International Business
Aviation Council

Suite 16.33
999 University Street
Montreal, Quebec
H3C 5J9, Canada

www.ibac.org

Business Aviation Safety Brief

Summary of Global Accident Statistics

2009-2013

Issue No. 13
September 1, 2014

Contents

Page Intentionally Left Blank

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 2014. 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 2009 to 2013. 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. 2013) 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 2013, the last year covered by the report, is as follows:

2013 Global Business Aircraft Population	
Business Jets	19,027
Turbo Props	14,642
All Turbine Business A/C	33,669

Table 2.1a

Analysis

Business aircraft in North America represent 61.2% of the global fleet. South and Central America have approximately 11.6% and Europe 13.0% of the world's fleet. Other regions account for the remaining 14% of the fleet.

2.2 Number of Flight Hours

The 2013 summarized flight hour totals are as follows:

2013 Global BusAv Flight Hours	
Business Jets	7,685,043
Turbo Props	3,692,602
All Turbine Business A/C	11,657,645

Table 2.2a

Analysis

For the period 2009-2013, 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 2013 year is as follows:

2013 Global BusAv Departures	
Business Jets	5,333,420
Turbo Props	2,514,662
All Turbine Business A/C	7,848,082

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 2009 – 2013)

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	73	15	14.6	4.9
Corporate	23	2	4.6	0.4
Owner Operated	13	4	2.6	0.8
Government	1	4	0.2	0.8
Fractional	0	6	0	1.2
Manufacturer	1	0	0.2	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	236	64	47.2	12.8
Corporate	34	12	6.8	2.4
Owner Operated	92	13	18.4	2.6
Government	14	3	2.8	0.6
Manufacturer	3	0	0.6	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 8.0%	10 8.0%	12 9.6%	4 3.2%	4 3.2%	1 0.8%	9 7.2%	75 60.0%	125 100%
Turbo Props	12 3.3%	22 6.0%	45 12.3%	28 7.6%	5 1.4%	14 3.8%	63 17.2%	178 48.5%	367 100%

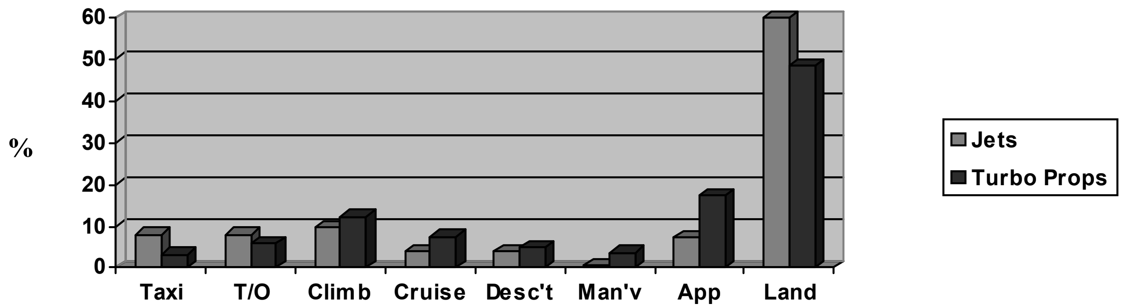


Table 3.2a

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												
	2009		2010		2011		2012		2013		**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	0.37	0.08	0.48	0.10	0.44	0.07	0.49	0.10	0.27	0.10	**0.44**	**0.10**
Turbo props	0.70	0.46	1.64	0.29	1.72	0.51	1.43	0.46	1.91	0.88	**1.58**	**0.48**
All Bus A/C	0.90	0.24	0.99	0.18	1.03	0.27	0.91	0.27	0.83	0.36	**0.95**	**0.27**

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)	16,431,857	309	79	1.88	0.48
Corporate	29,890,846	57	14	0.19	0.04
Owner-operated	7,729,459	105	35	1.35	0.45
*All Business Aircraft	54,052,163	499	131	0.92	0.24

