

NASA/CR–2020-220565



Changes in Frequency of the Severity and Type of Aviation Accidents (1987 to 2016)

Joni K. Evans

Analytical Mechanics Associates, Inc., Hampton, Virginia

February 2020

NASA STI Program . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA scientific and technical information (STI) program plays a key part in helping NASA maintain this important role.

The NASA STI program operates under the auspices of the Agency Chief Information Officer. It collects, organizes, provides for archiving, and disseminates NASA's STI. The NASA STI program provides access to the NTRS Registered and its public interface, the NASA Technical Reports Server, thus providing one of the largest collections of aeronautical and space science STI in the world. Results are published in both non-NASA channels and by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA Programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA counter-part of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.

- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services also include organizing and publishing research results, distributing specialized research announcements and feeds, providing information desk and personal search support, and enabling data exchange services.

For more information about the NASA STI program, see the following:

- Access the NASA STI program home page at <http://www.sti.nasa.gov>
- E-mail your question to help@sti.nasa.gov
- Phone the NASA STI Information Desk at 757-864-9658
- Write to:
NASA STI Information Desk
Mail Stop 148
NASA Langley Research Center
Hampton, VA 23681-2199

NASA/CR–2020-220565



Changes in Frequency of the Severity and Type of Aviation Accidents (1987 to 2016)

Joni K. Evans

Analytical Mechanics Associates, Inc., Hampton, Virginia

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23681-2199

Prepared for Langley Research Center
under Contract 80LARC17C0003

February 2020

Available from:

NASA STI Program / Mail Stop 148
NASA Langley Research Center
Hampton, VA 23681-2199
Fax: 757-864-6500

Introduction

This document reports the fourth analysis to identify the types of accidents with the greatest impact on the overall safety risk in U.S. civil aviation. The first three analyses examined accidents in 1997-2006¹, in 2001-2010² and in 2005-2014³. The safety risks herein are defined to include four elements:

- the number of total accidents
- the number of fatal accidents
- the number of total injuries
- the number of fatal injuries

Two of the previous analyses also included the number of incidents, but incident data since 2007 are difficult to separate by flight operation. Other incident details are no longer recorded as well. Due to these changes, the author's working copy of the incident data has not been updated since 2011 (for incidents through 2010), and the incident data were not included in this analysis. Powerplant and non-powerplant system component failures were the only categories with a greater contribution to the overall safety risk from incidents than from accidents.

Accident types, as well as accident rates, have been shown to vary considerably among different flight operations (e.g., large air carriers versus general aviation). For this reason, all analyses were done separately for four types of flight operations (Part 121, Scheduled Part 135, Non-Scheduled Part 135 and Part 91).

Nomenclature

Organizations

NTSB	National Transportation Safety Board
FAA	Federal Aviation Administration
CAST	Commercial Aviation Safety Team
ICAO	International Civil Aviation Organization
CICTT	CAST/ICAO Common Taxonomy Team

Acronyms and Abbreviations

ARC	Abnormal Runway Contact
AMAN	Abrupt Maneuver

¹ Jones SM, Reveley, MS, Withrow C, Evans, JK, Barr LC, Leone, K. "Systems Analysis of NASA Aviation Safety Program: Final Report"; October 2013.

² Evans, JK, "Frequency of specific categories of aviation accidents and incidents during 2001-2010"; August 2012.

³ Evans, JK, "Most frequently observed categories of aviation accidents during 2005-2014"; June 2016

ADRM	Aerodrome
ATM	Air Traffic Management
BIRD	Bird Strike
CABIN	Cabin Safety Events
CTOL	Collision with Obstacle(s) during Takeoff and Landing
CFIT	Controlled Flight Into or toward Terrain
CWO-PL	Collision with Object – Precautionary Landing
CWT-PL	Collision with Terrain – Precautionary Landing
EVAC	Evacuation
EWT-PL	Encounter with Terrain – Precautionary Landing
FI-NI	Fire/Smoke Non-Impact
FI-POST	Fire/Smoke Post-Impact
FUEL	Fuel Related
GCOL	Ground Collision
ICE	Icing
INCAP	Pilot Incapacitation or Severe Impairment
LOC-G	Loss of Control – Ground
LOC-I	Loss of Control – In flight
LALT	Low Altitude Operations
MAC	Airprox/TCAS Alert/Loss of Separation/Near Mid-Air Collision/ Mid-Air Collision
MED	Medical Emergencies
PL-FUEL	Loss of Engine Power – Fuel Related (same as FUEL)
PL-OTHER	Loss of Engine Power – Other Reasons
PL-UNK	Loss of Engine Power – Unknown Reasons
RAMP	Ground Handling
RE or RUNEXC	Runway Excursion
RI-VAP	Runway Incursion – Vehicle, Aircraft or Person
SEC	Security Related
SCF-NP	System/Component Failure or Malfunction – Non-powerplant
SCF-PP	System/Component Failure or Malfunction – Powerplant
SCF-SLE	System/Component Failure or Malfunction (Stress Limits Exceeded)
TURB	Turbulence Encounter
UIMC	Unintended Flight in Instrument Meteorological Conditions
USOS	Undershoot/Overshoot
WSTRW	Wind Shear or Thunderstorm

Data Sources

The National Transportation Safety Board is an independent Federal agency tasked with

- a) investigating every civil aviation accident in the United States and significant accidents in the other modes of transportation,
- b) conducting special investigations and safety studies, and
- c) issuing safety recommendations to prevent future accidents.

The information collected by the NTSB investigators during their investigations into these aviation events resides in the NTSB Aviation Accident and Incident Data System. A copy of this database in Microsoft Access format was obtained from the Aviation Safety Information Analysis and Sharing (ASIAS) department of the FAA Office of Aviation Safety⁴ in May 2019. At that point in time, the NTSB investigation was not complete for a substantial number of 2017 accidents, particularly those which occurred toward the end of the year. For this reason, all work on the database was restricted to the period 1986-2016, which resulted in an update of two years beyond the previous working version of the data.

The NTSB database includes events involving a wide variety of aircraft (airplanes, helicopters, hot air balloons, gliders, ultra-lights, etc.) with operations conducted under various Federal Aviation Regulations (Part 91: General Aviation, Part 121: Commercial Air Carriers, Part 129: Foreign Air Carriers, Part 135: Commuters and On-Demand Air Taxis, Part 137: Agricultural Operations, etc.). In March 1997 a change was made in the Federal Aviation Regulations defining the requirements for Part 121 versus Part 135 operations. As a result, Part 121 regulations were applied to commuter operations with 10 or more passengers⁵.

The NTSB considers each event to be either an accident or an incident, under the following definitions:⁶

Accident - an occurrence associated with the operation of an aircraft, which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage

Incident - an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations

Any injury or aircraft damage which occurs when there was no intent for flight (high speed taxi tests, movement of the aircraft around the airfield, maintenance run-ups, etc.) is, by definition, an incident.

All recorded accidents involving commercially built fixed-wing airplanes operating under FAR Part 121, Part 135 or Part 91 were included in this working dataset, regardless of whether the investigation is in a preliminary stage or finalized, and whether or not the event occurred within the United States. For Part 91, this includes aircraft registered in another country but operating in

⁴ http://www.asias.faa.gov/portal/page/portal/asias_pages/asias_home/

⁵ National Transportation Safety Board. *Annual Review of Aircraft Accident Data US Air Carrier Operations, Calendar Year 1999, NTSB/ARC-02/03, PB2002-109241*, November 13, 2002, page 1.

⁶ National Transportation Safety Board, "Government Information Locator Service (GILS): Aviation Accident Synopses" <http://www.nts.gov/GILS/Pages/Synopses.aspx>

the US, and all US registered aircraft operating outside the US; but does not include foreign aircraft operating outside the United States. Amateur built or experimental aircraft were excluded, as were helicopters, ultra light aircraft, gliders and balloons.

In 1997 the NTSB developed a classification system in order to combine injury and aircraft damage into one rating of accident severity. The classification was developed for Part 121 aircraft only, but has been expanded in this report to apply to all aircraft. When multiple aircraft were involved in the accident, the most severe injury and damage was used to classify the accident. The definitions for these classifications are as follows:

- Major: the aircraft was destroyed
 OR there were multiple fatalities
 OR there was one fatality and the aircraft was substantially damaged
- Serious: there was one fatality without substantial aircraft damage
 OR there was at least one serious injury and the aircraft was substantially damaged
- Injury: no fatalities but at least one serious injury
 (with less than substantial damage to the aircraft)
- Damage: no fatalities or serious injuries, but the aircraft was substantially damaged

Accident Occurrence Category

All of the accidents included in this report have been assigned occurrence categories based on the taxonomy developed by the Commercial Aviation Safety Team/International Civil Aviation Organization (CAST/ICAO) Common Taxonomy Team (CICTT)⁷. A few categories were added to this taxonomy for non-transport accidents, and details of all categories can be found in Appendix A. The assignment of categories for accidents was performed by means of a computer program, based on the occurrence codes and causal factor codes in the NTSB database. During the assignment process, many of the more complicated accidents were reviewed by the author, with assistance from other systems analysis staff within the Aeronautics Research Mission Directorate. Note that a particular accident might have been assigned multiple occurrence categories. A navigation error category was new to the latest release by the CICTT, and has not yet been included in the assignment of categories to the accidents.

One CICTT specification was not followed; this was regarding loss of control when a system/component failure/malfunction rendered the aircraft uncontrollable. The CICTT taxonomy states that the loss of control should not be considered as a separate category in these cases. However, this analysis retained the loss of control category in all circumstances,

⁷ CAST/ICAO Common Taxonomy Team, "Aviation Occurrence Categories Definitions and Usage Notes, October 2013 (4.6) <http://www.intlaviationstandards.org/Documents/OccurrenceCategoryDefinitions.pdf>

regardless of malfunctions, in order to capture all of the loss of control including those that followed system/component failure/malfunction or other circumstances (e.g., incapacitation, weather, etc.) that might have rendered the aircraft uncontrollable.

As previously mentioned, analyses were completed in 2010, 2012 and 2016 to identify the CICTT occurrence categories with the largest contribution to the safety risk, which was defined to include the number of accidents, fatal accidents and incidents (only in 2010 and 2012), and the number of total injuries and fatal injuries. This collection of occurrence categories has been referred to as ‘tall poles.’ It is logical to ask the question: “Is the set of ‘tall poles’ dependent upon the specific years that are included in that analysis?” Since all of the previous analyses used a ten-year time period, five sets with ten years of data were selected to repeat these analyses, and the results were compared.

The collection of occurrence categories was determined by selecting the top few occurrence categories within each flight operation within each time period for four outcomes: total accidents, fatal accidents, total injuries and fatal injuries. The actual number of categories selected varies among outcomes and flight operation (generally 3-5), but in each case a clear demarcation in percentages exists to distinguish those selected from those not selected.

Results and Discussion

Table 1 summarizes the number of accidents and fatal accidents, and also the number of total injuries and fatal injuries sustained in these accidents, for each of the four flight operation categories.

Table 1. Summary of Accidents, Injuries and Incidents (1987-2016)

Type of Outcome	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	1034	306	1601	37707
Total Injuries	5768	785	1789	30264
Fatal Accidents	80	65	396	7133
Fatal Injuries	2536	399	937	13588

Figure 1 shows the accident rate (per 1 million flight hours) over time for each of the four flight operation categories. Data for total flight hours per year were obtained from tables published by the NTSB, which they based on data from the FAA⁸.

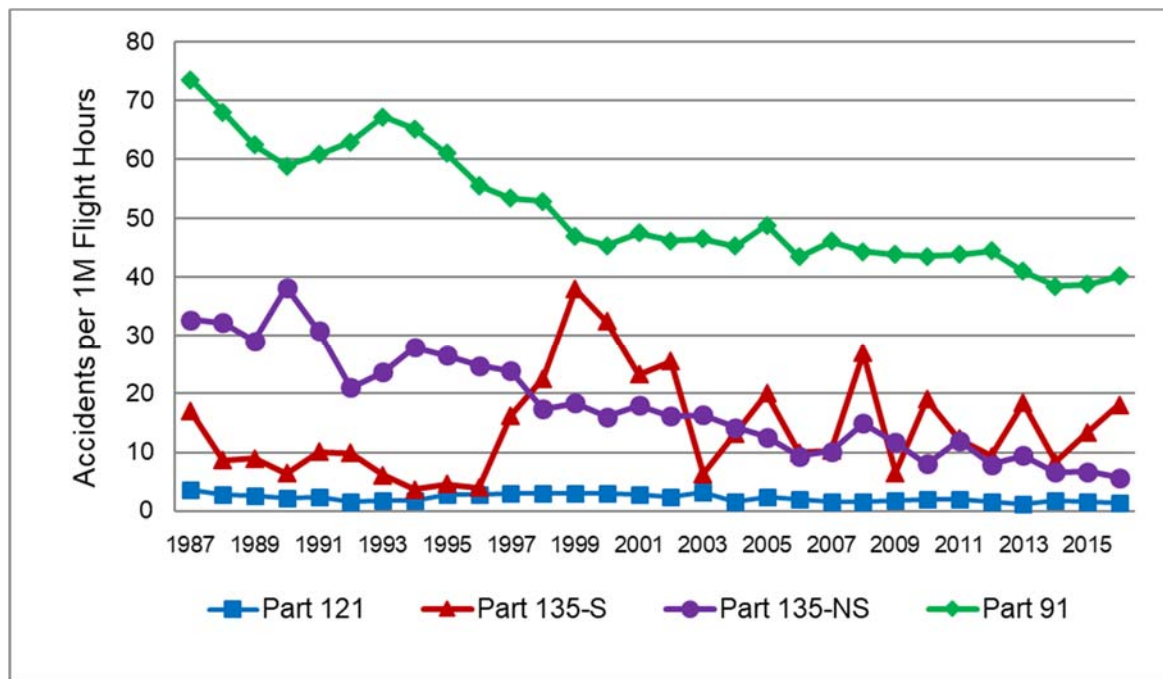


Figure 1. Total Accident Rates in Four Categories of Flight Operations (1987-2016).

⁸ Tables 5, 8, 9 and 10. https://www.nts.gov/investigations/data/Pages/aviation_stats.aspx

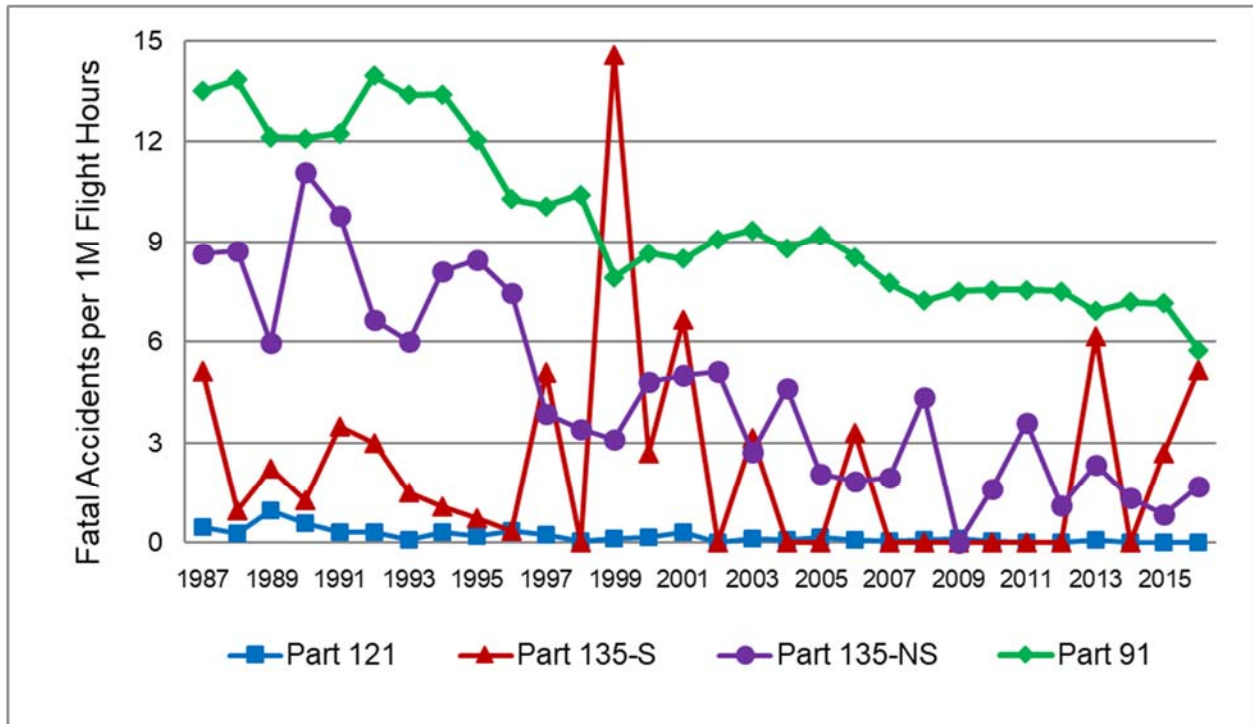


Figure 2. Fatal Accident Rates in Four Categories of Flight Operations (1987-2016).

In general, the rates are decreasing over time for all flight operations except scheduled Part 135. The same is true for fatal accident rates (Figure 2). In nearly all years, the highest accident rates and fatal accident rates are in Part 91, followed by Part 135 and Part 121. It is interesting that prior to 1997, the accident rates and fatal accident rates in scheduled Part 135 were most similar to the rates in Part 121, but since 1997, there is more similarity between scheduled Part 135 and non-scheduled Part 135.

It is worth noting that prior to 1997 the total flight hours in scheduled Part 135 were very close to the total flight hours in non-scheduled Part 135, but in more recent years, the scheduled Part 135 flight hours are roughly ten percent of those for non-scheduled Part 135. The low number of flight hours contributes to the variation seen in the rates for scheduled Part 135, although the larger problem is the amount of variation in small numbers of accidents (between two and eight accidents per year from 2001 to 2016).

The year-to-year variation in accident rates can make it difficult to read these charts. An alternative is to summarize the data by periods of several years. We have thirty years of available data, so we chose to define six time periods of five years each. Figures 3 and 4 present the accident rates and fatal accident rates for each flight operation and each time period.

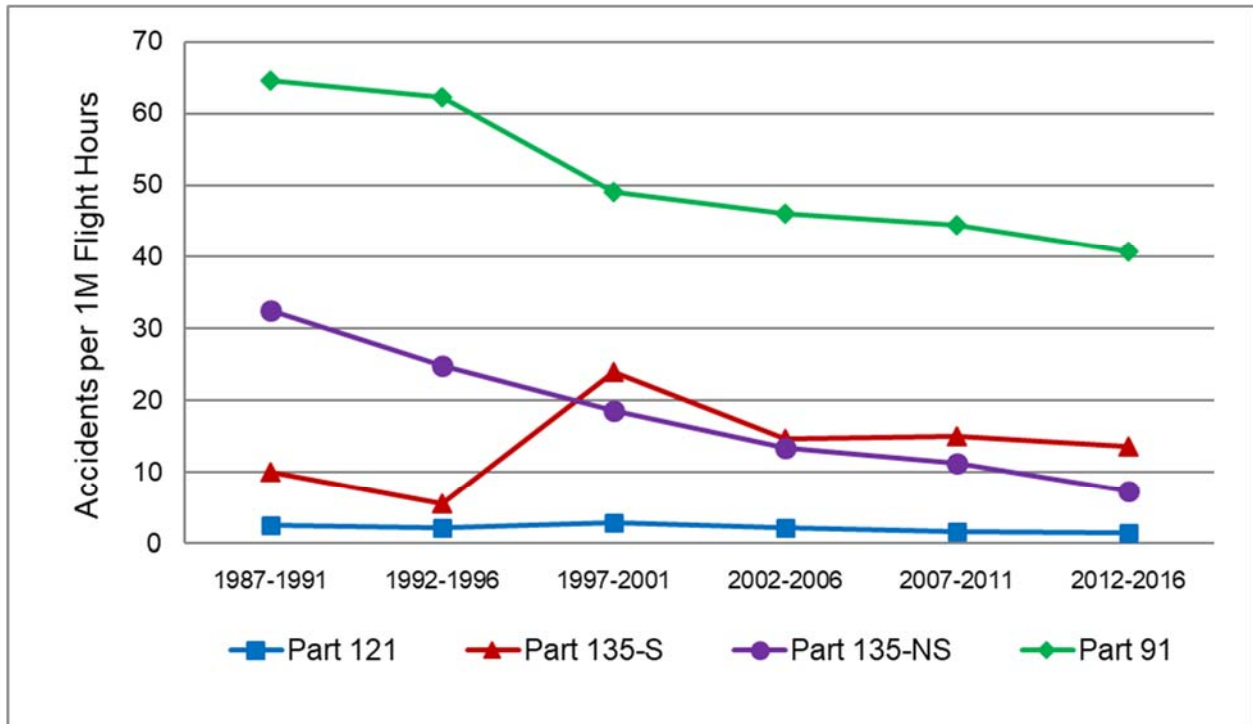


Figure 3. Accident Rates in Four Categories of Flight Operations (1987-2016).

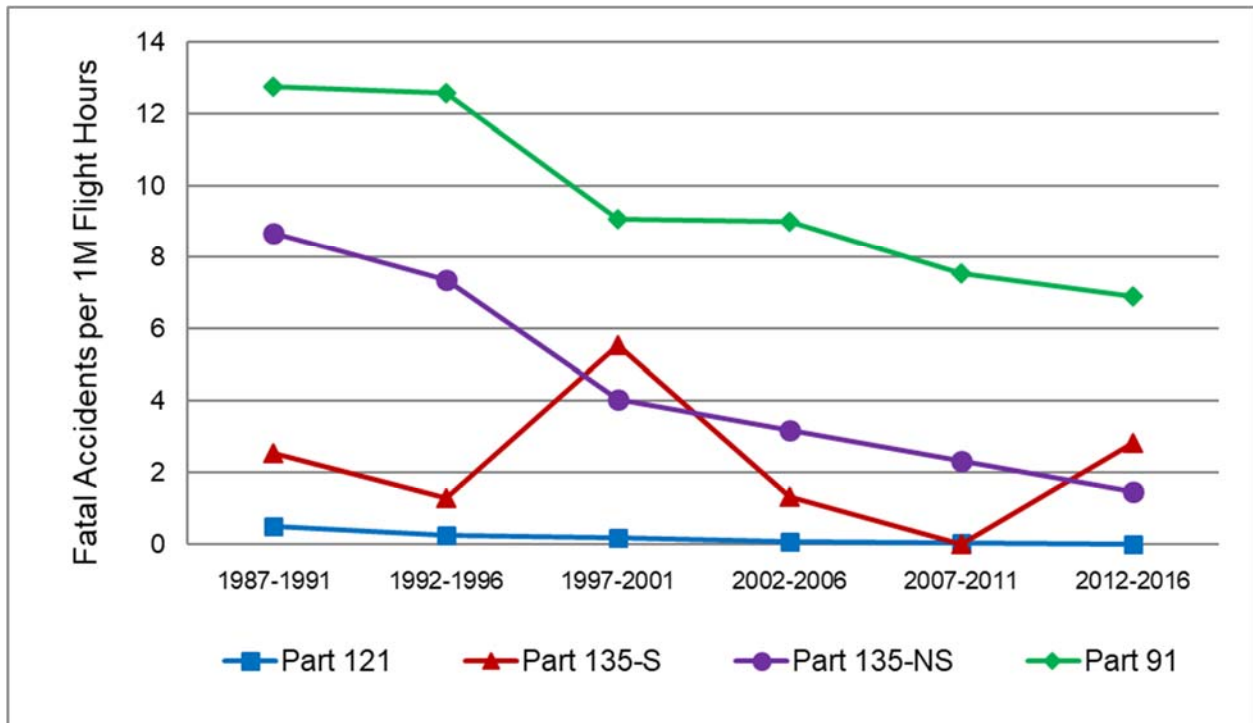


Figure 4. Fatal Accident Rates in Four Categories of Flight Operations (1987-2016).

Now it is much easier to see that in Part 91, there were large decreases in both rates from 1992-1996 to 1997-2006, and more consistent but more modest decreases between other time periods.

In non-scheduled Part 135, there was also a substantial decrease in the fatal accident rate, similar to Part 91, but the total accident rate decreased consistently across the time periods.

The patterns in scheduled Part 135 vary between charts. Both the total accident rate and fatal accident rate increased significantly in 1997. While the total accident rate has generally decreased since then, the fatal accident rate had a sharp increase during the last time period (2012-2016).

In Part 121, the fatal accident rate peaked in 1989 and decreased steadily until 2001. From 2002-2016 only 17 accidents included a fatality. Although the highest total accident rate during the study period was in 1987 (3.5 per million flight hours), in each of the years 1995 to 2001 the accident rate was at least 2.7, giving a slight bump to the accident rate in the 1997-2001 time period. From 2004 to 2016, the accident rate exceeded 2 accidents per million flight hours only once.

The remainder of this report will be organized by flight operation.

Part 121 operations

Figure 5 shows the accident rates for four categories of injury severity. These categories are based on the most severe injury sustained in the accident. The predominance of these categories has changed over time. For all time periods except 2002-2006, the highest accident rate was among those with serious injuries. During 2002-2006, the rate of accidents with no injuries was higher than the rates of accidents with other injuries. From 1987 to 1996, minor injuries were least likely to be the most severe injury in accidents. Starting in 1997-2001, fatal injuries were the least likely among all categories, although from 2002-2016 the rate of accidents with at most minor injuries was nearly identical to the rate of accidents with fatal injuries.

Figure 6 shows the accident rates associated with four levels of aircraft damage. From 1987 to 1996 and from 2007-2016, no damage was just as likely as substantial damage, but from 1997 to 2006 accidents most often resulted in substantial damage. Rates of aircraft destruction have decreased similarly to rates of fatal injuries.

Figure 7 shows the accident rate according to the NTSB severity classification system. Although not identical, the rates for fatal injuries and aircraft destruction are very comparable to each other, which led to a similar line for rates of major accidents. Additionally, no injuries plus substantial aircraft damage result in the 'damage' category, and those rates were comparable. Likewise no damage plus serious injuries result in the 'injury' category. It is not surprising that these three charts resemble each other to a high degree.

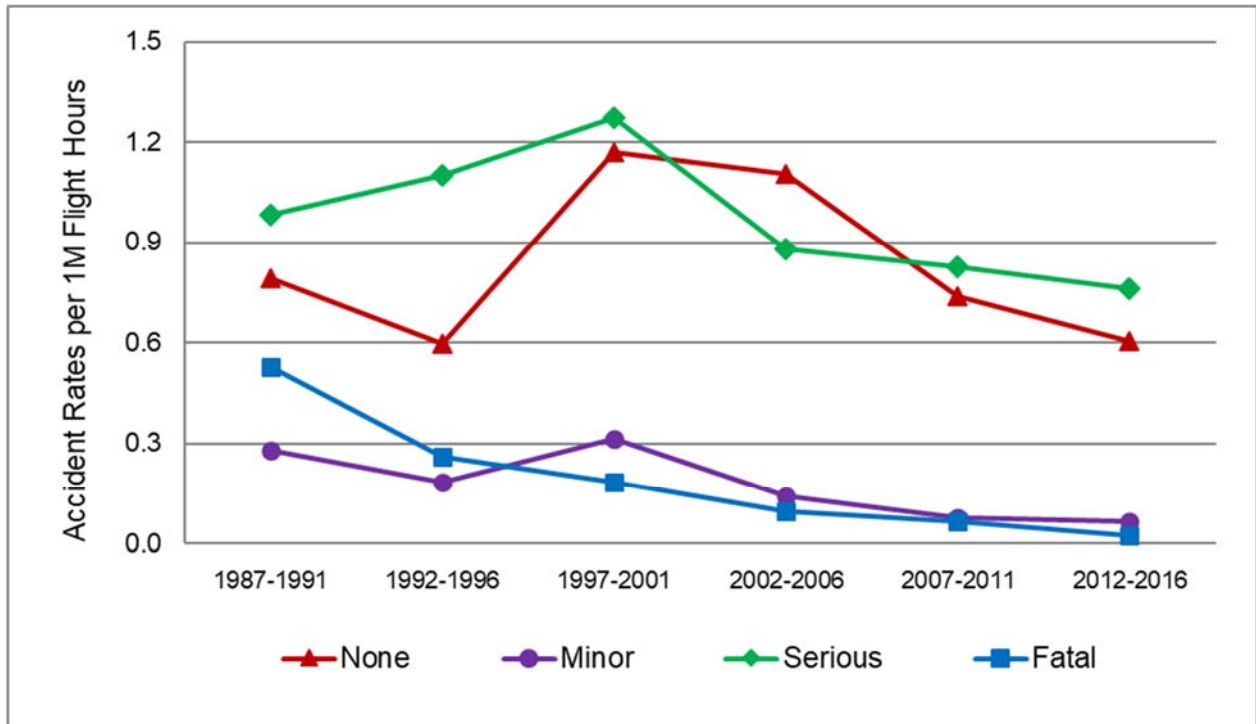


Figure 5. Accident Rates in Four Levels of Injury Severity (Part 121; 1987-2016)

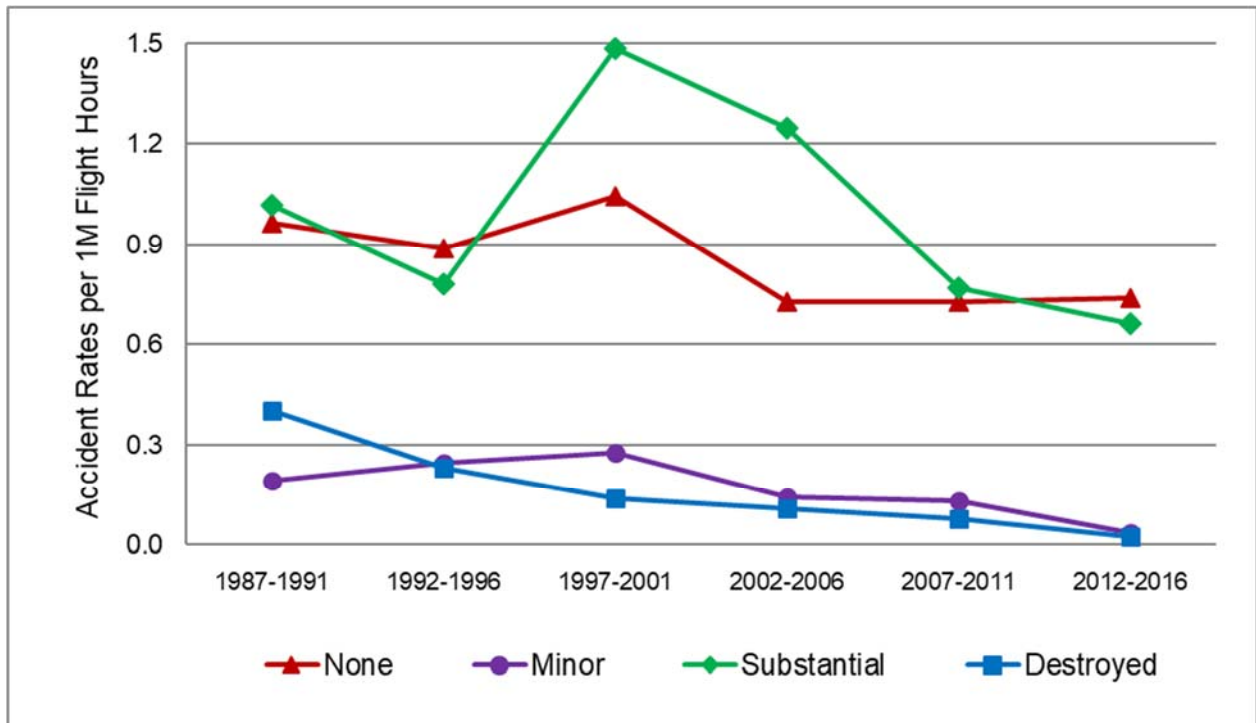


Figure 6. Accident Rates in Four Levels of Aircraft Damage (Part 121; 1987-2016).

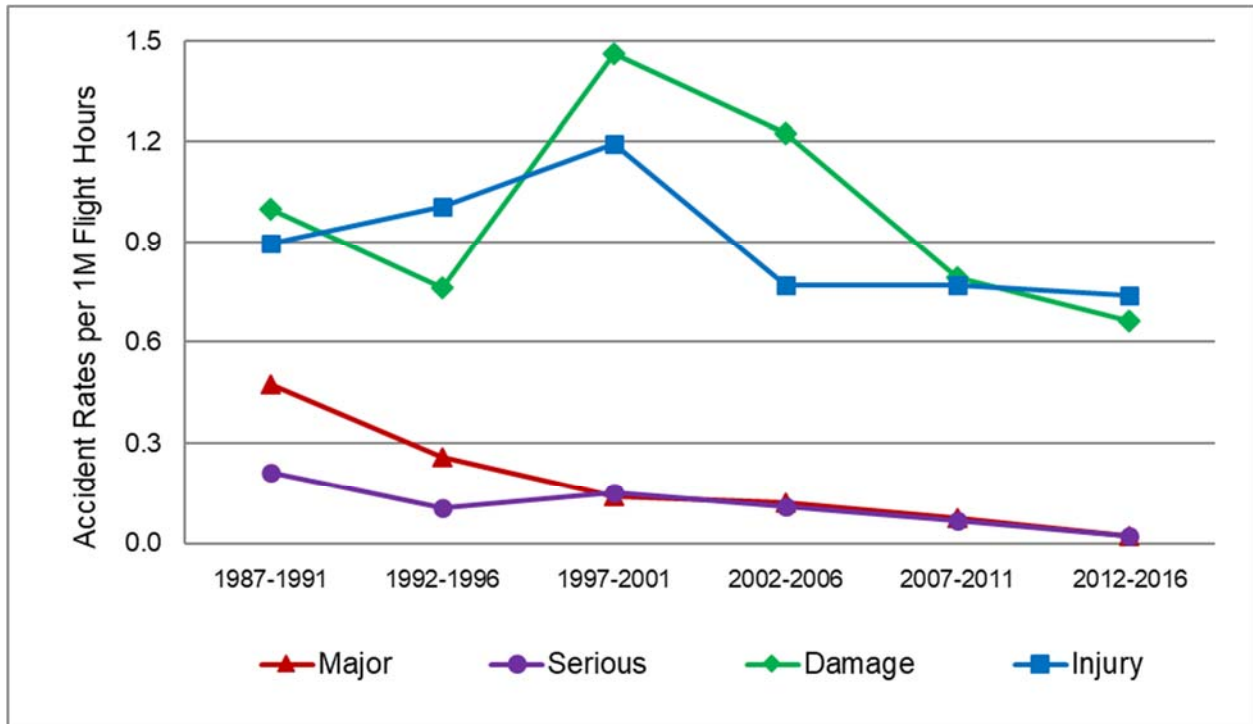


Figure 7. Accident Rates in Four Levels of Accident Severity (Part 121; 1987-2016).

Table 2 shows the number of total and fatal accidents, injuries and fatalities across the entire study period (1987-2016) for each CICTT occurrence category. All of the percentages are based on the total number of accidents or injuries, respectively. The reader is reminded that a particular accident might be assigned multiple occurrence categories. The additional categories that are not part of the official CICTT taxonomy are denoted with an asterisk (*).

In light of the changes over time seen above in terms of injury and damage, one might guess that there were also changes in the rates of different accident categories. It is reasonable to look at trends only in the occurrence categories that have a minimum quantity of occurrence. To determine that set of occurrence categories, first those categories representing less than five percent of both total accidents and fatal accidents were eliminated. This left a set of categories which represented at least five percent of one type of event. We imposed an additional requirement that there be at least ten events comprising that minimum percentage. An example of this second requirement is in the category of non-impact fire, which represents nine percent of fatal accidents, but that percentage is based on only seven events. Nine accident categories were retained. Tables for total accidents and fatal accidents in each 5-year time period, upon which the following charts were based, can be found in Appendix B.

