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Business Aviation Safety Brief

Summary of Global Accident Statistics

2010-2014

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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 Council 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 2015. 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 2010 to 2014. IBAC will update the Brief annually and the IBAC Planning and Operations Committee (POC) will review 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. 2014) 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).

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 2014, the last year covered by the report, is as follows:

2014 Global Business Aircraft Population	
Business Jets	20,164
Turbo Props	14,980
All Turbine Business A/C	35,144

Table 2.1a

Analysis

Business aircraft in North America represent 61% of the global fleet. South and Central America have approximately 14.4% and Europe 11.4% of the world's fleet. Other regions account for the remaining 13% of the fleet.

2.2 Number of Flight Hours

The 2014 summarized flight hour totals are as follows:

2014 Global BusAv Flight Hours	
Business Jets	5,917,471
Turbo Props	4,557,269
All Turbine Business A/C	10,474,740

Table 2.2a

Analysis

For the period 2010-2014, flying hours in North America represents 63.4% of the total, Europe 13.2%, Central/South America 12.5%, and the rest of the world 11%.

2.3 Number of Departures

The number of business aviation departures in the 2014 year is as follows:

2014 Global BusAv Departures	
Business Jets	4,106,725
Turbo Props	3,103,500
All Turbine Business A/C	7,210,225

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, namely 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 2010 – 2014)

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	72	17	14.4	3.4
Corporate	28	4	5.6	0.8
Owner Operated	18	8	3.6	1.6
Government	4	1	0.8	0.2
Fractional	7	0	1.4	0
Manufacturer	0	0	0	0

Table 3.1a

Accidents by Operator Type - Turbo Prop Aircraft				
Turbo Prop Aircraft	Total Accidents	Fatal Accidents	Average Total Accidents per year	Average Fatal Accidents per year
Commercial	224	70	44.8	14
Corporate	31	14	6.2	2.8
Owner Operated	89	34	17.8	6.8
Government	17	3	3.4	0.6
Manufacturer	2	0	0.4	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 EASA 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	10 7.6%	11 8.4%	14 10.7%	3 2.3%	3 2.3%	3 2.3%	13 9.9%	74 56.5%	131 100%
Turbo Props	10 2.8%	25 6.9%	40 11.1%	27 7.5%	6 1.6%	21 5.8%	46 12.8%	185 51.5%	360 100%

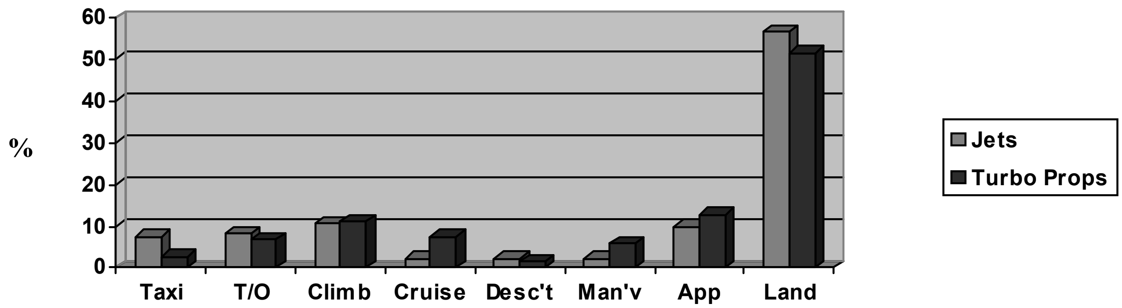


Table 3.2a

Analysis

The trend over a period of 35 years demonstrates a 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 approach phase. The percentage of accidents in the climb phase has also increased substantively for turbo prop 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												
	2010		2011		2012		2013		2014		**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	0.48	0.10	0.44	0.07	0.49	0.10	0.27	0.10	0.45	0.18	**0.47**	**0.13**
Turbo props	1.64	0.29	1.72	0.51	1.43	0.46	1.91	0.88	1.10	0.39	**1.51**	**0.47**
All Bus A/C	0.99	0.18	1.03	0.27	0.91	0.27	0.83	0.36	0.73	0.27	**0.93**	**0.50**

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.

