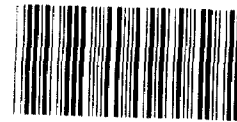136980

United States General Accounting Office

GAO

Report to the Honorable
Robert C. Byrd, U.S. Senate

September 1988

AVIATION SAFETY

Enhanced Requirements Can Improve Commuter Pilot Training

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RELEASED

GAO/RCED-88-218

543387/543387

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-228633

September 28, 1988

The Honorable Robert C. Byrd
United States Senate

Dear Senator Byrd:

In response to your request, we evaluated the Federal Aviation Administration's (FAA) commuter airline pilot training regulations. You expressed concerns about commuter airline safety and commuter airlines' ability to keep pace with the training needs of recently hired, less experienced pilots. To address your concerns and determine whether commuter pilot training regulatory requirements need to be revised, as agreed with your office, we evaluated (1) changes in the commuter airline industry, (2) commuter and major airline pilot training regulatory requirements, and (3) commuter airline accident reports and statistics.

Results in Brief

We found the following:

- The commuter airline industry has changed since the training regulations were last revised in 1978. Commuter airlines are flying more passengers, on more routes, in larger, more complex planes. At the same time commuter airlines have been losing experienced pilots to major airlines. As a result, copilots are often upgraded to captain more rapidly than in the past, allowing less time for them to accumulate experience.
- Commuter and major airline pilot training regulations are similar except that the commuter regulations do not specify required minimum training hours or flight training requirements.
- Accident investigation statistics show pilots cited as a factor in 57 percent of commuter airline accidents between 1980 and 1984 and 95 percent in 1985, the most recent year data are available. The statistics show that takeoff/ascent and approach/landing are the most accident-prone flight segments. Several recent accident investigations cited problems with cockpit resource management, including crew coordination, standard operating procedures, and pilot decision-making, rather than the pilots' flying ability or equipment problems.

We believe that, as part of its ongoing review of commuter airline pilot training regulations, FAA can improve the requirements by providing (1) guidance describing minimum pilot training program requirements using standards such as pilot performance criteria or required training hours,

(2) guidance describing required flight training maneuvers and proce-
dures, and (3) cockpit resource management training requirements,
including crew coordination, standard operating procedures, and pilot
decision-making, and guidance describing acceptable training programs.
Together, these actions help compensate for rapid pilot turnover, less
experienced pilots, and problems indicated in accident analyses.

Background

FAA requires airlines to have pilot training programs and provides regu-
lations on their content.[1] Pilot training is divided into ground and flight
training segments. During ground training, pilots receive classroom
instruction in topics such as aircraft systems, equipment and perform-
ance, weather, navigation, and air traffic control to ensure that they
have the basic knowledge necessary to be commuter airline pilots. Flight
training provides actual flight or simulator practice in the maneuvers
and procedures that the commuter airline specified in its training man-
ual. This may include pretakeoff checks, takeoffs and landings, and
emergency procedures. Pilots receive both ground and flight training
when they start working at an airline, when making the transition to
different aircraft, when upgrading from copilot to pilot, and on a recur-
rent basis to ensure proficiency (see app. I for further details).

Commuter Airlines Have Changed Since Deregulation

The structure and scope of the commuter airline industry have changed
profoundly since pilot training regulations were revised in 1978. The
existing regulations were written when commuter airlines were primar-
ily small-scale, low-volume operations. After airline deregulation, com-
muter airlines increased the size and scope of their operations and their
interrelationship with major airlines. Commuter airline passengers
increased from 11.3 million in 1978 to almost 32 million in 1987 and are
projected to reach about 58 million by 1999. The number of airports
served by commuter airlines grew from 681 in 1978 to 834 in 1987.
Average commuter plane size increased about 66 percent during this
period, from about 12 to almost 20 seats per plane. Interrelationships
between commuter and major airlines also increased dramatically in the
last 5 years. The number of marketing agreements between major and
commuter airlines, known as code sharing, grew from about 10 in 1983
to about 63 in 1987, including 43 of the top 50 commuter airlines. Code

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[1]FAA divides scheduled commercial airlines into two basic types, depending on plane size. Commuter
airlines operate aircraft designed to carry 30 or fewer passengers under Federal Aviation Regulation
part 135. Major airlines fly aircraft designed for more than 30 passengers under part 121. Training
requirements for each type of airline are included under each regulation.

sharing commuter airlines now carry 90 percent of commuter airline passengers (see app. II for further details).

Commuter Airlines Have Lost Many Experienced Pilots

During the same period that commuter airlines were growing, they lost many experienced pilots as they became a primary source of pilots for major airlines. Major and commuter airline pilot demand since deregulation has exceeded the traditional source of pilots from the military. While total pilot hiring increased from less than 700 new hires in 1980 to almost 7,000 in 1986, the percentage of major airline pilots hired from the military dropped from about 83 percent in 1980 to about 44 percent in 1986, according to the Future Aviation Professionals of America, a pilot employment information organization. Major airlines increasingly turned to commuter airlines as a source of experienced pilots. The Regional Airline Association (RAA), an industry group representing commuter airlines, said that recent annual pilot turnover for its members ranged from 20 to 120 percent. We found that the commuter airline industry replaced 36 percent of its pilots in 1986.[2] Commuter airlines are expected to continue losing pilots to major airlines as pilot demand remains elevated because of continued airline growth and a growing number of major airline pilots facing mandatory retirement.