Figures 8-A, 8-B and 8-C show the accident rates for those nine categories. Accident rates have not increased consistently over the study period in any occurrence category, but for several categories (FI-POST, LOC-I, EVAC, SCF-NP) rates have generally decreased over time. The highest accident rates are associated with turbulence and ground handling (RAMP), both of which increased across the first half of the study period, then decreased to earlier rate levels.

Table 2. Part 121 Accidents and Injuries by CICTT Occurrence Category (1987-2016)

CICTT Occurrence Category	Total Accidents	Total Injuries	Fatal Accidents	Fatal Injuries
Total Events	1034	5768	80	2536
Abrupt Maneuver	21 (2.0%)	309 (5.4%)	1 (1.3%)	265 (10.5%)
Abnormal Runway Contact	97 (9.4%)	103 (1.8%)	0 (0.0%)	
Aerodrome	15 (1.5%)	73 (1.3%)	0 (0.0%)	
Air Traffic Management	31 (3.0%)	481 (8.4%)	7 (8.8%)	252 (9.9%)
Bird Strikes	29 (2.8%)	12 (0.2%)	0 (0.0%)	
Cabin Safety or Pilot Incapacitation	40 (3.9%)	48 (0.8%)	2 (2.5%)	2 (0.1%)
Controlled Flight Into Terrain	9 (0.9%)	341 (5.9%)	6 (7.5%)	327 (12.9%)
Collision with Object – Takeoff or Landing	5 (0.5%)	165 (2.9%)	1 (1.3%)	156 (5.2%)
Collision with Object – Prec Landing *	0 (0.0%)		0 (0.0%)	
Collision with Terrain – Prec Landing *	4 (0.4%)	40 (0.7%)	3 (3.8%)	30 (1.2%)
Encounter w/ Terrain – Prec Landing *	3 (0.3%)	12 (0.2%)	0 (0.0%)	
Evacuation	69 (6.7%)	559 (9.7%)	2 (2.5%)	3 (0.1%)
Fire – Non-Impact	44 (4.3%)	709 (12.3%)	7 (8.8%)	402 (15.9%)
Fire – Post Impact	43 (4.2%)	1838 (31.9%)	29 (36.3%)	1209 (47.7%)
Ground Collision	74 (7.2%)	55 (1.0%)	0 (0.0%)	
Ground Handling or Inadequate Pre-Flight	216 (20.9%)	197 (3.4%)	21 (26.3%)	52 (2.1%)
Icing	10 (1.0%)	283 (4.9%)	6 (7.5%)	177 (7.0%)
Low Altitude Operations	1 (0.1%)	0 (0.0%)	0 (0.0%)	
Loss of Control – In Flight	35 (3.4%)	1770 (30.7%)	27 (33.8%)	1336 (52.7%)
Loss of Control – On Ground	5 (0.5%)	2 (0.1%)	0 (0.0%)	
Mid Air Collision	4 (0.4%)	4 (0.1%)	0 (0.0%)	
Power Loss – Fuel	3 (0.3%)	9 (0.2%)	1 (1.3%)	1 (0.1%)
Power Loss – Other Reasons *	5 (0.5%)	1 (0.1%)	0 (0.0%)	
Power Loss – Unknown Reason *	2 (0.2%)	27 (0.5%)	1 (1.3%)	27 (1.1%)
Runway Excursion	69 (6.7%)	547 (9.5%)	5 (6.3%)	69 (2.7%)
Runway Incursion (Vehicle, Aircraft or Person)	10 (1.0%)	113 (2.0%)	6 (7.5%)	46 (1.8%)
SCF – Powerplant	40 (3.9%)	379 (6.6%)	4 (5.0%)	119 (4.7%)
SCF – Non Powerplant	95 (9.2%)	756 (13.1%)	11 (13.8%)	308 (12.1%)
SCF – Stress Limits Exceeded *	4 (0.4%)	495 (8.6%)	2 (2.5%)	495 (19.5%)
Security Related	8 (0.8%)	588 (10.2%)	6 (7.5%)	578 (22.8%)
Turbulence Encounter	282 (27.3%)	1221 (21.2%)	2 (2.5%)	2 (0.1%)
Thunderstorm or Windshear	15 (1.5%)	193 (3.3%)	4 (5.0%)	50 (2.0%)
Undershoot or Overshoot	4 (0.4%)	23 (0.4%)	0 (0.0%)	
Unintended Flight in IMC	0 (0.0%)		0 (0.0%)	
Wildlife	5 (0.5%)	1 (0.1%)	0 (0.0%)	
Other	12 (1.2%)	9 (0.2%)	0 (0.0%)	
Unknown or Undetermined	22 (2.1%)	23 (0.4%)	3 (3.8%)	4 (0.2%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

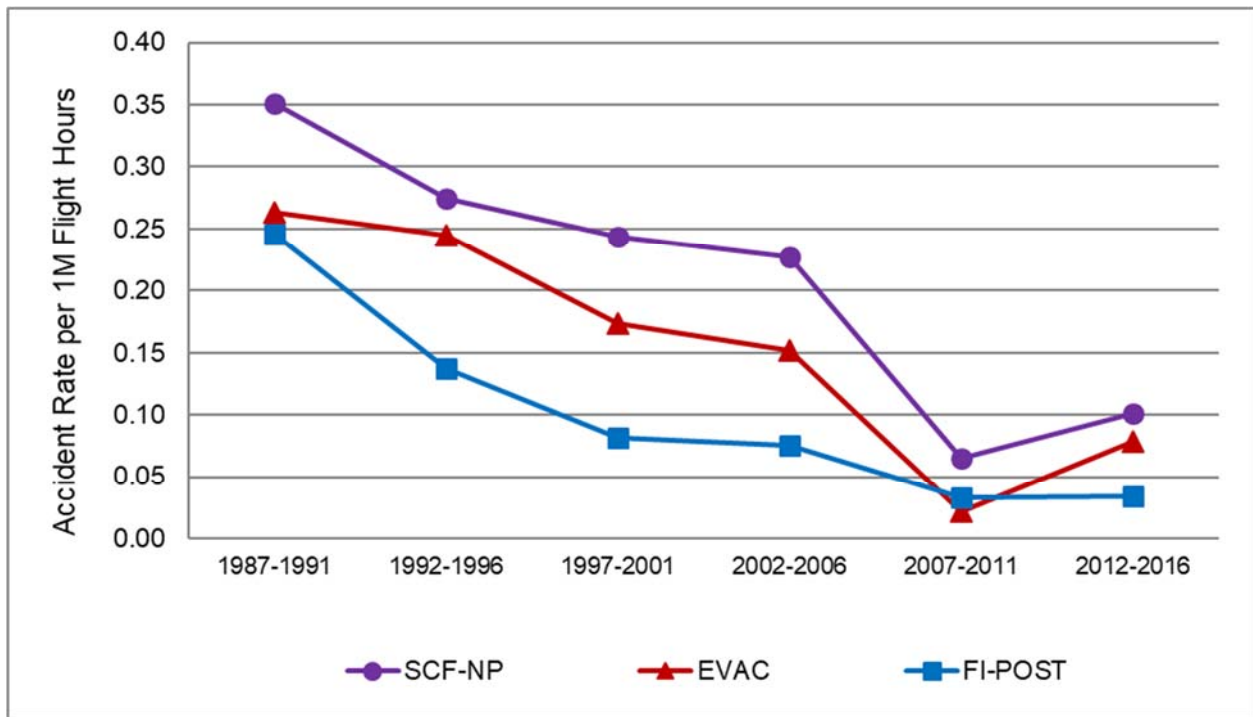


Figure 8-A. Accident Rates by CICTT Occurrence Category (Part 121; 1987-2016).

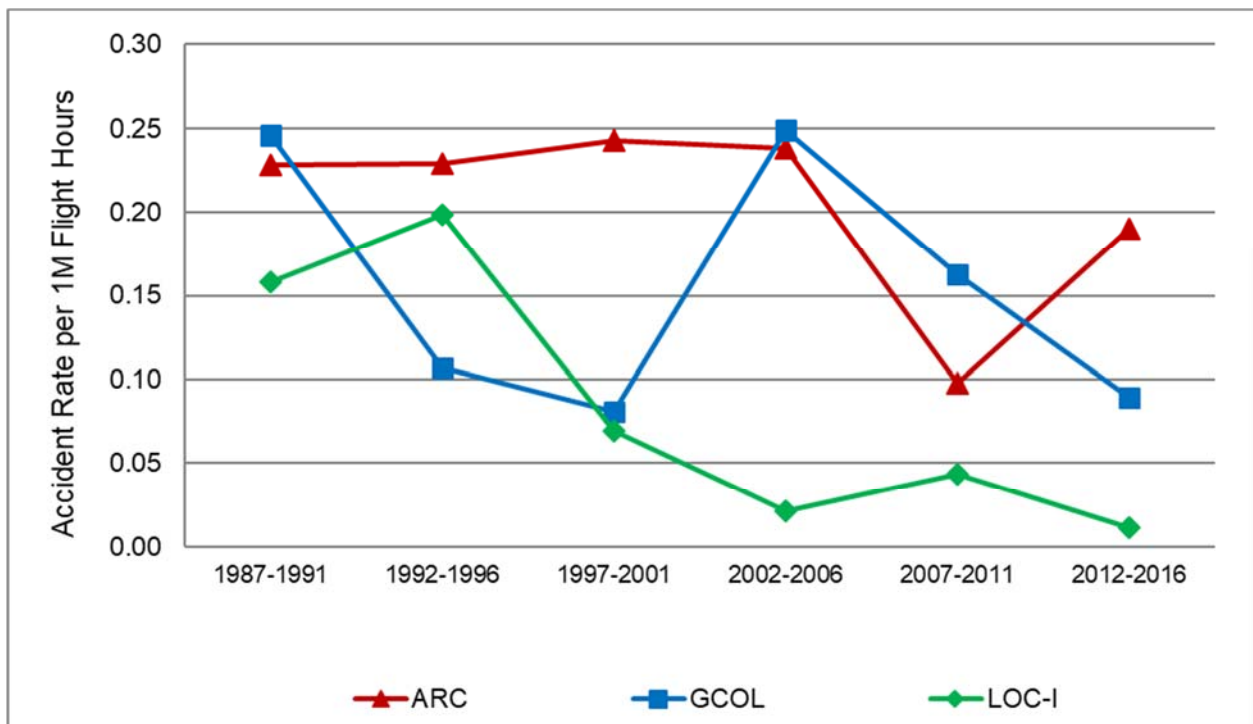


Figure 8-B. Accident Rates by CICTT Occurrence Category (Part 121; 1987-2016).

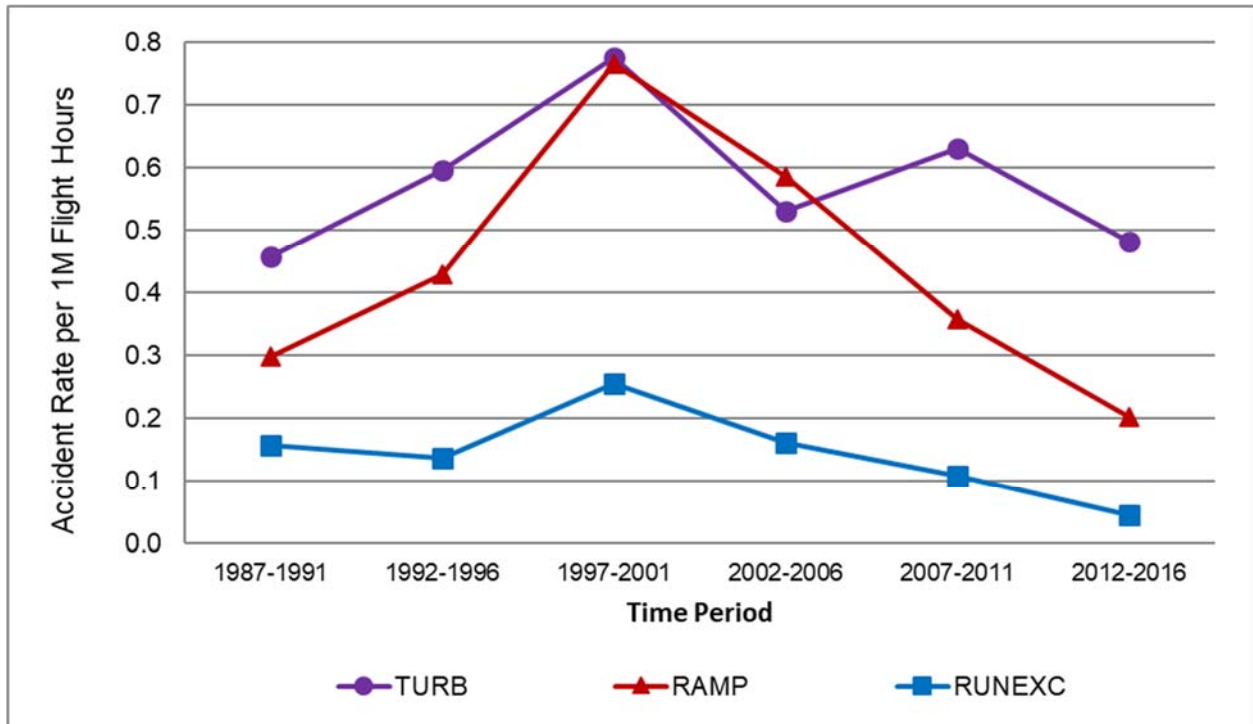


Figure 8-C. Accident Rates by CICTT Occurrence Category (Part 121; 1987-2016).

Figures 9-A and 9-B show the fatal accident rates for the five categories with more than two fatal events during the study period. Large decreases in rates have been seen in post-impact fire (FI-POST), in-flight loss of control (LOC-I) and ground handling (RAMP). Rates for fatal runway excursion (RUNEXC) and non-powerplant system/component failure/malfunction (SCF-NP) have decreased to zero from already low rates.

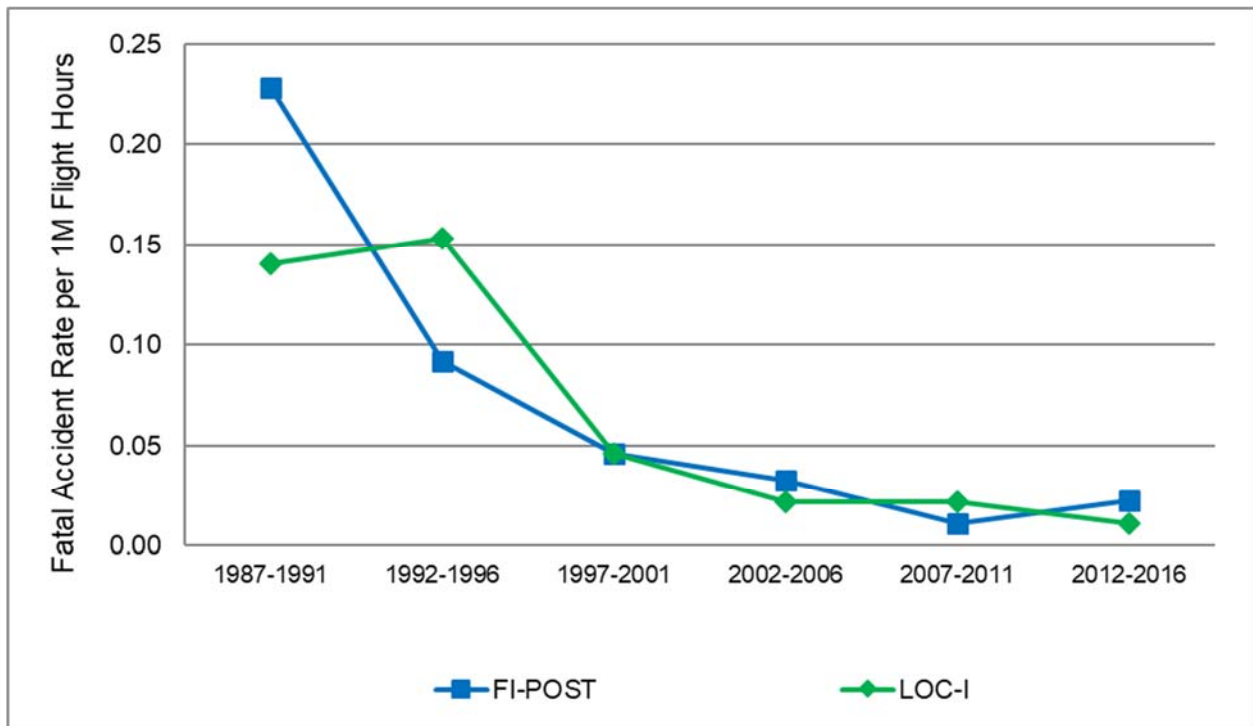


Figure 9-A. Fatal Accident Rates by CICTT Occurrence Category (Part 121; 1987-2016).

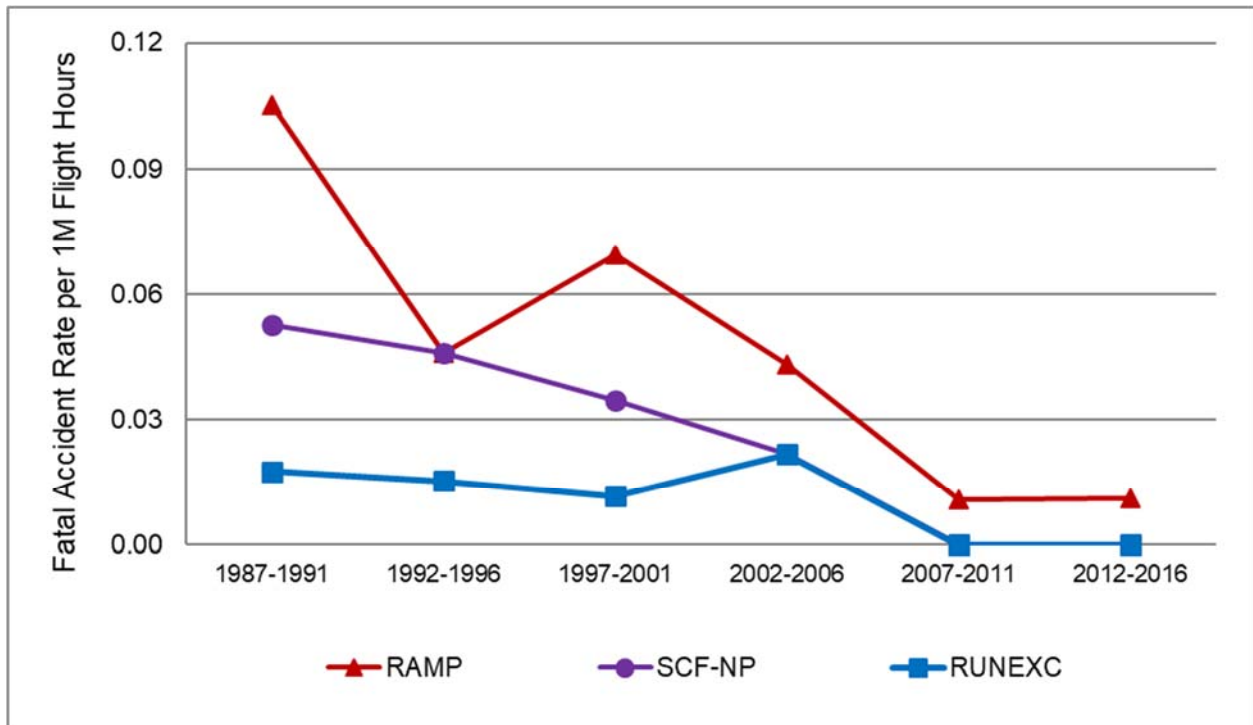


Figure 9-B. Fatal Accident Rates by CICTT Occurrence Category (Part 121; 1987-2016).

Prior analyses have looked at the set of ‘tall poles,’ the most frequently occurring accident categories for total accidents, fatal accidents, total injuries or fatal injuries. Table 3 summarizes which occurrence categories could be considered ‘tall poles’ in each of five time periods. Tables for total accidents, fatal accidents, total injuries and fatal injuries in each 10-year time period, upon which the selection of ‘tall poles’ was based, can be found in Appendix C.

Table 3. Occurrence Category ‘Tall Poles’ in Selected Time Periods (Part 121)

CICTT Occurrence Category	1987-1996	1992-2001	1997-2006	2002-2011	2007-2016
Abrupt Maneuver		✓	✓		
Controlled Flight Into or Toward Terrain	✓				
Fire – Non-Impact	✓	✓			
Fire – Post Impact	✓	✓	✓	✓	✓
Ground Handling	✓	✓	✓	✓	✓
Icing				✓	✓
Loss of Control – In Flight	✓	✓	✓	✓	✓
Runway Excursion				✓	
SCF – Non Powerplant	✓	✓	✓	✓	
Security	✓	✓	✓		
Turbulence	✓	✓	✓	✓	✓

Four occurrence categories are considered ‘tall poles’ in every time period (post-impact fire, ground handling, in-flight loss of control and turbulence).

Abrupt maneuver was driven into the ‘tall poles’ by one fatal accident (Belle Harbour in 2001) which accounted for 18% of fatal injuries in 1992-2001 and 35% of fatal injuries in 1997-2006.

Six of the nine total CFIT accidents, and four of the six fatal CFIT accidents, occurred during 1987-1996. Those accidents accounted for 18% of all fatalities in that time period.

Five fatal accidents involving non-impact fire occurred between June 1995 and October 1996; these represented 380 of the 548 fatalities during those two years. There have been only two fatal accidents involving non-impact fire since 1996.

Icing contributed to six fatal accidents (10 total accidents) in 1987-2016; five of those were in 1987-1994. However, the one fatal icing accident after 1994 (2009) resulted in 50 fatalities, which was 30% of the 166 total fatalities in 2002-2011 and 75% of the 67 total fatalities in 2007-2016.

Runway excursion accounted for only seven percent of total accidents and six percent of fatal accidents overall. But during 2002-2011, runway excursion resulted in 20% of all injuries and 30% of fatal injuries. Sixty percent of all injuries in this time period were minor, but one accident (in 2006) resulted in 49 fatalities.

The percentage of accidents in which non-powerplant system/component failure/malfunction was a factor dropped in each time period (13%, 10%, 9%, 7%, 5%). Only 12% of these accidents were fatal. The percentage of fatalities attributable to SCF-NP ranged from 10% to 25% in the first four time periods, but there were only four total injuries and no fatalities in 2007-2016.

Only one security-related accident occurred during 1989-2000. However, the three fatal security-related accidents in 1986-1988 accounted for 18% of all the fatalities in 1987-1996, while the events of 9/11/2001 accounted for 18% of fatal injuries in 1992-2001 and 35% of fatal injuries in 1997-2006.

Scheduled Part 135 operations

In this report, the phrase “Part 135-S” may sometimes be used to abbreviate “Scheduled Part 135.” Figure 10 shows the accident rates by severity of injury. In all time periods, accidents resulting in no injuries were more frequent than accidents with other levels of injury (Figure 10). However, in eighty-eight percent of the accidents during 2002-2016, the aircraft suffered substantial damage (Figure 11). Substantial damage has carried the highest rate throughout the study period.

Similarly, the highest accident rates are among the ‘damage’ accidents (Figure 12). We also see in this chart an interesting difference between Part 121 and Part 135-S. In Part 121, a large part of the accidents are classified as ‘injury,’ meaning there was at least one serious injury but less than substantial damage to the aircraft. These are mostly accidents from turbulence encounters. But in Part 135-S, the ‘injury’ classification was assigned to only nine of the 306 accidents.

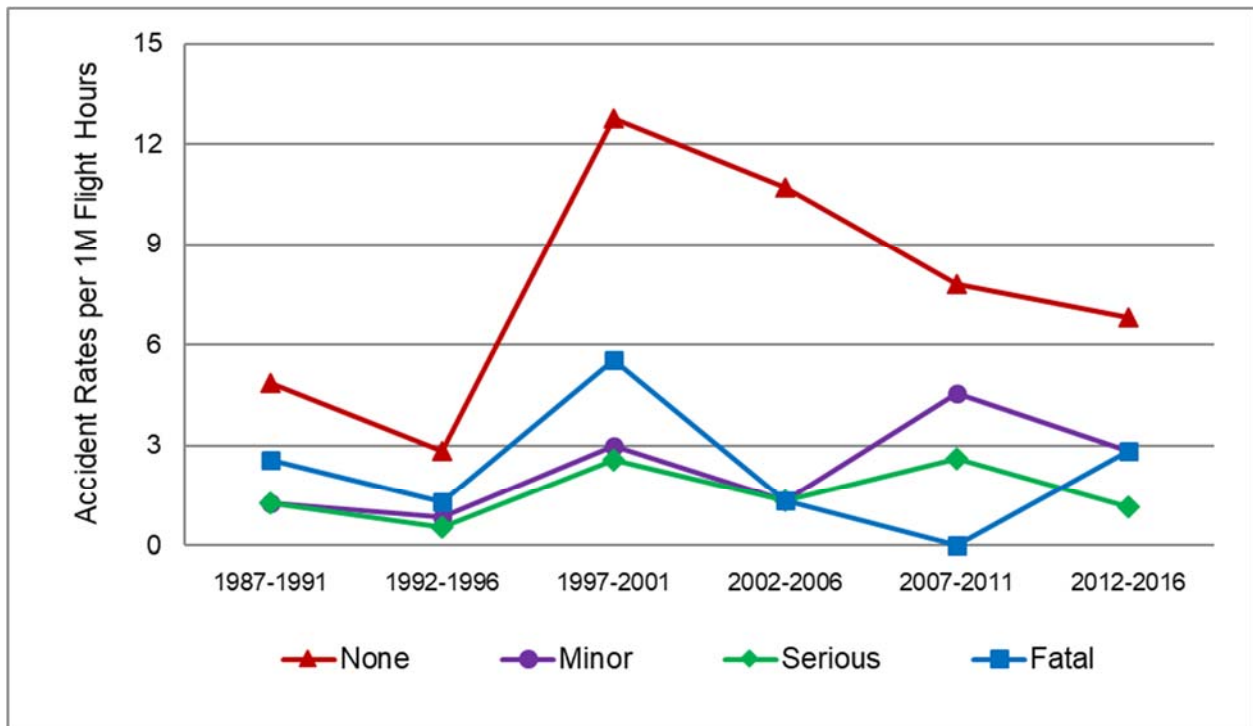


Figure 10. Accident Rates in Four Levels of Injury Severity (Part 135-S; 1987-2016).

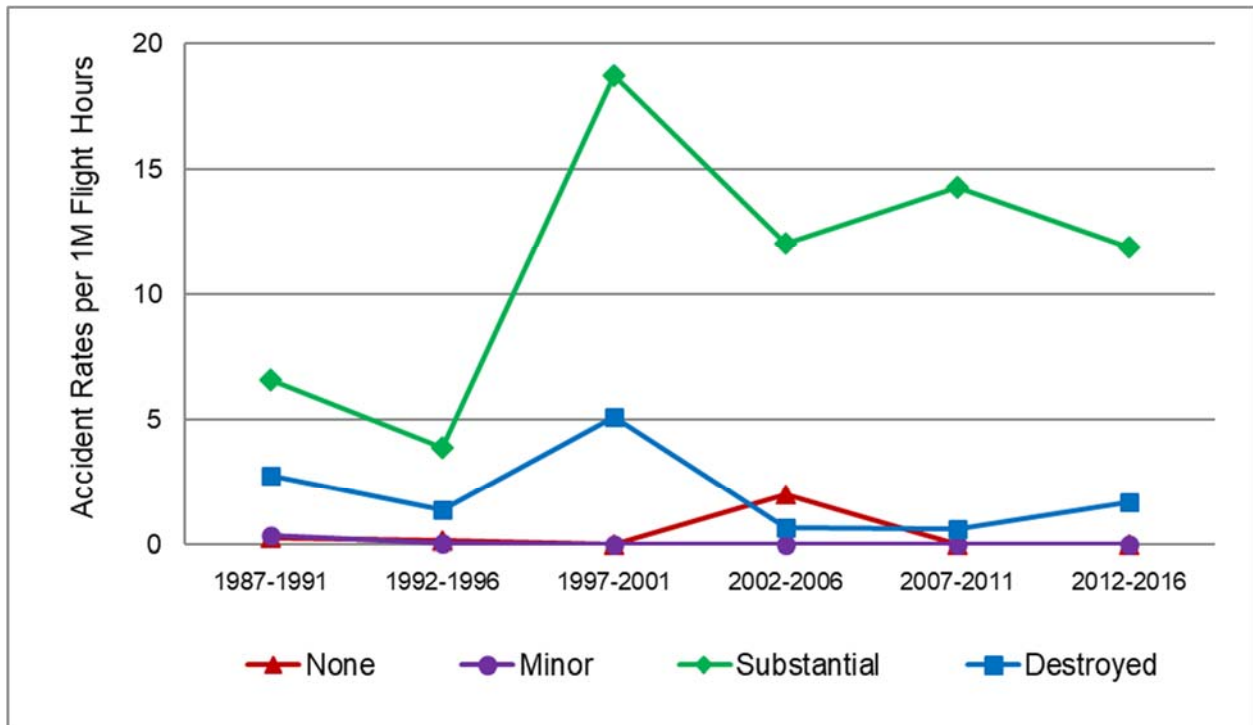


Figure 11. Accident Rates in Four Levels of Aircraft Damage (Part 135-S; 1987-2016).

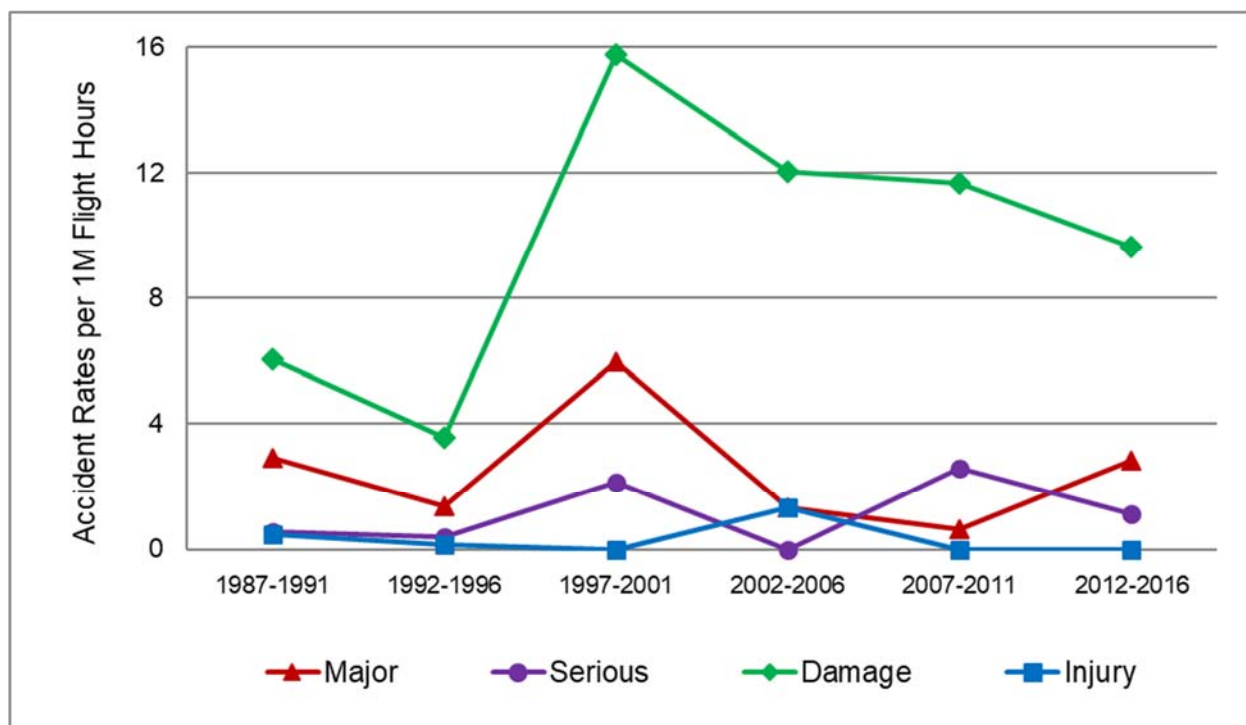


Figure 12. Accident Rates in Four Levels of Accident Severity (Part 135-S; 1987-2016).

Table 4 shows the number of total and fatal accidents, injuries and fatalities across the entire study period (1987-2016) for each CICTT occurrence category. All of the percentages are based on the total number of accidents or injuries, respectively. The reader is reminded that a particular accident might be assigned multiple occurrence categories. The additional categories that are not part of the official CICTT taxonomy are denoted with an asterisk (*).

We used the same rules that were previously described to determine the set of occurrence categories that have occurred with high enough frequency to make it possible to look at these categories in different time periods. Twelve accident categories were retained. Tables for total accidents and fatal accidents in each 5-year time period, upon which the following charts were based, can be found in Appendix B.

Figures 13-A, 13-B and 13-C show the accident rates for those twelve categories. Rates of in-flight loss of control (LOC-I) varied substantially between time periods. The rate of powerplant system/component failure/malfunction (SCF-PP) generally increased over time while the rate of non-powerplant system/component failure/malfunction (SCF-NP) quadrupled before dropping to zero. The most consistent decline in rates was in post-impact fire (FI-POST). Rates of controlled flight into terrain (CFIT), icing (ICE), unintended flight in instrument meteorological conditions (UIMC), runway excursion (RUNEXC) and in flight loss of control (LOC-I) all spiked dramatically in 1997-2001.

