

Uncovering the policy factor in accidents

This analysis by a prominent accident investigator shows that managerial policy - not "crew error" - most often triggers airline tragedies.

By Gerrard M. Bruggink

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This article is considered a milestone in the long journey for developing a conceptual frame to understand the causal mechanism of air accidents.

It was published in May 1985 issue of Air Line Pilot [U.S. ALPA magazine].

This conceptual frame was confirmed and further developed in a sequential causal model by prof. James Reason [University of Manchester] with his "organizational accident" theory, presented several years later and adopted as a reference framework for accident analysis by ICAO. It was formally endorsed by some accident investigation agencies such as the Australian Transport Safety Bureau [ASTB]: «Professor James Reason, whose model of no-blame systemic safety analysis forms the basis of the ATSB's investigation practice, defines good safety culture as '...an organisational climate in which people are prepared to report their errors'.»



In accident investigation, one sentence has been repeated so often and so convincingly that it has become an axiom: most aircraft accidents are caused by the human factor, especially by crew error. In March 1984, the chairman of the National Transportation Safety Board told a Senate subcommittee, "The flight crew has been identified as a causal factor in about 65 to 70 percent of all air carrier accidents." The statistical validity of this statement cannot be questioned; the mandate to determine causes puts NTSB in the best position to know where it points its finger most often.

But what is the safety value of statements of cause that focus exclusively on human error? Selectively emphasizing mistakes made by mostly licensed personnel ignores the interplay between the two types of decisions that govern safety.

First, **policy making** at the managerial level is an unhurried, deliberate, and usually collective process of open-eyed risk assessment.

It involves management at regulatory agencies, manufacturers, air carriers, professional associations, and airports.

Second, **individual decision making** at the working level is an urgent and constant process based on the individual's immediate perception of the variables in a fluid situation.

It involves first-line supervisors, maintenance and support personnel, dispatchers, air traffic controllers, and pilots.

Individuals at the lower end of the organization have an unlimited opportunity to make wrong decisions. The easily identified link between their errors and accidents threatens to obscure the less conspicuous role of policy factors. The better term, as used here, refers to managerial shortcomings in applying accident avoidance principles.

A policy factor becomes an inherent part of the causal mechanism when top management of manufacturers, air carriers, professional organizations, airports or regulatory agencies helped set the stage for the accident by ignoring the lessons from predictive incidents and similar accidents in the past, or by tolerating unwarranted compromises for reasons of self-image, economy, or ineptness.

The objective of this study is to determine to what extent the role of policy factors in accidents is properly identified in official determinations of cause.

The facts needed to identify policy factors in past accidents were available only in accident reports that followed the International Civil Aviation Organization format, such as NTSB's "blue-cover" reports. This meant that the accident records in only one type of flying permitted a meaningful search for policy factors: air carrier operations under Part 121. To avoid excessive diversity in accident data, only fatal accidents involving scheduled passenger operations in turbojet aircraft were selected. The period 1973-82 was chosen because it was the latest 10-year period for which formal accident reports were available.

A total of 29 fatal turbojet accidents in scheduled Part 121 passenger operations occurred during that period. However, 6 single fatality mishaps were not included in the tabulation because the operational safety of the aircraft was not threatened by these occurrences. NTSB characterized them as "bizarre" accidents, such as passenger falling off a stair platform.

Fatal turbojet accidents under Part 121 (1973-1982)								
Case# - Airline	Date	Location	a/c	Phase of flight	Occupant	Fatalities	Official cause	Policy factor
1-PanAm	7/22/73	Thaiti	707	Takeoff	79	78	Undetermined	-
2-Delta	7/31/73	Boston	DC9	Approach	89	89	Crew, ATC, design	Yes
3-TWA	8/28/73	Los Angeles	707	In flight	152	1	Design	-
4-National	11/03/73	Albuquerque	DC10	In flight	128	1	Design	-
5-PanAm	1/30/74	Pago Pago	707	Approach	101	96	Crew, wind shear	Yes
6-PanAm	4/23/74	Bali	707	Approach	107	107	Crew	-
7-TWA	9/8/74	Ionian Sea	707	In flight	88	88	Sabotage	-
8-Eastern	9/11/74	Charlotte	DC9	Approach	82	72	Crew	Yes
9-TWA	12/1/74	Berryville	727	Approach	92	92	Crew, ATC	Yes
10-Eastern	6/24/75	New York	727	Approach	124	112	Wind shear	Yes
11-Alaska	4/5/76	Ketchikan	727	Landing	50	1	Crew	Yes
12-American	4/27/76	St.Thomas	727	Landing	88	37	Crew	-
13-Southern	4/4/77	New Hope	DC9	In flight	85	62	Crew, dispatch	Yes
14-Continental	3/1/78	Los Angeles	DC10	Takeoff	200	2	Tire failure	Yes
15-National	5/8/78	Pensacola	727	Approach	58	3	Crew	Yes
16-PSA	9/25/78	San Diego	727	Approach	135	135	Crew, ATC	Yes
17-United	12/28/78	Portland	DC8	Approach	189	10	Crew	-
18-American	5/25/79	Chicago	DC10	Takeoff	271	271	Maintenance, design	Yes
19-Western	10/31/79	Mexico City	DC10	Landing	89	72	Crew	Yes
20-Air Florida	1/13/82	Washington	737	Takeoff	79	74	Crew	Yes
21-World	1/23/82	Boston	DC10	Landing	212	2	FAA, a/p mgt, ATC	Yes
22-PanAm	7/9/82	New Orleans	727	Takeoff	145	145	Wind shear	Yes
23-PanAm	8/11/82	Honolulu	747	In flight	288	1	Sabotage	-
					Tot 2931	Tot 1551		

