International Business Aviation Council

Business Aviation Safety Brief

Summary of Global Accident Statistics 2011-2015

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1.0 Introduction

Business Aviation has established a record as one of the world's safest forms of transportation. Professionally flown aircraft of all sizes are operated on unscheduled routes to all corners of the globe, yet the safety record continues to be excellent in spite of the very challenging operating environment.

The exemplary safety record of business aviation can be attributed to professionalism and attention to safe operating practices. The business aviation community promotes safety through industry standards and good training, as well as through monitoring and analysing safety information to facilitate continuous improvement. The business aviation representative associations assist operators by providing safety data and programs in their respective countries. The Organization representing the national and regional associations at the global level, the International Business Aviation Council (IBAC), has in turn developed a program to collect and analyse worldwide information. To that end, IBAC has contracted with Robert Breiling and Associates to develop global data on business aircraft accidents.

Summary information presented in this brief is taken from the analysis conducted by Robert Breiling and Associates in 2016. Breiling's detailed report contains information on accidents from all regions of the world.

This Business Aviation Safety Brief covers a five year period from 2011 to 2015. IBAC updates the brief annually and the IBAC Planning and Operations Committee (POC) reviews the information continuously to determine useful trend data. In addition, the IBAC Governing Board has determined that the Safety Brief will be scrutinized from time to time by independent organizations and feedback will be considered by IBAC's POC.

This summary data includes all accidents involving aircraft when used in conducting business operations. It does not include accidents of business aircraft when used in airshows and other non-business related flying.

Listings of Business Jet and Turboprop accidents that occurred in the preceding calendar year (i.e. 2015) are contained in Appendices A & B.

The compilation, analysis and publication of safety data is an essential foundation for the development of measures to prevent accidents and thus, is not a means unto itself. In this regard, and as a separate IBAC initiative, the International Standard for Business Aircraft Operations (IS-BAO) was introduced in 2002 and was designed to raise the safety bar by codifying safety best practices.

Recognizing that it will be many, many years before safety data will reflect the impact of the IS-BAO, IBAC commissioned an independent, retrospective analysis to subjectively assess the extent to which (i.e. in terms of probability) had the IS-BAO been implemented by the operator concerned the accident could have been prevented. A synopsis of the findings of this study are presented in Section 5.0.

This edition provides an analysis of landing accidents (see appendix D)

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2.0 Business Aviation Community

2.1 Number of Turbine Aircraft

The Breiling Report contains data covering a five-year period for the global population and the distribution of aircraft by region. A summary of the aircraft population in 2015, the last year covered by the report, is as follows:

2015 Global Business Aircraft Population	
Business Jets	20,459
Turbo Props	14,704
All Turbine Business A/C	35,163

Table 2.1a

Analysis

Business aircraft in North America represent 61.1% of the global fleet. South and Central America have approximately 14.3%, Europe 10.8%, and Asia 7.1% of the world's fleet. Other regions account for the remaining 6.7% of the fleet.

2.2 Number of Flight Hours

The 2015 summarized flight hour totals are as follows:

2015 Global Business Aviation Flight Hours	
Business Jets	6,878,117
Turbo Props	5,491,215
All Turbine Business A/C	12,369,332

Table 2.2a

Analysis

For the period 2011-2015, flying hours in North America represents 63.8% of the total, Europe 9.6%, Central/South America 13.4%, Asia 7.2% and the rest of the world 6%.

2.3 Number of Departures

The number of business aviation departures in the 2015 year is as follows:

2015 Global Business Aircraft Departures	
Business Jets	4,775,835
Turbo Props	3,732,331
All Turbine Business A/C	8,508,166

Table 2.3a

(Note: These are derived figures based on flight hours and sector durations typical for each category of jet and turboprop aircraft.)

2.4 Organization of the Community

Business Aircraft operations are classified into three (3) separate categories:

1. **Business Aviation Commercial**
   Aircraft flown for business purposes by an operator having a commercial operating certificate (generally on-demand charters).

2. **Corporate**
   Non-commercial operations with professional crews employed to fly the aircraft.

3. **Owner Operated**
   Aircraft flown for business purposes by the owner of the business.

(Note : Consult IBAC for formal definitions of the three categories. Two additional classifications are included in the Breiling Report: Government (public operations) and Manufacturer aircraft. These are not, by their use, considered to be "business aircraft", but are included in the data for completeness.)

3.0 Business Aircraft Global Accident Data
(5 year period 2011 – 2015)

3.1 Accidents by Operator Type

A summary of the total accidents over five (5) years by type of operator is as follows:

Accidents by Operator Type - Jet Aircraft				
Business Jet Aircraft	Total Accidents (5 yrs)	Fatal Accidents (5 yrs)	Average Total Accidents per year	Average Fatal Accidents per year
Commercial/Air Taxi	63	18	12.6	3.6
Corporate	33	10	6.6	2.0
Owner Operated	18	7	3.6	1.4
Government	3	1	0.6	0.2
Fractional	5	0	1.0	0
Manufacturer	1	0	0.2	0

Table 3.1a

Accidents by Operator Type – Turbo Prop Aircraft				
Turbo Prop Aircraft	Total Accidents (5 yrs)	Fatal Accidents (5 yrs)	Average Total Accidents per year	Average Fatal Accidents per year
Commercial/Air Taxi	203	69	40.6	13.8
Corporate	29	11	5.8	2.2
Owner Operated	92	40	18.4	8.0
Government	10	4	2.0	0.5
Manufacturer	1	0	0.2	0

Table 3.1b

*(Note: No analysis provided for **Fractional** operations conducted with **Turbo Prop Aircraft**.)*

Analysis

The majority of business aircraft accidents occur in the commercial category, where operations are governed by commercial regulations (such as FAA Part 135 and JAR OPS 1). The next most frequent number of accidents occurs with aircraft flown by business persons. Accidents of corporate aircraft remain rare.

