Decisions, Motivation, Mind Set

Accident investigations highlight the necessity of stressing human factors in pilot training. It is no longer adequate to cite "pilot error" as the cause of an accident, rather more emphasis is now being placed on the pilot's judgment, motivation and cockpit management in regards to their effect on an accident.

by

John A. Pope

It wasn't too many years ago that there was little doubt or concern about a pilot's capacity for decision making. The only question of importance was, "How well can the pilot fly the airplane?" There was a natural assumption that the pilot decision making process existed or functioned outside the area of consciousness or subliminally. That talent came in the same package with other assorted aeronautical skills. If the pilot's logbook showed an equal number of takeoffs and landings, that was ample proof that all of the necessary decisions relating to flying the airplane had fallen neatly into place.

Gradually, the emphasis in accident investigations shifted and broadened from the over simplified "pilot error" causal factor to more complex human factor influences. Among those could be the pilot's ability to process information, judgment, decision making, motivation, mind set, mental block and cockpit management.

In recognition of the growing part that human factors might play in an aircraft accident, study groups delved into the pilot's individual characteristics. Each characteristic was dissected, discussed and reviewed in what has become a continuing search for the true causes of pilot performance in aircraft accidents. Comprehensive pilot training programs have been one result and with the purpose of giving the pilot clues or a handle on how the pilot behaves under a variety of circumstances. The pilot, knowing what strong or weak points are part of his/her mental make-up, can then shore up the weak points and take advantage of strengths.

What Makes Good Pilot Judgment

The DOT/FAA/PM-86/42 report, dated July, 1988, and entitled, "Aeronautical Decision Making for Commercial Pilots," is a product of Systems Control Technology, Inc. The report is actually a study guide which undertakes an explanation of the risks associated with commercial flying, the underlying behavioral causes of typical accidents and the effects of stress on pilot decision making. The document provides a means for the individual pilot to develop an "Attitude Profile" through a self-assessment inventory and inflight stress management techniques.

The report states:

"Aeronautical decision making (ADM), which can be equated with pilot judgment, is broadly defined as the mental process that pilots use in formulating decisions. Judgment is present in all flying decisions that involve uncertainty either in the information used or in the potential outcome. When this process is broken down into its two components, good pilot judgment is defined as:

1. The ability to search for and establish the relevance of all available information regarding a flying situation, to establish alternative courses of action and to determine expected outcomes from each alternative.

2. The motivation to choose and authoritatively execute a suitable course of action within the time frame permitted by the situation.

Where:

a. "Suitable" is an alternative consistent with societal norms.

b. "Action" includes no action, some action, or action to seek more information.

"The first component of the definition refers to intellectual abilities or 'Headwork.' It is 'knowledge based' and relies upon the pilot's capabilities to sense, store, retrieve and integrate information.

The second component in the definition, motivation, is where the decision is made, indicating that it can be affected, both, by motivation and attitude. It implies that pilot decisions are sometimes based on tendencies to use non-safety related information, such as job demands, convenience, economics, commitment, emotion, etc., in choosing a course of action."

Both components are essential for one, knowledge or information gathering, causes the pilot to get the facts, organize thoughts and diagnose problems. The other, motivation or attitude, tends to make the pilot cautious, critical and conservative.

The definition is not all difficult to understand. What is difficult to comprehend, however, are the decisions some pilots make in light of all the circumstances and the motivation that precipitated the pilot's actions.

A Pilot Who Made the Wrong Decisions

The report presents a scenario involving an incident where the aircraft was flown by one pilot although the aircraft was certificated for two pilot operation. No source was credited for the following:

"The pilot had a disagreement with his employer (who owned the aircraft) just prior to departing on a trip from Casper, Wyoming, to Oklahoma City. As he described it, 'I was not able to suppress my desires to be out of this man's (his boss) reach any longer.' He admits to flying the small jet after consuming alcoholic beverages five hours before the flight and to flying single pilot although the aircraft was not certified single pilot. He attributed his disregard for the rules and good sense to lack of rest resulting from the heavy flying schedule imposed on him by the boss over the previous weekend."

So, here you have a pilot who is ticked off at the boss, who consumed alcohol five hours before the flight (no mention was made of how much was consumed) and who jumped into an unnamed jet that, by regulation, required two pilots. There is nothing in the U.S. Federal Aviation Regulations that requires a pilot who flies for pay to be on friendly and good terms with the employer. But, ignoring the regulation that requires a pilot to abstain from the consumption of alcoholic beverages eight hours prior to the flight is a violation. Flying the airplane without the required second pilot on board is inexcusable.

This pilot's aeronautical decision making capability would appear to rest at zero on a scale of one to ten. What makes this scenario interesting is that the pilot recommended mandatory courses or seminars for the owners of high performance and turbine aircraft on pilot stress, crew rest and accepting **pilot judgment** (emphasis supplied). He felt that this would aid corporate pilots greatly by relieving a great deal of stress and tension.

The report makes no mention of what the pilot recommended to put himself on track. Apparently, he found no fault with his own decisions, and what he is seeking is a little bit of respect.

The report goes on. "As it stands, if the corporate pilot says, 'no go' for a legitimate reason, there is a good chance the owner/boss will find another (probably less experienced) pilot that will go. Unfortunately, the new pilot may eventually become an accident report statistic, along with the boss."

Given the circumstances of the aforementioned flight, the owner of the aircraft would probably be in safer hands with a less experienced pilot who would state the legitimate reasons for not going — drinking and the absence of a second pilot — and decline the flight as gracefully as possible. The boss can then activate his decision making processes and, if he is the kind who says, "If you don't go, I'll get someone who will," he deserves to spend the rest of his corporate days with the pilot who violated the regulations . . . and with his last will and testament in the ready position.