[\[A synoptic report of each listed accident is attached at the end of this article\]](#)

The table above shows the 23 fatal accidents that fall within the scope of this analysis. Three of these accidents occurred on foreign soil and were investigated by other governments; for one of these accidents, no cause could be determined. The official cause(s) of the remaining 22 accidents are listed in the sequence used in the statements of cause. In cases where NTSB's probable cause statement merely described what happened, the column for official cause reflects the board's apparent intent or the opinion of dissenting board members.

This study did not include the contributing factors listed in NTSB's probable cause statement because their role in the summary of causes was not clear. According to the NTSB's coding handbook, such factors "may or may not have contributed significantly to the accident."

The obsolete practice of differentiating between primary and secondary causal elements perpetuates preoccupation with accountability rather than prevention.

The second to last column of the table lists 31 official causes for the 22 accidents for which causes were determined. The term "management" appears only once- in the form of airport management. The only other cause that satisfies the meaning of policy factor is the reference to the Federal Aviation Administration in the statement of the cause of the same accident (Case 21, the World Airways DC-10 landing at Boston's Logan Airport).

The last column of the table identifies 15 accidents in which at least one policy factor must be considered part of the cause. Before drawing statistical inferences from the column, this study will present the rationale for assigning that factor in each of the 15 cases.

The second table summarizes the fatal accidents in scheduled Part 121 passenger operations from 1973 to 1982.

Takeoff, approach and landing accidents resulted in 1398 aircraft-occupant and 24 other fatalities. This means that 90 percent of all fatalities occurred within about the first two or the last eight minutes of flight.

Distribution of fatalities by flight phase				
Phase of flight	No. of accidents	Total no. of occupants	Total occupant fatalities	Occupant fatality rate %
Takeoff	5	774	570	74
In flight	5	741	153	21
Approach	9	977	716	73
Landing	4	439	112	26
Totals	23	2931	1551	53

Takeoff accidents

Case 14: NTSB attributed this Continental DC-10 takeoff accident at Los Angeles to tire failure. The probable cause statement does not even hint that policy factors played a role in this mishap. One has to study the accident report and the safety recommendation to discover that regulatory/industrial compromises in design, certification, and procedures allowed this and several similar accidents to happen.

Case 18: The policy factors in the catastrophic American Airlines DC-10 takeoff accident at Chicago's O'Hare Airport need little elaboration. Five months before the previously damaged aft pylon bulkhead of the No.1 engine completely failed, another carrier had experienced similar damage using similar maintenance procedures.

Case 20: NTSB officially attributed the Air Florida 737 accident at Washington National to the crew on three counts: (1) failure to use engine anti-icing, (2) the

decision to takeoff with snow/ice on the airfoils, and (3) failure to reject the takeoff. Actually the NTSB came closer to the root of this accident in what it classified as a contributing factor: "The limited experience of the flight crew in jet transport winter operations." This so-called contributing factor may have been intended to soften the board's harsh judgement of the crew; in reality it constitutes a policy factor of the first order. The captain's commercial jet operating experience began in October 1978, in August 1980 he was upgraded to 737 captain. According to NTSB, he "missed the seasoning experience normally gained as a first officer as a result of the rapid expansion [of the carrier]."

Case 22: According to the probable cause statement, the Pan Am 727 wind shear accident at New Orleans, which caused 153 deaths, was unavoidable due to the limits the existing state of technology placed on detecting and avoiding severe weather. However this accident, as well as case 10 (an Eastern 727 approach accident at New York's Kennedy Airport, which was attributed to wind shear), had several policy connotations, which follow:

- An industrywide, schedule-driven attitude that seems to condone risk-taking with regard to severe weather in the terminal area as long as there are no ill effects.
- Failure to establish more practical criteria for pilots' reporting wind shear.
- Reluctance to stress the captain's prerogative when the first officer is flying and the situation demands immediate control.
- Failure to instill respect for severe weather information that is already available.

In-flight accidents

Case 13: This accident involved total loss of power and major engine damage when the Southern Airways DC-9 penetrated a severe thunderstorm area near New Hope, Georgia. According to the accident report, that storm system "was one of the most severe systems in the United States in the past three years... About 20 tornadoes and 30 severe thunderstorms were included in the system."

The National Weather Service had issued a tornado warning, but the crew was not alerted. This accident had its origin in the long-standing policy failure to ensure the timely communication of available weather information to flight crews, traffic controllers, and dispatchers.

Approach accidents

Case 2,5,8, and 15: These four approach accidents (a Delta DC-9 at Boston's Logan Airport, a Pan Am 707 at Pago Pago, an Eastern DC-9 at Charlotte, North Carolina, and a National Airlines 727 at Pensacola) were officially attributed to the crews and involved, among other factors, their failure to make the prescribed callouts.

This policy factor runs like a refrain through U.S. air carrier approach and landing accidents during the last few decades. Although some callout procedures are undoubtedly superior to others, they all serve to reduce errors in perception and decision-making. Nevertheless, investigators often treat a professional crew's apparent disregard for established procedures as a human factor problem in the cockpit. They do not consider that flight crews do not suddenly become undisciplined; prolonged exposure to substandard or compromising managerial practices fosters an indifferent attitude toward procedural safeguards.

