USHST | United States Helicopter Safety Team

Our Vision: A U.S. Civil Helicopter Community With Zero Accidents

COMPARATIVE REPORT, Volume 2

U.S. JHIMDAT Data to U.S. JHSAT Data

U.S. Joint Helicopter Implementation Measurement Data Analysis Team

To

The United States Helicopter Safety Team

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The U.S. JHSAT analyzed 523 U.S. registered helicopter accidents that occurred in CY2000, CY2001 and CY2006 (JHSAT data). The U.S. JHIMDAT analyzed 415 U.S. registered helicopter accidents that occurred in CY2009-2011 (JHIMDAT data). This report contains the comparative JHIMDAT to JHSAT data analysis. The purpose was to identify differences of statistical significance. By noting areas of improvement, regression, and stagnation, this analysis allowed the opportunity for a strategic approach to future helicopter accident rate reduction efforts.

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U.S. JHIMDAT Members

The following JHIMDAT Member organized the data, conducted the comparative analysis, and wrote the comparative report between the JHIMDAT and JHSAT data.

Name	Company/Organization
Lee Roskop	FAA Rotorcraft Standards Staff

The following JHIMDAT Members contributed to one or all of the following activities: analysis of the JHIMDAT data, review of the comparative report, and development of summary and conclusions.

Name	Company/Organization	Position
Steve Gleason	Sikorsky Aircraft Corporation	JHIMDAT Co-Chair (Industry)
Scott Tyrrell	FAA Rotorcraft Standards Staff	JHIMDAT Co-Chair (Government)
Eric Barnett	FAA Rotorcraft Standards Staff	Member
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Mark Colborn	Dallas Police Department	Member
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Gary Howe	Bell Helicopter Textron	Member
Lee Roskop	FAA Rotorcraft Standards Staff	Member
Bill Wallace	Bill Wallace & Associates	Member

Description

In 2006, the U.S. Joint Helicopter Safety Analysis Team (JHSAT) began analysis work on U.S. accidents that occurred in calendar year 2000. After publishing a report with the results of their work, the JHSAT proceeded to complete comparable analysis on the U.S. accidents that occurred in 2001 and followed completion of that project with analysis of 2006. In 2011, the JHSAT consolidated the results of all three respective years into a compendium report (hereafter known in this report as "JHSAT data"). The JHSAT data established a baseline for future U.S. helicopter accident analysis.

As a follow up to the compendium report, the U.S. Joint Helicopter Implementation Measurement and Data Analysis Team (JHIMDAT) attempted to measure progress by comparing the JHSAT data to analysis performed on the three calendar years 2009-2011 (hereafter known in this report as "JHIMDAT data"). Analysis of the JHIMDAT data remained consistent with the JHSAT's methodology. However, the extensive depth of analysis performed on the JHSAT data required monthly meetings of one week duration that were no longer feasible for analysis of the JHIMDAT data. The JHIMDAT transitioned to quarterly meetings consisting of a much smaller team composition than the original JHSAT. To account for the realities of a smaller team that met less frequently, the JHIMDAT reduced the scope of the analysis effort. The team accomplished a "high level" analysis of the three years from 2009-2011 through quarterly meetings conducted over a 9 month period.

The JHIMDAT's preference would have been to use rate based comparisons in their analysis. The rate would have been calculated using accident counts as the numerator and flight hours as the denominator. However, while it was possible to make some reasonable estimates for the *total* U.S. rotorcraft flight hours, it was not possible to accurately refine that flight hour estimate across the numerous different analysis areas used by the JHIMDAT. With this limitation, the JHIMDAT made comparisons in their research based on accident counts that were converted to percentages to express frequency.

The JHIMDAT's intent was to find where meaningful differences existed between the JHIMDAT data and the JHSAT data. Areas where improvement occurred were candidates for exploring successful implementation measures for use in other areas where progress was less substantial. Areas where regression occurred or stagnation was evident were candidates for adapting different intervention strategies to encourage improvement. In either case, adjustments could be made to further the progress toward the 80% accident rate decrease sought by the IHST. Initial comparison of the JHIMDAT data and JHSAT data showed differences did exist. However, the JHIMDAT sought to further identify areas where ***statistically significant*** differences existed. The team opted for a chi squared analysis to support this purpose, based on the JHSAT's and JHIMDAT's method of organizing the accident analysis data according to a nominal scale. "Nominal scale" describes a grouping of data into various categories based on some common characteristic. A partial list of examples would include the following: 1) "Industry", such as Personal/Private, Instructional/Training, or Aerial Application; 2) "Activity" descriptions, such as Positioning/RTB, Instructional/Training (Dual), or Maintenance/Test flight; and 3) "Occurrence Categories", such as Loss of Control, Autorotation, or System Component Failure.

The chi squared analysis consisted of either a “goodness of fit” test (most cases) or a “test of homogeneity” (a few cases). The goodness of fit test allowed the team to directly compare one group of JHIMDAT data to the corresponding group of JHSAT data to assess statistical differences. The test of homogeneity was a slightly more complex approach that the team used for a few limited cases where the goal was to examine two categories (e.g., VMC or IMC) against two other categories (e.g., fatal accident or non-fatal accident). The test of homogeneity did not allow the same direct comparison of JHIMDAT data to JHSAT data as was possible with the goodness of fit test. However, a viable comparison was still possible in these cases according to the following method. The team first applied the test of homogeneity to identify whether a statistical difference existed within the JHSAT data, then applied the same test of homogeneity to the corresponding categories within the JHIMDAT data, and concluded by assessing if the results between the two data sets were similar or different. Also as part of the chi squared analysis (for both goodness of fit test and test of homogeneity), the team often used the standardized residual to determine what specific nominal data was a major contributor to driving the statistical difference. For example, if a statistical difference was found in the area of industry sectors, the standardized residual would identify the specific industry sectors most responsible for the statistical difference.

For each analysis scenario in this report, the JHIMDAT used the chi squared critical values associated with $p = .01$. The “p value” is associated with the probability of rejecting a null hypothesis that is actually true. The p values associated with measurements of statistical significance are typically .05 or less, so the JHIMDAT’s use of $p = .01$ was consistent with using a rigorous standard to assess statistical significance. In the case of the JHIMDAT and JHSAT data comparison, the null hypothesis in each case was that there was *not* a difference between the nominal data from the JHIMDAT as compared to the nominal data from the JHSAT. In order to reject the null hypothesis for any of the areas studied in this report, the calculated chi squared value had to exceed the chi squared critical value for $p = .01$. Any time the team found a statistical difference in the JHIMDAT and JHSAT data, use of $p = .01$ meant that there was a 1% (or less) probability that our conclusion was incorrect and a statistical difference between the data did not exist.

A goal of the JHIMDAT was to produce a report that was succinct and easily read so that results from the report could be quickly translated by the readers into implementation. We sought to avoid a cumbersome and overly detailed document that would never be read. Consistent with this approach, the team separated the comparative analysis into two volumes. The intent was to ensure Volume 1 emphasized the most important aspects of the comparative analysis. The team intentionally truncated most of the tables in Volume 1 such that only the most frequently cited areas in the analysis were listed. The data suggested these areas could have the most significant impact on future accident reduction efforts. Volume 2 of the comparative analysis has the complete data tables for the reader who would like to explore the analysis at an additional level of detail. Volume 2 also includes some data tables that were limited to a textual summary in Volume 1.

Industry

Industry described the type of work or operation where the helicopter is *typically* used. The team categorized each accident from both the JHSAT data and JHIMDAT data by Industry into one of fifteen possible options. Table 1 lists the Industry categories from the JHIMDAT data alongside the respective percentages from the JHSAT data. The Industry categories are listed in descending order of frequency based on the JHIMDAT column.

There were two separate chi squared analyses accomplished as related to Industry.

1) The team analyzed the aggregate group of JHIMDAT accidents as categorized by Industry against the aggregate group of JHSAT accidents categorized by Industry. The conclusion was the two data sets were statistically different. Major contributors to the statistical difference were the increase in the proportion of Aerial Application accidents and the decreases in the proportions of Firefighting, Logging, and Electronic News Gathering accidents.

2) The team conducted a separate, individual analysis of each specific Industry segment (1 degree of freedom). As shown in Table 1, statistically significant differences existed for the following industries: Aerial Application (increased), Firefighting (decreased), and Logging (decreased).

    a. The following is an example of how the team structured the individual chi squared analysis.

% of Accidents CY 00-01, 06	Industry	Accidents Observed CY 09-11	Accidents Expected CY 09-11	Chi Squared Value	Conclusion
18.5%	Personal/Private	86	77	0.256	>0.01, Not Significant
81.5%	All Other Industries	329	338		

    b. The team could not perform an individual chi squared analysis for the following two industry sectors: Utilities Patrol/Construction and Electronic News Gathering. In both of these cases, the “expected” number of events from the chi squared analysis was below 10. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than 10 “expected” events for cases of 1 degree of freedom.

Table 1. Industry Comparison

Industry	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
Personal/Private	20.7% (86)	18.5% (97)	
Instructional/Training	20.5% (85)	17.6% (92)	
Aerial Application	15.7% (65)	10.3% (54)	
Emergency Medical Services	8.0% (33)	7.6% (40)	
Commercial	7.5% (31)	7.5% (39)	
Law Enforcement	5.5% (23)	6.5% (34)	
Business	5.1% (21)	5.0% (26)	
Aerial Observation	4.1% (17)	4.0% (21)	
Air Tour / Sightseeing	3.6% (15)	5.9% (31)	
Offshore	2.9% (12)	4.2% (22)	
External Load	2.4% (10)	2.7% (14)	
Utilities Patrol / Construction	2.4% (10)	2.1% (11)	X
Firefighting	1.0% (4)	3.6% (19)	
Logging	0.5% (2)	2.7% (14)	
Electronic News Gathering	0.2% (1)	1.7% (9)	X

(red) Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

(green) Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

(white) Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Activity

Activity is different from Industry in that it described the specific function the helicopter was engaged in at the time the accident actually occurred. The team categorized each accident from both the JHSAT data and JHIMDAT data by Activity into one of twenty-seven possible options. Table 2 lists the Activity categories from the JHIMDAT data alongside the respective percentages from the JHSAT data. The Activity categories are listed in descending order of frequency based on the JHIMDAT column.

There were two separate chi squared analyses accomplished as related to Activity.

1) The team analyzed the aggregate group of JHIMDAT accidents as categorized by Activity against the aggregate group of JHSAT accidents categorized by Activity. The conclusion was the two data sets were statistically different. Among some of the major contributors to the statistical difference was the increase in the proportion of accidents in the following Activities: Instructional/Training (Dual), Personal/Private, and Instructional/Training (Solo).

    a. A limitation existed in comparing the aggregate groups. For cases where degrees of freedom are greater than 1, best practice from statistical reference sources suggested that no more than 20% of the overall data set should have "expected" number of events less than five. Nine out of twenty-seven (33%) of the Activity category choices had "expected" numbers of events less than five in the chi squared analysis. To correct for exceeding the recommended 20%, the team considered two different approaches.

        i. In the first approach, the team consolidated the nine Activity categories with "expected" number of events below five events into a single "low event" Activity category for purposes of the aggregate chi squared analysis. After organizing the data in this manner and conducting the statistical analysis, the team observed the two data sets were statistically different.

        ii. In considering a second approach, the team observed that the nine categories with "expected" number of events less than five accounted for less than 10% of the accidents in either the JHSAT data or the JHIMDAT data. For purposes of the chi squared analysis, the team excluded the nine categories and compared only the remaining eighteen categories with "expected" number of events greater than five. After organizing the data in this manner and conducting the statistical analysis, the conclusion was consistent with the first approach in finding the two data sets were statistically different.