Editorial Note: The rates under column 2012 have been restated and corrected, thus superseding those in Safety Brief No 12 dated September 15, 2013.

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 on 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 64% 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 100,000 flight hours are as follows (based on data over 5 years):

Global Accident Rates by Operator Type *(Extrapolated)* *(per 100,000 flight hours)* **All Business Aircraft**					
Operator Type	Hours of Operation (5 yrs)	Total Accidents	Fatal Accidents	Total Accident Rate	Fatal Accident Rate
Commercial (Air Taxi)	16,113,004	296	87	1.83	0.53
Corporate	29,310,826	59	18	0.20	0.06
Owner-operated	7,579,472	107	42	1.41	0.55
*All Business Aircraft	53,003,303	494	148	0.93	0.27

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 Accident Rates by Operator Type *(Extrapolated)* *(per 100,000 flight hours)* **Jet Aircraft**					
Operator Type	Hours of Operation (5 yrs)	Total Accidents	Fatal Accidents	Total Accident Rate	Fatal Accident Rate
Commercial (Air Taxi)	8,908,927	72	17	0.80	0.19
Corporate	16,219,804	28	4	0.17	0.02
Owner-operated	4,194,271	18	8	0.42	0.19
*All Business Aircraft	29,330,568	137	38	0.46	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 Accident Rates by Operator Type *(Extrapolated)* *(per 100,000 flight hours)* **Turbo Prop Aircraft**					
Operator Type	Hours of Operation (5 yrs)	Total Accidents	Fatal Accidents	Total Accident Rate	Fatal Accident Rate
Commercial (Air Taxi)	7,196,511	224	70	3.11	0.97
Corporate	13,091,022	31	14	0.23	0.10
Owner-operated	3,385,201	89	34	2.62	1.0
*All Business Aircraft	23,672,735	357	111	1.50	0.46

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 sector warrants 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 en-route 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 Accident and Rate by Departures *(per 100,000 departures)*					
Accident Rate	Departures	Accidents (5 Years)		Accident Rate	
		Total	Fatal	Total	Fatal
Large Jet Aircraft	5,798,859	24	9	0.41	0.15
Medium Jet Aircraft	6,713,476	27	6	0.40	0.09
Light Business Jets	9,534,393	86	23	1.06	0.28
*All Business Jets	20,626,227	137	38	0.66	0.18

Table 4.3a

Business Turbo Prop Accidents and Rates by Departures *(per 100,000 departures)*					
	Departures	Accidents (5 Years)		Accident Rate	
		Total	Fatal	Total	Fatal
Large Turbo Prop	709,809	47	15	6.62	2.11
Medium Turbo Prop	14,327,816	250	72	1.74	0.5
Light Turbo Prop	1,108,353	60	24	5.41	2.16
All Turbo Prop	16,145,978	357	148	2.21	0.69

Table 4.3b

All Business Turbine Accidents and Rates by Departures (per 100,000 departures)					
	Departures	Accidents (5 Years)		Accident Rate	
		Total	Fatal	Total	Fatal
All Business Aircraft	36,772,205	494	148	1.34	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 Accident 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)	11,178,750	296	87	2.64	0.77
Corporate	20,335,029	59	18	0.29	0.08
Owner-operated	5,258,425	107	42	2.03	0.79
*All Business Aircraft	36,772,205	494	148	1.34	0.40

Table 4.3d

Business Aircraft Accident 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)	6,270,323	72	17	1.14	0.27
Corporate	11,406,303	28	4	0.24	0.03
Owner-Operated	2,494,550	18	8	0.61	0.27
*All Business Aircraft	20,626,227	137	38	0.66	0.18

Table 4.3e

Business Aircraft Accident 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)	4,908,377	224	70	4.56	1.42
Corporate	8,928,725	31	14	0.34	0.15
Owner-Operated	2,308,875	89	34	3.85	1.47
*All Business Aircraft	16,145,978	357	111	2.21	0.68

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 incongruencies 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, turboprop or recips etc. While it is unlikely that these incongruencies can ever be fully reconciled, IBAC is making every effort to understand and identify these factors and will continue to promote international recognition of the IBAC safety data.

