtain a master's degree before being admitted to the doctoral program.

Statement	*Respondents who possess FAA license(s)*		*Respondents with none*		*p-value for Fisher's Exact Test*
	#	%	#	%	
Strongly Disagree-Somewhat Agree	20	32.8	7	77.8	
Agree/Strongly Agree	41	67.2	2	22.2	
Total	61	87.1	9	12.9	.023*

*p <.05.

Although Table 5 indicates there is a significant relationship, caution is suggested in interpreting the data because most of the respondents who do not possess a private pilot license have a commercial pilot license or higher. Out of the 61 respondents who do not possess a private pilot license, nine have no licenses at all (review Table 4) while the remaining 52 respondents have a commercial pilot license or higher. This can be attributed to, for example, a private pilot upgrading a certificate to commercial standards. In contrast, only 14 respondents reportedly have a private pilot license.

Table 5
UAA Member Opinions about Master's Degree Requirements for Admission to a Ph.D. Program in Aeronology by Possession of a Private Pilot License

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have a requirement for students to obtain a master's degree before being admitted to the doctoral program.

Statement	*Respondents who possess a Private license*		*Respondents who do not*		*p-value for Fisher's Exact Test*
	#	*%*	*#*	*%*	
Strongly Disagree-Somewhat Agree	5	35.7	5	8.2	
Agree/Strongly Agree	9	64.3	56	91.8	
Total	14	18.7	61	81.3	.016*

*p <.05.

The data in Table 6 show that a significant relationship exists between the degree of agreement and disagreement and the respondents' Airline Transport Pilot (ATP) license status. Most of the respondents who possess an ATP license support professional certification requirements. There are 18 out of 26 individuals (69.2 percent) that have an ATP license who agreed or strongly agreed with a requirement for professional certification requirements before applicants are admitted into the Ph.D. program. Of those who do not have an ATP license, 20 out of 48 individuals (41.7 percent) agreed or strongly agreed to professional certification requirements.

Table 6
UAA Member Opinions about Professional Certification Requirements for Admission to a Ph.D. Program in Aeronology by Possession of an ATP License

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have a requirement for professional certification requirements before applicants are admitted into the Ph.D. program.

Statement	*Respondents who possess an ATP license*		*Respondents who do not*		*p-value for Fisher's Exact Test*
	#	*%*	*#*	*%*	
Strongly Disagree-Somewhat Agree	8	30.8	28	58.3	
Agree/Strongly Agree	18	69.2	20	41.7	
Total	26	35.1	48	64.9	.030*

*p <.05.

Table 7 shows a significant relationship between the degree of agreement and disagreement and the respondents' instructor license status. There are 29 out of 43 individuals (67.4 percent) that have an instructor's license who agreed or strongly agreed with professional certification requirements. Of those who do not have an instructor's license, nine out of 31 individuals (29.0 percent) agreed or strongly agreed to professional requirements. Caution in interpreting the data in Table 7 is advised because most of the individuals who possess an ATP license (see Table 6) also possess an instructor's license.

Table 7
UAA Member Opinions about Professional Certification Requirements for Admission to a Ph.D. Program in Aeronology by Possession of an Instructor's License

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have professional certification requirements before applicants are admitted into the Ph.D. program.

Statement	*Respondents who possess an Instructor's license*		*Respondents who do not*		*p-value for Fisher's Exact Test*
	#	*%*	*#*	*%*	
Strongly Disagree-Somewhat Agree	14	32.6	22	71.0	
Agree/Strongly Agree	29	67.4	9	29.0	
Total	43	58.1	31	41.9	.002*

*p <.05.

The data in Table 8 illustrate a significant relationship between the degree of agreement and disagreement and the respondents' tenure or tenure-track status. Perhaps surprisingly, a greater percentage of respondents in non-tenure track positions supported requirements for performance-based assessments for doctoral students, portfolios, anecdotal records, etc. Sixteen individuals out of 21 (76.2 percent) in non-tenure track positions agreed or strongly agreed with the requirements while only 16 out of 40 tenured or tenure-track individuals (40.0 percent) agreed or strongly agreed.