On the other policy factors at work in these accidents, only one will be mentioned. In the National Airlines nonprecision instrument approach over water at night, the ground proximity warning system might have prevented the accident if the crew had not been given the option of determining whether the warning was valid. Such policy oversights become root causes that are labeled statistically as human error

accidents.

Case 9: This accident - a TWA 727 into Mount Weather at Barryville, Virginia - involved controlled flight into terrain (CFIT). It was made possible by regulatory/industrial complacency in resolving the ambiguity surrounding the term "cleared for the approach." Two months before the accident, a serious incident on the same approach drew attention to that ambiguity.

Case 10: NTSB officially attributed the Eastern 727 approach accident at Kennedy to wind shear. The policy factor assigned to it is based on the rationale explained under Case 22, the Pan Am 727 accident at New Orleans.

Case 16: The accident report officially assigned the responsibility for the PSA 727 midair collision at San Diego to the flight crew and air traffic control procedures.

Inexplicably, the accident report belittles the role of an enabling factor that probably degraded crew performance: failure to implement the sterile cockpit concept, a no cost method to avoid distractions during critical phases of flight. The predisposing role of that policy factor was also conspicuous in Case 8, the Eastern DC-9 accident at Charlotte.

One approach accident (Case 6, a Pan Am 707 on approach at Bali) could not be examined for policy factors because of the incompleteness of the accident report.

Landing accidents

Cases 11 and 19: These two landing accidents - an Alaska Airlines 727 at Ketchikan and a Western DC-10 at Mexico City- involved non-adherence to prescribed callout procedures, which have already been classified as policy factor in four accidents.

The Western Airlines accident (a night approach to a closed runway followed by a sidestep to the parallel runway in use) might have included in additional policy factor in the form of reported but unresolved crew incompatibility.

Case 21: The World Airways DC-10 overran the end of Boston's Logan Airport runway at 49 knots, following a nonprecision instrument approach and a touchdown 2,500 feet beyond the displaced threshold on an ice-covered runway. The probable cause statement assigns most of the responsibility to two policy-making entities, FAA and airport's management, but does not mention the manufacturer or the carrier. This is a bewildering omission in view of one of the NTSB's findings: "Present FAA standards and *accepted operating practices* do not preclude a pilot from landing an airplane on a runway which is too slippery to provide adequate friction to stop the airplane" (emphasis added). NTSB 11-page letter of recommendations to FAA, in essence, exposes the industry's reluctance to accept operational restrictions aimed at greater safety margins for takeoffs and landings on slippery runways.

Distribution of crew error and policy factors

Accident type	Accidents	Fatalities*
Total	23	1583
With policy factors	15 (65%)	1260 (80%)
With crew factors	13 (56%)	872 (55%)
With crew & policy factors	10 (43%)	718 (45%)
With crew factors only	3 (13%)	154 (10%)

* Includes persons on the ground

The table shows the distribution of accidents with officially assigned crew factors and accidents involving policy factors. The table also gives the total fatalities associated with those factors. The fact that official determinations of cause were made in all but one of the 23 accidents was not taken into account in the

tabulation; the only effect was a slight decrease in the percentage in both columns. Of the 13 accidents involving the crew, 10 also had policy factors. Of the 3 accidents that had official crew factors only, one could not be assessed with regard to policy involvement. Giving management the benefit of the doubt in that case, this implies that just 13 percent of all accidents had a crew factor only. This findings contrasts sharply with the NTSB chairman's statement that the crew is the principal factor in 65 to 70 percent of all air carrier accidents.

Official causes distort policy error

In conclusion, this study shows that official causes assigned to 23 fatal air carrier accidents over a 10-year period distort the true nature of the accident problem.

Probable cause statements that ignore the link between human factors and policy factors create the false notion that, in a professional environment, avoiding accidents starts at the bottom, rather than at the top. Thus, causal statements that make headlines can actually deter comprehensive safety efforts.

When the mandate to determine causes is interpreted to mean the spelling out of accountability, the rules of evidence used by the investigation authority must stress the provability, rather than the preventability of causes.

This self-imposed rules are the main reason that policy factors have not gained recognition as a recurring theme in most air carrier accidents.

Top managers of manufacturers, air carriers, professional organizations, airports, and regulatory agencies have a collective responsibility to establish and maintain an operational climate that allows for the controllable elements of human failure. If safety improvements have to wait for incontrovertible proof that certain policy factors provoke accidents, our industry will never reclaim its primacy.

The mounting evidence of deregulation's built-in temptation to compromise safety margins provides more reason than ever to take the policy factor out of the closet by:

- replacing the blame-oriented probable cause summary with a "probable sequence of accident events" that lists the manner of performance of all functions that appear to have sustained the accident's development, and
- treating policy factors as the upstream source of most so-called human factor accidents.

[G.M. Bruggink \[1985\]](#)

Brief descriptions & synoptic reports of accidents considered by Gerrard Bruggink in his (1985) study. [credit goes to Aviation Safety Network by Harro Ranter]

1-PanAm	7/22/73	Thaiti	707	Takeoff	79	78	Undetermined	
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The Boeing ("Clipper Winged Racer") took off from runway 04 for it's 2nd leg of the Auckland-Papeete-Honolulu-Los Angeles flight and climbed to 300ft. At 300ft a left turn was initiated and the aircraft struck the sea in a descending excessive bank turn. The wreckage sank into the 700m deep waters off Papeete. Both CVR and FDR were not recovered.