2) The team conducted a separate, individual analysis of each specific Activity comparing the JHIMDAT data to the JHSAT data. The results are in Table 2.

a. The following is an example of how the team structured the individual chi squared analysis.

% of Accidents CY 00-01, 06	Industry	Accidents Observed CY 09-11	Accidents Expected CY 09-11	Chi Squared Value	Conclusion
14.0%	Instructional/Training (Dual)	80	58	0.002	<0.01, Significant
86.0%	All Other Activities	335	357		

b. The team could not perform an individual chi squared analysis for thirteen of the twenty-seven Activity categories. In each of the thirteen cases, the "expected" number of events from the chi squared analysis was below ten. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than ten "expected" events for cases of 1 degree of freedom.

Table 2. Activity Comparison

Activity	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
Instructional / Training (Dual)	19.3% (80)	14.0% (73)	
Personal/Private	17.8% (74)	12.4% (65)	
Positioning/RTB	13.7% (57)	13.2% (69)	
Aerial Application - Spraying/Disbursing	8.9% (37)	8.0% (42)	
Instructional / Training (Solo)	5.3% (22)	3.3% (17)	
Passenger/Cargo (Commercial)	5.1% (21)	6.1% (32)	
External Load - Line	3.6% (15)	6.7% (35)	
Aerial Application - Other	2.9% (12)	1.0% (5)	X
Maintenance/Test flight	2.7% (11)	2.5% (13)	
Passenger/Cargo (Non-Commercial)	2.2% (9)	3.6% (19)	
Aerial Observation - Photography / Filming	2.2% (9)	3.3% (17)	
Aerial Observation - Fish/Game Spotting	2.2% (9)	1.5% (8)	X
Animal Control/Hunting	1.9% (8)	1.7% (9)	X
Emergency Medical Services	1.9% (8)	1.1% (6)	X
Air Tour	1.7% (7)	2.9% (15)	
Aerial Observation - Other	1.7% (7)	0.2% (1)	X
Instructional / Training (Evaluation)	1.2% (5)	1.5% (8)	X
External Load - Other	1.2% (5)	1.0% (5)	X
Ferry	1.0% (4)	4.0% (21)	
Instructional/Training	0.7% (3)	4.0% (21)	
Aerial Observation - Law Enforcement	0.7% (3)	2.5% (13)	
Sightseeing	0.7% (3)	2.1% (11)	X
Utilities Patrol	0.7% (3)	1.0% (5)	X
SAR	0.7% (3)	0.4% (2)	X
Aerial Observation - Property	0.0% (0)	1.0% (5)	X
Electronic News Gathering	0.0% (0)	1.0% (5)	X
Aerial Observation - Traffic	0.0% (0)	0.2% (1)	X

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Industry and Activity Pairs

The combination of the Industry category for each accident and the Activity category for each accident can be paired together to refine the understanding of the accidents that happened. This pairing resulted in ninety-seven Industry and Activity combinations that were used in the JHIMDAT and JHSAT analysis. Table 3 lists the Industry and Activity pairs from the JHIMDAT data alongside the respective percentages from the JHSAT data. The Industry and Activity pairs are listed in descending order of frequency based on the JHIMDAT column.

The team accomplished two separate chi squared analyses as related to Industry and Activity pairs.

1) We analyzed the aggregate group of JHIMDAT accidents as categorized by Industry and Activity pairs against the aggregate group of JHSAT accidents categorized by Industry and Activity pairs. The conclusion was the two data sets were statistically different. Among some of the major contributors to the statistical difference was the increase in the proportion of accidents in the following Industry and Activity pairs: Personal/Private – Personal/Private, Instructional/Training - Instructional/Training (Solo), and Aerial Application – Positioning/RTB.

    a. A limitation existed in comparing the aggregate groups. For cases where degrees of freedom are greater than 1, best practice from statistical reference sources suggested that no more than 20% of the overall data set should have "expected" number of events less than five. Seventy-four out of ninety-seven (76%) of the Industry and Activity pairs had "expected" numbers of events less than five in the chi squared analysis. To correct for exceeding the recommended 20%, the team considered two different approaches.

        i. In the first approach, the team consolidated the seventy-four Industry and Activity pairs with "expected" number of events below five events into a single "low event" Industry and Activity pair for purposes of the aggregate chi squared analysis. After organizing the data in this manner and conducting the statistical analysis, the team observed the two data sets were statistically different.

        ii. In considering a second approach, the team observed that the seventy-four categories with "expected" number of events less than five accounted for about 24% of the accidents in the JHSAT data and about 26% in the JHIMDAT data. For purposes of the chi squared analysis, the team excluded the seventy-four categories and compared only the remaining twenty-three categories with "expected" number of events greater than 5. After organizing the data in this manner and conducting the statistical analysis, the conclusion was consistent with the first approach in finding the two data sets were statistically different.

2) The team attempted a separate, individual analysis to compare the data sets for each of the ninety-seven Industry and Activity pairs. However, an accurate individual analysis was only possible for ten of the ninety-seven pairs. For the remaining eighty-seven pairs, the "expected" number of events from the chi squared analysis was below ten. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there is less than ten "expected" events for cases of 1 degree of freedom.

Table 3. Industry and Activity Pairs Comparison

Industry	Activity	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
Personal/Private	Personal/Private	17.8% (74)	12.0% (63)	
Instructional/Training	Instructional/Training (Dual)	15.2% (63)	13.6% (71)	
Aerial Application	Aerial Application - Spraying/Disbursing	8.9% (37)	8.0% (42)	
Instructional/Training	Instructional / Training (Solo)	4.3% (18)	2.7% (14)	
Emergency Medical Services	Positioning/RTB	4.1% (17)	5.5% (29)	
Aerial Application	Positioning/RTB	3.4% (14)	1.1% (6)	X
Commercial	Passenger/Cargo (Commercial)	2.7% (11)	3.3% (17)	
Law Enforcement	Instructional/Training (Dual)	2.7% (11)	0.4% (2)	X
External Load	External Load - Line	2.4% (10)	2.5% (13)	
Aerial Application	Aerial Application - Other	2.4% (10)	1.0% (5)	X
Offshore	Passenger/Cargo (Commercial)	2.2% (9)	2.1% (11)	X
Emergency Medical Services	Emergency Medical Services	1.9% (8)	1.1% (6)	X
Aerial Observation	Aerial Observation - Fish/Game Spotting	1.9% (8)	1.0% (5)	X
Air Tour / Sightseeing	Air Tour	1.7% (7)	2.9% (15)	
Business	Positioning/RTB	1.7% (7)	0.6% (3)	X
Business	Passenger/Cargo (Non-Commercial)	1.4% (6)	1.9% (10)	X
Aerial Observation	Aerial Observation - Photography / Filming	1.2% (5)	1.9% (10)	X
Commercial	Positioning/RTB	1.2% (5)	1.3% (7)	X
Commercial	Animal Control/Hunting	1.0% (4)	1.3% (7)	X
Instructional/Training	Instructional/Training (Evaluation)	1.0% (4)	1.1% (6)	X
Law Enforcement	Positioning/RTB	1.0% (4)	0.6% (3)	X
Personal/Private	Instructional/Training (Solo)	1.0% (4)	0.6% (3)	X
Personal/Private	Maintenance/Test flight	1.0% (4)	0.6% (3)	X
Air Tour / Sightseeing	Positioning/RTB	1.0% (4)	0.4% (2)	X
Emergency Medical Services	Maintenance/Test flight	1.0% (4)	0.4% (2)	X
Aerial Observation	Aerial Observation - Other	1.0% (4)	0.2% (1)	X
Business	Animal Control/Hunting	1.0% (4)	0.2% (1)	X

Industry	Activity	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
Law Enforcement	Aerial Observation - Law Enforcement	0.7% (3)	2.3% (12)	
Air Tour / Sightseeing	Sightseeing	0.7% (3)	2.1% (11)	X
Offshore	Positioning/RTB	0.7% (3)	1.7% (9)	X
Business	Maintenance/Test flight	0.7% (3)	0.8% (4)	X
Utilities Patrol / Construction	External Load - Other	0.7% (3)	0.6% (3)	X
Commercial	Aerial Observation - Photography/Filming	0.7% (3)	0.2% (1)	X
Aerial Application	Aerial Observation - Other	0.7% (3)	0.0% (0)	X
Emergency Medical Services	Instructional/Training (Dual)	0.7% (3)	0.0% (0)	X
Logging	External Load - Line	0.5% (2)	2.5% (13)	
Personal/Private	Ferry	0.5% (2)	2.1% (11)	X
Utilities Patrol / Construction	Utilities Patrol	0.5% (2)	1.0% (5)	X
Firefighting	External Load - Other	0.5% (2)	0.4% (2)	X
Utilities Patrol / Construction	Positioning/RTB	0.5% (2)	0.2% (1)	X
Commercial	Aerial Application - Other	0.5% (2)	0.0% (0)	X
Utilities Patrol / Construction	External Load - Line	0.5% (2)	0.0% (0)	X
Law Enforcement	SAR	0.5% (2)	0.0% (0)	X
Commercial	Instructional/Training (Dual)	0.5% (2)	0.0% (0)	X
Law Enforcement	Instructional/Training	0.2% (1)	1.7% (9)	X
Personal/Private	Instructional/Training	0.2% (1)	1.0% (5)	X
Firefighting	Passenger/Cargo (Non-Commercial)	0.2% (1)	0.6% (3)	X
Electronic News Gathering	Positioning/RTB	0.2% (1)	0.6% (3)	X
Commercial	Instructional/Training	0.2% (1)	0.6% (3)	X
Law Enforcement	Passenger/Cargo (Non-Commercial)	0.2% (1)	0.4% (2)	X
Commercial	Ferry	0.2% (1)	0.4% (2)	X
Utilities Patrol / Construction	Passenger/Cargo (Commercial)	0.2% (1)	0.2% (1)	X
Business	Aerial Observation - Photography / Filming	0.2% (1)	0.2% (1)	X
Law Enforcement	Aerial Observation - Fish/Game Spotting	0.2% (1)	0.2% (1)	X
Firefighting	SAR	0.2% (1)	0.2% (1)	X
Commercial	External Load - Line	0.2% (1)	0.2% (1)	X
Emergency Medical Services	Passenger/Cargo (Non-Commercial)	0.2% (1)	0.2% (1)	X
Aerial Application	Ferry	0.2% (1)	0.0% (0)	X
Personal/Private	Instructional/Training (Dual)	0.2% (1)	0.0% (0)	X
Air Tour / Sightseeing	Instructional/Training (Evaluation)	0.2% (1)	0.0% (0)	X
Commercial	Utilities Patrol	0.2% (1)	0.0% (0)	X
Firefighting	External Load - Line	0.0% (0)	1.5% (8)	X
Electronic News Gathering	Electronic News Gathering	0.0% (0)	1.0% (5)	X
Personal/Private	Aerial Observation - Photography/Filming	0.0% (0)	1.0% (5)	X
Business	Ferry	0.0% (0)	0.8% (4)	X