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)	9,159,095	73	15	0.79	0.16
Corporate	16,657,480	23	2	0.13	0.01
Owner-operated	4,307,450	13	4	0.30	0.09
*All Business Aircraft	30,122,026	120	21	0.56	0.06

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)	7,274,477	236	64	3.24	0.87
Corporate	13,233,380	34	12	0.27	0.09
Owner-operated	3,422,013	92	31	2.68	0.90
*All Business Aircraft	23,930,163	379	121	1.58	0.45

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	6,714,774	25	6	0.37	0.08
Medium Jet Aircraft	8,131,858	29	5	0.48	0.08
Light Business Jets	9,584,702	78	19	1.96	0.23
*All Business Jets	20,905,887	132	30	0.63	0.14

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	713,219	52	19	7.29	2.66
Medium Turbo Prop	14,543,453	268	74	1.84	0.51
Light Turbo Prop	1,051,694	59	21	5.61	1.99
All Turbo Prop	20,905,887	379	114	1.37	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	37,214,223	511	144	1.37	0.39

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)	11,313,123	309	79	2.73	0.69
Corporate	20,579,465	57	14	0.27	0.06
Owner-operated	5,321,634	105	35	1.97	0.65
*All Business Aircraft	37,214,223	499	141	1.34	0.37

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)	6,355,390	73	15	1.14	0.23
Corporate	11,560,955	23	2	0.19	0.01
Owner-Operated	2,989,542	13	4	0.43	0.13
*All Business Aircraft	20,905,887	120	21	0.57	0.10

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)	4,957,734	236	64	4.76	1.29
Corporate	9,018,510	34	12	0.37	0.13
Owner-Operated	2,332,092	92	31	3.94	1.32
*All Business Aircraft	16,308,336	379	121	2.32	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)*	0.39
Corporate Aviation (Jets)**	0.01
Corporate Aviation (Jet and Turbo Prop)***	0.06
All Business Jets****	0.10
Boeing Annual Report – Jet aircraft MCTOM over 60,000lbs engaged in commercial scheduled passenger operations.*****	0.035

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 1959-2012, dated July 2012. Rate is for Scheduled Commercial Passenger Operations for a 10 year period, 2003-2012
[Data for 2004-2013 not available at time of publication.]