3.2 Accident Summary by Phase of Flight

Five (5) year totals by phase of flight are as follows:

Accident Summary by Phase of Flight									
	Taxi	T/O	Climb	Cruise	Desc't	Man'v	App	Land	Total
Business Jets	7 5.7%	14 11.4%	12 9.8%	4 3.3%	2 1.6%	4 3.3%	10 8.1%	70 56.9%	123 100%
Turbo Props	13 3.9%	20 6.0%	48 14.3%	27 8.1%	5 1.5%	20 6.0%	47 14.0%	155 46.3%	335 100%

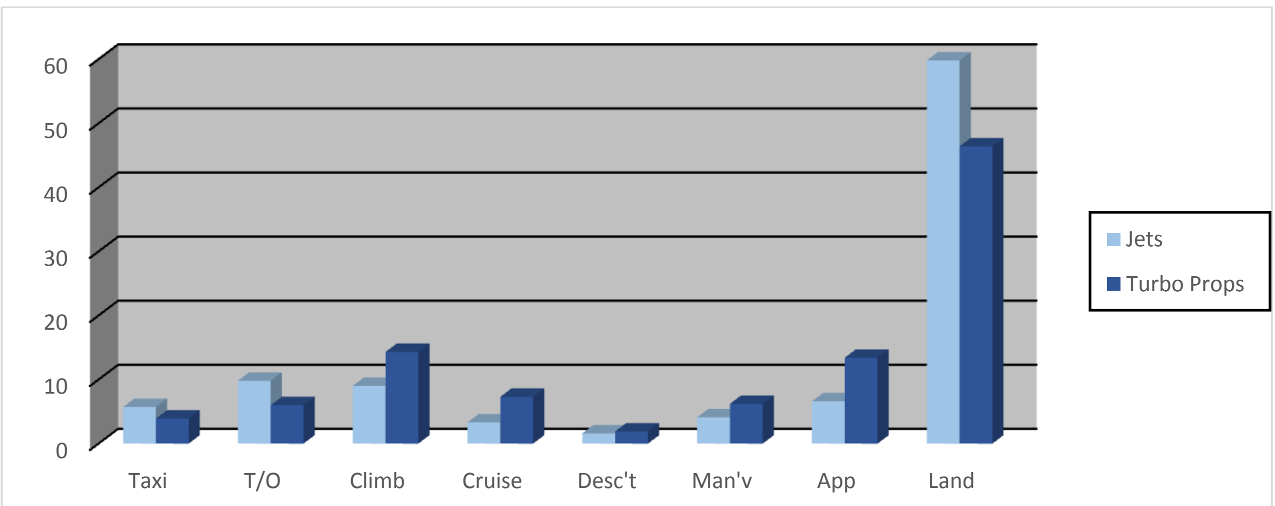


Table 3.2a

Analysis

The trend over a period of 35 years continues to demonstrate an overall substantive decrease in the percentage of taxi accidents, and a notable decrease in accidents in the landing phase, although landing accidents remain as the most prevalent.

The trend indicates an increase in the number of accidents occurring in the climb phase for turboprop aircraft and a decrease in the approach phase for jet aircraft. The distribution of accidents in the other phases has remained relatively unchanged.

(Note: Supplementary data collected by Robert Breiling over a 35-year period was used to develop this trend.)

4.0 Global Accident Rate Data

4.1 Accident Rate by Aircraft Type

The accident rate per 100,000 flight hours for each year over a five year period, as well as for the total, is as follows:

Accident Rate per 100,000 hours by Aircraft Type												
	2011		2012		2013		2014		2015		**5 Year Total**	
	Acc Rate	Fatal Rate	Acc Rate	Fatal Rate	Acc Rate	Fatal Rate	Acc Rate	Fatal Rate	Acc Rate	Fatal Rate	**Acc Rate**	**Fatal Rate**
Business Jets	0.42	0.05	0.48	0.11	0.37	0.14	0.47	0.20	0.33	0.10	**0.41**	**0.12**
Turbo Props	1.77	0.60	1.52	0.46	1.82	0.848	1.10	0.39	0.98	0.38	**1.42**	**0.52**
All Turbine Bus A/C	1.04	0.30	0.94	0.26	0.99	0.44	0.74	0.29	0.62	0.23	**0.86**	**0.30**

Table 4.1a

(Note: Some of the above figures have been re-stated as a result of the availability of subsequently published accident investigation reports and/or additional information.)

4.2 Accident Rate by Operator Type

Global data for the numbers of aircraft in each of the business aviation operational categories (commercial, corporate and owner-operated) proved difficult to obtain as few States collect this information. Similarly, flight hours by type of operation are not available. Due to the lack of good exposure data, it was not possible to calculate, without some error, the rate of each category of operation. Additionally, the operational status of a single airframe may legally vary from flight to flight (i.e., an aircraft may be commercial on one flight and private on a flight made later the same day or vice versa).

Nevertheless, by applying US data relevant to the division between categories of operator, and by making the assumption that the division is relatively similar for the rest of the world, an estimate of the rate by operator type can be made. Given that the North American data represents approximately 63% of the global total, it is unlikely that the distortion generated by the assumption will be very large.

The percentage of flight hours for each of the three categories in the USA is as follows:

Commercial (Air Taxi)	30.4%
Corporate	55.3%
Owner-operated	14.3%

Ed note: Additional information is provided at Appendix C. The profiling for the above three categories has changed significantly from that in all Safety Briefs prior to Issue 7. Consequently, the data presented in the tables which follow cannot be directly compared with that in the same tables in previous edition of the Safety Brief, and vice versa.

Assuming a similar division globally, the accident rates per <u>100,000 flight hours</u> are as follows (based on data over 5 years):

Global Accidents Rates by Operator Type *(Extrapolated)* *(per 100,0000 hours)* **All Business Aircraft**					
Operator Type	Hours of Operation (5 yrs)	Total Accidents (5 yrs)	Fatal Accidents (5 yrs)	Total Accident Rate	Fatal Accident Rate
Commercial	16,243,091	266	86	1.64	0.53
Corporate	29,547,464	58	21	0.20	0.07
Owner Operated	7,640,664	110	47	1.44	0.62
*All Business Aircraft	53,431,219	458	159	0.86	0.30

Table 4.2a

*(Note: *This line includes the three lines above it, plus **Government, Manufacturers** and **Fractional** aircraft operators. Also included are accidents involving operators for which insufficient information was available to assign the operator type)*

Global Accidents Rates by Operator Type *(Extrapolated)* *(per 100,0000 hours)* **Jet Aircraft**					
Operator Type	Hours of Operation (5 yrs)	Total Accidents (5 yrs)	Fatal Accidents\ (5 yrs)	Total Accident Rate	Fatal Accident Rate
Commercial	9,056,398	63	17	0.70	0.19
Corporate	16,474,303	33	10	0.20	0.06
Owner Operated	4,260,082	18	7	0.42	0.16
*All Business Aircraft	29,790,783	123	35	0.41	0.12