Newly Hired Pilots' Experience Has Decreased

As experienced captains leave commuter airlines to join major airlines, commuter pilots' average experience level has become a concern to airline management and FAA. Experience makes it easier for pilots to respond rapidly and appropriately to circumstances encountered in flight. While new pilots must meet FAA standards to obtain their flight certificate, according to RAA, many newly hired commuter pilots are less experienced than their predecessors. This is causing industrywide concern, because RAA believes that pilot experience and training are principal factors affecting commuter airline safety. FAA expressed similar concern. In a 1986 memorandum FAA's Acting Manager of the Air Transportation Division requested that regional FAA officials inform airlines of FAA's concern that the average experience level of newly hired crew members had declined. The memorandum called on FAA and air carriers to be aware of the situation and prevent decreased experience from resulting in diminished crew performance.

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[2]Aviation Safety: Airlines Should Check Pilot Applicants' Safety History (GAO/RCED-88-154, June 7, 1988).

Rapid Upgrading From Copilot to Captain Reduces Crew Experience

As experienced pilots leave, commuter airlines need to upgrade copilots to captain in order to have enough pilots to staff all of their flights. In some cases, newly hired copilots may be promoted to captain in 4 months or less. Ten years ago progress through the system was much slower. Pilots typically spent several years as copilots, gaining experience before upgrading to captain. According to the training manager at one of the airlines we visited, they prefer new pilots spend at least 1 year as copilot before upgrading to captain. However, because of high pilot turnover, he said, copilots are typically upgraded after 6 months. He said that lack of experience affects pilot judgment more than physical flying skills and that 6 months as copilot does not provide enough experience to equip a pilot with sufficient decision-making skills. The National Transportation Safety Board (NTSB) cited rapid upgrades to captain and crew inexperience as contributing factors in three 1985-86 commuter accidents.

Commuter Pilot Training Regulations Lack Minimum Training Time and Flight Training Specifics

In contrast to major airline pilot training regulations, commuter regulations do not specify the minimum time to be spent on each pilot training phase or the maneuvers and procedures included in flight training. While the scarcity of simulation devices for commuter planes has limited commuter airlines' ability to conduct a full range of flight training, FAA and private industry have taken action to increase simulation device availability.

Minimum Training Time Requirements

Major airline training regulations require airlines to specify minimum training time requirements for each training phase. For example, 120 hours of initial ground training and 20 hours of initial flight training are required for captains. Airlines may deviate from these minimums only after FAA approval. FAA principal operations inspectors can require commuter airlines to specify training hours to obtain training program approval, although this is not required by regulation. Once the training program receives final FAA approval, the airline must comply with the specified hours. Eight of the nine commuter airlines we visited specified minimum training hours in their training programs; however, the number of specified hours varied.

Experts disagree over the benefits of requiring minimum training hours for commuter pilots. Some FAA, safety organization, and industry officials say that specifying minimum hours establishes a base level of

training, provides FAA inspectors a basis for evaluating training program adequacy, and makes commuter airline training requirements similar to major airline requirements. Other experts, citing the fact that FAA can and does reduce minimum time requirements, believe that minimum hours are ineffective for defining training program adequacy. Further, they reason, minimum hours may be inappropriate for commuter airlines because of varying equipment complexity, pilot experience, and training needs. Several FAA, airline, and safety association officials told us that it would be more effective to identify and require pilots to meet performance standards. These standards would specify performance criteria for pilots to demonstrate after completing training.

Flight Training Requirements

Commuter pilot training regulations provide little guidance on flight training content, including the extent and type of practice in takeoff and landings, even though most commuter airline accidents occur during takeoff and landing. While major airline regulations contain an appendix describing required flight training maneuvers and procedures in detail, including various types of takeoffs and landings, commuter airline regulations do not provide specific guidance. Instead, commuter regulations call for airlines to describe, in the airlines' training curriculum, the flight training maneuvers and procedures the airline intends to conduct. Accident statistics show that in 1985 almost 86 percent of commuter accidents occurred during takeoff and landing (see app. III for details). From 1980 to 1984, about 63 percent of commuter airline accidents occurred during these flight segments. Because of their shorter route structure, commuters do more takeoffs and landings than majors. According to RAA, pilots typically do 6 to 8 takeoffs and landings in a normal commuter airline work day, as opposed to 2 or 3 at a major airline.

Increased Simulation Availability Could Benefit Flight Training

The scarcity of simulation devices for commuter airplanes limits commuter pilots' ability to practice emergency takeoff and landing procedures. Simulator training allows one to safely recreate in-flight emergencies without risk. Unlike major airlines, many commuters perform flight training in the air because commuter plane simulation devices are unavailable or more expensive than training in planes. Many emergency maneuvers that can be practiced safely in simulation cannot be practiced safely in the air. As a result, training in the air cannot be as complete as practicing in simulation devices. According to Flight Safety International, a pilot training contractor, studies done in a commuter aircraft show that about 85 percent of emergency procedures identified by FAA cannot be practiced safely in the aircraft. In order to address the

unavailability of simulation devices, FAA recently provided guidance on using less sophisticated and less expensive simulation devices called advanced training devices. Companies such as Flight Safety International are moving to increase commuter airplane simulator availability by developing simulators for more types of commuter airplanes and making them available at several locations around the country.

