The direction of aviation safety - are the lessons of the past being applied today?

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Abstract
The aim of this review is to compare the crash of Sitka 43 Boeing C17 at Elmendorf-Richardson air base in Alaska on 28.7.2010 to that of Czar 52 Boeing B52 at Fairchild air base on 24.6.1994. Initial investigation revealed a strong similarity of the Captains' actions and non-compliance in both cases. The climate surrounding the two events and the response provided by the investigating authorities will also be addressed. The final part of this review will discuss what interventions have been applied and whether these have been of benefit in the modern air safety environment, particularly in the domain of training.

Accident Summaries
CZAR 52
On the 24th of June 1994, *Czar 52*, A B-52H assigned to the 325th Bomb Squadron, 92d Bomb Wing, Fairchild Air Force Base, WA, launched at approximately 1358 hours Pacific Daylight Time (PDT), to practice manoeuvres for an upcoming airshow. The aircrew had planned and briefed a profile, *through the Wing Commander level*, that grossly exceeded aircraft and regulatory limitations (Kern, 1995).

The investigation found that as the B52 entered its final turn sequence around the tower, its IAS was 182 knots. Additional engine power was applied, but it was too late, although the airspeed indicator was available to the four aircrew members.

Eight seconds prior to impact the aircrafts' IAS had deteriorated to 145 knots and the bank angle past 60^{o}. Full right spoiler, right rudder and nose up elevator were applied at this time. Due to the bank angle, the stall speed at that moment was 147 knots, thus flying at 145 knots IAS the aircraft stalled without sufficient altitude to recover.

Human Factors
To achieve continuity with the report on SITKA 43, the framework of the Department of Defence (DOD) Human Factors Analysis and Classification System (DOD-HFACS) (Weigmann & Shappell, 2003) will be utilised to consider the above accident. Although not researched at the time of the CZAR 52 accident, it will enable a closer examination of the two accident sequences (refer SITKA 43 accident report).

Causal

Procedural Error
The Mishap Pilot (MP) committed two procedural errors during the mishap sortie. He replaced aerial demonstration procedures with his own techniques and failed to implement proper stall recovery procedures.

The MP flew the aircraft in a manner that violated regulatory provisions and flight manual guidance. His aggressive flying placed the aircraft outside viable flight parameters at an altitude and attitude where recovery was not possible. The MP applied a series of procedural errors (improper techniques) that, when combined, resulted in a stall beyond the pilot's recovery capacity. Additionally, he flew aggressive aerial demonstration profiles while max performing the aircraft.

MP's Previous Violations

Situation One: Fairchild AFB Air show - 19 May 1991

MP was the pilot and aircraft commander for the B-52 exhibition in the 1991 Fairchild AFB air show. During this exhibition, the MP violated several regulations and a tech order (Dash 11) limits of the B-52 by (1) exceeding bank and pitch limits and (2) flying directly over the air show crowd in violation of Federal Aviation Regulation (FAR) Part 91 (Kern, 1995).

Situation Two: 325th BMS Change of Command "Fly Over" - 12 July 1991

MP was the aircraft commander and pilot for a "fly over" for a 325th BMS Change of Command ceremony. During the "practice" and actual fly over, the MP accomplished passes that were estimated to be "as low at 100-200 feet". Additionally, the MP flew steep bank turns (greater than 45 degrees) and extremely high pitch angles, in violation of the Dash 11 Tech Order, as well as a "wing over". The Dash 11 recommends against wing over type manoeuvres because the sideslip may cause damage to the aircraft (Kern, 1995).

Situation Three: Fairchild Air Show - 17 May 1992

The MP flew the B-52 exhibition at the Fairchild Air Show. The profile flown included several low altitude steep turns in excess of 45 degrees of bank and a high speed pass down the runway. At the completion of the high speed pass, the MP accomplished a high pitch angle climb, estimated at over 60 degrees nose high. At the top of the climb, the B-52 levelled off using a wing over manoeuvre (Kern, 1995).

Situation Four: Fairchild Air Show - 8 August 1993

The MP flew the B-52 exhibition for the 1993 Fairchild Air Show. The profile included steep turns of greater than 45 degrees of bank, low altitude passes and a high pitch manoeuvre which one crew member estimated to be 80 degrees nose high - ten degrees shy of completely vertical. Each of these three manoeuvres exceed technical order guidance. As was the case in previous air shows, Air Combat Command approval was required, but was neither requested or granted (Kern, 1995).

Although a further two incidents are outlined by Kern, the above relate to the mishap sequence and are therefore more relevant to the accident.

MP Failed to Employ Proper Stall Recovery Procedure

Eight seconds prior to impact the aircrafts' IAS had deteriorated to 145 knots and the bank angle past 60^{o}. Full right spoiler, right rudder and nose up elevator were applied at this time. Due to the bank angle, the stall speed at that moment was 147 knots, thus flying at 145 knots IAS the aircraft stalled without sufficient altitude to recover.

Contributing Factors

Warning Ignored

The MP was the Chief of the 92d Bombardment Wing Standardization and Evaluation Section at Fairchild Air Force Base. This position made him responsible for the knowledge and enforcement of academic and in-flight standards for the wing's flying operations. He was regarded by many as an outstanding pilot, perhaps the best in the entire B-52 fleet. He was an experienced instructor pilot and had served with the Strategic Air Command's 1st Combat Evaluation Group (CEVG), considered by many aviators to be the "top of the pyramid". But between 1991 and June of 1994, a pattern of poor airmanship began to surface (Kern, 1995).

Selecting an aviator who exercised poor airmanship as the Chief of Stan Eval was a poor choice, but leaving him there after multiple flagrant and wilful violations of regulations sent an extremely negative message to the rest of the wing flyers. Individuals who hold key positions are looked up to as role models by junior crew members. They must be removed if they cannot maintain an acceptable standard of professionalism. Even if the MP had not crashed, the damage he had done through his bad example of airmanship is incalculable. Not only did many young officers see his lack of professionalism as a bad example, but they also observed several senior leaders witness his actions and fail to take any corrective action (Kern, 1995).