PROBABLE CAUSE: Unknown. It is considered possible that an instrument failure may have diverted the crew's attention during the turn. Since it was dark outside and the turn was made towards the sea. No visual references were available.

2-Delta	7/31/73	Boston	DC9	Approach	89	89	Crew, ATC, design	yes
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As Delta Flight 723 was descending, the approach clearance was given by the controller after a delay, because the controller was preoccupied with a potential conflict between two other aircraft. This caused the flight to be poorly positioned for approach. The aircraft passed the Outer Marker at a speed of 385km/h (80km/h too fast) and was 60m above the glide slope. The flight director was inadvertently used in the 'go-around-mode', which led to abnormal instrument indications. This caused some confusion. The first officer, who was flying the approach, became preoccupied with the problem. The DC-9 continued to descend and struck a seawall 3000ft short of and 150ft to the right of runway 04R crashed and caught fire. RVR at the time was 500m with 60m overcast.

PROBABLE CAUSE: "The failure of the flight crew to monitor altitude and to recognize passage of the aircraft through the approach decision height during an unstabilized precision approach conducted in rapidly changing meteorological conditions. The unstabilized nature of the approach was due initially to the aircraft's passing the outer marker above the glide slope at an excessive airspeed and thereafter compounded by the flight crew's preoccupation with the questionable information presented by the flight director system. The poor positioning of the flight for the approach was in part the result of nonstandard air traffic control services."

3-TWA	8/28/73	Los Angeles	707	In flight	152	1	Design	
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The plane porpoised while descending to LAX. The aircraft was subjected to 2 minutes of peak acceleration forces of 2.4 g. A combination of design tolerances in the aircraft's longitudinal control system which, under certain conditions, produced a critical relationship between control forces and aircraft response.

4-National	11/03/73	Albuquerque	DC10	In flight	128	1	Design	
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Overspeeding of the starboard engine caused the engine to disintegrate. Pieces struck the fuselage, breaking a window, causing rapid explosive decompression and a passenger was sucked out of the plane. The plane landed safely. The captain and flight engineer were experimenting with the autothrottle system by tripping the circuit breakers, which supplied the instruments which measured the rotational speed of each engine's low pressure compressor. This led to engine overspeeding and destruction of the engine.

5-PanAm	1/30/74	Pago Pago	707	Approach	101	96	Crew, wind shear	yes
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The aircraft, on approach to Pago Pago, encountered windshear some 3nm short of the runway, causing it to deviate above the glide slope. Power was reduced, but at 1,25nm short the aircraft went into a 1500ft/min descent until striking trees 0,65nm short of the runway 05.

PROBABLE CAUSE: "The flight crew's late recognition, and failure to correct in a timely manner, an excessive descent rate which developed as a result of the aircraft's penetration through destabilizing wind changes. The winds consisted of horizontal and vertical components produced by a heavy rainstorm and influenced by uneven terrain close to the aircraft's approach path. The captain's recognition was hampered by restricted visibility, the illusory effects of a "black hole" approach, inadequate monitoring of flight instruments, and the failure of the crew to call out descent rate during the last 15 seconds of flight." (NTSB-AAR-77-7)



6-PanAm	4/23/74	Bali	707	Approach	107	107	Crew	
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The aircraft, named "Clipper Climax", crashed into a mountain while preparing for a runway 09 approach to Denpasar after a 4h20m flight from Hong Kong.

PROBABLE CAUSE: "The premature execution of a right-hand turn to join the 263 degrees outbound track which was based on the indication given by only one of the ADFs while the other one was still in steady condition".

7-TWA	9/8/74	Ionian Sea	707	In flight	88	88	Sabotage	
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Flight TW841 (Tel Aviv-Athens-Rome-New York) left Athens at 09.12 GMT for a 1h48min flight to Rome. The flight was cruising at FL280 when to suddenly enter a steep climb attitude. The captain of PanAm flight 110 who witnessed the event, said the aircraft then rolled to the left into a steep descent. The Boeing 707 disintegrated and crashed into the sea. It was determined that the detonation of an explosive device in the aft cargo compartment buckled and damaged the cabin floor in such a manner that one or more of the elevator and rudder system control cables was stretched and, perhaps, broken. The resultant displacement of control surfaces caused a violent pitch up and yaw and made the aircraft uncontrollable.

PROBABLE CAUSE: "The detonation of an explosive device within the aft cargo compartment of the aircraft which rendered the aircraft uncontrollable

8-Eastern	9/11/74	Charlotte	DC9	Approach	82	72	Crew	yes
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The DC-9 struck trees while flying 135m too low and 80km/h too fast. The aircraft crashed 3.3 miles short of runway 36 during a VOR/DME approach.

PROBABLE CAUSE: "The flight crew's lack of altitude awareness at critical points during the approach due to poor cockpit discipline in that the crew did not follow prescribed procedure."

9-TWA	12/1/74	Berryville	727	Approach	92	92	Crew, ATC	yes
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The crew descended below minimum altitude during a runway 12 VOR/DME approach to Washington-Dulles. The aircraft struck high ground at 1800ft.