Cockpit Resource Management Training Needed to Address Accident Analyses Findings

Our review of NTSB accident reports and discussions with industry organizations and aviation experts indicate a need for new training in cockpit resource management, including crew coordination, standard operating procedures, and pilot decision-making. Training in these areas would address the findings of accident analyses and could help compensate for less experienced, newly hired pilots (see app. IV for examples of accident analysis findings). NTSB cited pilots as a factor in 95 percent of commuter accidents in 1985, the most recent year that data are available, and 57 percent of commuter accidents between 1980 and 1984 (see app. III for details). Experts we contacted unanimously endorsed implementing cockpit resource management training at commuter airlines. Seven of the nine commuter airlines whose training programs we examined used cockpit resource management, and nearly all major airlines have cockpit resource management training programs.

Crew Coordination

Crew coordination encourages effective use of all available information, crew experience, and interpersonal skills to coordinate crew activities, make accurate effective decisions, and achieve safe flight operations. Some of the principles of crew coordination include delegating cockpit responsibilities, establishing priorities, monitoring and cross checking, managing distractions, communicating effectively, and providing sound leadership by the captain. Traditionally, pilot training concentrated on developing physical flying skills, aircraft systems knowledge, and spatial orientation skills. While these skills continue to be important, experts agree that improved teamwork skills are necessary to ensure safety. Crew coordination training emphasizes the need for the crew to work together as a team and communicate effectively. According to RAA and the training director of one major airline, commuter airlines especially need crew coordination training since the new pilots they hire often come from single-pilot plane backgrounds and are not used to working together with other pilots as a crew.

Standard Operating Procedures

Standard operating procedures identify which pilot is expected to carry out specified tasks (i.e., describe crew coordination responsibilities) and define how tasks are to be carried out. Although standard operating procedures are not required by regulation, airlines commonly establish them for portions of the flight. For example, crews usually have a standard checklist that they go through in a specified manner before takeoff. Some airlines also standardize pilot responsibilities in the cockpit for the pilot flying the plane (i.e., the pilot who is actually controlling the plane) and the nonflying pilot. One of the nine airlines we visited also standardized radio communications.

According to the Aviation Safety Institute, a nonprofit aviation safety organization, and other experts, standardizing pilot activities is a key to improving pilot training and safety and could reduce reliance on pilot experience to ensure that required cockpit duties are performed in a uniform, prescribed manner. When all pilots perform in the same way, people become more interchangeable, expectations are well established, and there is less room for error. The training manager at one commuter airline told us that standard procedures are the core of increasing safety by providing pilots with knowledge of what the other pilot in the cockpit is going to do in normal and emergency situations. Standard operating procedures can be especially important for newly hired commuter pilots who have a primarily one-pilot plane background.

Pilot Decision-Making

Pilot decision-making training provides a systematic approach to improved decision-making and information management skills. It seeks to refine the decision-making process, provide tools necessary to respond accurately and quickly to situations encountered in the air, and eliminate consideration of factors unrelated to flight safety from the decision-making process. Some decision-making training emphasizes practice experience to instill the correct response to situations, while other training approaches emphasize providing pilots with a structured framework for analyzing problems, identifying pertinent considerations, arriving at a timely conclusion, and taking effective action.

Experts told us that decision-making training can help compensate for reduced pilot experience. Flight Safety International explained that experience can save pilots time when solving problems. Without decision-making training, pilots acquire judgment and decision-making skills by observing experienced pilots. Decision-making training seeks to compress the judgment benefits of flying experience into a relatively short training period to provide pilots with techniques to successfully respond

to unusual occurrences. With less experienced pilots joining the commuter ranks in an environment that upgrades them to captain more quickly than in the past, several experts recommended pilot decision-making training to augment the decision-making skills that pilots acquire during their limited time as copilot.

FAA Commuter Pilot Training Initiatives

In its report on the Department of Transportation's 1987 appropriation bill, the House Committee on Appropriations indicated concern about differences between major and commuter airline training regulations. The Committee called on FAA to close the gaps between major and commuter airline training requirements. In its March 1987 response, FAA said that it initiated a regulatory project for revising commuter pilot training regulations. To assist in the regulatory project, in August 1987, FAA obtained assistance from a broad array of industry experts to serve on a joint FAA/industry flight crew performance task force. In June 1988, the task force presented recommendations for revising pilot training requirements to the FAA Administrator.

The joint FAA/industry flight crew performance task force included conclusions in its report similar to those presented in our analysis (see app. V for details). Its recommendations call for commuter airlines to comply with major airline training requirements, as appropriate to their operations. Complying with major airline training regulations would provide minimum training requirements and specific flight training maneuvers and procedures. In addition, the task force called for all airlines to implement cockpit resource management training programs and for FAA to provide airlines with guidelines to use in formulating acceptable cockpit resource management training programs. The recommendations also call for a voluntary program, to be defined, that will explore innovative pilot training techniques. Commuter airlines could participate in this program in lieu of complying with existing major airline training regulations. The results of the voluntary program will be evaluated on an ongoing basis and used to revise pilot training requirements after 3 to 5 years. According to the Acting Deputy Director of Flight Standards, FAA plans to initiate a rule-making to consider the task force recommendations and determine which ones to adopt.