Dangers of a Preconditioned Action

The motivation for this pilot is quite obvious — continued employment. That induced a form of mind set which has been described as preconditioning the brain to perform a specific task. In spite of any external signals that might indicate a preconditioned action is not totally desirable, the mind carries out the pre-set program. Did this pilot precondition himself to make the flight regardless of the external signals? Don't bet against it.

The above scenario brings to mind a fatal accident that happened in 1982 at Mountain View, Missouri. A Cessna 551, Citation II, with a pilot and two passengers on board crashed immediately after takeoff, killing all. At the time of the accident, the weather at Mountain View Airport was a ceiling of about 100 feet, with visibility one mile in fog. Details are taken from the U.S. National Transportation Safety Board report NTSB/AAR-83/04, dated July, 1983.

For background, some of the avionics equipment had been reported by the chief pilot (who was not on the airplane) as slow to warm up. The Global Navigation System required four to five minutes to become operational, the attitude director indicator (ADI) on the pilot's side also required more time to warm up and there were occasions when it took one to one and one-half minutes for the artificial horizon to leave the caged position. In the last 10 flying hours, the pilot's heading indicator took increasingly longer for the flag to disappear before the instrument was ready for flight. That sometimes resulted in using the copilot's heading indicator until the pilot's heading indicator was operational.

The pilot just happened to be the president of the company that owned the aircraft and was described by acquaintances and employees as a strong-willed, aggressive individual who had total confidence in himself as a pilot and businessman. He disliked wasting time and would schedule and conduct flights to minimize delays. Pilots and individuals who had flown with him said he was a skilled pilot, although he sometimes violated certain aviation safety practices. Four persons said that they had been in the airplane with him when he rolled the aircraft, usually at cruise flight above 18,000 feet. He was conscientious about maintenance and flight/ground training, but he approached operating the aircraft in direct contradiction to his responsible programs for maintenance and training. Interviews with persons who knew the pilot indicated that he normally operated the airplane in a hurried manner without thorough use of checklists.

Analysis of the Pilot's Decision Making Process

How did this pilot plan for the fatal flight? What decision making processes did he go through? What was his motivation? Did he suffer from mind set?

An instrument flight plan request was filed a day before the flight from Mountain View to Lambert Airport, St. Louis, with a request for a 0930 departure. At 0730 on the day of the flight, the pilot called a fixed base operator at Lambert and asked about the weather. The answer came from someone, neither a pilot nor a weather observer, who said that the visibility was about a mile and a half and the ceiling was fairly low. The fixed base operator called FAA air traffic control at Lambert, inquired about traffic delays and called the pilot back, relaying the information acquired. There was no record of any other weather briefing.

At 0909, the pilot called the FAA flight service station (FSS) from his home for his instrument clearance and said he would need 15 minutes to get to the airport. FSS gave him a clearance which was valid until 0930. The telephone conversation ended at 0914 which allowed just 16 minutes to make the trip from home to the airport.

Meanwhile, back at the airport, the chief pilot of the company who was not assigned to the flight, took the airplane out of the hangar, preflighted it, loaded the baggage and boarded the passengers.

The pilot/boss arrived between 0920 and 0925, beating his estimated time en route from home to the airport considerably. By the time the chief pilot had driven the tug back to the hangar, both engines on the aircraft were started. The airplane was on the ramp for 15 to 30 seconds while a person handed the pilot company material through the cockpit window.

Then, the aircraft taxied 225 feet to the runway and stopped for approximately 30 to 60 seconds. According to the chief pilot who was watching, the takeoff roll started at exactly 0930 by his pilot's timepiece. It was his assumption that the generators were turned on as soon as the second engine was started. Two minutes elapsed between generator turn on and takeoff roll.

To witnesses, the takeoff appeared normal but the aircraft used almost three-quarters of the runway and disappeared from sight when it was 20 to 50 feet above the runway. There were no witnesses to the accident but persons on the ground heard the aircraft over head and an explosion soon afterward. The sheriff's office was called at 0934. The crash site was 1 3/4 miles from the airport.

Outcome of Rushing Preflight Procedures

Among the NTSB conclusions:

1. The pilot allowed minimal time for the preflight and prestart procedures. The pilot had less than five minutes to perform all of the prestart, start, taxi and takeoff checklists.

2. About two minutes elapsed from the time the avionics master switch was turned on and the takeoff roll.

3. The pilot's horizontal situation indicator probably had not become operational at the time the takeoff was started.

4. The takeoff was probably made with the pilot flying the airplane manually using attitude information provided by the pilot's attitude director indicator but most likely using the copilot's horizontal situation indicator for heading information.

5. Low ceilings deprived the pilot of outside visual references.

How did this pilot who was aggressive, self-confident, minimized delays, violated safety practices, rolled the aircraft and rushed through checklists stack up in decision making?

While this pilot also happened to be the boss, can a comparison be drawn with the pilot in the first scenario, the one who ignored regulations, disliked his boss and, perhaps, fretted about being fired for not taking the flight? What was the motivation and where did mind set come in?

The motivation factors were not entirely dissimilar for ego and the macho pilot image which may have been involved.

In the first instance, ego may not have allowed the pilot to admit to the boss that the flight could and should not be made. In the second, ego may have insisted that, notwithstanding those circumstances which shouted, "slow down!", getting to St. Louis but "fast" was the overriding motivation.

The Citation pilot's mind set ignored the external signals — sluggish instruments, low ceilings at departure and landing, etc. — for he was programmed to get the aircraft off the ground before the instrument clearance expired.

The Value of Cockpit Resource Management

While both of these scenarios relate to incidents where one pilot was flying, the symptoms experienced are not uncommon in two pilot cockpits. This is where cockpit resource management training should show great applicability, for the assumption is that pilots who are attuned to the crew concept will react and assert themselves by communicating when problems show signs of developing.

The DOT/FAA report cites the following incident "observed by a company pilot riding jump seat back to his home town."

