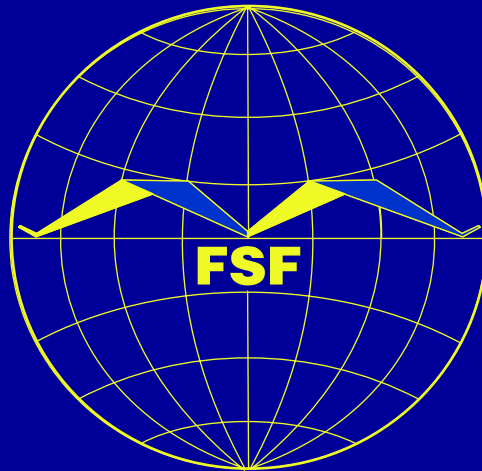


Aviation Safety Successes and Challenges



Jim Burin

Director of Technical Programs
Flight Safety Foundation

What is the Flight Safety Foundation ?

- **Independent**
- **Non-Profit**
- **International**

Founded in 1947 by Aviation Industry

FSF Goal:

Make Aviation Safer by Reducing the Risk of an Accident



The Fleet - 2006

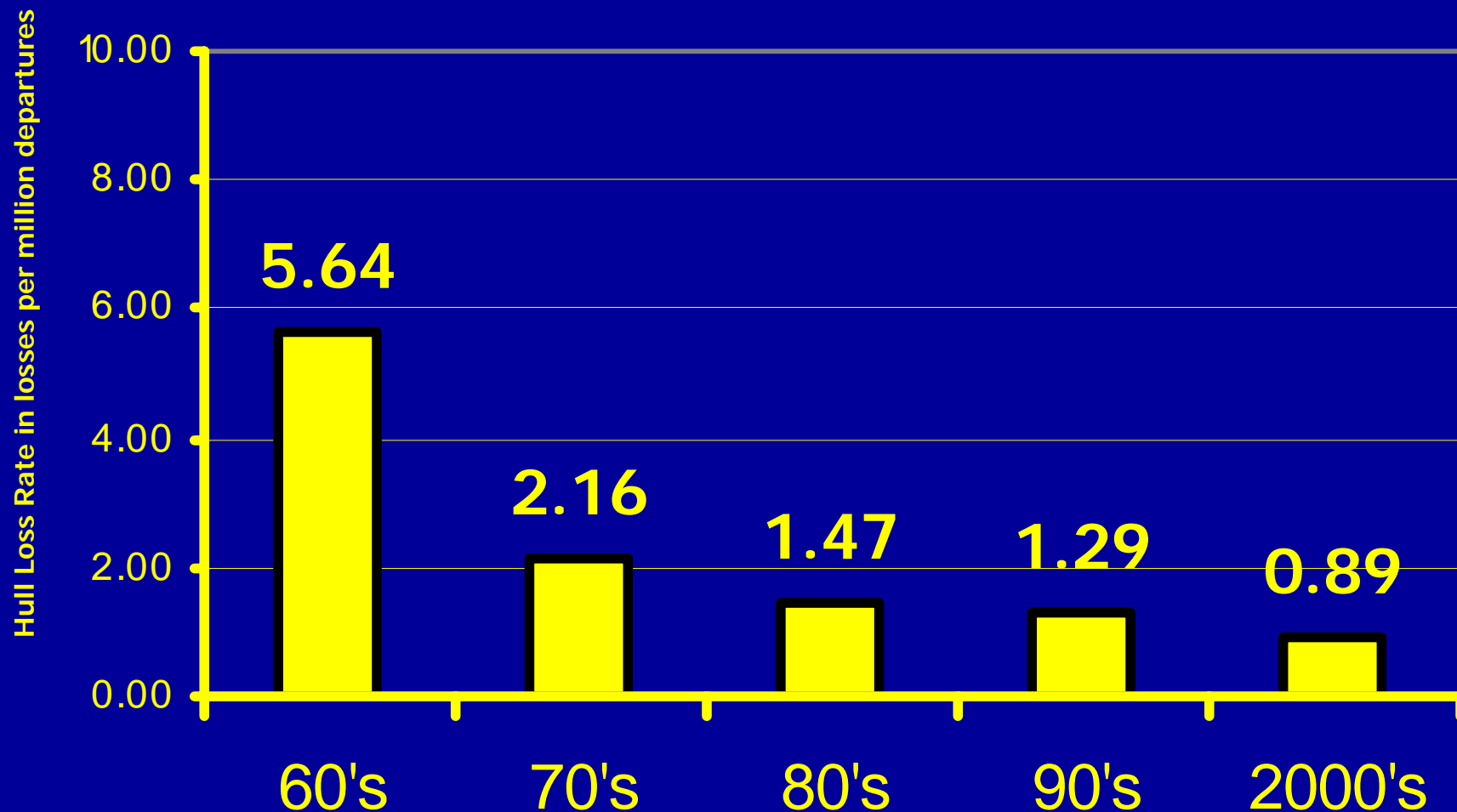
<u>Type</u>	<u>Western Built</u>	<u>Eastern Built</u>	<u>Total</u>
Turbojets	17,609	1,839	19,548
Turboprops	4,774	1,710	6,484
Business Jets			12,724