Table 4.2b

*(Note: *This line includes the three lines above it, plus* ***Government, Manufacturers*** *and* ***Fractional*** *aircraft operators. Also included are accidents involving operators for which insufficient information was available to assign the operator type)*

Global Accidents Rates by Operator Type *(Extrapolated)* *(per 100,0000 hours)* **Turbo Prop Aircraft**					
Operator Type	Hours of Operation (5 yrs)	Total Accidents (5 yrs)	Fatal Accidents (5 yrs)	Total Accident Rate	Fatal Accident Rate
Commercial	7,186,693	203	69	2.82	0.96
Corporate	13,073,161	25	11	0.19	0.08
Owner Operated	3,380,582	92	40	2.72	1.18
*All Business Aircraft	23,640,436	335	124	1.42	0.52

Table 4.2c

*(Note: *This line includes the three lines above it, plus* ***Government, Manufacturers*** *and* ***Fractional*** *aircraft operators. Also included are accidents involving operators for which insufficient information was available to assign the operator type)*

Analysis

The accident rates calculated in Table 4.2 include both turbo-prop and jet aircraft. The rate data indicates an excellent level of safety in corporate operations, whereas the accident rates in the commercial and owner operated sectors continue to warrant increased attention by the business aviation community.

4.3 Accident Rate by Departures

There is a growing trend for organizations reporting safety data to do so using accident rates per number of departures given that safety exposure is greatest during departure and arrival. Accidents of aircraft enroute are rare except for flights in low level flight in marginal visual conditions. Accident rates per departure, or flight segment or cycle, therefore provide more realistic safety correlations.

Ed note:
Additional information is provided at Appendix C. The profiling for the above three categories has changed significantly from that in all Safety Briefs prior to Issue 7. Consequently, the data presented in the tables which follow cannot be directly compared with that in the same tables in previous edition of the Safety Brief, and vice versa.

The accident rate per 100,000 departures is as follows:

Business Jet Accidents and Rates by Departures *(per 100.0000 departures)*					
Jet Category	Departures	Accidents (5 yrs)		Accident Rate	
		Total	Fatal	Total	Fatal
Large Jet Aircraft	5,369,405	13	5	0.24	0.09
Medium Jet Aircraft	6,516,439	27	8	0.41	0.12
Light Jet Aircraft	6,747,929	83	22	1.23	0.33
All Business Jets	18,633,773	123	35	0.66	0.19

Table 4.3a

Business Turbo Prop Accidents and Rates by Departures *(per 100.0000 departures)*					
Turbo Prop Category	Departures	Accidents (5 yrs)		Accident Rate	
		Total	Fatal	Total	Fatal
Large Turbo Prop	384,912	33	12	8.57	3.12
Medium Turbo Prop	19,322,579	231	77	1.20	0.40
Light Turbo Prop	1,159,051	71	35	6.13	3.02
All Turbo Prop	20,866,542	335	124	1.61	0.59

Table 4.3b

Business Turbine Accidents and Rates by Departures *(per 100.0000 departures)*					
Category	Departures	Accidents (5 yrs)		Accident Rate	
		Total	Fatal	Total	Fatal
All Business Aircraft	39,500,307	458	159	1.16	0.40

Table 4.3c

If an assumption is made that the distribution of departures for operator types of commercial (30.4%), corporate (55.3%) and owner-operated (14.3%) is relatively the same as the distribution between flight hours, the accident rates by type of operation can be calculated as follows:

Business Aircraft Accidents Rates by Operator Type *(Extrapolated)* *(per 100,000 Departures)*					
Operator Type	Departures (5 yrs)	Total Accidents	Fatal Accidents	Total Accident Rate	Fatal Accident Rate
Commercial (Air Taxi)	12,008,093	264	77	2.19	0.64
Corporate	21,843,670	62	24	0.28	0.11
Owner Operated	5,648,544	110	44	1.95	0.78
All Business Aircraft	39,500,307	458	159	1.16	0.40

Table 4.3d

Business Aircraft Accidents Rates by Operator Type *(Extrapolated)* *(per 100,000 Departures)* **Jet Aircraft**					
Operator Type	Departures (5 yrs)	Total Accidents	Fatal Accidents	Total Accident Rate	Fatal Accident Rate
Commercial (Air Taxi)	5,664,665	64	17	1.13	0.30
Corporate	10,304,472	32	10	0.31	0.10
Owner Operated	2,664,628	18	5	0.68	0.19
All Business Aircraft	18,633,765	127	32	0.68	0.17

Table 4.3e

Business Aircraft Accidents Rates by Operator Type *(Extrapolated)* *(per 100,000 Departures)* **Turbo Prop Aircraft**					
Operator Type	Departures (5 yrs)	Total Accidents	Fatal Accidents	Total Accident Rate	Fatal Accident Rate
Commercial (Air Taxi)	6,343,429	200	60	3.15	0.95
Corporate	11,539,198	30	14	0.26	0.12
Owner Operated	2,983,916	92	39	3.08	1.31
All Business Aircraft	20,866,542	331	122	1.58	0.58

Table 4.3f

Analysis

A number of assumptions have been made related to the distribution of exposure data, and as a result the data should be used with some caution. Nevertheless, no other rate data is known to exist for worldwide business aviation. The results of the extrapolation should be sufficiently accurate to provide a reasonable comparison with accident information from other aviation sectors.

4.4 Comparison With Other Aviation Sectors

IBAC is experiencing increasing difficulty in drawing meaningful comparisons of business aviation safety data i.e. accident rates per 100,000 departures with those developed and published for other sectors of the aviation community. The incongruence inhibiting such comparisons include; operational classification i.e. commercial vs. non-commercial, classification of accidents involving fatalities i.e. passengers only or crew, hull loss accidents, range of aircraft MCTOM encompassed by the data, lack of disaggregation by power plant i.e. turbojet, turbo- prop or reciprocating etc. While it is unlikely that this incongruence can ever be fully reconciled, IBAC is making every effort to understand and identify these factors and will continue to pro- mote international recognition of the IBAC safety data.

Business Aviation Sector	**Fatal Accident Rate** *(per 100,000 departures)*
All Business Aircraft (Jet and Turbo Prop)*	0.40
Corporate (Jets) **	0.10
Corporate (Jet and Turbo Prop) ***	0.11
All Business Jets ****	0.19
Boeing Annual Report – Jet aircraft MCTOM over 60,000lbs engaged in commercial scheduled passenger operations.*****	0.029

Table 4.4a

* Per Table 4.3c. IBAC rate is 5 year average.