"The weather was 400 and 1/2 at Greater Cincinnati Airport (CVG) when the aircraft carrying cargo in plastic bags departed at 4 a.m. Checklists were not being used during the flight, so it was not surprising that the bleed air switch was still in the 'emergency' position as it had been used for defog on the way into CVG. The transient pilot (also rated as a check airman in the aircraft) was certain that the inordinately loud rush of air would bring the situation to the attention of the crew. Not so. Shortly after becoming airborne, the cabin temperature climbed high enough to begin melting the plastic liner of the cabin as well as the plastic bags around the cargo.

"Fumes began filling the cabin and the crew still had not recognized a problem. As the jet entered the clouds, the first officer suddenly became aware of the difficulty. Without saying anything to the captain, the first officer immediately declared an emergency. The departure controller responded requesting the nature of the emergency and their intentions. The first officer responded that they wanted to return to land at CVG. The controller instructed them to climb to 2,700 feet and gave them a vector.

"During all of this, the pilots donned their oxygen masks as the fumes were unbearable. The passenger did not have access to oxygen. The captain had continued to fly the aircraft, though not following ATC's instructions. Instead, he descended out of the clouds and got on the radio and stated that he was the captain and that they were not declaring an emergency. He reported the airport in sight and requested to circle and land.

"After terminating with ATC, the captain proceeded to berate the first officer regarding declaring an emergency and not doing as he was told. During the entire episode, no attempt to resolve the situation was initiated and, of course, the emergency procedure checklist remained stowed in its unavailable position.

The report stated the incident was an extreme example of poor communication techniques in the cockpit and there is no argument with that. However, what happened to the captain's decision making processes, what was the motivation for ignoring the problem and the captain's cancellation of the emergency and did mind set play a part?

The captain did continue to fly the aircraft and disregarded ATC instructions. Can this be regarded in the same light as the pilot in the first scenario who drank five hours prior to flight and in his aircraft alone when two pilots were required? Disregarding ATC instructions is sufficient for instigating enforcement action for a violation just as any other rule infractions.

Assessing the Pilot's Mind Set

External factors related to mind set were numerous — not using the checklists, fumes, melting plastic, oxygen masks, etc. — but none changed the captain's way of doing business. Is the objection to declaring an emergency a result of mind set? Some pilots have demonstrated an aversion to making such declarations for fear that it will reflect an inability to cope with an aircraft problem and thereby be to their discredit. Consequently, when a bona fide emergency does take place, mind set blocks declaring that such a state exists.

Accident investigation technology which includes the use of cockpit voice recorders, along with a more systematic analysis of accident statistics has resulted in increased recognition of the importance of pilot judgment errors. Good pilot judgment does not come in the same bag with aeronautical skill but can be learned when properly motivated. A first good step would be for pilots themselves to understand that experience, skill and knowledge are the building blocks for judgment.

The DOT/FAA report states:

"Motivations give us reasons for flying. Without them flight would not be possible. Good judgment, on the other hand, requires proper development of attitudes, recognizing that they can inhibit or override the intellectual component of judgment. Controlling such interference requires the development of personal leadership styles that can overcome influences and related pressures that lead to bad decisions." ♦

*Reference documents:

DOT/FAA/PM-86-42, July, 1988
NTSB/AAR-83/04, July 19, 1983

Reports Received At FSF

AC 20-11D. *Index of Aviation Technical Standard Orders.* FAA Advisory Circular. 12 June 1987. AWS-120, FAA Hq., Washington, DC 20591 US.

Summary: This describes the public procedure the FAA will use to develop and issue Technical Standard Orders (TSOs) for aeronautical products to be used on civil aircraft. The AC presents an index of the TSOs that contain minimum performance standards for specified materials, parts, processes and appliances used on civil aircraft.

AC 23-7. *Substantiation For An Increase In Maximum Weight, Maximum Landing Weight, or Maximum Zero Fuel Weight.* FAA Advisory Circular. 1 July 1987. ACE-100, FAA Hq., Washington, DC 20591 US.

Summary: This provides information and guidance concerning acceptable means of compliance with Part 23 of the FARs. The need occasionally arises to modify and substantiate the structure for an increase in these weights, due to changes in the operational requirements of an owner or operator. Any increase affects the airplane's basic loads and structural integrity and could affect the limitations and performance.

GAO/RCED-87-182. *Aviation Security — FAA Needs Preboard Passenger Screening Performance Standards.* General Accounting Office Report. July 1987.

Summary: This is a GAO letter to the U.S. Secretary of Transportation and a statement of Kenneth Mead, Associate Director of the GAO's Resources, Community and Economic Development Division, before the Subcommittee on Government Activities and Transportation Committee on Government Operations of the U.S. House of Representatives.

It provides the results of GAO's work on the FAA's testing of preboard passenger screening and contains GAO conclusions and recommendations. GAO acknowledges the deterrent influence of the preboard screening devices to crimes against civil aviation, but found shortfalls in the screening program and wide variations in the frequency with which weapons are detected.

GAO found that detection rates varied widely, ranging from a high of 99 percent to a low of 34 percent at the 28 major airports whose test results were analyzed. GAO concludes that FAA needs to establish performance standards for passenger screening and recommends that FAA establish a minimum standard that the airlines must meet for the detection of FAA test weapons and use the standard as one of several management tools in its oversight of passenger screening.

CAA Paper 87007. *Report of the Helicopter Human Factors Working Group.* Civil Aviation Authority. 1987. Report available for L4.00. Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England.

Summary: This document reports on the activities of the Helicopter Human Factors Working Group in determining what available technology could do to minimize human error and assist the pilot in performing his task. The data available revealed other related problems which the Group felt it should not ignore, and the results therefore include these additional problems not directly related to human factors. Topics discussed in the report include: avionics and instrumentation (navigation assistance, low visibility rig approaches, engine health, fuel and oil gauging, landing gear, wheel brakes, loading indication, intake blockage, autorotative landing guidance, automatic stabilizer systems, and loss of rotor RPM); design detail (windscreens and windscreen wipers, hearing and ventilation, rainwater leaks, noise and vibration, seats, pilot's view, space and stowage, crew clothing and equipment, collective friction control, labelling terminology, and tail rotor failures); and operational considerations (flight deck environment, meteorological data, helideck turbulence, paperwork, and scheduling and flight times).