The MP and the Mishap Crew (MC), who were professionally at odds, were to be paired in the cockpit for the next several months. The MC had confided in his wife that he did not trust the MP to fly with his aircrews (Kern, 1995).

Channelized Attention
The MP displayed two instances of channelized attention. First, during the attempted turn around the control tower the MP aggressively continued turning the Mishap Aircraft (MA) and ignored the speed of the aircraft. Second, when the stall occurred, the MP moved the control stick full right and applied right rudder. He never applied forward control stick pressure to reduce the angle of attack and recover controlled flight. The MP channelized his attention on accomplishing the turn rather than the stall recovery.

Overconfidence and Expectancy
The crash of Czar 52 was primarily the result of actions taken by a singularly outstanding "**stick and rudder pilot**", but one who, ironically, practiced incredibly poor **airmanshi**p. The distinction between these two similar sounding roles will be made clear as we progress in this analysis. Of equal or greater significance, was the fact that supervision and leadership facilitated the accident through failed policies of **selective enforcement** of regulations, as well as failing to heed the desperate warning signals raised by peers and subordinates over a period of three years prior to the accident. At the time of the accident, there was considerable evidence of the MP's poor airmanship spanning a period of over three years (Kern, 1995).

Misplaced Motivation
On an individual basis, the MP refused to follow written regulations and B-52 tech orders, as well as ignoring the verbal orders and guidance given by the Wing Commanders. Even when verbal reprimands and counselling sessions focused on the specific problem of airmanship, he steadfastly refused to follow their guidance. At one point, only weeks prior to the accident, he clearly stated his feelings on the issue of guidance from senior officers.

> "I'm going to fly the airshow and yeah, I may have someone senior in rank flying with me, --. He may be the boss on the ground, but I'm the boss in the air and I'll do what I want to do."
>
> (Kern, 1995)

Procedural Guidance/Publications
The prescribed procedures in TO IB-52G-1-11 aka Dash 11 limits of the B-52 for flying demonstration profiles were clear and, if flown according to these procedures, exercising the limitations laid out in the Dash 11 document, i.e.

- bank (angles not greater than 45^{o})
- pitch limits
- the manoeuvre known as a wing over (which was not recommended due to likely damage which may be caused to the aircraft)

the demonstration profiles were safe.

Despite these guidelines and the instructions of senior officers, the MP continued to operate outside the above limits.

Program Oversight/Program Management
A rogue aviator was allowed, for over three years, to operate with a completely difference set of rules than those applied to the rest of the wing aviators. The institutional integrity of the 92d Bomb Wing leadership was severely damaged by this unwillingness to act. The entire leadership structure of Fairchild Air Force Base (above the squadron level) appeared to be operating in a state of denial, hoping for the best until the base closed or the MP retired. Why? Either the wing leadership did not understand or know that the rules were being violated, or they chose not to apply them uniformly. The first case illustrates possible negligence and incompetence; the second hints at a lack of integrity (Kern, 1995).

In the words of retired army Lt General Calvin Waller, *"Bad news doesn't improve with age."* Leaders must act upon information or evidence of non-compliance. If they elect not to act, they should communicate their reasons for not doing so. Failure to do either invites second guessing and criticism, often eroding the critical element of trust between the leader and the led. Leaders must also learn to recognise the traits of the rogue aviator; for a while the MP stood out like a beacon - many others still operate today to a lesser degree (Kern, 1995).

SITKA 43 (Summary of Facts 2)
At 1822 hours local time (L), 28 July 2010, the mishap aircraft (MA), a C-17A, T/N 00-0173, departed JBER to practice for the upcoming Arctic Thunder Airshow. The mishap crew (MC) consisted of the mishap pilot (MP), the mishap co-pilot (MCP), the mishap safety officer (MSO) and the mishap loadmaster (MLM). The MP performed a maximum power take off at 40 degrees nose high attitude. The MA levelled off at approximately 850 feet above ground level (AGL). The MP then executed a left hand 80 degree turn, continued outbound for seven seconds, and then initiated a right 260 degree reversal turn. Five seconds into the right turn, the stall warning system activated. As the MP continued the manoeuvre, the MA's bank angle increased to 62 degrees. The MP utilized full right rudder and pulled the control stick aft, which stalled the aircraft. The aircraft ultimately reached a bank angle of 82 degrees and a descent rate of 9,000 feet per minute. The MA impacted wooded terrain northwest of the airfield and was destroyed. Additional damage occurred to Alaskan Railroad train tracks. The MA was valued at $184,570,581. All four aircrew members died instantly. There were no civilian casualties (USAF Aircraft Accident Investigation Board Report, 2010).

