Colgan 3407 Eight Years Later -

Making a Difference in Aviation Safety

**by Roger Cox**

**ISASI #MO6117**

 *Roger Cox was the NTSB’s operational factors group chairman during the Colgan 3407 investigation. He authored or co-authored a number of the recommendations in the NTSB report, and he co-managed the NTSB public forum on Professionalism in Aviation in 2010. He was an investigator for nine years and a National Resource Specialist at the NTSB following his career as an airline pilot. During his flying career, he logged 18,000 hours in a variety of aircraft, including Boeing, Airbus and Lockheed transports. He is now retired but remains active in safety and accident investigation affairs.*

## Abstract

 Colgan flight 3407, a Bombardier DHC-8-400 (Q400), crashed near Buffalo, New York on February 12, 2009. The accident attracted wide attention and became one of the landmark investigations done in recent years. As a result of the accident, the United States Congress took the unusual step of enacting a new aviation safety law in 2010, building on and adding to the NTSB’s recommendations from its investigation. Eight years after the accident, over half the NTSB’s recommendations are still open, and some of the actions mandated by the law remain incomplete. Significant safety issues addressed by the NTSB in its report included 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. Congress further addressed regional airline oversight and disclosure, safety management systems, screening and qualification of pilots, pilot records, and new requirements for ATP certification.

 This paper summarizes the progress made toward improved aviation safety as a result of the investigation, and discusses actions still needed. The paper contrasts pilot certification, records and selection issues, pilot training issues, safety management issues, and FAA oversight and design standards issues before and after the investigation and attempts to realistically assess how much difference the investigation really made.

**Introduction**

 The reduction in the U.S. commercial airline accident rate and the increasing flow of operational data available to airlines and the FAA have led some observers to declare that actual accident investigations are of less and less value to air safety. For example, in a 2016 press release about the Commercial Air Safety Team (CAST), the FAA declared in part:

“CAST has evolved and the group is moving beyond the “historic” approach of examining past accident data to a proactive approach that focuses on detecting risk and implementing mitigation strategies before accidents or serious incidents occur.”[[1]](#endnote-2)

The implication was that data is replacing accident investigation analysis and recommendations as a rationale for changing policy and regulation. While there is no doubt that safety programs like Aviation Safety Action Programs (ASAP), Flight Operational Quality Assurance (FOQA) programs, and the Aviation Safety Information Analysis and Sharing (ASIAS) program are providing an enormous amount of operational data that hold great potential for safety improvements, investigations are still a vital part of understanding and preventing accidents. Given sufficient emphasis and resources, accident investigators can find out not only what happened, but can delve deeply into why it happened. Safety deficiencies that have lain dormant for many years come to light.Accident investigations can then provide a catalyst for action that masses of operational data cannot.

 The Colgan 3407 accident investigation was one of those catalyst investigations. Company officials were often defensive, media coverage was relentless, and there was strong pressure from within the Board to complete the report in one year or less. Nonetheless, the investigative team was able to build on the work of previous investigations and probe deeply into the reasons why the accident occurred. The emergent facts during the investigation and the power of the final report energized the public, gained the attention of Congress, and drove the FAA and the industry to make substantive changes to practices they had resisted changing for years.

 Only a few months after the NTSB issued its final report,**[[2]](#endnote-3)** the United States Congress acted, enacting PL 111-216, “The Airline Safety and Federal Aviation Administration Extension Act of 2010,” on August 1, 2010.**[[3]](#endnote-4)** This intervention by Congress into air safety issues was fairly rare. Normally aviation regulations are written by the FAA under authority granted to it by Congress. The passage of laws directing creation of specific regulations usually only happens following one or more major accidents. For example, the FAA was created in 1958 following several midair collisions, one of which took place between two airliners over the Grand Canyon. Several other air safety actions were taken by Congress following accidents. A Department of Defense Commercial Airlift Review Board was created by Congress after a military charter plane crash in Gander, Newfoundland in 1985. The Aviation Disaster Family Assistance Act was passed in 1996 following the US Air 427 accident in Pittsburgh, and its provisions were added to foreign carriers following the Korean Airlines accident in Guam in 1997.

 Many of the Colgan accident victims were from the Buffalo, New York, area. The Buffalo News provided extensive coverage of the accident investigation and soon an ad hoc group of victims’ families formed. Calling themselves “Families of Continental 3407,”**[[4]](#endnote-5)** they became a strong and effective lobbying group supporting changes to air safety rules. The NTSB’s public hearing, held only three months after the accident, drew a full house in the agency’s boardroom, and the testimony of the airline’s officials under questioning from investigators and board members drew surprise and anger from public observers.

 Even with the imposition of new law on the FAA and the aviation industry, progress in some areas has been slow. Rule-making was required by many of the law’s provisions, and rule-making is an inherently time consuming process. Advisory groups and commenters can bring progress almost to a halt. Nonetheless, almost all the provisions of the airline safety act have been completed. The phasing in of congressionally mandated changes will go on for another 2 years. Eight of the NTSB’s new and reiterated recommendations have been implemented; five have been closed unacceptable or no longer applicable, and fifteen remain open. Of the remaining open recommendations, most are getting close to resolution.