4.5 Accident Rate Trend

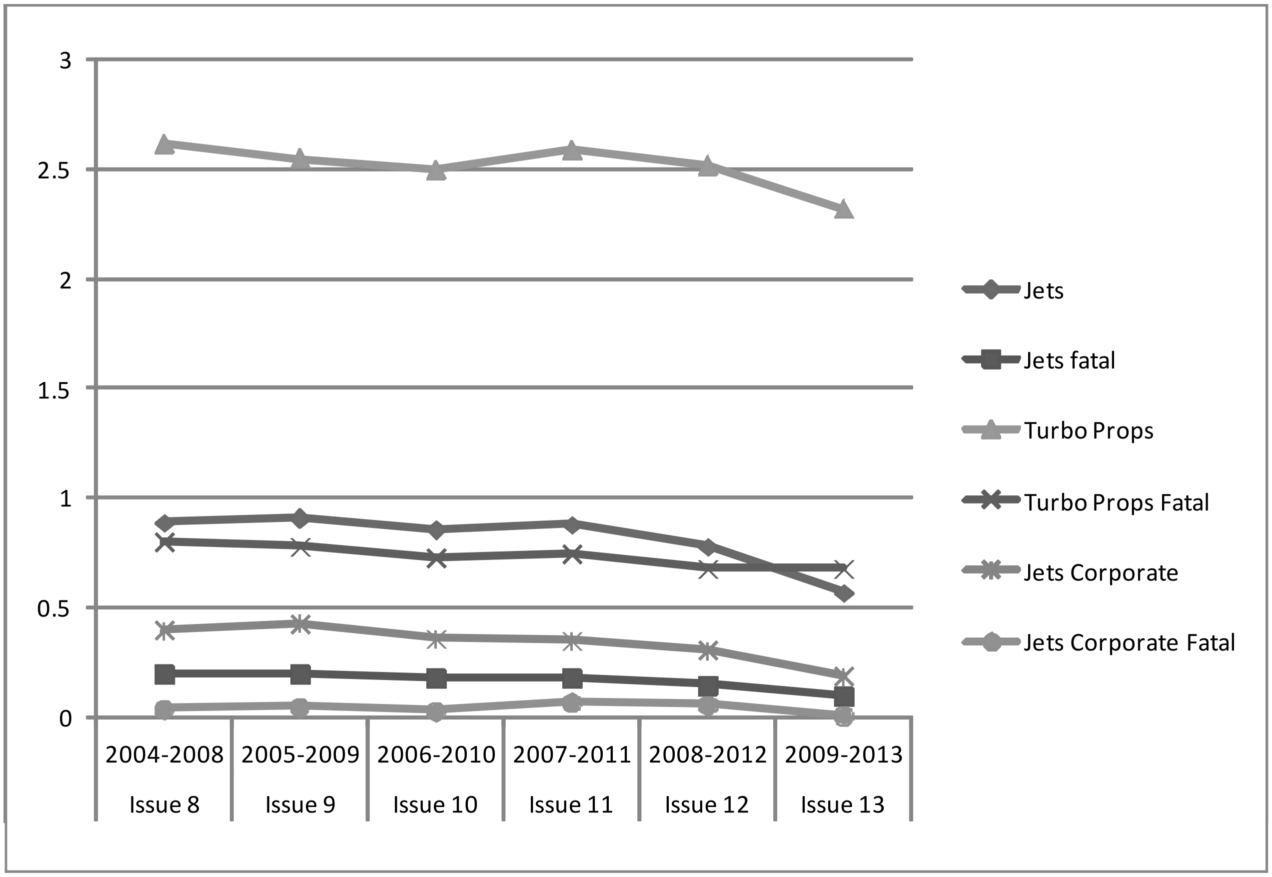


Table 4.5a

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.

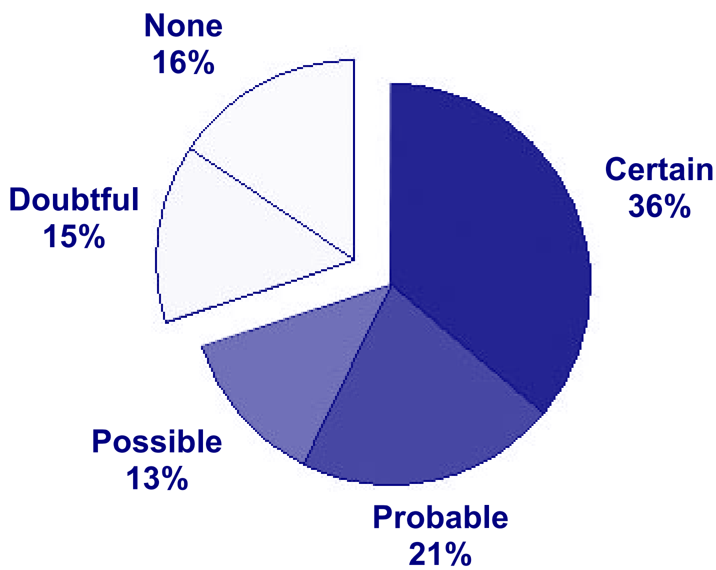
A further step in the methodology included a quality assurance analysis by a group of current pilots through an assessment of a random selection of twelve accidents as a means of verifying the results of the analysts.