Aviation Sector	Fatal Accident Rate (per 100,000 departures)
All Business Aircraft (Jet and Turbo Prop)*	0.40
Corporate Aviation (Jets)**	0.03
Corporate Aviation (Jet and Turbo Prop)***	0.08
All Business Jets****	0.18
Boeing Annual Report – Jet aircraft MCTOM over 60,000lbs engaged in commercial scheduled passenger operations.*****	0.033

Table 4.4a

* Per Table 4.3c. IBAC rate is 5 year average.
** Per Table 4.2b. 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 1959-2013, dated August 2014. Rate is for Scheduled Commercial Passenger Operations for a 10 year period, 2004-2013
[Data for 2005-2014 not available at time of publication.]

4.5 Accident Rate Trend

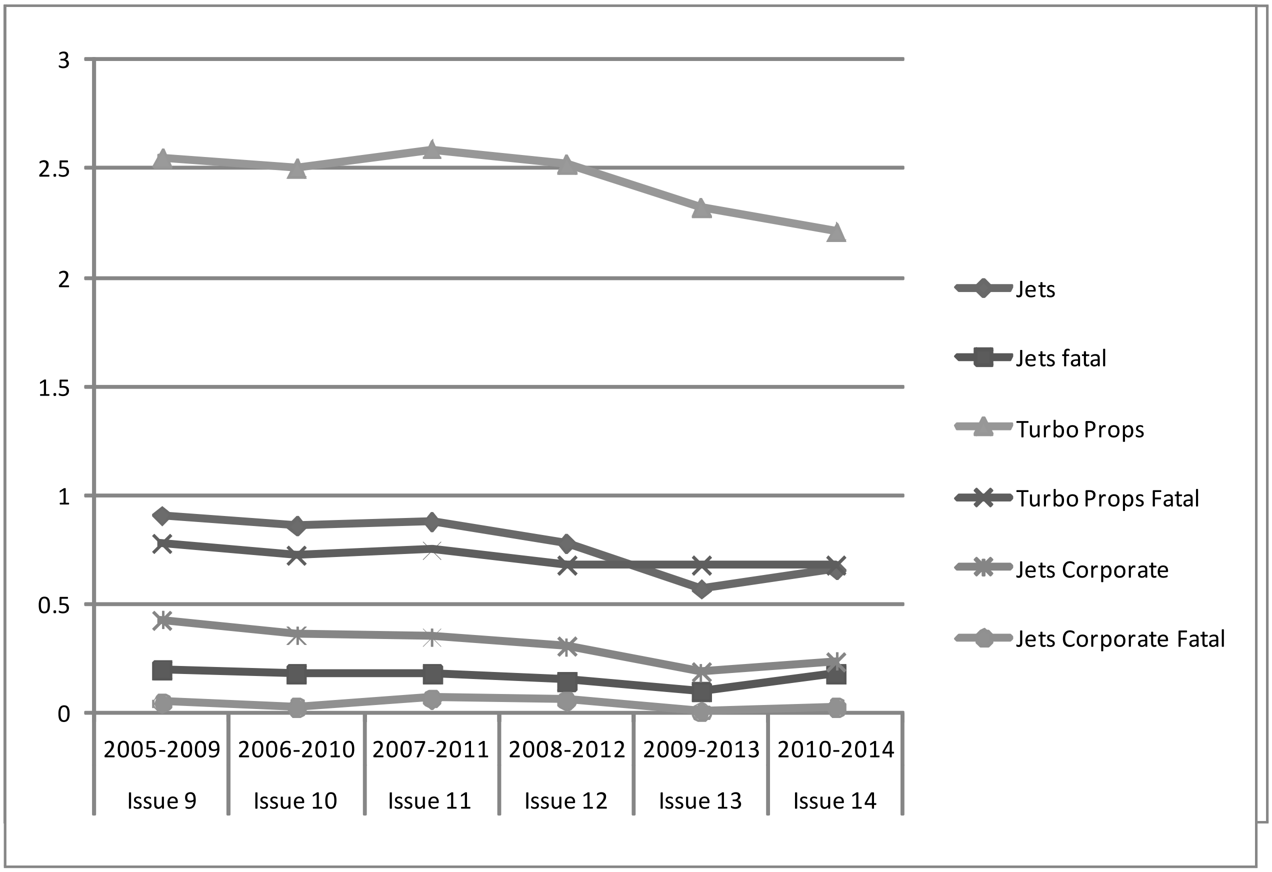


Table 4.5a