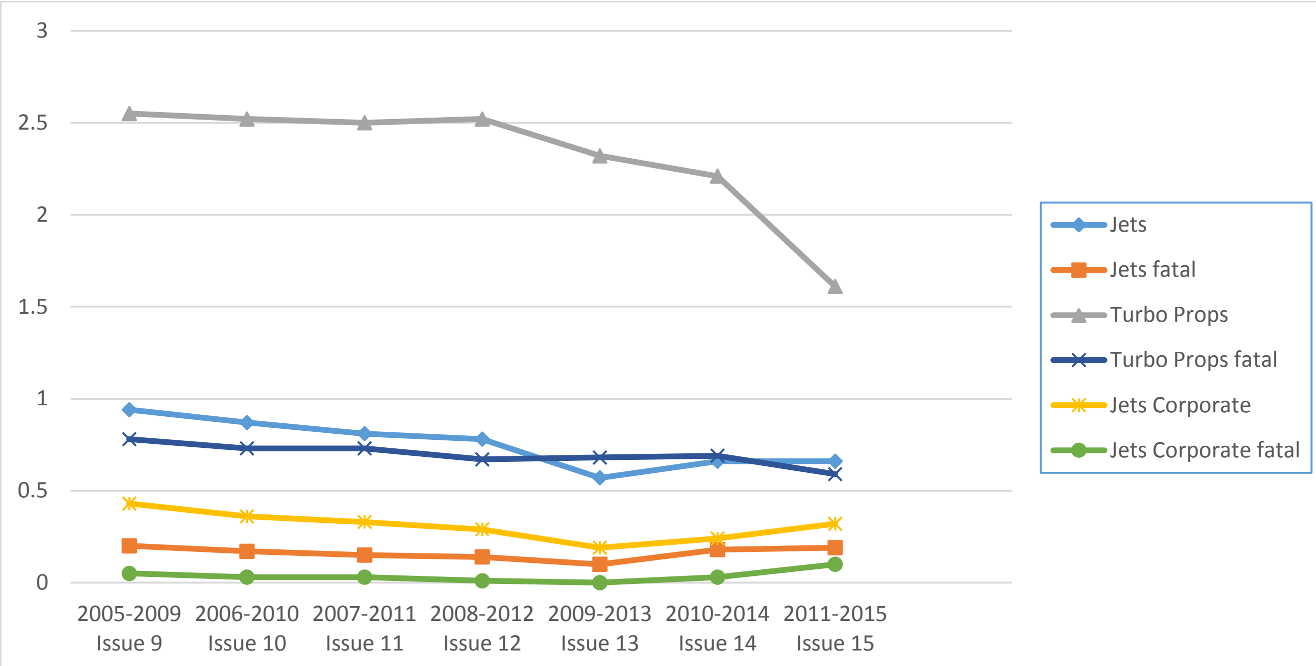
** Per Table 4.3e. IBAC rate is 5 year average

*** Per Table 4.3d. IBAC rate is 5 year average.

**** Per Table 4.3a. IBAC rate is 5 year average.

***** Boeing – Statistical Summary of Commercial Jet Airplane Accidents, Worldwide Operations 1959-2015. Rate is for Scheduled Commercial Passenger Operations for a 10 year period, 2006-2015

4.5 Accident Rate Trend



5.0 IS-BAO Safety Value

5.1 A Code of Practice

The International Standard for Business Aircraft Operations (IS-BAO) is an industry safety standard introduced in 2002 as the industry's code of practice designed to raise the safety bar by codifying safety best practices. Given that there are very few accidents in the business aviation community, it will be many years before a determination can be made regarding whether or not the IS-BAO is making a safety impact. Therefore, to assess the safety value a study was initiated based on historical accident data.

An analysis of past accidents required a considerable amount of subjective assessment as the analysts had to review the details of accidents against a full understanding of the IS-BAO to make a value judgment regarding whether the accident may have been avoided if the IS-BAO had been implemented.

The study was conducted by an independent analyst who reviewed a total of 500 accidents covering the period between 1998 and 2003. A total of 297 accidents of the 500 were considered to contain sufficient information to be further assessed. The study against the provisions of the IS-BAO standard was performed to determine a level of probability that if the flight department had known about and implemented the IS-BAO the accident may have been avoided. The data was classified and analysed to determine the potential impact of the IS-BAO and the accidents were rated on a five point scale ranging from certainty of prevention to no effect.

Two assessments were made. First, the analysts made the assumption based on indicators that the flight department may have implemented the IS-BAO, and if implemented, the potential for accident avoidance. The accidents were then further analysed to determine the potential outcome given that the IS-BAO was implemented in full before the accident. An audit by an accredited auditor leading to an IBAC Certificate of Registration is the recommended means of demonstrating full implementation.

As part of the analysts' work, the accidents were classified in a number of different ways to see if there were any meaningful trends in the prevention probability between the different factors. Classification methodologies applied include:

1. Simple Four Factors – Human, Technical, Environmental and Management.
2. Events – or significant type of accident (such as loss of control).
3. Breakdown on Human Factors.
4. Boeing Accident Prevention Strategies.

Probabilities were calculated for all accidents, phase of fight, type of accident, four factors (per above), type of operation, Commercial or non-commercial, fatalities and single versus two pilot operations.

A further step in the methodology included a quality assurance analysis by a group of current pilots through an assessment of a random selection of twelve accidents as a means of verifying the results of the analysis.