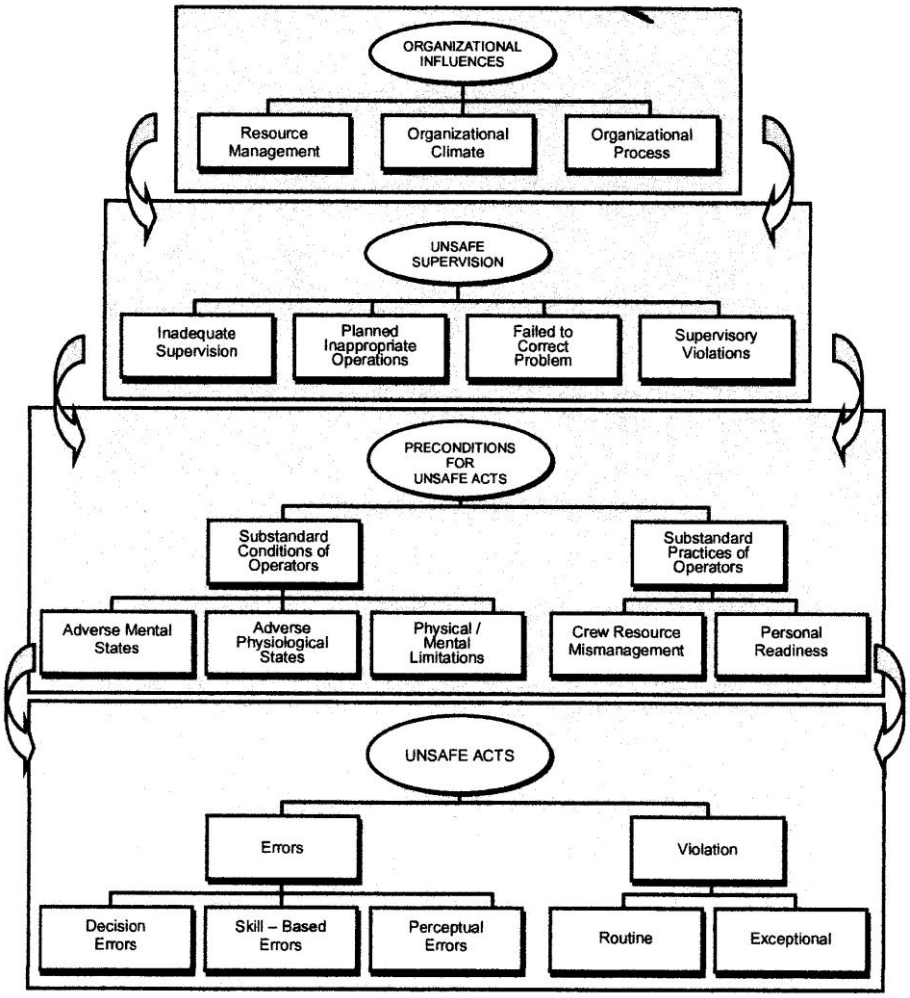
Human Factors
Using the Department of Defence (DOD) Human Factors Analysis and Classification System (DOD-HFACS) (Weigmann & Shappell, 2003) used by all members of the Investigation Board to accurately capture and recreate the complex layers of human error in context with the individual, environment, team and mishap or event, it describes four main areas of Human Factors that may have contributed to the mishap. They are:

Acts are those factors that are most closely tied to the mishap, and can be described as active failures or actions committed by the operator that result in human error or unsafe situations.

Preconditions are factors in a mishap if active and/or latent preconditions such as conditions of the operators, environmental or personnel factors affect practices, conditions or actions of individuals and result in human error or an unsafe situation.

Supervision is a factor in a mishap if the methods, decisions or policies of the supervisory chain of command directly affect practices, conditions or actions of individuals and result in human error or an unsafe situation.

Organisational Influences are factors in a mishap if the communications, actions, omissions or policies of upper level management directly or indirectly affect supervisory practices, conditions or actions of the operator(s) and result in system failure, human error or an unsafe situation.



Causal

Procedural Error

The MP committed two procedural errors during the mishap sortie. He replaced aerial demonstration procedures with his own techniques and failed to implement proper stall recovery procedures.

The MP flew the aircraft in a manner that violated regulatory provisions and flight manual guidance. His aggressive flying placed the aircraft outside viable flight parameters at an altitude and attitude where recovery was not possible. The MP applied a series of procedural errors (improper techniques) that, when combined, resulted in a stall beyond the pilot's recovery capacity. Additionally, he flew aggressive aerial demonstration profiles while max performing the aircraft, as follows:

- Executed climb out to 840 feet AGL instead of 1,500 feet AGL
- Focused on a climb pitch angle of 40 degrees instead of a minimum climb out speed
- Exceeded 60 degree bank turns instead of prescribed 45 degrees
- Failed to execute stall recovery procedures
- Maintained control stick pressure and rudder during stall condition

The MP's errors diminished flight safety margins and caused the aircraft to stall. First, he executed a level off at approximately 850 feet despite Air Force Instruction (AFI) requirements of 1,500 feet. Second, the MP climbed in a 40 degree nose high attitude and disregarded minimum climb out speed. He flew the climb out 26 kts below the V_{MCO} (C17 engine obstacle clearance speed), greatly reducing his safety margin. Third, he planned and executed the profile at 60 degrees of bank, in violation of AFI 11-246. Fourth, the MP failed to execute stall recovery procedures when the stall warning activated. Fifth, after the aircraft stalled, the MP maintained control stick pressure and rudder, making recovery impossible (USAF Aircraft Accident Investigation Board Report, 2010).

MP Failed to Employ Proper Stall Recovery Procedure

IAW the C-17 flight manual, the stall recovery procedure is:

1. apply forward stick pressure
2. apply maximum available thrust, and
3. return to or maintain a level flight attitude

Large rudder inputs should be avoided. Failure to follow flight manual procedures resulted in the loss of the aircraft and crew (USAF Aircraft Accident Investigation Board Report, 2010).

Contributing Factors

Caution and Warning Ignored/Challenge and Reply

As the lead C-17 aerial demonstration pilot for JBER, the MP routinely planned to ignore stall warnings during aerial demonstrations. During the mishap sortie, this became apparent once the stall warning system activated. The MP neither replied nor adjusted his control inputs, continued the turn and failed to implement stall recovery procedures. Additionally, neither MCP nor MSO directed recovery until the MA actually stalled.

The MP also instructed demonstration aircrew members to utilise "silent" check list procedures. Flaps and slats were retracted automatically "on speed", without a challenge or reply. The use of these procedures eliminates supportive feedback and acknowledgement to ensure situational awareness. During the mishap sortie, the MCP retracted the slats five kts below V_{MSR}. There are no indications the MP or MSO understood the MA's configuration (USAF Aircraft Accident Investigation Board Report, 2010).