5.0 IS-BAO Safety Value

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 analyzed 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 analyzed 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.

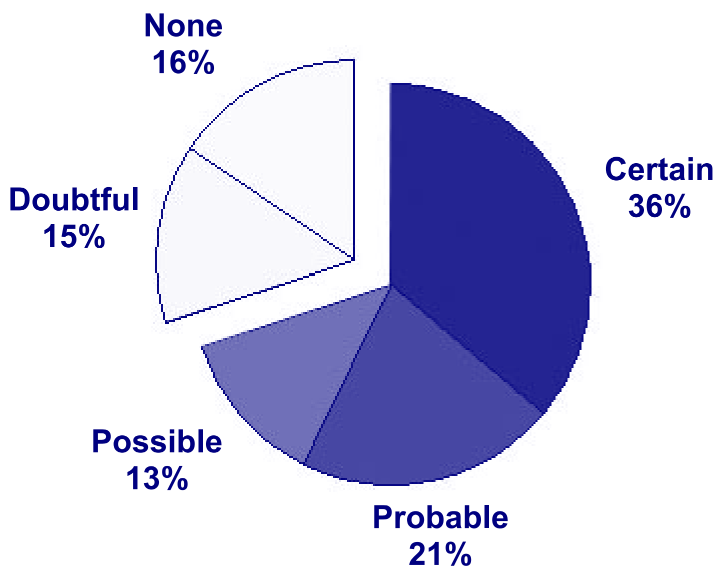
A further step in the methodology included a quality assurance analysis by a group of current pilots through an assessment of a random selection of twelve accidents as a means of verifying the results of the analysts.

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)



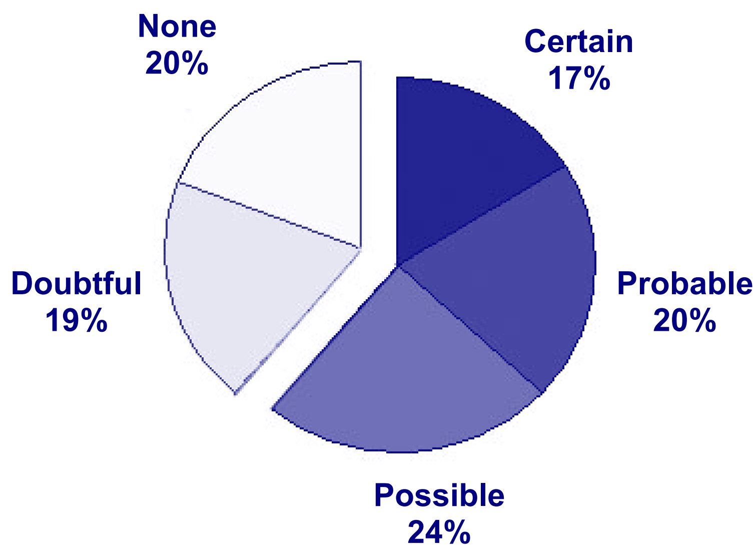
Conclusion - The probability of prevention is 57.2%, with a further 12.8% possible for a total of <u>70% potential that the aircraft accident could have been avoided</u>.