**Background**

 Colgan Airlines was a regional airline. It contracted with major airlines, including United and Continental, to carry those airlines’ passengers from hub airports to smaller cities. By 2009, the regional airline industry had evolved from flying light reciprocating engine powered airplanes to flying jet and turboprop aircraft at sizes and speeds almost comparable to mainline airlines. In that year, regional airlines carried almost one quarter of the commercial passengers in the U.S.**[[5]](#endnote-6)** even though most of them were not known to the public under their own name, but under a mainline “express” name. The practice of selling passengers a ticket for a flight on a mainline carrier while providing part of the travel on a regional airline, known as code sharing, was not widely understood by the public. Regional airlines typically hired entry level pilots, paid them relatively low wages, and expected to see many of them leave for better paying jobs within a few years.

 Colgan was certified under 14 CFR part 121, the same rules that pertain to major airlines. Investigators approached the Colgan accident with the same objectivity they employed with any investigation. However, the safety standards of regional airlines compared with major airlines was a subject of interest to the investigators.

 In the 6 years before the Colgan accident, U.S. scheduled passenger airlines experienced the lowest number of fatalities in their history, with the exception of one segment - the regional airlines. Regional passenger airlines had 10 major accidents during that period, six of which involved fatalities. All but two of these accident flights involved companies with code sharing agreements with larger airlines. Flight crew actions, sometimes involving unprofessional behavior, were a factor in every accident but one. These accidents are shown in Table 1.

**Table 1 - Regional Airline Accidents 2003 - 2008**

**(Scheduled Passenger Flights)[[6]](#endnote-7)**

| *Year* | *Carrier* | *Date* | *Flight fatalities* | *Ground fatalities* | *Crew a factor* | *Regional code share* |
| --- | --- | --- | --- | --- | --- | --- |
| 2003 | Expressjet 2051 | 1/06/2003 | 0 | 0 | x | x |
|  | Air Midwest 5481 | 1/08/2003 | 21 | 1 |  | x |
|  | Air Sunshine 527 | 7/13/2003 | 2 | 0 | x |  |
| 2004 | Corporate 5966 | 10/19/2004 | 13 | 0 | x | x |
|  | Pinnacle 3701 | 10/14/2004 | 2 | 0 | x | x |
| 2006 | Comair 5191 | 8/27/2006 | 49 | 0 | x | x |
|  | Peninsula 842 | 12/14/2006 | 2 | 0 | x |  |
| 2007 | Pinnacle 4712 | 4/12/2007 | 0 | 0 | x | x |
|  | Air Wisconsin 3758 | 12/16/2007 | 0 | 0 | x | x |
| 2008 | Shuttle America 6448 | 2/18/2008 | 0 | 0 | x | x |
| Total |  |  | **89** | **1** |  |  |

 In addition, a cargo turboprop flight, Empire 8284, crashed just two weeks before the Colgan accident, and it was another crew-involved accident. The Colgan captain’s extensive record of certification and training failures, which was revealed early in the investigation, and the casual atmosphere in the cockpit during the accident flight, which was revealed when the docket was opened, added to concerns of a negative trend in pilot performance standards and professional conduct at regional airlines.

 At the time of the Colgan accident, many aspects of airline regulation had not changed substantively in decades. New airline first officers (FO’s) were only required to have an FAA commercial certificate, which could be obtained when a pilot had 250 flight hours, or in some cases, less. The Airline Transport Pilot (ATP) certificate could be obtained without any airline training. Airline pilot training records varied widely in quality and were rapidly being replaced by electronic systems that eliminated many details. Safety programs also varied widely in quality, and the data collection programs that enabled better analysis were optional. Pilot flight and duty time rules designed to ensure pilots were properly rested were arbitrary and largely unchanged since before the advent of the jet age. Airline stall training was based on the idea that practicing recovery from actual stalls was unnecessary. Flight simulators lacked the ability to simulate full stalls. There was confusion by pilots at regional airlines about when an ice contaminated tail stall (ICTS) would occur; airlines provided videos on tail stall but no actual training.

 Airline pilot professionalism was generally taken for granted. The FAA and the industry assumed captains would be highly observant of rules and procedures. Crew compliance with the ban on use of personal electronic devices (PED’s) and with the sterile cockpit rule were assumed by the FAA. Proper monitoring of a flight’s progress by the pilot not flying was a skill the FAA thought was understood and done by all pilots. Pilots who travelled long distances from home to begin their flights were assumed to ensure they would be fit and ready for flight.

Colgan Airlines and the regional airline industry bore the brunt of scrutiny during the Colgan investigation. Colgan itself was merged into its corporate parent airline and disappeared. However, regional airlines as a whole continued to grow and most of the recommendations and laws from the investigation pertained not just to regional airlines, but to the entire airline industry.

**Actions and Results**

 The NTSB’s final report, which was adopted on February 2, 2010, was an omnibus report. The analysis addressed 13 main issues and 24 sub-issues. Recommendations from previous reports which had not been acted on by the FAA were revived and reconsidered in the light of the facts of the Colgan accident. The NTSB recommendations, which are not binding, were scrutinized carefully by congressional staff as they drafted the new law. The new airline safety act mandated the main ideas of some of the NTSB recommendations and added major changes to rules on pilot certification, pilot hiring, pilot training, pilot records, pilot fatigue, airline safety programs and FAA oversight. The resulting regulations were a product of new and old NTSB recommendations, FAA sponsored ARC’s,**[[7]](#endnote-8)** FAA internal analysis, and the provisions of the new law.

 Following is a summary of the major safety changes made as a direct or indirect result of the Colgan investigation, including remaining implementation concerns. A detailed examination of every change made as a result of the Colgan investigation is beyond the scope of this report. Further information about the recommendations can be found on the NTSB website at WWW.NTSB.GOV. The current status of the NTSB recommendations is shown in table 2, and of the provisions of the airline safety act in table 3. (The first letter of the recommendation status indicates if the recommendation is open or closed; the second letter indicates acceptable or unacceptable; the remaining letters are qualifiers, such as “response,” “action,” or “alternate action.”)