Channelized Attention

The MP displayed two instances of channelized attention. First, during the 260 degree reversal turn, the MP aggressively continued turning the MA and ignored the stall warning system. Second, when the stall occurred, the MP moved the control stick full left and applied left rudder. He never applied forward control stick pressure to reduce the angle of attack and recover controlled flight. The MP channelized his attention on accomplishing the turn rather than stall recovery (USAF Aircraft Accident Investigation Board Report, 2010).

Overconfidence and Expectancy

During simulator training, the MP taught everyone stall warnings were an "anomaly". He considered the warnings inaccurate and transitory due to aggressive aerial demonstration manoeuvres. The MP also believed these warnings would cease at completion of the turns and not adversely affect the aircraft. He flew numerous aerial demonstrations in the aircraft with the stall warnings active and without incident. At times, the MP would even "tickle" in and out of the stall warning during the 80/260 degree manoeuvre, reinforcing a sense of overconfidence and invulnerability. Finally, the MP's overconfidence in both his abilities and the capabilities of the C-17, as well as his false perception that the aircraft would not stall, contributed to the mishap (USAF Aircraft Accident Investigation Board Report, 2010).

Misplaced Motivation

The MP constantly wanted to "put on a good air show", keeping his turns crisp, tight and as aggressive as possible. In order to achieve this goal, he utilised unsafe techniques in an effort to keep the aircraft as close to the airfield as possible, impress the crowd and improve the air show (USAF Aircraft Accident Investigation Board Report, 2010).

Procedural Guidance/Publications

The prescribed procedures in AFI 11-246 for flying the demonstration profiles are clear and, if flown according to these procedures, the demonstration profiles are safe. The General Instructions section in AFI 11-246 clearly states that crews will adhere to the prescribed procedures for the demonstration profiles and further directs that "Aircrews will not deviate from the mission plan except for safety considerations". However, also contained within this document is an ambiguity with the language "The procedures in these profiles are general guidelines" and this ambiguity resulted in an unsafe situation (USAF Aircraft Accident Investigation Board Report, 2010).

Program Oversight/Program Management

The JBER C-17 Aerial Demonstration program's office of primary responsibility is the 3 OG/OGV Standardisation and Evaluation (Stan/Eval) office. Testimony revealed the Stan/Eval staff lacked an adequate understanding of AFI 11-246 regulations concerning air show profiles execution. This lack of understanding prevented adequate supervision of the program. Without supervision, the MP manipulated Profile 3 (the aerial demonstration profile for the mishap flight) and routinely flew outside the prescribed parameters.

In addition, there was little oversight by 3 OG/OGV regarding the MP's instruction of crew members and the aerial demonstration training program. The MP alone trained the MCP and MSO to fly an unsafe profile. As a result, "checks and balances" within this program were insufficient (USAF Aircraft Accident Investigation Board Report, 2010).

Analysis

Procedural Errors

In both accident sequences aerial demonstration procedures were replaced by individual techniques. Proper stall recovery procedures were not initiated.

Contributing Factors

In both cases caution and warning were ignored. From two perspectives, in the case of Czar 52, it was a human problem and MP's actions were not corrected by the organisation.

In the case of Sitka 43 the actions of the MP were to ignore stall warnings and to use non-standard procedures to operate the aircraft, again not being corrected by the crew or the organisation.

Channelised Attention
Both accident pilots showed two instances of channelised attention. Firstly, they both continued with aggressive turns and ignored stall warnings. Secondly, they failed to apply correct stall recovery techniques.

Over-Confidence and Expectancy
Although appearing to be different, this attitude was exhibited by both command pilots. In Czar 52 the continual belief of the pilot that he was invincible and could make the B52 do his bidding no matter what and that no-one was going to stop him. In the Sitka 43 case the same aspects, over-confidence and invulnerability, had been reinforced by the fact that up to this point nothing had gone wrong.

In both cases there was evidence of misdirected training. In the case of Czar 52 there was the pilots' mindset that he had to push junior pilots to a limit that was unacceptable. With Sitka 43 was the training to depart from standard call outs and to ignore stall warnings.

Misplaced Motivation
Misplaced motivation stemmed from the belief by both pilots that the show would go on and it would be a spectacular show for the attendees in contradiction of the orders, both written and verbal in the case of Czar 52 and written for Sitka 43; both were of the opinion that aggressive manoeuvres were required when the opposite was the case.

Procedural Guidance/Publications
In both instances the requirements and limitations were laid out in the relevant documentation. However, in both cases these were not enforced or were ignored by the supervising senior staff.

Program Oversight/Program Management
In both cases, lack of supervision by responsible senior staff allowed the actions of the pilots to continue unchecked. In the Czar 52 case, any attempts to supervise and control the situation lacked persistence. As for Sitka 43, the pilot was allowed to conduct the training of the crew without direct input from senior staff due to their unavailability.

Summary of Military Cases
The question we need to ask ourselves, as a group of safety-oriented professionals, is "How did the training provided not pass on lessons from the past?" With all the initiatives that have been provided to the US Air Force, in particular in terms of Human Factors, Accident Investigation and Safety Management Systems, it would appear that the lessons have not translated over the 16 year period between these two accidents. Are we not continuing to train or is it assumed by senior staff/management that the training has been delivered and knowledge gained and applied? Is it lack of supervision on a very large scale?

The Civil Arena
There are distinct commonalities when accidents like Colgan Air (Continental Connection Flt 3407) are reviewed. In this event the aircraft was again stalled *however no corrective action was applied to recover from the stall*.