Photo by Samuel Lo

Hull Loss Accidents

Western Built Commercial Jets (>60,000 lbs) 1960 thru 2005



Major Accidents Commercial Jets 1 January to 31 December 2006

Date	Operator	Aircraft	Location	Phase	Fatal
8 February	UPS	DC-8F	Philadelphia, USA	Enroute	0
3 May	Armavia	A-320	Alder-Sochi, Russia	Approach	113
9 July	S7 Airlines	A-310	Irkutsk, Russia	Landing	126
22 August	Pulkovo Aviation	TU-154	Nr. Donetsk, Ukraine	Enroute	170
27 August	Comair	CRJ-100	Lexington, KY, USA	Takeoff	49
1 September	Iran Air Tours	TU-154	Mashhad, Iran	Landing	28
29 September	GOL	B-737	Sao Felix, Brazil	Enroute	154
3 October	Mandala Airlines	B-737	Tarakan, Indonesia	Landing	0
10 October	Atlantic Airways	BAE-146	Stord-Sorstokken, Norway	Landing	4
29 October	ADC Airlines	B-737	Abuja, Nigeria	Takeoff	96
18 November	Aerosucre Colombia	B-727	Bogota, Colombia	Approach	5

Source: Ascend

Why They are the “Killers”

2004: 196 Commercial Jet Fatalities

0 CFIT, 1 Loss of Control

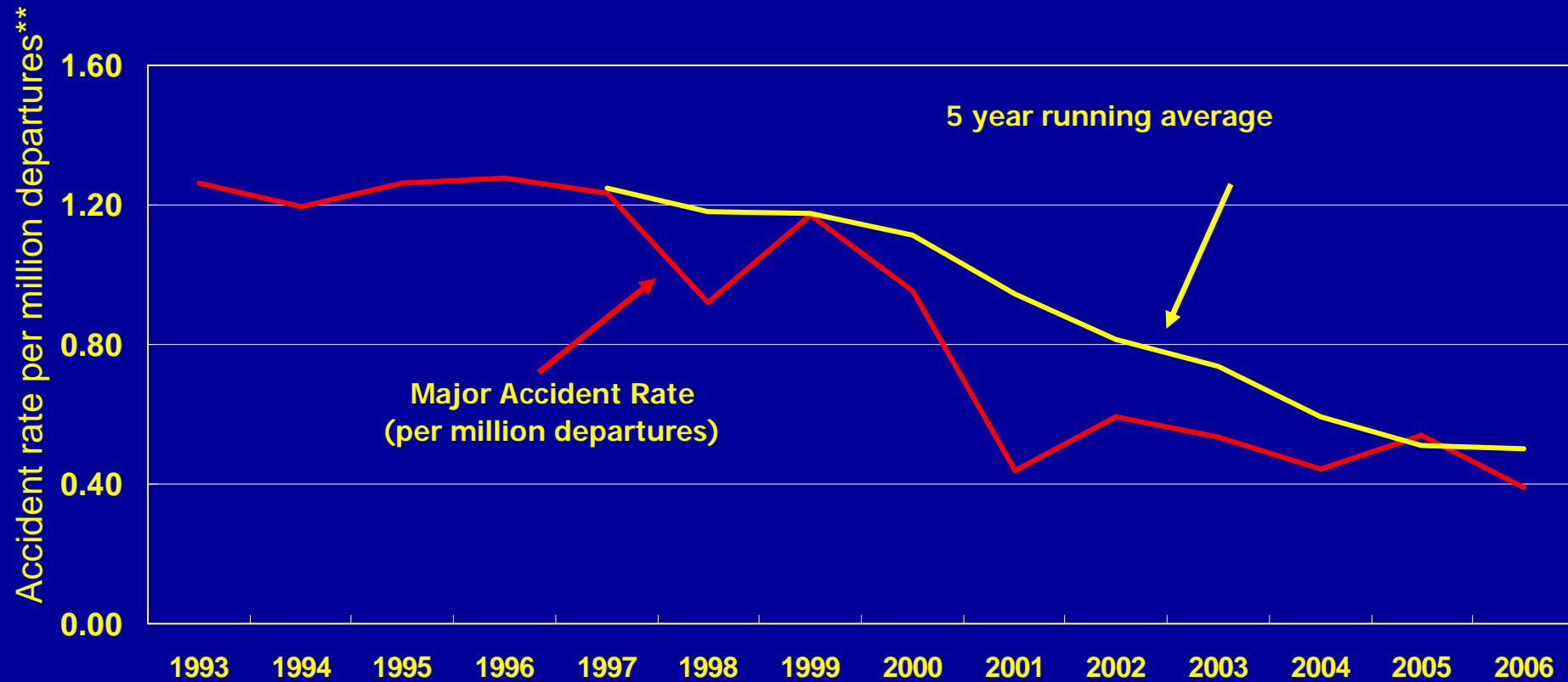
