

The Causes of Aircraft Accidents: What Happens in The Cockpit before The Crash

The Cockpit: Where Custom & Tradition, Technology and Humans Collide

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Theme: [History](#)

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AWRY: The B-52 exceeded authorized maneuvers and, after aborting a landing, lost altitude

Source of photo: http://w1.rob.com/pix/B52_crash/B52CRSH2

The title photograph above represents the fate of one thousand seventy-six people who died needlessly in five accidents, one of which involved two airliners. In four of these accidents, and possibly many others over the years, there is a common thread. A fatalist would quickly use the tag of pilot-error and attempt to satisfy the curious public and the victim's families with a hollow statement oft used by politicians and military leaders, you have to expect losses. That's too easy and doesn't explain what really goes on in the cockpit. So what is this thread?

The Probable Cause summation at the end of an aircraft accident investigation report is the official determination of why an accident occurred, but there is one factor which is seldom

mentioned or considered in the reports. It is the vulnerability of the command structure, as we know it. That vulnerability is often overlooked when an accident is charged off to pilot error when the true cause of the accident might well have roots in a strident and inflexible command structure. Being so well hidden within the catch-all phrase of pilot error, it becomes a challenging study. In general terms it could be described as a failure of the command system, a situation that does not allow for the full utilization of all the occupants in the cockpit for whatever reasons.

In the early days of airline flying there was only one pilot in an open cockpit and pilots were hired mainly because of one reason, they were survivors, and they were prone to be highly individualistic, if not somewhat arrogant. After all, they had dodged the the grim-reaper on a daily basis and had become bullet-proof and highly skilled at staying alive. Legends and egos proliferated. Likewise, in military aviation, as the numbers of successful missions were recorded commanders became exalted and imposing. As aircraft technology and reliability improved pilots became somewhat less dependant on super-human personal skills and began to use standardized procedures; no need to reinvent the wheel on each flight. Indeed, there was little room for individual thought, just use the proper procedure for the increasingly rare emergency at hand. Then there was growth, the airlines added a co-pilot, then a flight engineer and a navigator on overseas flights. As the cockpit family grew companies began to look at other qualities in pilots.

Labor issues over pay and working conditions developed and one airline leader even enlisted aid of his old friend who happened to be the head of the FAA to establish an age limit for pilots. With the stroke of a pen he was able to get rid of the old trouble makers. They had served their purpose so now management needed a new breed.

One of the goals was to find pilots that would follow orders without question; they didn't want a group of head-strong cowboys to question every corporate decision. And where to find these well trained personnel? Voilà, the military! Not that military pilots are not superbly trained and generally highly experienced, but...

One of the by-products of military-like discipline is the requirement and then willingness to accept authority and over time, a compliance mentality develops. What can follow is the loss of the ability or perhaps, the reluctance, to think or act in the interest of one's own safety.

Completion of the mission becomes paramount. If that ability is not completely lost it can certainly be impaired. When fatalism is added to the mix the stage is set for a potentially dangerous situation to develop. That compliance mentality has developed over generations and we see it in other walks of life as well as in aviation. To keep your job you keep your mouth shut, you generally accept whatever the boss says, you don't rock the boat, and you stay within the chain of command. Political correctness becomes a way of life. Then, time after time in re-current training sessions at the flight academy, or the school-house as it is called, that mentality is cemented into place with more subservient type training. Now we are set up to follow the leader without question, And every now and then, we follow the leader right into the jaws of hell, into a violent thunderstorm, or into the side of a mountain. Another example of this type thinking allows the pilot group to fly any type of aircraft the industry can design; ego and the compliance mentality will get it into the air, even if it is a dreadful design. Aircraft with only hydraulic controls or the newest engineering craze, fly-by-wire with no manual back-up come to mind right away.

Authority and blind obedience are wonderful construction blocks for parades but in critical situations that can occur in a cockpit it is highly desirable to have all the players fully

contributing to insure success and survivability of the operation. Too often, one or more members of the flight crew can be locked out of the decision-making by custom and tradition. In the cockpit every nuance of human character can be magnified and exposed with crystal-clear definition but to avoid confrontation the present command structure is accepted as the standard and when it fails the potential for disaster is greatly increased. To protect the ego of an impaired commander or to blindly follow an inappropriate procedure just to satisfy the system is unimaginable yet at times, that is exactly what can happen.

To an outside observer, if allowed to watch the clash in the cockpit it would be apparent as to which team would be able to succeed and which team would fail but alas, the cockpit door is always closed, that is until after the crash. Even then it is not usually discussed. A notable exception is the 1994 crash of an Air Force B-52 at Fairchild Air Force Base, Washington.[1] The aircraft commander's reckless piloting history was well known but the command structure was such that changes (removal from flight status) were almost impossible to make. A few individuals might have refused to fly with the Colonel and people talked but nevertheless nothing happened as the community waited for the inevitable to occur. When it did happen the video cameras were rolling to capture the image of the B-52 as it rolled into a 90 degree bank around a hundred feet above the ground, well into the coffin-corner and beyond the point of a successful recovery. The military command structure system survived but the crew and the multi-million dollar aircraft perished.