Conclusions

As commuter airlines have been evolving from independent, small-scale operations into larger organizations closely affiliated with major airlines, they have also been losing experienced pilots to major airlines. The resulting lower average commuter pilot experience level has become a

concern to the airlines and FAA. While it may have been sufficient in the past for training to emphasize ensuring that pilots know their planes and how to operate them, regulatory requirements need to be enhanced to cope with less experienced pilots progressing rapidly to captain. Our analysis of accident reports and statistics shows that training is needed to address the human side of being a pilot, including performing, allocating, and coordinating cockpit duties and responding to unusual situations.

FAA has an opportunity to address these training needs in its upcoming pilot training rule-making. The rule-making specifics have not yet been defined. While we recognize the difficulty involved in providing regulation for pilot training in unconventional matters, we believe that FAA should work towards including in the regulations guidance describing minimum pilot training, flight training, and cockpit resource management training. Minimum pilot training guidelines could be defined in terms of skills pilots must demonstrate upon completing training or minimum training hours. Flight training guidance would indicate maneuvers and procedures FAA believes are critical for quality flight training, especially for takeoff and landing, when most commuter airline accidents occur.

We found widespread support among aviation experts for requiring cockpit resource management training, including crew coordination, standard operating procedures, and decision-making. Crew coordination provides behavioral and team-working skills to deal with situations that arise, standard operating procedures divide responsibility among the crew and provide a template for normal operations, and decision-making training seeks to provide a system for deciding how to respond to unusual situations by augmenting the experience available in the cockpit. While these types of training have been implemented at some airlines, regulations are needed to provide guidance and criteria describing acceptable programs.

Recommendations

We recommend that the Secretary of Transportation direct the Administrator, Federal Aviation Administration, to include as part of the forthcoming rule-making for commuter pilot training
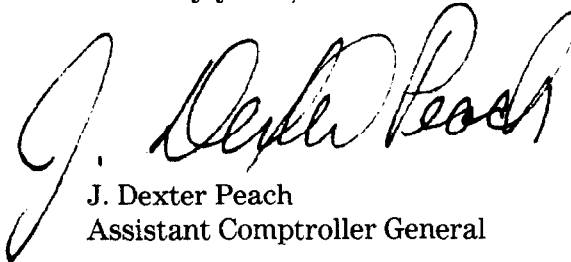
- guidance describing minimum training program requirements using standards such as pilot performance criteria or required training hours,
- guidance describing required flight training maneuvers and procedures, and

- requirements for cockpit resource management training, including crew coordination, standard operating procedures, and pilot decision-making, and guidance describing acceptable training programs.

In conducting our review, we examined pertinent legislation, regulations, and FAA handbooks and interviewed airline managers, FAA officials, and aviation safety experts. We discussed the results of our review with agency officials, who agreed with the facts presented, and incorporated their comments where appropriate. At your request, we did not obtain agency comments on a draft of this report. We performed our review in accordance with generally accepted government auditing standards. (See app. VI for details on our scope and methodology.)

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days from the date of this letter. At that time, we will send copies to the Secretary of Transportation and the Administrator, FAA. This work was done under the direction of Ken Mead, Associate Director. Major contributors are listed in appendix VII.

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

Contents

Tables

Abbreviations

FAA	Federal Aviation Administration
GAO	General Accounting Office
NTSB	National Transportation Safety Board
RAA	Regional Airline Association

Commuter Pilot Training Requirements

Federal aviation regulations require commuter airlines to develop and implement training programs for their pilots and other flight personnel. Each commuter airline employing more than one pilot must have a training program approved by the Federal Aviation Administration (FAA) that is appropriate for the airline's operations. An airline may not use a pilot unless that person has completed the appropriate, required training.

FAA approves each training program in two phases. Initial FAA approval is granted after the airline's proposed program has been evaluated by the FAA principal operations inspector for that airline and judged to be in compliance with the applicable federal aviation regulations. Final approval is granted after the principal operations inspector reviews training program implementation and is satisfied with its content and execution.

Commuter pilot training regulations require both ground and flight training. Ground training usually consists of classroom or other on-the-ground instruction to ensure that pilots have the basic knowledge necessary to serve as a commuter airline pilot. It usually includes topics such as aircraft performance, systems and equipment, weather, navigation, and air traffic control. Flight training provides practice, in a plane or flight simulator, in the maneuvers and procedures specified in the training program. It generally includes pretakeoff checks, normal and rejected takeoffs and landings, aircraft systems operation, and flight emergency procedures.

Pilot training is further divided into five phases: initial, recurrent, upgrade, transition, and differences training. Each of these phases includes both ground and flight training. Initial and recurrent training concludes with an oral or written test and a flight competency test given in the aircraft. The regulations indicate general areas to be covered in the oral/written test, but allow the check airman, who gives the in-flight competency test, to determine what will be included in the in-flight test. The regulations do not require testing upon completing upgrade, transition, or differences training.

Initial training is required when a pilot begins working for an airline. It provides basic information on company and aircraft procedures. Subjects covered include basic indoctrination, emergency and hazardous materials, meteorology, navigation, and communications. Aircraft-specific subjects include aircraft systems, performance characteristics, and emergency procedures. Initial training also includes flight training and

practice in maneuvers and procedures specified in the approved training program.

Recurrent training provides annual refresher training to ensure that pilots remain proficient at their assigned responsibilities. Commuter regulations allow substituting an annual flight test for recurrent flight training. Recent FAA action facilitates advanced training device use by commuter airlines for alternating recurrent training sessions. Advanced training devices are aircraft simulators without motion or visual simulation. FAA's action was intended to encourage airlines, which tended to favor flight checks in lieu of recurrent flight training, to provide more recurrent flight training.