In addition, four major causes of accidents not specifically human factors related were also covered: crop spraying, training, maintenance errors, and doors, hatches, etc. Recommendations for corrective actions are provided for the items discussed.

Flight Safety — 10 Years After Airline Deregulation

A statistical review of airline performance and safety indicators

Airline deregulation incites the airline industries to a rapid expansion for a free competition. In reality, deregulation is supposed to bring forth a financially healthy environment for the industries, and to provide better and safer air service to air travel public. Just prior to the deregulation becoming effective in 1978, there were 10 trunk air carriers, 13 local carriers, four international air carriers, three all cargo and two other carriers, for a total of 32 airlines operating under FAR Parts 121 and 125. At the end of 1987, 10 years later, there were 14 major air carriers, 20 national carriers, 32 large regional carriers, 27 medium regional carriers, 65 all cargo and other carriers for a total of 158 airlines operating under FAR Parts 121 and 125[1]. The number of airlines increased more than quadruple not counting the over 200 commuter air carriers and 1,500 air taxi operators operating under FAR Part 135. Since some activity data for commuter and air taxi operators are either incomplete or not readily available, this review is based upon the statistics for large airlines only.

Over the past 10 years, in addition to number of air carriers, all airline performance indicators showed substantial increase. Table 1 presents the trends of aircraft hours flown, miles flown and departures of the large airlines in the last decade. It shows airline aircraft hours flown increased 61 percent, aircraft mile flown 54 percent and aircraft departures over 40 percent although there was a stoppage in the years of early 1980s as the result of a slowdown of U.S. economy.

Table 1 — U.S. AIRLINES
Aircraft Hours Flown, Miles Flown and Departures
1978 thru 1987

YEAR	Hours Flown(000)		Miles Flown(MLN)		Aircraft Departures	
	Number	Changes	Number	Changes	Number	Changes
1978	6,032	——	2,520	——	5,016	——
1979	6,713	+11.6%	2,791	+10.8%	5,400	+7.6%
1980	6,798	+1.3	2,816	0.9	5,353	-0.9
1981	6,571	-3.3	2,703	-4.2	5,212	-0.8
1982	6,440	-2.0	2,699	-0.1	4,964	-4.7
1983	6,649	+3.2	2,809	+4.1	5,034	+1.4
1984	7,438	+11.7	3,133	+11.5	5,448	+8.2
1985	7,947	+6.8	3,320	+6.3	5,835	+7.1
1986	9,357	+17.7	3,276	+12.3	6,440	+10.4
1987	9,711	+3.8	3,875	+4.0	6,980	+8.4
10 Year Changes		+61.0%		+54.0%		+39.2%

Source: FAA

[1] Beginning with the January 1981 issue of the publication of Air Carrier Traffic statistics by the Transportation Systems Center of the Department of Transportation's Research and Special Program Administration, new air carrier groupings have been established as follows:

Carrier Groupings	Carriers with annual revenue	
Majors	$1,000,000,000+	
National	$100,000,000-	$1,000,000,000
Larger regional	$10,000,000-	$99,999,999
Medium	$Less than	$9,999,999

To cope with the air traffic growth, the National Airspace Systems (NAS) have been consolidated and improved. Table 2 presents the 10-year consolidation and improvement of air route facilities and service as well as the air traffic difficulties, i.e., the increase of near midair collision reports and air traffic delays. Although it shows that radar equipment increases 69 percent; instrument landing systems 59 percent and the number of airport control towers increased 38 percent, the near midair collision reports continue rising on an average of 6 percent annually: the number of near midair collisions rose from 375 in 1981 to over 1,000 in 1987. The annual number of air traffic delays jumped up and down over the period, and there is no improvement trend in sight. Such developments create public anxiety to wonder if the National Airspace systems were inadequate to cope with the air traffic growth?

Table 2 — U.S. Air Route Facilities and Services Air Traffic Delays and Near Midair Collisions

Year	VOR /VECTAC	Instrument Lndg Systems	Radar Equipment	Air Traffic Control etc.	Airport Towers	Traffic Delays	Nr.Midair Collisions
1978	1,020	698	185	25	494	52,239	na
1979	1,028	753	192	25	499	61,589	na
1980	1,037	796	192	25	502	57,600	na
1981	1,033	840	199	25	501	96,423	375
1982	1,029	884	197	25	492	332,000	311
1983	1,032	934	197	25	494	244,000	476
1984	1,035	955	197	25	497	405,000	589
1985	1,039	968	198	25	500	334,000	777
1986	1,043	977	312	25	686	418,644	840
1987	1,045	1,100	312	25	686	356,718	1,059

* Delays reporting 15 minutes or more as of 1/1/82. Prior to 1/1/82 only those delays 30 minutes or more were reported.

Table 3 shows the number and annual change rates of aviation safety inspectors, airline transport rated (ATR) pilots and air traffic controllers. The ATR pilots increased seven percent annually from 55,881 in 1978 to 91,287 in 1987, although overall pilot population during the same period reduced from 798,833 in 1978 to 699,653, or 14 percent. In addition to the increasing needs of ATR pilots as a result of airline expansion, this significant growth of ATR pilot population also could be the direct result of the airline's strategy to hire more young and less-experienced pilots to cut labor cost. The statistics also show that the FAA aviation safety inspectors increased 17 percent from 1,999 to 2,350. The FAA flight inspectors may not be adequate to safeguard flight safety if it is compared to the number of aircraft used by the airlines before and after the deregulation. The statistics also show that air traffic controllers decreased 22 percent from 27,688 in 1978 to 22,651 in 1987, a sharp drop from 27,190 in 1980 to 17,190 in 1981 as a direct result of the air traffic controller strike in 1981. One may wonder if more air traffic controllers are needed to cut down the daily air traffic delays.