Table 4. Scheduled Part 135 Accidents and Injuries by CICTT Occurrence Category (1987-2016)

CICTT Occurrence Category	Total Accidents	Total Injuries	Fatal Accidents	Fatal Injuries
Total Events	306	785	65	399
Abrupt Maneuver	2 (0.7%)	0 (0.0%)	0 (0.0%)	
Abnormal Runway Contact	38 (12.4%)	49 (6.2%)	1 (1.5%)	5 (1.3%)
Aerodrome	16 (5.2%)	4 (0.5%)	0 (0.0%)	
Air Traffic Management	7 (2.3%)	85 (10.8%)	3 (4.6%)	48 (12.0%)
Bird Strikes	10 (3.3%)	1 (0.1%)	0 (0.0%)	
Cabin Safety or Pilot Incapacitation	3 (1.0%)	18 (2.3%)	1 (1.5%)	9 (2.3%)
Controlled Flight Into Terrain	40 (13.1%)	193 (24.6%)	23 (35.4%)	104 (26.1%)
Collision with Object – Takeoff or Landing	4 (1.3%)	9 (1.1%)	0 (0.0%)	
Collision with Object – Prec Landing *	6 (2.0%)	41 (5.2%)	3 (4.6%)	15 (3.8%)
Collision with Terrain – Prec Landing *	6 (2.0%)	22 (2.8%)	2 (3.1%)	3 (0.8%)
Encounter with Terrain – Prec Landing*	11 (3.6%)	19 (2.4%)	0 (0.0%)	
Evacuation	4 (1.3%)	22 (2.8%)	2 (3.1%)	3 (0.8%)
Fire – Non-Impact	7 (2.3%)	15 (1.9%)	1 (1.5%)	14 (3.5%)
Fire – Post Impact	34 (11.1%)	377 (48.0%)	29 (44.6%)	251 (62.9%)
Ground Collision	25 (8.2%)	8 (1.0%)	0 (0.0%)	
Ground Handling or Inadequate Pre-Flight	32 (10.5%)	52 (6.6%)	5 (7.7%)	33 (8.3%)
Icing	22 (7.2%)	111 (14.1%)	5 (7.7%)	71 (17.8%)
Low Altitude Operations	5 (1.6%)	13 (1.7%)	3 (4.6%)	6 (1.5%)
Loss of Control – In Flight	51 (16.7%)	295 (37.6%)	28 (43.1%)	214 (53.6%)
Loss of Control – On Ground	13 (4.2%)	4 (0.5%)	0 (0.0%)	
Mid Air Collision	6 (2.0%)	18 (2.3%)	3 (4.6%)	13 (3.3%)
Power Loss – Fuel	4 (1.3%)	3 (0.4%)	1 (1.5%)	2 (0.5%)
Power Loss – Other Reason *	3 (1.0%)	22 (2.8%)	0 (0.0%)	
Power Loss – Unknown Reason *	6 (2.0%)	19 (2.4%)	3 (4.6%)	12 (3.0%)
Runway Excursion	48 (15.7%)	55 (7.0%)	0 (0.0%)	
Runway Incursion (Vehicle, Aircraft or Person)	2 (0.7%)	78 (9.9%)	2 (3.1%)	48 (12.0%)
SCF – Powerplant	23 (7.5%)	117 (14.9%)	6 (9.2%)	45 (11.3%)
SCF – Non Powerplant	24 (7.8%)	40 (5.1%)	4 (6.2%)	22 (5.5%)
SCF – Stress Limits Exceeded *	1 (0.3%)	14 (1.8%)	1 (1.5%)	14 (3.5%)
Security Related	2 (0.7%)	2 (0.3%)	0 (0.0%)	
Turbulence Encounter	7 (2.3%)	22 (2.8%)	1 (1.5%)	3 (0.8%)
Thunderstorm or Windshear	4 (1.3%)	25 (3.2%)	2 (3.1%)	15 (3.8%)
Undershoot or Overshoot	7 (2.3%)	0 (0.0%)	0 (0.0%)	
Unintended Flight in IMC	30 (9.8%)	113 (14.4%)	17 (26.2%)	67 (16.8%)
Other	1 (0.3%)		0 (0.0%)	
Unknown or Undetermined	3 (1.0%)	6 (0.8%)	2 (3.1%)	6 (1.5%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

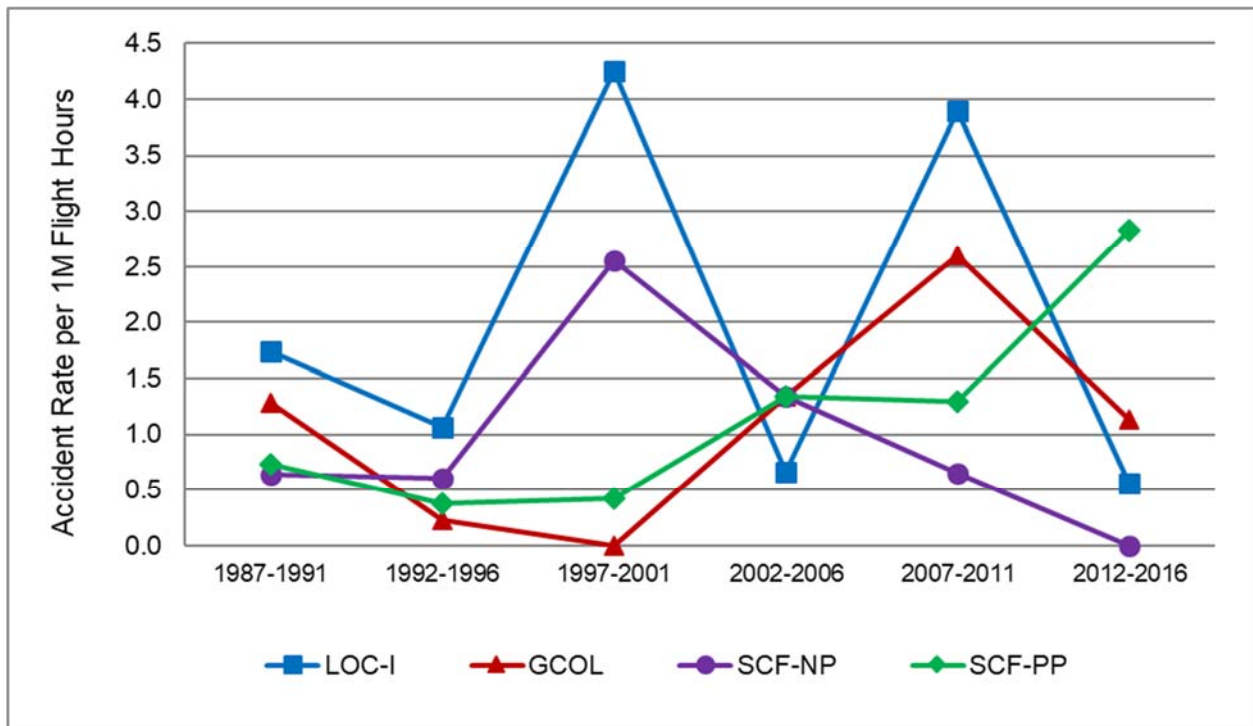


Figure 13-A. Accident Rates by CICTT Occurrence Category (Part 135-S; 1987-2016).

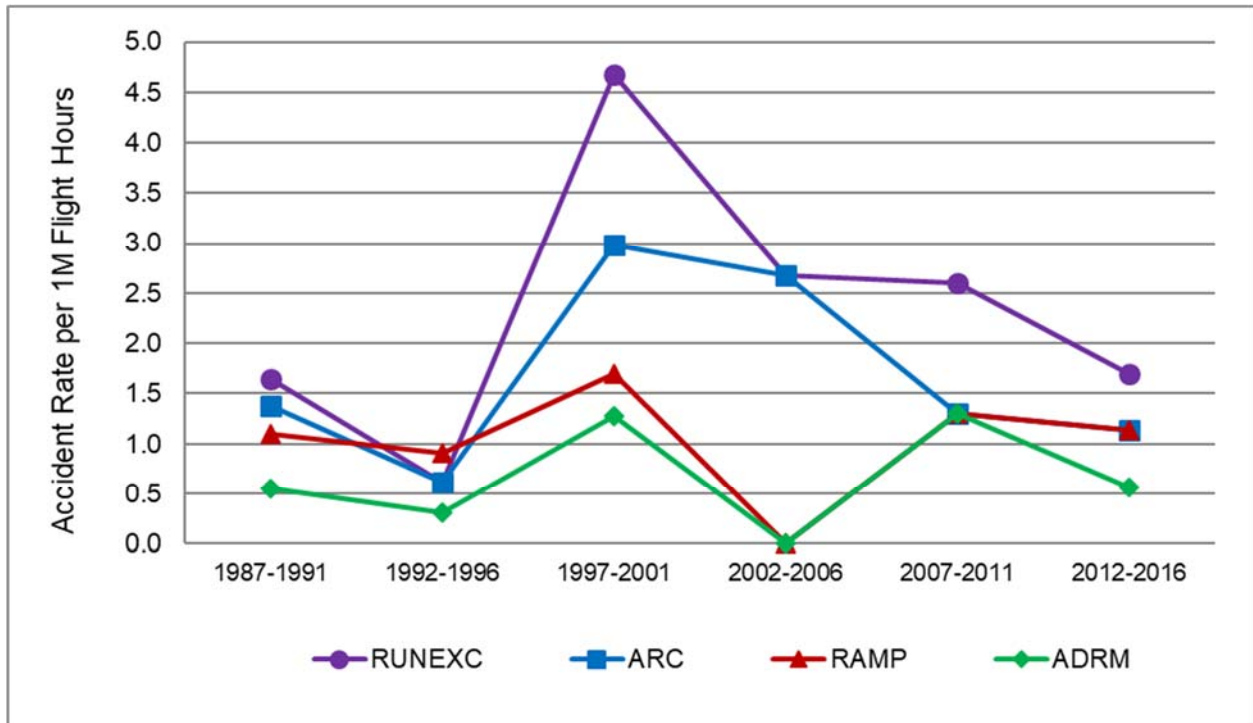


Figure 13-B. Accident Rates by CICTT Occurrence Category (Part 135-S; 1987-2016).

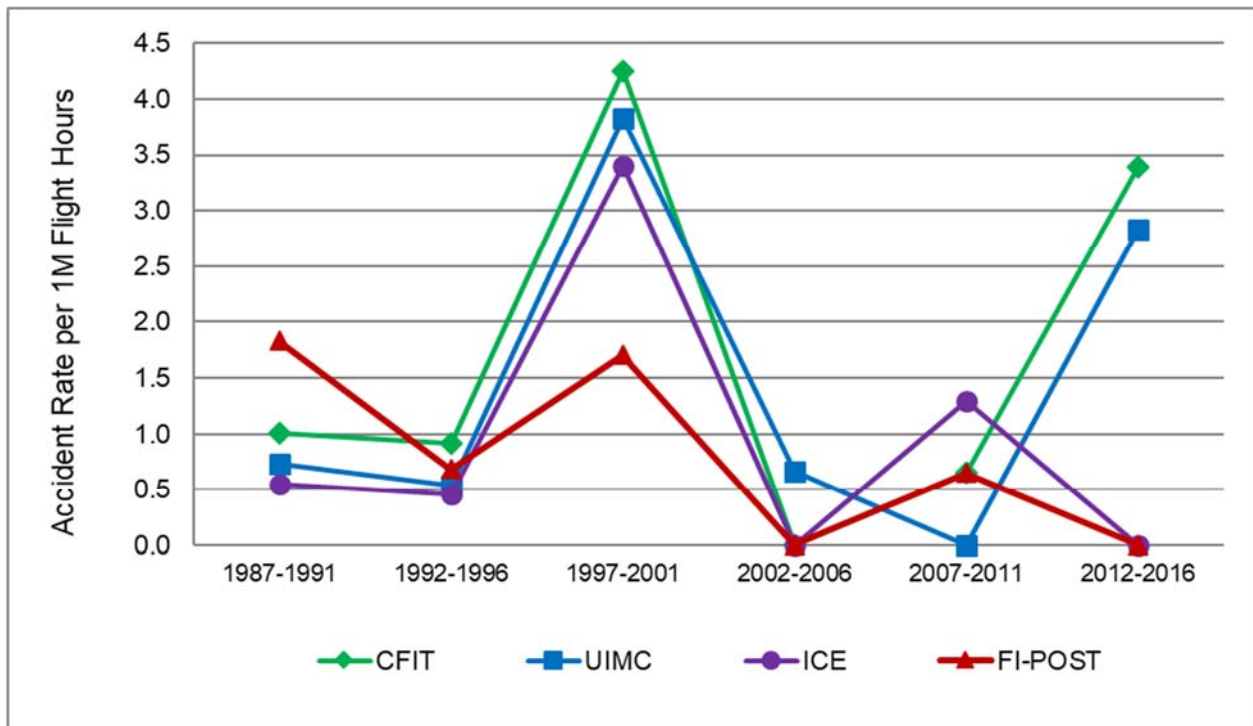


Figure 13-C. Accident Rates by CICTT Occurrence Category (Part 135-S; 1987-2016).

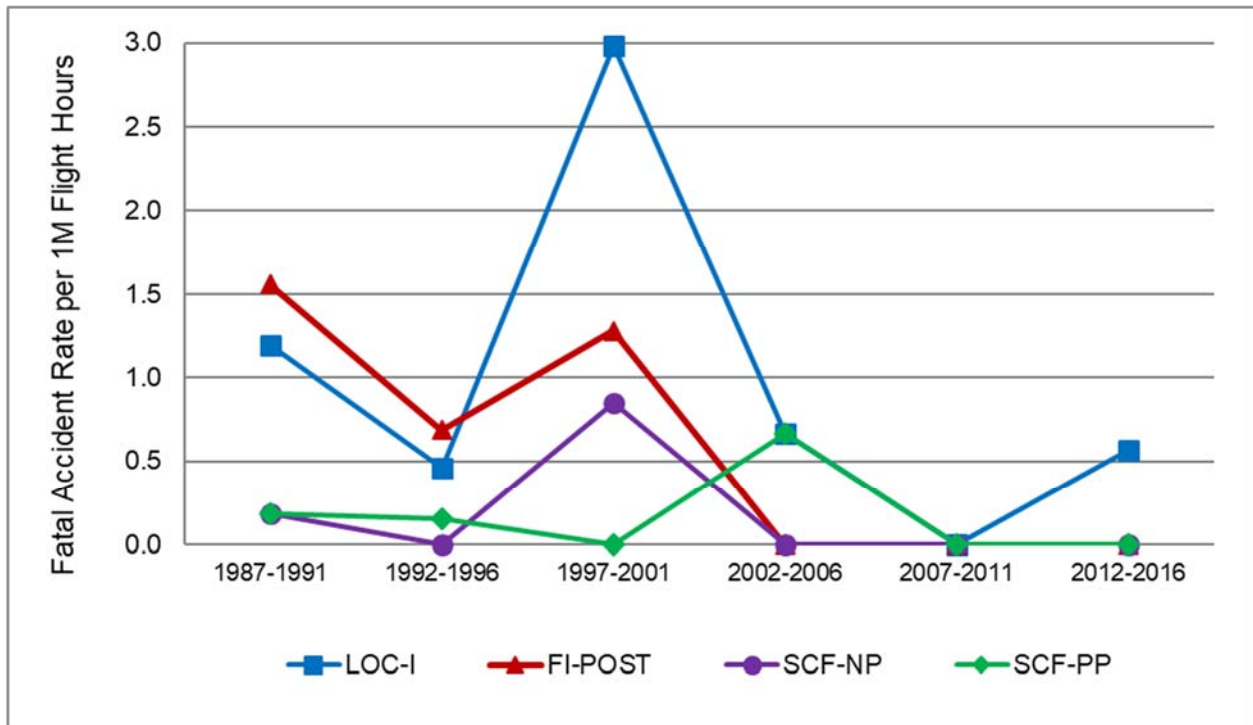


Figure 14-A. Fatal Accident Rates by CICTT Occurrence Category (Part 135-S; 1987-2016).

Figures 14-A and 14-B show the fatal accident rates for the eight categories with more than one fatal event. All of these categories demonstrate substantial rate changes between time periods, with no consistency or pattern outside of a general decrease in post-impact fire (FI-POST).

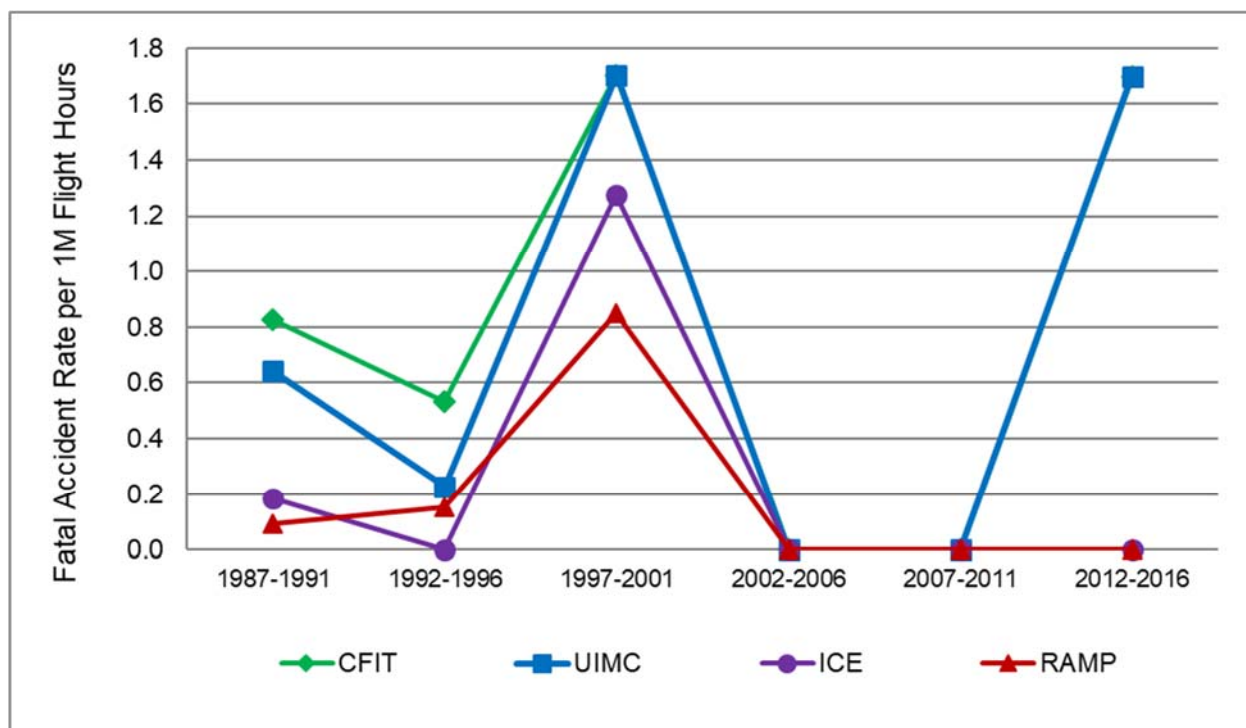


Figure 14-B. Fatal Accident Rates by CICTT Occurrence Category (Part 135-S; 1987-2016).

Table 5 summarizes which occurrence categories could be considered ‘tall poles’ in each of the five time periods selected for this analysis. Only two occurrence categories are considered ‘tall poles’ in every time period (in-flight loss of control and runway excursion). Tables for total accidents, fatal accidents, total injuries and fatal injuries in each 10-year time period, upon which the selection of ‘tall poles’ was based, can be found in Appendix C.

Abnormal runway contact (ARC) accounts for only twelve percent of Part 135-S accidents (1987-2016) and these accidents tend not to result in many injuries. The time periods in which the percentage of ARC was above average were considered ‘tall poles,’ and when the percentage was below average ARC was not a ‘tall pole.’

Controlled flight into terrain (CFIT) was a ‘tall pole’ in almost every time period, due to all four categories of risk. However, there was only one CFIT accident (nonfatal) during 2002-2011. Similarly, only one accident in 2002-2011 resulted from unintended flight in IMC (UIMC), also with no injuries. UIMC represented at least 22% of fatal accidents in each of the other time periods.

Only four accidents in 1987-2016 ended with an evacuation, and two of those four included a fatality. A fatal and a nonfatal accident with evacuation occurred in 2003 and 2011, respectively. This one fatal accident accounted for 50% of all fatal accidents and 50% of all fatalities in 2002-2011. During that same period, thirteen percent of the accidents were due to ground collision (GCOL), whereas GCOL accounted for less than five percent of accidents prior to 2002.

Table 5. Occurrence Category ‘Tall Poles’ in Selected Time Periods (Part 135-S)

CICTT Occurrence Category	1987-1996	1992-2001	1997-2006	2002-2011	2007-2016
Abnormal Runway Contact	✓		✓	✓	
Controlled Flight Into or Toward Terrain	✓	✓	✓		✓
Evacuation				✓	
Fire – Post Impact	✓	✓	✓		
Ground Collision				✓	
Ground Handling	✓				
Icing		✓	✓		
Loss of Control – In Flight	✓	✓	✓	✓	✓
Runway Excursion	✓	✓	✓	✓	✓
SCF – Powerplant				✓	✓
Unintended Flight in IMC	✓	✓	✓		✓

Only two accidents resulted in post-impact fires between 2001 and 2016, and neither resulted in fatalities. These two represented less than three percent of accidents and less than two percent of injuries in the last two time periods, whereas post-impact fire represented at least 20% of fatal accidents in the first three time periods.

Seventy-five percent of ground handling accidents occurred during 1987-1996. Only two of the ground handling accidents after 1996 (1997 and 2001) were fatal. In both cases the issue was inadequate ice removal during preflight.

Sixty-four percent of the icing accidents, and 60% of the fatal icing accidents, occurred between 1992 and 2001. There were six icing accidents before 1996 (2 fatal) and only two more recently than 2002 (neither fatal).

The simple frequency of accidents due to powerplant system/component failure/malfunction did not increase over time, but because the total number of accidents declined substantially over time, the percentage of SCF-PP accidents generally rose in each time period, and the two fatalities in a 2003 accident represents half of the fatalities during 2002-2011.

Non-Scheduled Part 135 operations

In this report, the phrase “Part 135-NS” may sometimes be used to abbreviate “non-scheduled Part 135.” Figure 15 shows the accident rates by severity of injury. The largest decrease in accident rates was associated with no injuries, and the second largest decrease was seen in fatal accidents.

Large decreases also have occurred in the rates of substantial aircraft damage and aircraft destruction (Figure 16). In Part 135-NS, it is rare for an accident aircraft to have little or no damage.

Figure 17 shows the accident rates associated with four levels of accident severity. ‘Injury’ accidents and ‘serious’ accidents have not been common, but ‘major’ and ‘damage’ accidents have decreased substantially over the study period.

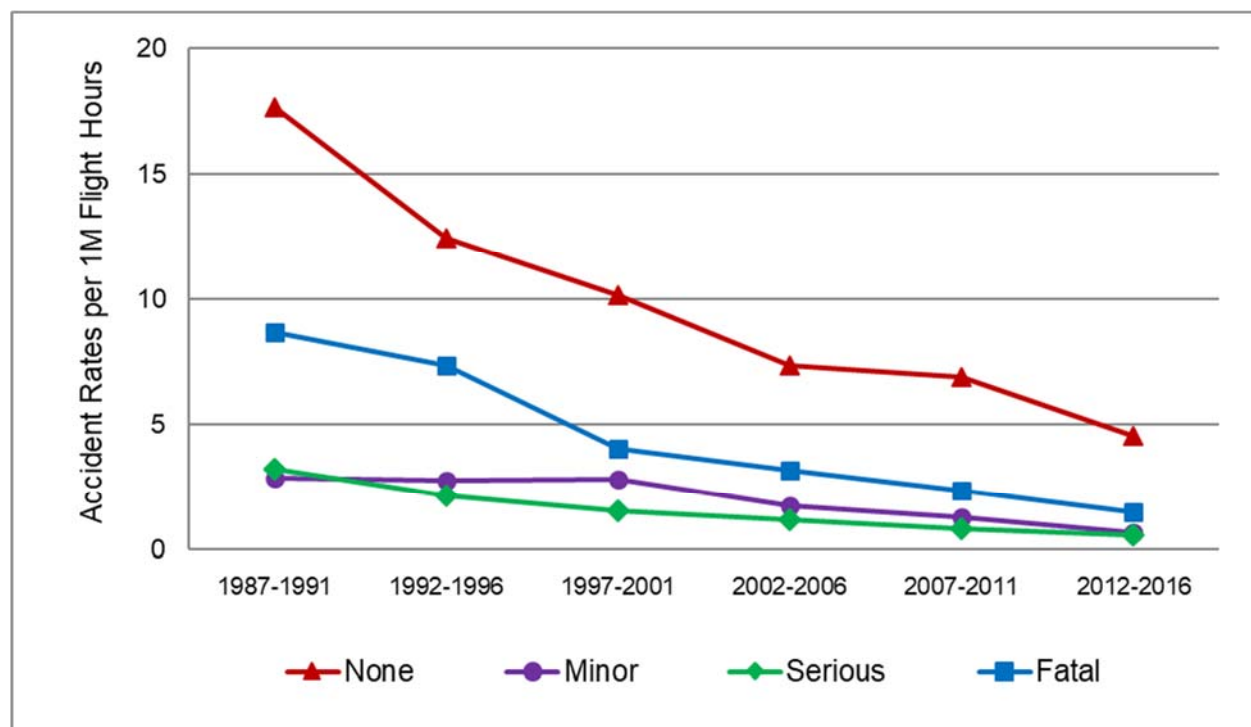


Figure 15. Accident Rates in Four Levels of Injury Severity (Part 135-NS; 1987-2016).

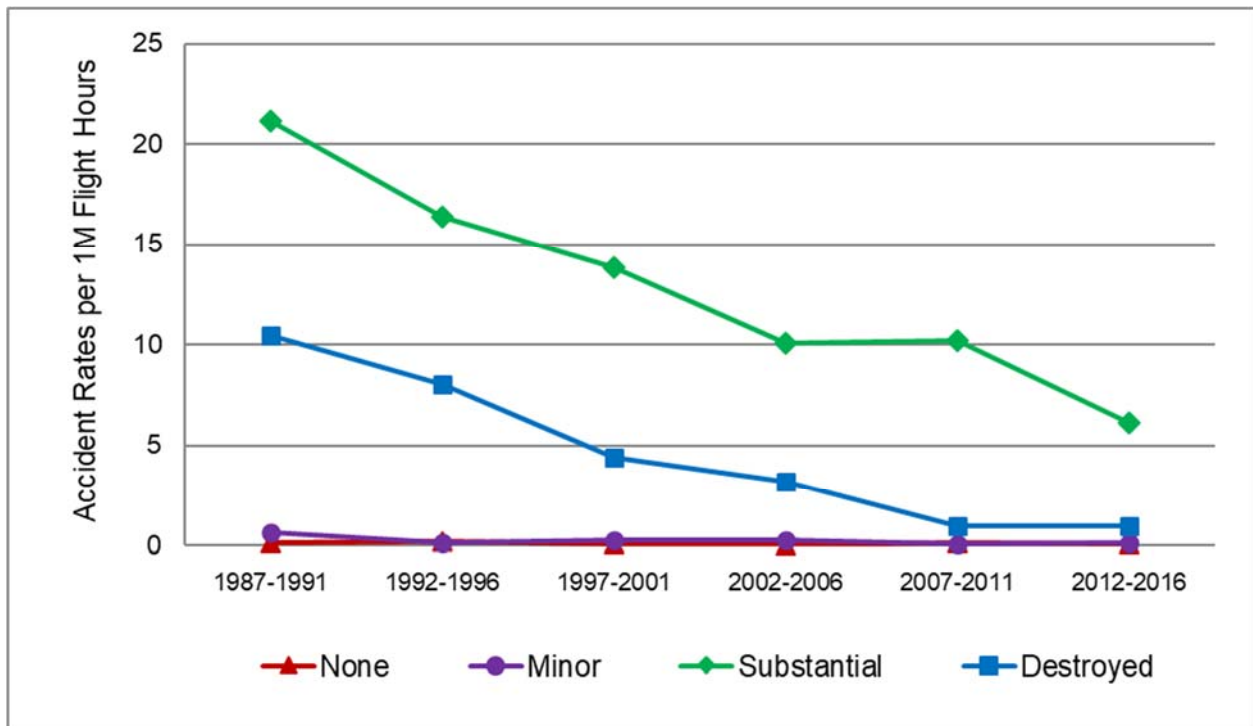


Figure 16. Accident Rates in Four Levels of Aircraft Damage (Part 135-NS; 1987-2016).

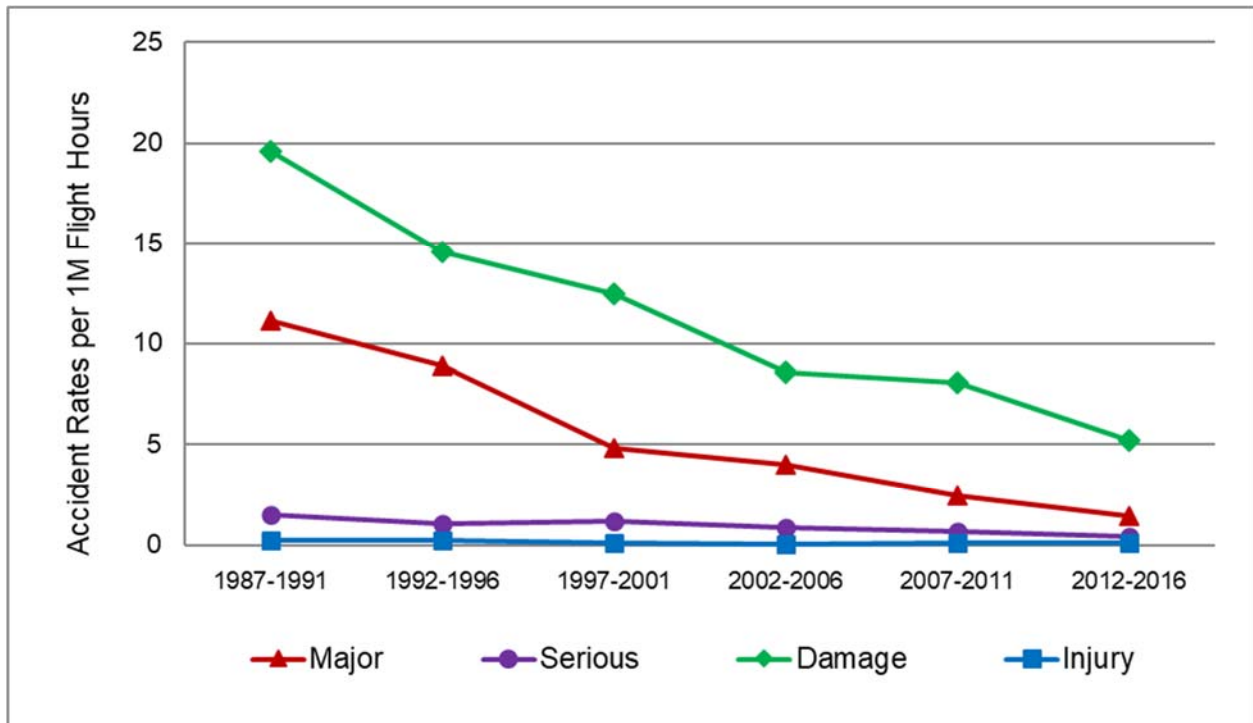


Figure 17. Accident Rates in Four Levels of Accident Severity (Part 135-NS; 1987-2016).

Table 6. Non-Scheduled Part 135 Accidents and Injuries by CICTT Occurrence Category (1987-2016)

CICTT Occurrence Category	Total Accidents	Total Injuries	Fatal Accidents	Fatal Injuries
Total Events	1601	1789	396	937
Abrupt Maneuver	7 (0.4%)	11 (0.6%)	3 (0.8%)	4 (0.4%)
Abnormal Runway Contact	174 (10.9%)	76 (4.3%)	3 (0.8%)	13 (1.4%)
Aerodrome	54 (3.4%)	10 (0.6%)		
Air Traffic Management	19 (1.2%)	16 (0.9%)	5 (1.3%)	7 (0.7%)
Birdstrike	13 (0.8%)	3 (0.2%)		
Cabin Safety or Pilot Incapacitation	13 (0.8%)	24 (1.3%)	13 (3.3%)	21 (2.2%)
Controlled Flight Into Terrain	150 (9.4%)	353 (19.7%)	107 (27.0%)	257 (27.4%)
Collision with Object – T/O or Landing	44 (2.7%)	36 (2.0%)	5 (1.3%)	14 (1.5%)
Collision with Object – Prec Landing *	95 (5.9%)	139 (7.8%)	24 (6.1%)	41 (4.4%)
Collision with Terrain – Prec Landing *	71 (4.4%)	139 (7.8%)	21 (5.3%)	46 (4.9%)
Encounter with Terrain – PrecLanding *	75 (4.7%)	64 (3.6%)	1 (0.3%)	1 (0.1%)
Evacuation	1 (0.1%)	6 (0.3%)		
Fire – Non-Impact	39 (2.4%)	58 (3.2%)	13 (3.3%)	34 (3.6%)
Fire – Post Impact	207 (12.9%)	540 (30.2%)	163 (41.2%)	415 (44.3%)
Ground Collision	75 (4.7%)	10 (0.6%)		
Ground Handling or Inadequate Pre-Flight	78 (4.9%)	128 (7.2%)	22 (5.6%)	52 (5.6%)
Icing	82 (5.1%)	86 (4.8%)	29 (7.3%)	37 (3.9%)
Low Altitude Operations	65 (4.1%)	171 (9.6%)	42 (10.6%)	118 (12.6%)
Loss of Control – In Flight	279 (17.4%)	544 (30.4%)	175 (44.2%)	389 (41.5%)
Loss of Control – On Ground	168 (10.5%)	73 (4.1%)	1 (0.3%)	2 (0.2%)
Mid Air Collision	25 (1.6%)	43 (2.4%)	12 (3.0%)	32 (3.4%)
Power Loss – Fuel	113 (7.1%)	147 (8.2%)	16 (4.0%)	42 (4.5%)
Power Loss – Other Reason *	9 (0.6%)	17 (1.0%)	2 (0.5%)	2 (0.2%)
Power Loss – Unknown Reason *	60 (3.7%)	72 (4.0%)	12 (3.0%)	26 (2.8%)
Runway Excursion	228 (14.2%)	129 (7.2%)	3 (0.8%)	13 (1.4%)
Runway Incursion (Vehic, Acft, Person)	5 (0.3%)	2 (0.1%)		
SCF – Powerplant	147 (9.2%)	215 (12.0%)	38 (9.6%)	83 (8.9%)
SCF – Non Powerplant	179 (11.2%)	100 (5.6%)	21 (5.3%)	54 (5.8%)
SCF – Stress Limits Exceeded *	14 (0.9%)	21 (1.2%)	14 (3.5%)	21 (2.2%)
Security Related	1 (0.1%)	3 (0.2%)	1 (0.3%)	2 (0.2%)
Turbulence Encounter	22 (1.4%)	35 (2.0%)	13 (3.3%)	19 (2.0%)
Thunderstorm or Windshear	23 (1.4%)	33 (1.8%)	10 (2.5%)	20 (2.1%)
Undershoot or Overshoot	40 (2.5%)	43 (2.4%)	2 (0.5%)	2 (0.2%)
Unintended Flight in IMC	65 (4.1%)	195 (10.9%)	42 (10.6%)	140 (14.9%)
Wildlife	11 (0.7%)	0 (0.0%)		
Other	25 (1.6%)	8 (0.4%)	2 (0.5%)	3 (0.3%)
Unknown or Undetermined	31 (1.9%)	72 (4.0%)	20 (5.1%)	65 (6.9%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table 6 shows the number of total and fatal accidents, injuries and fatalities across the entire study period (1987-2016) for each CICTT occurrence category. All of the percentages are based on the total number of accidents or injuries, respectively. The reader is reminded that a particular accident might be assigned multiple occurrence categories. The additional categories that are not part of the official CICTT taxonomy are denoted with an asterisk (*).

We used the same set of rules that were previously described to determine the set of occurrence categories that have occurred with high enough frequency to make it possible to look at these categories in different time periods. Thirteen accident categories were retained. Tables for total accidents and fatal accidents in each 5-year time period, upon which the following charts were based, can be found in Appendix B.

Figures 18-A, 18-B and 18-C show the accident rates for those thirteen categories. The largest decreases in accidents rates were associated with in-flight loss of control (LOC-I), post-impact fire (FI-POST), powerplant system/component failure/malfunction (SCF-PP), runway excursions (RUNEXC) and controlled flight into terrain (CFIT). For several occurrence categories the accident rates decreased very little, but there were no consistent increases in the accident rate for any of these thirteen categories.

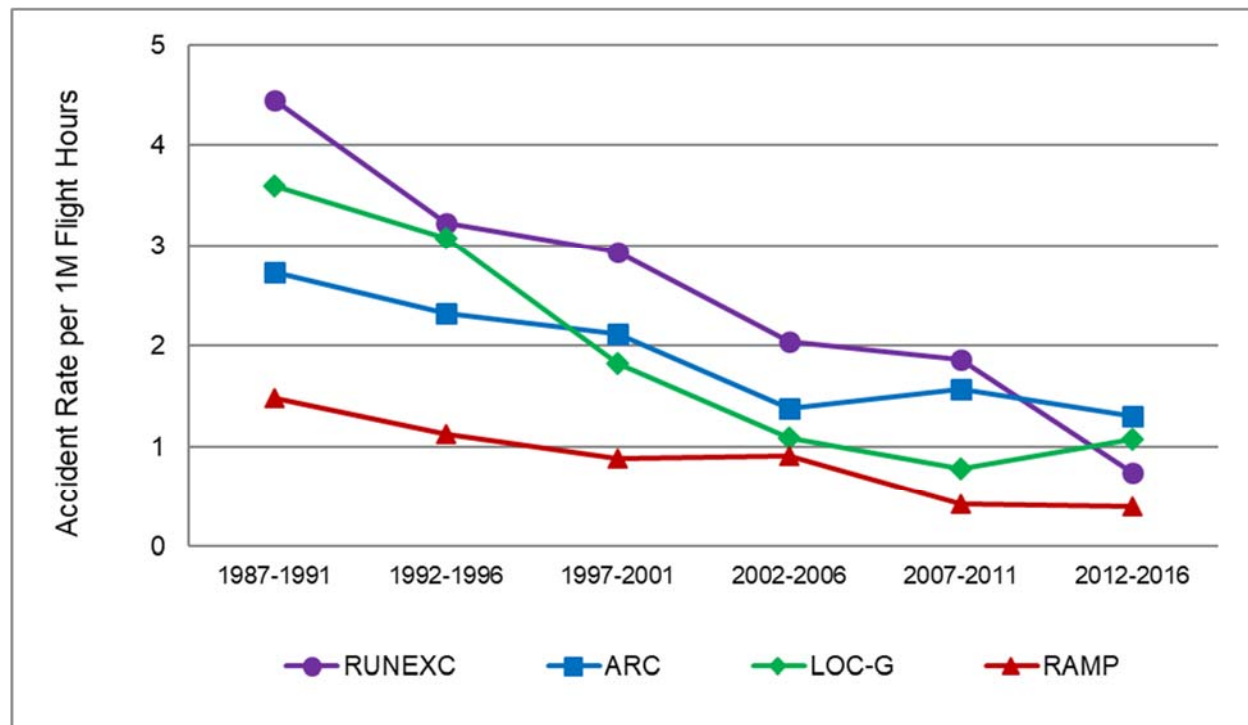


Figure 18-A. Accident Rates by CICTT Occurrence Category (Part 135-NS; 1987-2016).