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)



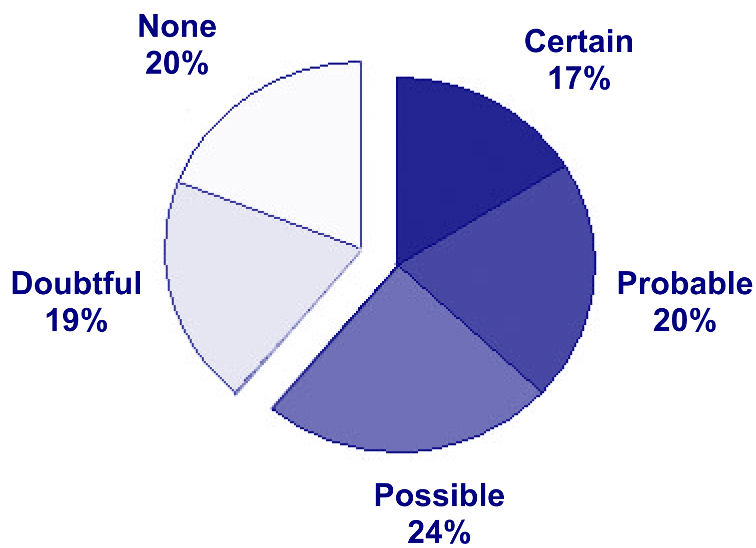
Conclusion - The probability of prevention is 57.2%, with a further 12.8% possible for a total of 70% potential that the aircraft accident could have been avoided.

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 a total of 61.3% potential that the aircraft accident could have been avoided.

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

2013 Business Jet Accidents

U.S. Registered

Date	Model	Description	Location	Phase	Operator	Fatalities
2/20/2013	Premier 1	Aircraft aborted the landing and hit trees and a utility pole, night	NA	Landing	Corp	Yes
3/17/2013	Premier I	Aircraft crashed following an aborted approach, day	NA	Approach	Pvt/Bus	Yes
5/5/2013	L-60	Aircraft crashed into a residential area on approach in heavy rain	NA	Approach	Corp	Yes
5/13/2013	L-35A	Aircraft overran runway and down an embankment on landing	NA	Landing	Comm	No
6/13/2013	CL-601-3A	During mtnce. run up, aircraft jumped chocks and impacted hangar	NA	Parked	Corp	No
6/13/2013	L-39C	Two Vodochody L-39C aircraft collided in air show race, Reno, NV	NA	Maneuver	Pvt/Bus	No
6/13/2013	L-39C	Two Vodochody L-39C aircraft collided in air show race, Reno, NV	NA	Maneuver	Pvt/Bus	No
6/18/2013	IAI 1124	During a touch and go landing, the left main gear collapsed	NA	Landing	Comm	No
8/5/2013	Phenom 300	Aircraft overran runway landing, went thru fence, stopped on road	NA	Landing	Frax	No
9/29/2013	CE-525A	Aircraft veered off runway landing, hit hangars, caught fire	NA	Landing	Pvt/Bus	Yes
10/12/2013	CE-525A	Bird struck wingtip during landing approach, Epply Field, NE	NA	Climb	Mfgr.	No
10/18/2013	CE-500	Aicraft control lost in climb due to unknown reasons	NA	Climb	Pvt/Bus	Yes
11/29/2013	IAI 1124A	Aircraft landed wheel up for unreported reason	NA	Landing	Comm	No
12/2/2013	CE-560	Engine cowl came off during descent damaging stabilizer	NA	Descent	Frax	No
12/17/2013	Premier I	Crash during attempted return to departure airport in VMC, night	NA	Descent	Pvt/Bus	Yes
12/31/2013	CE-525	Acft. Experienced high altitude stall at FL 430, recovered, landed	NA	Cruise	Pvt/Bus	No