PROBABLE CAUSE: "The crew's decision to descend to 1800ft before the aircraft had reached the approach segment where that minimum altitude applied. The crew's decision to descend was a result of inadequacies and lack of clarity in the air traffic control procedures which led to a misunderstanding on the part of the pilots and of the controllers regarding each other's responsibilities during operations in terminal areas under instrument meteorological conditions. Nevertheless, the examination of the plan view of the approach chart should have disclosed to the captain that a minimum altitude of 1800ft was not a safe altitude. Contributing factors were: 1) The failure of the FAA to take timely action to resolve the confusion and misinterpretation of air traffic terminology although the Agency had been aware of the problem for several years; 2) The issuance of the approach clearance when the flight was 44 miles from the airport on an unpublished route without clearly defined minimum altitudes; and 3) Inadequate depiction of altitude restrictions on the profile view of the approach chart for the VOR/DME approach to runway 12 at Dulles Int. Airport."

10-Eastern	6/24/75	New York	727	Approach	124	112	Wind shear	yes
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The aircraft struck approach lights during a runway 22L ILS approach. The aircraft broke up and caught fire.

PROBABLE CAUSE: "The aircraft's encounter with adverse winds associated with a very strong thunderstorm located astride the ILS localizer course, which resulted in high descent rate into the non-frangible approach light towers. The flight crew's delayed recognition and correction of the high descent rate were probably associated with their reliance upon visual cues rather than on flight instrument reference. However, the adverse winds might have been too severe for a successful approach and landing even had they relied upon and responded rapidly to the indications of the flight instruments. Contributing to the accident was the continued use of runway 22L when it should have become evident to both air traffic control personnel and the flight crew that a severe weather hazard existed along the approach path."(NTSB-AAR-768)

11-Alaska	4/5/76	Ketchikan	727	Landing	50	1	Crew	yes
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Flight 60 was making a runway 11 ILS approach under conditions of low ceilings and low visibility. Descending through 4000ft visual contact with the ground and water was acquired. The captain decided to proceed visually. The aircraft touched down fast (at 145kts) with a 3kts tailwind component. Braking action was poor, so the captain decided to execute a go-around. Ground spoilers were retracted, flaps set at 25deg. The thrust reversers didn't disengage fully, so full take-off thrust couldn't be obtained. Attempts to disengage the reversers failed, so ground spoilers were deployed again. The aircraft overran the wet runway, crossed a gully and a service road, struck the antenna array support structure and continued before ending up in a ravine, 700ft past the runway.

PROBABLE CAUSE: "The captain's faulty judgement in initiating a go-around after he was committed to a full stop landing following an excessively long and fast touchdown from an unstabilized approach. Contributing to the accident was the pilot's unprofessional decision to abandon the precision approach." (NTSB-AAR76-20)

12-American	4/27/76	St.Thomas	727	Landing	88	37	Crew	
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Flight 625 (Providence-New York-St.Thomas) departed New York at 12.00 AST. At 15.04 the flight crew cancelled their IFR flight plan and proceeded VFR. The captain however elected to use the runway 9 ILS for vertical guidance. The glideslope was intercepted at 1500ft msl (flaps 15deg and at a 160 KIAS airspeed). The flaps were lowered to 25 and later to 30deg. The company prescribed 40deg was never selected. The speed was still 10 KIAS above Vref when the aircraft passed the threshold at an estimated altitude of 30-40ft. At 1000ft down the runway (while initiating flare) turbulence caused the right wing to drop. The wings were leveled and the aircraft floated a while until touchdown at 2200-2300ft down the runway. The captain decided that the aircraft couldn't be stopped on the remaining runway. He immediately initiated a go-

around. Because of the absence of any sensation either of power being applied or of aircraft acceleration, the throttles were closed again. The aircraft, in an 11deg nose up attitude, ran off the runway and struck a localizer antenna. The right wingtip clipped a hillside just south of the antenna and the aircraft continued, hit an embankment, became airborne and contacted the ground on the opposite side of the perimeter road. The aircraft continued and came to rest 83ft past the perimeter road, bursting into flames.

PROBABLE CAUSE: "The captain's actions and his judgment in initiating a go-around maneuver with insufficient runway remaining after a long touchdown. The long touchdown is attributed to a deviation from prescribed landing techniques and an encounter with an adverse wind condition, common at the airport. The non-availability of information about the aircraft's go-around performance capabilities may have been a factor in the captain's abortive attempt to go-around a long landing." (NTSB-AAR-77-1)

13-Southern	4/4/77	New Hope	DC9	In flight	85	62	Crew, dispatch	yes
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Southern Flight 242 (Huntsville-Atlanta) entered severe thunderstorms between FL170 and FL140 over Rome, GA. Both engines failed and couldn't be restarted. An emergency landing was carried out on State Spur Highway 92. The aircraft crashed.

PROBABLE CAUSE: "Total and unique loss of thrust from both engines while the aircraft was penetrating an area of severe thunderstorms. The loss of thrust was caused by the ingestion of massive amounts of water and hail which, in combination with thrust lever movement, induced severe stalling in and major damage to the engine compressors. Major contributing factors include the failure of the company's dispatching system to provide the flight crew with up-to-date severe weather information pertaining to the aircraft's intended route of flight, the captain's reliance on airborne weather radar for penetration of thunderstorm areas, and limitations in the FAA's ATC system which precluded the timely dissemination of real-time hazardous weather information to the flight crew."

