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TRAINING PILOTS OR EDUCATING CAPTAINS? A FRAMEWORK FOR COLLEGIATE AB INITIO PROGRAMS

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During the past five years, several studies have been conducted to assess the future availability of airline pilots and other aviation professionals (McDonnell Douglas Aircraft Co., 1989; Sypher-Mueller International, 1992; U.S. Department of Defense, 1988; U.S. Department of Transportation, Federal Aviation Administration [FAA], 1993). These studies conclude, not surprisingly, that the traditional sources of airline pilots—the military and general aviation—are in a period of decline. This situation, coupled with the predicted flood of airline pilot retirements, will lead to a shortage of pilots before the end of the decade. Although estimates vary, most suggest that the current excess of pilots will be absorbed by 1996.

If the forecasts hold true, the aviation industry could face an unprecedented and critical pilot shortage. Even if the predictions are overly pessimistic, concern exists that the industry is ill-prepared to cope with the rapid escalation in the knowledge required for safe and efficient flight operations. According to the recent report of the FAA's Blue Ribbon Panel (BRP), an issue equally important as the predicted pilot shortage "is the question of quality and the need to update the minimum training standards to insure knowledge of computers, human factors, aeromedical issues, etc., in light of increasingly sophisticated equipment" (FAA, 1993, p. x).

The BRP report, along with other voices in the aviation community, suggests that future demand will need to be met by new sources of supply, specifically ab initio pilot education programs. Ab initio programs try to substitute more training for less experience while maintaining high quality and safety standards. This model has been used effectively by foreign air carriers for more than 30 years. The system for training military pilots in this country is, in essence, an ab initio program.

However, this method is a relatively new and evolving concept in U.S. civilian aviation and little consensus or generally agreed on standards for ab initio flight education exist among the various sectors of the aviation community. The BRP report also describes industry resistance to ab initio programs because the air carriers, the unions, and the government "regard flight hours as the predominant factor in assessing experience." The report goes on to say that "this emphasis on flight hours runs counter to proficiency-based programs conducted by a number of foreign carriers who have very successful results, and needs to be reexamined in light of the future demand for pilots" (FAA, 1993, p. ix).

The current downsizing of the military, however, soon will push this issue to the top of the list of commercial aviation concerns. Traditionally, approximately 80% of airline pilots have come from the military. One vice-president for training at a major airline predicts that number will drop to 10% in the next decade. The question becomes, where will future airline pilots receive initial and intermediate flight education?

Although several solutions to the pilot shortage may exist, compelling reasons support the development of comprehensive ab initio programs at the university. First, airlines clearly want individuals with college degrees in pilot positions: 95% of the pilots employed by the major airlines have at least a four-year degree. Second, collegiate aviation programs can establish intimate intellectual ties with other academic departments and, consequently, provide a much-needed multi-disciplinary emphasis with greater ease and expertise than an industrial setting. Third, but equally important, the ongoing, holistic review of the curriculum that characterizes university programs ensures continuity and quality for the most important beneficiaries of this effort, the student.

We strongly believe that the collegiate aviation

community should take the lead in the development and implementation of ab initio programs and we applaud the attempts made so far. However, many collegiate flight education programs—even those touted as ab initio programs—are lacking in scope, content, and organization, given the future needs of the airline industry; this deficiency comes from pilot training curricula driven by FAA certification requirements rather than by industry needs. We could argue that the regulations—the standards to which collegiate aviation trains—provide little support for the innovative and more responsive educational programs central to an improved supply infrastructure. Further, existing professional pilot training programs at the university tend to spread the flight training over a four-year period, which reduces currency and, often, recency of experience at the time of graduation.

This paper will describe the results of a project funded by the W.K. Kellogg Foundation to evaluate existing ab initio programs in several countries and to integrate ab initio into a baccalaureate professional pilot program. First, we will describe the characteristics of the ab initio programs we observed in the United States and in Europe. We also will discuss the results of interviews with industry representatives conducted over 18 months on the airline industry's future needs. We also will identify concerns with collegiate flight programs and the regulations that drive them. Finally, we will suggest a solution, an educational model that integrates the best of collegiate education and ab initio training programs.