Non-U.S. Registered

Date	Model	Description	Location	Phase	Operator	Fatalities
1/22/2013	CE-560XLS	During engine runup test. aircraft gases damaged airframe	Europe	Parked	Comm	No
2/1/2013	Premier I	Bird injestion no. 1 engine, leading edge, nose, landed safely	Europe	Climb	PvtBus	No
2/6/2013	HS-4000	Aircraft landed long and overshot 6,000 ft. runway, day, VMC	Africa	Landing	Comm	No
2/15/2013	Phenom 100	Right main landing gear collapsed during landing at Berlin	Europe	Landing	Comm	No
3/4/2-13	Premier I	Aircraft struck a house shortly after takeoff, day VMC	C.A.	Takeoff	Comm	Yes
5/18/2013	CE-500	Aircraft veered off runway side during landing	S.A.	Landing	Comm	No
6/28/2013	Premier I	Aircraft damaged by thunderstorm winds while parked	S.A.	Static	Comm	No
7/5/2013	NA-265-65	Aircraft went off taxiway and struck a beam due hyd. malfunction	C.A.	Taxi	Corp	No
9/8/2013	L-35A	Rwy. overshoot landing, right main gear collapsed, IMC,rain, night	C.A.	Landing	Comm	No
11/4/2013	HS-125-400	Forced down by Venezuelan Air Force, possible drug flight	C.A.	Maneuver	…	Unknown
11/19/2013	L-35A	Aircraft crashed into Ocean 1 mi. after takeoff from FLL, night	C.A.	Climb	Comm	Yes

Appendix B

2013 Business Turbo Prop Accidents

U.S. Registered						
Date	**Model**	**Description**	**Location**	**Phase**	**Operator**	**Fatalities**
1/12/2013	PA-46 500TP	Aircraft crashed shortly after takeoff from Cox Field, Paris, TX	N.A.	Climb	Pvt/Bus	Yes
1/15/2013	CE-208B	The aircraft impacted trees shortly after takeoff at night in VMC	N.A.	Climb	Comm	Yes
1/16/2013	PC-12	Aircraft crashed shortly after departure in darkness	N.A.	Climb	Corp	Yes
2/6/2013	BE-E90	Aircraft crashed during a training flight, VMC day	N.A.	Maneuver	Pvt/Bus	Yes
2/13/2013	PA-46 500 TP	Aircraft wing struck a building during engine start	N.A.	Taxi	Pvt/Bus	No
2/28/2013	CE-208	Power lost, aircraft force landed 1 mi. short of the airport	N.A.	Landing	Comm	No
3/8/2013	BE-1900C	Aircraft crashed during IMC approach in IMC	N.A.	Approach	Comm	Yes
3/10/2013	PA-46TP	Cvn Aircraft landed hard, went off runway side and wing failed, night	N.A.	Landing	Pvt/Bus	No
3/13/2013	PA-46 500TP	Landing gear sheared off during landing, aircraft landed short	N.A.	Landing	Pvt/Bus	No
3/15/2013	PA-31T	Aircraft crashed during initial climb, electronics test flight, day	N.A.	Climb	Pvt/Bus	Yes
3/29/2013	BE-C90	Aircraft experienced power loss after takeoff and force landed	N.A.	Climb	Corp	No
4/6/2013	TBM-700	Aircraft landed gear up at a private strip	N.A.	Landing	Pvt/Bus	No
4/28/2013	PA-46 500TP	Aircraft failed to climb after takeoff & forced lded, 7,500 ft. elev.	N.A.	Landing	Pvt/Bus	No
6/3/2013	PA-46 500 TP	Aircraft struck a culvert during taxi for takeoff	N.A.	Taxi	Pvt/Bus	No
6/7/2013	BE-200GT	Aircraft crashed after TO due fuel exh. after maintenance	N.A.	Climb	Pvt/Bus	Yes
6/20/2013	AC-690	Aircraft crashed following control loss during a training flight	N.A.	Maneuver	Pvt/Bus	Yes
6/25/2013	BE-200	Aircraft force landed on a road, possible fuel exhaustion	N.A.	Landing	Pvt/Bus	No
7/7/2013	DHC-3TP	Aircraft crashed after takeoff, cloudy, light rain, daylight	N.A.	Climb	Comm	Yes
7/17/2013	CE-208B	Aircraft tipped on its tail during loading prior departure	N.A.	Static	Comm	No
8/6/2013	PA-3IT	Tire blew landing, aircraft went off runway side	N.A.	Landing	Comm	No
8/8/2013	TBM-850	Aircraft crashed on approach in IMC in Auvergne, France	N.A.	Approach	Comm	Yes