**Table 2 - Colgan Recommendations Status**

**as of March 2017**

| *Recommendation* | *Subject Area* | *Status* | *Date completed* |
| --- | --- | --- | --- |
| A-10-10 | SOP’s and monitoring | CUA | 1/11/2013 |
| A-10-11 | Low speed caution | CAA | 12/03/2013 |
| A-10-12 | Redundant low speed warnings | OAR |  |
| A-10-13 | Captain leadership training AC | OUR |  |
| A-10-14 | Captain leadership training | OUR |  |
| A-10-15 | Professionalism guidance using media | OUR |  |
| A-10-16 | Commuting fatigue risk | CUA | 12/27/2013 |
| A-10-17 | Document pilot training records | OAR |  |
| A-10-18 | Use training records for remediation | OAR |  |
| A-10-19 | Use training records for PRIA | OAR |  |
| A-10-20 | Guarantee record accuracy | OAR |  |
| A-10-21 | Match speed switch and speed bugs | CAAA | 3/22/2012 |
| A-10-22 | New more effective stall training | OUR |  |
| A-10-23 | Stick pusher training | OUR |  |
| A-10-24 | New simulator fidelity for stall training | CAA | 7/21/2016 |
| A-10-25 | Establish tail stall relevance | CAA | 7/21/2016 |
| A-10-26 | Better surveillance standards | CAA | 11/02/2015 |
| A-10-27 | Mandate FOQA | CNLA | 2/04/2013 |
| A-10-28 | Protect FOQA data | CNLA | 2/04/2013 |
| A-10-29 | Use all available data sources | OAAR |  |
| A-10-30 | Prohibit use of PED’s on flight deck | CUA | 6/14/2012 |
| A-10-31 | Document SAFO actions | OUR |  |
| A-10-32 | Provide relevant weather data | CAA | 7/23/2014 |
| A-10-33 | POI’s review weather data | CAA | 7/23/2014 |
| A-10-34 | Update AIM icing definitions | OAR |  |
| Reiterated |  |  |  |
| A-05-01 | Operators check certificate disapprovals | OAR |  |
| A-05-14 | Establish remedial training | CAA | 3/18/2014 |
| A-07-13 | Teach monitoring skills | OAR |  |

**Table 3 - Status of Provisions of PL 111-216**

**as of March 2017**

| *Section* | *Issue Area* | *Product* | *Date Completed* |
| --- | --- | --- | --- |
| 202 | Annual report on 121 safety | Report | annual |
| 203 | Pilot records | Rule |  |
| 204 | Air Carrier Safety Task Force | Report | 7/31/2012 |
| 205 | FAA inspectors review | Report | 5/1/2011 |
| 206 | Mentoring and leadership | Rule | 8/01/2013 |
| 207 | Crew pairing and CRM Study | Report | 8/26/2011 |
| 208 | Stall and other training | Rule | 11/12/2013 |
| 209 | Air Carrier Training | Rule | 11/12/203 |
| 210 | Ticket disclosure | Amend USC | 8/01/2010 |
| 211 | Inspections of regional airlines | FAA action | annual |
| 212 | Pilot fatigue | Rule | 12/21/2011 |
| 213 | Voluntary safety programs | Report | 3/16/2011 |
| 214 | ASAP and FOQA | Report | 4/14/2011 |
| 215 | SMS | Rule | 1/08/2015 |
| 216 | Pilot screening and qualification | Rule | 7/15/2013 |
| 217 | ATP certification | Rule | 7/15/2013 |

**Pilot Certification, Records and Selection**

 **ATP Certification and Airline Hiring**

The airline safety act required that both the pilot-in-command (PIC) and second-in-command (SIC) at part 121 airlines have an Airline Transport Pilot (ATP) certificate and multiengine flight experience. The Act also mandated that ATP applicants have 1,500 flight hours,**[[8]](#endnote-9)** and required the FAA to write more stringent rules for the ATP certification training process. The NTSB’s report provided details of the captain’s certification difficulties but did not recommend changes to airline hiring standards or FAA pilot certification. The report did reiterate an open 2005 recommendation urging all operators to check a pilot’s flight check failures prior to employment. Sections 216 and 217 of the airline safety act addressed these subjects. It mandated extensive preemployment screening for pilots by airlines and, in section 203, created a new pilot records database to facilitate this screening.

The FAA published the “Pilot Certification and Qualification Requirements for Air Carrier Operations” final rule in July, 2013.**[[9]](#endnote-10)** The rule required ATP applicants to complete a certification training program (CTP), standards for which were set by the FAA. All CTP programs are now reviewed by FAA headquarters. So far, 75 colleges have been approved to provide training for the restricted ATP certificate, and 21 organizations, including 10 airlines and 11 simulator-equipped training schools,**[[10]](#endnote-11)** have been approved to complete the CTP.**[[11]](#endnote-12)** Minimum standards for CTP instructors were also established, including at least two years experience as a Part 121 airline pilot.

 The new pilot certification rules were the result of far more than just the events of the Colgan accident. The FAA took into consideration recommendations of the First Officer Qualification (FOQ) ARC, analysis of 58 pilot-involved accidents, and 23 previous NTSB recommendations, including two from the Colgan report. However, the circumstances of the Colgan accident, including the captain’s unusually numerous certification failures and the lack of adequate screening, training, and supervision of pilots at the airline were a significant driver of the new rules. Investigators traced both of the accident pilots’ performance histories back to their previous employers, and even further back to their original training, and showed how they developed over time. This helped the FAA and Congress understand how the training and certification process needed to be strengthened.