14-Continental	3/1/78	Los Angeles	DC10	Takeoff	200	2	Tire failure	yes
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Continental Flight 603 (Los Angeles - Honolulu) received clearance to taxi to runway 6R at 09.01h. At 09.22h the flight was cleared to taxi into position and hold. Takeoff clearance was given a minute later, but the crew delayed the acknowledgment, because the captain thought the clearance was given too soon after a heavy jet aircraft had made its takeoff. Acceleration was normal, but while approaching the V1 speed (156kts) a loud "metallic bang" was heard, followed by a quivering. As rejected takeoff procedures were begun, the airspeed continued to increase to 159kts. The aircraft appeared to be decelerating normally, but with 2000ft of runway remaining, the flightcrew became aware that the rate of deceleration had decreased and they believed that the aircraft would not be able to stop on the runway. The aircraft was steered to the right and departed the right corner of the runway end. About 100ft beyond the runway, the left maingear broke through the nonload-bearing tarmac surface and failed. A fire erupted in this area as the aircraft turned to the left, coming to rest 664ft from the runway end and 40ft right of the extended centreline in a 11deg left wing low and 1,3deg nose-up attitude.

PROBABLE CAUSE: "The sequential failure of two tyres on the left main landing gear and the resultant failure of another tire on the same landing gear at a critical time during the take-off roll. These failures resulted in the captain's decision to reject the take-off."



15-National	5/8/78	Pensacola	727	Approach	58	3	Crew	yes
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Flight 193 operated as a scheduled passenger from Miami to Pensacola, FL, with en route stops at Melbourne and Tampa, New Orleans, Louisiana, and Mobile. About 21.02 CDT the flight departed Mobile on an IFR flight plan to Pensacola and climbed to the cruising altitude of 7,000ft. At 21.09h, the crews were told that they would be vectored for an airport surveillance radar (ASR) approach to runway 25. At 21.13h, the radar controller told National 193 that it was 11 nm NW of the airport and cleared it to descend and maintain 1700 ft. At 21.17h flaps were selected at 15deg and two minutes later the flight was cleared to descend to 1500ft and shortly after that further down to the MDA (480ft). As the aircraft rolled out on the final approach heading, the captain called for the landing gear and the landing final checklist. At 21.20:15h, the ground proximity warning system (GPWS) whooper warning continued for nine seconds until the first officer silenced the warning. Nine seconds later the 727 hit the water with gear down and flaps at 25deg. It came to rest in about 12 ft of water. The weather at the time of the accident was 400ft overcast, 4 mls visibility in fog and haze, wind 190deg/7kts.

PROBABLE CAUSE: "The flightcrew's unprofessionally conducted nonprecision instrument approach, in that the captain and the crew failed to monitor the descent rate and altitude, and the first officer failed to provide the captain with required altitude and approach performance callouts. The captain and first officer did not check or utilize all instruments available for altitude awareness and, therefore, did not configure the aircraft properly and in a timely manner for the approach. The captain failed to comply with the company's GPWS flightcrew response procedures in a timely manner after the warning began. The flight engineer turned off the GPWS warning 9 seconds after it began without the captain's knowledge or consent.

Contributing to the accident was the radar controller's failure to provide advance notice of the start-descent point which accelerated the pace of the crew's cockpit activities after the passage of the final approach fix."



16-PSA	9/25/78	San Diego	727	Approach	135	135	Crew, ATC	yes
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Gibbs Flite Center Cessna 172 aircraft had taken off from Montgomery Field at 08.16 PST and proceeded to Lindbergh Field where two practice ILS approaches to runway 9 were flown. At 09.00 the Cessna pilot was instructed to maintain VFR at or below 3500ft, heading 70deg. PSA Flight 182 (a scheduled passenger flight from Sacramento to San Diego via Los Angeles), cleared for a runway 27 approach, was advised by the approach controller that there was traffic in front of them. The PSA crew reported the traffic in sight immediately thereafter and the PSA flight was instructed to maintain visual separation and contact Lindbergh tower. Lindbergh tower

again warned the PSA flightcrew of "traffic, twelve o'clock, one mile, a Cessna". The crew had lost track of the Cessna and radioed back: "think he's passing off to our right". The flightcrew still weren't sure of the actual position of the Cessna. At 09.01:28 a conflict alert warning began in the San Diego Approach Control facility, indicating a collision hazard between PSA182 and the Cessna. At 09.01:47 the approach controller warned the Cessna pilot of traffic in the vicinity. At the same moment both aircraft collided. Flight 182 was descending and overtaking the Cessna, which was climbing in a wings level attitude. The Cessna broke up immediately and exploded after colliding with the Boeing's right wing. The Boeing entered a shallow right descending turn and crashed into a residential area.

PROBABLE CAUSE: "The failure of the flightcrew of Flight 182 to comply with the provisions of a maintain-visual-separation clearance, including the requirement to inform the controller when visual contact was lost; and the air traffic control procedures in effect which authorized the controllers to use visual separation procedures in a terminal area environment when the capability was available to provide either lateral or vertical separation to either aircraft. Contributing to the accident were (1) the failure of the controller to advise Flight 182 of the direction of movement of the Cessna; (2) the failure of the pilot of the Cessna to maintain his assigned heading; and (3) the improper resolution by the controller of the conflict alert."