Appendix B

2013 Business Turbo Prop Accidents, continued

U.S. Registered Con't

Date	Model	Description	Location	Phase	Operator	Fatalities
8/9/2013	AC-690B	Aircraft crashed 2 mi. short of rwy, fatal to 2 on ground, 2 in acft.	N.A.	Approach	Pvt/Bus	Yes
9/19/2013	BE-C90A	Aircraft undershot approach, landed in field 1 mi. short, gear failed	N.A.	Landing	Pvt/Bus	No
10/22/2013	CE-208B	Power loss in climb, aircraft landed on a road, hit signs,night,VMC	N.A.	Climb	Comm	No
11/1/2013	BE-C90	Aircraft crashed reportedly due to low fuel state	N.A.	Approach	Pvt/Bus	Yes
11/3/2013	AC-690B	Aircraft ditched in Ocean while operating in the Bahama Islands	N.A.	Cruise	Pvt/Bus	No
11/10/2013	MU-2K	Aircraft crashed following engine failure in cruise, crased in woods	N.A.	Cruise	Pvt/Bus	Yes
11/22/2013	BE-1900C	Gear separated landing on strip, Deadhorse, AK	N.A.	Landing	Comm	No
11/23/2013	PA-46-500TP	Aircraft went off runway side during takeoff, Monroe NC	N.A.	Takeoff	Pvt/Bus	No
11/19/2013	TBM-700	Aircraft crashed during an enroute flight in France, cause un-	N.A.	Enroute	Pvt/Bus	Yes
11/29/2013	CE-208B	Aircraft crashed at St. Marys, AK. Operating VMC in IMC	N.A.	Approach	Pvt/Bus	Yes
12/2/2013	PA-46TP	Cvn Control lost during night flight NY to GA, single owner/pilot	N.A.	Enroute	Pvt/Bus	Yes
12/2/2013	SA-227AC	Aircraft entered an uncontrallable high speed descent, VMC	N.A.	Descent	Comm	Yes
12/7/2013	PA-46-500TP	On landing, aircraft went off runway side into a field	N.A.	Landing	Pvt/Bus	No
12/11/2013	CE-208B	Arcft. Crashed into sea after takeoff from Molokai, HA, power loss	N.A.	Climb	Comm	Yes
12/21/2013	BE-C90A	Aircraft impacted a bird on departure, returned and landed safely	N.A.	Climb	Comm	No

Appendix B

2013 Business Turbo Prop Accidents, continued

Non-U.S. Registered

Date	Model	Description	Location	Phase	Operator	Fatalities
1/15/2013	CE-208B	Power lost in flight, aircraft damaged landing on a road	S.A.	Landing	Comm	No
1/23/2013	DHC-300	Aircraft crashed during flight over Antartica	N.A.	Maneuver	Comm	Yes
1/29/2013	PA-46 500TP	Aircraft undershot during flight over Antartica	N.A.	Landing	Pvt/Bus	No
2/3/2013	BE-C90B	Aircraft crashed while enroute in heavy rainshowers	S.A.	Maneuver	Corp	Yes
3/6/2013	BE-B200	Aircraft crashed on approach in IMC. May have hit wires	S.A.	Approach	Comm	Yes
3/12/2013	PA-31T	Aircraft crashed enroute, night	S.A.	Enroute	Comm	Yes
3/29/2013	BE-C90	Power lost on initial climb, force landed in vineyard	Europe	Climb	Corp	No
4/7/2013	BE-1900	Aircraft crashed into the sea during a ferry flight in poor wx.	Africa	Approach	Comm	Yes
4/26/2013	TBM-700	Aircraft crashed on approach, IMC, 500 ft. overcast, 1 mi. vis,	Europe	Approach	Corp	Yes
4/28/2013	TBM-700	Power loss after takeoff, force landed in field, fuel shortage	Europe	Landing	Comm	No
4/30/2013	BE-300	Aircraft crashed shortly after takeoff after loss of one engine	C.A.	Climb	Public	Yes
5/27/2013	CE-208B	Aircraft veered off runway side landing due brake problem	Asia	Landing	Comm	No
6/3/2013	BE-B200	Landing gear collapsed during landing	Africa	Landing	Comm	No
6/4/2013	BE-90E	Nose gear collapsed during landing	Africa	Landing	Comm	No
6/8/2013	CE-208B	Aircraft undershot landing, gear collapsed in a field	N.A.	Landing	Pvt/Bus	No
6/10/2013	CE-208	Aircraft crashed on approach due power loss, day, IMC	Africa	Approach	Comm	Yes
6/10/2013	BE-100	Acft lost power during ILS and crashed in field following mtnce	N.A.	Landing	Comm	No
6/11/2013	BE-100A	Aircraft landed with landing gear retracted	N.A.	Landing	Comm	No
6/29/2013	EMB-110	Aircraft crashed on a 2nd approach in marginal wx. And low vis.	Africa	Approach	Comm	Yes
7/15/2013	CE-208B	Aircraft crashed 2.5 mi. from runway end while on approach	Africa	Approach	Comm	No
7/29/2013	BE-B90	Aircraft landed with landing gear retracted	S.A.	Landing	Comm	No
8/7/2013	BE-B200	Aircraft crashed during approach returning from an EMS flight	Europe	Approach	Comm	Yes