Industry	Activity	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
Offshore	Passenger/Cargo (Non-Commercial)	0.0% (0)	0.4% (2)	X
Emergency Medical Services	Instructional/Training	0.0% (0)	0.4% (2)	X
Personal/Private	Positioning/RTB	0.0% (0)	0.4% (2)	X
Law Enforcement	Ferry	0.0% (0)	0.4% (2)	X
Aerial Observation	Aerial Observation - Property	0.0% (0)	0.4% (2)	X
Personal/Private	Aerial Observation - Property	0.0% (0)	0.4% (2)	X
Firefighting	Positioning/RTB	0.0% (0)	0.4% (2)	X
Aerial Observation	Personal/Private	0.0% (0)	0.2% (1)	X
Air Tour / Sightseeing	Passenger/Cargo (Commercial)	0.0% (0)	0.2% (1)	X
Aerial Observation	Aerial Observation - Traffic	0.0% (0)	0.2% (1)	X
Aerial Observation	Positioning/RTB	0.0% (0)	0.2% (1)	X
Air Tour / Sightseeing	Maintenance/Test flight	0.0% (0)	0.2% (1)	X
Air Tour / Sightseeing	Instructional/Training	0.0% (0)	0.2% (1)	X
Business	Aerial Observation - Property	0.0% (0)	0.2% (1)	X
Business	Aerial Observation - Fish/Game Spotting	0.0% (0)	0.2% (1)	X
Utilities Patrol / Construction	Ferry	0.0% (0)	0.2% (1)	X
Logging	Passenger/Cargo (Non-Commercial)	0.0% (0)	0.2% (1)	X
Aerial Application	Instructional/Training	0.0% (0)	0.2% (1)	X
Personal/Private	Aerial Observation - Fish/Game Spotting	0.0% (0)	0.2% (1)	X
Personal/Private	Aerial Observation - Law Enforcement	0.0% (0)	0.2% (1)	X
Instructional/Training	Personal/Private	0.0% (0)	0.2% (1)	X
Personal/Private	Animal Control/Hunting	0.0% (0)	0.2% (1)	X
Firefighting	Passenger/Cargo (Commercial)	0.0% (0)	0.2% (1)	X
Firefighting	Maintenance/Test flight	0.0% (0)	0.2% (1)	X
Law Enforcement	Instructional/Training (Evaluation)	0.0% (0)	0.2% (1)	X
Law Enforcement	Maintenance/Test flight	0.0% (0)	0.2% (1)	X
Law Enforcement	Passenger/Cargo (Commercial)	0.0% (0)	0.2% (1)	X
External Load	Positioning/RTB	0.0% (0)	0.2% (1)	X
Commercial	Instructional/Training (Evaluation)	0.0% (0)	0.2% (1)	X
Electronic News Gathering	Maintenance/Test flight	0.0% (0)	0.2% (1)	X
Business	SAR	0.0% (0)	0.2% (1)	X
Firefighting	Ferry	0.0% (0)	0.2% (1)	X

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Occurrence Category

Occurrence Categories provided a concise description of "what happened" in an accident. Table 4 lists the Occurrence Categories from the JHIMDAT data alongside the respective percentages from JHSAT data. The table lists eighteen Occurrence Categories in descending order of frequency based on the JHIMDAT column.

A chi squared analysis that compared the aggregate group of JHIMDAT to JHSAT accidents by Occurrence Categories was not possible using the same format as the Industry and Activity data. This is because each accident was not limited to assignment in a single Occurrence Category. Both the JHSAT and JHIMDAT methodology allowed each individual accident to be coded with up to four different Occurrence Categories. This aspect of the methodology explains why the percentages of Occurrence Categories from each data set should not be summed with the expectation of the result totaling 100%. Multiple Occurrence Categories per accident ensured the summed total will far exceed 100%.

However, the team did attempt a separate, individual analysis to compare the data sets for each of the eighteen Occurrence Categories. This was possible by grouping all accidents where an Occurrence Category had been used at least once into one set of data (e.g., all Loss of Control accidents), while grouping all accidents where that same Occurrence Category was never used into another set of data (e.g., all accidents where Loss of Control was not cited). As shown in Table 4, Loss of Control and Controlled Flight Into Terrain (CFIT) showed statistically significant increases while Systems Component Failure (SCF), Landing Zone (LZ), and External Load (EXTL) showed statistically significant decreases.

An accurate individual analysis was only possible for fourteen of the eighteen Occurrence Categories. For the remaining four categories, the "expected" number of events from the chi squared analysis was below ten. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than ten "expected" events for cases of 1 degree of freedom.

The team decided further explanation was needed for the Abnormal Runway Contact (ARC) Occurrence Category shown in Table 4. Although (ARC) had sufficient "expected" events for an accurate chi squared analysis, the JHIMDAT excluded it along with the four previously mentioned categories. The decision may appear puzzling in that the team assigned ARC to 24.6% of the accidents in the JHIMDAT data as compared to 7.6% of the accidents in the JHSAT data. It would appear the Occurrence Category is a clear candidate for assessing whether a significant statistical difference existed. However, the JHIMDAT excluded this category because we attributed the relatively large difference in proportions to a different understanding and assignment of the ARC category in the JHIMDAT analysis as opposed to how it was previously used in the JHSAT analysis. The JHIMDAT did not think there was an actual increase in the cases of ARC; rather, there was a different application of the Occurrence Category by the JHIMDAT. This led to inconsistency in how it was assigned in the JHIMDAT data when compared to the earlier JHSAT work.

Table 4. Occurrence Category Comparison

Occurrence Category	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
LOC - Loss of Control	47.5% (197)	41.5% (217)	
AUTO - Autorotation	32.8% (136)	31.7% (166)	
ARC - Abnormal Runway Contact	24.6% (102)	7.6% (40)	X
SCF - System Component Failure	21.4% (89)	27.5% (144)	
STRIKE	19.8% (82)	16.4% (86)	
FUEL	8.2% (34)	7.6% (40)	
VIS - Visibility	8.0% (33)	10.7% (56)	
FIRE	7.0% (29)	6.1% (32)	
CFIT - Controlled Flight into Terrain	6.7% (28)	3.1% (16)	
ADRM - Airport	3.9% (16)	2.3% (12)	X
RAMP	3.9% (16)	1.3% (7)	X
AMAN - Abrupt Manuever	3.6% (15)	4.0% (21)	
LZ - Landing Zone	3.1% (13)	7.5% (39)	
UNK - Unknown/Other	3.1% (13)	6.5% (34)	
DITCH - Ditching	2.7% (11)	2.3% (12)	X
WSTRW - Windshear/Thunderstorm	2.7% (11)	0.4% (2)	
EXTL - External Load	1.4% (6)	4.8% (25)	
ICE - Icing	0.2% (1)	1.3% (7)	X

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Fatal and Non-Fatal Accident Proportions by Occurrence Category

Tables 5 through 12 compare the proportion of fatal and non-fatal accidents between the JHIMDAT and JHSAT data for a selected list of Occurrence Categories. The team selected the eight most frequently cited Occurrence Categories from the JHIMDAT data (see Table 4). For reasons noted earlier in the report, the team did not include Abnormal Runway Contact as one of the eight selected Occurrence Categories. For each selected occurrence category, the JHIMDAT used a chi squared analysis to determine whether there was a statistical difference between the number of fatal and non-fatal accidents in the JHIMDAT data as compared to the number of fatal and non-fatal accidents in the JHSAT data.

An accurate chi squared analysis was not possible for two of the selected Occurrence Categories: Autorotation and Fuel. In these two cases, the "expected" number of events from the chi squared analysis was below ten. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than ten "expected" events for cases of 1 degree of freedom.

For each of the six occurrence categories where a reliable chi squared analysis was possible, there was not a statistical difference between the JHIMDAT data and the JHSAT data.

Table 5. Fatal/Non-Fatal Loss of Control (LOC)

Injury Outcome	JHIMDAT (CY09-11): 197 LOC Accidents	JHSAT (CY00-01, 06): 217 LOC Accidents
Non-Fatal	88.8% (175)	87.1% (189)
Fatal	11.2% (22)	12.9% (28)

Table 6. Fatal/Non-Fatal Autorotation (AUTO)

Injury Outcome	JHIMDAT (CY09-11): 136 AUTO Accidents	JHSAT (CY00-01, 06): 166 AUTO Accidents
Non-Fatal	95.6% (130)	94.6% (157)
Fatal	4.4% (6)	5.4% (9)

Table 7. Fatal/Non-Fatal System Component Failure (SCF)

Injury Outcome	JHIMDAT (CY09-11): 89 SCF Accidents	JHSAT (CY00-01, 06): 144 SCF Accidents
Non-Fatal	93.3% (83)	88.2% (127)
Fatal	6.7% (6)	11.8% (17)

Table 8. Fatal/Non-Fatal Strike

Injury Outcome	JHIMDAT (CY09-11): 82 Strike Accidents	JHSAT (CY00-01, 06): 86 Strike Accidents
Non-Fatal	82.9% (68)	76.7% (66)
Fatal	17.1% (14)	23.3% (20)

Table 9. Fatal/Non-Fatal Fuel Issue

Injury Outcome	JHIMDAT (CY09-11): 34 Fuel Accidents	JHSAT (CY00-01, 06): 40 Fuel Accidents
Non-Fatal	85.3% (29)	90.0% (36)
Fatal	14.7% (5)	10.0% (4)

Table 10. Fatal/Non-Fatal Visibility (VIS) Issue

Injury Outcome	JHIMDAT (CY09-11): 33 VIS Accidents	JHSAT (CY00-01, 06): 56 VIS Accidents
Non-Fatal	45.5% (15)	60.7% (34)
Fatal	54.5% (18)	39.3% (22)

Table 11. Fatal/Non-Fatal Fire

Injury Outcome	JHIMDAT (CY09-11): 29 Fire Accidents	JHSAT (CY00-01, 06): 32 Fire Accidents
Non-Fatal	41.4% (12)	37.5% (12)
Fatal	58.6% (17)	62.5% (20)

Table 12. Fatal/Non-Fatal Controlled Flight Into Terrain (CFIT)

Injury Outcome	JHIMDAT (CY09-11): 28 CFIT Accidents	JHSAT (CY00-01, 06): 16 CFIT Accidents
Non-Fatal	42.9% (12)	56.3% (9)
Fatal	57.1% (16)	43.8% (7)

Occurrence Category's Influence on Fatal & Non-Fatal Accidents

The JHIMDAT analyzed whether the presence or absence of a selected Occurrence Category resulted in any statistical difference regarding the proportion of fatal and non-fatal accidents.

The team used the same eight Occurrence Categories shown in Tables 5 through 12. However, the chi squared analysis was different from previous sections in that it consisted of two dimensions. The Occurrence Category (either present or absent) was one dimension and the injury outcome (either fatal or non-fatal) was the second dimension. Because of the two dimensions, the team used a chi squared test of homogeneity (rather than a chi squared goodness of fit) for the comparison.

The test of homogeneity had to be conducted independently on each data set, meaning that the JHIMDAT data and JHSAT data were not compared to each other within the same test. However, once the test was separately completed on each respective data set, the team could then determine if the results of the test of homogeneity had changed from the JHSAT data to the JHIMDAT data.