NTSB Executive Summary

On February 12, 2009, about 2217 eastern standard time, a Colgan Air, Inc., Bombardier DHC-8-400, N200WQ, operating as Continental Connection flight 3407, was on an instrument approach to Buffalo-Niagara International Airport, Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about 5 nautical miles northeast of the airport. The 2 pilots, 2 flight attendants and 45 passengers aboard the airplane were killed, one person on the ground was killed and the airplane was destroyed by impact forces and a post crash fire. The flight was operating under the provisions of 14 Code of Federal Regulations Part 121. Night visual meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determines that the probable cause of this accident was the captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the aeroplane did not recover. Contributing to the accident were (1) the flight crew's failure to monitor airspeed in relation to the rising position of the lowspeed cue, (2) the flight crew's failure to adhere to sterile cockpit procedures, (3) the captain's failure to effectively manage the flight, and (4) Colgan Air's inadequate procedures for airspeed selection and management during approaches in icing conditions.

The safety issues discussed in the report focus on strategies to prevent flight crew monitoring failures, pilot professionalism, fatigue, remedial training, pilot training records, airspeed selection procedures, stall training, Federal Aviation Administration (FAA) oversight, flight operational quality assurance programs, use of personal portable electronic devices on the flight deck, the FAA's use of safety alerts for operators to transmit safety-critical information and weather information provided to pilots. Safety recommendations concerning these issues are addressed to the FAA.

(NTSB, 2010)

Pilot Skill Levels

It is worthwhile noting that the FAA is to publish their findings on a study "Pilots' Relationship with Airliner Flight Decks" later this year. This study is expected to establish a connection between accidents and inadequate training, identifying specific areas where there is a need to change pilot training, airlines' standard operating procedures and the design of interfaces between pilots and automated systems (Learmount, 2011).

The Flight Safety Foundation International Aviation Seminar held in Milan in November 2010 produced some interesting presentations. Dr Kathy Abbott, FAA Human Factors specialist, is carrying out a study entitled "Operational Use of Flight Path Management Systems". The study examines how successful pilots are at using the flight management systems and the effect they have on pilot performance overall.

At the same event, aviation industry groups represented by Airbus, Boeing and the US Airline Pilots Association presented on subjects that acknowledged the worrying decline in line pilots' basic flying skills. There were three presentations on stalling and stall recovery and one on the art of the go around.

The ability to carry out safe stall recovery and go arounds is fundamental to basic pilot competence, so the need to cover them in such depth at one of the worlds' main forums for presenting safety policy suggests that airline recurrent training is not addressing the basics.

And now Abbott reveals that training is also failing to impart skills for managing advanced automation, suggesting that training at many airlines is deficient on all counts when it comes to ensuring that pilots gain and retain the skills needed for the job (Learmount, 2011).

At the EBACE business-aviation conference in Geneva, Bombardier had conducted a two-day European version of its much-respected Safety Standdown for pilots, and the subject of stall recovery was addressed at the associated Advanced Aerodynamics Workshop. The workshop revealed that the stall-recovery drill commercial airline crew are taught is different from the way test pilots manage stall recovery when they are certificating the aircraft that the airlines fly (Learmount, 2011).

Basic Instrument Flying Skills

In his article, Michael W. Gillen reported that basic instrument flying by airline pilots revealed a performance below ATP standards. In the study, designed to assess their instrument skills, 30 airline pilots were asked to perform five basic manoeuvres without using automation. Also included in the study was a questionnaire on how the pilot group viewed their ability to conduct basic instrument flying sequences. Although the pilots believed they had retained a high degree of skill, the sequences showed a standard below that required to pass an ATP check by the FAA.

In a 1998 survey by the then Australian Bureau of Air Safety Investigation, now the ATSB (Australian Transport Safety Bureau), found that 43 per cent of pilots surveyed said their manual flying skills had declined after flying advanced technology aircraft (Gillen, 2010).

Most pilots hand fly their aircraft at some stages of each flight. Anecdotal evidence indicates that the main reasons for this are the pilot's personal satisfaction in performing manual flying tasks, the requirement to perform manual flying exercises during simulator sessions (including recurrent training and license renewal) and the need to be able to manually fly the aircraft should the automated systems fail.

Nevertheless, it appears that both the pilots who were tested and their airlines have failed to maintain their perceived level of manual flight skills. In response, some airlines have implemented supplementary simulator programs to bolster these skills (Gillen, 2010).

Other studies in the 1990s found that highly automated cockpits tend to change the way pilots perform tasks and make decisions. The studies identified problems in the use of advanced automated systems, including mode misunderstanding, failures to understand automated system behaviour, confusion or lack of awareness concerning what automated systems are doing and why, and difficulty tracing the functioning or reasoning process of automated agents (Gillen, 2010).

Simulator Performance

The pilots performed the five basic instrument manoeuvres in an FAA-certified Level D simulator - the most advanced type of simulator, with a 180-degree wrap-around visual display and a daylight visual system. The manoeuvres were rated by an FAA-certified check pilot and were graded on a scale of 1 through 5, based on the standards of both a major airline and the FAA.

The rating scale was as follows:

- 5 - Well within airline standards. Performance was exemplary.
- 4 - Within airline standards. Pilot flew to ATP standards.
- 3 - Minor deviations from airline standards that were promptly corrected. Pilot flew at the basic instrument level.
- 2 - Major deviations (e.g. full-scale localiser/glideslope deflection) for more than 10 seconds.
- 1 - Major deviations from airline standards that were not promptly corrected and/or were unsafe; or the pilot was unable to perform the manoeuvre/task without assistance. Crash or loss of control. (Gillen, 2010).

Misplaced Confidence?

Technical failures in advanced glass aircraft can significantly degrade cockpit instrumentation. Poor basic instrument flying skills make these failures more difficult to detect because cross-checking raw data from the basic instruments is the key factor in quickly identifying failures.