 The most controversial element of the new airline regulations was the “1500 hour rule.” Historically, major airlines have hired pilots with flight experience far in excess of 1500 hours, even though the minimum FAA requirement for an SIC was only a commercial certificate (250 hours or less).**[[12]](#endnote-13)** Earning low pay working in marginal, even hazardous, conditions was a rite of passage for most airline pilots. Typically, pilots who did not serve in the military gained experience flying at air charter companies, commuter airlines, supplemental airlines, or served as flight instructors. As regional airlines have grown into a major segment of the airline business, their low pay and limited career opportunities have made it more difficult for them to recruit entry level pilots. Their perceived need is to go back to hiring pilots with 400 to 600 hours, as Colgan did. Their trade association, the Regional Airline Association (RAA), has lobbied Congress to relax the 1500 hour rule, so far without success.

 The airline industry will need to find a way to recruit and develop adequate numbers of new pilots to serve in the future without sacrificing the standards now in effect.

 **Pilot Records**

There were four recommendations in the NTSB report about pilot records. They addressed the need for better accuracy and completeness of records, and the need to use these improved records for remedial training and pilot hiring. Investigators were able to obtain detailed training records from the accident captain’s previous employers that Colgan had never obtained, and these records clearly showed he had major proficiency issues before he ever was hired at Colgan. Investigators also showed Colgan retained only minimal records of the captain’s training events even though he either failed or barely passed his first three company check rides. The NTSB report showed records had to be better kept and better used, and Congress agreed.

 The NTSB did not call for the creation of a new FAA pilot records database (PRD), but section 203 of the airline safety act did. To date, the database is not fully operational. The Department of Transportation Office of inspector General (DOT OIG) told Congress in 2016 “a robust, centralized database for pilot records remains years away.”**[[13]](#endnote-14)** While a PRD NPRM has not yet been published, the FAA did establish a three phase PRD deployment plan in December, 2016.**[[14]](#endnote-15)** In the current phase one period, the FAA provides airline access to pilot information so far available while maintaining the existing requirements of the older pilot Records improvement Act (PRIA) rule.

 The difficulty the FAA has had in implementing the PRD reflects in part conflicts within the industry. Pilots and airlines, concerned about privacy and liability, want to minimize the data maintained in the database. Safety advocates, including the NTSB, want to see more robust data. A major problem caused by the FAA’s failure to move more quickly is that large amounts of historical data may be lost as time passes. Other safety improvements, including training, remediation and pilot hiring rules and practices, depend on the quality of the PRD. The FAA will need to move more quickly to establish the PRD.

**Training**

 **Airline Stall and Stick Pusher Training**

 A significant change to airline training recommended by the NTSB was the requirement for airline pilots to do periodic training on full aerodynamic stall recognition and recovery. Three recommendations in the NTSB report addressed aerodynamic stalls. One was a simple procedural change that was quickly adopted by Q400 operators. Two others were more challenging. One called for a significant change in the way air carrier pilots train to recognize and recover from aerodynamic stalls. Another called for stick pusher simulator training for pilots flying stick pusher equipped airplanes. Section 208 of the airline safety act made this training mandatory. Both the stall and stick pusher training required significant improvements in simulator fidelity.

 The FAA published the “Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers” final rule in November, 2013.[[15]](#endnote-16) This included new 14 CFR Part 121.423 which will require the stall training recommended by the NTSB. An advisory circular (AC) on stall and stick pusher training was published by the FAA in August, 2012. 14 CFR Part 121 carriers have until March, 2019 to comply. Part 135 and 91K operators are not directly affected by these rules.

 The main impetus for these changes was the finding by the NTSB that the Colgan captain reacted improperly to the stall warning, took actions that induced an actual stall, and then failed to properly react to the stick pusher activation. The report tied the FAA’s long-standing stall training policy to the captain’s actions. The FAA had required pilots to maintain altitude during “approach to stall“ recoveries during training. The captain appeared to place a priority on maintaining altitude instead of recovering from the stall. The new stall training requires airline pilots to perform recoveries from a full stall, rather than an approach to stall, which has been the standard since airline simulators were first introduced. Maintaining altitude is no longer a requirement. The full stall training will be instructor guided, not graded.

 The Colgan crew was not alone among airline crews in experiencing an aerodynamic stall. There were at least four large turbojet accidents resulting from stalls between 1996 and 2008. Turboprop airliners experienced even more stall accidents during this period. Many of the turboprop events took place in icing conditions. These accidents are shown in table 4.