Table 3 — Number and Annual Changes of Aviation Safety Inspectors, ATR Pilots and Air Traffic Controllers, 1978 thru 1987

Year	Safety Inspectors		ATR Pilots		Air Traffic Controllers	
	Number	Changes	Number	Changes	Number	Changes
1978	1,999	——	55,881	——	27,688	——
1979	2,016	+0.8%	63,652	+13.9%	27,783	+0.3%
1980	2,038	+1.1	69,569	9.3	27,190	-2.1
1981	1,942	-4.7	70,311	1.1	17,418	-35.9
1982	1,835	-5.5	73,471	4.5	20,906	+20.0
1983	1,805	-1.6	75,938	3.4	21,271	+1.8
1984	1,945	+7.6	79,192	5.0	21,759	+2.3
1985	1,897	-2.5	82,740	4.5	22,114	+1.6
1986	2,204	+16.2%	87,186	5.4	22,036	-0.4
1987	2,350	+6.6%	91,287	4.7	22,651	+2.8
10 Year Changes		+17.6		+63.6		-22.2%

Source: FAA

The competition among airlines to create a unique situation for each airline searching for new passenger markets and to obtain more fuel efficient aircraft to increase available seat-miles and cut cost in order to attract more passengers. Table 4 shows the changes of the structure of aircraft operated by the airlines, and Table 5 presents the increase of available seat-miles and passenger enplanements and passenger revenues etc. In 1979, turbine-engine aircraft accounted for 85 percent of total aircraft, it increased to 92 percent in the beginning of 1988. In the turbine-engine aircraft fleet, turbojets accounted for 81 percent of total turbine-engine aircraft in 1978 and reduced to 74 percent in 1987. For reason of fuel efficiency, the small airlines apparently used more turboprops than turbojets. Table 5 shows the airline available seat-miles increase over 75 percent. The number of passenger enplanements and the revenue passenger miles increased accordingly. Although average on-line passenger trip length (miles) is slightly larger in recent years, the revenue passenger load factor remained unchanged at 61 percent. The average passenger revenue per passenger miles increases from 7.49 cents to 10.38 cents or 39 percent. The increase of passenger revenue could have been offset by the overall inflation rate, leaving many airlines in great financial trouble.

Table 4
Total Aircraft Reported In Operation By Air Carriers by Type of Aircraft: 1978 — 1987

Year	Total	Fixed Wing						Total Rotary-Wing
		Total Fixed-Wing	Turbine			Piston		
			Total	Turbojet	Turboprop			
1978	2,545	2,542	2,477	2,237	240	65		3
1979	3,609	3,608	3,052	2,486	566	547		1
1980	3,808	3,806	3,218	2,531	687	588		2
1981	3,973	3,969	3,363	2,511	852	603		4
1982	4,072	4,067	3,501	2,674	827	566		5
1983	4,203	4,194	3,643	2,767	876	551		9
1984	4,370	4,358	3,915	2,959	956	443		12
1985	4,678	4,673	4,240	3,164	1,076	433		5
1986	4,909	4,907	4,487	3,283	1,204	420		2
1987	5,253	5,240	4,819	3,575	1,244	421		13

Note: Beginning in 1987, the number of aircraft is the monthly average of the number of aircraft reported in use for the last three months of the year. Prior to 1987, it was the number of aircraft reported in use during December of the year.

Source: Air Carrier Aircraft Utilization and Propulsion Reliability Report; Aviation Standards National Field Office, Federal Aviation Administration.

Table 5

Passenger Ope rations In Sc heduled Domes tic Operation s of The Large Certificated Air Carriers 1978-1987

Year	Revenue Passenger Enplanements (000)	Revenue Passenger Miles (000)	Available Seat-Miles (000)	Revenue Passenger Load Factor[1]	Average On-Line Passenger Trip Length (Miles)	Average Passenger Revenue Per Passenger Miles (Cents)
1978	253,957	182,669,238	299,541,841	61.0	719	8.49
1979	292,700	208,890,884	332,796,130	62.8	714	8.93
1980	272,829	200,829,303	346,028,272	58.0	736	11.49
1981	265,304	198,714,755	346,171,952	57.4	749	12.74
1982	274,342	210,149,315	359,527,716	58.5	766	12.21
1983	296,721	226,908,925	379,150,158	59.8	765	12.13
1984	321,047	243,692,254	422,506,609	57.7	759	12.79
1985	357,109	270,584,011	455,825,864	60.7	758	12.32
1986 (R)	393,864	302,089,903	497,990,815	60.7	767	11.18
1987 (P)	416,468	324,480,986	526,663,456	61.6	779	11.50

1 Percent revenue passenger-miles of available seat-miles.

(P) Preliminary.

(R) Revised.

Source: "Air Carrier Traffic Statistics" — RSPA

The reports of financial difficulties and safety violations of many airlines stimulates the public's concerns over airline safety performance. Table 6 shows the airline accidents and rates after the deregulation. The number of annual accidents fluctuated between 12 and 31 with an average of 20 accidents in a year. Fatal accidents fluctuates between no fatal accidents and five fatal accidents with four fatal accidents in five of the last 10 years. An analytical analysis of the safety statistics reveals not only that the number of accidents, fatal accidents and fatalities fluctuate without a downward trend, but that all the accident rates have no apparent downward trends at all.