Upgrade training is provided to copilots before they can serve as the captain on the same type of aircraft. It includes initial ground and flight training subjects. It also requires the pilot to pass a flight check.

Transition training is provided to pilots and copilots of one kind of aircraft before they can serve in the same function on a different aircraft. It includes basic indoctrination, emergency training, other initial ground training subjects, and flight training similar to that required in initial training.

Differences training is provided to pilots before they can serve as captain or copilot on a variation of an aircraft that contains equipment different from that on the aircraft they are presently qualified to fly. FAA determines when differences training is necessary. The content of the training depends on the differences between the variations of the aircraft.

Commuter Airline Code Sharing

Code sharing is a marketing agreement between commuter and major airlines in which the commuter adopts the major airline's two-letter designator code used to identify the major airline in the official airline guide and computerized reservation systems. The commuter also usually adopts a name similar to the major airline it is code sharing with, such as American Eagle, United Express, and Delta Connection. These marketing agreements complement the hub-and-spoke network that has increasingly characterized air travel route structures since deregulation. The code sharing commuter airline carries passengers from the shorter spokes to the code sharing major airline's hub on routes that have too few passengers to be profitably served by large jet aircraft.

Code sharing has grown dramatically during the 1980s, from about 10 code sharing relationships in 1983 to about 63 by April 1988, as shown in table II.1, including 43 of the top 50 commuter airlines. In 1987, code sharing commuters dominated the commuter industry, carrying almost 90 percent of commuter airline passengers. Some code sharing majors have also acquired partial or complete equity interest in their commuter code sharing partners. The growing trend of commuter acquisitions by major airlines could, according to an FAA official, eventually result in all the major commuter airlines being owned by major airlines.

Table II.1: Commuter Airline Code Sharing Agreements

Major airline	Commuter partner
Alaska Airlines	Bering Air
	ERA Aviation
	Horizon Air Industries[a]
	LAB Flying Service
	Temsco Airlines
Aloha Airlines	Princeville Airways[a]
American Airlines	AMR Eagle[a]
	Chaparral Airlines
	Command Airways
	Executive Air Charter
	Metro Airlines
	Metroflight
	Nashville Eagle[a]
	Simmons Airlines
	Wings West Airlines

(continued)

Major airline	Commuter partner
Braniff	Altus Airlines
	Executive Express
	Capitol Air Service
	Midcontinent Airlines
Continental Airlines	Britt Airways[a]
	PBA[a]
	Rocky Mountain Airways[a]
	Southern Jersey Airways
Delta Air Lines	Atlantic Southeast
	Airlines
	Business Express
	Comair
	Sky West Airlines
Eastern Air Lines	Air Midwest
	Atlantis Airlines
	Aviation Associates
	Bar Harbor Airlines[a]
	Eastern Metro Express
	Precision Airlines
	PBA
	Southern Jersey Airways
MarkAir	Hermens Air[a]
Midway Airlines	Fischer Brothers Aviation[a]
	Iowa Airways
Northwest Airlines	Big Sky Transportation
	Express Airlines I
	Mesaba Aviation
	Simmons Airlines
Pan American	Pan Am Express[a]
Piedmont Aviation	Brockway Airlines
	CCAir
	Henson Aviation[a]
	Jetstream International[a]
Trans World Airlines	Air Midwest
	Resort Air
	Resort Commuter

(continued)

Major airline	Commuter partner
United	Air Wisconsin
	Aspen Airways
	NPA
	Presidential/Colgan
	San Juan Airlines
	SouthCentral Air
	WestAir Airlines
USAir	Air Kentucky
	Chautauqua Airlines
	Crown Airways
	Pennsylvania Airlines[a]
	Pocono Airlines
	Suburban Airlines[a]

[a]Controlling interest in carrier acquired by major airline partner.

Sources: Regional Airline Association 1988 Annual Report; FAA Aviation Forecasts, fiscal years 1988-1999.

Commuter Airline Accident Statistics

According to NTSB statistics, pilots play a significant role in most aircraft accidents.[1] As shown in table III.1, pilots were cited as a factor in 95 percent of the commuter airline accidents that occurred during 1985. Between 1980 and 1984, pilots were cited as a factor in about 57 percent of commuter airline accidents. Table III.2 shows that the planning/decision-making aspects of human performance played a greater role in accidents than the pilot's ability to handle the plane. Overall, human performance accounted for about 57 percent of the 127 causal factors cited. Planning and decision-making accounted for about 33 citations, or about 26 percent of the causal factors, twice as many causal factors as the 16 citations for aircraft handling.

Takeoff and landing accounted for 85.7 percent of the accidents involving scheduled commuter airline flights in 1985 and 63.2 percent between 1980 and 1984. In 1985, as shown in table III.3, 14.3 percent of accidents involving scheduled commuter airline flights occurred during the broad category takeoff, including takeoff and climb. Between 1980 and 1984, 23.5 percent of the commuter accidents occurred during this phase. Landing, which includes descent, approach, and landing, accounted for 71.4 percent of accidents involving scheduled commuter airline flights during 1985 and 39.7 percent between 1980 and 1984.