CHARACTERISTICS OF FOREIGN AB INITIO PROGRAMS

The information in this section was gathered on visits to several flight training academies in the United States operated by foreign airlines, on visits to flight training academies in the United Kingdom, from interviews with training personnel from several European airlines, and from the director of flight crew licensing for the European Joint Aviation Authorities. The characteristics described in this section are, in many cases, generalizations. Although some deviations will be noted, our observations are intended to reflect commonalities rather than differences among the ab initio programs evaluated as part of this project.

Most foreign airlines rely on a rigorous and comprehensive process to select pilot candidates before entry into the ab initio program. The process normally includes personality assessment and multiple measures of technical and psychomotor skills. Although expensive, this process has been important because foreign airlines traditionally have "sponsored" the student; that is, they have paid all costs associated with training. Given the financial environment of the airline industry worldwide, the practice of sponsorship will be modified considerably. In the future, students will be expected to pay 50% to 100% of training costs. The change will affect pilot candidates in the European community more than those in other regions.

An ab initio pilot training program begins with extensive ground school or technical training well beyond the regulatory requirements of the licensing agency. The ground training averages 1,200 hours, a large part of which occurs before flight training. In many cases, however, the ground school segment includes the development of mathematics and English competencies. In general, ground training follows the typical classroom-lecture model. The use of computer-based training varies widely among the academies, with some using CBT moderately and others not at all.

The first several phases of flight training are conducted in a four-place single-engine piston aircraft. At most academies training flight crews consist of one flight instructor and two students so the crew concept can be integrated early into the flight training process. (This was not true in the flight academies in the United Kingdom.) These basic phases include airwork, traffic pattern, and basic instruments. The intermediate phases include instrument flight and commercial maneuvers in a single-engine piston aircraft. This phase also includes aerobatic maneuvers conducted in dedicated aerobatic aircraft such as the Swiss Bravo or the Beechcraft T-34 Mentor.

Advanced flight training is generally completed in either piston or turbine multi-engine aircraft. This phase consists of commercial maneuvers and instrument flight. An airline operational environment is mimicked as much as possible. In most programs, the training during this phase is similar to line-oriented flight training (LOFT) as it is currently conducted by major airlines. Further, flight

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time accumulated during training is dichotomized as "pilot flying" and "pilot not flying" and both positions are viewed as integral to successful completion of the flight.

Phase checks are conducted throughout the curriculum. However, given the extensive selection process, the failure rate at some academies is as low as 1%. Usually a support system is in place to provide intervention when needed. For example, at one academy the flight instructor is viewed as a facilitator as much as an instructor. Problems are handled by one of the airline's captains on staff at the academy acting as a motivator and gatekeeper. At another training academy a group leader among the U.S. flight instructors serves a similar function.

The instructors employed by these academies are highly qualified, full-time career flight instructors. Although their backgrounds vary, a flight instructor will typically have about 5,000 hours total time, 2,000 hours of dual given and, in general, about 65% of the instructors hold ATPs. The student/instructor ratio during flight training varied from a low of 2:1 to a high of 4:1. The proposed Joint Aviation Authorities regulations limit the student/instructor ratio to 4:1.

Ab initio pilot training takes one to three years, depending on the scope of the training program. Students complete the training with 170 to 350 hours of flight time. The three-year program, for example, includes a six-month stint with the airline as a baggage handler or similar position, approximately 40 hours of flight time in a turbine-powered aircraft, and six to nine months of training in jet aircraft. In most programs, the student acquires knowledge through the Airline Transport Pilot License (ATPL) level. Graduates normally obtain a "frozen" ATPL that can be converted to an unrestricted ATPL after age and time requirements are met. In contrast, the one-year program is limited to the training necessary for a commercial/instrument: 700 hours of ground school and 200 hours of flight time, including 35 hours in a piston multi-engine aircraft at the high end of the training.