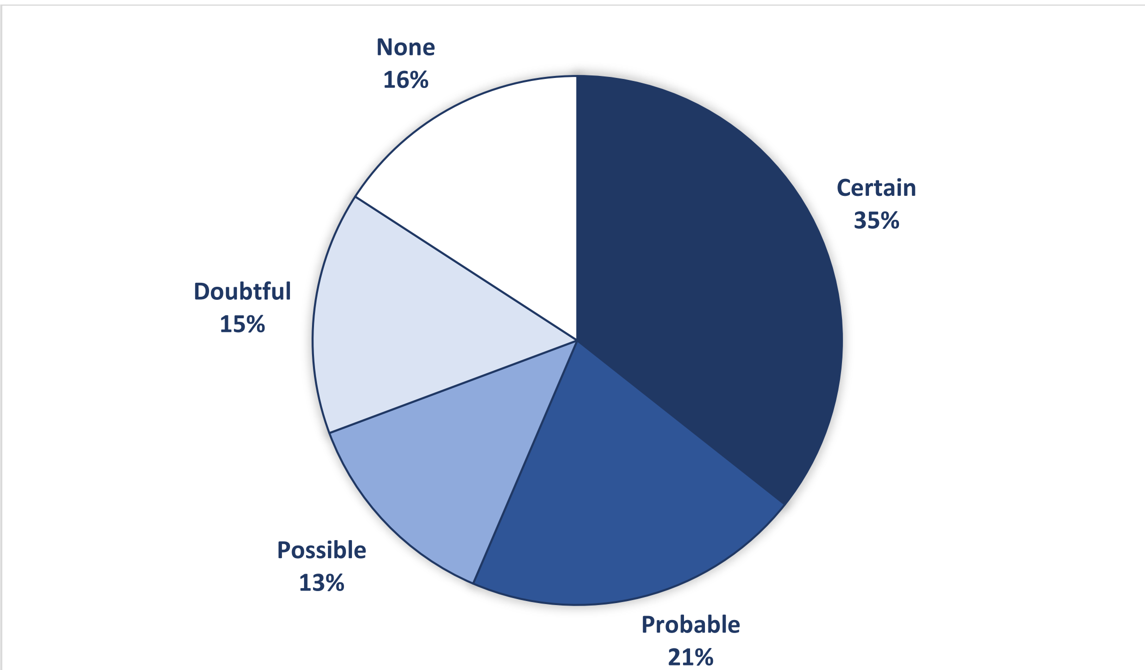
5.2 Results of Analysis

Criteria A

Assumes Operators Had Completely Implemented IS-BAO Prior to the Occurrence.

This part of the analysis made the assumption that the operator had implemented the IS-BAO standard in full. An assessment was then made regarding the potential that the accident could have been prevented. The following were the results of the assessment:

Certain of prevention	36.0% (107 of 297 accidents)
Probable prevention	21.2% (63 of 297)
Possible prevention	12.8% (38 of 297)
Doubtful of prevention	14.5% (43 of 297)
No prevention possibility	15.5% (46 of 297)

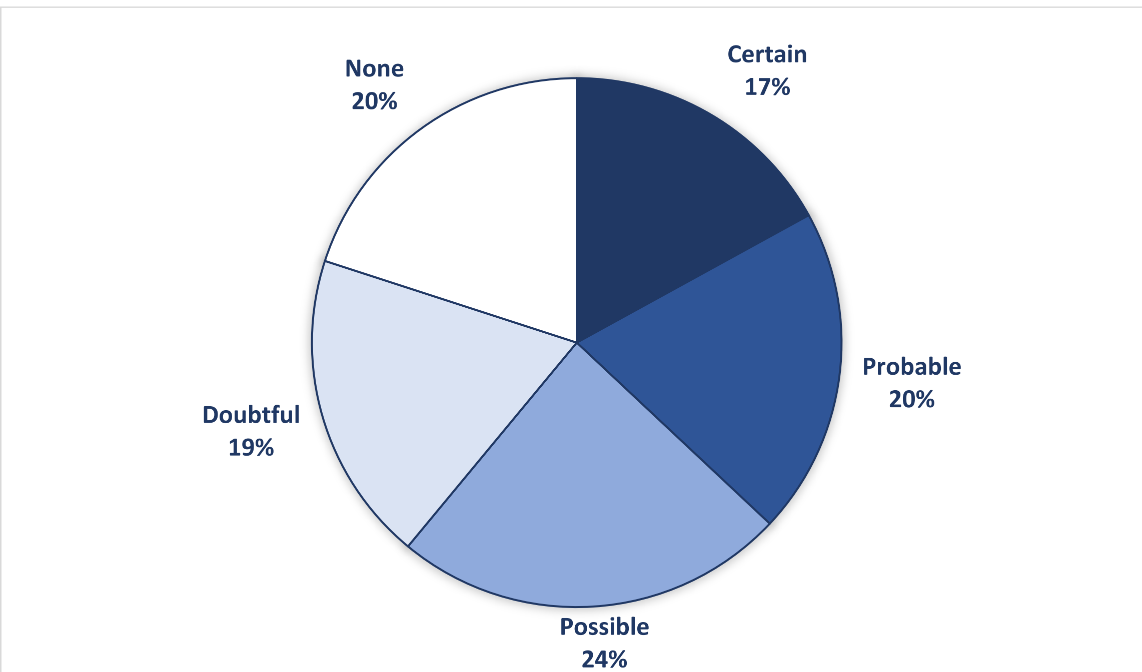


Conclusion - The probability of prevention is 57.2%, with a further 12.8% possible for a total of <u>70% potential that the aircraft accident could have been avoided.</u>

Criteria B

Takes into Account Operators Background and Probability of Introduction of IS-BAO.
The assessment of whether the accident may have been prevented if the flight department had known about the IS-BAO, and if the operator was sufficiently responsible to implement the standard and had done so thoroughly, produced the following results:
Certain of prevention 17.2% (51 of 297 accidents) Probable prevention 20.2% (60 of 297) Possible prevention 23.9% (71 of 297) Doubtful of prevention 19.2% (57 of 297) No prevention possibility 19.5% (58 of 297)

Certain of prevention	17.2% (51 of 297 accidents)
Probable prevention	20.2% (60 of 297)
Possible prevention	23.9% (71 of 297)
Doubtful of prevention	19.2% (57 of 297)
No prevention possibility	19.5% (58 of 297)



Conclusion - The probability of prevention is 37.4%, with a further 23.9% possible for a total of <u>61.3% potential that the aircraft accident could have been avoided</u>.

Criteria C

Probability of Prevention by Types of Operation and Aircraft.

The analysis showed that there is a greater probability that the accident could have been pre- vented for jet aircraft type accidents versus turboprop. This was a trend consistent through most methods of analysis and type of accident, although in some cases there was little to distinguish between jet and turboprop probabilities. For example, for the landing accidents (the most common type of accident) the probability of prevention was much greater for jets than turboprop aircraft. Yet, for loss of control accidents there was substantially no difference. The reason for the difference considered by the analysts was that there would be a greater potential for prevention in two pilot operations more typical in jet aircraft.