2005: 778 Commercial Jet Fatalities

5 CFIT, 3 Loss of Control

Major Accident Rate

Western-Built Commercial Jets

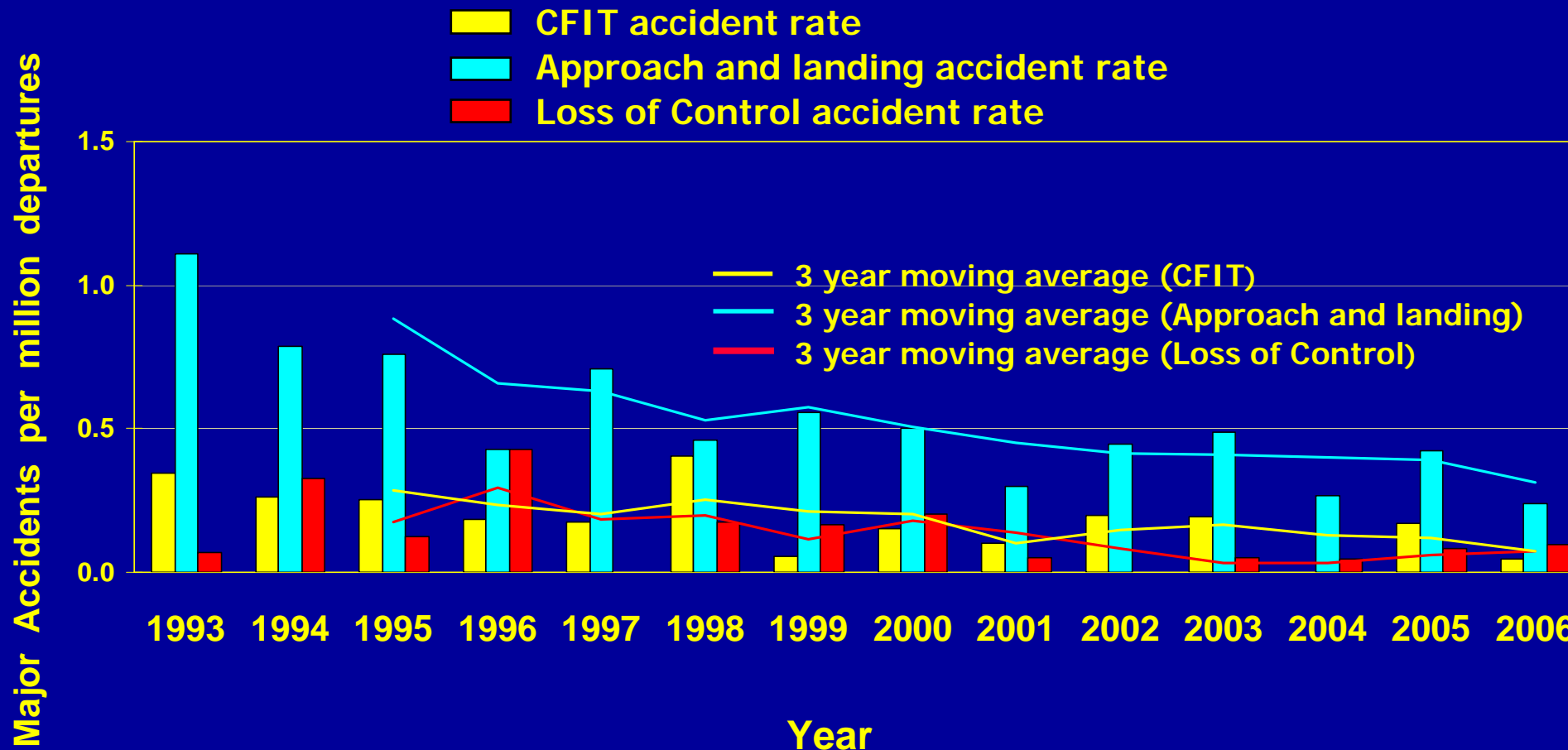
1993 – 2006



Source: Ascend

CFIT, Approach and Landing, and Loss of Control Major Accidents

Western-Built Commercial Jets



Departure data not available for Eastern-Built Aircraft

Hawaii - 27 Sept 1998 - Navajo - 10 Families



Major Accidents

Commercial Turboprops (> 14 seats)

1 January to 31 December 2006

Date	Operator	Aircraft	Location	Phase	Fatal
2 January	Ruenzori Airways	Antonov 26	Fataki, DR Congo	Climb	0
24 January	Aerolift	Antonov 12	Mbuji Mayi, DR Congo	Landing	0
5 February	Air Cargo Carriers	Shorts 360	Watertown, WI, USA	Enroute	3
8 February	Tri Costal Air	Metro II	Paris, TN, USA	Enroute	1
11 March	Air Deccan	ATR 72	Bangalore, India	Landing	0
18 March	Ameriflight	Beech 99	Butte, MT, USA	Enroute	2
28 March	Phoenix Avia	Antonov 12	Payam, UAE	Climb	0
31 March	TEAM	Let 410	Saquarema, Brazil	Enroute	19