To initiate the analysis, the JHIMDAT first categorized each accident in the JHSAT data into two groups. The first group was all accidents where the Occurrence Category under study was present, while the second group was all accidents where it was not. After this initial grouping, the team further divided the JHSAT data into fatal accidents and non-fatal accidents. Once the team completed this division of data for each of the Occurrence Categories under study in the JHSAT data, we also used the same method of categorization for the JHIMDAT data.

For all but one Occurrence Category, the statistical conclusion reached from the chi squared test of homogeneity was the same when results from the JHIMDAT data were compared to results from the JHSAT data. The proportions of fatal and non-fatal accidents for each Occurrence Category studied from the JHIMDAT and JHSAT data are shown in Tables 13 through 20.

The one Occurrence Category where the team noted different results between the JHIMDAT data and the JHSAT data was System Component Failure (SCF). For the JHIMDAT data, the team noted a statistically significant difference between SCF and No SCF accidents regarding the proportion of fatal and non-fatal accidents. This statistical difference was not evident in the JHSAT data. To be clear, in the JHSAT data the same *trends* were noted in the SCF proportions of fatal and non-fatal accidents as were evident in the JHIMDAT data; however, in the JHSAT data the differences did not rise to a level that constituted *statistical significance* using p=.01.

Table 13. Loss of Control (LOC) Occurred Compared to No LOC Occurred

JHIMDAT (CY09-11) Data*	Not Fatal	Fatal
LOC Occurred	**88.8%** (175/197)	**11.2%** (22/197)
No LOC Occurred	**79.8%** (174/218)	**20.2%** (44/218)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
LOC Occurred	**87.1%** (189/217)	**12.9%** (28/217)
No LOC Occurred	**81.0%** (248/306)	**19.0%** (58/306)

Conclusion: There was no statistical difference between LOC and non-LOC accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

***Note:** For the JHIMDAT data, the conclusion that there was a lack of statistical difference was based on a calculated p value (0.012) that was greater than the p value used as the standard for determining statistical significance throughout this report (0.01). As evident, however, the difference between the two p values was relatively small (.002). The team thought it worth sharing this observation and noting that had a larger (but still acceptable) p value (such as 0.02 or 0.05) been used, there would be a statistical difference between the LOC and non-LOC accidents regarding the proportion of fatal and non-fatal accidents in the JHIMDAT data.

Table 14. Autorotation (AUTO) Occurred Compared to No AUTO Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
AUTO Occurred	**95.6%** (130/136)	**4.4%** (6/136)
No AUTO Occurred	**78.5%** (219/279)	**21.5%** (60/279)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
AUTO Occurred	**94.6%** (157/166)	**5.4%** (9/166)
No AUTO Occurred	**78.4%** (280/357)	**21.6%** (77/357)

Conclusion: There was a statistical difference between AUTO and non-AUTO accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

Major statistical contributor(s) to difference: **1)** Accidents where an AUTO occurred had fewer fatal outcomes than statistically expected. **2)** Accidents where no AUTO occurred had more fatal outcomes than statistically expected.

Table 15. System Component Failure (SCF) Occurred Compared to No SCF Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
SCF Occurred	**93.3%** (83/89)	**6.7%** (6/89)
No SCF Occurred	**81.6%** (266/326)	**18.4%** (60/326)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
SCF Occurred	**88.2%** (127/144)	**11.8%** (17/144)
No SCF Occurred	**81.8%** (310/379)	**18.2%** (69/379)

Conclusion: There was a statistical difference between SCF and non-SCF accidents regarding the proportion of fatal and non-fatal accidents (applies only to JHIMDAT data as no statistical difference was found in JHSAT data).

Major statistical contributor(s) to difference: Accidents where a SCF occurred had fewer fatal outcomes than statistically expected (applies only to JHIMDAT data).

Table 16. Strike Occurred Compared to No Strike Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
Strike Occurred	**82.9%** (68/82)	**17.1%** (14/82)
No Strike Occurred	**84.4%** (281/333)	**15.6%** (52/333)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
Strike Occurred	**76.7%** (66/86)	**23.3%** (20/86)
No Strike Occurred	**84.9%** (371/437)	**15.1%** (66/437)

Conclusion: There was no statistical difference between Strike and non-Strike accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

Table 17. Fuel Issue Occurred Compared to No Fuel Issue Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
Fuel Issue Occurred	**85.3%** (29/34)	**14.7%** (5/34)
No Fuel Issue Occurred	**84.0%** (320/381)	**16.0%** (61/381)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
Fuel Issue Occurred	**90.0%** (36/40)	**10.0%** (4/40)
No Fuel Issue Occurred	**83.0%** (401/483)	**17.0%** (82/483)

Conclusion: There was no statistical difference between Fuel issue and non-Fuel issue accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

Table 18. Visibility (VIS) Issue Occurred Compared to No VIS Issue Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
VIS Issue Occurred	**45.5%** (15/33)	**54.5%** (18/33)
No VIS Issue Occurred	**87.4%** (334/382)	**12.6%** (48/382)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
VIS Issue Occurred	**60.7%** (34/56)	**39.3%** (22/56)
No VIS Issue Occurred	**88.9%** (415/467)	**11.1%** (52/467)

Conclusion: There was a statistical difference between VIS Issue and non-VIS Issue accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

Major statistical contributor(s) to difference: Accidents where a VIS Issue occurred had more fatal outcomes and fewer non-fatal outcomes than statistically expected (JHIMDAT data and JHSAT data). Accidents where a VIS Issue occurred had fewer non-fatal outcomes than statistically expected (JHIMDAT data only).

Table 19. Fire Occurred Compared to No Fire Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
Fire Occurred	**41.4%** (12/29)	**58.6%** (17/29)
No Fire Occurred	**87.3%** (337/386)	**12.7%** (49/386)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
Fire Occurred	**37.5%** (12/32)	**62.5%** (20/32)
No Fire Occurred	**86.6%** (425/491)	**13.4%** (66/491)

Conclusion: There was a statistical difference between Fire and non-Fire accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

Major statistical contributor(s) to difference: Accidents where a Fire occurred had more fatal outcomes and fewer non-fatal outcomes than statistically expected (JHIMDAT data and JHSAT data).

Table 20. CFIT Occurred Compared to No CFIT Occurred

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
CFIT Occurred	**42.9%** (12/28)	**57.1%** (16/28)
No CFIT Occurred	**87.1%** (337/387)	**12.9%** (50/387)
[redacted]		
JHSAT (CY00-01, 06) Data	**Not Fatal**	**Fatal**
CFIT Occurred	**56.3%** (9/16)	**43.8%** (7/16)
No CFIT Occurred	**84.4%** (428/507)	**15.6%** (79/507)

Conclusion: There was a statistical difference between CFIT and non-CFIT accidents regarding the proportion of fatal and non-fatal accidents (applies to independent analysis of both JHIMDAT data and JHSAT data).

Major statistical contributor(s) to difference: Accidents where CFIT occurred had more fatal outcomes than statistically expected (JHIMDAT data and JHSAT data). Accidents where CFIT occurred had less non-fatal accidents than statistically expected (JHIMDAT data only).

Sub-Occurrence Category

The Sub-Occurrence Category served the purpose of providing a more detailed description within each Occurrence Category. Table 21 lists the 50 Occurrence Category/Sub-Occurrence Category pairs from the JHIMDAT data alongside the respective percentages from JHSAT data. The table lists the pairs in descending order of frequency based on the JHIMDAT column.

For the same reasons noted in the Occurrence Category portion of the report, a chi squared analysis that compared the aggregate group of JHIMDAT to JHSAT accidents by Occurrence Category/Sub-Occurrence pairs was not possible.

However, the team did attempt a separate, individual analysis to compare the data sets for each of the 50 Occurrence Category/Sub-Occurrence Category pairs. This was possible by grouping all accidents where a pairing had been used at least once into one set of data (e.g., all Loss of Control – Performance Management), while grouping all accidents where that same pairing was never used into another set of data (e.g., all accidents where Loss of Control – Performance Management was not cited). The results are shown in Table 21.

An accurate individual analysis was only possible for 23 of the 50 Occurrence Category/Sub-Occurrence Category pairs. For the remaining 27 pairs, the "expected" number of events from the chi squared analysis was below ten. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than ten "expected" events for cases of 1 degree of freedom.

There were statistical differences found between the JHIMDAT and JHSAT data for the nine pairs:

Accidents Increased:
1) Loss of Control – Performance Management
2) Strike - Low Altitude Mission
3) Strike - Takeoff and Landing
4) CFIT - CFIT

Accidents Decreased:
1) System Component Failure – Helicopter
2) Landing Zone – Unprepared
3) Strike – Object Strike
4) Unknown/Other – Regulatory
5) External Load – External Load

There were not statistical differences found for the other 14 pairs where a chi squared analysis was possible. For these cases, any differences between the JHIMDAT data and the JHSAT data were attributed to random fluctuations.

As also noted in the Occurrence Category section of the report, the team did not analyze the Occurrence Category/Sub-Occurrence Category pair of Abnormal Runway Contact (ARC) for a statistical difference. The explanation is the same as previously noted. The team did not think there was an actual increase in the cases of ARC; rather, there was a different application of the Occurrence Category by the JHIMDAT and this led to inconsistency in how it was assigned by the JHIMDAT when compared to the earlier JHSAT work.

Table 21. Sub-Occurrence Category Comparison

Occurrence Category / Sub-Occurrence Category	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents	
Abnormal Rwy Contact - Abnormal Rwy Contact	24.6% (102)	7.6% (40)	X
Autorotation - Emergency	22.9% (95)	21.8% (114)	
Loss of Control - Performance Management	21.7% (90)	15.1% (79)	
Autorotation - Practice	11.8% (49)	10.9% (57)	
Strike - Low Altitude Mission	8.7% (36)	5.5% (29)	
Strike - Takeoff or Landing	8.7% (36)	4.0% (21)	
Loss of Control - Dynamic Rollover	8.4% (35)	5.9% (31)	
System Component Failure - Engine	8.0% (33)	10.1% (53)	
System Component Failure - Helicopter	7.5% (31)	14.3% (75)	
CFIT - CFIT	6.7% (28)	3.1% (16)	
Fire - Post Impact	6.0% (25)	5.2% (27)	
System Component Failure - Unconfirmed/Perceived	5.8% (24)	2.5% (13)	X
Loss of Control - Exceeding Operating Limits	4.3% (18)	5.2% (27)	
Ramp - Ramp	3.9% (16)	1.3% (7)	X
Visibility - Inadvertent IMC	3.6% (15)	5.0% (26)	
Abrupt Maneuver - Abrupt Maneuver	3.6% (15)	4.0% (21)	
Fuel - Exhaustion	3.4% (14)	3.4% (18)	
Loss of Control - Unknown	3.4% (14)	2.9% (15)	
Loss of Control - Interference with Controls	3.1% (13)	3.3% (17)	
Loss of Control - Loss of T/R Authority	2.9% (12)	4.4% (23)	
Fuel - Starvation	2.9% (12)	2.1% (11)	X
Landing Zone - Unprepared	2.7% (11)	6.9% (36)	
Loss of Control - Emergency Procedures	2.7% (11)	4.4% (23)	
Ditching - Ditching	2.7% (11)	2.3% (12)	X
Strike - Object Strike	2.4% (10)	7.3% (38)	
Loss of Control - Settling w/power	2.2% (9)	0.6% (3)	X
Visibility - Night/Darkness	1.9% (8)	4.2% (22)	
Unknown/Other - Other	1.7% (7)	0.8% (4)	X
Windshear/Thunderstorm - Windshear	1.7% (7)	0.2% (1)	X
Unknown/Other - Regulatory	1.4% (6)	5.7% (30)	
External Load - External Load	1.4% (6)	4.8% (25)	
Airport - Mobile Helipad	1.4% (6)	1.1% (6)	X
Fuel - Carb Ice	1.4% (6)	1.1% (6)	X
Visibility - Sun/Glare	1.4% (6)	0.4% (2)	X
Airport - Platform	1.4% (6)	0.2% (1)	X
Loss of Control - Unattended Aircraft	1.2% (5)	0.0% (0)	X
Fire - Non Impact	1.0% (4)	1.0% (5)	X