As would be expected there was a significantly greater probability of prevention related to Management Factors compared to Environmental factors, whereas Technical Factors and Human Factors ranked in the middle of these two.

There was no significant difference between the probability of prevention of commercial operations (air taxi) versus non-commercial. Evidence indicates that there is a higher probability that IS-BAO implementation would prevent accidents with two pilot operations versus one pilot.

Accidents with causal factors related to human performance totalled 232, and were broken down into the following;

1. Knowledge Based (no standard solution) 37
2. Rule Based (need to modify behaviour) 46
3. Skill Based (routine practiced tasks) 149

There was no significant difference between the probability of prevention between these three categories.

Conclusion

The study by an independent analyst indicates that the IS-BAO standard has considerable potential to improve safety. The extent of potential benefit depends significantly on the commitment of the operator to implement and adhere to the standard.

Appendix A

2015 Business Jet Accidents

North American Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/3/2015	CL-601-1A	Rnwy overshoot landing, nose gear collapsed, Marco Isl FL	FL	Landing	Corp	No
3/15/2015	DA-7X	Wing substantially damaged during landing,Bozeman, MT	MT	Landing	Corp	No
3/28/2015	IAI-1125	Struck snowbank landing on closed runway, no NOTAM issued	CDA	Landing	Corp	No
5/13/2015	L-35	Nose gear failed on landing, aircraft veered off runway	VA	Landing	Comm	No
6/12/2015	Eclipse 500	Lert gear penetrate wing and fuel tank during landing	CA	Landing	Pvt/Bus	No
6/22/2015	L-35A	Aircraft struck a deer during takeoff roll	MI	Takeoff	Comm	No
8/5/2015	CE-580	Wing struck a construction post during taxi	UT	Taxi	Corp	No
8/16/2015	NA-265-60	Mid air on approach with a CE-172 at Brown Field, CA	CA	Approach	Corp	Yes
10/29/2015	CL-300	Bird strike left engine on takeoff, aircraft re-landed safely	WI	Takeoff	Corp	No
11/10/2015	HS-125-700	Aircraft crashed on approach in marginal weather, rain, fog	OH	Approach	Comm	Yes

Non-North American Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/8/2015	L-45	Damaged in hangar collapse due heavy rain & high winds	Brazil	Hangared	Corp	No
1/8/2015	L-60XR	Damaged in hangar collapse due heavy rain & high winds	Brazil	Hangared	Comm	No
1/8/2015	L-60	Damaged in hangar collapse due heavy rain & high winds	Brazil	Hangared	Comm	No
1/8/2015	CL-300	Damaged in hangar collapse due heavy rain & high winds	Brazil	Hangared	Comm	No
1/8/2015	L-45	Damaged in hangar collapse due heavy rain & high winds	Brazil	Hangared	Comm	No
3/10/2015	DA-900	Wheel/brake fire following a takeoff abort	Ghana	Takeoff	Corp	No
3/12/2015	Premier I	Rnwyovershoot landing, nose gear collapsed, day, VMC	U.K.	Landing	Comm	No
4/8/2015	HS-800SP	Right gear caught fire during VI takeoff abort	Israel	Takeoff	Comm	No
6/10/2015	CE-525	Runway overshoot landing by 500 ft. beyond runway end	Japan	Landing	Pvt/Bus	No
7/19/2015	L-35A	Aircraft landed with gear retracted, day, VMC	Panama	Landing	Comm	No
7/31/2015	EMB-300	Runway overshoot landing at a U.K. Airport, fire followed	S. Arabia	Landing	Corp	Yes
8/26/2015	CE-550	Aircraft landed long, overshot runway on second apprch	Venezuela	Landing	Comm	No
9/5/2015	HS-700	Aircraft reported missing over the Atlantic on an EMS flt	Senegal	Maneuver	Comm	Yes
10/12/2015	L-31A	Enrout to Toluca, MX, no other info.	Mexico	Cruise	Comm	Yes
10/19/2015	L-35A	Takeoff aborted, gear collapsed, fire followed, Buenos Aires	Argentina	Takeoff	Comm	No
11/10/2015	CE-650	Acft. lost control and entered steep dive initiating apprch	Brazil	Maneuver	Corp	Yes
12/1/2015	G-200 plus*	4 aircraft damaged by monsoon flood waters, Chennai, India	India	Static	Unknown**	No
12/7/2015	Eclipse 500	Acft. spun down from altitude, possible loss of oxygen	S. Africa	Cruise	Comm	Yes
12/23/2015	BE-400XP	Aircraft struck a snowplow landing that was cleared on runway	Mexico	Landing	Comm	No