**Table 4 - U.S. Stall-Related Air Carrier Accidents**

**1996 to 2008**

| *Flight* | *Airplane type* | *Date* | *NTSB event* |
| --- | --- | --- | --- |
| Turbojets |  |  |  |
| ABX N827AX | DC-8-63 | 12/22/1996 | DCA97MA016 |
| AA 903 | A300 | 5/12/1997 | DCA97MA049 |
| Pinnacle 3701 | CL-600 | 10/14/2004 | DCA05MA003 |
| Fedex 764 | MD-10 | 6/14/2008 | DCA08FA075 |
| Turboprops |  |  |  |
| Ameriflight 262 | BE-1900 | 8/13/1997 | SEA97FA188 |
| Scenic Airlines N12022 | Cessna 208 | 10/08/1997 | DCA98MA002 |
| Hageland 500 | Cessna 208 | 11/08/1997 | ANC98MA008 |
| Penair N9316F | Cessna 208 | 1/30/1998 | ANC98LA018 |
| Baron Aviation 8315 | Cessna 208 | 3/05/1998 | MIA98FA091 |
| Corporate Air 8738 | Cessna 208 | 4/07/1998 | CHI98FA119 |
| Comair 3272 | EMB-120 | 11/04/1998 | DCA97MA017 |
| Comair 5054 | EMB-120 | 3/19/2001 | DCA01MA031 |
| Corporate Air 8810 | Cessna 208 | 5/05/2001 | DEN01FA094 |
| Penair 350 | Cessna 208 | 10/10/2001 | DCA02MA003 |
| Priority Air Charter N228PA | Cessna 208 | 3/15/2002 | CHI02FA093 |
| Aviation Charter N41BE | Beech A100 | 10/25/2002 | DCA03MA008 |
| Baron Aviation N944FE | Cessna 208 | 1/24/2003 | FTW03FA089 |
| Corporate Air 8773 | Cessna 208 | 10/29/2003 | DEN04MA015 |
| Salmon Air 1860 | Cessna 208 | 12/06/2004 | SEA05FA025 |
| Arctic Circle 218 | Cessna 208 | 12/18/2007 | ANC08LA027 |

 Certain airlines, in particular Alaska Airlines, have been very proactive in getting the necessary improvements made to their simulators and in developing the new training curriculum. Other organizations, notably the European Aviation Safety Agency (EASA) and Airbus, have expressed reservations about doing this training, in part because of the belief that fly-by-wire airplanes with envelope protection obviate the need for the training. However, the Air France 447 and AirAsia 8501 accidents show that even these airplanes are vulnerable to aerodynamic stalls.

 As airline flight simulators are remodeled and re-certified and airlines begin training pilots in stall recognition and recovery, it will be essential for training department managers and instructors to fully understand the airplane’s post stall behavior and the nuances of proper recovery technique. The pilot community will need to understand and accept the need for these changes to their training.

 **Tail Stall Training**

 One Colgan recommendation addressed the need for operators to identify any airplanes in their fleet susceptible to ice contaminated tail stall (ICTS) and to provide appropriate training. Equally importantly, it insisted that any reference to tail stall procedures be removed by operators if their airplanes were not susceptible to ICTS. The impetus for this recommendation was the fact that the Colgan crew had seen a video about ICTS and may have been influenced by it during the accident stall even though the manufacturer told the NTSB during the investigation the airplane was not susceptible to ICTS.

 The FAA compiled a list of all airplanes used in 14 CFR Part 121, and broke the list into three categories. These were: airplanes not susceptible to ICTS; airplanes with risk mitigated by design changes, operating limitations, and/or operating procedures; and airplanes not evaluated. The FAA published a notice to its inspectors on the subject in June, 2014, directing principal operations inspectors (POI’s) to see that operators complied with the guidance. Notably, POI’s were directed to verify the NASA “Tailplane Icing” video was not part of the operators training if its airplanes were not susceptible to ICTS. Pilots working at air carriers should no longer be getting conflicting or unclear guidance about ICTS for the airplanes they fly.

 However, that list has not been made public. One of the problems identified in the NTSB’s Colgan investigation was widespread confusion among pilots about ICTS. There have been multiple articles published recently in aviation magazines about tail stall, possibly adding to confusion about when a tail stall recovery is needed. FAA publication of the ICTS aircraft list would help to minimize confusion on the subject for all pilots.

 **Monitoring Training**

There were two recommendations on monitoring in the Colgan report, one of which was a reiteration of an earlier recommendation. The NTSB wanted to see FAA POI’s at every airline review their airline’s procedures to ensure monitoring was being taught. The FAA did not agree to do that, but it published a final rule on qualification, service and use of crew members and dispatchers in November, 2013 that mandated air carrier pilot monitoring procedures. In January, 2017 the FAA also did a major rewrite of its AC 120-71 on standard operating procedures (SOP’s) and pilot monitoring duties. These actions met the spirit, if not necessarily the letter of the recommendations.

 Monitoring is an activity that takes place in cockpits by pilots. Mandates and training are valuable means to improve monitoring, but the ultimate responsibility lies with pilots. The FAA’s final rule mandating monitoring does not go into effect until 2019, but there is no reason for pilots to wait. All pilots of multi-crew aircraft should be improving their monitoring skills today.

 **Remedial Training**

The NTSB published a recommendation on remedial training in 2005 and it was reiterated in the Colgan report. A new recommendation addressed the need to use improved pilot records in conjunction with the remedial training program. Colgan had no remedial training program to work with pilots who had training problems. The investigation discovered the company had not taken steps to correct the accident captain’s known training deficiencies and had no effective system in place to do so. Remedial training was mandated by Congress in section 208 of the airline safety act. 14 CFR 121.415, published in November, 2013, requires this training.

 The major rewrite of airline training that includes remedial training does not become effective until March, 2019. Air carriers should be working now to ensure their training programs are robust and ready for implementation by that time. Improved pilot records - part of a new pilot records database - should assist remediation when the database is fully in place.

 **Professional Development Training**

The NTSB report addressed professionalism and leadership in three recommendations, asking the FAA to create a new advisory circular (AC), mandate training, and produce a multimedia presentation on the subject. In addition, the NTSB held a public forum on pilot and controller professionalism in May, 2010 as a follow-up to the accident report. Section 206 of the airline safety act required that airlines establish mentoring programs, professional development committees, and additional leadership training. The law specifically addressed compliance with the existing sterile cockpit rule.