Table 21. Sub-Occurrence Category Comparison (continued)

Windshear/Thunderstorm - Thunderstorm	1.0% (4)	0.2% (1)	X
Loss of Control - Ground Resonance	0.7% (3)	1.0% (5)	X
Loss of Control - Tie-downs/hoses	0.7% (3)	0.8% (4)	X
Visibility - White-out/Brown-out	0.5% (2)	1.5% (8)	X
Visibility - Flat Light	0.5% (2)	1.3% (7)	X
Fuel - Contamination	0.5% (2)	1.0% (5)	X
System Component Failure - Mission Equipment	0.5% (2)	1.0% (5)	X
Airport - Heliport/Airport	0.5% (2)	0.6% (3)	X
Landing Zone - Prepared	0.5% (2)	0.6% (3)	X
Airport - Fixed Helipad	0.5% (2)	0.4% (2)	X
Icing - Icing	0.2% (1)	1.3% (7)	X
Visibility - Fog/Glare	0.2% (1)	1.1% (6)	X
Visibility - Glassy Water	0.0% (0)	0.2% (1)	X

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Joint Aircraft System/Component (JASC) Codes

The original JHSAT data delineated System Component Failure (SCF) accidents into one of four categories: 1) Engine, 2) Helicopter, 3) Mission Equipment, or 4) Unconfirmed/Perceived. The JHIMDAT sought to expand on the specificity associated with SCF accident analysis through use of JASC codes. The team included a JASC Code analysis for the 89 SCF accidents from the JHIMDAT data (comprising 21.4% of the 415 total accidents) and then returned to the original JHSAT data and did likewise for the 144 SCF accidents (comprising 27.5% of the 523 total accidents). The team used thirty-nine different four digit JASC Codes in the JHIMDAT data and fifty-six different four digit JASC Codes in the JHSAT data.

Because of the many different JASC Codes used between the two data sets, the team had to consolidate them to allow for an accurate statistical comparison between the JHIMDAT and the JHSAT data. For this purpose, we sorted the variety of JASC Codes into three general categories. Table 22 lists the consolidated JASC Code categories from the JHIMDAT data alongside the respective percentages from the JHSAT data. The JASC Codes are listed in descending order of frequency based on the JHIMDAT column.

There were two separate chi squared analyses accomplished as related to JASC Code.

1) The team analyzed the aggregate group of JHIMDAT accidents as categorized by JASC Code against the aggregate group of JHSAT accidents categorized by JASC Code. The conclusion was the two data sets were not statistically different.

2) The team conducted a separate, individual analysis for each of the JASC Code categories in Table 22. Each of the consolidated categories was compared to all accidents where that consolidated category of JASC Codes was *not* used. As shown in Table 22, there was not a statistically significant difference between the JHSAT data and the JHIMDAT data for any of the three categories.

Table 22. Comparison of Consolidated JASC Codes

JASC Description	JHIMDAT (CY09-11): 89 SCF Accidents	JHSAT (CY00-01, 06): 144 SCF Accidents
Powerplant Systems (7000, 8000 series)	55.1% (49)	45.8% (66)
Rotor Systems (6000 series)	29.2% (26)	38.2% (55)
Airframe Systems (2000, 3000, 4000, 5000 series)	15.7% (14)	16.0% (23)

Denotes statistically significant increase in proportion of accidents from JHSAT data to JHIMDAT data

Denotes statistically significant decrease in proportion of accidents from JHSAT data to JHIMDAT data

Denotes no statistically significant change in proportion of accidents from JHSAT data to JHIMDAT data

Table 23 has a more detailed list of the JASC codes using the first two digits of the JASC code to group the data. The table is organized in descending order of frequency based on the JHIMDAT column. After organizing the data into two digit JASC codes, the team attempted an aggregate chi squared analysis but found an accurate statistical analysis was not possible. We found that 70% of the categories in the data set had "expected" events less than five. For cases where degrees of freedom are greater than 1, best practice from statistical reference sources suggested that no more than 20% of the overall data set should have "expected" number of events less than five. Likewise, an individual chi squared analysis was attempted for each individual two digit JASC category but also could not be performed accurately. The individual analysis found that only one of the twenty-three categories had greater than ten "expected" events. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than ten "expected" events for cases of 1 degree of freedom.

Despite the limitations noted, Table 23 can still be used to assess the frequency that various two digit JASC codes occur in relation to each other.

Table 23. JASC Codes by Major System Identifier (First 2 Digits)

JASC	Description	JHIMDAT: 89 SCF Accidents	JHSAT: 144 SCF Accidents
7200	Turbine/Turboprop Engine	24.7% (22)	18.1% (26)
8500	Reciprocating Engine	13.5% (12)	8.3% (12)
7300	Engine Fuel and Control	12.4% (11)	9.7% (14)
6300	Main Rotor Drive	10.1% (9)	9.7% (14)
6200	Main Rotor	7.9% (7)	4.2% (6)
6700	Rotors Flight Control	6.7% (6)	7.6% (11)
2800	Fuel	5.6% (5)	2.1% (3)
2900	Hydraulic Power	3.4% (3)	2.8% (4)
5300	Fuselage	3.4% (3)	2.8% (4)
6500	Tail Rotor Drive	3.4% (3)	9.7% (14)
3200	Landing Gear	2.2% (2)	0.7% (1)
7400	Ignition	2.2% (2)	0.7% (1)
2500	Equipment/Furnishings	1.1% (1)	4.2% (6)
6400	Tail Rotor	1.1% (1)	6.9% (10)
7100	Powerplant	1.1% (1)	4.9% (7)
7600	Engine Controls	1.1% (1)	1.4% (2)
2100	Air Conditioning	0.0% (0)	0.7% (1)
2400	Electrical Power	0.0% (0)	0.7% (1)
2700	Flight Controls	0.0% (0)	1.4% (2)
5200	Doors	0.0% (0)	0.7% (1)
7700	Engine Indicating	0.0% (0)	0.7% (1)
7900	Engine Oil	0.0% (0)	0.7% (1)
8100	Turbocharging	0.0% (0)	1.4% (2)

Initiator of System Component Failure (SCF)

The JHIMDAT observed that each System Component Failure (SCF) had an initiating event. The team designated this event as the Initiator of SCF and found that four major categories existed: Maintenance Error, Manufacturing Error, Pilot Error, or Unknown. Table 25 has the four categories organized in descending order of frequency based on the JHIMDAT column. Identical to the JASC Code analysis, note that the percentages shown in the table are based only on the subset of ***SCF*** accidents. This consisted of 89 accidents from the JHIMDAT data (21.4% of the 415 total accidents) and 144 accidents from the JHSAT data (27.5% of the 523 total accidents).

There were two separate chi squared analyses accomplished as related to the Initiator of SCF.

> 1) The team analyzed the aggregate group of JHIMDAT accidents categorized by the Initiator of SCF against the aggregate group of JHSAT accidents categorized by the Initiator of SCF. The conclusion was the two data sets were statistically different. Major contributors to the statistical difference were the increase in the proportion of accidents where the Initiator of SCF was Unknown and the decrease in the proportion of accidents where the Initiator of SCF was Manufacturing Error.
>
> 2) The team attempted a separate, individual analysis for each specific Initiator of SCF comparing the JHIMDAT data to the JHSAT data. The results are in Table 24. Of note, however, is that the team could not perform an individual chi squared analysis for the Pilot Error category. For this category, the "expected" number of events from the chi squared analysis was below 10. According to best practice from statistical reference sources, the chi squared analysis is not considered reliable if there are less than 10 "expected" events for cases of 1 degree of freedom.

The statistically significant increase in the Unknown category of the JHIMDAT data inhibited the ability to draw more meaningful conclusions from the analysis. The Unknown category effectively masks the true proportions of accidents in the more descriptive categories associated with Initiator of SCF. For example, note that the Initiator of SCFs attributable to Manufacturing Error showed a statistically significant decrease between data sets. However, it is possible the decrease was artificial. We did not know how many of the accidents within the Unknown category may have actually been attributable to Manufacturing Error if more investigative information had been available. So, Manufacturing Error may have shown a true statistically significant decrease, or the decrease may have been artificial if more Manufacturing Error cases were hidden in the Unknown category. This same condition could have affected the results of the Maintenance Error and Pilot Error categories.

Table 24. Initiator of System Component Failures (SCFs)

Iniator of SCF	JHIMDAT (CY09-11): 89 SCF Accidents	JHSAT (CY00-01, 06): 144 SCF Accidents	
Unknown	44.9% (40)	18.1% (26)	
Maintenance Error	40.4% (36)	50.7% (73)	
Manufacturing Error	7.9% (7)	21.5% (31)	
Pilot Error	6.7% (6)	9.8% (14)	X

Denotes statistically significant increase in proportion of accidents from JHSAT data to JHIMDAT data

Denotes statistically significant decrease in proportion of accidents from JHSAT data to JHIMDAT data

Denotes no statistically significant change in proportion of accidents from JHSAT data to JHIMDAT data

X Excluded from individual chi squared analysis

Type Engine Installed

The team grouped accidents from both the JHIMDAT data and the JHSAT data into one of three categories of installed engine or engines: turbine twin, turbine single, or reciprocating.

There were two separate chi squared analyses accomplished as related to the Initiator of SCF.

1) The team analyzed the aggregate group of JHIMDAT accidents categorized by the Type Engine Installed against the aggregate group of JHSAT accidents categorized by the Type Engine Installed. The conclusion was the two data sets were statistically different. Major contributors to the statistical difference were the increase in the proportion of accidents where rotorcraft had a reciprocating engine installed and the decrease in the proportion of accidents where rotorcraft had twin turbine engines installed.

2) The team conducted a separate, individual analysis for each category of Type Engine Installed comparing the JHIMDAT data to the JHSAT data. The results are in Table 25.

Table 25. Type Engine Installed Comparison

Engine Installation	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents
Turbine Twin	6.0% (25)	9.4% (49)
Turbine Single	43.4% (180)	48.2% (252)
Reciprocating	50.6% (210)	42.4% (222)

Denotes statistically significant increase in proportion of accidents from JHSAT data to JHIMDAT data

Denotes statistically significant decrease in proportion of accidents from JHSAT data to JHIMDAT data

Denotes no statistically significant change in proportion of accidents from JHSAT data to JHIMDAT data

X Excluded from individual chi squared analysis

Accidents by Month

The team grouped accidents from both data sets based on the month of occurrence.

There were two separate chi squared analyses accomplished as related to the accidents by month.

1) The team analyzed the aggregate group of JHIMDAT accidents categorized by the month of occurrence against the aggregate group of JHSAT accidents categorized by the month of occurrence. There was not a statistical difference between the two data sets.