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[1] In order to determine whether pilots are a significant factor in commuter aircraft accidents and whether any phase of flight is more accident-prone than others, we reviewed NTSB's 1985 Annual Review of Aircraft Accident Data, the most recent year available. We used the data for scheduled commuter airlines operating under Federal Aviation Regulations part 135. This includes data for commuter airlines operating aircraft with 30 or fewer passenger seats.

Table III.1: Broad Causes/Factors in All Commuter Airline Accidents

Broad cause/factor	1985		1980-1984	
	Number	Percent	Mean	Percent
Pilot	20	95.2	15.4	56.6
Personnel	10	47.6	9.0	33.1
Weather	6	28.6	7.8	28.7
Powerplant	5	23.8	5.4	19.9
Terrain	6	28.6	4.0	14.7
Landing gear	4	19.0	3.4	12.5
Miscellaneous	3	14.3	3.4	12.5
Airframe	3	14.3	2.4	8.8
Airport/airways/facilities	1	4.8	2.2	8.1
Systems	3	14.3	1.8	6.6
Undetermined	1	4.8	1.8	6.6
Rotorcraft	0	0.0	0.8	2.9
Instruments/equipment/accessories	2	9.5	0.2	0.7
Total/Average	**21**		**27.2**	

Source: Data taken directly from Annual Review of Aircraft Accident Data-1985, U.S. Carrier Operations, NTSB.

Table III.2: Commuter Airline Accident Causes and Factors

	All accidents - 1985		
	Cause	Factor	Total
Aircraft	14	9	23
Aircraft environment	0	9	9
Environmental conditions	0	23	23
Human performance[a]	50	22	72
Planning/decision-making	24	9	33
Aircraft handling	15	1	16
Total	**64**	**63**	**127**

[a]Categories shown under human performance are only a partial list and will not add to total for that category.

Source: Data taken directly from Annual Review of Aircraft Accident Data-1985, U.S. Carrier Operations, NTSB.

Table III.3: Flight Segment in Which Accident Occurred

Flight Segment	1985		1980-1984	
	Number	Percent	Mean	Percent
Takeoff	3	14.3	5.6	20.6
Climb	0	0.0	0.8	2.9
Total Takeoff		**14.3**		**23.5**
Descent	1	4.8	1.2	4.4
Approach	10	47.6	5.0	18.4
Landing	4	19.0	4.6	16.9
Total Landing		**71.4**		**39.7**
Taxi	1	4.8	3.6	13.2
Cruise	1	4.8	3.2	11.8
Standing	0	0.0	2.2	8.1
Maneuvering	0	0.0	0.6	2.2
Other	1	4.8	0.2	0.7
Not Reported	0	0.0	0.2	0.7
Total[a]	**21**	**100.1**	**27.2**	**99.9**

[a]Total percentages may not add to 100 due to rounding.

Source: Data taken directly from Annual Review of Aircraft Accident Data-1985, U.S. Carrier Operations, NTSB.

Commuter Airline Accidents Relating to Cockpit Resource Management

Problems with various elements of cockpit resource management have been cited in NTSB accident reports as causal factors in commuter airline accidents.[1] Among the specific problem areas cited in accidents are crew coordination, standard operating procedures, and pilot decision-making. Several examples of problems in each of these areas leading to commuter airline accidents and further description of accident investigation findings are provided below.

Crew Coordination

Ineffective crew coordination has been implicated in several commuter accidents. NTSB's investigation of the 1985 Bar Harbor Airlines accident concluded that a lack of crew coordination could explain, in part, the operational discrepancies leading to the accident. NTSB's report on the 1985 Henson airlines accident concluded that inadequate cockpit coordination resulting from having two pilots who were both inexperienced in their positions could explain in part the otherwise inexplicable navigational error by these pilots. NTSB's investigation of the 1986 Simmons airlines accident also indicated that proper crew coordination was not followed. NTSB's report on the August 1987 Northwest DC-9 crash at Detroit airport called on FAA to expedite issuance of guidance materials for both major and commuter airlines to guide cockpit resource management training implementation.

Standard Operating Procedures

Failure to follow generally accepted or company standard procedures was cited as a factor in commuter accidents. NTSB's report on the 1985 midair collision involving a Wings West airline plane and a corporate plane concluded that the probable cause of the accident was the pilots' failure to follow generally accepted standard operating procedures in the Airman's Information Manual[2] regarding monitoring airport radio frequencies. NTSB cited the crew's inexperience and failure to follow the before-takeoff checklist as factors in the May 1987 Air New Orleans commuter accident. In the 1985 Bar Harbor airlines accident, NTSB concluded that company management failed to ensure that flight crews adhered to company standard operating procedures. NTSB determined that both the captain and copilot made radio transmissions, contrary to company procedures of dividing duties between the flying and nonflying

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[1] Cockpit resource management is not required for either major or commuter airline pilot training. In addition to commuter airlines, this appendix refers to a major airline accident in which cockpit resource management was cited as a factor.

[2] The Airman's Information Manual is an FAA publication that serves as an official guide to basic flight information and air traffic control procedures.

pilot. The captain and the first officer were relatively inexperienced in their respective positions, and the division of cockpit duties between the flying and nonflying pilot may not have been performed as effectively as it might have if one or both had been more experienced. NTSB recommendations resulting from the Northwest Airlines DC-9 accident in Detroit called on FAA to require all major and commuter airlines to emphasize disciplined application of standard operating procedures and in particular emphasize rigorous adherence to prescribed checklist procedures.