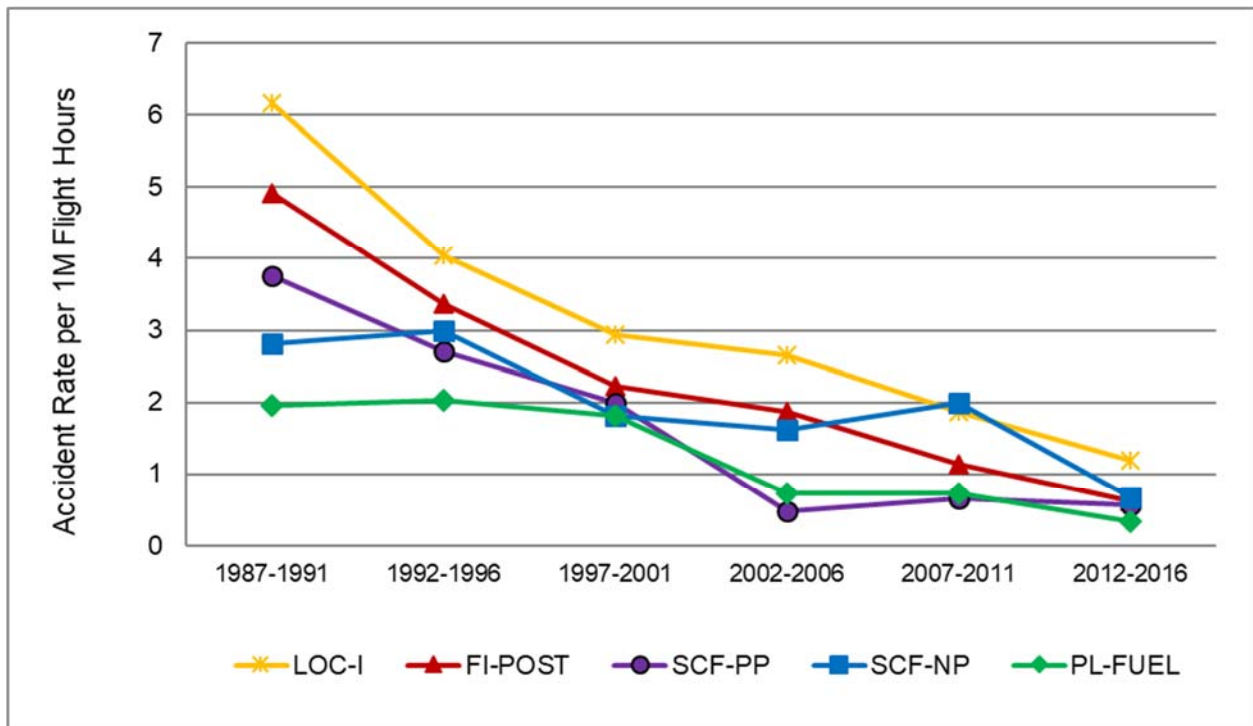


Figure 18-B. Accident Rates by CICTT Occurrence Category (Part 135-NS; 1987-2016).

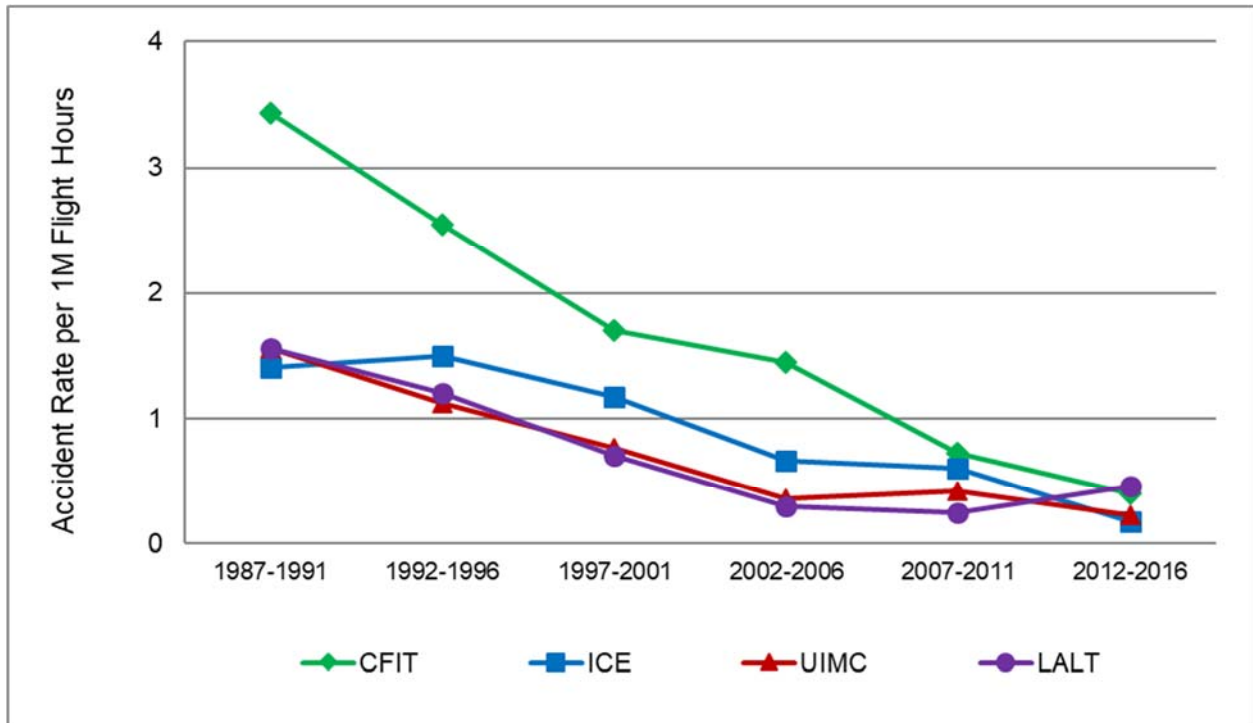


Figure 18-C. Accident Rates by CICTT Occurrence Category (Part 135-NS; 1987-2016).

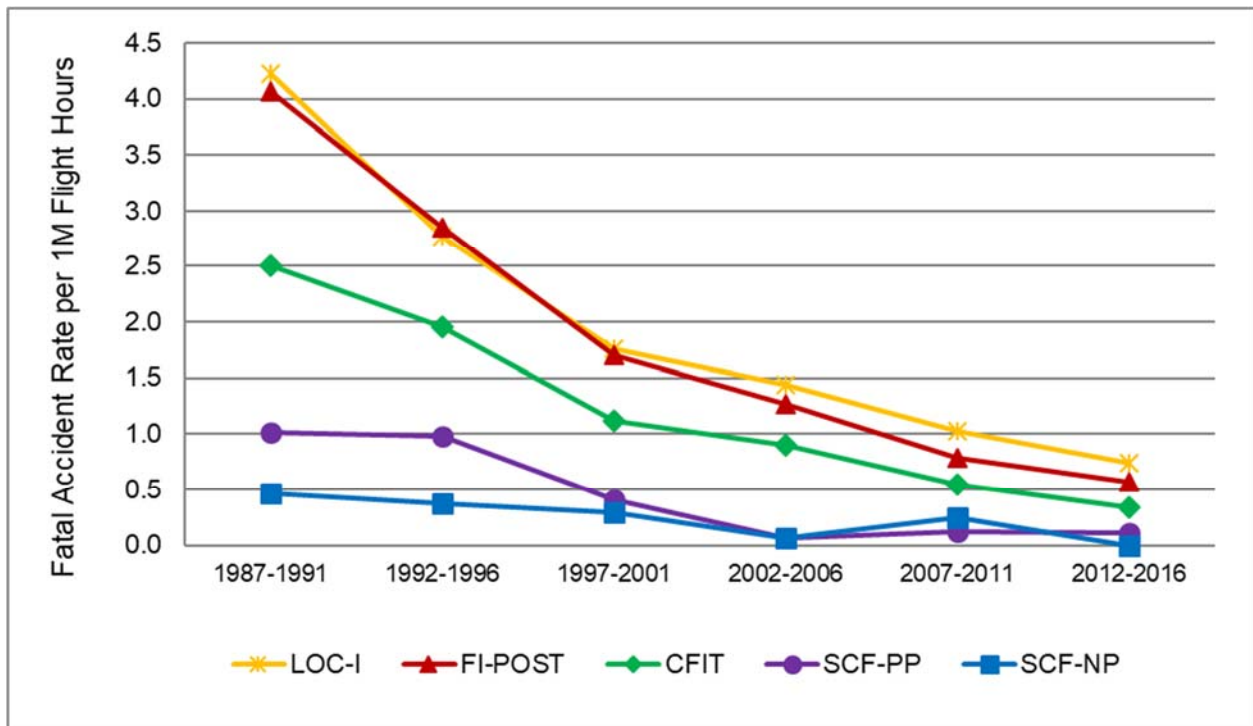


Figure 19-A. Fatal Accident Rates by CICTT Occurrence Category (Part 135-NS; 1987-2016).

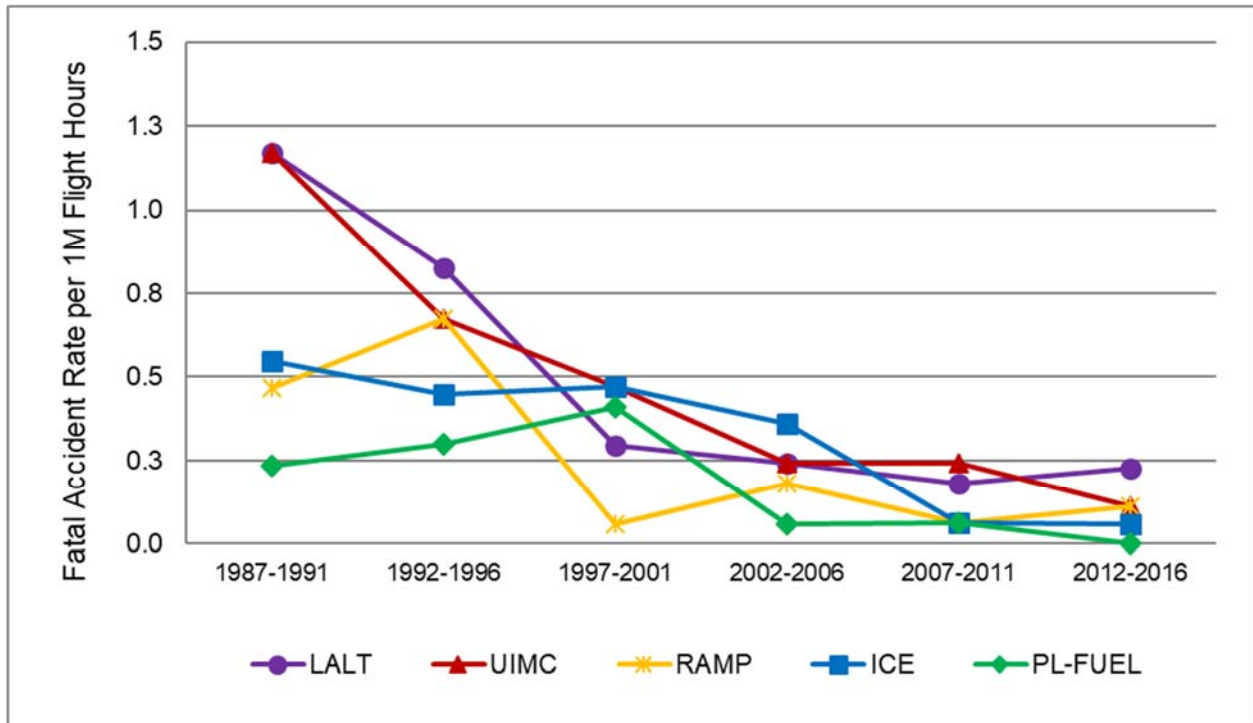


Figure 19-B. Fatal Accident Rates by CICTT Occurrence Category (Part 135-NS; 1987-2016).

Figures 19-A and 19-B show the fatal accident rates for ten of those thirteen occurrence categories. Because ARC, LOC-G and RUNEXC contributed to no more than three fatal accidents each, those categories were omitted. Again, the largest decreases in fatal accidents rates were associated with post-impact fire (FI-POST), in-flight loss of control (LOC-I) and controlled flight into terrain (CFIT). There were no increases across the entire study period in the fatal accident rate for any of these ten categories.

Table 7 summarizes which occurrence categories could be considered ‘tall poles’ in each of the five time periods selected for this analysis. Four occurrence categories are considered ‘tall poles’ in every time period (CFIT, post-impact fire, in-flight loss of control and runway excursion). Tables for total accidents, fatal accidents, total injuries and fatal injuries in each 10-year time period, upon which the selection of ‘tall poles’ was based, can be found in Appendix C.

Table 7. Occurrence Category ‘Tall Poles’ in Selected Time Periods (Part 135-NS)

CICTT Occurrence Category	1987-1996	1992-2001	1997-2006	2002-2011	2007-2016
Abnormal Runway Contact					✓
Controlled Flight Into or Toward Terrain	✓	✓	✓	✓	✓
Fire – Post Impact	✓	✓	✓	✓	✓
Loss of Control – In Flight	✓	✓	✓	✓	✓
Runway Excursion	✓	✓	✓	✓	✓
SCF – Non Powerplant				✓	✓

Abnormal runway contact is the second most frequent accident category in 2007-2016 (15.5%). The incidence of abnormal runway contact increased in every time period, from nine percent in 1987-1996 to 12% in 2002-2011.

Non-Powerplant system/component failure/malfunction represents 14.6% of accidents in 2002-2011 and 14.2% in 2007-2016, up from 10-11% in previous time periods.

Part 91 Operations

Figure 20 shows the accident rates associated with four levels of injury severity. More than half of the Part 91 accidents resulted in no injury. Accident rates associated with all four levels of injury have declined, but the rate of decline slowed after 2001.

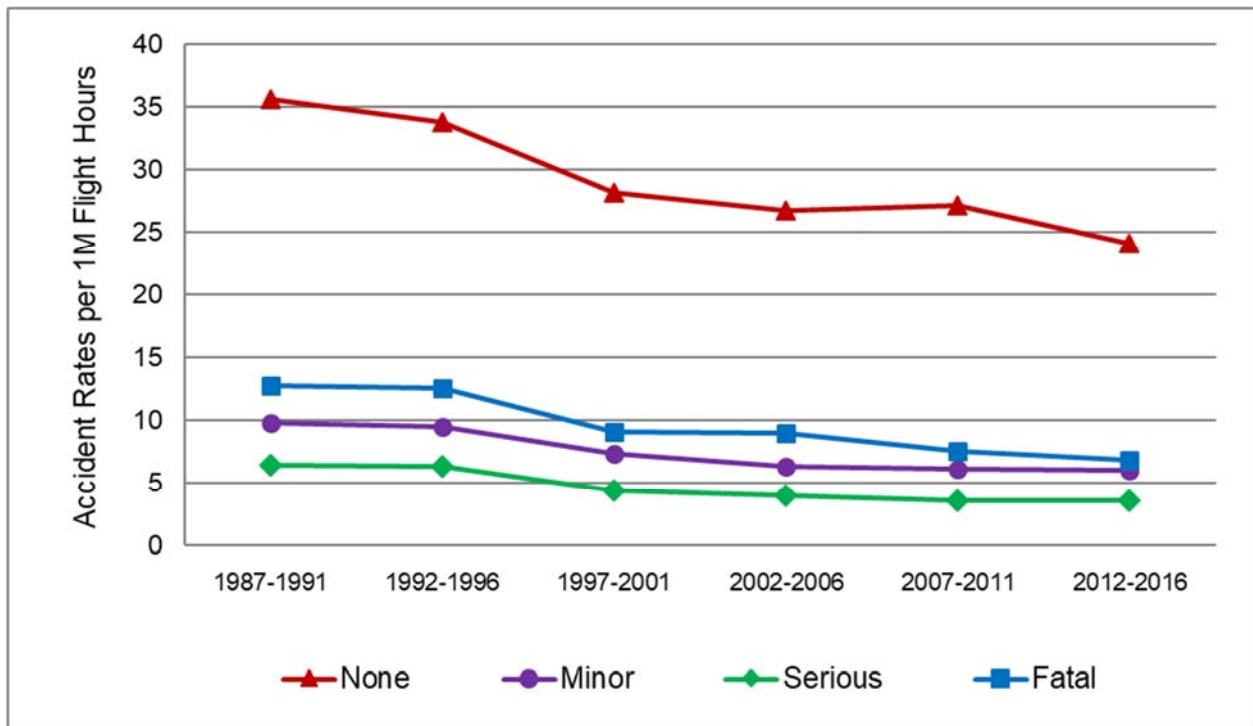


Figure 20. Accident Rates in Four Levels of Injury Severity (Part 91; 1987-2016).

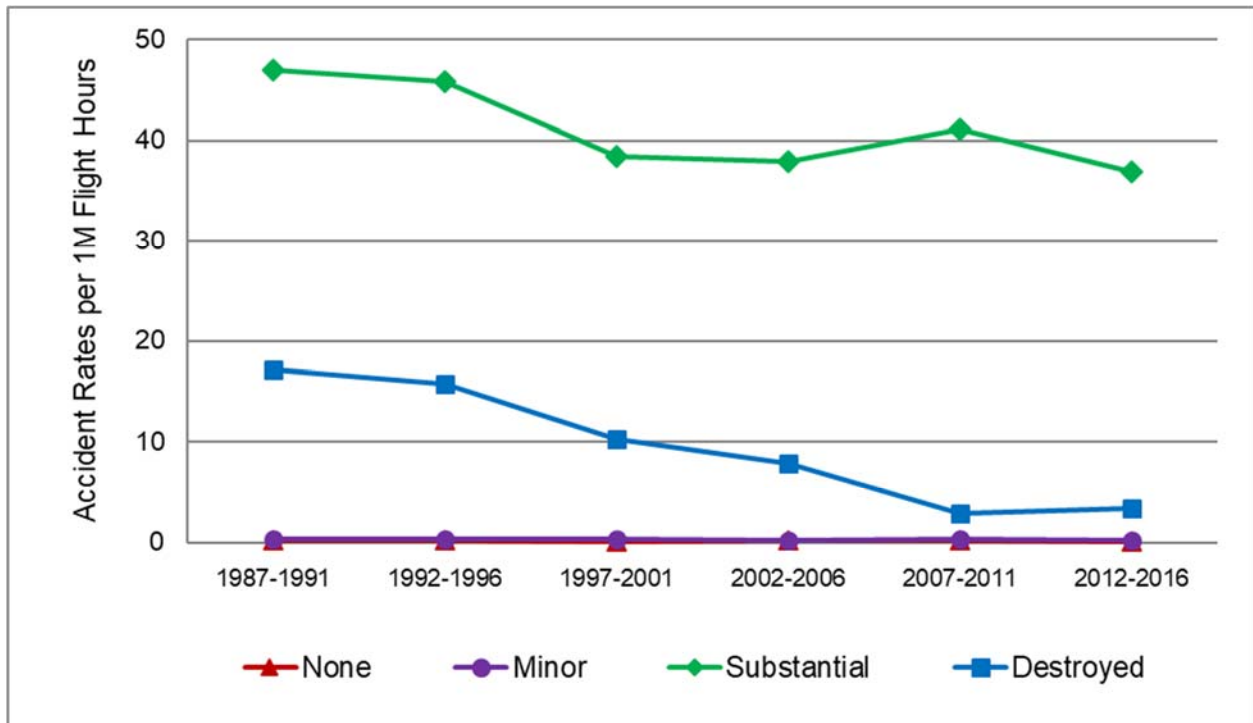


Figure 21. Accident Rates in Four Levels of Aircraft Damage (Part 91; 1987-2016).

Figure 21 shows the accident rates by level of aircraft damage. Most of the aircraft suffered substantial damage. The rates of substantial damage leveled off after 2001, whereas rates of aircraft destruction continued to decline until 2011.

Most of the Part 91 accidents are characterized by substantial damage with no injury, so it follows that most accidents will fall into the severity classification of “damage.” The rates of both “injury” accidents and “serious” accidents have not changed very much across the study period, but the rate of “major” accidents has declined substantially (Figure 22).

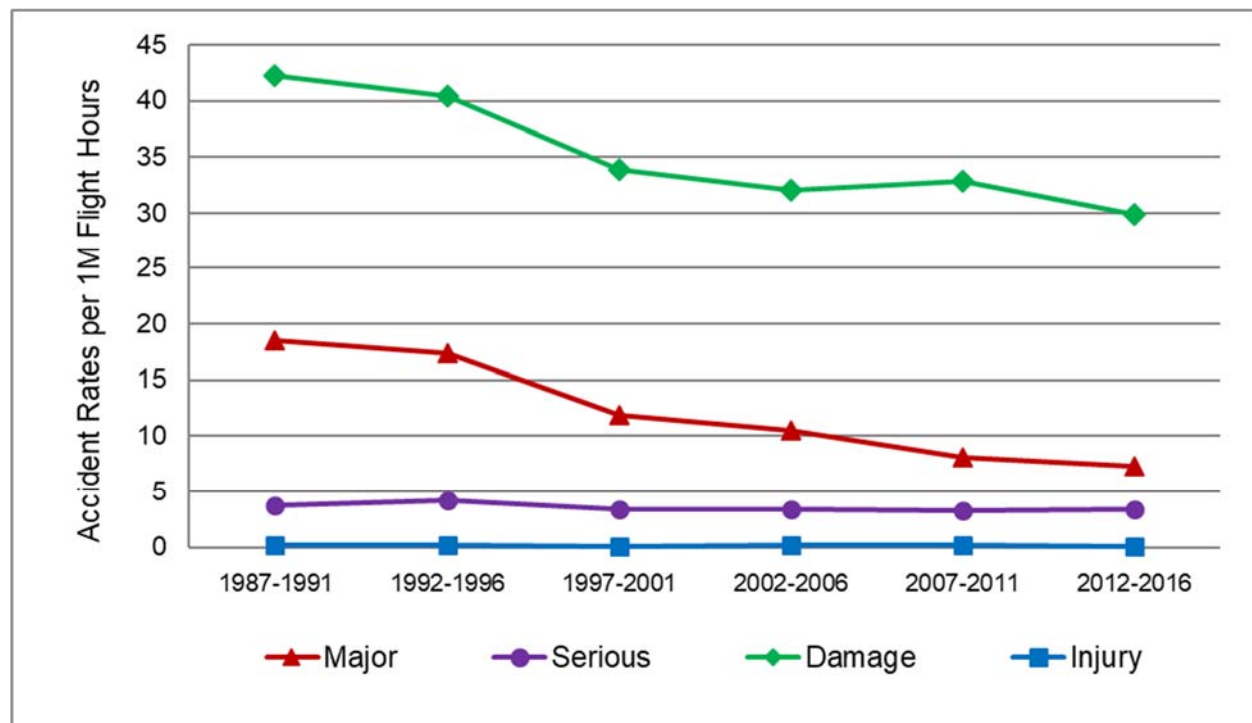


Figure 22. Accident Rates in Four Levels of Accident Severity (Part 91; 1987-2016).

Table 8 shows the number of total and fatal accidents, injuries and fatalities across the entire study period (1987-2016) for each CICTT occurrence category. All of the percentages are based on the total number of accidents or injuries, respectively. The reader is reminded that a particular accident might be assigned multiple occurrence categories. The additional categories that are not part of the official CICTT taxonomy are denoted with an asterisk (*).

Table 8. Part 91 Accidents and Injuries by CICTT Occurrence Category (1987-2016)

CICTT Occurrence Category	Total Accidents	Total Injuries	Fatal Accidents	Fatal Injuries
Total Events	37707	30264	7133	13588
Abrupt Maneuver	196 (0.5%)	218 (0.7%)	91 (1.3%)	157 (1.2%)
Abnormal Runway Contact	4803 (12.7%)	1215 (4.0%)	86 (1.2%)	140 (1.0%)
Aerodrome	474 (1.3%)	115 (0.4%)	8 (0.1%)	17 (0.1%)
Air Traffic Management	211 (0.6%)	314 (1.0%)	129 (1.8%)	274 (2.0%)
Bird Strikes	110 (0.3%)	39 (0.1%)	7 (0.1%)	17 (0.1%)
Cabin Safety or Pilot Incapacitation	595 (1.6%)	927 (3.0%)	443 (6.2%)	714 (5.2%)
Controlled Flight Into Terrain	1255 (3.3%)	2465 (8.1%)	973 (13.6%)	1942 (14.3%)
Collision with Object – Takeoff or Landing	1461 (3.9%)	1433 (4.7%)	239 (3.4%)	432 (3.2%)
Collision with Object – Prec Landing *	3607 (9.6%)	3533 (11.7%)	376 (5.3%)	621 (4.6%)
Collision with Terrain – Prec Landing*	1446 (3.8%)	1676 (5.5%)	213 (3.0%)	373 (2.7%)
Encounter w/ Terrain – Prec Landing *	2486 (6.6%)	1483 (4.9%)	32 (0.4%)	44 (0.3%)
Fire – Non-Impact	400 (1.1%)	287 (0.9%)	68 (1.0%)	139 (1.0%)
Fire – Post Impact	3292 (8.7%)	6845 (22.6%)	2431 (34.1%)	5154 (37.9%)
Ground Collision	820 (2.2%)	111 (0.4%)	11 (0.2%)	13 (0.1%)
Ground Handling or Inadequate PreFlight	1015 (2.7%)	1583 (5.2%)	330 (4.6%)	800 (5.9%)
Icing	469 (1.2%)	719 (2.4%)	206 (2.9%)	474 (3.5%)
Low Altitude Operations	2248 (6.0%)	3458 (11.4%)	1325 (18.6%)	2317 (17.1%)
Loss of Control – In Flight	7751 (20.6%)	12423 (41.0%)	4054 (56.8%)	7935 (58.4%)
Loss of Control – On Ground	6429 (17.1%)	1706 (5.6%)	41 (0.6%)	46 (0.3%)
Mid Air Collision	493 (1.3%)	724 (2.4%)	292 (4.1%)	596 (4.4%)
Power Loss – Fuel	5031 (13.3%)	4490 (14.8%)	507 (7.1%)	833 (6.1%)
Power Loss – Other Reason *	372 (1.0%)	362 (1.2%)	38 (0.5%)	67 (0.5%)
Power Loss – Unknown Reason *	2146 (5.7%)	2066 (6.8%)	292 (4.1%)	535 (3.9%)
Runway Excursion	7199 (19.1%)	1921 (6.3%)	75 (1.1%)	132 (1.0%)
Runway Incursion (Vehicle, Aircraft or Person)	184 (0.5%)	113 (0.4%)	21 (0.3%)	37 (0.3%)
SCF – Powerplant	2398 (6.4%)	2277 (7.5%)	331 (4.6%)	668 (4.9%)
SCF – Non Powerplant	2497 (6.6%)	1197 (4.0%)	251 (3.5%)	471 (3.5%)
SCF – Stress Limits Exceeded *	331 (0.9%)	728 (2.4%)	314 (4.4%)	719 (5.3%)
Security Related	147 (0.4%)	137 (0.5%)	85 (1.2%)	103 (0.8%)
Turbulence	334 (0.9%)	433 (1.4%)	128 (1.8%)	270 (2.0%)
Thunderstorm or Windshear	453 (1.2%)	677 (2.2%)	228 (3.2%)	498 (3.7%)
Undershoot or Overshoot	794 (2.1%)	375 (1.2%)	16 (0.2%)	34 (0.3%)
Unintended Flight in IMC	1139 (3.0%)	2162 (7.1%)	937 (13.1%)	1860 (13.7%)
Wildlife	187 (0.5%)	34 (0.1%)	1 (0.1%)	3 (0.1%)
Other	279 (0.7%)	107 (0.4%)	28 (0.4%)	36 (0.3%)
Unknown or Undetermined	389 (1.0%)	647 (2.1%)	254 (3.6%)	519 (3.8%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Twelve occurrence categories (only from the official CAST/ICAO taxonomy) that were assigned to at least five percent of total accidents or fatal accidents, were examined for changes over time. Tables for total accidents and fatal accidents in each 5-year time period, upon which the following charts were based, can be found in Appendix B.

Figures 23-A, 23-B and 23-C show the accident rates for these twelve occurrence categories. The largest decreases in accidents rates were associated with fuel related loss of engine power (PL-FUEL), in-flight loss of control (LOC-I), on ground/water loss of control (LOC-G) and low altitude operations (LALT). Large decreases in the accident rates were also seen in post-impact fire (FI-POST) and powerplant system/component failure (SCF-PP). Relatively high accident rates are associated with runway excursions (RUNEXC) and abnormal runway contact (ARC), but these rates have not changed much at all over the study period.

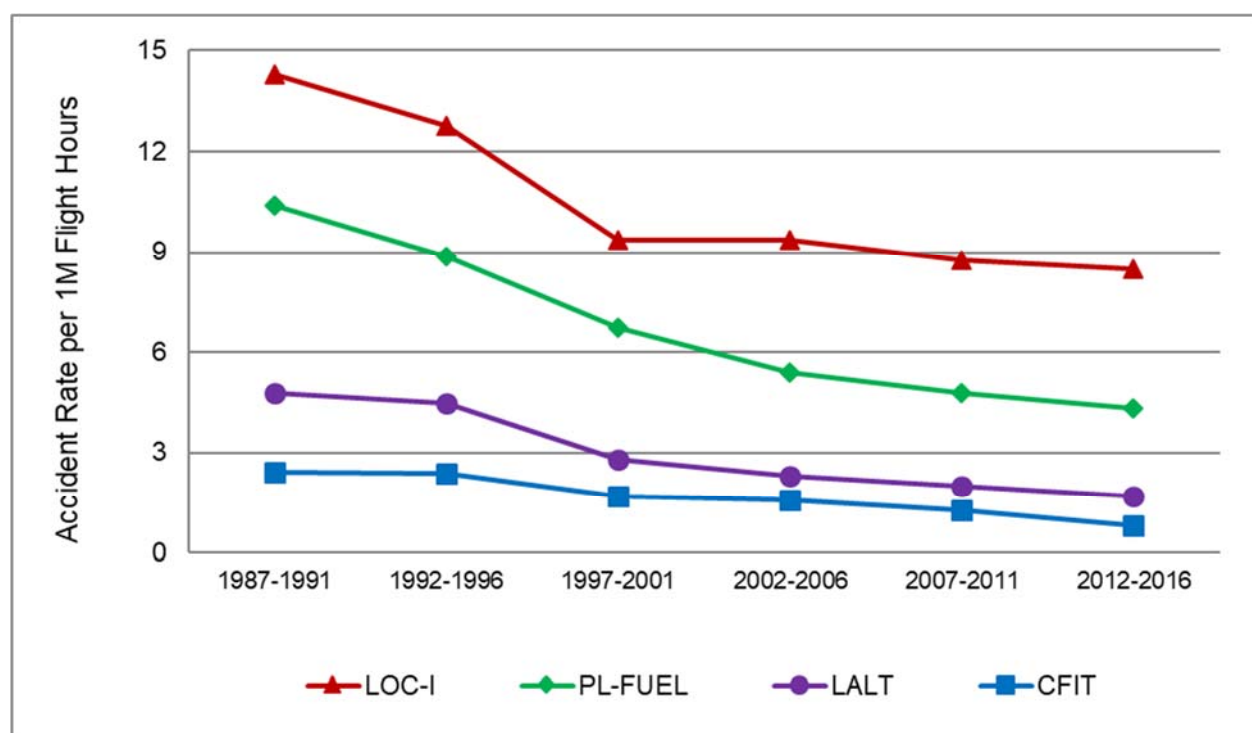


Figure 23-A. Accident Rates by CICTT Occurrence Category (Part 91; 1987-2016).

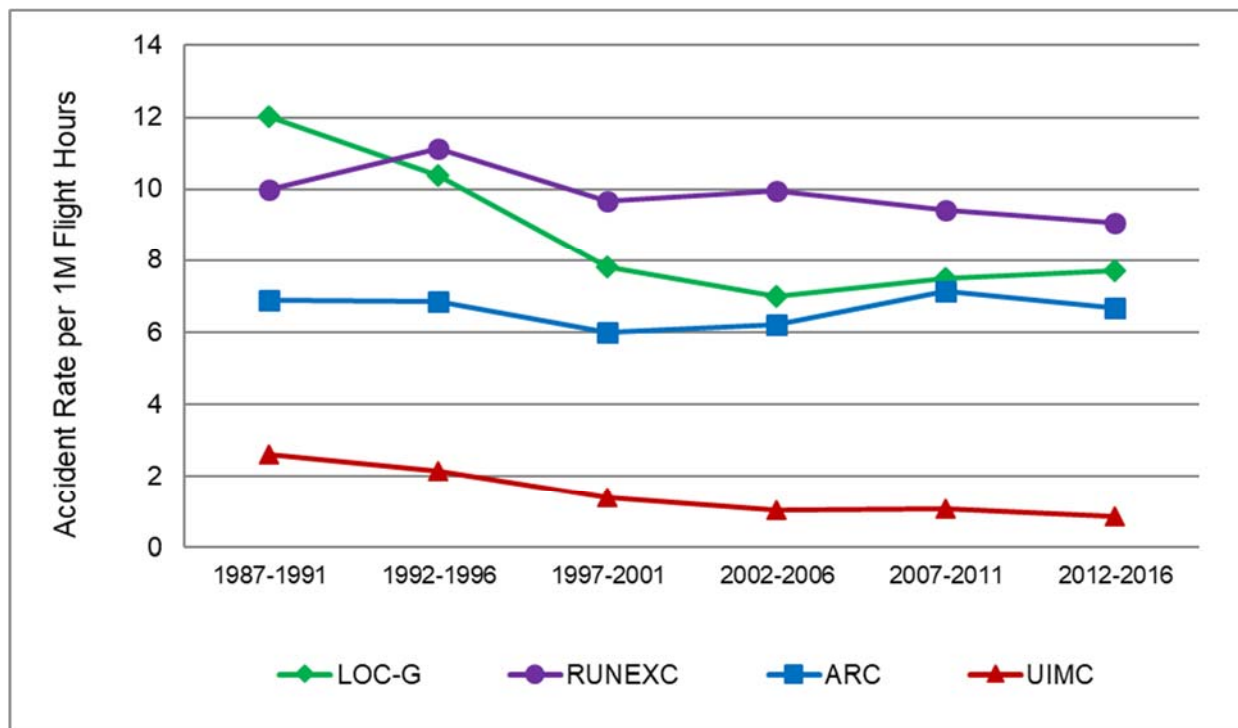


Figure 23-B. Accident Rates by CICTT Occurrence Category (Part 91; 1987-2016).