2) The team conducted a separate, individual analysis for each month comparing the JHIMDAT data to the JHSAT data. The results are in Table 26.

The team also attempted a separate, individual analysis of accidents by month for each of the five most frequently cited Industry categories: 1) Personal/Private, 2) Instructional/Training, 3) Aerial Application, 4) EMS, and 5) Commercial. However, an accurate individual analysis was only possible for Instructional/Training. For the remaining four Industry categories mentioned, more than 20% of the months in each data set had an "expected" number of events less than five. For cases where degrees of freedom are greater than 1, best practice from statistical reference sources suggested that no more than 20% of the overall data set should have "expected" number of events less than five.

Instructional/Training showed a statistically significant difference from the JHSAT data to the JHIMDAT data. The major contributors to the statistical difference in Instructional/Training accidents by month were an increase in the proportion of accidents in October and a decrease in the proportion of accidents in December.

Table 26. Accidents by Month Comparison

Month	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents
January	5.3% (22)	6.5% (34)
February	6.0% (25)	7.3% (38)
March	9.2% (38)	8.6% (45)
April	5.3% (22)	8.2% (43)
May	9.6% (40)	12.2% (64)
June	9.9% (41)	9.0% (47)
July	14.9% (62)	10.5% (55)
August	8.9% (37)	10.1% (53)
September	11.1% (46)	8.6% (45)
October	8.2% (34)	6.7% (35)
November	6.7% (28)	6.3% (33)
December	4.8% (20)	5.9% (31)

Denotes statistically significant increase in proportion of accidents from JHSAT data to JHIMDAT data

Denotes statistically significant decrease in proportion of accidents from JHSAT data to JHIMDAT data

Denotes no statistically significant change in proportion of accidents from JHSAT data to JHIMDAT data

X Excluded from individual chi squared analysis

Weather Condition

The team grouped accidents from both the JHIMDAT and the JHSAT according to whether the accident occurred in Visual Meteorological Conditions (VMC) or Instrument Meteorological Conditions (IMC). There was not a statistically significant difference in the proportion of VMC and IMC accidents between the two data sets.

Table 27 lists the percentages of accidents categorized by weather conditions of VMC or IMC for both the JHIMDAT and JHSAT analyses.

Table 27. Weather Comparison

Weather	JHIMDAT (CY09-11): 415 Accidents	JHSAT (CY00-01, 06): 523 Accidents
VMC	95.9% (398)	94.5% (494)
IMC	4.1% (17)	5.5% (29)

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Fatal and Non-Fatal Accident Counts by Weather Condition

Table 28 shows the frequency of fatal and non-fatal accidents for VMC Only accidents in the JHIMDAT data as compared to the frequency of fatal and non-fatal accidents for VMC Only accidents in the JHSAT data. Table 29 is similarly arranged, but provides analysis for IMC only accidents.

According to the chi squared analysis of VMC Only accidents, the proportion of fatal and non-fatal accidents in the JHIMDAT data was not statistically different from the JHSAT data. The same conclusion was true for IMC Only accidents.

Table 28. VMC Only Accidents

Injury Outcome	JHIMDAT (CY09-11): 398 VMC Accidents	JHSAT (CY00-01, 06): 494 Accidents
Non-Fatal	85.9% (342)	86.2% (426)
Fatal	14.1% (56)	13.8% (68)

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Table 29. IMC Only Accidents

Injury Outcome	JHIMDAT (CY09-11): 17 IMC Accidents	JHSAT (CY00-01, 06): 29 IMC Accidents
Non-Fatal	41.2% (7)	37.9% (11)
Fatal	58.8% (10)	62.1% (18)

Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

Weather Condition's Influence on Fatal & Non-Fatal Accidents

The JHIMDAT analyzed whether a difference in the weather conditions (either VMC or IMC) resulted in any statistical difference regarding the proportion of fatal and non-fatal accidents. This is different from the preceding section where the JHIMDAT separately analyzed the VMC Only accidents and the IMC Only accidents.

In this case, the chi squared analysis used the same two dimensional approach as the earlier section of the report titled "Occurrence Category as Related to Fatal & Non-Fatal Accidents". The weather condition (either VMC or IMC) was one dimension. The injury outcome (either fatal or non-fatal) was the second dimension. Because of the two dimensions, the team used a chi squared test of homogeneity (rather than a chi squared goodness of fit) for the comparison.

The test of homogeneity had to be conducted independently on each data set, meaning that the JHIMDAT data and JHSAT data were not compared to each other within the same test. However, once the test was separately completed on each respective data set, the JHIMDAT could then determine if the results of the test of homogeneity had changed from the JHSAT data to the JHIMDAT data.

To initiate the analysis, the JHIMDAT first categorized each accident in the JHSAT data into two groups. The first group was all accidents that occurred during VMC, while the second group was all accidents that occurred during IMC. After this initial grouping, the team further divided the JHSAT data into fatal accidents and non-fatal accidents. Once the team completed this division of data for each accident in the JHSAT data, we also used the same method of categorization for the JHIMDAT data.

The statistical conclusion reached from the chi squared test of homogeneity was the same when results from the JHIMDAT data were compared to results from the JHSAT data. There was a statistical difference between VMC and IMC accidents regarding the proportion of fatal and non-fatal accidents for each data set. The standardized residual identified the major statistical contributors to the difference were that IMC accidents had fewer non-fatal outcomes and more fatal outcomes than statistically expected. The proportions of fatal and non-fatal accidents from the JHIMDAT and JHSAT data are shown in Table 30.

Table 30. VMC and IMC Related to Injury Outcome

JHIMDAT (CY09-11) Data	Not Fatal	Fatal
VMC	**85.9%** (342/398)	**14.1%** (56/398)
IMC	**41.2%** (7/17)	**58.8%** (10/17)

JHSAT (CY00-01, 06) Data	Not Fatal	Fatal
VMC	**86.2%** (426/494)	**13.8%** (68/494)
IMC	**37.9%** (11/29)	**62.1%** (18/29)

Light Condition

The team grouped accidents from both data sets according to whether the accident occurred during the day or during the night. We categorized the following light conditions as "night" for purposes of the analysis: dawn, dusk, twilight, night bright, and night dark. Note that there was not light condition data available for one of the accidents in the JHSAT data and eight of the accidents in the JHIMDAT data. Absence of this data, however, did not affect the statistical outcome. There was not a statistically significant difference in the proportion of day and night accidents between the two data sets.

Table 31 lists the percentages of accidents categorized by light condition for both the JHIMDAT and JHSAT analyses.

Table 31. Light Condition Comparison

Weather	JHIMDAT (CY09-11): 407* Accidents	JHSAT (CY00-01, 06): 522* Accidents
Day	87.7% (357)	87.2% (455)
Night	12.3% (50)	12.8% (67)

■ Denotes statistically significant increase in proportion of accidents from JHSAT to JHIMDAT

■ Denotes statistically significant decrease in proportion of accidents from JHSAT to JHIMDAT

□ Denotes no statistically significant change in proportion of accidents from JHSAT to JHIMDAT

X Excluded from individual chi squared analysis

* Light condition not reported for 8 JHIMDAT accidents and 1 JHSAT accident

Accidents by Pilot's Flight Hours

The team analyzed accidents from the JHIMDAT data and the JHSAT data using two different types of pilot's flight hours: rotorcraft flight hours and make/model flight hours. A major limitation was associated with drawing conclusions related to the proportion of accidents as categorized by pilot's flight hours in a specific flight hour increment. The limitation was that the actual flight hours were unknown for the ***non-accident*** U.S. helicopter pilots.

Historical studies that pre-date IHST suggested the percentage of helicopter accidents associated with a specific increment of pilot's flight hours have a high positive correlation to the percentage of the total population of helicopter pilots (accident pilots and non-accident pilots) within each corresponding pilot's flight hour increment. If these past historical studies continue to be reliable, the following example illustrates the implications. It would be possible that if the percentage of accidents is twice as high for pilots with 0-500 hours rotorcraft hours as compared to pilots with 501-1,000 rotorcraft hours, the reason may be attributable to the total population of pilots with 0-500 rotorcraft hours being twice as large as the population of pilots with 501-1,000 rotorcraft hours. This conclusion is quite different than concluding lower flight hours alone (less flying experience) is the cause of why pilots with 0-500 rotorcraft hours have twice as many accidents as those in the 501-1,000 hour increment.

In the context of a comparative analysis such as this report, the same limitation applies. The underlying reason a specific pilot's flight hour increment may show a statistical difference in proportion of accidents between the JHIMDAT data and the JHSAT data may be because the flight hour increments for the total population of pilots may have changed. In summary, any conclusions related to an increase or decrease in the percentage of rotorcraft accidents associated with a specific pilot flight hour increment must include deliberation of the increases or decreases associated with the total population of pilots in that same flight hour increment.

Rotorcraft Flight Hours

The team analyzed the aggregate group of accidents from the JHIMDAT data by rotorcraft flight hour increments against the aggregate group of JHSAT data by rotorcraft flight hour increments. We used flight hour increments of 500 flight hours from 0 up to 7,500 flight hours (e.g. 0-500 hours, 501-1,000 hours, 1,001-1,500 hours, etc.).

There were accidents where the pilot had greater than 7,500 rotorcraft flight hours. However, the number of pilots per each 500 hour increment above 7,500 rotorcraft flight hours was low. When the team organized the data and included cases above 7,500 rotorcraft flight hours in the chi squared analysis, we found that most of the 500 hour increments above 7,500 rotorcraft hours had less than five expected events. For cases where degrees of freedom are greater than 1, best practice from statistical reference sources suggested that no more than 20% of the overall data set should have "expected" number of events less than five. If the 500 hour increments above 7,500 rotorcraft hours had been included, the data set would exceed the 20% threshold. In the interest of ensuring an accurate statistical analysis, the team elected to exclude accidents where the pilot had more than 7,500 hours.

According to the chi squared analysis, there was not a statistically significant difference between the two data sets when comparing accidents by rotorcraft flight hours for pilots with up to 7,500 rotorcraft hours. Of note, however, is that the difference would have been statistically significant at p values greater than or equal to .03 (remember p = .01 was used for statistical analysis throughout the Comparative Report). Large magnitude differences were evident for the increments of 0-500 hours and 501-1,000 hours (proportions of accidents increased for both cases) as well as the increments of 2,001-2,500 hours and 3,501-4,000 hours (proportion of accidents decreased in both cases).

For both the JHIMDAT and JHSAT data, Table 32 lists the percentages of accidents categorized by rotorcraft flight hours for cases where the pilot had up to 7,500 hours. Note that percentages in the table are based only on the number of pilots with up to 7,500 hours.