Pilot Decision-Making

Pilot decision-making has been implicated in airline accidents. NTSB data for the 21 commuter airline accidents that occurred in 1985 show a total of 127 causal factors attributed to these accidents. Pilot planning and decision-making accounted for 33, or about 26 percent, of the causal factors. NTSB's investigation of a 1983 Air Illinois accident found the probable cause to be the captain's decision to continue the flight instead of returning to the nearby departure airport after losing electrical power from both generators. NTSB partially attributed the 1986 Simmons airlines accident to the pilot's decision to continue a landing approach despite instrument indications of being off course and without obtaining the latest weather information.

NTSB Accident Report Excerpts

NTSB accident investigations provide detailed analyses of commercial aviation accidents. Through various methods, NTSB attempts to determine the cause of accidents and makes recommendations on corrective actions. The following excerpts provide further information on the accidents previously cited and present selected findings and recommendations from commuter and pertinent major airline accident investigations.

August 16, 1987—(major airline accident) A Northwest airlines DC-9 crashed on takeoff at Detroit Metropolitan Airport, killing 148 passengers and 6 crew members. NTSB found that the plane attempted takeoff with its wings' trailing edge flaps and leading edge slats retracted, which would cause the wings to produce inadequate lift for takeoff. NTSB further concluded that the flight crew did not perform the airplane's checklist in accordance with the prescribed company standard procedures.

May 26, 1987—An Air New Orleans 19-passenger plane crashed on takeoff at New Orleans International Airport. NTSB attributed the crash to a breakdown in flight crew coordination that resulted in its failure to

provide proper engine power settings prior to takeoff. The crew failed to comply with the before-takeoff checklist. A contributing factor was both crew members' limited experience with the type of plane that they were flying.

March 13, 1986—A Simmons airlines plane crashed on landing with seven passengers on board, killing one crew member and two passengers. NTSB concluded that the probable cause of the accident was the crew's attempt to land without following established standard procedures. In addition, NTSB indicated, proper crew coordination was not followed, and the flight crew was inexperienced in flying through difficult meteorological conditions. The captain did not obtain the latest weather information prior to landing and did not evaluate all pertinent aspects of the flight in making the decision to land.

September 23, 1985—A Henson airlines plane with 12 passengers and 2 crew members crashed on approach to land, killing all on board. NTSB concluded that the inexperienced crew flying in difficult meteorological conditions committed an inexplicable navigational error resulting partly from inadequate crew coordination. Further, NTSB found that the airline's flight crew training was deficient and had been further degraded by rapid turnover of instructors, check airmen, and management.

August 25, 1985—A Bar Harbor airlines plane with six passengers and two crew members crashed on approach to land. NTSB cited several factors leading to the accident, including the crew's failure to follow company standard procedures and the pilot's decision to continue an unstabilized approach.

August 24, 1985—A Wings West airlines plane and a private plane had a midair collision killing 15 people on the Wings West plane and the 2 pilots on the private plane. NTSB determined that the probable cause of the accident was the failure of the pilots in both aircraft to follow standard procedures for radio communication recommended in the Airmen's Information Manual. Following these procedures could have alerted each to the other's presence and provided air traffic controllers better information.

October 11, 1983—An Air Illinois plane with seven passengers and three crew members crashed, killing all aboard. NTSB determined that the probable cause of the accident was the pilot's decision to continue the flight towards the more distant destination airport after serious

problems developed with the plane, rather than returning to the departure airport. The captain's decision was adversely affected by self-imposed psychological factors that led him to inadequately assess the situation and the risks involved.

June 12, 1980—An Air Wisconsin plane with 15 people on board crashed, killing 13 and seriously injuring 2. NTSB found that the probable cause of the accident was the flight crew's decision to continue the flight through an area of severe thunderstorms. Heavy rain caused both engines to fail.

FAA/Industry Flight Crew Performance Task Force

In August 1987 FAA formed a joint FAA/industry task force to identify problems with both major and commuter pilot training and produce recommendations for regulatory revisions to address these problems. The joint task force included members representing major and commuter airlines, pilots, and government organizations. On June 8, 1988, the task force provided recommendations to the FAA Administrator identifying the need to require a higher level of training for commuter airline pilots. The recommendations include

- requiring commuter airlines flying planes that require two pilots to comply with major airline pilot training requirements;
- providing a Special Federal Aviation Regulation permitting airlines to develop innovative pilot training programs;
- requiring cockpit resource management training and encouraging greater use of line oriented flight training, which simulates a complete flight from takeoff to landing in a simulator and provides problem-solving exercises;
- establishing a National Air Carrier Training Program Office to provide training oversight at a national level; and
- requiring training for all crew members to ensure a base level of familiarity with the airline's standard operating procedures.

The task force's final report included other recommendations, detailed information on the content of proposed regulations, and information on the rationale behind its conclusions. Its discussion included views on minimum training requirements, cockpit resource management, and standard operating procedures.

Minimum Training Requirements

The text accompanying the task force recommendations did not take a firm position on using minimum training hours or training program/pilot proficiency criteria to provide a measure of training program adequacy. The recommendations called for FAA to provide training program approval on the basis of course content and training aids used, rather than specific program hours, because the task force believed that curriculum content is more important than the amount of time spent. Therefore, the task force said, training program approvals should be based on satisfactory subject-matter treatment. However, the task force also said that knowing the number of planned hours for completing a particular curriculum may be a practical necessity and air carrier requests for training program approval should include the planned curriculum time, recognizing that this may be adjusted for individual student progress. Further, the task force called on FAA to permit individuals to progress

through ground training faster than the planned hours indicated in the training program according to the individual's aptitude, with certain checks and balances, using an approach that is similar to the training-to-proficiency provision in existing regulations for flight training.