Manoeuvre Ratings		
	Number of Pilots	Mean[1]
Take off manoeuvre	30	3.2000
V_1 cut manoeuvre	30	3.0333
Holding manoeuvre	30	2.3667
ILS manoeuvre	30	2.9667
Missed approach	30	3.0667
ILS = instrument landing system		
Note		
1. The mean is the average of manoeuvre ratings received by all 30 participants. Each manoeuvre was rated on a scale from 1 to 5. A grade of 4 represented the standards established by the U.S. Federal Aviation Administration for an airline transport pilot.		
Source: Michael W. Gillen		

In addition, when these failures occur, pilots must use basic instrument skills to safely fly the airplane. Pilots who are competent in basic instrument flying enhance their overall flying skills; because they can devote less attention and cognitive function to physically flying the airplane, they can spend more time managing their environment (Gillen, 2010).

Airlines should be able to improve overall safety levels by more effectively addressing loss-of-control procedures in training and operational venues.

Loss of control has replaced controlled flight into terrain as the No. 1 cause of accidents in recent years. Overall, the airline industry has reached a plateau for safety performance improvement in the past decade. But the Flight Safety Foundation's European Aviation Safety Seminar in Istanbul concluded that this must change.

"The recurrence of replica accidents is distressing and frustrating," Mike Ambrose, director general of the European Regions Airline Association, said. "The same thing happens over and over again," Michael Coker, a senior safety pilot at Boeing, agreed. The overwhelming majority of loss-of-control accidents can be linked to pilot behaviour (Flottau, 2011).

Many of the accidents include stalls. Coker, along with Claude LeLaie, Airbus special adviser to CEO Tom Enders, and Paul Kolisch, supervisor of flight operations training at U.S. regional carrier Mesaba, emphasise that the industry has for decades been teaching the wrong recovery procedures.

"In most cases, stalls are recoverable," Coker says. "But most pilots pull back [on the control column] when actually they should push forward even if that means a high rate of descent." Pilots pull back and apply full power because they have been trained to maintain altitude at all cost. But "altitude control is unrealistic, particularly during recovery" (Flottau, 2011).

Even more frustrating, Coker notes, is that most stalls "occur with sufficient altitude to recover." In other words: those aircraft would not have crashed if the right technique had been applied by pilots. He is critical of the fact that stall recovery is still not included in recurring training at many airlines; it remains limited to initial type rating training (Flottau, 2011).

Conclusion

Airline safety can be improved by ensuring that pilots are competent not only when all advanced instrumentation is functioning but also when that instrumentation fails. Pilots possessed these basic instrument skills at one time in their careers, and their skill levels can be increased through training and practice (Gillen, 2010).

The level of concern for pilot skills among senior Airbus, Boeing and ALPA training experts, the findings that Abbott's report is soon expected to reveal, and Gillen's study all point in the same direction: airline recurrent training needs radical change (Learmount, 2011).

I now wish to draw your attention to the article that V.P. Paul Mayes wrote in the Jan-Mar 2011 edition of ISASI Forum:

"The ideal situation is that any safety hazard or safety concern is reported and action is taken to address these before they become an incident or accident. I believe we have the reporting side of this equation under control, but we have not achieved an effective analysis and safety improvement process. This is the Utopia of preventative or proactive safety."

There still seems much to learn or re-learn for both old and new members of the aviation community and I feel it can be summed up by the application of the words of Professor James Reason:

CHRONIC UNEASE

References

Flottau, J. (2011). Training turnaround. Aviation safety experts push for new stall recovery techniques. *Aviation Week & Space Technology*.

Gillen, M.W. (2010). An examination of basic instrument flying by airline pilots reveals performance below ATP standards. *Aerosafetyworld*.

Kern, A.T. (1995). Darker shades of blue: a case study of failed leadership.

Learmount, D. (2011). Industry sounds warnings on airline pilot skills. *Flight International*

National Transportation Safety Board (2010). *Abstract AAR-10/01*.

United States Air Force Aircraft Accident Investigation Board Report (2010). *C-17A, T/N 00-0173, 3rd Wing, Joint Base Elmendorf-Richardson, Alaska*: Author.

Weigmann, D.A. & Shappell, S.A. (2003). A human error approach to aviation accident analysis, the human factors analysis and classification system. Hants, UK: Ashgate

The direction of aviation safety – are the lessons of the past being applied today?