Table 6 — U.S. Airline Accidents and Fatalities and Rates
1978 thru 1987

Year	Total Accidents				Fatal Accidents				Fatalities
	Number		Rates		Number		Rates		
		Hours*	Miles*	Deptes*		Hours*	Miles*	Deptes*	
1978	20	0.33	0.01	0.40	5	0.08	0.00	0.10	160
1979	23	0.34	0.01	0.43	4	0.06	0.00	0.07	351
1980	15	0.22	0.01	0.26	0	0.00	0.00	0.00	0
1981	25	0.38	0.00	0.48	4	0.06	0.00	0.08	4
1982	15	0.23	0.01	0.30	3	0.05	0.00	0.06	233
1983	22	0.33	0.01	0.44	4	0.06	0.00	0.08	15
1984	12	0.16	0.01	0.22	1	0.01	0.00	0.02	4
1985	17	0.21	0.01	0.29	4	0.05	0.00	0.07	197
1986	20	0.21	0.01	0.31	1	0.01	0.00	0.02	1
1987	31	0.31	0.01	0.43	4	0.03	0.00	0.04	231
Means	20	0.27	0.01	0.35	3	0.04	0.00	0.06	77
Median	20	0.27	0.01	0.35	4	0.05	0.00	0.06	----

Hours* Rate per 100,000 aircraft flying hours.
Miles* Rate per 1,000,000 aircraft miles flown.
Deptes* Rate per 100,000 aircraft departures.
Sources: NTSB/FAA

However, the most recent information released by the Department of Transportation and the FAA reported that airline safety and service indicators shows a major improvement during the first nine months of 1988. Near midair collision reports, air traffic controller errors, air fatalities rates, flight delays and airline consumer complaints all declined significantly.

Near midair collision reports dropped by 35 percent in the January-September period when compared with the same months a year ago. Operational errors were down by 15 percent during the same reporting period. For the nine months of 1988, FAA tallies 246,518 delays of 15 minutes or more at airports and in the nation's airspace. That is 12 percent less than the 280,514 for the same period last year.

Fatal accident rates for scheduled air carriers declined markedly. The rate for the first nine months of this year was 0.031 fatal accidents per 100,000 hours flown compared to 0.041 for all of 1987, i.e., a 24 percent decline.

The Department of Transportation reported that the on-time performance of the nation's major airlines improved substantially. In October, the 13 largest passenger carriers recorded an average 86 percent on-time arrival record, their best month since they began reporting data to DOT more than a year ago. October is the seventh consecutive month in which the carrier's overall on-time performance exceeded 80 percent. That is compared to the 66 percent reported in December 1987.

Apparently, the objectives of airline deregulation have not yet been met, but hopefully, it is pointing at the right direction.

Comparison of Accident Rates and Trends
Commuter Air Carrier vs. Major Air Carrier
1978 – 1987

Accidents per
100,000 hours

Graphic not available

Year

Accident/Incident Briefs

Air Carrier

Approach In Fog

Argentina - June

MD-81: Aircraft destroyed. Fatal injuries to seven crew members and 15 passengers.

The air carrier that had departed from Buenos Aires and made a stop at Resistencia in northern Argentina was approaching for landing at Posadas shortly before 10:00 a.m. Weather was reported as foggy.

The aircraft hit trees and crashed about a mile short of the runway. The crew of another aircraft that overflew the crash site approximately 10 minutes later reported that the aircraft was totally engulfed in flames.

Approach In Fog

Portugal - July

Boeing 707 Cargo: Presumably destroyed. Fatal injuries to six.

En route from Belguim, the Boeing cargo aircraft was approaching the Lagos Airport to refuel. It was flying through fog and low clouds when it cut through some trees and crashed into a river. The six occupants, all crew members, were killed.

There were reports that the pilot had a previous problem with one of the engines, but radio communications did not confirm this.

High Speed Abort

India - July

Boeing 747: Extensive damage. Minor injuries to some passengers.

The aircraft was on its takeoff run from the New Delhi International Airport at 1:30 a.m. with 272 occupants aboard. At 160 mph the pilot decided to abort after he got an indication of fire in the outer starboard engine. (Passengers later reported that they had seen flames escaping from the engine.)

The airplane ran off the end of the runway and veered to the left, losing the landing gear as it skidded into an area of rocks, marshland and scrub. It came to rest in soft gravel with its wheels and parts of both wings shorn off. All four engines were imbedded in the gravel. The underbelly of the airplane was completely shredded.

The 15 members of the crew helped the passengers evacuate quickly. There were some minor injuries as people scrambled away from the airplane in the darkness. Fire crews arrived at the scene promptly and extinguished a small fire.

Fire On Takeoff

Bulgaria - August

Yak-40: Substantial damage. Fatal injuries to 25 and various injuries to 12.

The airliner with 33 passengers and four crew members aboard caught fire just after takeoff from Bulgaria's Sofia Airport and crashed within the airport perimeter. The fire was quickly extinguished by crash crews and 14 injured persons were taken to area hospitals, two of whom, including the captain and a child, later died.

Monsoon Mishap

Hong Kong - August

HS Trident: Aircraft extensively damaged. Fatal injuries to seven, various injuries to 14, no injuries to 68.

The airliner, with 78 passengers and 11 crew members, ran off the runway at Hong Kong's Kai Tak International Airport while attempting to land in heavy rain and fog during a monsoon. The aircraft broke in two when it plunged into Victoria Harbor.

Data reported in the accident/incident briefs on this and the following pages are based upon preliminary information obtained from agencies and organizations participating in the FSF Accident Prevention Program, as well as the news media. They are subject to future revision.

Six crew members were among the seven persons killed in the accident. The airport was closed, temporarily stranding thousands of travelers as flights were diverted for most of the day following the mid-morning accident. British military helicopters, fire service and police boats and divers assisted in the rescue efforts that saw injured passengers plucked from the semi-submerged fuselage and rushed to area hospitals.

Lightning On Approach

Thailand - September

Tu-134: Aircraft destroyed. Fatal injuries to 75, lesser injuries to six.