 The NTSB’s analysis of the accident crew’s conversation concluded the crew was not following that rule and were distracted before the stall warning occurred. The investigation also found the accident FO used her cellphone during pre-departure taxi, a violation of 14 CFR Part 121.306. The NTSB asked the FAA to mandate use of checklists to ensure personal electronic devices were not used during critical phases of flight, but the FAA did not agree.

 The FAA issued a Notice of Proposed Rulemaking (NPRM) in October, 2016 on Pilot Professional Development.**[[16]](#endnote-17)** The new rule will add familiarization flights and leadership and mentoring training to air carrier training and will add pilot professional development committees (PPDC’s) to airline organizations. When the FAA proposed rule is implemented it should meet or exceed the NTSB recommendations on professionalism for operations under 14 CFR Part 121. The new pilot professional development rules will be in addition to previous rules and programs put forth to influence or direct pilot behavior, including the sterile cockpit rule, crew resource management (CRM) training and programs such as pilot union professional standards committees.

 The underlying purpose of the NTSB recommendations and public forum on professionalism was to reach every pilot with the message that disciplined, attentive, cooperative behavior is the standard pilots should aspire to. There are still too many accidents and incidents in which pilots do not meet those standards. It will take greater determination by crew members to achieve this end. Strong advocacy from institutional leaders will help.

**Safety Management**

 **Fatigue and Commuter Policies**

The Colgan report included a recommendation that specifically addressed fatigue caused by pilot commuting and placed responsibility for a solution on both pilots and air carriers. NTSB investigators surveyed the Colgan pilots and learned that almost 70% commuted in to the base for their flights. The accident crew had done so, and had poor rest as a result.

 Section 212 of the airline safety act mandated that the FAA would issue new regulations on pilot flight and duty time based on the best available scientific information. These regulations were to include the effects of commuting. The FAA issued a final rule, “Flightcrew Member Duty and Rest Requirements,” in January, 2012,**[[17]](#endnote-18)** establishing the new 14 CFR Part 117 governing fatigue management for passenger airline pilots. The rule became effective in December, 2014. The new regulation included a provision, 117.5, “Fitness for Duty,” that placed responsibility for fatigue on both the operator and the crew member. The FAA also mandated a fatigue risk management system and issued an AC on the subject in 2013.

 Although the FAA’s actions were a quantum leap forward for fatigue management, the NTSB thought there were two flaws. Part 117 only pertained to Part 121 passenger airlines, because the air cargo industry obtained what was known as a “carveout,” allowing them to remain under the existing Part 121 rules. In addition, airline responsibilities regarding pilot commuting were not addressed in specific detail.

 Pilot commuting is probably still just as prevalent today as it was in 2009. The structure of the industry dictates that pilots must move from location to location as they change companies and as those companies grow or shrink their bases. Some hub cities like New York are still too expensive for many pilots to afford. Companies will need to keep close track of where their pilots live and monitor the commuting action of pilots who have the most difficult commutes. Company rest facilities and subsidies for moves may be necessary. Paired with this action, commuting pilots will have to allow more time to travel to and from their bases. Pilots will need to recognize when they are in an untenable situation and move to their base, change bases or even change jobs. A systematic solution to commuting fatigue at airlines has not yet been found.

 **FOQA and SMS**

There were three recommendations addressing the implementation of flight operational quality assurance (FOQA)**[[18]](#endnote-19)** programs in the Colgan report. The NTSB wanted FOQA to be mandated for all commercial operators, subject to obtaining the necessary statutory or regulatory authority to fully protect the data. The Board also recommended use of all available data sources - in part a reference to cockpit voice recorder (CVR) data. The Board had previously recommended safety management systems (SMS’s) for all operators. FOQA programs are typically a major part of an SMS program. Section 215 of the airline safety act mandated that Part 121 airlines adopt SMS’s and consider including FOQA within these SMS programs.

 The International Civil Aviation Organization (ICAO) requires member countries to require flight data analysis programs (FDAP) as part of an SMS. FOQA is an FDAP type program. It is FAA policy to conform to ICAO Standards and Recommended Practices to the maximum extent practicable.

 Accident investigators found that if Colgan and other Q400 operators had adopted FOQA programs they might well have discovered how often pilots mis-set the airplane’s “ref speed switch,” resulting in premature stall warning activations such as happened in the Colgan accident. At the time of the accident, most regional airlines did not have FOQA programs and none were required.

 In June, 2009, the FAA administrator encouraged airlines to set up FOQA programs, and by January, 2010, 11 regional airlines had begun to do so.**[[19]](#endnote-20)** By February, 2013, FAA reported that 39 airlines (about half of part 121 airlines) had set up FOQA programs. In January of 2015, the FAA published a final rule requiring Part 121 airlines to have SMS programs.**[[20]](#endnote-21)** However, the agency did not require FOQA. Congress did not provide the statutory support the Board wanted the FAA to obtain for mandatory FOQA.**[[21]](#endnote-22)** The FAA also felt FOQA was cost prohibitive or impractical for some smaller airlines and older airplanes.

 As audio and video recording technology continues to improve, even flight schools and corporate operators are adopting flight data monitoring systems. As the cost of systems drops and becomes more miniaturized, FOQA type programs become more and more feasible for all. While voluntary compliance is still the rule for airline FOQA programs in the U.S., the Colgan investigation showed the public has a stake in airline safety too. The public should know which operators have robust FOQA programs and which ones do not.