17-United	12/28/78	Portland	DC8	Approach	189	10	Crew	
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While approaching Portland, there appeared to be a problem with the extension of the landing gear. The DC-8 circled for about an hour while the crew were busy trying to solve the problem. After running out of fuel, a forced landing was carried out in a wooded, populated area.

PROBABLE CAUSE: "The failure of the captain to monitor properly the aircraft's fuel state and to properly respond to the low fuel state and the crewmember's advisories regarding fuel state. This resulted in fuel exhaustion to all engines. His inattention resulted from preoccupation with a landing gear malfunction and preparations for a possible landing emergency. Contributing to the accident was the failure of the other two flight crewmembers either to fully comprehend the criticality of the fuel state or to successfully communicate their concern to the captain. "

Follow-up / safety actions:

The NTSB made 4 recommendations to the FAA:

- 1) Issue an Operations Alert Bulletin to have FAA inspectors assure that crew training stresses differences in fuel-quantity measuring instruments and that crews flying with the new system are made aware of the possibility of misinterpretation of gage readings. (Class II-- Priority Action) (A-79-32)

- 2) Emphasize to engineering personnel who approve aircraft engineering changes or issuance of Supplemental Type Certificates the need to consider cockpit configuration and instrumentation factors which can contribute to pilot confusion, such as the use of similar-appearing instruments with different scale factors. (Class II--Priority Action) (A-79-33)
- 3) Audit Supplemental Type Certificate SA3357WE-D for completeness, especially in the area of system calibration after installation. (Class II--Priority Action) (A-79-34)
- 4) Issue an operations bulletin to all air carrier operations inspectors directing them to urge their assigned operators to ensure that their flightcrews are indoctrinated in principles of flightdeck resource management, with particular emphasis on the merits of participative management for captains and assertiveness training for other cockpit crewmembers. (Class II, Priority Action) (A-79-47)



18-American	5/25/79	Chicago	DC10	Takeoff	271	271	Maintenance, design	yes
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Flight 191 left the gate at Chicago-O'Hare at 14.59h and taxied to runway 32R. At 15.02h the flight was cleared for takeoff. The takeoff roll was normal until just before rotation at which time sections of the No. 1 engine pylon structure came off the aircraft. During rotation the entire No.1 engine and pylon separated from the aircraft, went over the top of the wing, and fell to the runway. Flight 191 lifted off about 6,000 ft down the runway, climbed out in a wings level attitude, and reached an altitude of about 300ft agl with its wings still level. Shortly thereafter, the aircraft began to turn and roll to the left, the nose pitched down, and the aircraft began to descend. As it descended, it continued to roll left until the wings were past the vertical position. The DC-10 crashed in an open field and trailer park about 4,680 ft northwest of the departure end of runway 32R. The aircraft was demolished during the impact, explosion, and ground fire. Two persons on the ground were killed.

PROBABLE CAUSE: "The asymmetrical stall and the ensuing roll of the aircraft because of the uncommanded retraction of the left wing outboard leading edge slats and the loss of stall warning and slat disagreement indication systems resulting from maintenance-induced damage leading to the separation of the no.1 engine and pylon assembly procedures which led to failure of the pylon structure. Contributing to the cause of the accident were the vulnerability of the design of the pylon attach points to maintenance damage; the vulnerability of the design of the leading edge slat system to the damage which produced asymmetry; deficiencies in FAA surveillance and reporting systems which failed to detect and prevent the use of improper maintenance procedures; deficiencies in the practices and communications among the operators, the manufacturer, and the FAA which failed to determine and disseminate the particulars regarding previous maintenance damage incidents; and the intolerance of prescribed operational procedures to this unique emergency."



19-Western	10/31/79	Mexico City	DC10	Landing	89	72	Crew	yes
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Flight 2605 departed Los Angeles at 01.40h for a flight to Mexico City. Because of refurbishing work on runway 23L, the flight was cleared for a runway 23R approach. Descend through a fog bank was continued below the 600ft minimum for instrument approaches. The aircraft touched down with the left maingear in the grass left of 23L and with the right maingear on the runway shoulder. Go-around power was added and the nose lifted 10-11deg. The right maingear then collided with a truck located on the runway. The gear leg separated and struck the right tailplane and elevator, causing substantial damage. The aircraft banked to the right until it struck the left wing struck the cab of an excavator, 1500m from the runway threshold, continued and crashed into a building and caught fire.

PROBABLE CAUSE: "Non-compliance with the meteorological minima for the approach procedure, as cleared; failure to comply with the aircraft's operating procedures during the approach phase, and landing on a runway closed to traffic."