Table 8
UAA Member Opinions about Performance-Based Assessments of Students in a Ph.D. Program in Aeronology by Tenure Status

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have performance-based assessments of doctoral students, portfolios, anecdotal records, and/or the use of multimedia.

Statement	*Tenured and Tenure-Track Respondents*		*Non-Tenure Track Respondents*		*p-value for Fisher's Exact Test*
	#	*%*	*#*	*%*	
Strongly Disagree-Somewhat Agree	24	60.0	5	31.3	
Agree/Strongly Agree	16	40.0	16	76.2	
Total	40	65.6	21	34.4	.014*

*p <.05.

In Table 9, a significant relationship was found to exist between the degree of agreement and disagreement and the respondents' time of employment at their present institutions. Nineteen out of 33 individuals (57.6 percent) employed 10 years or less agreed or strongly agreed with the optional foreign exchange or collaboration programs while five out of 31 individuals (16.1 percent) employed 11 or more years agreed or strongly agreed.

Table 9
UAA Member Opinions about Foreign Exchange or Collaboration Programs for Students in a Ph.D. Program in Aeronology and Years Employed at Present Institution

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have optional foreign exchange programs and other forms of collaboration opportunities with international schools that offer non-engineering aeronautical/aerospace science graduate programs.

Statement	*Respondents Employed 10 years or less*		*Employed 11 years or more*		*p-value for Fisher's Exact Test*
	#	%	#	%	
Strongly Disagree-Somewhat Agree	14	42.4	26	83.9	
Agree/Strongly Agree	19	57.6	5	16.1	
Total	33	51.6	31	48.4	.001*

*p <.05.

Table 10 illustrates a significant relationship between the degree of agreement and disagreement and the respondents' time of employment at their present institutions. Most of the respondents employed 10 years or less were more inclined to support requirements for performance-based assessments for doctoral students, portfolios, anecdotal records, etc. Twenty-three out of 34 individuals (67.6 percent) employed 10 years or less agreed or strongly agreed with the requirements while nine out of 27 individuals (33.3 percent) employed 11 or more years agreed or strongly agreed.

Table 10
UAA Member Opinions about Performance-Based Assessments for Students in a Ph.D. Program by Aeronology by Years Employed at Present Institution

A successful non-engineering Ph.D. program in aeronautical/aerospace science should have performance-based assessments of doctoral students, portfolios, anecdotal records, and/or the use of multimedia.

Statement	*Respondents Employed 10 years or less*		*Employed 11 years or more*		*p-value for Fisher's Exact Test*
	#	%	#	%	
Strongly Disagree-Somewhat Agree	11	32.4	18	66.7	
Agree/Strongly Agree	23	67.6	9	33.3	
Total	34	55.7	27	44.3	.010*

*p <.05.

CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to design and to propose a curriculum model for a Ph.D. degree program in aeronology based upon the professional expertise from the U.S. University Aviation Association institutional members. Along with the two curriculum models presented in the questionnaire a research/practitioner model and a practitioner model a series of statements related to some aspect of curriculum design were presented to the scholars in the questionnaire.

Conclusions

The results of the study revealed ten significant relationships between the questionnaire statements and the demographic information. The most commonly reoccurring statement (occurred three times) involved in generating significant relationships was that professional certification requirements (e.g., a commercial/instrument license, accredited by the American Association of Airport Executives) should be required before applicants are admitted into the Ph.D. program. The significance was associated with the following demographic characteristics: highest degree held, possession of an ATP license, and possession of an instructor's license.

The most commonly reoccurring demographic characteristic which generated significance was highest degree held. This characteristic showed significance when related to professional certification requirements, minimum work experiences and incorporating a practitioner-based model.

Scholars actively engaged in the design of a new Ph.D. program need to be very cognizant of identity issues. To assist scholars worldwide in describing the non-engineering aviation/aerospace field as an academic field of study collectively, a new term, aeronology, was developed and incorporated into the study for consideration. Perhaps a Ph.D. in aeronology may be a future reality. However, whether or not this new term will be readily embraced by scholars remains to be seen.