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)



Conclusion - The probability of prevention is 37.4%, with a further 23.9% possible for <u>a total of 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 prevented 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 totaled 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

2014 Business Jet Accidents

North American Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/14/2014	G-200	APU access door opened during climb on mtnce. test flight	GA	Climb	Frax	No
2/3/2014	CE-525	Aircraft hit a electric pole during night, IMC approach, night	OK	Approach	Pvt/Bus	No
2/15/2014	CE-500	Pilot failed to extend landing gear prior landing	Canada	Landing	PvtlBus	No
2/24/2014*	G-550	Fuselage struck and damaged by tug while parked, Luton, U.K.	U.K.	Parked	Corp	No
3/13/2014	BE-400A	Bird strike in number 2 engine, aircraft returned and landed safely	NY	Climb	Corp	No
3/16/2014	CE-500	Downwind, x-wind landing, brakes exceeded, runway overshoot	FL	Landing	Pvt/Bus	No
4/26/2014	CE-525B	Acft. overshot landing ended in lake, Spruce Creek, FL, VMC	FL	Landing	Pvt/Bus	No
5/9/2014	CE-525C	Right engine caught fire during engine start	OH	Parked	Comm	No
5/31/2014	G-IVSP	Acft. cashed on takeoff due unsuccessful late abort, night, VMC	MA	Takeoff	Corp	Yes
6/18/2014	IAI 1124 II	Aircraft crashed after takeoff during a training flight, day, VMC	AL	Takeoff	Corp	Yes
8/18/2014	CE-560	Wing hit deer on landing causing substantial damage	Canada	Landing	Comm	No
9/19/2014	EMB-300	Overshot 5,000 ft. runway landing in heavy rain and IMC	TX	Landing	Frax	No
10/27/2014	CE-510	Aircraft impacted a flock of geese in cruise, landed safely	MN	Cruise	Pvt/Bus	No
11/9/2014	L-35A	Aircraft impacted a crane mast 4 mi. from landing airport	Bahamas	Approach	Corp	Yes
11/21/2014	EMB-100	Aircraft overshot runway landing stopped in creek, light rain, x-	TX	Landing	Comm	No
11/24/2014	G-III	Aircraft went off runway side during takeoff at Beggin Hill Airport	U.K.	Takeoff	Corp	No
12/8/2014	EMB-100	Acft crashed into house short of the runway killing 3, VMC, day	MD	Approach	Pvt/Bus	Yes
12/19/2014	L-25D	Aircraft impacted terrain in Mexico at night, no other information	Mexico	Landing	Comm	Yes

*not counted as an operational accident

Appendix B

2014 Business Jet Accidents Continued

Non-North American Registered						
Date	Model	Description	Location	Phase	Operator	Fatalities
1/5/2014	CL-600	Aircraft crashed landing on 2nd attemp,, strong x-wind, downwind	CO	Landing	Corp	Yes
1/12/2014	CE-501	Aircraft undershot approach and hit power lines, IMC, fog	Germany	Landing	Pvt/Bus	Yes
2/1/2014	L-31	Aircraft overshot runway during landing, nose gear collapsed	Urugray	Landing	Comm	No
3/3/2014	DA-20E	Aircraft crashed into the sea near Iran	Iran	Maneuver	Public	Yes
4/10/2014	L-25D	Possible drug flight. Acft. destroyed after landing by Venezuelan AF	Brazil	Landing	Stolen	Yes
4/19/2014	HS-125 700	Acft. crashed into an industrial complex on approach, IMC, fog	Mexico	Approach	Comm	Yes
6/13/2014	CE-525	Runway overshoot by 1,000 ft landing and gear collapsed	Brazil	Landing	Corp	No
6/23/2014	L-35A	Aircraft crashed after mid-air with German fighter on joint exercise	Germany	Maneuver	Comm	Yes
7/7/2014	HS-125-800B	Gear up landing on foam after left gear remained retracted	Russia	Landing	Comm	No
8/13/2014	CE-56OXLS	Aircraft crashed executing a missed approach in poor wx.	Brazil	Approach	Comm	Yes
10/13/2014	CE-525	Aircraft struck by tractor during taxi, night, Milan,	Italy	Taxi	Comm	No
10/16/2014	DA-50	Aircraft destroyed on the ground by warlike action	Ukrane	Parked	Comm	No
10/20/2014	DA-50	On takeoff, main gear hit snowplow on runway, crashed landing back	France	Takeoff	Corp	Yes
12/9/2014	NA-265-60	Aircraft forced down for violating Venezuelan airspace	Mexico	Landing	Comm	?