Procedures trainers, part-task trainers, and simulators (from no-motion/no-visual to full-motion models) were integrated into all the ab initio training programs, although at varying levels. At one airline-operated academy, of the 353 hours completed by the students, 211 hours are in aircraft and 142 hours are in simulators, a fairly typical breakdown.

Although ground-based trainers are not used notably during the early phases, sophisticated turbine-aircraft simulators are used extensively in the advanced phase that prepares students for airline operations, specifically high altitude and LOFT sessions. At one academy, for example, cadets receive 40 hours in a turbine-aircraft simulator and 20 hours in the aircraft. At another, the time was divided almost equally: 36 hours in a turbine aircraft and 33 hours in the simulator.

After completing the ab initio program, graduates typically receive "bridge" training from the sponsoring airline to the more sophisticated jet aircraft operated on the line. In general, bridge training consists of intensive cockpit procedures and systems training in aircraft-specific carrels and LOFT scenarios conducted in full-motion simulators. After completing bridge training, pilots advance to first officer positions on the line.

The cost of the average program ranges from $60,000 to $77,000. The $60,000 version includes ground and flight instruction through commercial, instrument, and multi-engine, and one hour in an aerobatic aircraft. Total flight time after completing the program is 225 hours. Similarly, two ab initio programs in Europe included ground and flight instruction through instrument, commercial, and multi-engine. As in the program already described, the price does not include any flight time in turbine aircraft.

The cost for the European programs ranges from $75,000 to $77,000. Room and board for the 13 months runs an additional $12,000. The airline-operated three-year program included flight time in a turbine aircraft and room and board. The airline was unwilling to disclose the cost of its training program.

Most ab initio programs are highly structured. At several academies the influence of the military was unmistakable: students are referred to as cadets and training sessions are called missions. The inculcation of organizational culture and values appeared to be important for some airlines and the training at several academies was airline-specific. These generalizations, of course, do not hold true across the board.

INDUSTRY NEEDS AND COLLEGIATE AVIATION

Over 18 months, we interviewed representatives from the airlines, industry organizations, and governmental agencies in the United States and in Europe. We requested information on the skills and behaviors required of pilots into the next century. Without exception, the experts described a new operating environment that makes demands beyond the technical knowledge and skills traditionally taught in collegiate flight programs. The new environment is represented, first, by the transition to automated aircraft and two-person crews. The transition requires a shift from training in basic stick-and-rudder skills toward an education that includes computer competency, vigilance, and interpersonal skills. Automated aircraft also demand different problem-solving and decision-making skills than their predecessors.

The second, but equally pervasive, change is that economic forces have expanded the role of the flight crew. Although the primary task continues to be flying passengers safely from Point A to Point B, a captain now must function also as a front-line manager of one of the airline's primary profit centers. He or she is responsible not only for flying the aircraft in a safe and efficient manner, but also for using all the resources available, in and out of the cockpit, to increase the profitability and effectiveness of the flight operation.

Although collegiate aviation provides an ideal setting for meeting the industry's future needs, modifications are needed to our traditional perspectives on developing professional pilots. Typically, collegiate flight training programs have emphasized the acquisition of technical skills and knowledge required by the FAA to obtain a given license or rating. This approach is driven by regulations that use flight hours and the ability to fly within plus or minus so many feet or degrees as the bench mark of competency. The student's normal progression is from private through commercial, instrument, flight instructor, and multi-engine, although the certification levels vary. For example, the Airway Science Systems Management curriculum, which is designed to prepare future commercial pilots, includes FAA flight instructor certification. Yet flight instructor certification is clearly not a criterion for an airline pilot job.

In general, the acquisition of aeronautical skills during flight training occurs in a two-place aircraft. The emphasis during the first several hundred hours of training is undeniably on individual psychomotor and decision-making skills. Usually graduates go on to flight instruct or fly cargo for the next 1,000 hours of their aviation careers, again asked to use skills, apply knowledge, and make decisions unassisted. When the log book finally sports the magic number and these individuals are hired by an airline, they must shift to using skills, applying knowledge, and making decisions as part of a team, a role for which their training and experience has not adequately prepared them.