Recommendations

The results of this study reflect the professional opinions from experienced scholars (over one-half are department chairs and directors) currently employed in the postsecondary aviation/aerospace field. It is anticipated that the findings from this study, combined with other related studies, can be used to assist scholars and industry representatives in developing an effective curriculum for a specific non-engineering aeronautical/aerospace science Ph.D. program. The University of Nebraska at Omaha (1996) has identified a need and, consequently, aviation-related specializations have been established in their existing Ph.D. programs. In considering the need for scholars to design and develop a curriculum, and implement a specific non-engineering aeronautical/aerospace science doctoral program, the following recommendations based upon the findings from this study are made:

1. Scholars should seriously consider using the research/practitioner model as a template in developing specific degree programs based upon a needs assessment. Although neither the research/practitioner-based model nor the practitioner-based-model was overwhelmingly received by the institutional members, the benefits of using a research/practitioner model are indicative because (a) the Ph.D. is the most appropriate academic degree combining scholarly research with practice at the postsecondary level; (b) the research/practitioner model incorporates more research courses necessary for aviation/aerospace scholars to engage in theoretical and applied applications; and (c) the research/practitioner model incorporates an applied inquiry/assessment course—a course that very much reflects society's increasing demands for greater accountability in higher education (Banta, Lund, Black, & Oblander, 1996). The applied inquiry/assessment course will be useful in preparing future aviation/aerospace scholars to continuously question and refine learning outcomes in their classrooms, programs, and institutions.

2. In designing a new Ph.D. program, it is recommended that scholars incorporate a core program requirement. The results of this study indicate a core program requirement was overwhelmingly received by 57 institutional members (76.0 percent). In justifying a core curriculum for home economics, Pestle and Wall (1988) reasoned that "a basic reason for a core curriculum is the heterogeneity of the home economics student body" (p. 44) because home economics doctoral programs attract candidates with diverse backgrounds ranging from the physical and social sciences to the arts and humanities. Like the multidisciplinary background of prospective candidates for home economics masters and doctoral programs, it is anticipated that a newly developed Ph.D. program in the aviation/aerospace sciences will attract candidates with diverse backgrounds as well.

3. It is recommended that aeronology scholars require a second area of specialization even though the findings from this study indicate only 30 of the institutional members (40.0 percent) agreed or strongly agreed with a multidisciplinary approach requirement, (e.g., management, instructional design, computer science) that complements the Ph.D. degree. (Note: If the scholars who responded Somewhat Agree are included with the Agree and Strongly Agree responses, the percentage of scholars who support a multidisciplinary approach is increased to 61 percent.) By nature, the aviation/aerospace field is multidisciplinary and it is recommended that aeronology scholars conduct a needs assessment to identify specific content needs at their specific institutions. One option in requiring a second area of specialization may be achieved through a university consortium Ph.D. degree that includes several aviation/aerospace specializations. Some scholars indicate that developing multidisciplinary Ph.D. programs provides a receptive response by a state's board of regents because the program serves many constituents instead of a select few. A multidisciplinary program also provides doctoral graduates with greater flexibility. A problem encountered by avoiding a multidisciplinary approach can be

exemplified by the possibility of an unidentifiable program mission. For example, a newly created Ph.D. program in aeronology focuses on aerodynamics. The question may arise: What does a Ph.D. program in aeronology focusing on aerodynamics prepare graduates to do after graduation. If there is a demand for aviation faculty specializing in teaching flight and academic courses, the Ph.D. degree specializing in aerodynamics may be suitable. If, however, the postsecondary need does not exist for this type of degree, what other avenues of employment do graduates have available to them? Conversely, a student who enrolls in a Ph.D. program in aeronology with an area of specialization in human factors has the flexibility of obtaining gainful employment as a faculty member in a postsecondary setting or a researcher within a private/governmental organization.

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