Cockpit Resource Management

The task force recommendations stated that recent understanding of incident and accident causes has convinced the aviation community that emphasis must be placed on crew performance rather than individual performance. Cockpit resource management training was developed to address the need for crew concept training. Advances in simulation technology permit these programs to be accomplished in an entirely realistic but totally risk-free environment. The recommendations called on FAA to procure and place in the public domain a body of cockpit resource management material that all airlines can use to establish or update their programs. Further, the task force called on FAA to fund a model cockpit resource management development program.

Standard Operating Procedures

The task force recommendations called on airline training departments to develop training programs to achieve procedural standardization through the training and checking process. Further, they called on air carrier flight departments to define clearly in their operating manuals the duties for the pilot flying and the pilot not flying, particularly in critical phases of the flight, including takeoff, approach, and landing.

Objectives, Scope, and Methodology

In his April 20, 1987, letter, Senator Robert C. Byrd expressed concern regarding commuter airline safety, particularly in light of decreasing average commuter pilot experience and the airlines' ability to keep pace with these pilots' training needs. As agreed with the Senator's office, we evaluated commuter pilot training requirements to determine whether the regulations need to be revised. Specifically, we evaluated (1) changes in the commuter airline industry, (2) commuter and major airline pilot training regulatory requirements, and (3) commuter airline accident reports and statistics.

To evaluate changes in the commuter airline industry, we obtained government documents and private studies describing the evolution and status of the commuter airline industry. We also interviewed FAA headquarters and regional officials and pilot training and aviation experts from several private and government organizations. The organizations and their locations are listed below.

Organization	Location
Air Line Pilots Association	Herndon, Virginia
Aviation Safety Institute	Worthington, Ohio
Boeing Commercial Airplane Co.	Seattle, Washington
Flight Safety International Inc.	Flushing, New York
National Transportation Safety Board	Washington, D.C.
Regional Airline Association	Washington, D.C.

At these organizations we obtained information on changes in the commuter airline industry and on commuter pilot training regulation adequacy, pilot training method effectiveness, the merits of training hour requirements compared with pilot proficiency criteria for specifying minimum training requirements, who should receive the training (captain and/or copilot), and the training phase when various subjects should be provided. We also obtained these types of information and information on pilot training regulation implementation at nine commuter airlines operating in FAA's eastern, southern, and northwest mountain regions. The airlines and their headquarters locations are listed below.

Airline	Headquarters location
AVAir, Inc.	Raleigh, North Carolina
Big Sky Transportation Co. (Northwest Airlink)	Billings, Montana
Sallee's Aviation, Inc. (Coastal Airways)	Sequim, Washington
Colgan Airways Corp.	Manassas, Virginia
Crown Airways, Inc.	DuBois, Pennsylvania
Horizon Air Industries (Horizon Air)	Seattle, Washington
San Juan Airlines, Inc.	Port Angeles, Washington
SkyWest Airlines, Inc.	St. George, Utah
Trans-Colorado Airlines, Inc. (Continental Express)	Colorado Springs, Colorado

These airlines were selected to represent a range of sizes and types of operations. The airlines varied in terms of area served, number of aircraft, size of aircraft, and number of pilots. At each airline we reviewed the pilot training manual and other documentation and interviewed airline managers, including pilot training program officials. We did not visit each airline's training classes or discuss the training programs with airline instructors or pilots. To supplement our understanding of each airline's training program, we met with the FAA principal operations inspector responsible for approving the training program. We also discussed our observations on airline training program regulatory compliance with principal operations inspectors.

To evaluate and compare commuter and major airline pilot training requirements, we examined pertinent legislation, including the Federal Aviation Act of 1958, as amended, and the Airline Deregulation Act of 1978. We compared Federal Aviation Regulations for major and commuter airlines (parts 121 and 135), noted their differences, and held discussions with FAA officials, aviation experts, and airline officials. We also reviewed FAA orders, handbooks, advisory circulars, proposed FAA inspector handbook revisions, and other documentation relating to commuter pilot training regulations. We interviewed FAA headquarters officials, including personnel in FAA's Commuter and Air Taxi Branch, Office of Flight Standards, and also interviewed managers, supervisors, and inspectors in FAA's northwest mountain region and inspectors in FAA's eastern and southern regions. The principal FAA offices we visited are listed below.

Eastern Region
District office, Chantilly, Virginia
District office, West Mifflin, Pennsylvania

Southern Region
District office, Raleigh, North Carolina

Northwest Mountain Region
Regional office, Seattle, Washington
District office, Denver, Colorado
District office, Helena, Montana
District office, Salt Lake City, Utah
District office, Seattle, Washington

To determine whether additional types of training are needed, we reviewed NTSB accident reports for recent major commuter accidents (listed in app. V) to determine whether any commonalities existed. In addition, we obtained opinions from the previously cited FAA officials, airlines, aviation experts, and industry groups.

Our field work was conducted from March 1987 through July 1988. We performed our review in accordance with generally accepted government auditing standards.

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