Consequently, collegiate professional pilot curricula lack the continuity, consistency, and crew-centered activities characteristic of most ab initio programs. Even collegiate programs referred to as ab initio stretch the flight training over four years. In some collegiate programs, no flight training is conducted after the required level of pilot certification is achieved. Collegiate programs tend to emphasize flight time or pilot's certificates. The certificates often are obtained in a sporadic manner. In some cases, ground instruction and flight training are conducted in isolation from each other.

Ab initio programs have a focus similar to that of most collegiate professional pilot programs: developing technical skills and knowledge. However, ab initio training is condensed into a very short time-frame with goals related to the long-term professional needs of the student and the airline. As a result, the graduate of an ab initio program is at peak proficiency and is better prepared for the airline's bridge training. Despite their advantages, however, ab initio programs are designed to train pilots. They lack the broad-based, holistic foundations of a collegiate education, foundations that are essential to educating captains.

INTEGRATING AB INITIO INTO COLLEGIATE AVIATION

Western Michigan University's aviation program was established in 1939 as part of the war effort to train hundreds of pilots and maintenance technicians. Housed in the College of Engineering and Applied Sciences, the

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School of Aviation Sciences has 550 students and offers curricula in professional flight, technical management, aviation maintenance management, and aircraft maintenance engineering technology.

In 1992 the School embarked on a program to review its goals and curricula in the context of its primary mission: to produce graduates who will think critically, communicate effectively, and participate meaningfully and ethically in the dynamic field of aviation. The first curriculum reviewed was the professional pilot program. New goals were established. Because the School wanted to develop a new curriculum from a clean slate, from a perspective unbiased by institutional history or industry tradition, an outside consultant was hired.

After months of research and interviews, a new professional pilot curriculum was completed that, we believe, reflects a comfortable juxtaposition of the knowledge/skill requirements identified by industry experts and the unique vision, mission, and goals of WMU's School of Aviation Sciences. Conversations with industry experts suggested that a model was needed to address the broader skills and behaviors associated with the changing role of the airline captain—and certainly airlines do not hire individuals to be first or second officers indefinitely. They hire individuals to become, eventually, captains. Similarly, the goals of the School emphasize intellectual as well as technical competencies, educating individuals to act responsibly from a business perspective, preparing students for changing environmental, economic, and technological realities in an increasingly global context. Clearly, we should be in the business of educating captains, not training pilots. Because our goal is to educate captains rather than train pilots, we deliberately chose a holistic approach to curriculum development, an approach fundamentally opposed to the myopic method of creating a program based solely on task, conditions, and standards.

Appendix A presents the 127-semester unit professional pilot curriculum; some modifications were made to the original because of the university's curriculum-approval process. The curriculum incorporates: (a) the strength of a college education—a strong foundation in general studies; (b) the identified needs of the airline industry—competencies in interpersonal skills, management theory, and computer literacy and (c) the strength of the ab initio model—an intensive pilot-training segment at the end of the degree program.

Careful attention was given to the integration of ground instruction and flight training, and to ground-based instruction, computer-based training, and low-cost simulation as other instructional methods for curricular improvement and cost-cutting.

The curriculum not only gives students a broad-based foundation that includes general education and focused aviation course work, but also gives them courses selected to enhance their understanding of international economic, management, and environmental issues. A course on crew-resource management and team-building was developed. However, these concepts are integrated into all aviation courses and all flight training. Computer skills are emphasized because computerized cockpits have become prevalent throughout the industry. Upper-division aviation courses emphasize aerodynamics, systems, international flight, high-altitude flight, and automated flight and navigation systems.

A non-flight aviation course is included in each of the first three semesters and two non-flight courses in the fourth semester. The courses are designed not only to introduce students to the discipline and to maintain their interest, but also to impart the department's philosophy, to involve students in departmental activities, and to provide opportunities to get acquainted with aviation faculty.