The Vietnamese Tu-134 from Hanoi was approaching Bankok's Don Muang International Airport during a monsoon rainstorm when it was hit by lightning according to later reports from the two surviving pilots. The aircraft crashed about five miles short of the airport, and came to rest with the nose and one large piece of the fuselage partially submerged in a pond beside a dirt road. The main section of the fuselage was completely burned out.

Bird Ingestion

United Kingdom - June

BAC 1-11: Bird ingestion damage to one engine. No injuries.

The V_1 speed for the charter flight had been calculated at 144 knots, and the flight was cleared for takeoff from Newcastle Airport bound for Mahon. The first officer was flying the airplane.

Passing through 100 knots, the pilots observed a flock of birds on the center of the runway ahead of them. As the airplane passed through the birds, the captain checked the engine gauges and, noticing a wind-down of Number One engine, called "Stop." The first officer applied reverse thrust and brakes, commenting later that the braking seemed less effective than he had expected.

Although braking and full reverse were maintained until the aircraft stopped, it overran the runway by about 160 feet. All occupants safely evacuated the airplane using main and ventral stairs. There was no fire or damage to the airframe.

During the investigation, both pilots recalled that lift dump had not been actuated during the abort, a factor which was calculated to have added slightly more than 100 feet to the rollout. Another aspect considered a factor contributing to the overrun was the fact that the decision to stop was made at a speed of about 147 knots — above V_1.

Air Taxi/Commuter

Ten More Feet

United States - September

Pilatus Britten-Norman
BN-2A Islander: Substantial damage. Fatal injuries to one, lesser injuries to nine.

A twin-engine commuter failed, *by 10 feet*, to clear a mountain pass at the 2,000-foot level near Indigo Lake in southeast Alaska. The aircraft was enroute from Sitka to Petersburg.

The ELT signal was picked up by a high-flying aircraft and helicopters were dispatched. A commercial helicopter was first to arrive at the scene and found four survivors standing near the extensively damaged aircraft. The helicopter crew evacuated three of them to a Sitka hospital, returning with medical personnel. A Coast Guard helicopter had by then joined the effort and the rest of the nine injured were flown out. It took two hours to cut free one woman passenger.

Uncommanded Left Turn

United States - July

Aerospatiale 330J: Aircraft destroyed. Fatal injuries to one, serious injuries to one, no injuries to pilot and 12 other passengers.

The air taxi pilot had stabilized his helicopter at a hover and was transitioning to forward flight when the aircraft entered a slow "uncommanded" turn to the left. The pilot later reported that he had added right anti-torque pedal but that it did not stop the rotation. The nose dropped and the aircraft fell into water, rolled and submerged.

Later inspection of the tail boom and tail rotor gear boxes revealed no indication of mechanical failure.

Corporate Executive

Engine Problem On Takeoff

Argentina - June

DH 104 Dove: Aircraft destroyed. Fatal injuries to eight, nonfatal injuries to one.

Shortly after takeoff from La Plata, the twin-engine de Havilland Dove developed engine trouble and crashed.

One engine quit six minutes after takeoff and the pilot attempted to return to the airport. The aircraft was unable to maintain altitude, however, and crash landed in an uninhabited area. The single survivor was treated at a nearby hospital.

Failed Takeoff

United States - August

Piper 601P Aerostar: Aircraft destroyed. Fatal injuries to all three in the airplaneand non-fatal injuries to two on the ground.

The twin-engine aircraft had just taken off from North Perry Airport, about 16 miles north of downtown Miami, FL, when it lost altitude, hit power lines and exploded as it crashed into a crowded shopping center.

The ensuing fire sent flames 200 feet into the air and gutted four stores. Intense flames kept fire fighters and rescue crews at bay for several hours and hundreds of shoppers and shop employees were evacuated. The crash of the six-seat aircraft caused about $1 million in damage on the ground.

Surprise Rollover

United States - July

Enstrom 280C: Substantial damage. No injuries.

The pilot was preparing to taxi the helicopter at the start of a business flight when it rolled over while idling.

According to the pilot, while executing the before-taxi checklist, he adjusted the friction setting on the collective pitch control. At some point, the collective restraining chain slipped off and the collective snapped up under the pilot's arm. This caused the aircraft to execute a roll to the left during which the main rotor blades struck the ground, causing substantial damage to the aircraft. There were no reported injuries.

Other General Aviation

Midair Over Water

Iceland - June

Maule MX-7-235: Substantial damage. No injuries.
Maule MX-7: Aircraft and pilot missing in ocean.

The two single-engine lightplanes were on a delivery flight from the United States to Europe, and were flying in side-by-side formation.

Almost 200 miles west of Iceland, on a leg that began in Goose Bay, the two aircraft collided. One Maule crashed into the sea and the other, with substantial damage to a wing, managed to reach Reykjavik safely.

Sightseeing Deviation

Japan - July

Cessna T210: Aircraft substantially damaged. Fatal injuries to six.

The single-engine lightplane was en route from Oshima, a small island south of Tokyo, to Honda Airport in Saitama Prefecture with a pilot and five passengers aboard.

According to the Ministry of Transport, the aircraft deviated from its expected course to fly over the home of one of the passengers. The aircraft was reported to have taken a "sinuous" course and crashed into a hillside on Mount Monomi in dense fog. The pilot and passengers were killed and the airplane heavily damaged.

Just Plain Incredible

United Kingdom - July

Piper PA-31 Navajo: No damage. No injuries.

The U.S. pilot was taking his family on vacation to England

and France and was running into problems near the end of the leg from Reykjavik to Glasgow. The following events during the last 35 minutes of the flight illustrates a set-up for disaster that will impress any pilot.

Here is the sequence of events beginning 35 miles out from Glasgow.

• Pilot reported he was "acutely" short of fuel.

• At 22 miles out and at 5,000 feet, one engine had quit from fuel starvation but had been restarted by crossfeeding from another tank that also was expected to run out at any time.