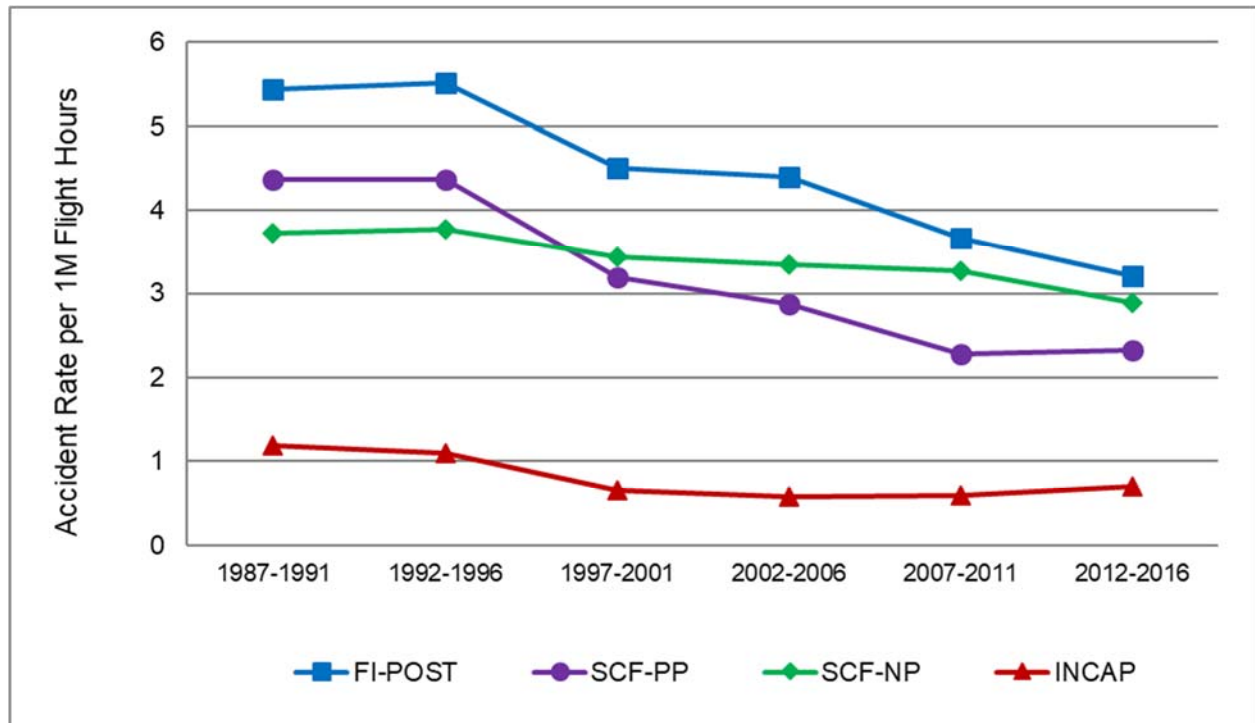


Figure 23-C. Accident Rates by CICTT Occurrence Category (Part 91; 1987-2016).

Figures 24-A, 24-B and 24-C show the fatal accident rates for these twelve occurrence categories. The categories with the largest rate of decrease in the fatal accident rate are in flight loss of control (LOC-I), low altitude operations (LALT) and post-impact fire (FI-POST). The fatal accident rates associated with abnormal runway contact (ARC) seem to be increasing slightly over the study period, but the number of fatal accidents is very low.

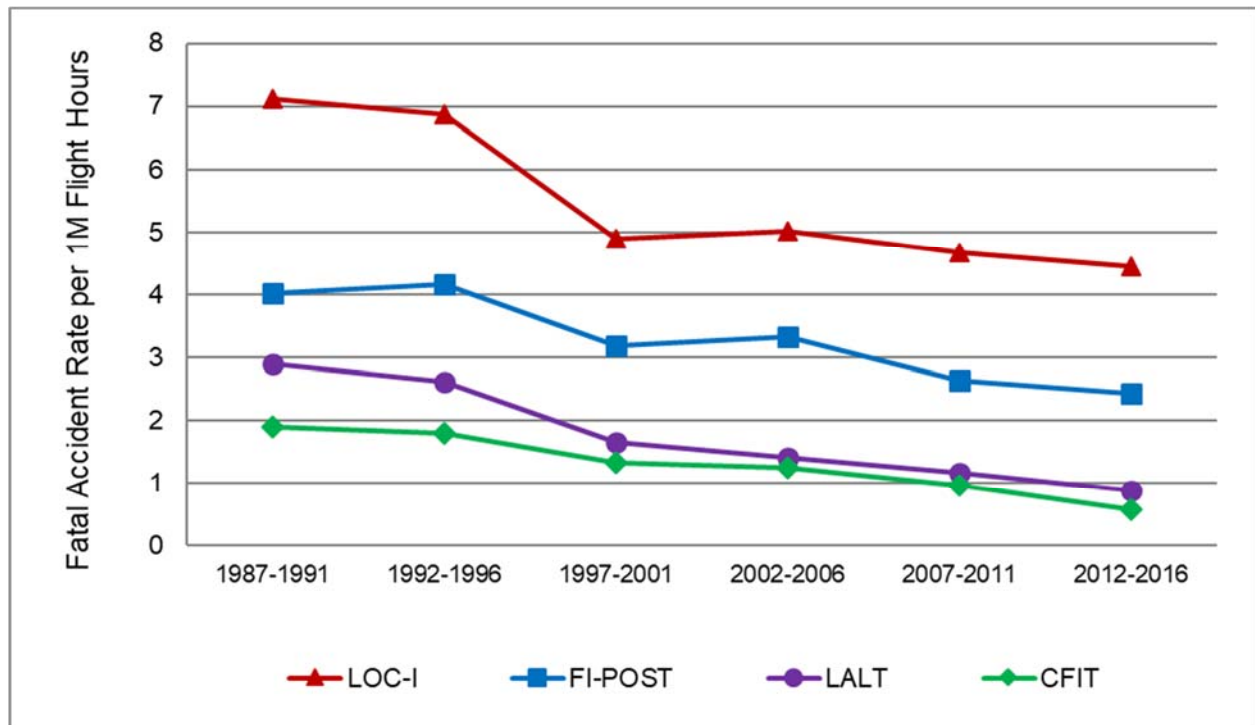


Figure 24-A. Fatal Accident Rates by CICTT Occurrence Category (Part 91; 1987-2016).

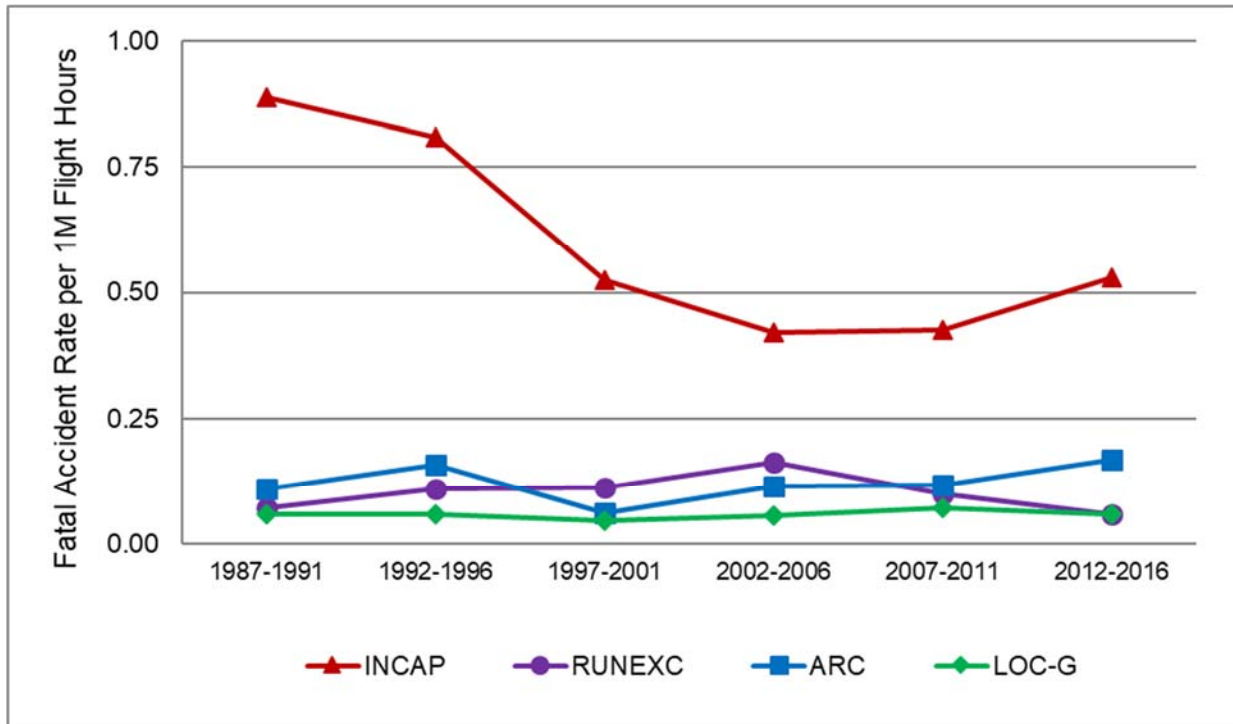


Figure 24-B. Fatal Accident Rates by CICTT Occurrence Category (Part 91; 1987-2016).

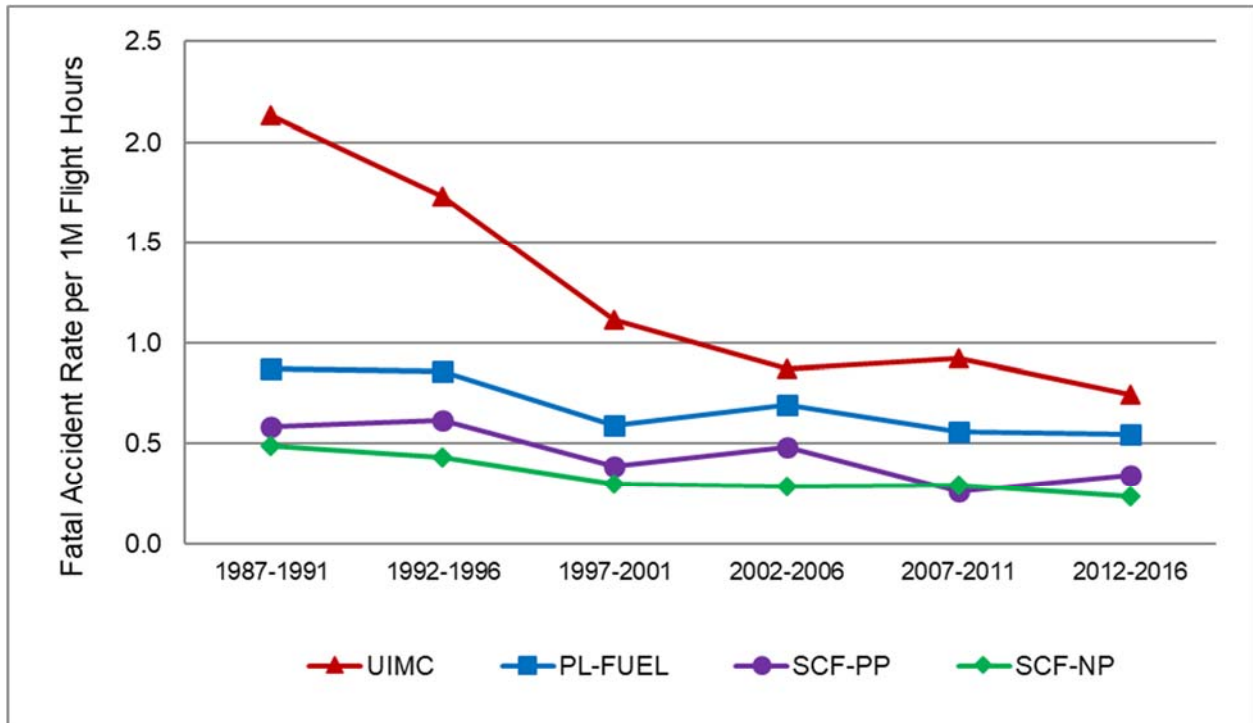


Figure 24-C. Fatal Accident Rates by CICTT Occurrence Category (Part 91; 1987-2016).

Table 9 summarizes which occurrence categories could be considered ‘tall poles’ in each of the four time periods selected for this analysis. All nine categories are considered ‘tall poles’ in every time period (abnormal runway contact, controlled flight into terrain, post-impact fire, low altitude maneuvering, loss of control – in flight, loss of control – on ground/water, fuel related loss of engine power, runway excursion and unintended flight in IMC). Tables for total accidents, fatal accidents, total injuries and fatal injuries in each 10-year time period, upon which the selection of ‘tall poles’ was based, can be found in Appendix C.

Table 9. Occurrence Category ‘Tall Poles’ in Selected Time Periods (Part 91)

CICTT Occurrence Category	1987-1996	1992-2001	1997-2006	2002-2011	2007-2016
Abnormal Runway Contact	✓	✓	✓	✓	✓
Controlled Flight Into or Toward Terrain	✓	✓	✓	✓	✓
Fire – Post Impact	✓	✓	✓	✓	✓
Low Altitude Maneuvering	✓	✓	✓	✓	✓
Loss of Control – In Flight	✓	✓	✓	✓	✓
Loss of Control – On Ground/water	✓	✓	✓	✓	✓
Power Loss - Fuel	✓	✓	✓	✓	✓
Runway Excursion	✓	✓	✓	✓	✓
Unintended Flight in IMC	✓	✓	✓	✓	✓

Summary

Total and Fatal Accident Rates

In general, the total and fatal accident rates have decreased over time for all flight operations. The lone exception is the accident rate in scheduled Part 135, which was higher in 2011-2016 than in 1987-1991, but appears to be in decline since 1999. In 1997, many flights that previously could have been conducted under Part 135 were required to be conducted under Part 121. It is interesting that prior to 1997, the accident rates and fatal accident rates in scheduled Part 135 were comparable to the rates in Part 121, but since 1997, there is more similarity between scheduled Part 135 and non-scheduled Part 135. In nearly all years, the highest accident rates and fatal accident rates were in Part 91, the lowest rates were in Part 121, with Part 135 rates in the middle.

Accident Severity

The composition of accident severity in Part 121 has changed substantially over time. From 1992-1996 to 1997-2001 there was a large jump in the amount of accidents involving substantial damage with little or no injury, with fewer ‘injury’ accidents (serious injury with little or no aircraft damage). The rate of all severity types has decreased since 2001, and in the most recent time period there were slightly more ‘injury’ accidents than ‘damage’ accidents, and the rates of ‘major’ and ‘serious’ accidents were identical and nearly zero.

Although the accident rate in recent years has been higher than earlier in the study period in Scheduled Part 135, most of those more recent accidents resulted in no injuries. However, in eighty-eight percent of the accidents during 2002-2016, the aircraft suffered substantial damage. An interesting difference between Part 121 and Part 135-S is that in Part 121, a large part of the accidents are classified as ‘injury,’ meaning there was at least one serious injury but less than substantial damage to the aircraft. These accidents result mostly from turbulence encounters. But in Part 135-S, the “injury” classification was assigned to only nine of the 306 accidents. Roughly two-thirds of all accidents in Part 135 and Part 91 were classified as ‘damage’ accidents, compared with 45% of Part 121 accidents.

The largest decrease in Non-scheduled Part 135 accident rates was associated with no injuries, and the second largest decrease was seen in fatal accidents. Large decreases have also occurred in the rates of substantial aircraft damage and aircraft destruction. In Part 135-NS, ‘injury’ accidents and ‘serious’ accidents have not been common, but ‘major’ and ‘damage’ accidents have decreased substantially over the study period.

More than half of the Part 91 accidents result in no injury but substantial aircraft damage. In Part 135-NS and Part 91, it is rare for an accident aircraft to suffer little or no damage. The accident rates associated with ‘major’ accidents has declined more than ‘damage’ accidents, while the rates of both ‘injury’ accidents and ‘serious’ accidents have been fairly constant across the study period.

Occurrence Categories

The highest accident rates in Part 121 operations are associated with turbulence (TURB) and ground handling (RAMP), both of which increased across the first half of the study period, then decreased to the level of earlier rates. Accident rates have not increased consistently over the study period in any occurrence category, but for several categories (post-impact fire, in flight loss of control, evacuations and non-powerplant system/component failure/malfunction) rates have generally decreased over time. Fatal accidents associated with post-impact fire (FI-POST), in-flight loss of control (LOC-I) and ground handling (RAMP) were reduced substantially.

Among scheduled Part 135 operations, the rates of controlled flight into terrain (CFIT), icing (ICE), unintended flight in IMC (UIMC), runway excursion (RUN EXC) and in flight loss of control (LOC-I) all spiked dramatically during 1997-2001. The rate of powerplant system/component failure/malfunction (SCF-PP) generally increased over time while the most consistent decline in both total and fatal accident rates was in post-impact fire (FI-POST).

The largest decreases in non-scheduled Part 135 accidents rates were associated with in-flight loss of control (LOC-I), post-impact fire (FI-POST), powerplant system/component failure/malfunction (SCF-PP), runway excursions (RUNEXC) and controlled flight into terrain (CFIT). For several occurrence categories the accident rates decreased very little, but there were no consistent increases in the accident rate for any of the thirteen categories that were examined. The largest decreases in fatal accidents rates were associated with post-impact fire (FI-POST), in-flight loss of control (LOC-I) and controlled flight into terrain (CFIT). None of the ten categories examined displayed an increase in the fatal accident rate across the entire study period.

In Part 91, the largest decreases accidents rates were associated with fuel related loss of engine power (PL-FUEL) in-flight loss of control (LOC-I), on ground/water loss of control (LOC-G) and low altitude operations (LALT). Large decreases in accident rates were also seen in post-impact fire (FI-POST) and powerplant system/component failure (SCF-PP). Relatively high accident rates are associated with runway excursions (RUNEXC) and abnormal runway contact (ARC), but these rates have not changed much at all over the study period. The fatal accident rates associated with abnormal runway contact (ARC) seems to be increasing slightly over the study period, but the number of fatal accidents is very low. The categories with the largest rate of decrease in the fatal accident rate are in flight loss of control (LOC-I), low altitude operations (LALT) and post-impact fire (FI-POST).

‘Tall poles’ comparison

In order to compare the sets of occurrence categories that make the largest contribution to the safety risk (total accidents, fatal accidents, total injuries and fatal injuries), we defined five 10-year time periods and determined the so-called ‘tall poles’ in each time period.

In Part 121, four occurrence categories are considered ‘tall poles’ in every time period (post-impact fire, ground handling, in-flight loss of control and turbulence). Abrupt maneuver is not a

‘tall pole’ in the early years of the study period, but becomes one by accounting for 18% of fatal injuries in 1992-2001 and 35% of fatal injuries in 1997-2006. Most of the fatal accidents associated with CFIT and non-impact fire occurred between 1987 and 1996, so these are not included with the ‘tall poles’ in later years. The one fatal icing accident in 2009 resulted in 50 fatalities, which was 30% of the 166 total fatalities in 2002-2011 and 75% of the 67 total fatalities in 2007-2016. Runway excursion accounted for only seven percent of total accidents and six percent of fatal accidents overall. But during 2002-2011, runway excursion resulted in 20% of all injuries and 30% of fatal injuries. The percentage of fatalities attributable to non-powerplant system/component failure/malfunction (SCF-NP) ranged from 10% to 25% in the first four time periods, but SCF-NP contributed to only four total injuries and no fatalities in 2007-2016. Only one security-related accident occurred during 1989-2000. However, the three fatal security-related accidents in 1986-1988 accounted for 18% of all the fatalities in 1987-1996, while the events of 9/11/2001 accounted for 18% of fatal injuries in 1992-2001 and 35% of fatal injuries in 1997-2006.

In scheduled Part 135, only two occurrence categories are considered ‘tall poles’ in every time period (in-flight loss of control and runway excursion). Abnormal runway contact (ARC) accounts for only twelve percent of Part 135-S accidents (1987-2016) and these accidents tend not to result in many injuries, but the actual percentages vary over time. In three time periods, the percentage was high enough relative to other accident categories to be considered a ‘tall pole,’ and in the other two time periods the percentage was lower. Controlled flight into terrain (CFIT) was a ‘tall pole’ in most time periods, due to all four categories of risk. However, there was only one CFIT accident (nonfatal) during 2002-2011. Similarly, only one accident in 2002-2011 resulted from unintended flight in IMC (UIMC), also with no injuries. UIMC represented at least 22% of fatal accidents in each of the other time periods.

In non-scheduled Part 135, four occurrence categories are considered ‘tall poles’ in every time period (CFIT, post-impact fire, in-flight loss of control and runway excursion). Abnormal runway contact (ARC) is the second most frequent accident category in 2007-2016 (15.5%), following increasing incidence in every time period, from nine percent in 1987-1996 to 12% in 2002-2011. Non-Powerplant system/component failure/malfunction represents 14.6% of accidents in 2002-2011 and 14.2% in 2007-2016, up from 10-11% in previous time periods.

For Part 91, nine categories are considered ‘tall poles’ in every time period (abnormal runway contact, CFIT, post-impact fire, low altitude maneuvering, in flight loss of control, loss of control on ground/water, fuel related loss of engine power, runway excursion, and unintended flight in IMC). The number of Part 91 accidents has decreased over the study period, many of the accident category rates have declined, but no accident categories have increased in frequency.

Conclusions

Both total and fatal accident rates have generally decreased over time for all flight operations. In nearly all years, the highest accident rates and fatal accident rates were in Part 91, the lowest rates were in Part 121, and Part 135 rates were in the middle.

In all flight operations, ‘damage’ is the most frequent category of severity (substantial aircraft damage with no injuries). In Part 121 the second most frequent category is ‘injury’ (serious injury with at most minor aircraft damage), but in all other operations the second most frequent category is ‘major’ accidents (aircraft destruction or multiple fatalities or one fatality and substantial damage).

This disparity in accident severity is reflected in the most frequent accident categories. In Part 121, the top categories are ground handling and turbulence encounters; most ground handling accidents result in substantial aircraft damage but few injuries, whereas turbulence encounters result in serious injury but no aircraft damage. In other flight conduct the accidents tend to result in destruction and fatalities from CFIT or in flight loss of control, or in substantial damage with few injuries from runway excursion and abnormal runway contact.

In flight loss of control, and, to a lesser extent, post-impact fire are the only categories to be consistently among the ‘tall pole’ in all categories, although CFIT and runway excursion make the list in all Part 135 and Part 91 ‘tall poles.’ The set of ‘tall poles’ in Part 91 has not varied across time, but the same cannot be said for other flight operations. The contribution of various categories to the safety risk has changed substantially, and is even dependent upon how time periods are defined, since often one or two accidents can determine whether or not that category is among the most frequent in terms of fatal injuries.

Appendix A

Aviation Occurrence Categories

The CAST/ICAO Common Taxonomy Team (CICTT) was jointly chartered by the International Civil Aviation Organization (ICAO) and the Commercial Aviation Safety Team (CAST), and was charged with developing common taxonomies and definitions for aviation accident and incident reporting systems (for additional information see <http://www.intlaviationstandards.org/>). The occurrence categories are listed below, with brief descriptions of each. The information is taken from a document dated October 2013.

CICTT Categories

Abnormal Runway Contact (ARC): Any takeoff or landing involving abnormal contact with the runway or landing surface. Included are hard/heavy landings, long/fast landings, crabbed landings, nose wheel first touchdowns, tail strikes, wing/nacelle strikes and gear up landings.

Abrupt Maneuver (AMAN): The intentional abrupt maneuvering of the aircraft (in-flight or on-ground) by the flight crew to avoid a collision with terrain, objects, weather or other aircraft.

Aerodrome (ADRM): Occurrences involved aerodrome design, service or functionality issues. The aerodrome includes runways, taxiways, ramp areas, parking areas, buildings and structures, lighting, signage Crash/Fire/Rescue (CFR) services.

ATM/CNS (ATM): Occurrences involving air traffic management (ATM) or communication, navigation or surveillance (CNS) service issues.

Bird Strike (BIRD): Occurrences involving collisions or near collisions with bird(s) or wildlife.

Cabin Safety Events (CABIN): Includes significant events in the passenger cabin, related to carry-on baggage, supplemental oxygen, missing/non-operational emergency equipment, the inadvertent deployment of emergency equipment, and the medical emergency (not caused by turbulence encounters) of persons other than the flight crew or medical evacuation patients.

Collision with Obstacle(s) During Takeoff and Landing (CTOL): A collision with an object or obstacle during airborne phases of take-off or landing.

Controlled Flight into or toward Terrain (CFIT): In-flight collision or near collision with terrain, water or obstacle without indication of loss of control. Excludes intentional low altitude operations, intentional flight into terrain and runway undershoot/overshoot.

Evacuation (EVAC): Occurrences including one or more of the following: an unnecessary evacuation was performed, person(s) were injured during the evacuation, evacuation equipment failed to perform as required, or the evacuation was a factor in the outcome.

External Load Related Occurrences (EXTL): Occurrences during or as a result of external load or external cargo operations. Includes cases where external load or the load lifting equipment contacts terrain, water surface or objects.

Fire/Smoke Non-Impact (FI-NI): Fire or smoke in the aircraft (in-flight or on-ground) which was not the result of an impact.

Fire/Smoke Impact (FI-POST): Fire or smoke resulting from impact.

Fuel Related (FUEL): One or more powerplants experienced reduced or no power output due to fuel exhaustion (no usable fuel on board), fuel starvation (usable fuel is not available to the engine), fuel contamination (by water, sand, dirt, bugs) or wrong fuel, or carburetor and/or induction icing.

Glider Towing Related Events (GTOW): Premature release, inadvertent release or non-release during towing, entangling with towing, cable, loss of control, or impact into towing aircraft/winch.

Ground Handling (RAMP): Occurrences during (or as a result of) ground operations, including preflight configuration errors that lead to subsequent events (such as improperly latched doors, pitot tube contamination, or weight/balance issues).

Ground Collision (GCOL): Collision with an aircraft, person, animal, ground vehicle, building, etc., while taxiing to or from the runway in use.

Icing (ICE): The accumulation of snow, ice, freezing rain or frost on aircraft surfaces to the extent that aircraft control or performance is adversely affected.

Loss of Control – Ground (LOC-G): Loss of aircraft control while the aircraft is on the ground, which may result from a contaminated runway, evasive action due to a runway incursion, or the failure or malfunction of a system or component.

Loss of Control – In flight (LOC-I): Loss of aircraft control while in flight; may occur in Instrument Meteorological Conditions (IMC) or Visual Meteorological Conditions (VMC).

Loss of Lifting Conditions En-Route: (LOLI): Landing en-route due to loss of lifting conditions. Applicable only to aircraft that rely on static lift to maintain or increase flight attitude, namely sailplanes, gliders, hang gliders, and paragliders, balloons and airships.

Low Altitude Operations (LALT): Collision or near collision with terrain/objects/obstacles while intentionally operating near the surface (excludes landing and takeoff phases). Includes aerobatics, sight-seeing, aerial photography, aerial application, scud running, and flying in close proximity to mountains or box canyons where the aircraft aerodynamic capability is not sufficient to avoid impact.

Airprox/TCAS Alert/Loss of Separation/Near Mid-Air Collision/Mid-Air Collision (MAC): Airprox, TCAS alerts and loss of separation, as well as near collisions or collisions between aircraft in flight.

Medical Emergency (MED): Occurrences involving illnesses of persons on board an aircraft, leading to medical emergencies or inability to perform duties.

Navigation Errors (NAV): Occurrences involving the incorrect navigation of aircraft on the ground or in the air.

Other (OTHER): Any occurrence not covered under another category.

Runway Excursion (RE): A veer off the side or overrun off the end of the runway.

Runway Incursion – Vehicle, Aircraft or Person (RI-VAP): The incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for takeoffs or landings.

Security Related (SEC): Criminal or security related acts such as hijacking, aircraft theft, flight control interference, sabotage or suicide.

System/Component Failure or Malfunction – Non-powerplant (SCF-NP): Failure or malfunction of an aircraft system or component other than the powerplant.

System/Component Failure or Malfunction – Powerplant (SCF-PP): Failure or malfunction of an aircraft system or component related to the powerplant.

Turbulence Encounter (TURB): In flight encounter with turbulence; includes clear-air or cloud turbulence, mountain wave and wake vortex.

Unintended Flight in Instrument Meteorological Conditions (UIMC): Applicable if the pilot was flying according to Visual Flight Rules (VFR), and by any reason found oneself inadvertently in IMC. Only to be used if pilot not qualified to fly in IMC and/or aircraft not equipped to fly in IMC, and only in the case of a loss of visual references.

Undershoot/Overshoot (USOS): A touchdown off the runway surface but in close proximity to the runway. Excludes off-airport emergency landings.

Unknown or Undetermined (UNK): Insufficient information exists to categorize the accident; includes missing aircraft.

Wildlife (WILD): Collision with, risk of collision with, or evasive action taken by an aircraft to avoid an animal (other than birds) on the runway in use. Previously known as Runway Incursion – Animal (RI-A).

Windshear or Thunderstorm (WSTRW): Flight into windshear or thunderstorm; includes hail and heavy rain.

Additional Categories

Many of the following categories were added in order to completely capture the event sequence. An emergency landing is required in most cases of System/Component Failure/Malfunction and Loss of Engine Power, and may be performed after an encounter with adverse weather; such landings often are not without further incident. Control of the aircraft may be lost, hard or bounced landings may occur, terrain unsuitable for a proper landing may be encountered, the aircraft may collide with power lines, fences or ground vehicles during an off-airport landing, the aircraft may be unable to avoid rising terrain due to degraded performance. The single category of “Loss of Engine Power” is not sufficient to explain why the aircraft was destroyed.

Several categories (collisions with terrain or objects and loss of control) were further subdivided by general phase of flight (ground, takeoff, in flight, approach/landing) because either the root cause or the consequences of the occurrence differ by phase of flight.

Collision with Object – Precautionary Landing (CWO-PL): A collision with an object or obstacle occurred during a precautionary landing approach. CFIT is not an appropriate category in these cases because a system/component failure/malfunction or non-mechanical loss of engine power necessitated the landing.

Collision with Terrain – Precautionary Landing (CWT-PL): A collision with terrain occurred during a precautionary landing approach. CFIT is not an appropriate category in these cases because a system/component failure/malfunction or non-mechanical loss of engine power necessitated the landing. This code was also used in cases where the pilot “ditched” the aircraft in water.

Encounter with Terrain – Precautionary Landing (EWT-PL): An encounter with terrain occurred on the ground away from an airport environment during a precautionary landing, causing damage to the aircraft. The difference between this category and CWT-PL is primarily the force with which the aircraft strikes the ground at touchdown. An encounter with terrain involves a normal touchdown, with rough terrain encountered during the landing roll. Included here are intentional gear-up off-airport landings.

Pilot Incapacitation or Severe Impairment (INCAP): Pilot became incapacitated (due to illness or fatigue) or severely impaired (due to illness, alcohol or illegal drugs). Does not include minor impairment caused by fatigue or the use of unapproved prescription medications.

Loss of Engine Power – Fuel Related (PL-FUEL): Loss of engine power due to fuel exhaustion (no usable fuel on board), fuel starvation (usable fuel is not available to the

engine), fuel contamination (by water, sand, dirt, bugs) or wrong fuel, or carburetor and/or induction icing (see FUEL above).

Loss of Engine Power – Other Reasons (PL-OTHER): Loss of engine power due to other non-mechanical reasons. Reasons include foreign object damage (e.g. bird strikes), ice ingestion, improper simulated engine out procedures, other improper procedures.

Loss of Engine Power – Unknown Reasons (PL-UNK): Loss of engine power occurred but the exact cause was undetermined.

System/Component Failure or Malfunction – Stress Limits Exceeded (SCF-SLE): Structural failure due to exceeding the designed stress limits of the aircraft, most often resulting from loss of control, from forces associated with severe weather or from pilot actions such as excessive airspeed or abrupt maneuvering.