*Phenom 100 VT-ASI, Global Exp. VT-SNG, HS-125 900 VT-10A

**Not counted as operational business operation

Appendix B

2015 Business Turbo Prop Accidents

North American Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/14/2015	BE-F90	Aircraft landed with landing gear retracted, night	KY	Landing	Pvt/Bus	No
1/16/2015	PA-31T	Nose gear failed to extend, gear up landing	Cda	Landing	Comm	No
1/23/2015	BE-300	Bird strike left wing during approach caused substantial damage	IL	Approach	Public	No
1/30/2015	PA-46 TPcvn	Aircraft spun in at high speed while enroute from Geneva	Belgium	Cruise	Pvt/Bus	Yes
1/31/2015	CE-208	Aircraft struck apprch lights landing went onto grass, gear collapsed	WA	Landing	Comm	No
2/4/2015	PA-46 500TP	Aircraft collided with a tower during approach 5 mi from airport	TX	Approach	Pvt/Bus	Yes
2/4/2015	CE-441	Aircraft crashed on approach 10 mi. short of airport, night	TX	Approach	Pvt/Bus	Yes
2/23/2015	BE-300	Severe turbulance encounter damaging wing, aircraft landed safely	CA	Approach	Frax	No
3/24/2015	CE-208B	Power loss shortly after takeoff, hard landing followed, on a test flight	OK	Landing	Comm	No
3/30/2015	PA-46TP500	Aircraft lost control during landing, veered off runway side	CO	Landing	Pvt/Bus	No
4/8/2015	BE-200	Landed gear up, pulled up and re-landed safely	Cda	Landing	Comm	No
4/12/2015	PA-31T	Acft. crashed on approach after reporting an unknown problem	FL	Approach	Pvt/Bus	Yes
4/13/2015	SA-226TC	Aircraft crashed in mountainous terrain, no other information	Cda	Maneuver	Comm	Yes
4/16/2015	SA-227AC	Engine failed during IMC climb, returned and landed safely	CO	Climb	Comm	No
5/7/2015	PA-46TP500	Engine malfunction, aircraft crashed attempting an emergency landing	WA	Landing	Pvt/Bus	Yes
6/30/2015	BE-99	Power lost on takeoff, late abort, landed gear collapsed	UT	Landing	Comm	No
6/25/2015	DHC-3TP	Float equipped Beaver crashed on low level sight seeing flight	AK	Maneuver	Comm	Yes
7/6/2015	Kodiak 100	Aircraft forced landed after takeoff, due to a power loss	Russia	Landing	Comm	No
7/29/2015	TBM-850	Aircraft crashed during a missed approach, Milwaukee, WI	WI	Approach	Pvt/Bus	Yes
8/1/2015	BE-C90B	Aircraft reported an engine problem and crashed short of the runway	KY	Approach	Pvt/Bus	No
8/2/2015	CE-208B	Aircraft damaged by high winds during taxi, Chicago	IL	Taxi	Comm	No
8/6/2015	CE-208B	Power lost in climb, pilot forced landed on sea ice in bay and sank	AK	Climb	Comm	No
8/7/2015	PA-46TP500	Aircraft crashed vertically into terrain after takeoff, dusk, VMC	NY	Climb	Pvt/Bus	Yes
8/12/2015	CE-208B	Power lost in flight, aircraft ditched in Caribbean	Antilles	Climb	Comm	No
8/16/2015	BE-100	Right gear collapsed landing at short strip	Cda	Landing	Comm	No
8/28/2015	BE-90E	Acft. Landed gear up In a field due electrical and gear malfunctions	TN	Landing	Pvt/Bus	No
9/6/2015	DHC-6 200	Takeoff aborted, aircraft ran into trees, Raleigh Apt., NC	NC	Takeoff	Comm	No
9/15/2015	DHC-3T	Aircraft impacted trees after water takeoff, dark night but VMC	AK	Climb	Corp	Yes
10/9/2015	Kodiak 100	Aircraft crashed on takeoff, n- o cause given,Sherldan, WY	WY	Takeoff	Mfgr.	No
11/9/2015	CE-441	Aircraft lost control on approach in IMC, fog, 2 mi.vis. 400 ft. overcast	GA	Cruise	Pvt/Bus	Yes
12/10/2015	PA-46TP 500	Aircraft hit powerlines, crashed on highway 1 mile from airport	IA	Approach	Comm	Yes
12/11/2015	CE-208	Aircraft crashed shortly after takeoff in marginal weather	Cda	Climb	Comm	Yes
12/24/2015	PA-48TP500	Acft.crashed returning to land after reporting open cowl door takeoff	MS	Climb	Pvt/Bus	No
12/30/2015	BE-200	Aircraft landed hard due possible airframe icing	IN	Landing	Comm	No

Non-North American Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/9/2015	CE-208	Aircraft landed hard in poor weather in Guyana	Guyana	Landing	Pass	No
1/12/2015	DHC-3T	Aircraft jumped chocks, hit hangar during engine start	Germany	Start	Comm	No
1/15/2015	PA-46TP cvn	Aircraft undershot runway landing collapsing 1 main gear	Germany	Landing	PvtlBus	No
1/20/2015	BN-2TP	Forced landing after both engines failed, cause unknown	S.Africa	Landing	Corp	No
2/7/2015	BE-90E	Runway overshoot landing at a private strip	S. Africa	Landing	PvtlBus	No
2/11/2015	BE-1900	Aircraft crashed shortly after takeoff, crew radioed engine problems	Venezuela	Climb	Comm	Yes
2/15/2015	PA-46TP500*	Power loss shortly after takeoff, broke up on emergency landing	Sweden	Climb	Comm	No
2/19/2015	BE-200	Aircraft struck animals landing, left main gear collapsed night	S.Africa	Landing	Comm	No
3/19/2015	BE-B90	Aircraft crashed shortly after night takeoff	Uruguay	Climb	Corp	Yes
4/25/2015	BE-200	Engine failure takeoff, abort, runway overshoot, fire followed	Venezuela	Takeoff	Comm	No
5/19/2015	CE-208	Wing extensively damaged during landing, South Sudan, Africa	S.Africa	Landing	Comm	No
5/30/2015	PA-31T	Aircraft crashed during approach, Anzoategui Airport,	Venezuela	Approach	PvtlBus	No
6/2/2015	SA-226TC	Aircraft crashed shortly after takeoff on maintenance test flight	Mexico	Climb	Comm	Yes
6/7/2015	BE-90C	Aircraft crashed after takeoff, fire followed, no cause given, daylight	Brazil	Climb	Comm	Yes
6/27/2015	AC-690B	Runway overshoot landing, nose and left main gear collapsed	Mexico	Landing	Comm	No
8/16/2015	CE-441	Crash on approach to Capetow Airport, in IMC, rain, fog	S. Africa	Approach	Comm	Yes
10/2/2015	DHC-8	Aircraft came to rest on top of a seawall during landing	UAR	Landing	Comm	No
10/3/2015	BE-200	Aircraft crashed shortly after departure from Stapleford, Essex	U.K.	Climb	Comm	Yes
10/14/2015	CE-208B	Aircraft crashed during survey flight, at low altitude	Brazil	Maneuver	Comm	Yes
11/1/2015	G-159	Landing gear collapsed landing after it failed to retract	Congo	Landing	Comm	No
12/22/2015	BE-200	Acft. damaged during takeoff, crashed on approach returning to land	India	Approach	Public	Yes

*owned and operated by a non-NA company

Appendix C

Methodology

1. Annual Accident Assessment

IBAC contracts annually to Robert Breiling and Associates to assess and collate business aviation accidents. The Breiling Report provides IBAC with operating hours for each aircraft type as well as accident statistics by aircraft type, by operator type and by area of the world. IBAC uses the information to publish a summary report in the annual *Business Aviation Safety Brief*.

To date the Brief has provided only limited information on accident by operator type due to the lack of acceptable exposure data in terms of hours of operation for each operator type.