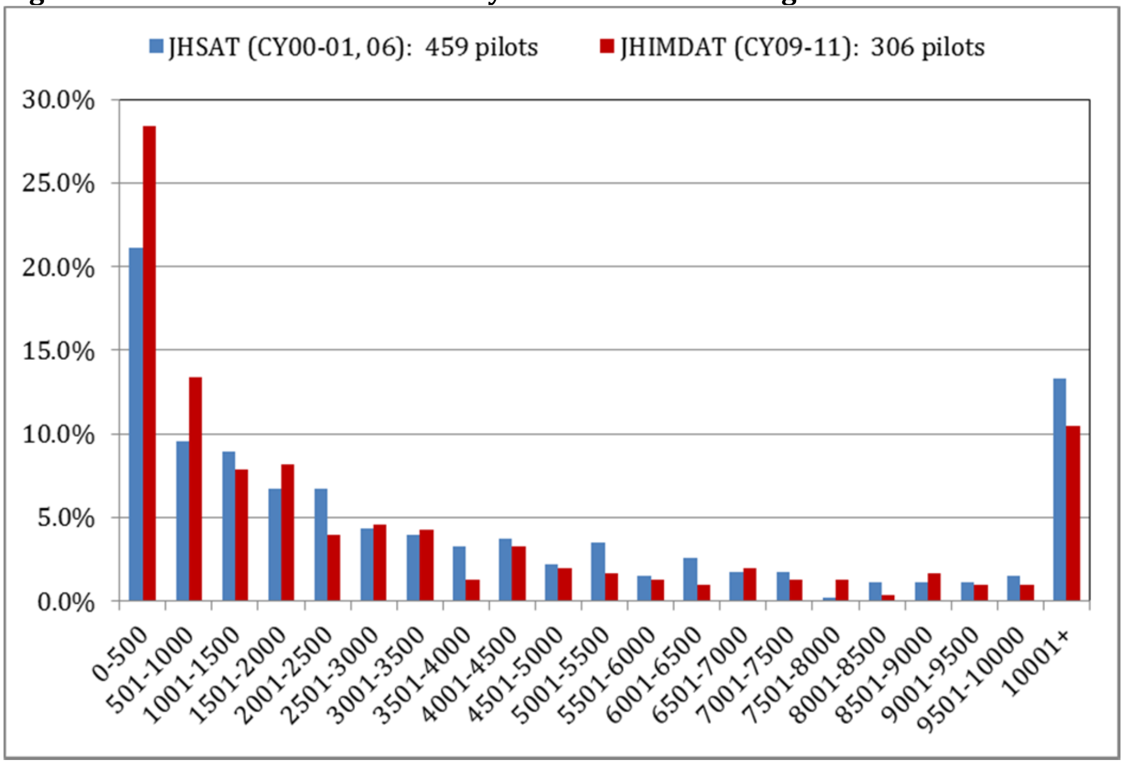
Table 32. Accidents by Rotorcraft Flight Hours for Pilots with < or = 7,500 Hours

Pilot Rotorcraft Hours	JHIMDAT (CY09-11): 258 Pilots < or = 7,500 Hours	JHSAT (CY00-01, 06): 375 Pilots < or = 7,500 hours
0-500	33.7% (87)	25.9% (97)
501-1000	15.9% (41)	11.7% (44)
1001-1500	9.3% (24)	10.9% (41)
1501-2000	9.7% (25)	8.3% (31)
2001-2500	4.7% (12)	8.3% (31)
2501-3000	5.4% (14)	5.3% (20)
3001-3500	5.0% (13)	4.8% (18)
3501-4000	1.6% (4)	4.0% (15)
4001-4500	3.9% (10)	4.5% (17)
4501-5000	2.3% (6)	2.7% (10)
5001-5500	1.9% (5)	4.3% (16)
5501-6000	1.6% (4)	1.9% (7)
6001-6500	1.2% (3)	3.2% (12)
6501-7000	2.3% (6)	2.1% (8)
7001-7500	1.6% (4)	2.1% (8)

Figure 1 illustrates the distribution of pilots' rotorcraft hours without limiting the data set to cases at or below 7,500 hours. For purposes of consolidating the data in the figure, all cases where the pilot's make/model flight hours exceeded 10,000 flight hours were included in one category, shown in the table as "10,001+". The figure includes data from 306 accidents in the JHIMDAT data and 459 accidents in the JHSAT data. As noted in the figure, there was not pilot rotorcraft flight hour data available for 109 JHIMDAT accidents and 64 JHSAT accidents.

The comparatively large magnitude of the accidents in the "10,001+" category of Figure 1 may be misinterpreted. In the interest of avoiding potential confusion, it is important to note that this category is not organized by a 500 hour increment like all other categories in the figure. Therefore, there cannot be a meaningful comparison between the "10,001+" category and all others in the figure. The intent was to keep the content of the figure to a reasonable size while still accounting for the reality that even pilots with the highest rotorcraft flight hour experience (over 10,000 rotorcraft hours) are still vulnerable to accidents.

Figure 1. Distribution of Accidents by Pilots 'Rotorcraft Flight Hours.



*64 JHSAT accidents and 109 JHIMDAT accidents did not have pilot rotorcraft time

Accidents with Pilot's Rotorcraft Flight Hours < or = 600 Hours

The team analyzed the aggregate group of accidents in the JHIMDAT data to the aggregate group of accidents in the JHSAT data for cases where the pilot's rotorcraft flight hours were less than or equal to 600 hours. The team organized the accidents that met this criterion into increments of 50 flight hours (e.g. 0-50 hours, 51-100 hours, 101-150 hours, etc).

The team initially organized the data based on cases of less than or equal to 1,000 hours rather than 600 hours. However, when attempting a chi squared analysis, we found that most of the 50 hour increments between 600 and 1,000 rotorcraft hours had less than five expected events. For cases where degrees of freedom are greater than 1, best practice from statistical reference sources suggested that no more than 20% of the overall data set should have "expected" number of events less than five. If the 50 hour increments between 600 and 1,000 rotorcraft hours had been included, the data set would exceed the 20% threshold. In the interest of ensuring an accurate statistical analysis, the team elected to exclude the 600 to 1,000 hour increments.

According to the chi squared analysis, there was not a statistically significant difference between the two data sets when comparing accidents by rotorcraft flight hours for pilots with 600 or less rotorcraft hours.

For both the JHIMDAT and JHSAT data, Table 33 lists the percentages of accidents categorized by rotorcraft flight hours for cases where the pilot had less than or equal to 600 hours. Note that percentages in table are based only on the number of pilots with less than or equal to 600 hours.

Table 33. Accidents by Rotorcraft Flight Hours for Pilots with < or = 600 Hours

Pilot Rotorcraft Hours	JHIMDAT (CY09-11): 98 Pilots < or = 600 Hours	JHSAT (CY00-01, 06): 109 Pilots < or = 600 Hours
0-50	9.2% (9)	11.0% (12)
51-100	14.3% (14)	9.2% (10)
101-150	10.2% (10)	8.3% (9)
151-200	6.1% (6)	11.0% (12)
201-250	7.1% (7)	11.0% (12)
251-300	10.2% (10)	10.1% (11)
301-350	8.2% (8)	5.5% (6)
351-400	10.2% (10)	11.9% (13)
401-450	8.2% (8)	4.6% (5)
451-500	5.1% (5)	6.4% (7)
501-550	6.1% (6)	4.6% (5)
551-600	5.1% (5)	6.4% (7)

Accidents by Pilot's Make/Model Flight Hours

The team analyzed the proportion of accidents categorized by pilot's make/model flight hours for both the JHIMDAT and JHSAT analyses. The analysis consisted of organizing the make/model flight hours by increments of 500 flight hours from 0 up to 4,500 flight hours. There were accidents where the pilots had greater than 4,500 make/model flight hours. However, the number of pilots per each 500 hour increment above 4,500 make/model flight hours was low. For the same reasons previously cited in the sections that described our analysis of accidents by rotorcraft flight hours, the cases above 4,500 make/model flight hours could not be included in the chi squared without sacrificing the accuracy of the statistical test.

According to the chi squared analysis, there was not a statistically significant difference between the two data sets when comparing the accidents by make/model flight hour increments.

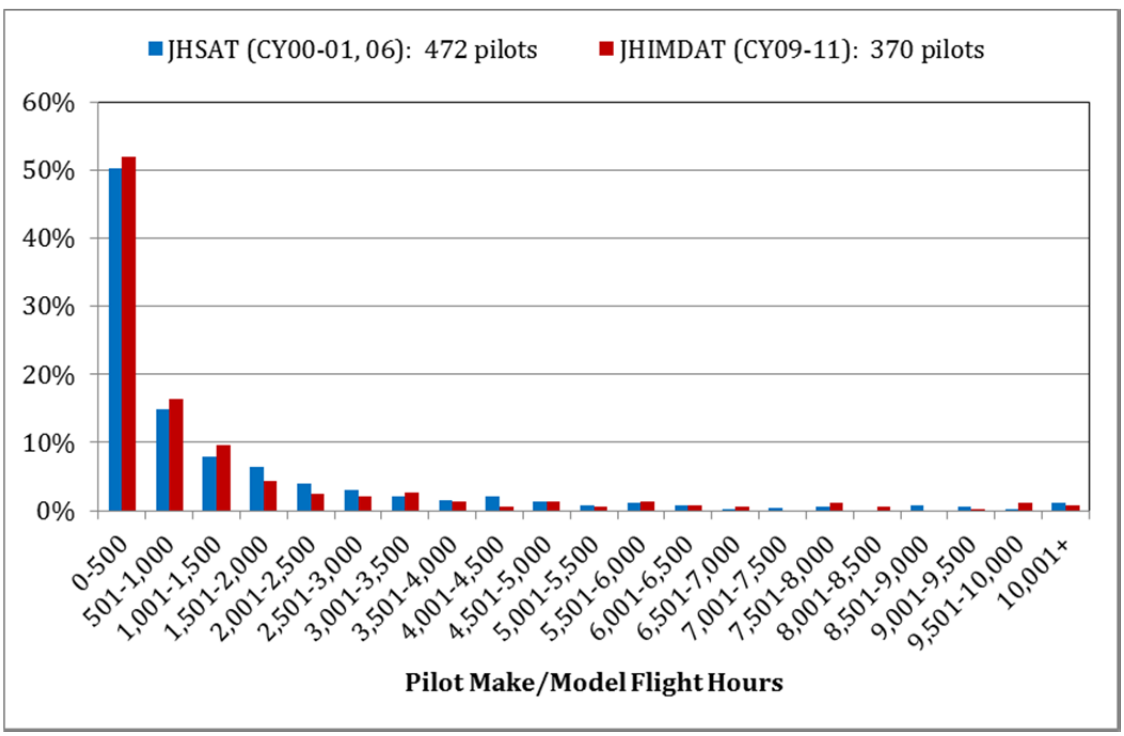
For both the JHIMDAT and JHSAT data, Table 34 lists the percentages of accidents categorized by make/model flight hours for cases where the pilot had less than or equal to 4,500 hours. Note that percentages in the table are based only on the number of pilots with less than or equal to 4,500 hours.

Table 34. Accidents by Make/Model Flight Hours for Pilots with < or = 4,500 Hours

Pilot Make/Model Hours	JHIMDAT (CY09-11): 339 Pilots < or = 4,500 Hours	JHSAT (CY00-01, 06): 434 Pilots < or = 4,500 hours
0-500	56.6% (192)	25.9% (237)
501-1000	18.0% (61)	11.7% (70)
1001-1500	10.6% (36)	10.9% (37)
1501-2000	4.7% (16)	8.3% (30)
2001-2500	2.7% (9)	8.3% (19)
2501-3000	2.4% (8)	5.3% (14)
3001-3500	2.9% (10)	4.8% (10)
3501-4000	1.5% (5)	4.0% (7)
4001-4500	0.6% (2)	4.5% (10)

Figure 2 illustrates the distribution of pilots' make/model flight hours without limiting the data set to cases at or below 4,500 hours. For purposes of consolidating the data in the figure, all cases where the pilot's make/model flight hours exceeded 10,000 flight hours were included in one category, shown in the table as "10,001+". The figure includes data from 370 accidents in the JHIMDAT data and 472 accidents in the JHSAT data. As noted in the figure, there was not pilot make/model flight hour data available for 45 JHIMDAT accidents and 51 JHSAT accidents.