The ab initio pilot training model is integrated into the academic curriculum. Flight training begins in the student's sixth semester. The flight training is condensed, intensive, and based on proficiency, not on flight time or classroom contact hours. There is no private pilot or commercial pilot course. The goal is not to get a license, but to develop the knowledge, skills, and behaviors necessary for successful flight operations. In our new curriculum, students receive concentrated flight education during the last two years of the program rather than spread over the four years as in most programs.

A loss of continuity and proficiency results when flight instruction is delivered in a protracted manner. The School is convinced that a more appropriate alternative

to course sequencing is to concentrate the flight segment of the curriculum in the later part of the student's academic career.

As students leave the program they will be at peak proficiency and will be better prepared to enter the job market. Admittedly, this sequencing of flight courses does not lend itself to articulation with community college flight courses.

That was not the intent. Although articulating flight courses is impossible, it was found that articulation of lower-division general studies and business courses with the community colleges is possible.

CONCLUSION

Recognizing the limitations of any educational model, the curriculum generates discussion among individuals responsible for collegiate flight education on the future of aviation, the educational needs of the industry into the next century, and the role of collegiate aviation in the future.

The model curriculum presented is not promoted as the definitive answer to the future of pilot education. It is, however, a solid but flexible curricular framework for WMU's professional flight program. A comprehensive assessment plan has been established to evaluate the program and the results of the assessment will be used to stimulate many improvements.

If collegiate aviation education is to lead the way in educating the airline captains of the future, some significant issues need to be raised. Perhaps the most compelling issue may be to begin to question the standards by which pilots are trained. Additionally, should the standards be dictated by regulations or the needs of the industry?

Federal Aviation Regulation Part 141 does not adequately address the needs of the industry in a professional pilot training program. Further, the 30-year success of the ab initio approach used by foreign airlines and the U.S. military deserves serious consideration.

The university aviation community should take the lead in proposing new regulations and training approaches that better meet the more complex requirements of educating the airline captains of the future.□

APPENDIX A
PROFESSIONAL PILOT CURRICULUM

SEMESTER I	
AVS 120	Introduction to Aviation (2)
COM 170	Interpersonal Communications I (3)
PHYS 107	Elementary Physics (4)
PHYS 108	Elementary Physics Lab (1)
IE 102	Technical Communication (3)
SEMESTER II	
AVS 121	Aerodynamics and Performance (2)
BIS 102	Intro. to Information Processing (3)
CHEM 103	General Chemistry I (4)
GEOG 105	Our Physical Environment (4)
MATH 200	Calculus with Applications (4)
PEGN	Physical Education (1)
SEMESTER III	
AVS 122	Aircraft Systems (3)
MATH 216	Business Statistics (3)
GEOG 225	Intro to Meteorology, Climatology (4)
PEGN	Physical Education (1)
Approved History Elective (3)	
SEMESTER IV	
AVS 212	Aviation Meteorology (2)
BIS 260	Microcomputer Business Appli. (3)
AVS 205	Aviation Safety (2)
GEOG 100	World Eco. Problems and Man (4)
ECON 201	Principles of Economics (3)
SEMESTER V	
BIS 340	Prin. of Business Communication (3)
MGMT 300	Fundamentals of Management (3)
MGMT 410	Multinational Management (3)
MGMT 453	Organizational Behavior (3)
AREA IV	Non-Western World (3)
AREA I	Humanities/Fine Arts (3)
SEMESTER VI	
AVS 321	Professional Flight I (5)
AVS 206	Flight Physiology (2)
AVS 207	Crew Resource Management (2)

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AVS 307	Advanced Aircraft Systems (3)
AVS 319	Aviation Legislation (3)
SEMESTER VII	
AVS 323	Professional Flight II (5)
AVS 306	Adv. Aerodynamics, Performance (3)
AVS 320	Global Nav. and Intern'l Flight (3)
AVS 411	Airline Flight Operations (2)
AVS 327	Airline Ops. and Administration (3)
SEMESTER VIII	
AVS 325	Professional Flight III (5)
AVS 412	Flight Operations Analysis (2)
BIS 350	Management Information Systems (3)
AVS/MGMT	Approved Elective (3)
AVS/MGMT	Approved Elective (3)

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