20-Air Florida	1/13/82	Washington	737	Takeoff	79	74	Crew	yes
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Air Florida Flight 90 was scheduled to leave Washington National Airport at 14.15h EST for a flight to Fort Lauderdale International Airport, FL, with an intermediate stop at the Tampa, FL. The aircraft had arrived at gate 12 as Flight 95 from Miami, FL, at 13.29h. Because of snowfall, the airport was closed for snow removal from 13.38h to 14.53h. At about 14.20h maintenance personnel began de-icing the left side of the fuselage with de-icing fluid Type II because the captain wanted to start the de-icing just before the airport was scheduled to reopen (at 14.30h) so that he could get in line for departure. Fluid had been applied to an area of about 10 feet when the captain terminated the operation because the airport was not going to reopen at 14.30h. Between 14.45h and 14.50h, the captain requested that the de-icing operation be resumed. The left side of the aircraft was deiced first. No covers or plugs were installed over the engines or airframe openings during de-icing operations. At 15.15h, the aircraft was closed up and the jet way was retracted and the crew received push-back clearance at 15.23h. A combination of ice, snow, and glycol on the ramp and a slight incline prevented the tug, which was not equipped with chains, from moving the aircraft. Then, contrary to flight manual guidance, the flight crew used reverse thrust in an attempt to move the aircraft from the ramp. This resulted in blowing snow which might have adhered to the aircraft. This didn't help either, so the tug was replaced and pushback was done at 15.35h. The aircraft finally taxied to runway 36 at 15.38h. Although contrary to flight manual guidance, the crew attempted to deice the aircraft by intentionally positioning the aircraft near the exhaust of the aircraft ahead in line (a

New York Air DC-9). This may have contributed to the adherence of ice on the wing leading edges and to the blocking of the engine's Pt2 probes. At 15:57:42h, after the New York Air aircraft was cleared for takeoff, the captain and first officer proceeded to accomplish the pre-takeoff checklist, including verification of the takeoff engine pressure ratio (EPR) setting of 2.04 and indicated airspeed bug settings. Takeoff clearance was received at 15:58h. Although the first officer expressed concern that something was 'not right' to the captain four times during the takeoff, the captain took no action to reject the takeoff. The aircraft accelerated at a lower-than-normal rate during takeoff, requiring 45 seconds and nearly 5,400 feet of runway, 15 seconds and nearly 2,000 feet more than normal, to reach lift-off speed. The aircraft initially achieved a climb, but failed to accelerate after lift-off. The aircraft's stall warning stick shaker activated almost immediately after lift-off and continued until impact. The aircraft encountered stall buffet and descended to impact at a high angle of attack. At about 16:01h, the aircraft struck the heavily congested northbound span of the 14th Street Bridge and plunged into the ice-covered Potomac River. It came to rest on the west end of the bridge 0.75 nm from the departure end of runway 36. When the aircraft struck the bridge, it struck six occupied automobiles and a boom truck before tearing away a 41-foot section of the bridge wall and 97 feet of the bridge railings. Four persons in vehicles on the bridge were killed; four were injured, one seriously.

PROBABLE CAUSE: " The flight crew's failure to use engine anti-ice during ground operation and takeoff, their decision to take off with snow/ice on the airfoil surfaces of the aircraft, and the captain's failure to reject the takeoff during the early stage when his attention was called to anomalous engine instrument readings. Contributing to the accident were the prolonged ground delay between de-icing and the receipt of ATC takeoff clearance during which the airplane was exposed to continual precipitation, the known inherent pitch up characteristics of the B-737 aircraft when the leading edge is contaminated with even small amounts of snow or ice, and the limited experience of the flight crew in jet transport winter operations."



21-World	1/23/82	Boston	DC10	Landing	212	2	FAA, a/p mgt, ATC	yes
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The DC-10 made a non-precision instrument approach to runway 15R and touched down 2800ft past the displaced threshold. When the crew sensed that the aircraft couldn't be stopped on the remaining runway, they steered the DC-10 off the side of the runway to avoid the approach light pier, and slid into the shallow water. The nose section separated as the DC-10 came to rest 250ft past the runway end, 110ft left of the extended centreline.

PROBABLE CAUSE: "The minimal braking effectiveness on the ice-covered runway; the failure of the Boston-Logan International Airport management to exercise maximum efforts to assess the condition of the runway to assure continued safety of landing operations; the failure of air traffic control to transmit the most recent pilot reports of braking action to the pilot of Flight 30H; and the captain's decision to accept and maintain an excessive airspeed derived from the auto throttle speed control system during the landing approach which caused the aircraft to land

about 2,800 ft beyond the runway's displaced threshold. Contributing to the accident were the inadequacy of the present system of reports to convey reliable braking effectiveness information and the absence of provisions in the Federal Aviation Regulations to require: (1) airport management to measure the slipperiness of the runways using standardised procedures and to use standardised criteria in evaluating and reporting braking effectiveness and in making decisions to close runways. (2) operators to provide flight crews and other personnel with information necessary to correlate braking effectiveness on contaminated runways with aircraft stopping distances, and (3) extended minimum runway lengths for landing on runways which adequately take into consideration the reduction of braking effectiveness due to ice and snow. " (NTSB)



22-PanAm	7/9/82	New Orleans	727	Takeoff	145	145	Wind shear	yes
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Flight 759 took off from runway 10 for Las Vegas after the intermediate stop at New Orleans. The Boeing climbed to 95-150ft when it began to descend. It struck some trees 2376ft past the runway end and crashed in a residential area, demolishing 6 houses.

PROBABLE CAUSE: "The airplane's encounter during the lift-off and initial climb phase of flight with a micro-burst induced windshear which imposed a downdraft and a decreasing headwind, the effects of which the pilot would have had difficulty recognizing and reacting to in time for the airplane's descent to be arrested before its impact with trees. Contributing to the accident was the limited capability of current ground based low level windshear detection technology to provide definitive guidance for controllers and pilots for use in avoiding low level wind shear encounters."

23-PanAm	8/11/82	Honolulu	747	In flight	288	1	Sabotage	
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Synoptic report not available