Figure 2. Distribution of Accidents by- Pilots' Make/Model Flight Hours



*51 JHSAT accidents and 45 JHIMDAT accidents did not have pilot make/model time

Accidents with Pilot's Make/Model Flight Hours < or = 1,000 Hours

The team analyzed the proportion of accidents from both the JHIMDAT and JHSAT analyses for cases where the pilot in the accident had less than or equal to 1,000 make/model flight hours. The analysis consisted of organizing the make/model flight hours by increments of 50 flight hours from 0 up to 1,000 flight hours.

According to the chi squared analysis, the JHIMDAT data was statistically different from the JHSAT data. The flight hour increments where the number of accidents changed enough to be a major contributor to the statistical difference were:

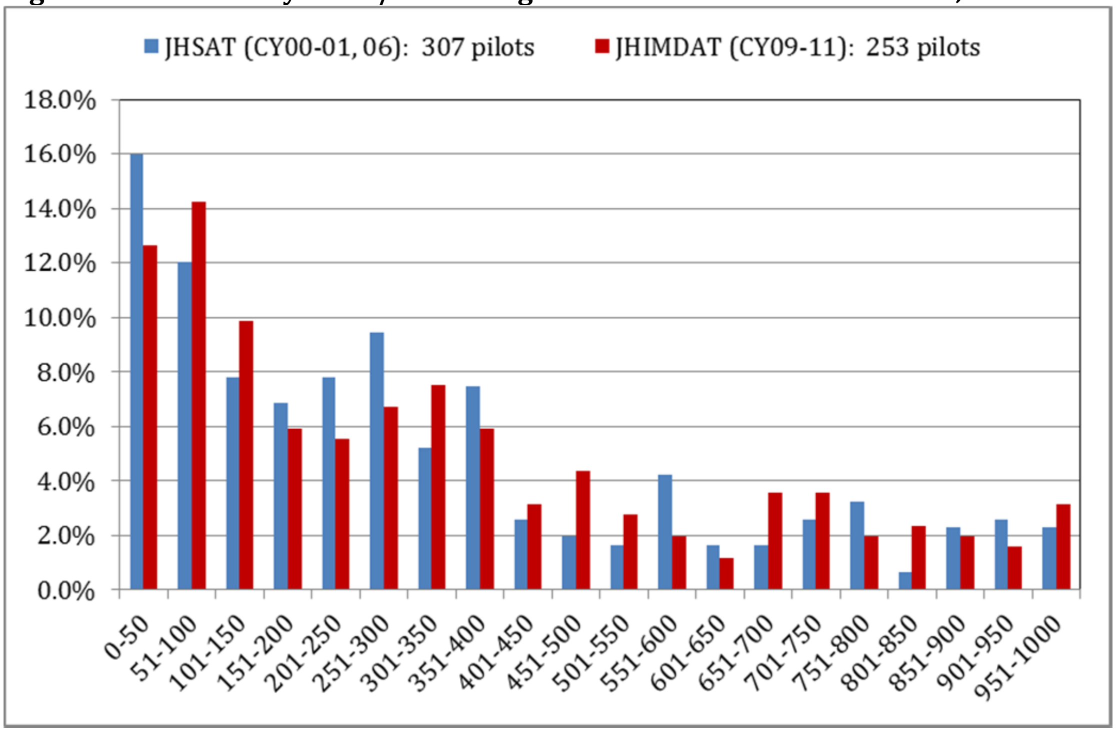
Flight Hour Increment	Change
451-500 hours	Increased from 2.0% to 4.3% of accidents
651-700 hours	Increased from 1.6% to 3.6% of accidents
801-850 hours	Increased from 0.7% to 2.4% of accidents

Table 35. Accidents by Make/Model Flight Hours for Pilots with < or = 1,000 Hours

Pilot Rotorcraft Hours	JHIMDAT (CY09-11): 253 Pilots < or = 1,000 Hours	JHSAT (CY00-01, 06): 307 Pilots < or = 1,000 Hours
0-50	12.6% (32)	16.0% (49)
51-100	14.2% (36)	12.1% (37)
101-150	9.9% (25)	7.8% (24)
151-200	5.9% (15)	6.8% (21)
201-250	5.5% (14)	7.8% (24)
251-300	6.7% (17)	9.4% (29)
301-350	7.5% (19)	5.2% (16)
351-400	5.9% (15)	7.5% (23)
401-450	3.2% (8)	2.6% (8)
451-500	4.3% (11)	2.0% (6)
501-550	2.8% (7)	1.6% (5)
551-600	2.0% (5)	4.2% (13)
601-650	1.2% (3)	1.6% (5)
651-700	3.6% (9)	1.6% (5)
701-750	3.6% (9)	2.6% (8)
751-800	2.0% (5)	3.3% (10)
801-850	2.4% (6)	0.7% (2)
851-900	2.0% (5)	2.3% (7)
901-950	1.6% (4)	2.6% (8)
951-1,000	3.2% (8)	2.3% (7)

Figure 3 illustrates the distribution of pilots' make/model flight hours for pilots with less than or equal to 1,000 hours.

Figure 3. Accidents by Make/Model Flight Hours for Pilots with < or = 1,000 Hours



Influence of Make/Model Flight Hours on Fatal & Non-Fatal Accidents

The JHIMDAT analyzed whether the quantity of pilot's make/model flight hours resulted in any statistical difference regarding the proportion of fatal and non-fatal accidents.

In this case, the chi squared analysis used the same two dimensional approach as the earlier sections of the report titled "Occurrence Category as Related to Fatal & Non-Fatal Accidents" and "Weather Condition as Related to Fatal & Non-Fatal Accidents". The pilot's make/model hours were one dimension. The injury outcome (either fatal or non-fatal) was the second dimension. Because of the two dimensions, the team used a chi squared test of homogeneity (rather than a chi squared goodness of fit) for the comparison.

The test of homogeneity had to be conducted independently on each data set, meaning that the JHIMDAT data and JHSAT data were not compared to each other within the same test. However, once the test was separately completed on each respective data set, the JHIMDAT could then determine if the results of the test of homogeneity had changed from the JHSAT data to the JHIMDAT data.

To initiate the analysis, the JHIMDAT first categorized each accident in the JHSAT data into two groups. The first group was all accidents that occurred where pilots had at or below a specific make/model time (e.g., < or = 100 hours), while the second group was all accidents that occurred where pilots had above a specific make/model time (e.g. > 100 hours). After this initial grouping, the team further divided the JHSAT data into fatal accidents and non-fatal accidents. Once the team completed this division of data for each accident in the JHSAT data, we also used the same method of categorization for the JHIMDAT data. The team performed the test of homogeneity 10 times for each data set, corresponding to make/model flight hours divisions every 100 hours starting with 100 hours and concluding with 1,000 hours.

The statistical conclusion reached from the chi squared test of homogeneity was the same when results from the JHIMDAT data were compared to results from the JHSAT data. Consistently for each of the 10 different make/model flight hour intervals analyzed, there was not a statistical difference for any case for either the JHSAT or the JHIMDAT data set regarding the proportion of fatal and non-fatal accidents.

Summary and Conclusions

In the comparative analysis of U.S. helicopter accidents from the JHIMDAT data (2009-2011) against the JHSAT data (2000, 2001, and 2006), the team observed that either stagnancy or regression was the most evident characteristic. The most frequently cited items were consistent between the data sets in many of the different analysis areas.

In the Industry analysis, the top five industries from Table 1 were the same and appeared in the same rank order from the JHSAT data to the JHIMDAT data: 1) Personal/Private, 2) Instructional/Training, 3) Aerial Application, 4) Emergency Medical Services, and 5) Commercial. These five industries accounted for about 70% of all U.S. accidents in the JHIMDAT data, so implementation measures must target more improvement in these industries to stimulate more significant accident reductions. Regrettably, the statistical analysis showed no significant difference between the proportions of accidents in four of the top five industries, an indication of stagnancy. The only Industry where the team noted a statistically significant difference was in Aerial Application, where regression occurred as evident by the significantly higher proportion of accidents.

The Industry/Activity pairs from Table 3 reinforced the observations about how a large volume of the accidents are disproportionately represented by a small number of industries. The three most frequently cited Industry/Activity pairs from the JHIMDAT analysis accounted for over 40% of the accidents from 2009-2011. Accidents from the Personal/Private Industry engaged in a Personal/Private Activity accounted for the highest percentage of accidents observed in the JHIMDAT data and showed a statistically significant increase in the proportion of accidents from the JHSAT data. The second and third most frequent Industry/Activity pairings in the JHIMDAT data were tied to the Instructional/Training and Aerial Application Industry sectors. Both of these pairings showed stagnancy in that there was no statistically significant change in the proportion of accidents observed in the JHIMDAT data when compared to the JHSAT data.

A separate but still perplexing problem in the Industry and Activity pairs is how frequently the Positioning/RTB Activity results in accidents for both the Emergency Medical Service and Aerial Application industries. Positioning/RTB involves moving the helicopter from one location to another and is not typically characterized by the same level of complexity as either of these Industry sectors would experience in executing the rest of their typical flight profile. Yet, Positioning/RTB was precisely the Activity that accounted for the highest number of accidents in each of these two Industry sectors.

In the Occurrence Category analysis from Table 4, the rank order for five out of the top six Occurrence Categories in the JHIMDAT data matched the JHSAT data and provided further evidence that the areas in need of the strongest implementation measures had not changed. Loss of Control continued to have the highest frequency of occurrence and also showed a statistically significant regression. One of the positive observations in the Occurrence Category analysis was that the System Component Failure category had a statistically significant improvement. The Sub-Occurrence Category analysis from Table 5 revealed this was attributable to a statistically significant improvement in the helicopter related System Component Failures (versus those that were engine related). Unfortunately, the rest of the most frequently cited Sub-Occurrence Categories showed either stagnation or regression.

The 21% reduction in the number of accidents that occurred in the three years covered by the JHIMDAT data (415 accidents) as compared to the three years in the JHSAT data (523 accidents) is progress and should not be disregarded nor minimized. However, the comparative analysis between the two data sets clearly showed that the areas responsible for the majority of U.S. helicopter accidents require more attention in order to achieve a more significant reduction in the overall number of accidents.

A key element missing from the comparative analysis between the data sets was clear answers to critical "Why" questions. For example, "Why is stagnancy and regression so prevalent in the analysis?" or "Why have implementation measures been less effective in these areas?" The origin of these questions is that we were uncertain as to what extent any of the tools and resources developed by the IHST had ever reached actual implementation with helicopter operators. The ambiguity left open several possibilities. Perhaps, some degree of implementation occurred yet did not produce any improvement. Unfortunately, there is also the possibility that implementation may never have occurred at all. There was no clear evidence for either of these two scenarios or any others, so this report chose not to speculate further. However, the prevalence of stagnancy and regression in the comparative analysis made it clear that the implementation measures for the highest accident producing Industry segments should be reevaluated. The USHST must either develop more rigorous implementation measures or formulate a more effective plan for ensuring that operators are actively using the implementation resources already available.

References

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