The clash, or failure of the system, is caused by the nature of the command structure and the lack of training that is required to provide an alternate backup when the primary flight director, the aircraft commander, is rendered ineffective due to incapacitation, fatigue, distraction, over-load or perhaps even a personality quirk. Marginal piloting skills, over-confidence and arrogance are not usually noted in an accident report but crew-members at any base will know the cockpits wherein they can be found so these factors should be addressed in any accident analysis.

Around 1978-1980, airline companies began to realize that their flight commanders might be becoming overloaded with the management of large crews and complex aircraft. To address the issues they piled on more automation and added Crew Resource Management courses to the recurrent training curriculum for the pilots. CRM was thought to be the cure but it wasn't the panacea which it was originally thought to be because it focused only on how the captain would manage the crew. It was a start but problems remained. In reality, no one knew how to handle the command supremacy issues in the cockpit. Nor was there a way to question or eliminate the technical mistakes made by the experts who wrote the bible. Bad procedures written into the aircraft operating manual are approved by the FAA and become like biblical commandments cast in stone. Those pilots that ignore the bible are considered careless rogue pilots; those who write the bible are called experts. Neither statement is true 100 per cent of the time.

Crew Resource Development might be a more effective undertaking. This training might prove beneficial in developing crew members to be effective contributors to the successful mission and not just subordinate robots that do not respond to a developing situation because of reticence, attitude, lack of training, or fear of insubordination. The fix is impossible to achieve on a moments notice when an aircraft is plunging to earth. The

further along the technology scale we progress the more subtle the clash between it and humans. Just following a check-list does not necessarily prevent an aircraft from crashing..

The following five airliner crashes resulted in 1076 fatalities. The probable causes listed in the accident reports are only a part of the story.

- KLM/Pan Am B747s collide Tenerife Airport Spain on 27 March 1977, 583 fatalities.[2]
- United Airlines 173 crash at Portland, OR, December 28, 1978, 10 fatalities.[3]
- American Airlines DC-10 crash at Chicago, IL, 25 May 1979, 273 fatalities.[4]
- Delta Airlines L-1011 crash at DFW Airport, Texas, 2 Aug 1985, 137 fatalities.[5]
- Avianca 52 crash at Cove Neck, NY, on Jan 25, 1990, with 73 fatalities.[6]

Interestingly, the crashes at Fairchild AFB, Tenerife, DFW Airport, Texas, and Cove Neck, NY involved perfectly good airplanes with no malfunctions. The other crash at Portland, OR, involved an aircraft with a comparatively minor landing gear problem. The Chicago crash involved an aircraft with a demanding emergency but it occurred in excellent weather and the aircraft was later determined to be very flyable; indeed, it was flying and climbing just as it was supposed to be doing until the pilot flying changed his flight profile to conform to the recommended and approved procedures. What could have gone so wrong as to have caused the worst aircraft accident in aviation history at Tenerife, the worst aircraft crash in U.S. history at Chicago, and the other equally tragic and preventable accidents?

The deficiency of the command structure could be assigned a major part for the crashes in all except the DC-10 accident at Chicago. Those deficiencies manifested themselves as an infallibility of the captain and a reluctance of the co-pilot and other crew members to step forward with command alternatives. Unwarranted blind faith in procedures contributed to the Chicago crash. The aviation community gives command structure lip-service but the supremacy and infallibility of the aircraft commander is alive and well. A co-pilot is like a secretary in the business world, taking orders and doing paperwork but not making decisions for the company. When a corporate CEO falters the board of directors provides another leader. When a captain falters there is a possibility of a great void developing; a void propagated by the system. When a bad procedure is discovered, usually after a crash, the flight manual is simply changed. Rogue pilots were probably already using some sort of a modified procedures that provided better safety margins.

In the Tenerife accident, seven people watched the sequence of events fall into place that preceded the wreck with only a few low-keyed inputs.[7] Basically, the KLM airplane took off directly into the path of the Pan Am airplane that was taxiing in an opposite direction on the same runway in very foggy conditions, but it was not quite so simple. There was more involved. Those seven that were involved in the accident included the airport's control tower operator, the three cockpit crew members of the Pan Am airplane and the three cockpit crew members of the KLM plane. In reality, only the tower operator and the two captains were making decisions but what about the second-in-command and the other crew members in both airplanes?