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JUL 24 1994

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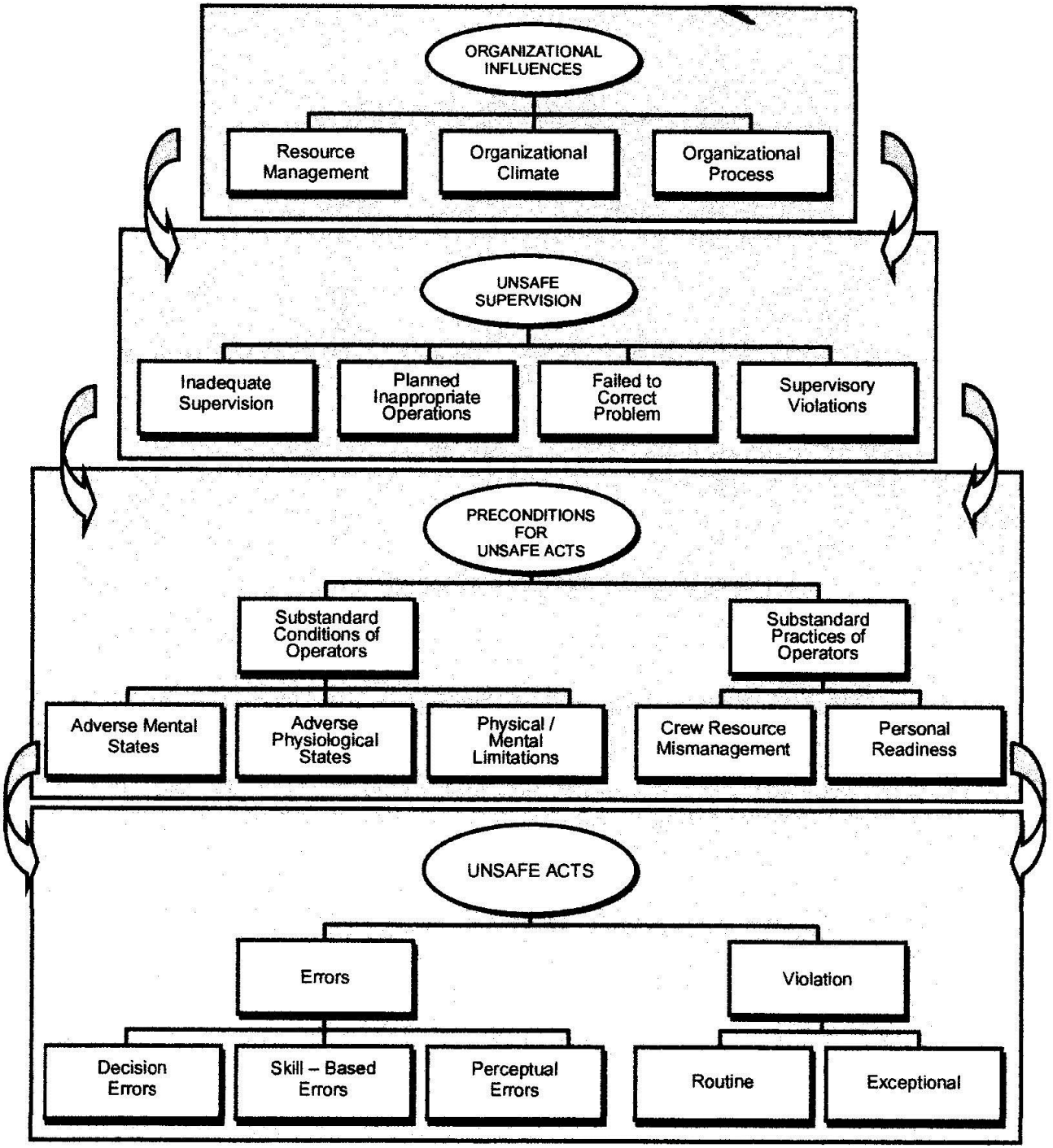
Using the Department of Defence (DOD) Human Factors Analysis and Classification System (DOD-HFACS) (Weigmann & Shappell, 2003) used by all members of the Investigation Board to accurately capture and recreate the complex layers of human error in context with the individual, environment, team and mishap or event, it describes four main areas of Human Factors that may have contributed to the mishap.

Acts are those factors that are most closely tied to the mishap, and can be described as active failures or actions committed by the operator that result in human error or unsafe situations.

Preconditions are factors in a mishap if active and/or latent preconditions such as conditions of the operators, environmental or personnel factors affect practices, conditions or actions of individuals and result in human error or an unsafe situation.

Supervision is a factor in a mishap if the methods, decisions or policies of the supervisory chain of command directly affect practices, conditions or actions of individuals and result in human error or an unsafe situation.

Organisational Influences are factors in a mishap if the communications, actions, omissions or policies of upper level management directly or indirectly affect supervisory practices, conditions or actions of the operator(s) and result in system failure, human error or an unsafe situation.


ORGANIZATIONAL INFLUENCES
Resource Management
Organizational Climate
Organizational Process
UNSAFE SUPERVISION
Inadequate Supervision
Planned Inappropriate Operations
Failed to Correct Problem
Supervisory Violations
PRECONDITIONS FOR UNSAFE ACTS
Substandard Conditions of Operators
Substandard Practices of Operators
Adverse Mental States
Adverse Physiological States
Physical / Mental Limitations
Crew Resource Mismanagement
Personal Readiness
UNSAFE ACTS
Errors
Violation
Decision Errors
Skill – Based Errors
Perceptual Errors
Routine
Exceptional

ANALYSIS

Procedural Errors

In both accident sequences aerial demonstration procedures were replaced by individual techniques. Proper stall recovery procedures were not initiated.

Contributing Factors

In both cases caution and warning were ignored. From two perspectives, in the case of Czar 52, it was a human problem and MP's actions were not corrected by the organisation.

In the case of Sitka 43 the actions of the MP were to ignore stall warnings and to use non-standard procedures to operate the aircraft, again not being corrected by the crew or the organisation.

Channelised Attention

Both accident pilots showed two instances of channelised attention. Firstly, they both continued with aggressive turns and ignored stall warnings. Secondly, they failed to apply correct stall recovery techniques.

Over-Confidence and Expectancy

Although appearing to be different, this attitude was exhibited by both command pilots. In Czar 52 the continual belief of the pilot that he was invincible and could make the B52 do his bidding no matter what and that no-one was going to stop him. In the Sitka 43 case the same aspects, over-confidence and invulnerability, had been reinforced by the fact that up to this point nothing had gone wrong.

In both cases there was evidence of misdirected training. In the case of Czar 52 there was the pilots' mindset that he had to push junior pilots to a limit that was unacceptable. With Sitka 43 was the training to depart from standard call outs and to ignore stall warnings.

Misplaced Motivation

Misplaced motivation stemmed from the belief by both pilots that the show would go on and it would be a spectacular show for the attendees in contradiction of the orders, both written and verbal in the case of Czar 52 and written for Sitka 43; both were of the opinion that aggressive manoeuvres were required when the opposite was the case.

Procedural Guidance/Publications

In both instances the requirements and limitations were laid out in the relevant documentation. However, in both cases these were not enforced or were ignored by the supervising senior staff.