**FAA Oversight and Design Standards**

 **Simulator Fidelity**

At the time of the Colgan accident, airline flight simulators could not accurately duplicate the actions of an airplane when it was fully stalled. An NTSB recommendation called for new simulator fidelity requirements that would support the new stall recovery training. The FAA put those requirements into effect in March, 2016 with the publication of a new rule, “Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks.”**[[22]](#endnote-23)** The new simulator standards also required the ability to simulate upsets other than stalls, icing conditions, gusty crosswinds during takeoff and landing, and bounced landings. These requirements stemmed from earlier accident recommendations. Airlines had until March, 2019 to put these standards into effect.

 Simulator manufacturers depend on airplane flight test data to model simulator flight path and flight control response. In the new rule, the FAA allows for aerodynamic stall models to be developed and validated using engineering and analytical methods, and requires the post-stall airplane behavior to be type-specific and sufficiently accurate to be able to conduct the necessary training. Subject matter experts (SME’s), typically type-experienced test pilots, will validate the accuracy of the modified simulators performances.

 For many years, the lack of simulator accuracy prevented the aviation industry from moving forward in stall training. Improper training using old, inaccurate simulator motion models contributed to several accidents, and the FAA had concerns about “negative training.” The Colgan accident report caused a breakthrough in the resistance to changing simulators to allow the needed stall training.

 According to an official at Bihrle Applied Research, a stall simulation provider, only about 5 out of 100 flight simulators in the U.S. contain the data necessary for full stall simulation at the present time.**[[23]](#endnote-24)** In the two years that remain before the FAA requirements go into effect, airlines will have to make investments in simulators and new training curricula. Further delays in proper stall training could result in another stall-related accident.

 **Low Speed Cautions**

There were two recommendations in the Colgan report on the need for improved low speed warnings. Investigators found the accident airplane, while properly certificated, had neither a low speed amber band on the airspeed indicator nor a low speed aural cue, and that both of these could have alerted the accident crew to a pending stall before the stall warning activated. The FAA changed the design standard for the amber band in January, 2011, but so far has not taken action on the aural cue.

 **Surveillance**

Colgan was experiencing rapid growth at the time of the accident. The accident Q400 airplane type had only been in service at the airline for one year, and the company’s pilots were relatively new to the airplane. Investigators found the FAA inspectors assigned to oversee the airline were also new to the airplane, and had a heavy workload. Even though there were Q400 qualified FAA inspectors elsewhere, they were not assigned to help. One NTSB recommendation asked the FAA to better address workload and experience discrepancies of this type, and the FAA agreed, issuing amended policy and procedure in the fall of 2014.

 Congress agreed with the need to ensure better surveillance of airlines. They mandated the creation of an air carrier task force (Section 204 of the airline safety act), a review of FAA inspector staffing and workload (Section 205), and an annual inspection of regional airlines (Section 211). The FAA completed these actions between 2011 and 2012.

 The FAA has long been aware of the safety challenges of new airplane introductions, rapid growth, and industrial issues such as strikes at airlines. The FAA will need to provide close scrutiny to airlines based on these considerations.

 **Safety and Operational Communications**

The Colgan report included three recommendations pertaining to FAA’s dissemination of weather information to pilots and one recommendation about the FAA’s use of non-binding notices such as Safety Alert for Operators (SAFO’s) for safety-critical information. Most of the weather recommendations have been completed. The SAFO recommendation has not been closed. Investigators found the FAA had issued a SAFO addressing remedial training programs in response to an NTSB recommendation, but neither the Colgan POI nor Colgan officials were aware of it. This lack of awareness of SAFO’s had been commonly noted by the NTSB in other investigations. The FAA had no process in place to ensure and document that the safety-critical information in much of its communications to airlines was actually read, accepted and acknowledged.

 Safety information is of no value if no one reads it. Establishing a feedback loop between the FAA and airlines would seem to be a simple task. However, it remains a problem not yet resolved.

 **Code Sharing**

Colgan 3407 was a Continental Airlines codeshare flight. During the investigation, many observers, including families of the victims and journalists, expressed surprise that the accident airplane, painted in Continental’s colors and logo, was not actually a Continental flight. Investigators spoke with Continental officials and found that company disclaimed any responsibility for the safe operation of Colgan Airlines. In contrast, Colgan staff told investigators Continental exercised significant control over their company, including setting of schedules and making decisions about cancellations. The accident report did not discuss code sharing but the NTSB held a public forum on the subject in September, 2010.

 In section 210 of the airline safety act, Congress required airlines to disclose the actual air carrier to be flown on airline tickets, and in section 214 required annual FAA inspections of regional airlines.

 Code sharing is not a recent phenomenon. The NTSB made reference to “code sharing arrangements” in a 1994 safety study on commuter airline safety. That study helped to persuade the FAA in 1995 to place most commuter airlines into the same Part 121 regulatory regime as major airlines; the FAA called it creating “one level of safety.” The Colgan investigation showed that, even though it was certified under Part 121, the airline was clearly not operating at the same level of safety as major airlines.

**Conclusions**

 Before the Colgan investigation, some airlines, particularly regional airlines, met only very low minimum standards for pilot hiring, pilot training, pilot records, and pilot professional standards. Those standards have been raised. Before the Colgan investigation, all airlines conducted “maintain altitude” stall training. The change to realistic stall training is now under way. Before the Colgan investigation, thousands of turboprop pilots were confused about tail stalls. That has changed. Airline pilot monitoring training, remedial training and professional development training were minimal or non-existent. These are now required. Standards for pilot fatigue management, safety management systems, flight simulators and low speed cautions have improved.