• The fuel warning light came on at 13 miles out, and the pilot was given direct vectors to the airport.

• At a distance of eight miles out both engines stopped and the aircraft started descending at the rate of 1,000 fpm. ATC declared a full emergency.

• At five miles out the pilot reported passing through 2,500 feet.

• As the pilot reported passing through 1,500 feet at three miles out, the ATC controller advised him of the location of a highway and the River Clyde for possible emergency landing or ditching if necessary.

• At two miles the pilot reported that he had the airport in sight but that he did not see the runway.

• The airplane landed across the runway and stopped, undamaged, on a taxiway.

Undaunted, the pilot planned to leave the same evening for Paris, but a magneto problem during engine start delayed the departure. When a local mechanic checked the airplane the next day he found a considerable fuel leak from a wing tank.

Believe it or not, as Ripley would say, the pilot appeared quite unconcerned when he was told about the substantial fuel leak and it was further explained to him that six hours of fuel had been lost after four hours of flying. And here's what he did about it: When the magneto was repaired, he took off for France, flying the length of the British Isles, to continue on his vacation.

The airplane stopped at Glasgow again on its return flight to the United States. The fuel tank leak reportedly had still not been fixed.

Incredible — but true.

The British Civil Aviation Authority summed it all up rather succinctly with the comment: "One can only hope that neither this man nor his aircraft will ever again return to British airspace." The agency advised the U.S. FAA of the incident in detail.

Every Pilot's Nightmare

United Kingdom - June

Cessna 337 Skymaster: Front engine mount stressed, belly scraped. No injury to one.

The aircraft was five miles out on final approach and pre-landing checks were begun. Flaps were selected at 160 mph IAS but the pilot held off lowering the gear because the airspeed was still higher than the gear limiting speed of 144 mph.

After the landing flare, the airplane gently touched down — on its fuselage. It slid straight along the runway, stopping on the centerline.

The pilot later recalled that he had failed to return to the checklist after he had slowed the airplane to the safe gear-down speed and that he did not doublecheck the gear during final approach.

Bad Weather

West Germany - July

Bell UH-1D: Rotorcraft destroyed. Fatal injuries to six.

The West German army helicopter was based at a training camp in the mountains. Because of bad weather, five civilians were being flown down the mountain by an army captain and a crew of three.

The aircraft crashed into a cliff in thick fog, exploding on impact and falling more than 600 feet into thick forest.

No Joyride

Switzerland - July

Type not reported: Rotorcraft destroyed. One Fatality.

After he finished work as a mechanic at a local airline facility, the 21-year-old Swiss stole a helicopter from its hangar and took off for an illegal joyride. The mechanic was an enthusiastic flier who knew helicopter operational theory but had no training or experience flying them.

Witnesses reported seeing the helicopter performing "strange maneuvers" near Jungfrau Mountain.

Ninety minutes after the flight began, the rotorcraft crashed into the mountain, killing the pilot and destroying the aircraft.

Three Oilfield Ditchings

North Sea - July

Sikorsky S-61N: Rotorcraft sank. All 22 occupants rescued.

The helicopter was on the way from a floating hotel to the mainland with two crew members and 19 oilfield workers aboard when an engine fire occurred. The pilots made a controlled landing in the sea and the occupants took to life rafts.

Rescue helicopters began winching up survivors less than half an hour after the first distress call was received and picked up all unhurt. The ditched helicopter sank in 200 feet of water.

Gulf of Mexico - July

Aerospatiale SA 330J
Puma: Rotorcraft destroyed. Fifteen of sixteen occupants rescued.

The helicopter, with a crew of two, had just brought one oilfield crew to a drilling platform and was returning to the mainland with 14 passengers. The weather was clear with seas of two to three feet.

The helicopter was seen to crash into the sea by witnesses on two boats, and they began immediate rescue operations. Fifteen survivors were quickly rescued, one of whom was injured and was hospitalized. Coast Guard and commercial vessels, plus private and military aircraft, searched for the missing man. The pilot reported that he had encountered a control problem prior to the accident.

North Sea - July

Aerospatiale AS 332
Super Puma: Damage not reported. All 18 occupants rescued.

The helicopter was transporting oilfield workers from a rig to Stavanger, Norway, when it encountered vibrations attributed to rotor problems. It was forced to ditch 70 approximately miles off the coast of Norway. The pilot made a controlled landing in heavy seas under what was described as gale force weather conditions, and the occupants took to life rafts.

The downed aircraft remained afloat and all occupants got out safely. The two crew members and 16 passengers were picked up in good condition by rescue helicopters.

After the helicopter was recovered, it was found that a section of the leading edge protection on one of the main rotor blades had separated in flight, resulting in the severe vibration that led the pilot to ditch the aircraft.

External Load Exigencies

United States - July

Aerospatiale 315B: Substantial damage. Serious injuries to one.

While the helicopter was hovering at 200 feet, lowering an external load to a job site, the engine quit. Witnesses stated that they had observed flames coming from the engine exhaust pipe just before the power loss. The helicopter entered autorotation and impacted trees.

United States - July

Aerospatiale 315B: Aircraft destroyed. Serious injuries to one.

The helicopter was engaged in a log-lift operation, during which the external load got caught in a tree. The pilot released the load from the line, which in turn snagged another tree, pulling it toward the helicopter. When the line let go of the tree shortly thereafter, the abrupt release of tension resulted in an unexpected pitch/roll and loss of control of the helicopter at the other end of the cable.

The helicopter hit the ground and was destroyed. The pilot received serious injuries.

United States - July

Bell TH-1L: Substantial damage. Serious injuries to one.

During this log-lifting operation, the pilot felt a vibration and the helicopter began to yaw.

The pilot immediately released the external load and went into an autorotation that ended in a hard landing. The aircraft was substantially damaged, and the pilot received serious injuries.

Later examination revealed that the gearbox in the tail rotor drive system had failed.