Appendix B

Tables of the Frequencies of Total Accidents and Total Injuries, by Aviation Occurrence Categories In Five Year Periods

Table B-1. Number of Accidents by CICTT Occurrence Category (1987-1991)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	147	109	415	8953
Abrupt Maneuver		1 (0.9%)	2 (0.5%)	44 (0.5%)
Abnormal Runway Contact	13 (8.8%)	15 (13.8%)	35 (8.4%)	952 (10.6%)
Aerodrome	1 (0.7%)	6 (5.5%)	15 (3.6%)	131 (1.5%)
Air Traffic Management	13 (8.8%)	5 (4.6%)	4 (1.0%)	45 (0.5%)
Bird Strikes	1 (0.7%)	1 (0.9%)		11 (0.1%)
Cabin Safety or Pilot Incapacitation	6 (4.1%)	2 (1.8%)	4 (1.0%)	166 (1.9%)
Controlled Flight Into Terrain	4 (2.7%)	11 (10.1%)	44 (10.6%)	333 (3.7%)
Collision with Object – Takeoff or Landing	1 (0.7%)	2 (1.8%)	9 (2.2%)	365 (4.1%)
Collision with Object – Precautionary Landing *		3 (2.8%)	35 (8.4%)	868 (9.7%)
Collision with Terrain – Precautionary Landing *	1 (0.7%)		11 (2.7%)	280 (3.1%)
Encounter with Terrain – Precautionary Landing *	2 (1.4%)	4 (3.7%)	25 (6.0%)	627 (7.0%)
Evacuation	15 (10.2%)			
Fire – Non-Impact	8 (5.4%)	3 (2.8%)	12 (2.9%)	91 (1.0%)
Fire – Post Impact	14 (9.5%)	20 (18.3%)	63 (15.2%)	754 (8.4%)
Ground Collision	14 (9.5%)	14 (12.8%)	19 (4.6%)	198 (2.2%)
Ground Handling or PreFlight	17 (11.6%)	12 (11.0%)	19 (4.6%)	258 (2.9%)
Icing	3 (2.0%)	6 (5.5%)	18 (4.3%)	123 (1.4%)
Low Altitude Operations		2 (1.8%)	20 (4.8%)	662 (7.4%)
Loss of Control – In Flight	9 (6.1%)	19 (17.4%)	79 (19.0%)	1989 (22.2%)
Loss of Control – On Ground	3 (2.0%)	2 (1.8%)	46 (11.1%)	1667 (18.6%)
Mid Air Collision		4 (3.7%)	9 (2.2%)	139 (1.6%)
Power Loss – Fuel	2 (1.4%)	3 (2.8%)	25 (6.0%)	1439 (16.1%)
Power Loss – Other Reason *		3 (2.8%)	5 (1.2%)	129 (1.4%)
Power Loss – Unknown Reason *	1 (0.7%)	3 (2.8%)	14 (3.4%)	362 (4.0%)
Runway Excursion	9 (6.1%)	18 (16.5%)	57 (13.7%)	1381 (15.4%)
Runway Incursion (Vehicle, Aircraft or Person)	9 (6.1%)	1 (0.9%)	1 (0.2%)	54 (0.6%)
SCF – Powerplant	13 (8.8%)	8 (7.3%)	48 (11.6%)	606 (6.8%)
SCF – Non Powerplant	20 (13.6%)	7 (6.4%)	36 (8.7%)	516 (5.8%)
SCF – Stress Limits Exceeded*		1 (0.9%)	4 (1.0%)	80 (0.9%)
Security Related	3 (2.0%)		1 (0.2%)	56 (0.6%)
Turbulence Encounter	26 (17.7%)	2 (1.8%)	7 (1.7%)	95 (1.1%)
Thunderstorm or Windshear	3 (2.0%)	2 (1.8%)	6 (1.5%)	129 (1.4%)
Undershoot or Overshoot		3 (2.8%)	7 (1.7%)	198 (2.2%)
Unintended Flight in IMC		8 (7.3%)	20 (4.8%)	363 (4.1%)
Wildlife			4 (1.0%)	25 (0.3%)
Other	2 (1.4%)		6 (1.5%)	64 (0.7%)
Unknown or Undetermined	8 (5.4%)	3 (2.8%)	12 (2.9%)	113 (1.3%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-2. Number of Accidents by CICTT Occurrence Category (1992-1996)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	140	72	330	7443
Abrupt Maneuver	2 (1.4%)			45 (0.6%)
Abnormal Runway Contact	15 (10.7%)	8 (11.1%)	31 (9.4%)	818 (11.0%)
Aerodrome	3 (2.1%)	4 (5.6%)	10 (3.0%)	108 (1.5%)
Air Traffic Management	5 (3.6%)		4 (1.2%)	38 (0.5%)
Bird Strikes	1 (0.7%)	1 (1.4%)	1 (0.3%)	15 (0.2%)
Cabin Safety or Pilot Incapacitation	3 (2.1%)		2 (0.6%)	132 (1.8%)
Controlled Flight Into Terrain	2 (1.4%)	12 (16.7%)	34 (10.3%)	282 (3.8%)
Collision with Object – Takeoff or Landing	1 (0.7%)		9 (2.7%)	305 (4.1%)
Collision with Object – Precautionary Landing *		1 (1.4%)	15 (4.5%)	786 (10.6%)
Collision with Terrain – Precautionary Landing *		2 (2.8%)	18 (5.5%)	295 (4.0%)
Encounter with Terrain – Precautionary Landing *		1 (1.4%)	16 (4.8%)	481 (6.5%)
Evacuation	16 (11.4%)	1 (1.4%)		
Fire – Non-Impact	11 (7.9%)	1 (1.4%)	8 (2.4%)	86 (1.2%)
Fire – Post Impact	9 (6.4%)	9 (12.5%)	45 (13.6%)	660 (8.9%)
Ground Collision	7 (5.0%)	3 (4.2%)	15 (4.5%)	126 (1.7%)
Ground Handling or PreFlight	28 (20.0%)	12 (16.7%)	15 (4.5%)	215 (2.9%)
Icing	3 (2.1%)	6 (8.3%)	20 (6.1%)	117 (1.6%)
Low Altitude Operations		2 (2.8%)	16 (4.8%)	537 (7.2%)
Loss of Control – In Flight	13 (9.3%)	14 (19.4%)	54 (16.4%)	1525 (20.5%)
Loss of Control – On Ground	2 (1.4%)	2 (2.8%)	41 (12.4%)	1243 (16.7%)
Mid Air Collision	1 (0.7%)		3 (0.9%)	98 (1.3%)
Power Loss – Fuel			27 (8.2%)	1061 (14.3%)
Power Loss – Other Reason *	2 (1.4%)		1 (0.3%)	98 (1.3%)
Power Loss – Unknown Reason *		1 (1.4%)	9 (2.7%)	421 (5.7%)
Runway Excursion	9 (6.4%)	8 (11.1%)	43 (13.0%)	1332 (17.9%)
Runway Incursion (Vehicle, Aircraft or Person)	1 (0.7%)	1 (1.4%)	1 (0.3%)	49 (0.7%)
SCF – Powerplant	7 (5.0%)	5 (6.9%)	36 (10.9%)	523 (7.0%)
SCF – Non Powerplant	18 (12.9%)	8 (11.1%)	40 (12.1%)	452 (6.1%)
SCF – Stress Limits Exceeded*	2 (1.4%)		2 (0.6%)	91 (1.2%)
Security Related	1 (0.7%)	2 (2.8%)		29 (0.4%)
Turbulence Encounter	39 (27.9%)	1 (1.4%)	4 (1.2%)	59 (0.8%)
Thunderstorm or Windshear	3 (2.1%)	2 (2.8%)	2 (0.6%)	98 (1.3%)
Undershoot or Overshoot	1 (0.7%)	1 (1.4%)	8 (2.4%)	177 (2.4%)
Unintended Flight in IMC		7 (9.7%)	15 (4.5%)	255 (3.4%)
Wildlife			1 (0.3%)	33 (0.4%)
Other	1 (0.7%)		7 (2.1%)	52 (0.7%)
Unknown or Undetermined	2 (1.4%)		5 (1.5%)	125 (1.7%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-3. Number of Accidents by CICTT Occurrence Category (1997-2001)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	254	56	316	6564
Abrupt Maneuver	9 (3.5%)			29 (0.4%)
Abnormal Runway Contact	21 (8.3%)	7 (12.5%)	36 (11.4%)	800 (12.2%)
Aerodrome	7 (2.8%)	3 (5.4%)	11 (3.5%)	77 (1.2%)
Air Traffic Management	3 (1.2%)		4 (1.3%)	37 (0.6%)
Bird Strikes	8 (3.2%)	6 (10.7%)	1 (0.3%)	12 (0.2%)
Cabin Safety or Pilot Incapacitation	5 (2.0%)		2 (0.6%)	88 (1.3%)
Controlled Flight Into Terrain		10 (17.9%)	29 (9.2%)	227 (3.5%)
Collision with Object – Takeoff or Landing	2 (0.8%)	1 (1.8%)	6 (1.9%)	269 (4.1%)
Collision with Object – Precautionary Landing *		1 (1.8%)	18 (5.7%)	670 (10.2%)
Collision with Terrain – Precautionary Landing *	1 (0.4%)	1 (1.8%)	22 (7.0%)	236 (3.6%)
Encounter with Terrain – Precautionary Landing *		2 (3.6%)	18 (5.7%)	447 (6.8%)
Evacuation	15 (5.9%)			
Fire – Non-Impact	12 (4.7%)	1 (1.8%)	4 (1.3%)	76 (1.2%)
Fire – Post Impact	7 (2.8%)	4 (7.1%)	38 (12.0%)	603 (9.2%)
Ground Collision	7 (2.8%)		15 (4.7%)	156 (2.4%)
Ground Handling or PreFlight	66 (26.0%)	4 (7.1%)	15 (4.7%)	173 (2.6%)
Icing	2 (0.8%)	8 (14.3%)	20 (6.3%)	76 (1.2%)
Low Altitude Operations	1 (0.4%)	1 (1.8%)	12 (3.8%)	373 (5.7%)
Loss of Control – In Flight	6 (2.4%)	10 (17.9%)	50 (15.8%)	1250 (19.0%)
Loss of Control – On Ground		2 (3.6%)	31 (9.8%)	1043 (15.9%)
Mid Air Collision	2 (0.8%)	1 (1.8%)	4 (1.3%)	97 (1.5%)
Power Loss – Fuel			31 (9.8%)	897 (13.7%)
Power Loss – Other Reason *	3 (1.2%)		3 (0.9%)	61 (0.9%)
Power Loss – Unknown Reason *	1 (0.4%)	1 (1.8%)	15 (4.7%)	363 (5.5%)
Runway Excursion	22 (8.7%)	11 (19.6%)	50 (15.8%)	1292 (19.7%)
Runway Incursion (Vehicle, Aircraft or Person)				39 (0.6%)
SCF – Powerplant	10 (3.9%)	1 (1.8%)	34 (10.8%)	426 (6.5%)
SCF – Non Powerplant	21 (8.3%)	6 (10.7%)	31 (9.8%)	460 (7.0%)
SCF – Stress Limits Exceeded*	2 (0.8%)		3 (0.9%)	43 (0.7%)
Security Related	4 (1.6%)			21 (0.3%)
Turbulence Encounter	67 (26.4%)	1 (1.8%)	5 (1.6%)	55 (0.8%)
Thunderstorm or Windshear	5 (2.0%)		4 (1.3%)	55 (0.8%)
Undershoot or Overshoot	2 (0.8%)	2 (3.6%)	10 (3.2%)	143 (2.2%)
Unintended Flight in IMC		9 (16.1%)	13 (4.1%)	185 (2.8%)
Wildlife	3 (1.2%)		3 (0.9%)	39 (0.6%)
Other	4 (1.6%)	1 (1.8%)		49 (0.7%)
Unknown or Undetermined	2 (0.8%)		4 (1.3%)	61 (0.9%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-4. Number of Accidents by CICTT Occurrence Category (2002-2006)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	205	22	224	5695
Abrupt Maneuver	7 (3.4%)		1 (0.4%)	25 (0.4%)
Abnormal Runway Contact	22 (10.7%)	4 (18.2%)	23 (10.3%)	765 (13.4%)
Aerodrome	1 (0.5%)		10 (4.5%)	72 (1.3%)
Air Traffic Management	4 (2.0%)		3 (1.3%)	41 (0.7%)
Bird Strikes	6 (2.9%)	2 (9.1%)	4 (1.8%)	15 (0.3%)
Cabin Safety or Pilot Incapacitation	6 (2.9%)		3 (1.3%)	72 (1.3%)
Controlled Flight Into Terrain	2 (1.0%)		24 (10.7%)	193 (3.4%)
Collision with Object – Takeoff or Landing	1 (0.5%)		11 (4.9%)	206 (3.6%)
Collision with Object – Precautionary Landing *			9 (4.0%)	571 (10.0%)
Collision with Terrain – Precautionary Landing *	1 (0.5%)	1 (4.5%)	8 (3.6%)	245 (4.3%)
Encounter with Terrain – Precautionary Landing *		1 (4.5%)	8 (3.6%)	336 (5.9%)
Evacuation	14 (6.8%)	1 (4.5%)	1 (0.4%)	
Fire – Non-Impact	5 (2.4%)	1 (4.5%)	5 (2.2%)	53 (0.9%)
Fire – Post Impact	7 (3.4%)		31 (13.8%)	543 (9.5%)
Ground Collision	23 (11.2%)	2 (9.1%)	8 (3.6%)	123 (2.2%)
Ground Handling or PreFlight	54 (26.3%)		15 (6.7%)	110 (1.9%)
Icing			11 (4.9%)	77 (1.4%)
Low Altitude Operations			5 (2.2%)	284 (5.0%)
Loss of Control – In Flight	2 (1.0%)	1 (4.5%)	44 (19.6%)	1155 (20.3%)
Loss of Control – On Ground		4 (18.2%)	18 (8.0%)	863 (15.2%)
Mid Air Collision	1 (0.5%)		5 (2.2%)	55 (1.0%)
Power Loss – Fuel	1 (0.5%)		12 (5.4%)	666 (11.7%)
Power Loss – Other Reason *				41 (0.7%)
Power Loss – Unknown Reason *			12 (5.4%)	341 (6.0%)
Runway Excursion	15 (7.3%)	4 (18.2%)	34 (15.2%)	1229 (21.6%)
Runway Incursion (Vehicle, Aircraft or Person)			2 (0.9%)	21 (0.4%)
SCF – Powerplant	5 (2.4%)	2 (9.1%)	8 (3.6%)	355 (6.2%)
SCF – Non Powerplant	21 (10.2%)	2 (9.1%)	27 (12.1%)	413 (7.3%)
SCF – Stress Limits Exceeded*			2 (0.9%)	45 (0.8%)
Security Related				18 (0.3%)
Turbulence Encounter	49 (23.9%)	2 (9.1%)	1 (0.4%)	45 (0.8%)
Thunderstorm or Windshear	2 (1.0%)		6 (2.7%)	79 (1.4%)
Undershoot or Overshoot		1 (4.5%)	6 (2.7%)	114 (2.0%)
Unintended Flight in IMC		1 (4.5%)	6 (2.7%)	128 (2.2%)
Wildlife	2 (1.0%)		2 (0.9%)	38 (0.7%)
Other	2 (1.0%)		5 (2.2%)	46 (0.8%)
Unknown or Undetermined			4 (1.8%)	32 (0.6%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-5. Number of Accidents by CICTT Occurrence Category (2007-2011)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	157	23	188	4913
Abrupt Maneuver	3 (1.9%)		1 (0.5%)	32 (0.7%)
Abnormal Runway Contact	9 (5.7%)	2 (8.7%)	26 (13.8%)	790 (16.1%)
Aerodrome	3 (1.9%)	2 (8.7%)	3 (1.6%)	52 (1.1%)
Air Traffic Management	5 (3.2%)	2 (8.7%)	2 (1.1%)	21 (0.4%)
Bird Strikes	8 (5.1%)		3 (1.6%)	30 (0.6%)
Cabin Safety or Pilot Incapacitation	5 (3.2%)		1 (0.5%)	66 (1.3%)
Controlled Flight Into Terrain		1 (4.3%)	12 (6.4%)	138 (2.8%)
Collision with Object – Takeoff or Landing		1 (4.3%)	6 (3.2%)	176 (3.6%)
Collision with Object – Precautionary Landing *			9 (4.8%)	397 (8.1%)
Collision with Terrain – Precautionary Landing *	1 (0.6%)		6 (3.2%)	186 (3.8%)
Encounter with Terrain – Precautionary Landing *	1 (0.6%)	1 (4.3%)	5 (2.7%)	306 (6.2%)
Evacuation	2 (1.3%)	1 (4.3%)		
Fire – Non-Impact	6 (3.8%)	1 (4.3%)	4 (2.1%)	54 (1.1%)
Fire – Post Impact	3 (1.9%)	1 (4.3%)	19 (10.1%)	405 (8.2%)
Ground Collision	15 (9.6%)	4 (17.4%)	15 (8.0%)	112 (2.3%)
Ground Handling or PreFlight	33 (21.0%)	2 (8.7%)	7 (3.7%)	148 (3.0%)
Icing	2 (1.3%)	2 (8.7%)	10 (5.3%)	43 (0.9%)
Low Altitude Operations			4 (2.1%)	222 (4.5%)
Loss of Control – In Flight	4 (2.5%)	6 (26.1%)	31 (16.5%)	967 (19.7%)
Loss of Control – On Ground			13 (6.9%)	829 (16.9%)
Mid Air Collision			3 (1.6%)	59 (1.2%)
Power Loss – Fuel		1 (4.3%)	12 (6.4%)	529 (10.8%)
Power Loss – Other Reason *				30 (0.6%)
Power Loss – Unknown Reason *			4 (2.1%)	335 (6.8%)
Runway Excursion	10 (6.4%)	4 (17.4%)	31 (16.5%)	1041 (21.2%)
Runway Incursion (Vehicle, Aircraft or Person)			1 (0.5%)	7 (0.1%)
SCF – Powerplant	3 (1.9%)	2 (8.7%)	11 (5.9%)	252 (5.1%)
SCF – Non Powerplant	6 (3.8%)	1 (4.3%)	33 (17.6%)	361 (7.3%)
SCF – Stress Limits Exceeded*			1 (0.5%)	40 (0.8%)
Security Related				8 (0.2%)
Turbulence Encounter	58 (36.9%)	1 (4.3%)	3 (1.6%)	39 (0.8%)
Thunderstorm or Windshear	1 (0.6%)		2 (1.1%)	59 (1.2%)
Undershoot or Overshoot			3 (1.6%)	98 (2.0%)
Unintended Flight in IMC			7 (3.7%)	120 (2.4%)
Wildlife				21 (0.4%)
Other	1 (0.6%)		7 (3.7%)	42 (0.9%)
Unknown or Undetermined	2 (1.3%)		5 (2.7%)	24 (0.5%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-6. Number of Accidents by CICTT Occurrence Category (2002-2016)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	131	24	128	4139
Abrupt Maneuver		1 (4.2%)	3 (2.3%)	21 (0.5%)
Abnormal Runway Contact	17 (13.0%)	2 (8.3%)	23 (18.0%)	678 (16.4%)
Aerodrome		1 (4.2%)	5 (3.9%)	34 (0.8%)
Air Traffic Management	1 (0.8%)		2 (1.6%)	29 (0.7%)
Bird Strikes	5 (3.8%)		4 (3.1%)	27 (0.7%)
Cabin Safety or Pilot Incapacitation	15 (11.5%)	1 (4.2%)	1 (0.8%)	71 (1.7%)
Controlled Flight Into Terrain	1 (0.8%)	6 (25.0%)	7 (5.5%)	82 (2.0%)
Collision with Object – Takeoff or Landing			3 (2.3%)	140 (3.4%)
Collision with Object – Precautionary Landing *		1 (4.2%)	9 (7.0%)	315 (7.6%)
Collision with Terrain – Precautionary Landing *		2 (8.3%)	6 (4.7%)	204 (4.9%)
Encounter with Terrain – Precautionary Landing *		2 (8.3%)	3 (2.3%)	289 (7.0%)
Evacuation	7 (5.3%)	1 (4.2%)		
Fire – Non-Impact	2 (1.5%)		6 (4.7%)	40 (1.0%)
Fire – Post Impact	3 (2.3%)		11 (8.6%)	327 (7.9%)
Ground Collision	8 (6.1%)	2 (8.3%)	3 (2.3%)	105 (2.5%)
Ground Handling or PreFlight	18 (13.7%)	2 (8.3%)	7 (5.5%)	111 (2.7%)
Icing			3 (2.3%)	33 (0.8%)
Low Altitude Operations			8 (6.3%)	170 (4.1%)
Loss of Control – In Flight	1 (0.8%)	1 (4.2%)	21 (16.4%)	865 (20.9%)
Loss of Control – On Ground		3 (12.5%)	19 (14.8%)	784 (18.9%)
Mid Air Collision		1 (2.2%)	1 (0.8%)	45 (1.1%)
Power Loss – Fuel			6 (4.7%)	439 (10.6%)
Power Loss – Other Reason *				13 (0.3%)
Power Loss – Unknown Reason *		1 (2.2%)	6 (4.7%)	324 (7.8%)
Runway Excursion	4 (3.1%)	3 (12.5%)	13 (10.2%)	924 (22.3%)
Runway Incursion (Vehicle, Aircraft or Person)				14 (0.3%)
SCF – Powerplant	2 (1.5%)	5 (20.8%)	10 (7.8%)	236 (5.7%)
SCF – Non Powerplant	9 (6.9%)		12 (9.4%)	295 (7.1%)
SCF – Stress Limits Exceeded*			2 (1.6%)	32 (0.8%)
Security Related				15 (0.4%)
Turbulence Encounter	43 (32.8%)		2 (1.6%)	41 (1.0%)
Thunderstorm or Windshear	1 (0.8%)		3 (2.3%)	33 (0.8%)
Undershoot or Overshoot	1 (0.8%)		6 (4.7%)	64 (1.5%)
Unintended Flight in IMC		5 (20.8%)	4 (3.1%)	88 (2.1%)
Wildlife			1 (0.8%)	31 (0.7%)
Other	2 (1.5%)			26 (0.6%)
Unknown or Undetermined	8 (6.1%)		1 (0.8%)	34 (0.8%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-7. Number of Fatal Accidents by CICTT Occurrence Category (1987-1991)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	30	28	111	1767
Abrupt Maneuver			2 (1.8%)	24 (1.4%)
Abnormal Runway Contact			1 (0.9%)	15 (0.8%)
Aerodrome				3 (0.2%)
Air Traffic Management	6 (20.0%)	3 (10.7%)		26 (1.5%)
Bird Strikes				2 (0.1%)
Cabin Safety or Pilot Incapacitation	2 (6.6%)	1 (3.6%)	4 (3.6%)	123 (7.0%)
Controlled Flight Into Terrain	3 (10.0%)	9 (32.1%)	32 (28.8%)	262 (14.8%)
Collision with Object – Takeoff or Landing	1 (3.3%)		1 (0.9%)	53 (3.0%)
Collision with Object – Precautionary Landing *		1 (3.6%)	10 (9.0%)	86 (4.9%)
Collision with Terrain – Precautionary Landing *	1 (3.3%)		2 (1.8%)	42 (2.4%)
Encounter with Terrain – Precautionary Landing *				2 (0.1%)
Evacuation				
Fire – Non-Impact		1 (3.6%)	3 (2.7%)	19 (1.1%)
Fire – Post Impact	13 (43.3%)	17 (60.7%)	52 (46.8%)	558 (31.6%)
Ground Collision				3 (0.2%)
Ground Handling or PreFlight	6 (20.0%)	1 (3.6%)	6 (5.4%)	91 (5.2%)
Icing	3 (10.0%)	2 (7.1%)	7 (6.3%)	49 (2.8%)
Low Altitude Operations		1 (3.6%)	15 (13.5%)	400 (22.6%)
Loss of Control – In Flight	8 (26.6%)	13 (46.4%)	54 (48.6%)	987 (55.9%)
Loss of Control – On Ground				8 (0.5%)
Mid Air Collision		2 (7.1%)	5 (4.5%)	80 (4.5%)
Power Loss – Fuel		1 (3.6%)	3 (2.7%)	121 (6.8%)
Power Loss – Other Reason *			1 (0.9%)	14 (0.8%)
Power Loss – Unknown Reason *	1 (3.3%)	2 (7.1%)	1 (0.9%)	52 (2.9%)
Runway Excursion	1 (3.3%)			10 (0.6%)
Runway Incursion (Vehicle, Aircraft or Person)	5 (16.7%)	1 (3.6%)		2 (0.1%)
SCF – Powerplant	1 (3.3%)	2 (7.1%)	13 (11.7%)	81 (4.6%)
SCF – Non Powerplant	3 (10.0%)	2 (7.1%)	6 (5.4%)	68 (3.8%)
SCF – Stress Limit Exceeded*		1 (3.6%)	4 (3.6%)	77 (4.4%)
Security Related	2 (6.6%)		1 (0.9%)	26 (1.5%)
Turbulence Encounter	1 (3.3%)		4 (3.6%)	32 (1.8%)
Thunderstorm or Windshear	1 (3.3%)	1 (3.6%)	3 (2.7%)	64 (3.6%)
Undershoot or Overshoot				4 (0.2%)
Unintended Flight in IMC		7 (25.0%)	15 (13.5%)	295 (16.7%)
Wildlife				
Other			1 (0.9%)	6 (0.3%)
Unknown or Undetermined	1 (3.3%)	2 (7.1%)	3 (2.7%)	61 (3.5%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-8. Number of Fatal Accidents by CICTT Occurrence Category (1992-1996)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	17	17	98	1505
Abrupt Maneuver				18 (1.2%)
Abnormal Runway Contact			1 (1.0%)	19 (1.3%)
Aerodrome				2 (0.1%)
Air Traffic Management	1 (5.9%)			32 (2.1%)
Bird Strikes				1 (0.1%)
Cabin Safety or Pilot Incapacitation			2 (2.0%)	97 (6.4%)
Controlled Flight Into Terrain	1 (5.9%)	7 (41.2%)	26 (26.5%)	215 (14.3%)
Collision with Object – Takeoff or Landing			1 (1.0%)	46 (3.1%)
Collision with Object – Precautionary Landing *		1 (5.9%)	5 (5.1%)	66 (4.4%)
Collision with Terrain – Precautionary Landing *			9 (9.2%)	50 (3.3%)
Encounter with Terrain – Precautionary Landing *				7 (0.5%)
Evacuation	1 (5.9%)			
Fire – Non-Impact	5 (29.4%)		4 (4.1%)	19 (1.3%)
Fire – Post Impact	6 (35.3%)	9 (52.9%)	38 (38.8%)	497 (33.0%)
Ground Collision				3 (0.2%)
Ground Handling or PreFlight	3 (17.6%)	2 (11.8%)	9 (9.2%)	87 (5.8%)
Icing	2 (11.8%)		6 (6.1%)	55 (3.7%)
Low Altitude Operations		1 (5.9%)	11 (11.2%)	313 (20.8%)
Loss of Control – In Flight	10 (58.8%)	6 (35.3%)	37 (37.8%)	821 (54.6%)
Loss of Control – On Ground				7 (0.5%)
Mid Air Collision			1 (1.0%)	51 (3.4%)
Power Loss – Fuel			4 (4.1%)	103 (6.8%)
Power Loss – Other Reason *			1 (1.0%)	9 (0.6%)
Power Loss – Unknown Reason *			2 (2.0%)	55 (3.7%)
Runway Excursion	1 (5.9%)		1 (1.0%)	13 (0.9%)
Runway Incursion (Vehicle, Aircraft or Person)	1 (5.9%)	1 (5.9%)		11 (0.7%)
SCF – Powerplant	2 (11.8%)	2 (11.8%)	13 (13.3%)	74 (4.9%)
SCF – Non Powerplant	3 (17.6%)		5 (5.1%)	52 (3.5%)
SCF – Stress Limit Exceeded*	1 (5.9%)		2 (2.0%)	87 (5.8%)
Security Related				17 (1.1%)
Turbulence Encounter		1 (5.9%)	4 (4.1%)	28 (1.9%)
Thunderstorm or Windshear	1 (5.9%)	1 (5.9%)	1 (1.0%)	46 (3.1%)
Undershoot or Overshoot			1 (1.0%)	3 (0.2%)
Unintended Flight in IMC		3 (17.6%)	9 (9.2%)	207 (13.8%)
Wildlife				
Other			1 (1.0%)	6 (0.4%)
Unknown or Undetermined			5 (5.1%)	73 (4.9%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-9. Number of Fatal Accidents by CICTT Occurrence Category (1997-2001)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	16	13	69	1213
Abrupt Maneuver	1 (6.3%)			10 (0.8%)
Abnormal Runway Contact		1 (7.7%)		8 (0.7%)
Aerodrome				2 (0.2%)
Air Traffic Management			1 (1.4%)	19 (1.6%)
Bird Strikes				
Cabin Safety or Pilot Incapacitation			2 (2.9%)	70 (5.8%)
Controlled Flight Into Terrain		4 (30.8%)	19 (27.5%)	178 (14.7%)
Collision with Object – Takeoff or Landing			1 (1.4%)	47 (3.9%)
Collision with Object – Precautionary Landing *		1 (7.7%)	4 (5.8%)	62 (5.1%)
Collision with Terrain – Precautionary Landing *			6 (8.7%)	27 (2.2%)
Encounter with Terrain – Precautionary Landing *			1 (1.4%)	2 (0.2%)
Evacuation	1 (6.3%)			
Fire – Non-Impact			2 (2.9%)	11 (0.9%)
Fire – Post Impact	4 (25.0%)	3 (23.1%)	29 (42.0%)	426 (35.1%)
Ground Collision				3 (0.2%)
Ground Handling or PreFlight	6 (37.5%)	2 (15.4%)	1 (1.4%)	60 (4.9%)
Icing		3 (23.1%)	8 (11.6%)	28 (2.3%)
Low Altitude Operations		1 (7.7%)	5 (7.2%)	220 (18.1%)
Loss of Control – In Flight	4 (25.0%)	7 (53.8%)	30 (43.5%)	655 (54.0%)
Loss of Control – On Ground				5 (0.4%)
Mid Air Collision			3 (4.3%)	67 (5.5%)
Power Loss – Fuel			7 (10.1%)	79 (6.5%)
Power Loss – Other Reason *				3 (0.2%)
Power Loss – Unknown Reason *		1 (7.7%)	2 (2.9%)	42 (3.5%)
Runway Excursion	1 (6.3%)			15 (1.2%)
Runway Incursion (Vehicle, Aircraft or Person)				2 (0.2%)
SCF – Powerplant			7 (10.1%)	52 (4.3%)
SCF – Non Powerplant	3 (18.8%)	2 (15.4%)	5 (7.2%)	40 (3.3%)
SCF – Stress Limit Exceeded*	1 (6.3%)		3 (4.3%)	40 (3.3%)
Security Related	4 (25.0%)			14 (1.2%)
Turbulence Encounter	1 (6.3%)		2 (2.9%)	25 (2.1%)
Thunderstorm or Windshear	1 (6.3%)		3 (4.3%)	30 (2.5%)
Undershoot or Overshoot			1 (1.4%)	2 (0.2%)
Unintended Flight in IMC		4 (30.8%)	8 (11.6%)	149 (12.3%)
Wildlife				
Other				6 (0.5%)
Unknown or Undetermined			3 (4.3%)	53 (4.4%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-10. Number of Fatal Accidents by CICTT Occurrence Category (2002-2006)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	9	2	53	1112
Abrupt Maneuver				8 (0.7%)
Abnormal Runway Contact				14 (1.3%)
Aerodrome				
Air Traffic Management			2 (3.8%)	25 (2.2%)
Bird Strikes				1 (0.1%)
Cabin Safety or Pilot Incapacitation			3 (5.7%)	52 (4.7%)
Controlled Flight Into Terrain	1 (11.1%)		15 (28.3%)	153 (13.8%)
Collision with Object – Takeoff or Landing				40 (3.6%)
Collision with Object – Precautionary Landing *			2 (3.8%)	69 (6.2%)
Collision with Terrain – Precautionary Landing *	1 (11.1%)	1 (50.0%)	1 (1.9%)	46 (4.1%)
Encounter with Terrain – Precautionary Landing *				5 (0.5%)
Evacuation		1 (50.0%)		
Fire – Non-Impact	1 (11.1%)			5 (0.5%)
Fire – Post Impact	3 (33.3%)		21 (39.6%)	412 (37.1%)
Ground Collision				1 (0.1%)
Ground Handling or PreFlight	4 (44.4%)		3 (5.7%)	30 (2.7%)
Icing			6 (11.3%)	37 (3.3%)
Low Altitude Operations			4 (7.5%)	173 (15.6%)
Loss of Control – In Flight	2 (22.2%)	1 (50.0%)	24 (45.3%)	621 (55.8%)
Loss of Control – On Ground				7 (0.6%)
Mid Air Collision			1 (1.9%)	37 (3.3%)
Power Loss – Fuel	1 (11.1%)		1 (1.9%)	86 (7.7%)
Power Loss – Other Reason *				7 (0.6%)
Power Loss – Unknown Reason *			4 (7.5%)	61 (5.5%)
Runway Excursion	2 (22.2%)		1 (1.9%)	20 (1.8%)
Runway Incursion (Vehicle, Aircraft or Person)				2 (0.2%)
SCF – Powerplant		1 (50.0%)	1 (1.9%)	60 (5.4%)
SCF – Non Powerplant	2 (22.2%)		1 (1.9%)	35 (3.1%)
SCF – Stress Limit Exceeded*			2 (3.8%)	43 (3.9%)
Security Related				11 (1.0%)
Turbulence Encounter			1 (1.9%)	18 (1.6%)
Thunderstorm or Windshear			2 (3.8%)	40 (3.6%)
Undershoot or Overshoot				2 (0.2%)
Unintended Flight in IMC			4 (7.5%)	108 (9.7%)
Wildlife				
Other				2 (0.2%)
Unknown or Undetermined			4 (7.5%)	25 (2.2%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-11. Number of Fatal Accidents by CICTT Occurrence Category (2007-2011)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	6	0	39	833
Abrupt Maneuver				23 (2.8%)
Abnormal Runway Contact			1 (2.6%)	13 (1.6%)
Aerodrome				1 (0.1%)
Air Traffic Management				9 (1.1%)
Bird Strikes				2 (0.2%)
Cabin Safety or Pilot Incapacitation			1 (2.6%)	47 (5.6%)
Controlled Flight Into Terrain			9 (23.1%)	107 (12.8%)
Collision with Object – Takeoff or Landing			2 (5.1%)	24 (2.9%)
Collision with Object – Precautionary Landing *			1 (2.6%)	50 (6.0%)
Collision with Terrain – Precautionary Landing *	1 (16.7%)		1 (2.6%)	25 (3.0%)
Encounter with Terrain – Precautionary Landing *				8 (1.0%)
Evacuation				
Fire – Non-Impact	1 (16.7%)		2 (5.1%)	8 (1.0%)
Fire – Post Impact	1 (16.7%)		13 (33.3%)	290 (34.8%)
Ground Collision				1 (0.1%)
Ground Handling or PreFlight	1 (16.7%)		1 (2.6%)	34 (4.1%)
Icing	1 (16.7%)		1 (2.6%)	25 (3.0%)
Low Altitude Operations			3 (7.7%)	129 (15.5%)
Loss of Control – In Flight	2 (33.3%)		17 (43.6%)	517 (62.1%)
Loss of Control – On Ground			1 (2.6%)	8 (1.0%)
Mid Air Collision			2 (5.1%)	30 (3.6%)
Power Loss – Fuel			1 (2.6%)	62 (7.4%)
Power Loss – Other Reason *				1 (0.1%)
Power Loss – Unknown Reason *				38 (4.6%)
Runway Excursion			1 (2.6%)	11 (1.3%)
Runway Incursion (Vehicle, Aircraft or Person)				
SCF – Powerplant	1 (16.7%)		2 (5.1%)	29 (3.5%)
SCF – Non Powerplant			4 (10.3%)	32 (3.8%)
SCF – Stress Limit Exceeded*			1 (2.6%)	38 (4.6%)
Security Related				5 (0.6%)
Turbulence Encounter			1 (2.6%)	12 (1.4%)
Thunderstorm or Windshear	1 (16.7%)			28 (3.4%)
Undershoot or Overshoot				3 (0.4%)
Unintended Flight in IMC			4 (10.3%)	102 (12.2%)
Wildlife				
Other				4 (0.5%)
Unknown or Undetermined	2 (33.3%)		4 (10.3%)	19 (2.3%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table B-12. Number of Fatal Accidents by CICTT Occurrence Category (2012-2016)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	2	5	26	703
Abrupt Maneuver			1 (3.8%)	8 (1.1%)
Abnormal Runway Contact				17 (2.4%)
Aerodrome				
Air Traffic Management			2 (7.7%)	18 (2.6%)
Bird Strikes				1 (0.1%)
Cabin Safety or Pilot Incapacitation			1 (3.8%)	54 (7.7%)
Controlled Flight Into Terrain	1 (50.0%)	3 (60.0%)	6 (23.1%)	58 (8.3%)
Collision with Object – Takeoff or Landing				29 (4.1%)
Collision with Object – Precautionary Landing *			2 (7.7%)	43 (6.1%)
Collision with Terrain – Precautionary Landing *		1 (20.0%)	2 (7.7%)	23 (3.3%)
Encounter with Terrain – Precautionary Landing *				8 (1.1%)
Evacuation		1 (20.0%)		
Fire – Non-Impact			2 (7.7%)	6 (0.9%)
Fire – Post Impact	2 (100.0%)		10 (38.5%)	248 (35.3%)
Ground Collision				
Ground Handling or PreFlight	1 (50.0%)		2 (7.7%)	28 (4.0%)
Icing			1 (3.8%)	12 (1.7%)
Low Altitude Operations			4 (15.4%)	90 (12.8%)
Loss of Control – In Flight	1 (50.0%)	1 (20.0%)	13 (50.0%)	453 (64.4%)
Loss of Control – On Ground				6 (0.9%)
Mid Air Collision		1 (20.0%)		27 (3.8%)
Power Loss – Fuel				56 (8.0%)
Power Loss – Other Reason *				4 (0.6%)
Power Loss – Unknown Reason *			3 (11.5%)	44 (6.3%)
Runway Excursion				6 (0.9%)
Runway Incursion (Vehicle, Aircraft or Person)				4 (0.6%)
SCF – Powerplant		1 (20.0%)	2 (7.7%)	35 (5.0%)
SCF – Non Powerplant				24 (3.4%)
SCF – Stress Limit Exceeded*			2 (7.7%)	29 (4.1%)
Security Related				12 (1.7%)
Turbulence Encounter			1 (3.8%)	13 (1.8%)
Thunderstorm or Windshear			1 (3.8%)	20 (2.8%)
Undershoot or Overshoot				2 (0.3%)
Unintended Flight in IMC		3 (60.0%)	2 (7.7%)	76 (10.8%)
Wildlife				1 (0.1%)
Other				4 (0.6%)
Unknown or Undetermined			1 (3.8%)	23 (3.3%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Appendix C

**Tables of the Frequencies of
Total Accidents, Total Injuries, Fatal Accidents and Fatal Injuries
by Aviation Occurrence Categories
In Ten Year Periods**