It has always been recognized that achieving safety improvement is highly reliant on the knowledge base and understanding of the operations of greater risk so that mitigation can be deter- mined and applied. As an indicator applied to assessing risk, business aviation places importance on statistical comparisons of the accident rate between the different business aviation operational types, namely accident rates for operations of corporate aviation, on-demand commercial and owner operated. Given the difficulty in obtaining exposure data for the hours attributed to each operational type, in the past it has been difficult to obtain with any degree of confidence the accident rates for each operation. However, with recent changes in the methodology and accuracy of an annual survey of general aviation and on-demand Part 135 operators by the US Federal Aviation Administration, IBAC has now concluded that data developed from the Survey is sufficiently accurate to serve as a methodology to provide a global perspective of the difference in rates between the operator types.

Percentage of Operations by Operator Type

The following distribution by operator type is applied to the business aviation hour and departure data to determine exposure by operator used to calculate accident rates: (See Attachment for methodology)

Operator Type	Jet Average	TP Average	Total
Corporate	60.7%	43.2%	55.3%
Owner Operator	11.3%	21.1%	14.3%
Commercial On-Demand	28.0%	35.7%	30.4%

Table C-1

2. Availability of Exposure Data

The US FAA annually completes a survey of US operators, including hours of flight by operator type. Prior to 2006 IBAC was concerned that the gap between the total flying hours calculated by Robert Breiling was different from those of the FAA. However, over the last couple of years the gap has closed to the point that there is increased confidence in the survey results and IBAC has now concluded that the survey information is sufficiently accurate to provide a rea- sonable assessment of the differences between accident rates for each operator type.

The FAA survey is sent to 100% of general aviation and on-demand commercial operators of turbine aircraft in the US and follows up three times with operators that do not respond immedi- ately. Submissions are made annually by approximately 45% of the US turbine operator popu- lation. The US business aviation fleet consists of 65% of the world fleet and the distribution be- tween operator types is considered representative of the global fleet with the exception of the European fleet. The global distribution and an assessment of each region is as follows;

United States	65%	
North America without the US	8%	Distribution considered similar to the US
South America	7%	Distribution considered similar to the US
Europe	11%	Probable higher percent of on-demand commercial operations.
Rest of the World	9%	Different rule structures but most would be similar to the US

FAA survey data was applied over a three-year period to develop an average distribution by aircraft type (Jet, Turbo-Prop and Combined) and operator type (Commercial On-demand, Corporate and Owner-Operated). The data in Table C-1 was applied to the total business aviation hours to calculate the number of flying hours for each operational type.

3. Rate Calculation

Accident rates per operator type were calculated using accident data in the Safety Brief, along with exposure data as explained in S2 above. Tables were developed for both 100,000 flying hours and 100,000 departures.

4. Assumptions

IBAC recognizes that there is error built into the methodology, but given the lack of options the data is considered as accurate as anything available. The following assumptions that give rise to some error are:

The breakdown by operator types is derived from an FAA survey of US operators. An assumption is made that the remainder of the world will have an operator distribution similar to the US. Given that the US consists of approximately 65% of the global fleet, it is unlikely that the error due to this assumption will be very significant.

The FAA survey captured approximately 50% of the total global flying hours. It is assumed that the 50% is representative of the distribution for the complete population.

5. Sensitivity Analysis

As noted above, an assumption is made that the US distribution by operator type is representative of the global fleet distribution and yet it was also concluded that the European fleet distribution is likely different than that of the US. Given the potential that this may result in an unacceptable error, a sensitivity analysis was completed to determine the impact of a higher percentage of the European fleet being operated as on-demand charters.

Two samples for European distribution were selected to test the impact.

Operator Type	Baseline per US Survey	Sample 1	Sample 2
Commercial On-Demand	31%	60%	70%
Corporate	55%	30%	25%
Owner Operator	14%	10%	5%

Results of the analysis demonstrate a very small change when the sample data for Europe is applied. Typically, the sensitivity analysis tables conclude a difference ranging from .01% to .08% in the fatal accident rates, which demonstrates acceptable level of error for the comparison purposes intended by the statistics.

The following Table shows the results of applying to the Safety Brief Issue 6 data the two Sample distributions to the combined jet and turbo prop fleets.

Operator Type	Baseline (31/55/14 %)		Sample 1 (Europe 60/30/10 %)		Sample 2 (Europe 70/25/5 %)	
	Total	Fatal	Total	Fatal	Total	Fatal
Commercial On-Demand	2.28	0.66	2.48	0.71	2.58	0.74
Corporate	0.18	0.04	0.19	0.04	0.19	0.04
Owner Operator	1.86	0.64	1.85	0.63	1.92	0.64
Combined	1.08	0.31	1.08	0.31	1.08	0.31

Appendix D

Landing Accident Analysis

The IBAC Safety Strategy identifies the need to assess data on runway accidents of business aviation aircraft given the proportionally high number of accidents in that phase of operations.

In addition, the International Civil Aviation Organization (ICAO) is placing priority on determining causes and mitigation for global aviation runway accidents in recognition that these accidents are occurring too often.

ICAO convened a Global Runway Safety Symposium in Montreal in May 2011 at which IBAC made a presentation. That presentation was subsequently reviewed and updated for delivery at the EBACE 2012 Safety Day in Geneva on 13 May 2012. This Appendix provides the information presented at the latter event and some additional background.

A detailed analysis of accident data was compiled for a three year period and analyzed to determine most frequent causal factors

Analysis of Landing BA Jet Accidents

1.	Average landing accidents per year	19.3
2.	Wet or snow covered runways	55%
3.	Landed Long	19%
4.	Ran off the runway end	22%
5.	Hard Landing	19%
6.	Hit snow berms	17.2%
7.	7FR conditions	46%
8.	Runway longer than 5000 ft	88%
9.	Malfunction	20.6%
10.	Crew related	62%

Conclusions

Jets

- Overall fewer accidents but, high percentage in the landing phase (55%).

Turbo Prop

- Gear malfunction a frequent cause
- Significant number of single pilot operations.

Conclusions - General

Applicable to Jet and Turbo Prop aircraft

- Poor speed control and unstable approaches most prevalent cause.
- Incorrect or lack of reported runway conditions were a frequent factor.
- Crosswind and gusts were also frequent.
- Poor runway conditions and snow clearance frequent factors.

Overall Conclusions

- Runway length was seldom a factor.
- Fatigue did not appear as an issue.
- Pilot experience was not an evident problem,
- Low ceilings and visibility not prevalent.
- Day/night not a factor.

Mitigation

- Adherence to operations manual and aircraft flight manual.
- SMS and FDA will help.
- Improved runway condition reporting.
- Accelerate implementation of vertical guidance approaches.

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