Appendix B

2014 Business Turbo Prop Accidents

North American Registered

Date	Model	Description	Location	Phase	Operator	Fatalities
1/23/2014	PA-46 500TP	Acft. veered off runway side due to a left landing gear collapse	OK	Landing	Pvt/Bus	No
1/27/2014	BE-90C	Landing gear collapsed landing and aircraft caught fire	CA	Landing	Comm	No
1/31/2014	P-180	Gear was extended by emergency means but collapsed landing	IL	Landing	Corp	No
2/3/2014	AC-690C	Aircraft crashed during second approach in IMC	TN	Approach	Pvt/Bus	Yes
2/19/2014	BE-B100	Aircraft crashed on circling approach in IMC	TX	Approach	Pvt/Bus	Yes
3/22/2014	TBM-700	Aircraft crashed into reservoir short of it's destination	CO	Descent	Pvt/Bus	Yes
3/25/2014	BE-100A	Crew reported gear problems, on landing left main collapsed	Cda	Landing	Comm	No
4/8/2014	CE-208B	Aircraft crashed during a training flight in Alaska, VMC existed	AK	Maneuver	Comm	Yes
6/9/2014	BE-100A	Fuel truck damaged engine and propellar while starting	Cda	Starting	Comm	No
6/13/2014	PA-46 500TP	Aircraft crashed after takeoff in IMC and in dense fog, day at HPN	NY	Climb	Pvt/Bus	Yes
6/18/2014	PA-46TPConv	Control lost avoiding severe wx. at FL 29.5, T-storms,rain,gusts	TX	Maneuver	Pvt/Bus	Yes
6/20/2014	CE-208	Aircraft struck an object takeing off from a beach	AK	Takeoff	Corp	No
6/25/2014	BE-C90A	Aircraft encountered wind shear landing, fire followed	MS	Landing	Corp	No
7/25/2014	DHC-6-300	Aircraft hit by landing halo while taxiing for departure	NV	Taxi	Comm	No
8/6/2014	TBM-700B	Aircraft crashed into high ground during flight in France	France	Cruise	Pvt/Bus	Yes
8/22/2014	TBM-850	Nose gear collapsed landing causing substantial damage	SC	Landing	Pvt/Bus	No
9/3/2014	PA-46TPConv	Aircraft landed gear up during touch and go landing, training flight	CO	Landing	Pvt/Bus	No
9/5/2014	TBM-900	Aircraft crashed from long range cruise flight, out of oxygen `	Carribean	Cruise	Pvt/Bus	Yes
5/15/2014*	PC-12	Aircraft destroyed by hurricane parked at Cabo San Lucas	Mexico	Static	Pvt/Bus	No
9/25/2014	BE-C90	Aircraft veered to runway side and went off into grass. Improper trim	TN	Landing	Comm	No
10/4/2014	AC-690B	Aircraft landed long and went off runway side	CA	Landing	Public	No
10/5/2014	TBM-850	Forced landing in field following oil pressure loss soon after takeoff	GA	Landing	Pvt/Bus	No
10/28/2014	BE-100B	During approach power reduced, acft. Landed hard, gear collapsed	France	Landing	Corp	No
10/30/2014	BE-200B	Aircraft crashed shortly after lift off, hit building, killed 4 in building	KS	Takeoff	Pvt/Bus	Yes
11/18/2014	BE-C90A	Aircraft landed short of runway in field causing gear collapse	NE	Landing	Comm	No
11/20/2014	E-208	Aircraft forced landed on a frozen lake due heavy icing encounter	Cda.	Landing	Comm	No