Table C-1.1. Number of Accidents by CICTT Occurrence Category (1987-1996)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	287	181	745	16396
Abrupt Maneuver	2 (0.7%)	1 (0.6%)	2 (0.3%)	89 (0.5%)
Abnormal Runway Contact	28 (9.8%)	23 (12.7%)	66 (8.9%)	1770 (10.8%)
Aerodrome	4 (1.4%)	10 (5.5%)	25 (3.4%)	239 (1.5%)
Air Traffic Management	18 (6.3%)	5 (2.8%)	8 (1.1%)	83 (0.5%)
Bird Strikes	2 (0.7%)	2 (1.1%)	1 (0.1%)	26 (0.2%)
Cabin Safety or Pilot Incapacitation	9 (3.1%)	2 (1.1%)	6 (0.8%)	298 (1.8%)
Controlled Flight Into Terrain	6 (2.1%)	23 (12.7%)	78 (10.5%)	615 (3.8%)
Collision with Object – Takeoff or Landing	2 (0.7%)	2 (1.1%)	18 (2.4%)	670 (4.1%)
Collision with Object – Precautionary Landing *		4 (2.2%)	50 (6.7%)	1654 (10.1%)
Collision with Terrain – Precautionary Landing *	1 (0.3%)	2 (1.1%)	29 (3.9%)	575 (3.5%)
Encounter with Terrain – Precautionary Landing *	2 (0.7%)	5 (2.8%)	41 (5.5%)	1108 (6.8%)
Evacuation	31 (10.8%)	1 (0.6%)		
Fire – Non-Impact	19 (6.6%)	4 (2.2%)	20 (2.7%)	177 (1.1%)
Fire – Post Impact	23 (8.0%)	29 (16.0%)	108 (14.5%)	1414 (8.6%)
Ground Collision	21 (7.3%)	17 (9.4%)	34 (4.6%)	324 (2.0%)
Ground Handling or PreFlight	45 (15.7%)	24 (13.3%)	34 (4.6%)	473 (2.9%)
Icing	6 (2.1%)	12 (6.6%)	38 (5.1%)	240 (1.5%)
Low Altitude Operations		4 (2.2%)	36 (4.8%)	1199 (7.3%)
Loss of Control – In Flight	22 (7.7%)	33 (18.2%)	133 (17.9%)	3514 (21.4%)
Loss of Control – On Ground	5 (1.7%)	4 (2.2%)	87 (11.7%)	2910 (17.7%)
Mid Air Collision	1 (0.3%)	4 (2.2%)	12 (1.6%)	237 (1.4%)
Power Loss – Fuel	2 (0.7%)	3 (1.7%)	52 (7.0%)	2500 (15.2%)
Power Loss – Other Reason *	2 (0.7%)	3 (1.7%)	6 (0.8%)	227 (1.4%)
Power Loss – Unknown Reason *	1 (0.3%)	4 (2.2%)	23 (3.1%)	783 (4.8%)
Runway Excursion	18 (6.3%)	26 (14.4%)	100 (13.4%)	2713 (16.5%)
Runway Incursion (Vehicle, Aircraft or Person)	10 (3.5%)	2 (1.1%)	2 (0.3%)	103 (0.6%)
SCF – Powerplant	20 (7.0%)	13 (7.2%)	84 (11.3%)	1129 (6.9%)
SCF – Non Powerplant	38 (13.2%)	15 (8.3%)	76 (10.2%)	968 (5.9%)
SCF – Stress Limits Exceeded*	2 (0.7%)	1 (0.6%)	6 (0.8%)	171 (1.0%)
Security Related	4 (1.4%)	2 (1.1%)	1 (0.1%)	85 (0.5%)
Turbulence Encounter	65 (22.6%)	3 (1.7%)	11 (1.5%)	154 (0.9%)
Thunderstorm or Windshear	6 (2.1%)	4 (2.2%)	8 (1.1%)	227 (1.4%)
Undershoot or Overshoot	1 (0.3%)	4 (2.2%)	15 (2.0%)	375 (2.3%)
Unintended Flight in IMC		15 (8.3%)	35 (4.7%)	618 (3.8%)
Wildlife			5 (0.7%)	58 (0.4%)
Other	3 (1.0%)		13 (1.7%)	116 (0.7%)
Unknown or Undetermined	10 (3.5%)	3 (1.7%)	17 (2.3%)	238 (1.5%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-1.2. Number of Accidents by CICTT Occurrence Category (1992-2001)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	394	128	646	14007
Abrupt Maneuver	11 (2.8%)			74 (0.5%)
Abnormal Runway Contact	36 (9.1%)	15 (11.7%)	67 (10.4%)	1618 (11.6%)
Aerodrome	10 (2.5%)	7 (5.5%)	21 (3.3%)	185 (1.3%)
Air Traffic Management	8 (2.0%)		8 (1.2%)	75 (0.5%)
Bird Strikes	9 (2.3%)	7 (5.5%)	2 (0.3%)	27 (0.2%)
Cabin Safety or Pilot Incapacitation	8 (2.0%)		4 (0.6%)	220 (1.6%)
Controlled Flight Into Terrain	2 (0.5%)	22 (17.2%)	63 (9.8%)	509 (3.6%)
Collision with Object – Takeoff or Landing	3 (0.8%)	1 (0.8%)	15 (2.3%)	574 (4.1%)
Collision with Object – Precautionary Landing *		2 (1.6%)	33 (5.1%)	1456 (10.4%)
Collision with Terrain – Precautionary Landing *	1 (0.3%)	3 (2.3%)	40 (6.2%)	531 (3.8%)
Encounter with Terrain – Precautionary Landing *		3 (2.3%)	34 (5.3%)	928 (6.6%)
Evacuation	31 (7.9%)	1 (0.8%)		
Fire – Non-Impact	23 (5.8%)	2 (1.6%)	12 (1.9%)	162 (1.2%)
Fire – Post Impact	16 (4.1%)	13 (10.2%)	83 (12.8%)	1263 (9.0%)
Ground Collision	14 (3.6%)	3 (2.3%)	30 (4.7%)	282 (2.0%)
Ground Handling or PreFlight	94 (23.9%)	16 (12.5%)	30 (4.7%)	388 (2.8%)
Icing	5 (1.3%)	14 (10.9%)	40 (6.2%)	193 (1.4%)
Low Altitude Operations	1 (0.3%)	3 (2.3%)	28 (4.3%)	910 (6.5%)
Loss of Control – In Flight	19 (4.8%)	24 (18.8%)	104 (16.1%)	2775 (19.8%)
Loss of Control – On Ground	2 (0.5%)	4 (3.1%)	72 (11.1%)	2286 (16.3%)
Mid Air Collision	3 (0.8%)	1 (0.8%)	7 (1.1%)	195 (1.4%)
Power Loss – Fuel			58 (9.0%)	1958 (14.0%)
Power Loss – Other Reason *	5 (1.3%)		4 (0.6%)	159 (1.1%)
Power Loss – Unknown Reason *	1 (0.3%)	2 (1.6%)	24 (3.7%)	784 (5.6%)
Runway Excursion	31 (7.9%)	19 (14.8%)	93 (14.4%)	2624 (18.7%)
Runway Incursion (Vehicle, Aircraft or Person)	1 (0.3%)	1 (0.8%)	1 (0.2%)	88 (0.6%)
SCF – Powerplant	17 (4.3%)	6 (4.7%)	70 (10.8%)	949 (6.8%)
SCF – Non Powerplant	39 (9.9%)	14 (10.9%)	71 (11.0%)	912 (6.5%)
SCF – Stress Limits Exceeded*	4 (1.0%)		5 (0.8%)	134 (1.0%)
Security Related	5 (1.3%)	2 (1.6%)		50 (0.4%)
Turbulence Encounter	106 (26.9%)	2 (1.6%)	9 (1.4%)	114 (0.8%)
Thunderstorm or Windshear	8 (2.0%)	2 (1.6%)	6 (0.9%)	153 (1.1%)
Undershoot or Overshoot	3 (0.8%)	3 (2.3%)	18 (2.8%)	320 (2.3%)
Unintended Flight in IMC		16 (12.5%)	28 (4.3%)	440 (3.1%)
Wildlife	3 (0.8%)		4 (0.6%)	72 (0.5%)
Other	5 (1.3%)	1 (0.8%)	7 (1.1%)	101 (0.7%)
Unknown or Undetermined	4 (1.0%)		9 (1.4%)	186 (1.3%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-1.3. Number of Accidents by CICTT Occurrence Category (1997-2006)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	459	78	540	12259
Abrupt Maneuver	16 (3.5%)		1 (0.2%)	54 (0.4%)
Abnormal Runway Contact	43 (9.4%)	11 (14.1%)	59 (10.9%)	1565 (12.8%)
Aerodrome	8 (1.7%)	3 (3.8%)	21 (3.9%)	149 (1.2%)
Air Traffic Management	7 (1.5%)		7 (1.3%)	78 (0.6%)
Bird Strikes	14 (3.1%)	8 (10.3%)	5 (0.9%)	27 (0.2%)
Cabin Safety or Pilot Incapacitation	11 (2.4%)		5 (0.9%)	160 (1.3%)
Controlled Flight Into Terrain	2 (0.4%)	10 (12.8%)	53 (9.8%)	420 (3.4%)
Collision with Object – Takeoff or Landing	3 (0.7%)	1 (1.3%)	17 (3.1%)	475 (3.9%)
Collision with Object – Precautionary Landing *		1 (1.3%)	27 (5.0%)	1241 (10.1%)
Collision with Terrain – Precautionary Landing *	2 (0.4%)	2 (2.6%)	30 (5.6%)	481 (3.9%)
Encounter with Terrain – Precautionary Landing *		3 (3.8%)	26 (4.8%)	783 (6.4%)
Evacuation	29 (6.3%)	1 (1.3%)	1 (0.2%)	
Fire – Non-Impact	17 (3.7%)	2 (2.6%)	9 (1.7%)	129 (1.1%)
Fire – Post Impact	14 (3.1%)	4 (5.1%)	69 (12.8%)	1146 (9.3%)
Ground Collision	30 (6.5%)	2 (2.6%)	23 (4.3%)	279 (2.3%)
Ground Handling or PreFlight	120 (26.1%)	4 (5.1%)	30 (5.6%)	283 (2.3%)
Icing	2 (0.4%)	8 (10.3%)	31 (5.7%)	153 (1.2%)
Low Altitude Operations	1 (0.2%)	1 (1.3%)	17 (3.1%)	657 (5.4%)
Loss of Control – In Flight	8 (1.7%)	11 (14.1%)	94 (17.4%)	2405 (19.6%)
Loss of Control – On Ground		6 (7.7%)	49 (9.1%)	1906 (15.5%)
Mid Air Collision	3 (0.7%)	1 (1.3%)	9 (1.7%)	152 (1.2%)
Power Loss – Fuel	1 (0.2%)		43 (8.0%)	1563 (12.8%)
Power Loss – Other Reason *	3 (0.7%)		3 (0.6%)	102 (0.8%)
Power Loss – Unknown Reason *	1 (0.2%)	1 (1.3%)	27 (5.0%)	704 (5.7%)
Runway Excursion	37 (8.1%)	15 (19.2%)	84 (15.6%)	2521 (20.6%)
Runway Incursion (Vehicle, Aircraft or Person)			2 (0.4%)	60 (0.5%)
SCF – Powerplant	15 (3.3%)	3 (3.8%)	42 (7.8%)	781 (6.4%)
SCF – Non Powerplant	42 (9.2%)	8 (10.3%)	58 (10.7%)	873 (7.1%)
SCF – Stress Limits Exceeded*	2 (0.4%)		5 (0.9%)	88 (0.7%)
Security Related	4 (0.9%)			39 (0.3%)
Turbulence Encounter	116 (25.3%)	3 (3.8%)	6 (1.1%)	100 (0.8%)
Thunderstorm or Windshear	7 (1.5%)		10 (1.9%)	134 (1.1%)
Undershoot or Overshoot	2 (0.4%)	3 (3.8%)	16 (3.0%)	257 (2.1%)
Unintended Flight in IMC		10 (12.8%)	19 (3.5%)	313 (2.6%)
Wildlife	5 (1.1%)		5 (0.9%)	77 (0.6%)
Other	6 (1.3%)	1 (1.3%)	5 (0.9%)	95 (0.8%)
Unknown or Undetermined	2 (0.4%)		8 (1.5%)	93 (0.8%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-1.4. Number of Accidents by CICTT Occurrence Category (2002-2011)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	362	45	412	10608
Abrupt Maneuver	10 (2.8%)		2 (0.5%)	57 (0.5%)
Abnormal Runway Contact	31 (8.6%)	6 (13.3%)	49 (11.9%)	1555 (14.7%)
Aerodrome	4 (1.1%)	2 (4.4%)	13 (3.2%)	124 (1.2%)
Air Traffic Management	9 (2.5%)	2 (4.4%)	5 (1.2%)	62 (0.6%)
Bird Strikes	14 (3.9%)	2 (4.4%)	7 (1.7%)	45 (0.4%)
Cabin Safety or Pilot Incapacitation	11 (3.0%)		4 (1.0%)	138 (1.3%)
Controlled Flight Into Terrain	2 (0.6%)	1 (2.2%)	36 (8.7%)	331 (3.1%)
Collision with Object – Takeoff or Landing	1 (0.3%)	1 (2.2%)	17 (4.1%)	382 (3.6%)
Collision with Object – Precautionary Landing *			18 (4.4%)	968 (9.1%)
Collision with Terrain – Precautionary Landing *	2 (0.6%)	1 (2.2%)	14 (3.4%)	431 (4.1%)
Encounter with Terrain – Precautionary Landing *	1 (0.3%)	2 (4.4%)	13 (3.2%)	642 (6.1%)
Evacuation	16 (4.4%)	2 (4.4%)	1 (0.2%)	
Fire – Non-Impact	11 (3.0%)	2 (4.4%)	9 (2.2%)	107 (1.0%)
Fire – Post Impact	10 (2.8%)	1 (2.2%)	50 (12.1%)	948 (8.9%)
Ground Collision	38 (10.5%)	6 (13.3%)	23 (5.6%)	235 (2.2%)
Ground Handling or PreFlight	87 (24.0%)	2 (4.4%)	22 (5.3%)	258 (2.4%)
Icing	2 (0.6%)	2 (4.4%)	21 (5.1%)	120 (1.1%)
Low Altitude Operations			9 (2.2%)	506 (4.8%)
Loss of Control – In Flight	6 (1.7%)	7 (15.6%)	75 (18.2%)	2122 (20.0%)
Loss of Control – On Ground		4 (8.9%)	31 (7.5%)	1692 (16.0%)
Mid Air Collision	1 (0.3%)		8 (1.9%)	114 (1.1%)
Power Loss – Fuel	1 (0.3%)	1 (2.2%)	24 (5.8%)	1195 (11.3%)
Power Loss – Other Reason *				71 (0.7%)
Power Loss – Unknown Reason *			16 (3.9%)	676 (6.4%)
Runway Excursion	25 (6.9%)	8 (17.8%)	65 (15.8%)	2270 (21.4%)
Runway Incursion (Vehicle, Aircraft or Person)			3 (0.7%)	28 (0.3%)
SCF – Powerplant	8 (2.2%)	4 (8.9%)	19 (4.6%)	607 (5.7%)
SCF – Non Powerplant	27 (7.5%)	3 (6.7%)	60 (14.6%)	774 (7.3%)
SCF – Stress Limits Exceeded*			3 (0.7%)	85 (0.8%)
Security Related				26 (0.2%)
Turbulence Encounter	107 (29.6%)	3 (6.7%)	4 (1.0%)	84 (0.8%)
Thunderstorm or Windshear	3 (0.8%)		8 (1.9%)	138 (1.3%)
Undershoot or Overshoot		1 (2.2%)	9 (2.2%)	212 (2.0%)
Unintended Flight in IMC		1 (2.2%)	13 (3.2%)	248 (2.3%)
Wildlife	2 (0.6%)		2 (0.5%)	59 (0.6%)
Other	3 (0.8%)		12 (2.9%)	88 (0.8%)
Unknown or Undetermined	2 (0.6%)		9 (2.2%)	56 (0.5%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-1.5. Number of Accidents by CICTT Occurrence Category (2007-2016)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Accidents	288	47	316	9052
Abrupt Maneuver	3 (1.0%)	1 (2.1%)	4 (1.3%)	53 (0.6%)
Abnormal Runway Contact	26 (9.0%)	4 (8.5%)	49 (15.5%)	1468 (16.2%)
Aerodrome	3 (1.0%)	3 (6.4%)	8 (2.5%)	86 (1.0%)
Air Traffic Management	6 (2.1%)	2 (4.3%)	4 (1.3%)	50 (0.6%)
Bird Strikes	13 (4.5%)		7 (2.2%)	57 (0.6%)
Cabin Safety or Pilot Incapacitation	20 (6.9%)	1 (2.1%)	2 (0.6%)	137 (1.5%)
Controlled Flight Into Terrain	1 (0.3%)	7 (14.9%)	19 (6.0%)	220 (2.4%)
Collision with Object – Takeoff or Landing		1 (2.1%)	9 (2.8%)	316 (3.5%)
Collision with Object – Precautionary Landing *		1 (2.1%)	18 (5.7%)	712 (7.9%)
Collision with Terrain – Precautionary Landing *	1 (0.3%)	2 (4.3%)	12 (3.8%)	390 (4.3%)
Encounter with Terrain – Precautionary Landing *	1 (0.3%)	3 (6.4%)	8 (2.5%)	595 (6.6%)
Evacuation	9 (3.1%)	2 (4.3%)		
Fire – Non-Impact	8 (2.8%)	1 (2.1%)	10 (3.2%)	94 (1.0%)
Fire – Post Impact	6 (2.1%)	1 (2.1%)	30 (9.5%)	732 (8.1%)
Ground Collision	23 (8.0%)	6 (12.8%)	18 (5.7%)	217 (2.4%)
Ground Handling or PreFlight	51 (17.7%)	4 (8.5%)	14 (4.4%)	259 (2.9%)
Icing	2 (0.7%)	2 (4.3%)	13 (4.1%)	76 (0.8%)
Low Altitude Operations			12 (3.8%)	392 (4.3%)
Loss of Control – In Flight	5 (1.7%)	7 (14.9%)	52 (16.5%)	1832 (20.2%)
Loss of Control – On Ground		3 (6.4%)	32 (10.1%)	1613 (17.8%)
Mid Air Collision		1 (2.1%)	4 (1.3%)	104 (1.1%)
Power Loss – Fuel		1 (2.1%)	18 (5.7%)	968 (10.7%)
Power Loss – Other Reason *				43 (0.5%)
Power Loss – Unknown Reason *		1 (2.1%)	10 (3.2%)	659 (7.3%)
Runway Excursion	14 (4.9%)	7 (14.9%)	44 (13.9%)	1965 (21.7%)
Runway Incursion (Vehicle, Aircraft or Person)			1 (0.3%)	21 (0.2%)
SCF – Powerplant	5 (1.7%)	7 (14.9%)	21 (6.6%)	488 (5.4%)
SCF – Non Powerplant	15 (5.2%)	1 (2.1%)	45 (14.2%)	656 (7.2%)
SCF – Stress Limits Exceeded*			3 (0.9%)	72 (0.8%)
Security Related				23 (0.3%)
Turbulence Encounter	101 (35.1%)	1 (2.1%)	5 (1.6%)	80 (0.9%)
Thunderstorm or Windshear	2 (0.7%)		5 (1.6%)	92 (1.0%)
Undershoot or Overshoot	1 (0.3%)		9 (2.8%)	162 (1.8%)
Unintended Flight in IMC		5 (10.6%)	11 (3.5%)	208 (2.3%)
Wildlife			1 (0.3%)	52 (0.6%)
Other	3 (1.0%)		7 (2.2%)	68 (0.8%)
Unknown or Undetermined	10 (3.5%)		6 (1.9%)	58 (0.6%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-2.1. Number of Injuries by CICTT Occurrence Category (1987-1996)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Injuries	3199	558	852	14028
Abrupt Maneuver	5 (0.2%)	0 (0.0%)	3 (0.4%)	96 (0.7%)
Abnormal Runway Contact	29 (0.9%)	30 (5.4%)	41 (4.8%)	536 (3.8%)
Aerodrome	67 (2.1%)	1 (0.2%)	9 (1.1%)	67 (0.5%)
Air Traffic Management	430 (13.4%)	84 (15.1%)	5 (0.6%)	159 (1.1%)
Bird Strikes	5 (0.2%)	1 (0.2%)	0 (0.0%)	11 (0.1%)
Cabin Safety or Pilot Incapacitation	9 (0.3%)	17 (3.0%)	6 (0.7%)	471 (3.4%)
Controlled Flight Into Terrain	321 (10.0%)	118 (21.1%)	182 (21.4%)	1263 (9.0%)
Collision with Object – Takeoff or Landing	165 (5.2%)	0 (0.0%)	7 (0.8%)	635 (4.5%)
Collision with Object – Precautionary Landing *		40 (7.2%)	68 (8.0%)	1618 (11.5%)
Collision with Terrain – Precautionary Landing *	27 (0.8%)	5 (0.9%)	62 (7.3%)	678 (4.8%)
Encounter with Terrain – Precautionary Landing *	7 (0.2%)	11 (2.0%)	32 (3.8%)	673 (4.8%)
Evacuation	230 (7.2%)	1 (0.2%)		
Fire – Non-Impact	537 (16.8%)	15 (2.7%)	28 (3.3%)	136 (1.0%)
Fire – Post Impact	1230 (38.5%)	329 (59.0%)	274 (32.2%)	3001 (21.4%)
Ground Collision	36 (1.1%)	7 (1.3%)	9 (1.1%)	47 (0.3%)
Ground Handling or PreFlight	69 (2.2%)	41 (7.3%)	55 (6.5%)	814 (5.8%)
Icing	231 (7.2%)	60 (10.8%)	45 (5.3%)	385 (2.7%)
Low Altitude Operations		11 (2.0%)	97 (11.4%)	1872 (13.3%)
Loss of Control – In Flight	1304 (40.8%)	210 (37.6%)	221 (25.9%)	5654 (40.3%)
Loss of Control – On Ground	2 (0.1%)	0 (0.0%)	26 (3.1%)	788 (5.6%)
Mid Air Collision	1 (0.1%)	10 (1.8%)	25 (2.9%)	268 (1.9%)
Power Loss – Fuel	7 (0.2%)	3 (0.5%)	39 (4.6%)	2143 (15.3%)
Power Loss – Other Reason *	1 (0.1%)	22 (3.9%)	9 (1.1%)	214 (1.5%)
Power Loss – Unknown Reason *	27 (0.8%)	18 (3.2%)	29 (3.4%)	774 (5.5%)
Runway Excursion	198 (6.2%)	38 (6.8%)	70 (8.2%)	767 (5.5%)
Runway Incursion (Vehicle, Aircraft or Person)	113 (3.5%)	78 (14.0%)	0 (0.0%)	76 (0.5%)
SCF – Powerplant	329 (10.3%)	90 (16.1%)	123 (14.4%)	1105 (7.9%)
SCF – Non Powerplant	427 (13.3%)	26 (4.7%)	43 (5.0%)	566 (4.0%)
SCF – Stress Limit Exceeded *	230 (7.2%)	14 (2.5%)	8 (0.9%)	363 (2.6%)
Security Related	323 (10.1%)	2 (0.4%)	3 (0.4%)	69 (0.5%)
Turbulence Encounter	346 (10.8%)	5 (0.9%)	20 (2.3%)	210 (1.5%)
Thunderstorm or Windshear	70 (2.2%)	25 (4.5%)	10 (1.2%)	352 (2.5%)
Undershoot or Overshoot	0 (0.0%)	0 (0.0%)	26 (3.1%)	177 (1.3%)
Unintended Flight in IMC		54 (9.7%)	121 (14.2%)	1172 (8.4%)
Wildlife			0 (0.0%)	14 (0.1%)
Other	3 (0.1%)		4 (0.5%)	56 (0.4%)
Unknown or Undetermined	18 (0.6%)	6 (1.1%)	29 (3.4%)	392 (2.8%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-2.2. Number of Injuries by CICTT Occurrence Category (1992-2001)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Injuries	2891	291	747	11688
Abrupt Maneuver	288 (10.0%)			66 (0.6%)
Abnormal Runway Contact	36 (1.3%)	25 (8.6%)	19 (2.5%)	424 (3.6%)
Aerodrome	71 (2.5%)	1 (0.3%)	3 (0.4%)	44 (0.4%)
Air Traffic Management	105 (3.6%)		3 (0.4%)	122 (1.0%)
Bird Strikes	6 (0.2%)	1 (0.3%)	0 (0.0%)	6 (0.1%)
Cabin Safety or Pilot Incapacitation	8 (0.3%)		10 (1.3%)	348 (3.0%)
Controlled Flight Into Terrain	165 (5.7%)	82 (28.2%)	155 (20.8%)	982 (8.4%)
Collision with Object – Takeoff or Landing	3 (0.1%)	0 (0.0%)	7 (0.9%)	575 (4.9%)
Collision with Object – Precautionary Landing *		30 (10.3%)	54 (7.2%)	1382 (11.8%)
Collision with Terrain – Precautionary Landing *	0 (0.0%)	5 (1.7%)	80 (10.7%)	648 (5.5%)
Encounter with Terrain – Precautionary Landing *		1 (0.3%)	27 (3.6%)	543 (4.6%)
Evacuation	349 (12.1%)	1 (0.3%)		
Fire – Non-Impact	574 (19.9%)	1 (0.3%)	22 (2.9%)	112 (1.0%)
Fire – Post Impact	844 (29.2%)	134 (46.0%)	238 (31.9%)	2676 (22.9%)
Ground Collision	0 (0.0%)	1 (0.3%)	2 (0.3%)	52 (0.4%)
Ground Handling or PreFlight	105 (3.6%)	21 (7.2%)	55 (7.4%)	695 (5.9%)
Icing	146 (5.1%)	63 (21.6%)	46 (6.2%)	298 (2.6%)
Low Altitude Operations	0 (0.0%)	3 (1.0%)	58 (7.8%)	1366 (11.7%)
Loss of Control – In Flight	1127 (39.0%)	121 (41.6%)	229 (30.7%)	4615 (39.5%)
Loss of Control – On Ground	2 (0.1%)	1 (0.3%)	30 (4.0%)	621 (5.3%)
Mid Air Collision	4 (0.1%)	5 (1.7%)	22 (2.9%)	232 (2.0%)
Power Loss – Fuel			83 (11.1%)	1821 (15.6%)
Power Loss – Other Reason *	1 (0.1%)		9 (1.2%)	143 (1.2%)
Power Loss – Unknown Reason *	0 (0.0%)	1 (0.3%)	23 (3.1%)	722 (6.2%)
Runway Excursion	312 (10.8%)	30 (10.3%)	39 (5.2%)	774 (6.6%)
Runway Incursion (Vehicle, Aircraft or Person)	2 (0.1%)	14 (4.8%)	0 (0.0%)	69 (0.6%)
SCF – Powerplant	19 (0.7%)	48 (16.5%)	118 (15.8%)	902 (7.7%)
SCF – Non Powerplant	435 (15.0%)	19 (6.5%)	47 (6.3%)	496 (4.2%)
SCF – Stress Limit Exceeded *	495 (17.1%)		9 (1.2%)	303 (2.6%)
Security Related	269 (9.3%)	2 (0.7%)		49 (0.4%)
Turbulence Encounter	597 (20.7%)	12 (4.1%)	15 (2.0%)	174 (1.5%)
Thunderstorm or Windshear	179 (6.2%)	3 (1.0%)	17 (2.3%)	228 (2.0%)
Undershoot or Overshoot	23 (0.8%)	0 (0.0%)	16 (2.1%)	174 (1.5%)
Unintended Flight in IMC		45 (15.5%)	89 (11.9%)	822 (7.0%)
Wildlife	1 (0.1%)		0 (0.0%)	23 (0.2%)
Other	6 (0.2%)	0 (0.0%)	3 (0.4%)	38 (0.3%)
Unknown or Undetermined	1 (0.1%)		27 (3.6%)	338 (2.9%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-2.3. Number of Injuries by CICTT Occurrence Category (1997-2006)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Injuries	1999	142	587	9845
Abrupt Maneuver	299 (15.0%)		1 (0.2%)	48 (0.5%)
Abnormal Runway Contact	44 (2.2%)	19 (13.4%)	16 (2.7%)	348 (3.5%)
Aerodrome	6 (0.3%)	0 (0.0%)	1 (0.2%)	29 (0.3%)
Air Traffic Management	46 (2.3%)		6 (1.0%)	85 (0.9%)
Bird Strikes	2 (0.1%)	0 (0.0%)	3 (0.5%)	6 (0.1%)
Cabin Safety or Pilot Incapacitation	19 (1.0%)		11 (1.9%)	263 (2.7%)
Controlled Flight Into Terrain	18 (0.9%)	35 (24.6%)	115 (19.6%)	812 (8.2%)
Collision with Object – Takeoff or Landing	0 (0.0%)	0 (0.0%)	6 (1.0%)	496 (5.0%)
Collision with Object – Precautionary Landing *		1 (0.7%)	49 (8.3%)	1185 (12.0%)
Collision with Terrain – Precautionary Landing *	2 (0.1%)	8 (5.6%)	54 (9.2%)	581 (5.9%)
Encounter with Terrain – Precautionary Landing *		4 (2.8%)	20 (3.4%)	449 (4.6%)
Evacuation	291 (14.6%)	8 (5.6%)	6 (1.0%)	
Fire – Non-Impact	127 (6.4%)	0 (0.0%)	14 (2.4%)	81 (0.8%)
Fire – Post Impact	500 (25.0%)	47 (33.1%)	176 (30.0%)	2364 (24.0%)
Ground Collision	18 (0.9%)	0 (0.0%)	0 (0.0%)	45 (0.5%)
Ground Handling or PreFlight	107 (5.4%)	11 (7.7%)	47 (8.0%)	429 (4.4%)
Icing	0 (0.0%)	50 (35.2%)	33 (5.6%)	220 (2.2%)
Low Altitude Operations	0 (0.0%)	2 (1.4%)	35 (6.0%)	1030 (10.5%)
Loss of Control – In Flight	405 (20.3%)	69 (48.6%)	196 (33.4%)	3963 (40.3%)
Loss of Control – On Ground		1 (0.7%)	28 (4.8%)	462 (4.7%)
Mid Air Collision	3 (0.2%)	5 (3.5%)	16 (2.7%)	344 (3.5%)
Power Loss – Fuel	2 (0.1%)		74 (12.6%)	1446 (14.7%)
Power Loss – Other Reason *	0 (0.0%)		8 (1.4%)	107 (1.1%)
Power Loss – Unknown Reason *	0 (0.0%)	1 (0.7%)	26 (4.4%)	665 (6.8%)
Runway Excursion	283 (14.2%)	14 (9.9%)	40 (6.8%)	671 (6.8%)
Runway Incursion (Vehicle, Aircraft or Person)			1 (0.2%)	29 (0.3%)
SCF – Powerplant	17 (0.9%)	12 (8.5%)	72 (12.3%)	743 (7.5%)
SCF – Non Powerplant	325 (16.3%)	14 (9.9%)	26 (4.4%)	396 (4.0%)
SCF – Stress Limit Exceeded *	265 (13.3%)		9 (1.5%)	200 (2.0%)
Security Related	265 (13.3%)			40 (0.4%)
Turbulence Encounter	580 (29.0%)	13 (9.2%)	8 (1.4%)	139 (1.4%)
Thunderstorm or Windshear	122 (6.1%)		22 (3.7%)	196 (2.0%)
Undershoot or Overshoot	23 (1.2%)	0 (0.0%)	11 (1.9%)	123 (1.2%)
Unintended Flight in IMC		29 (20.4%)	42 (7.2%)	597 (6.1%)
Wildlife	1 (0.1%)		0 (0.0%)	14 (0.1%)
Other	5 (0.3%)	0 (0.0%)	3 (0.5%)	33 (0.3%)
Unknown or Undetermined	0 (0.0%)		29 (4.9%)	167 (1.7%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-2.4. Number of Injuries by CICTT Occurrence Category (2002-2011)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Injuries	793	52	433	8070
Abrupt Maneuver	21 (2.6%)		1 (0.2%)	76 (0.9%)
Abnormal Runway Contact	41 (5.2%)	0 (0.0%)	27 (6.2%)	328 (4.1%)
Aerodrome	0 (0.0%)	2 (3.8%)	1 (0.2%)	17 (0.2%)
Air Traffic Management	5 (0.6%)	1 (1.9%)	4 (0.9%)	78 (1.0%)
Bird Strikes	6 (0.8%)	0 (0.0%)	3 (0.7%)	19 (0.2%)
Cabin Safety or Pilot Incapacitation	19 (2.4%)		8 (1.8%)	206 (2.6%)
Controlled Flight Into Terrain	18 (2.3%)	6 (11.5%)	69 (15.9%)	636 (7.9%)
Collision with Object – Takeoff or Landing	0 (0.0%)	9 (17.3%)	16 (3.7%)	348 (4.3%)
Collision with Object – Precautionary Landing *			30 (6.9%)	973 (12.1%)
Collision with Terrain – Precautionary Landing *	13 (1.6%)	8 (15.4%)	25 (5.8%)	484 (6.0%)
Encounter with Terrain – Precautionary Landing *	5 (0.6%)	6 (11.5%)	10 (2.3%)	390 (4.8%)
Evacuation	102 (12.9%)	12 (23.1%)	6 (1.4%)	
Fire – Non-Impact	34 (4.3%)	0 (0.0%)	12 (2.8%)	67 (0.8%)
Fire – Post Impact	193 (24.3%)	1 (1.9%)	117 (27.0%)	1926 (23.9%)
Ground Collision	19 (2.4%)	1 (1.9%)	1 (0.2%)	31 (0.4%)
Ground Handling or PreFlight	60 (7.6%)	0 (0.0%)	30 (6.9%)	333 (4.1%)
Icing	52 (6.6%)	1 (1.9%)	26 (6.0%)	180 (2.2%)
Low Altitude Operations			25 (5.8%)	796 (9.9%)
Loss of Control – In Flight	96 (12.1%)	15 (28.8%)	144 (33.3%)	3434 (42.6%)
Loss of Control – On Ground		0 (0.0%)	21 (4.9%)	413 (5.1%)
Mid Air Collision	0 (0.0%)		3 (0.7%)	286 (3.5%)
Power Loss – Fuel	2 (0.3%)	0 (0.0%)	50 (11.5%)	1146 (14.2%)
Power Loss – Other Reason *				72 (0.9%)
Power Loss – Unknown Reason *			17 (3.9%)	675 (8.4%)
Runway Excursion	155 (19.5%)	3 (5.8%)	46 (10.6%)	554 (6.9%)
Runway Incursion (Vehicle, Aircraft or Person)			2 (0.5%)	8 (0.1%)
SCF – Powerplant	28 (3.5%)	16 (30.8%)	22 (5.1%)	544 (6.7%)
SCF – Non Powerplant	95 (12.0%)	0 (0.0%)	42 (9.7%)	268 (3.3%)
SCF – Stress Limit Exceeded *			3 (0.7%)	208 (2.6%)
Security Related				27 (0.3%)
Turbulence Encounter	284 (35.8%)	8 (15.4%)	8 (1.8%)	96 (1.2%)
Thunderstorm or Windshear	1 (0.1%)		9 (2.1%)	197 (2.4%)
Undershoot or Overshoot		0 (0.0%)	10 (2.3%)	80 (1.0%)
Unintended Flight in IMC		0 (0.0%)	27 (6.2%)	493 (6.1%)
Wildlife	0 (0.0%)		0 (0.0%)	3 (0.1%)
Other	0 (0.0%)		4 (0.9%)	28 (0.3%)
Unknown or Undetermined	4 (0.5%)		23 (5.3%)	84 (1.0%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-2.5. Number of Injuries by CICTT Occurrence Category (2007-2016)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Injuries	570	85	350	6391
Abrupt Maneuver	5 (0.9%)	0 (0.0%)	7 (2.0%)	74 (1.2%)
Abnormal Runway Contact	30 (5.3%)	0 (0.0%)	19 (5.4%)	331 (5.2%)
Aerodrome	0 (0.0%)	3 (3.5%)	0 (0.0%)	19 (0.3%)
Air Traffic Management	5 (0.9%)	1 (1.2%)	5 (1.4%)	70 (1.1%)
Bird Strikes	5 (0.9%)		0 (0.0%)	22 (0.3%)
Cabin Safety or Pilot Incapacitation	20 (3.5%)	1 (1.2%)	7 (2.0%)	193 (3.0%)
Controlled Flight Into Terrain	2 (0.4%)	40 (47.1%)	56 (16.0%)	390 (6.1%)
Collision with Object – Takeoff or Landing		9 (10.6%)	23 (6.6%)	302 (4.7%)
Collision with Object – Precautionary Landing *		0 (0.0%)	22 (6.3%)	730 (11.4%)
Collision with Terrain – Precautionary Landing *	11 (1.9%)	9 (10.6%)	23 (6.6%)	417 (6.5%)
Encounter with Terrain – Precautionary Landing *	5 (0.9%)	4 (4.7%)	12 (3.4%)	361 (5.6%)
Evacuation	38 (6.7%)	13 (15.3%)		
Fire – Non-Impact	45 (7.9%)	0 (0.0%)	16 (4.6%)	70 (1.1%)
Fire – Post Impact	108 (18.9%)	1 (1.2%)	90 (25.7%)	1480 (23.2%)
Ground Collision	1 (0.2%)	1 (1.2%)	1 (0.3%)	19 (0.3%)
Ground Handling or PreFlight	21 (3.7%)	0 (0.0%)	26 (7.4%)	340 (5.3%)
Icing	52 (9.1%)	1 (1.2%)	8 (2.3%)	114 (1.8%)
Low Altitude Operations			39 (11.1%)	556 (8.7%)
Loss of Control – In Flight	61 (10.7%)	16 (18.8%)	127 (36.3%)	2806 (43.9%)
Loss of Control – On Ground		3 (3.5%)	19 (5.4%)	456 (7.1%)
Mid Air Collision		3 (3.5%)	2 (0.6%)	112 (1.8%)
Power Loss – Fuel		0 (0.0%)	34 (9.7%)	901 (14.1%)
Power Loss – Other Reason *				41 (0.6%)
Power Loss – Unknown Reason *		0 (0.0%)	17 (4.9%)	627 (9.8%)
Runway Excursion	66 (11.6%)	3 (3.5%)	19 (5.4%)	483 (7.6%)
Runway Incursion (Vehicle, Aircraft or Person)			1 (0.3%)	8 (0.1%)
SCF – Powerplant	33 (5.8%)	15 (17.6%)	20 (5.7%)	429 (6.7%)
SCF – Non Powerplant	4 (0.7%)	0 (0.0%)	31 (8.9%)	235 (3.7%)
SCF – Stress Limit Exceeded *			4 (1.1%)	165 (2.6%)
Security Related				28 (0.4%)
Turbulence Encounter	295 (51.8%)	4 (4.7%)	7 (2.0%)	84 (1.3%)
Thunderstorm or Windshear	1 (0.2%)		1 (0.3%)	129 (2.0%)
Undershoot or Overshoot	0 (0.0%)		6 (1.7%)	75 (1.2%)
Unintended Flight in IMC		30 (35.3%)	32 (9.1%)	393 (6.1%)
Wildlife			0 (0.0%)	6 (0.1%)
Other	1 (0.2%)		1 (0.3%)	18 (0.3%)
Unknown or Undetermined	5 (0.9%)		14 (4.0%)	88 (1.4%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-3.1. Number of Fatal Accidents by CICTT Occurrence Category (1987-1996)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	47	45	209	3272
Abrupt Maneuver			2 (1.0%)	42 (1.3%)
Abnormal Runway Contact			2 (1.0%)	34 (1.0%)
Aerodrome				5 (0.2%)
Air Traffic Management	7 (14.9%)	3 (6.7%)		58 (1.8%)
Bird Strikes				3 (0.1%)
Cabin Safety or Pilot Incapacitation	2 (4.3%)	1 (2.2%)	6 (2.9%)	220 (6.7%)
Controlled Flight Into Terrain	4 (8.5%)	16 (35.6%)	58 (27.8%)	477 (14.6%)
Collision with Object – Takeoff or Landing	1 (2.1%)		2 (1.0%)	99 (3.0%)
Collision with Object – Precautionary Landing *		2 (4.4%)	15 (7.2%)	152 (4.6%)
Collision with Terrain – Precautionary Landing *	1 (2.1%)		11 (5.3%)	92 (2.8%)
Encounter with Terrain – Precautionary Landing *				9 (0.3%)
Evacuation	1 (2.1%)			
Fire – Non-Impact	5 (10.6%)	1 (2.2%)	7 (3.3%)	38 (1.2%)
Fire – Post Impact	19 (40.4%)	26 (57.8%)	90 (43.1%)	1055 (32.2%)
Ground Collision				6 (0.2%)
Ground Handling or PreFlight	9 (19.1%)	3 (6.7%)	15 (7.2%)	178 (5.4%)
Icing	5 (10.6%)	2 (4.4%)	13 (6.2%)	104 (3.2%)
Low Altitude Operations		2 (4.4%)	26 (12.4%)	713 (21.8%)
Loss of Control – In Flight	18 (38.3%)	19 (42.2%)	91 (43.5%)	1808 (55.3%)
Loss of Control – On Ground				15 (0.5%)
Mid Air Collision		2 (4.4%)	6 (2.9%)	131 (4.0%)
Power Loss – Fuel		1 (2.2%)	7 (3.3%)	224 (6.8%)
Power Loss – Other Reason *			2 (1.0%)	23 (0.7%)
Power Loss – Unknown Reason *	1 (2.1%)	2 (4.4%)	3 (1.4%)	107 (3.3%)
Runway Excursion	2 (4.3%)		1 (0.5%)	23 (0.7%)
Runway Incursion (Vehicle, Aircraft or Person)	6 (12.8%)	2 (4.4%)		13 (0.4%)
SCF – Powerplant	3 (6.4%)	4 (8.9%)	26 (12.4%)	155 (4.7%)
SCF – Non Powerplant	6 (12.8%)	2 (4.4%)	11 (5.3%)	120 (3.7%)
SCF – Stress Limit Exceeded*	1 (2.1%)	1 (2.2%)	6 (2.9%)	164 (5.0%)
Security Related	2 (4.3%)		1 (0.5%)	43 (1.3%)
Turbulence Encounter	1 (2.1%)	1 (2.2%)	8 (3.8%)	60 (1.8%)
Thunderstorm or Windshear	2 (4.3%)	2 (4.4%)	4 (1.9%)	110 (3.4%)
Undershoot or Overshoot			1 (0.5%)	7 (0.2%)
Unintended Flight in IMC		10 (22.2%)	24 (11.5%)	502 (15.3%)
Wildlife				
Other			2 (1.0%)	12 (0.4%)
Unknown or Undetermined	1 (2.1%)	2 (4.4%)	8 (3.8%)	134 (4.1%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-3.2. Number of Fatal Accidents by CICTT Occurrence Category (1992-2001)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	33	30	167	2718
Abrupt Maneuver	1 (3.0%)			28 (1.0%)
Abnormal Runway Contact		1 (3.3%)	1 (0.6%)	27 (1.0%)
Aerodrome				4 (0.1%)
Air Traffic Management	1 (3.0%)		1 (0.6%)	51 (1.9%)
Bird Strikes				1 (0.1%)
Cabin Safety or Pilot Incapacitation			4 (2.4%)	167 (6.1%)
Controlled Flight Into Terrain	1 (3.0%)	11 (36.7%)	45 (26.9%)	393 (14.5%)
Collision with Object – Takeoff or Landing			2 (1.2%)	93 (3.4%)
Collision with Object – Precautionary Landing *		2 (6.7%)	9 (5.4%)	128 (4.7%)
Collision with Terrain – Precautionary Landing *			15 (9.0%)	77 (2.8%)
Encounter with Terrain – Precautionary Landing *			1 (0.6%)	9 (0.3%)
Evacuation	2 (6.1%)			
Fire – Non-Impact	5 (15.2%)		6 (3.6%)	30 (1.1%)
Fire – Post Impact	10 (30.3%)	12 (40.0%)	67 (40.1%)	923 (34.0%)
Ground Collision				6 (0.2%)
Ground Handling or PreFlight	9 (27.3%)	4 (13.3%)	10 (6.0%)	147 (5.4%)
Icing	2 (6.1%)	3 (10.0%)	14 (8.4%)	83 (3.1%)
Low Altitude Operations		2 (6.7%)	16 (9.6%)	533 (19.6%)
Loss of Control – In Flight	14 (42.4%)	13 (43.3%)	67 (40.1%)	1476 (54.3%)
Loss of Control – On Ground				12 (0.4%)
Mid Air Collision			4 (2.4%)	118 (4.3%)
Power Loss – Fuel			11 (6.6%)	182 (6.7%)
Power Loss – Other Reason *			1 (0.6%)	12 (0.4%)
Power Loss – Unknown Reason *		1 (3.3%)	4 (2.4%)	97 (3.6%)
Runway Excursion	2 (6.1%)		1 (0.6%)	28 (1.0%)
Runway Incursion (Vehicle, Aircraft or Person)	1 (3.0%)	1 (3.3%)		13 (0.5%)
SCF – Powerplant	2 (6.1%)	2 (6.7%)	20 (12.0%)	126 (4.6%)
SCF – Non Powerplant	6 (18.2%)	2 (6.7%)	10 (6.0%)	92 (3.4%)
SCF – Stress Limit Exceeded*	2 (6.1%)		5 (3.0%)	127 (4.7%)
Security Related	4 (12.1%)			31 (1.1%)
Turbulence Encounter	1 (3.0%)	1 (3.3%)	6 (3.6%)	53 (2.0%)
Thunderstorm or Windshear	2 (6.1%)	1 (3.3%)	4 (2.4%)	76 (2.8%)
Undershoot or Overshoot			2 (1.2%)	5 (0.2%)
Unintended Flight in IMC		7 (23.3%)	17 (10.2%)	356 (13.1%)
Wildlife				
Other			1 (0.6%)	12 (0.4%)
Unknown or Undetermined			8 (4.8%)	126 (4.6%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-3.3. Number of Fatal Accidents by CICTT Occurrence Category (1997-2006)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	25	15	122	2325
Abrupt Maneuver	1 (4.0%)			18 (0.8%)
Abnormal Runway Contact		1 (6.7%)		22 (0.9%)
Aerodrome				2 (0.1%)
Air Traffic Management			3 (2.5%)	44 (1.9%)
Bird Strikes				1 (0.1%)
Cabin Safety or Pilot Incapacitation			5 (4.1%)	122 (5.2%)
Controlled Flight Into Terrain	1 (4.0%)	4 (26.7%)	34 (27.9%)	331 (14.2%)
Collision with Object – Takeoff or Landing			1 (0.8%)	87 (3.7%)
Collision with Object – Precautionary Landing *		1 (6.7%)	6 (4.9%)	131 (5.6%)
Collision with Terrain – Precautionary Landing *	1 (4.0%)	1 (6.7%)	7 (5.7%)	73 (3.1%)
Encounter with Terrain – Precautionary Landing *			1 (0.8%)	7 (0.3%)
Evacuation	1 (4.0%)	1 (6.7%)		
Fire – Non-Impact	1 (4.0%)		2 (1.6%)	16 (0.7%)
Fire – Post Impact	7 (28.0%)	3 (20.0%)	50 (41.0%)	838 (36.0%)
Ground Collision				4 (0.2%)
Ground Handling or PreFlight	10 (40.0%)	2 (13.3%)	4 (3.3%)	90 (3.9%)
Icing		3 (20.0%)	14 (11.5%)	65 (2.8%)
Low Altitude Operations		1 (6.7%)	9 (7.4%)	393 (16.9%)
Loss of Control – In Flight	6 (24.0%)	8 (53.3%)	54 (44.3%)	1276 (54.9%)
Loss of Control – On Ground				12 (0.5%)
Mid Air Collision			4 (3.3%)	104 (4.5%)
Power Loss – Fuel	1 (4.0%)		8 (6.6%)	165 (7.1%)
Power Loss – Other Reason *				10 (0.4%)
Power Loss – Unknown Reason *		1 (6.7%)	6 (4.9%)	103 (4.4%)
Runway Excursion	3 (12.0%)		1 (0.8%)	35 (1.5%)
Runway Incursion (Vehicle, Aircraft or Person)				4 (0.2%)
SCF – Powerplant		1 (6.7%)	8 (6.6%)	112 (4.8%)
SCF – Non Powerplant	5 (20.0%)	2 (13.3%)	6 (4.9%)	75 (3.2%)
SCF – Stress Limit Exceeded*	1 (4.0%)		5 (4.1%)	83 (3.6%)
Security Related	4 (16.0%)			25 (1.1%)
Turbulence Encounter	1 (4.0%)		3 (2.5%)	43 (1.8%)
Thunderstorm or Windshear	1 (4.0%)		5 (4.1%)	70 (3.0%)
Undershoot or Overshoot			1 (0.8%)	4 (0.2%)
Unintended Flight in IMC		4 (26.7%)	12 (9.8%)	257 (11.1%)
Wildlife				
Other				8 (0.3%)
Unknown or Undetermined			7 (5.7%)	78 (3.4%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-3.4. Number of Fatal Accidents by CICTT Occurrence Category (2002-2011)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	15	2	92	1945
Abrupt Maneuver				31 (1.6%)
Abnormal Runway Contact			1 (1.1%)	27 (1.4%)
Aerodrome				1 (0.1%)
Air Traffic Management			2 (2.2%)	34 (1.7%)
Bird Strikes				3 (0.2%)
Cabin Safety or Pilot Incapacitation			4 (4.3%)	99 (5.1%)
Controlled Flight Into Terrain	1 (6.7%)		24 (26.1%)	260 (13.4%)
Collision with Object – Takeoff or Landing			2 (2.2%)	64 (3.3%)
Collision with Object – Precautionary Landing *			3 (3.3%)	119 (6.2%)
Collision with Terrain – Precautionary Landing *	2 (13.3%)	1 (50.0%)	2 (2.2%)	71 (3.7%)
Encounter with Terrain – Precautionary Landing *				13 (0.7%)
Evacuation		1 (50.0%)		
Fire – Non-Impact	2 (13.3%)		2 (2.2%)	13 (0.7%)
Fire – Post Impact	4 (26.7%)		34 (37.0%)	702 (36.1%)
Ground Collision				2 (0.1%)
Ground Handling or PreFlight	5 (33.3%)		4 (4.3%)	64 (3.3%)
Icing	1 (6.7%)		7 (7.6%)	62 (3.2%)
Low Altitude Operations			7 (7.6%)	302 (15.5%)
Loss of Control – In Flight	4 (26.7%)	1 (50.0%)	41 (44.6%)	1138 (58.5%)
Loss of Control – On Ground			1 (1.1%)	15 (0.8%)
Mid Air Collision			3 (3.3%)	67 (3.4%)
Power Loss – Fuel	1 (6.7%)		2 (2.2%)	148 (7.6%)
Power Loss – Other Reason *				8 (0.4%)
Power Loss – Unknown Reason *			4 (4.3%)	99 (5.1%)
Runway Excursion	2 (13.3%)		2 (2.2%)	31 (1.6%)
Runway Incursion (Vehicle, Aircraft or Person)				2 (0.1%)
SCF – Powerplant	1 (16.7%)	1 (50.0%)	3 (3.3%)	89 (4.6%)
SCF – Non Powerplant	2 (13.3%)		5 (5.4%)	67 (3.4%)
SCF – Stress Limit Exceeded*			3 (3.3%)	81 (4.2%)
Security Related				16 (0.8%)
Turbulence Encounter			2 (2.2%)	30 (1.5%)
Thunderstorm or Windshear	1 (6.7%)		2 (2.2%)	68 (3.5%)
Undershoot or Overshoot				5 (0.3%)
Unintended Flight in IMC			8 (8.7%)	210 (10.8%)
Wildlife				
Other				6 (0.3%)
Unknown or Undetermined	2 (33.3%)		8 (8.7%)	44 (2.3%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-3.5. Number of Fatal Accidents by CICTT Occurrence Category (2007-2016)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatal Accidents	8	5	65	1536
Abrupt Maneuver			1 (1.5%)	31 (2.0%)
Abnormal Runway Contact			1 (1.5%)	30 (2.0%)
Aerodrome				1 (0.1%)
Air Traffic Management			2 (3.1%)	27 (1.8%)
Bird Strikes				3 (0.2%)
Cabin Safety or Pilot Incapacitation			2 (3.1%)	101 (6.6%)
Controlled Flight Into Terrain	1 (12.5%)	3 (60.0%)	15 (23.1%)	165 (10.7%)
Collision with Object – Takeoff or Landing			2 (3.1%)	53 (3.5%)
Collision with Object – Precautionary Landing *			3 (4.6%)	93 (6.1%)
Collision with Terrain – Precautionary Landing *	1 (12.5%)	1 (20.0%)	3 (4.6%)	48 (3.1%)
Encounter with Terrain – Precautionary Landing *				16 (1.1%)
Evacuation		1 (20.0%)		
Fire – Non-Impact	1 (12.5%)		4 (6.2%)	14 (0.9%)
Fire – Post Impact	3 (37.5%)		23 (38.4%)	538 (35.0%)
Ground Collision				1 (0.1%)
Ground Handling or PreFlight	2 (25.0%)		3 (4.6%)	62 (4.0%)
Icing	1 (12.5%)		2 (3.1%)	37 (2.4%)
Low Altitude Operations			7 (10.8%)	219 (14.3%)
Loss of Control – In Flight	3 (37.5%)	1 (20.0%)	30 (46.2%)	970 (63.2%)
Loss of Control – On Ground			1 (1.5%)	14 (0.9%)
Mid Air Collision		1 (20.0%)	2 (3.1%)	57 (3.7%)
Power Loss – Fuel			1 (1.5%)	118 (7.7%)
Power Loss – Other Reason *				5 (0.3%)
Power Loss – Unknown Reason *			3 (4.6%)	82 (5.3%)
Runway Excursion			1 (1.5%)	17 (1.1%)
Runway Incursion (Vehicle, Aircraft or Person)				4 (0.3%)
SCF – Powerplant	1 (12.5%)	1 (20.0%)	4 (6.2%)	64 (4.2%)
SCF – Non Powerplant			4 (6.2%)	56 (3.6%)
SCF – Stress Limit Exceeded*			3 (4.6%)	67 (4.4%)
Security Related				17 (1.1%)
Turbulence Encounter			2 (3.1%)	25 (1.6%)
Thunderstorm or Windshear	1 (12.5%)		1 (1.5%)	48 (3.1%)
Undershoot or Overshoot				5 (0.3%)
Unintended Flight in IMC		3 (60.0%)	6 (9.2%)	178 (11.6%)
Wildlife				1 (0.1%)
Other				8 (0.5%)
Unknown or Undetermined	2 (25.0%)		5 (7.7%)	42 (2.7%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-4.1. Number of Fatalities by CICTT Occurrence Category (1987-1996)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatalities	1717	307	464	6275
Abrupt Maneuver			3 (0.6%)	67 (1.1%)
Abnormal Runway Contact			11 (2.4%)	59 (0.9%)
Aerodrome				13 (0.2%)
Air Traffic Management	252 (14.7%)	48 (15.6%)		136 (2.2%)
Bird Strikes				4 (0.1%)
Cabin Safety or Pilot Incapacitation	2 (0.1%)	9 (2.9%)	6 (1.3%)	357 (5.7%)
Controlled Flight Into Terrain	312 (18.2%)	82 (26.7%)	131 (28.2%)	1004 (16.0%)
Collision with Object – Takeoff or Landing	156 (9.1%)		4 (0.9%)	174 (2.8%)
Collision with Object – Precautionary Landing *		14 (4.6%)	30 (6.5%)	262 (4.2%)
Collision with Terrain – Precautionary Landing *	27 (1.6%)		27 (5.8%)	173 (2.8%)
Encounter with Terrain – Precautionary Landing *				11 (0.2%)
Evacuation	2 (0.1%)			
Fire – Non-Impact	380 (22.1%)	14 (4.6%)	16 (3.4%)	77 (1.2%)
Fire – Post Impact	783 (45.6%)	211 (68.7%)	225 (48.5%)	2272 (36.2%)
Ground Collision				7 (0.1%)
Ground Handling or PreFlight	10 (0.6%)	22 (7.2%)	23 (5.0%)	443 (7.1%)
Icing	127 (7.4%)	24 (7.8%)	18 (3.9%)	240 (3.8%)
Low Altitude Operations		4 (1.3%)	75 (16.2%)	1237 (19.7%)
Loss of Control – In Flight	875 (51.0%)	150 (48.9%)	164 (35.3%)	3551 (56.6%)
Loss of Control – On Ground				16 (0.3%)
Mid Air Collision		10 (3.3%)	15 (3.2%)	215 (3.4%)
Power Loss – Fuel		2 (0.7%)	8 (1.7%)	379 (6.0%)
Power Loss – Other Reason *			2 (0.4%)	43 (0.7%)
Power Loss – Unknown Reason *	27 (1.6%)	11 (3.6%)	11 (2.4%)	206 (3.3%)
Runway Excursion	8 (0.5%)		8 (1.7%)	27 (0.4%)
Runway Incursion (Animal, Vehicle, Aircraft or Person)	46 (2.7%)	48 (15.6%)		35 (0.6%)
SCF – Powerplant	117 (6.8%)	42 (13.7%)	59 (12.7%)	314 (5.0%)
SCF – Non Powerplant	175 (10.2%)	16 (5.2%)	26 (5.6%)	238 (3.8%)
SCF – Stress Limits Exceeded	230 (13.4%)	14 (4.6%)	8 (1.7%)	358 (5.7%)
Security Related	313 (18.2%)		2 (0.4%)	51 (0.8%)
Turbulence	1 (0.1%)	3 (1.0%)	13 (2.8%)	132 (2.1%)
Thunderstorm or Windshear	38 (2.2%)	15 (4.9%)	9 (1.9%)	237 (3.8%)
Undershoot or Overshoot			1 (0.2%)	21 (0.3%)
Unintended Flight in IMC		45 (14.7%)	86 (18.5%)	1008 (16.1%)
Wildlife				
Other			3 (0.6%)	16 (0.3%)
Unknown or Undetermined	1 (0.1%)	6 (2.0%)	26 (5.6%)	301 (4.8%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-4.2. Number of Fatalities by CICTT Occurrence Category (1992-2001)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatalities	1465	169	415	5191
Abrupt Maneuver	265 (18.1%)			43 (0.8%)
Abnormal Runway Contact		5 (3.0%)	1 (0.2%)	45 (0.9%)
Aerodrome				5 (0.1%)
Air Traffic Management	37 (2.5%)		1 (0.2%)	109 (2.1%)
Bird Strikes				1 (0.1%)
Cabin Safety or Pilot Incapacitation			10 (2.4%)	270 (5.2%)
Controlled Flight Into Terrain	160 (10.9%)	50 (29.6%)	121 (29.2%)	774 (14.9%)
Collision with Object – Takeoff or Landing			2 (0.5%)	171 (3.3%)
Collision with Object – Precautionary Landing *		9 (5.3%)	12 (2.9%)	222 (4.3%)
Collision with Terrain – Precautionary Landing *			32 (7.7%)	139 (2.7%)
Encounter with Terrain – Precautionary Landing *			1 (0.2%)	12 (0.2%)
Evacuation	3 (0.2%)			
Fire – Non-Impact	380 (25.9%)		13 (3.1%)	64 (1.2%)
Fire – Post Impact	650 (44.4%)	94 (55.6%)	189 (45.5%)	1970 (38.0%)
Ground Collision				7 (0.1%)
Ground Handling or PreFlight	13 (0.9%)	15 (8.9%)	23 (5.5%)	371 (7.1%)
Icing	95 (6.5%)	47 (27.8%)	17 (4.1%)	194 (3.7%)
Low Altitude Operations		3 (1.8%)	43 (10.4%)	881 (17.0%)
Loss of Control – In Flight	1009 (68.9%)	92 (54.4%)	173 (41.7%)	2964 (57.1%)
Loss of Control – On Ground				14 (0.3%)
Mid Air Collision			17 (4.1%)	188 (3.6%)
Power Loss – Fuel			35 (8.4%)	320 (6.2%)
Power Loss – Other Reason *			1 (0.2%)	21 (0.4%)
Power Loss – Unknown Reason *		1 (0.6%)	13 (3.1%)	188 (3.6%)
Runway Excursion	17 (1.2%)		8 (1.9%)	44 (0.8%)
Runway Incursion (Animal, Vehicle, Aircraft or Person)	2 (0.1%)	14 (8.3%)		29 (0.6%)
SCF – Powerplant	6 (0.4%)	13 (7.7%)	45 (10.8%)	276 (5.3%)
SCF – Non Powerplant	232 (15.8%)	6 (3.6%)	27 (6.5%)	200 (3.9%)
SCF – Stress Limits Exceeded	495 (33.8%)		9 (2.2%)	297 (5.7%)
Security Related	265 (18.1%)			37 (0.7%)
Turbulence	1 (0.1%)	3 (1.8%)	10 (2.4%)	123 (2.4%)
Thunderstorm or Windshear	48 (3.3%)	2 (1.2%)	12 (2.9%)	164 (3.2%)
Undershoot or Overshoot			2 (0.5%)	11 (0.2%)
Unintended Flight in IMC		24 (14.2%)	62 (14.9%)	693 (13.4%)
Wildlife				
Other			2 (0.5%)	15 (0.3%)
Unknown or Undetermined			23 (5.5%)	277 (5.3%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-4.3. Number of Fatalities by CICTT Occurrence Category (1997-2006)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatalities	752	80	294	4525
Abrupt Maneuver	265 (35.2%)			28 (0.6%)
Abnormal Runway Contact		5 (6.3%)		32 (0.7%)
Aerodrome				3 (0.1%)
Air Traffic Management			4 (1.4%)	79 (1.7%)
Bird Strikes				2 (0.4%)
Cabin Safety or Pilot Incapacitation			11 (3.7%)	201 (4.4%)
Controlled Flight Into Terrain	13 (1.7%)	14 (17.5%)	82 (27.9%)	644 (14.2%)
Collision with Object – Takeoff or Landing			1 (0.3%)	160 (3.5%)
Collision with Object – Precautionary Landing *		1 (1.3%)	6 (2.0%)	214 (4.7%)
Collision with Terrain – Precautionary Landing *	1 (0.1%)	2 (2.5%)	10 (3.4%)	116 (2.6%)
Encounter with Terrain – Precautionary Landing *			1 (0.3%)	13 (0.3%)
Evacuation	1 (0.1%)	2 (2.5%)		
Fire – Non-Impact	20 (2.7%)		2 (0.7%)	30 (0.7%)
Fire – Post Impact	367 (48.8%)	40 (50.0%)	119 (40.5%)	1754 (38.8%)
Ground Collision				4 (0.1%)
Ground Handling or PreFlight	34 (4.5%)	11 (13.8%)	14 (4.8%)	206 (4.6%)
Icing		47 (58.8%)	17 (5.8%)	147 (3.2%)
Low Altitude Operations		2 (2.5%)	24 (8.2%)	694 (15.3%)
Loss of Control – In Flight	402 (53.5%)	61 (76.3%)	146 (49.7%)	2546 (56.3%)
Loss of Control – On Ground				15 (0.3%)
Mid Air Collision			16 (5.4%)	300 (6.6%)
Power Loss – Fuel	1 (0.1%)		31 (10.5%)	271 (6.0%)
Power Loss – Other Reason *				14 (0.3%)
Power Loss – Unknown Reason *		1 (1.3%)	9 (3.1%)	191 (4.2%)
Runway Excursion	61 (8.1%)		1 (0.3%)	60 (1.3%)
Runway Incursion (Animal, Vehicle, Aircraft or Person)				6 (0.1%)
SCF – Powerplant		2 (2.5%)	20 (6.8%)	239 (5.3%)
SCF – Non Powerplant	133 (17.7%)	6 (7.5%)	11 (3.7%)	141 (3.1%)
SCF – Stress Limits Exceeded	265 (35.2%)		9 (3.1%)	199 (4.4%)
Security Related	265 (35.2%)			29 (0.6%)
Turbulence	1 (0.1%)		4 (1.4%)	92 (2.0%)
Thunderstorm or Windshear	11 (1.5%)		10 (3.4%)	148 (3.3%)
Undershoot or Overshoot			1 (0.3%)	6 (0.1%)
Unintended Flight in IMC		14 (17.5%)	30 (10.2%)	503 (11.1%)
Wildlife				
Other				12 (0.3%)
Unknown or Undetermined			25 (8.5%)	143 (3.2%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-4.4. Number of Fatalities by CICTT Occurrence Category (2002-2011)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatalities	166	4	204	3816
Abrupt Maneuver				60 (1.6%)
Abnormal Runway Contact			2 (1.0%)	39 (1.0%)
Aerodrome				1 (0.1%)
Air Traffic Management			3 (1.5%)	71 (1.9%)
Bird Strikes				9 (0.2%)
Cabin Safety or Pilot Incapacitation			6 (2.9%)	160 (4.2%)
Controlled Flight Into Terrain	13 (7.8%)		46 (22.5%)	500 (13.1%)
Collision with Object – Takeoff or Landing			9 (4.4%)	116 (3.0%)
Collision with Object – Precautionary Landing *			5 (2.5%)	190 (5.0%)
Collision with Terrain – Precautionary Landing *	3 (1.8%)	2 (50.0%)	2 (1.0%)	116 (3.0%)
Encounter with Terrain – Precautionary Landing *				22 (0.6%)
Evacuation		2 (50.0%)		
Fire – Non-Impact	22 (13.3%)		8 (3.9%)	25 (0.7%)
Fire – Post Impact	133 (80.1%)		74 (36.3%)	1462 (38.3%)
Ground Collision				3 (0.1%)
Ground Handling or PreFlight	25 (15.1%)		6 (2.9%)	146 (3.8%)
Icing	50 (30.1%)		10 (4.9%)	132 (3.5%)
Low Altitude Operations			22 (10.8%)	549 (14.4%)
Loss of Control – In Flight	93 (56.0%)	2 (50.0%)	89 (43.6%)	2261 (59.3%)
Loss of Control – On Ground			2 (1.0%)	17 (0.4%)
Mid Air Collision			3 (1.5%)	248 (6.5%)
Power Loss – Fuel	1 (0.6%)		4 (2.0%)	241 (6.3%)
Power Loss – Other Reason *				11 (0.3%)
Power Loss – Unknown Reason *			5 (2.5%)	170 (4.5%)
Runway Excursion	50 (30.1%)		5 (2.5%)	51 (1.3%)
Runway Incursion (Animal, Vehicle, Aircraft or Person)				2 (0.1%)
SCF – Powerplant	2 (1.2%)	2 (50.0%)	9 (4.4%)	183 (4.8%)
SCF – Non Powerplant	41 (24.7%)		18 (8.8%)	110 (2.9%)
SCF – Stress Limits Exceeded			3 (1.5%)	207 (5.4%)
Security Related				19 (0.5%)
Turbulence			3 (1.5%)	62 (1.6%)
Thunderstorm or Windshear	1 (0.6%)		2 (1.0%)	161 (4.2%)
Undershoot or Overshoot				9 (0.2%)
Unintended Flight in IMC			17 (8.3%)	434 (11.4%)
Wildlife				
Other				10 (0.3%)
Unknown or Undetermined	3 (1.8%)		23 (11.3%)	81 (2.1%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