Program Oversight/Program Management

In both cases, lack of supervision by responsible senior staff allowed the actions of the pilots to continue unchecked. In the Czar 52 case, any attempts to supervise and control the situation lacked persistence. As for Sitka 43, the pilot was allowed to conduct the training of the crew without direct input from senior staff due to their unavailability.

Summary

- How did the training provided not pass on lessons from the past?
- Initiatives now in place:

  Human Factors
  Accident Investigation
  Safety Management Systems

- It would appear that the lessons have not translated over the 16 year period between the two accidents
- Is it that we are not continuing to train or is it the assumption of senior staff/management that the training has been delivered and appropriate knowledge gained and applied?
- Is it lack of supervision on a very large scale?

The Civil Arena

There are distinct commonalities when accidents like Colgan Air (Continental Connection Flt 3407) are reviewed. In this event the aircraft was again stalled *however no corrective action was applied to recover from the stall*.

NTSB Executive Summary

On February 12, 2009, about 2217 eastern standard time, a Colgan Air, Inc., Bombardier DHC-8-400, N200WQ, operating as Continental Connection flight 3407, was on an instrument approach to Buffalo-Niagara International Airport, Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about 5 nautical miles northeast of the airport. The 2 pilots, 2 flight attendants and 45 passengers aboard the airplane were killed, one person on the ground was killed and the airplane was destroyed by impact forces and a post crash fire.

Procedural Errors

The probable cause of this accident was the captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the aeroplane did not recover.

The flight crew's failure to monitor airspeed in relation to the rising position of the low speed cue

The captain's failure to effectively manage the flight

FAA Response

The safety issues discussed in the report focus on strategies to prevent flight crew monitoring failures, pilot professionalism, fatigue, remedial training, pilot training records, airspeed selection procedures and stall training.

Pilot Skill Levels

It is worthwhile noting that the FAA is to publish their findings on a study "Pilots' Relationship with Airliner Flight Decks" later this year. This study is expected to establish a connection between accidents and inadequate training, identifying specific areas where there is a need to change pilot training, airlines' standard operating procedures and the design of interfaces between pilots and automated systems (Learmount, 2011).

Dr Kathy Abbott, FAA Human Factors specialist, is carrying out a study entitled "Operational Use of Flight Path Management Systems". The study examines how successful pilots are at using the flight management systems and the effect they have on pilot performance overall.

Flight Safety Foundation International Aviation Seminar (Milan, 2010)

At this event, aviation industry groups represented by Airbus, Boeing and the US Airline Pilots Association presented on subjects that acknowledged the worrying decline in line pilots' basic flying skills. There were three presentations on stalling and stall recovery and one on the art of the go around.

The ability to carry out safe stall recovery and go arounds is fundamental to basic pilot competence, so the need to cover them in such depth at one of the worlds' main forums for presenting safety policy suggests that airline recurrent training is not addressing the basics.

Abbott reveals that training is also failing to impart skills for managing advanced automation, suggesting that training at many airlines is deficient on all counts when it comes to ensuring that pilots gain and retain the skills needed for the job (Learmount, 2011).

EBACE Business-Aviation Conference (Geneva, 2011)

The subject of stall recovery was addressed at the associated Advanced Aerodynamics Workshop. The workshop revealed that the stall-recovery drill commercial airline crew are taught is different from the way test pilots manage stall recovery when they are certificating the aircraft that the airlines fly (Learmount, 2011).

Basic Instrument Flying Skills

In his study, Michael W. Gillen reported that basic instrument flying by airline pilots revealed a performance below ATP standards.

Manoeuvre Ratings		
	Number of Pilots	Mean[1]
Take off manoeuvre	30	3.2000
V_1 cut manoeuvre	30	3.0333
Holding manoeuvre	30	2.3667
ILS manoeuvre	30	2.9667
Missed approach	30	3.0667

ILS = instrument landing system

Note

1. The mean is the average of manoeuvre ratings received by all 30 participants. Each manoeuvre was rated on a scale from 1 to 5. A grade of 4 represented the standards established by the U.S. Federal Aviation Administration for an airline transport pilot.

Source: Michael W. Gillen

Flight Safety Foundation's European Aviation Safety Seminar (Istanbul, 2011)

Loss of control has replaced controlled flight into terrain as the No. 1 cause of accidents in recent years. Overall, the airline industry has reached a plateau for safety performance improvement in the past decade.

"The recurrence of replica accidents is distressing and frustrating," Mike Ambrose, director general of the European Regions Airline Association, said. "The same thing happens over and over again," Michael Coker, a senior safety pilot at Boeing, agreed. The overwhelming majority of loss-of-control accidents can be linked to pilot behaviour (Flottau, 2011).

Many of the accidents include stalls. Coker, along with Claude LeLaie, Airbus special adviser to CEO Tom Enders, and Paul Kolisch, supervisor of flight operations training at U.S. regional carrier Mesaba, emphasise that the industry has for decades been teaching the wrong recovery procedures.

"In most cases, stalls are recoverable," Coker says. "But most pilots pull back [on the control column] when actually they should push forward even if that means a high rate of descent." Pilots pull back and apply full power because they have been trained to maintain altitude at all cost. But "altitude control is unrealistic, particularly during recovery" (Flottau, 2011).

He is critical of the fact that stall recovery is still not included in recurring training at many airlines; it remains limited to initial type rating training (Flottau, 2011).

Conclusion

The level of concern for pilot skills among senior Airbus, Boeing and ALPA training experts, the findings that Abbott's report is soon expected to reveal, and Gillen's study all point in the same direction: airline recurrent training needs radical change (Learmount, 2011).

"The ideal situation is that any safety hazard or safety concern is reported and action is taken to address these before they become an incident or accident. I believe we have the reporting side of this equation under control, but we have not achieved an effective analysis and safety improvement process. This is the Utopia of preventative or proactive safety." (Mayes, 2011)

CHRONIC UNEASE

Thank you for your attention

Questions