Appendix B

2013 Business Turbo Prop Accidents, continued

Non-U.S. Registered Con't

Date	Model	Description	Location	Phase	Operator	Fatalities
8/15/2013	AC-690B		S.A.	Landing	Comm	No
8/20/2013	SA-227AC	Aircraft overshot the runway during landing , daylight, large airport	S.A.	Landing	Comm	No
8/22/2013	BE-200C	Aircraft ditched in a lake following a power loss en route	Africa	Cruise	Comm	No
8/22/2013	DHC-3TP	Aircraft crashed under unknown circumstances in remote area	N.A.	unknown	Comm	Yes
9/3/2013	CE-441	Aircraft landed with landing gear retracted, pilot was distracted	Oceania	Landing	Pvt/Bus	No
9/9/2013	F/D-228	Aircraft crashed on approach during ferry flight in Chile	S.A.	Approach	Comm	Yes
9/17/2013	PC-12	During takeoff from narrow gravel strip, wing hit trees	Africa	Takeoff	Comm	No
9/25/2013	CE-208B	Aircraft crashed into a lake during a training flight	N.A.	Maneuver	Comm	Yes
10/3/2013	EMB-120	Aircraft crashed shortly after takeoff, possible engine malfunction	Africa	Climb	Comm	Yes
10/5/2013	DHC-8	Aircraft crashed during drug survey mission, cause unknown	Colombia	Maneuver	Military	Yes
10/12/2013	CE-208	Overran runway on takeoff from game preserve strip, into trees	Africa	Takeoff	Comm	No
10/14/2013	CE-208B	Aircraft destroyed impacting terrain near Loreto, BCS , Mexico	C.A.	Climb	Comm	Yes
10/19/2013	PC-6B2	Aircraft lost control during parachute drop, wing failed	Europe	Climb	Pvt/Bus	Yes
10/25/2013	F-27	Propeller blade failed and punctured fuselage during climb out	Europe	Climb	Comm	No
10/29/2013	CE-208B	Aircraft went off runway side onto soft grounf, gear collapsed	Asia	Landing	Comm	No
11/10/2013	BE-B100	Prop hit snow bank landing, aircraft went off runway side	N.A.	Landing	Comm	No
11/19/2013	TBM-700B	Aircraft crashed in France, owned/operated by French company	Europe	Enroute	Pvt/Bus	Yes
11/25/2013	BE-200B	Gear failed to extend, crew landed with gear retracted	Asia	Landing	Comm	No
11/25/2013	CE-208	Power loss in cruise, aircraft destroyed during emergency landing	Oceania	Approach	Comm	Yes
11/26/2013	CE-441	Power failed on 1 engine at rotation, runway overshoot on abort	N.A.	Takeoff	Comm	No
12/19/2013	BE-B90	Power loss both engines after takeoff due fuel exhaustion	S.A.	Landing	Comm	No

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.