*not counted as an operation accident

Appendix B

2014 Business Turbo Prop Accidents, continued

Non-North American Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/19/2014	CE-2088	Aircraft impacted wooded terrain after takeoff, day, VMC	Guyana	Climb	Comm	Yes
1/20/2014	BN-2TP	Aircraft crashed into hillside, unknown cause	Romania	Climb	Comm	Yes
2/3/2014	BE-C90	Aircraft crashed into an embankment in IMC	S.Africa	Landing	Corp	Yes
2/3/2014	PC-12	Aircraft landed with landing gear retracted	Mexico	Landing	Comm	No
2/10/2014	CE-208B	Aircraft ran off taxiway side into a ditch	Africa	Taxi	Comm	No
3/12/2014	BE-C90	Aircraft crashed attempting an emergency landing	Colombia	Landing	Comm	Yes
3/27/2014	BE-B200	Aircraft overshot runway during an aborted takeoff	India	Takeoff	Public	No
4/9/2014	Kodiak 100	Wing hit edge of bridge following takeoff	Indonesia	Takeoff	Corp	Yes
4/24/2014	PA-46TP500	Aircraft landed with landing gear retracted, Sao Paulo	Brazil	Landing	Pvt/Bus	No
5/27/2014	BE-B200	Aircraft crashed following a reported engine failure	Latvia	Cruise	Comm	Yes
6/2/2014	BE-B200	Aircraft damaged in forced landing, cause not given	Colombia	Landing	Public	No
6/17/2014	CE-208	Crashed operating in marginal weather enroute	S.Africa	Maneuver	Military	Yes
6/27/2014	BE-200A	Runway overrun, gear collapsed, VMC, day	Congo	Landing	Comm	No
7/28/2014	EMB-100P	Aircraft landed off field, gear up. No other information	Brazil	Landing	Comm	No

Appendix B

2014 Business Turbo Prop Accidents, continued

Non-North American Registered con't

Date	Model	Description	Location	Phase	Operator	Fatalities
9/7/2014	CE-208	Runway overshoot, training flight, engine pulled on takeoff	Africa	Landing	Comm	No
9/9/2014	CE-208B	Aircraft veered off runway side landing collapsing nose gear	Indonesia	Landing	Comm	No
9/9/2014	BE-200C	Main landing gear collapsed during landing roll at New Caladonia	France	Landing	Comm	No
9/14/2014	BE-300L	Aircraft reported engine problems and crashed into houses	Argentina	Maneuver	Pvt/Bus	Yes
9/15/2014*	2-CE-208's	damaged by hurricane winds , Cabo San Lucas	Mexico	Parked	Comm	No
9/20/2014	BE-E90	Aircraft hijacked by pax. with gun, force landed, burned, crew safe	Venezuela	Cruise	Pvt/Bus	No
9/20/2014	DHC-6	Aircraft crashed while positioning for an approach in IMC	N.Guinea	Maneuver	Comm	Yes
9/29/2014	BE-C90A	Gear collapsed during landing, aircraft went off runway side	Australia	Landing	Comm	No
10/4/2014	BE-300	Aircraft decending at high rate and landed hard	Venezuela	Landing	Comm	No
10/10/2014	AC-690C	Aircraft crashed into sea shortly after takeoff, Los Roques Isles.	Venezuela	Climb	Corp	No
10/11/2014	AC-690	Aircraft wreckage found in mountains on flight Teran to Zahedan	Iran	Cruise	Public	Yes
11/3/2014	B-200	Aircraft destroyed by Venezuelan military due illegal entry flight	Venezuela	_	_	_
12/2/2014	PA-31T	Pilot failed to extend landing gear prior landing	Chile	Landing	Comm	No
12/4/2014	CE-208B	Runway overshoot landing on wet runway	Belize	Landing	Comm	No
12/9/2014	AC-690B	Aircraft destroyed violating Venezuelan air space	Mexico	Landing	Comm	?

*not counted as operational accidents

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 determined 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)

	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 reasonable 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 immediately. Submissions are made annually by approximately 45% of the US turbine operator population. The US business aviation fleet consists of 65% of the world fleet and the distribution between 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 Operated	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.

	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 Operated	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 accident 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 analysed 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. IFR 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.