 Not every safety issue raised by the investigation has been fully resolved. Pilot records improvements have been very slow to develop. Most flight simulators still need to be modified for use in the new stall training. Voluntary compliance with rules and good judgment by pilots is still needed, as is the adoption of safety programs like FOQA by airlines. However, standards have been raised.

 For today’s accident investigators, it should be clear that good investigations really do matter. Explaining not just what happened, but why it happened leads pilots, airlines and the FAA to rethink the way they operate. Making recommendations is part of an investigation, and being willing to challenge the status quo is important. Even when recommendations miss their mark or fail to be accepted, they provide a reasoned argument for change.

 The findings and recommendations from many previous investigations influenced the changes made after the Colgan accident long after their reports were completed. For example, the air carrier stall related accident investigations shown in table 4 did not change stall training, but they provided strong support to the arguments that succeeded in making the change. Today’s investigators should recognize that every investigation is important, either now or later.

 Finally, maintaining a reputation for fairness, integrity, thoroughness and attention to detail as an investigative agency pays off in many ways. The Colgan investigation was not easy. Parties were fearful of liability, emotions ran strong, and there was strong pressure to produce a report within one year. Even so, the public, the victim’s families, and the Congress placed faith in the NTSB’s process, findings and recommendations, and this faith was what enabled change.

**Notes**

1. ”Fact Sheet - Commercial Air Safety Team,” FAA website, April 12, 2016. <https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=18178> [↑](#endnote-ref-2)
2. NTSB. “Accident Report: Loss of Control on Approach. Colgan Air, Inc. Operating as Continental Connection Flight 3407. Bombardier DHC-8-400, N200WQ, Clarence Center, New York. February 12, 2009” NTSB/AAR- 10/01. Adopted February 2, 2010. [↑](#endnote-ref-3)
3. Airline Safety and Federal Aviation Administration Extension Act of 2010; Public Law 111-216 - 124 Stat. 2348 - Aug. 1, 2010. Referred to as “the airline safety act” in this report [↑](#endnote-ref-4)
4. The members of the group believed Continental, the mainline codeshare partner, was responsible for the conduct of the flight [↑](#endnote-ref-5)
5. See Regional Airline Association (RAA) 2010 Annual Report. [↑](#endnote-ref-6)
6. Air Sunshine 527 and Peninsula 842 were Part 135 scheduled passenger flights [↑](#endnote-ref-7)
7. Advisory and Rulemaking Committee [↑](#endnote-ref-8)
8. 1500 flight hours was already a requirement for an ATP certificate. [↑](#endnote-ref-9)
9. Pilot Certification and Qualification Requirements for Air Carrier Operations; Final Rule; Fed. Reg. Vol. 78 No. 135, 42324, July 15, 2013 [↑](#endnote-ref-10)
10. Institutions Authorized to Certify its Graduates for an Airline Transport Pilot (ATP) Certificate with Reduced Aeronautical Experience, April 8, 2016 [↑](#endnote-ref-11)
11. Certificate Holders Authorized to Conduct the Airline Transport Pilot (ATP) Certification Training Program (CTP) revision 27, 2/23/2017 [↑](#endnote-ref-12)
12. See 14 CFR Part 61.129 [↑](#endnote-ref-13)
13. FAA’s Efforts to Maintain and Secure Pilot Records; U.S. Department of Transportation, Office of Inspector General; Hearing Before the Committee on Oversight and Government Reform, Subcommittee on Transportation and Public Assets, United States House of Representatives, February 3, 2016 [↑](#endnote-ref-14)
14. FAA, Deployment of Pilot Records Database; National Policy, N8900.394, Dec. 13, 2016 [↑](#endnote-ref-15)
15. Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers; Final Rule; Fed. Reg. Vol. 78 No. 218, 67800, Nov. 12, 2013 [↑](#endnote-ref-16)
16. Pilot Professional Development; NPRM; Fed. Reg. Vol. 81 No. 195, 69908, October 7, 2016 [↑](#endnote-ref-17)
17. Flightcrew Member Duty and Rest Requirements; Final Rule; Fed. Reg. Vol 77 No. 2, 330, January 4,2012 [↑](#endnote-ref-18)
18. FOQA programs include installation of extensive flight data recording systems which facilitate rapid transfer of recorded data, de-identification of that data, and agreements between pilot organizations and the air carriers which define how this information may be used. [↑](#endnote-ref-19)
19. FAA Fact sheet - Update on the FAA’s Call to Action to Enhance Airline Safety, January 27, 2010 [↑](#endnote-ref-20)
20. Safety Management Systems for Domestic, Flag, and Supplemental Operations Certificate Holders; Final Rule; Fed. Reg. Vol. 80 No. 5, 1308, Jan. 8, 2015. The effective date of the rule was March 9, 2015. Carriers had three years to comply. [↑](#endnote-ref-21)
21. See PL 112-95, FAA Modernization and Reform Act of 2012, Section 310 [↑](#endnote-ref-22)
22. Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks; Final Rule: Fed. Reg. Vol. 81 No. 61, 18178, March 30, 2016 [↑](#endnote-ref-23)
23. Canaday, Henry; [AerospaceAmerica.aiaa.org](http://AerospaceAmerica.aiaa.org), March 6, 2017 [↑](#endnote-ref-24)