Both custom and tradition can elevate a skipper to lofty heights and if the commander is further renowned by war records, professional position or special talents, he or she can become almost infallible. Such ascendancy has a certain amount of military heritage where

the mere mention of a great warrior's name can bring a hush over an entire group. When a flight commander becomes unaccountable and blinded by self-importance, the ability to use common sense and good logic in the thought process becomes impaired. This is an undesirable situation in the aviation world where things, especially bad things, can happen at a blinding pace.

The KLM pilot was obviously more than just a pilot, at least in the company structure. He was their most senior captain as well as a training pilot. As the company's senior training captain he had probably trained most, if not all, current KLM pilots; he was a living legend within the pilot group. Further, he was obviously highly regarded in the tight circle of upper management. His photograph was used in company publications with his image looming large, front and center. While holding such a large part of the big picture he was perhaps thinking beyond his local environment as a line pilot on this particular trip. If he had been a manager at company headquarters he might have been thinking about saving hotel expenses, contract negotiations, scheduling problems and the like, things that an ordinary line pilot might not worry about. But on this day he was not at headquarters; he was out of his element. He had spent much of his career as a training pilot in flight simulators where a crash results in an innocuous thump on the bottom of the simulator. Another insidious factor was in

place; in a flight simulator the training captain doesn't ask for take-off clearance; he gives the clearance. There is no control tower operator involved.

Could it be that on this foggy day in March, he momentarily forgot where he was? From the conversation left on the cockpit voice recorder he hadn't forgotten who he was. The cockpit voice-recorder shows the captain virtually disarmed with his demeanor his most vital safety link, his co-pilot, the second-in-command.

At numerous points along the short trip from the parking spot to the collision any member of the two crews could and should have interceded with a forceful protest or offered an alternate plan of action. Of course, the control tower operator could have held the Pan Am airplane short of the runway until the KLM plane had taken off. What the control tower did was not illegal and was probably done everyday at that airport with a single runway and no taxiways available. A judgment call of course, but on a day with heavy fog restricting visibility and no radar available to accurately determine the position of each aircraft why take an unnecessary risk? Another last-ditch effort would have been for the KLM 747 co-pilot to have applied the brakes on his plane or he could have pulled the throttles back on the big KLM 747. But how do you pull the throttles back on God?

Two years and two months after the Tenerife crash, a DC-10 took off from Chicago's O'Hare Airport and lost an engine, not just power, but the engine actually fell off the plane. As the plane lost its engine, it also lost one of the three hydraulic systems that operate the flight controls. However, on the DC-10, only one hydraulic system is needed to sustain flight and both #2 and #3 systems were operating normally. The engine that was lost also took its hydraulic pump with it, the heart of the #1 system. Concurrently with the loss of the engine and its hydraulic system, without a cockpit indication, the wing slats retracted on the left side of the airplane thus reducing the stall speed on that wing.

It was a demanding emergency to be sure but a three-engine aircraft will fly on two engines and it did, until the pilots changed to the approved flight profile that was written by the hands of god, the authors of company aeronautical canon. The engine-out procedure called

for the climb profile airspeed to be no more than $V_2 + 10$ knots, which was about 6 knots below the stall speed for their abnormal (but unbeknownst to the pilots) wing-slats configuration. Never mind that they were already flying beyond that speed at 172 knots and climbing nicely; one must conform as closely as possible to approved procedures. As their speed was reduced toward the procedural target airspeed the airplane's left wing stalled; the airplane rolled over on its back and crashed into the ground.

In most abnormal conditions of this type, a pilot is wise to maintain whatever airspeed that has been achieved. In the case of this crippled DC-10 airspeed was critical. Giving up airspeed to satisfy a procedure was not a good idea. However, once the procedure was printed in the company's operating manual it became the gospel, the printed word of God, the bible. After the crash the flight profile was changed in the operating manual; so much for the written word.

On a hot summer day of 1985, a Lockheed L-1011 jumbo jet is making an approach to the south at DFW Airport.[8] As they begin to turn in toward the airport an active thunderstorm sits right in its flight path. One of the crew points out that there is lightening flashing out of the storm just ahead; a clear indication that evasive action is necessary, immediate evasive action. The plane continues on its intercept heading. The pilot at the controls was about to do battle with Mother Nature, an angry mother on this day. The other two crewmen watched. Apparently, there was no plan of action on how to avoid the obvious hazard directly ahead. The surrounding area was clear of storms and there were at least three alternate airports within a few miles where they could have landed had fuel been an issue.

Indeed, the other side of the airport was in the clear. Without so much as a second thought, they drove straight into a devastating micro-burst, a severe downdraft of unbelievable power. If you can see storm clouds with visible lightening, you don't fly into that storm. It is not a good idea and bad things will likely happen. Without knowledge of either pilot's personality make-up it is impossible to say what factors were in place in that cockpit but for some reason, it appears, the pilot flying was not making decisions based on his own imitative. But why not?