Table C-4.5. Number of Fatalities by CICTT Occurrence Category (2007-2016)

CICTT Occurrence Category	Part 121	Scheduled Part 135	Non-Scheduled Part 135	Part 91
Total Fatalities	67	12	179	2788
Abrupt Maneuver			1 (0.6%)	62 (2.2%)
Abnormal Runway Contact			2 (1.1%)	49 (1.8%)
Aerodrome				1 (0.1%)
Air Traffic Management			3 (1.7%)	59 (2.1%)
Bird Strikes				11 (0.4%)
Cabin Safety or Pilot Incapacitation			4 (2.2%)	156 (5.6%)
Controlled Flight Into Terrain	2 (3.0%)	8 (66.7%)	44 (24.6%)	294 (10.5%)
Collision with Object – Takeoff or Landing			9 (5.0%)	98 (3.5%)
Collision with Object – Precautionary Landing *			5 (2.8%)	145 (5.2%)
Collision with Terrain – Precautionary Landing *	2 (3.0%)	1 (8.3%)	9 (5.0%)	84 (3.0%)
Encounter with Terrain – Precautionary Landing *				20 (0.7%)
Evacuation		1 (8.3%)		
Fire – Non-Impact	2 (3.0%)		16 (8.9%)	32 (1.1%)
Fire – Post Impact	59 (88.1%)		71 (39.7%)	1128 (40.5%)
Ground Collision				2 (0.1%)
Ground Handling or PreFlight	8 (11.9%)		15 (8.4%)	151 (5.4%)
Icing	50 (74.6%)		2 (1.1%)	87 (3.1%)
Low Altitude Operations			19 (10.6%)	386 (13.8%)
Loss of Control – In Flight	59 (88.1%)	3 (25.0%)	79 (44.1%)	1838 (65.9%)
Loss of Control – On Ground			2 (1.1%)	15 (0.5%)
Mid Air Collision		3 (25.0%)	1 (0.6%)	81 (2.9%)
Power Loss – Fuel			3 (1.7%)	183 (6.6%)
Power Loss – Other Reason *				10 (0.4%)
Power Loss – Unknown Reason *			6 (3.4%)	138 (5.0%)
Runway Excursion			4 (2.2%)	37 (1.3%)
Runway Incursion (Animal, Vehicle, Aircraft or Person)				4 (0.1%)
SCF – Powerplant	2 (3.0%)	1 (8.3%)	4 (2.2%)	115 (4.1%)
SCF – Non Powerplant			17 (9.5%)	92 (3.3%)
SCF – Stress Limits Exceeded			4 (2.2%)	162 (5.8%)
Security Related				23 (0.8%)
Turbulence			2 (1.1%)	46 (1.7%)
Thunderstorm or Windshear	1 (1.5%)		1 (0.6%)	113 (4.1%)
Undershoot or Overshoot				7 (0.3%)
Unintended Flight in IMC		8 (66.7%)	24 (13.4%)	349 (12.5%)
Wildlife				3 (0.1%)
Other				8 (0.3%)
Unknown or Undetermined	3 (4.5%)		14 (7.8%)	75 (2.7%)

* Denotes occurrence categories not in the official CAST/ICAO taxonomy.

REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>						
1. REPORT DATE (DD-MM-YYYY) 01-02-2020		2. REPORT TYPE Contractor Report		3. DATES COVERED (From - To)		
4. TITLE AND SUBTITLE Changes in Frequency of the Severity and Type of Aviation Accidents (1987 to 2016)				5a. CONTRACT NUMBER		
				5b. GRANT NUMBER 80LARC17C0003		
				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Evans, Joni K.				5d. PROJECT NUMBER		
				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER 090265.01.01.07.04		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NASA Langley Research Center Hampton, Virginia 23681-2199				8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001				10. SPONSOR/MONITOR'S ACRONYM(S) NASA		
				11. SPONSOR/MONITOR'S REPORT NUMBER(S) NASA/CR-2020-220565		
12. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified- Subject Category 03 Availability: NASA STI Program (757) 864-9658						
13. SUPPLEMENTARY NOTES Langley Technical Monitor: Sharon M. Jones						
14. ABSTRACT The purpose of this study was to analyze historical aviation accident and incident data to identify any statistical trends related to NASA Aeronautics Research Mission Directorate (ARMD) research and technologies. The incidence and severity of aviation accidents are known to vary substantially among different flight operations (Part 121, Part 135, Part 91). Prior analyses have shown variation among flight operation and across time, with regard to the accident categories which contribute to the overall safety risk (defined to include total accidents, fatal accidents, total injuries and fatal injuries). The analysis reported here was based on thirty years of civil aviation accident data (1987-2016). Accident rates have continued to decline for all flight operations, with the possible exception of Scheduled Part 135 fatal accident rates. The accident categories contributing to the safety risk (referred to as 'tall poles') were also determined for five different sets of 10-year time periods.						
15. SUBJECT TERMS Accidents; Civil Aviation; Fatal Accidents; Safety Risk						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON	
a. REPORT	b. ABSTRACT	c. THIS PAGE			STI Help Desk (email: help@sti.nasa.gov)	
U	U	U	UU	88	19b. TELEPHONE NUMBER (Include area code) (757) 864-9658	