Perhaps the most difficult task a second-in-command pilot will ever face is how to terminate a potentially dangerous action when it is being directed by the captain. This action has to be trained for and allowed to flourish. At the same time, flight commanders should be trained on how to recognize and resolve disputes with other crew members. Could the helmsman on the Titanic have counseled the captain that running through iceberg infested waters at full-speed, in the dead of night, was maybe not a healthy thing to do? Not a chance, as it were.

On the night of April 14, 1912, Captain John Edward Smith, the White Star Line's most prestigious captain, was commanding officer of the most technologically advanced steamship in the world, the Titanic.[9] On that night, the Titanic was sailing the North Atlantic under heavy clouds of unbridled, supreme arrogance. Other lesser ships in the area had shut down for the night as icebergs had been reported in that part of the dark Atlantic

Ocean. The KLM Boeing 747 was like the Titanic except that it was traveling at about 150 miles per hour when the iceberg was sighted, a few hundred feet dead ahead.

In past years during training, a co-pilot did not have to perform all the maneuvers that a captain was required to perform yet if the captain became incapacitated the co-pilot might have to perform any one of those exact maneuvers single-handed, without being trained to

do so. It would make sense that the second-in-command be trained and fully rated as a captain. On a day-to-day basis, only the captain is allowed or required to do certain things and herein is a problem. Only the captain signs the flight plan, starts the engines, taxis the airplane and sometimes, makes all the take-offs and landings. A competent and fully engaged co-pilot can do all those things. However, after years of being underutilized it is no wonder that usefulness of the co-pilot is diminished. Incidentally, incapacitation almost never gets reported unless a crew member actually dies or has to be physically assisted when leaving the cockpit.

A review of the command structure, i.e., eliminating the god-mentality in the cockpit, and developing a more comprehensive training of the second-tier managers might be in order. The not-uncommon practice of manning the cockpit with simulator pilots when peak demands arise likewise has obvious implications. Bad procedures can produce equally devastating results. It is apparent that the engine-out procedure in place at the time of the Chicago crash was inappropriate for the situation and once it was applied at low altitude there was not time for experimentation to find out what would work. Blind faith in the bible and its authors did not serve the passengers and crew well on American's DC-10 that day.

Standardization and adherence to flying procedures under the command structure usually makes for an easy flowing routine but there are times when neither is appropriate for the situation at hand. All of the previously mentioned accidents might well have been prevented if someone had stepped outside the box and provided an alternate game-plan. However, human nature apparently doesn't allow a person to work inside the box for extended periods of time and then to suddenly step out and deliver a command-performance. Also, the command system does not readily accept alternate game-plans. Crew Resource Management training was an attempt to address the situation but never quite achieved a solution because of the complexities of human nature and years of authoritarian training. Crew Resource Development might provide relief from the dark void that can sometimes kill.

A healthy cockpit is where all crewmembers feel free, and indeed, compelled, to offer judgmental calls on the operation of their craft. An unhealthy cockpit is a place where only one voice is heard and the other crewmen are unable to act because of previously mentioned reasons. While technology has progressed at an exponential rate, human engineering has eluded perfection.

All the crewmen in the previously mentioned accidents were experienced and qualified; they became victims with their passengers when fate interrupted their journey as technology and humans collided and custom and tradition hobbled their performance.

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Notes:

[1] File: Fairchild B-52 Crash.jpg, Wikipedia Commons

http://w1.rob.com/pix/B52_crash/B52CRSH2

[2] Subsecretaria de Aviacion Civil, Spain ,

<http://www.pan-american.de/Desasters/Teneriffe3.html>

[3] AirDisaster.com

<http://www.airdisaster.com/investigations/ua173.shtml>

[4] NTSB/AAR-79-17

<http://www.airdisaster.com/reports/ntsb/AAR79-17.pdf>

[5] AirDisaster.com

<http://www.airdisaster.com/special/special-dl191.shtml>

[6] NTSB Report, Avianca 52, Jan 25, 1990

<http://www.airdisaster.com/reports/ntsb/AAR91-04.pdf>

[7] Project-Tenerife

<http://www.project-tenerife.com/engels/>

[8] NTSB Accident Report, Delta Airlines,

http://www.nts.gov/ntsb/brief.asp?ev_id=20001214X37434&key=1

[9] Capt. John Smith, Commander of the White Star Line's "Titanic"

http://www.titanic-titanic.com/captain_smith.shtml

Title Photo credit:

The photo was taken by a USAF photographer and is in the public domain of the United States. The photograph was taken during an official "final-flight" ceremony for Colonel Wolff, one of the crew, that was to have followed the flight.

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