16 April	TAM	Fokker-27	Guayaramerin, Bolivia	Landing	1
24 April	Air Million Cargo	Antonov 32	Lashkar, Afghanistan	Landing	2
27 April	LAC Skycongo	Convair 580	Amisi, DR Congo	Landing	8
23 May	Air Sao Tome	DHC-6 Twin Otter	San Tome, Africa	Approach	4
5 June	Merpati Nusantara	CASA 212	Bandanaira, Indonesia	Landing	0
21 June	Yeti Airlines	DHC-6	Jumla, Nepal	Approach	9
7 July	Mango Airlines	Antonov 12	Goma, DR Congo	Climb	6
10 July	PIA	Fokker 27	Multan, Pakistan	Takeoff	45
12 July	TransAfrik	Lockheed Hercules	Kigoma, Tanzania	Approach	0

Source: Ascend

Major Accidents

Commercial Turboprops (> 14 seats)

1 January to 31 December 2006

Con't

Date	Operator	Aircraft	Location	Phase	Fatal
29 July	Adventure Aviation	DHC-6	Sullivan, MO, USA	Takeoff	6
3 August	Tracep	AN-28	Bukavu, DR Congo	Approach	17
4 August	AirNow	EMB-110	Bennington, VT, USA	Approach	1
13 August	Air Algerie	Lockheed Hercules	Piacenza, Italy	Enroute	3
28 August	Paraguay Air Service	Nomad 22B	Cerrillos, Argentina	Enroute	0
17 November	Trigana Air Service	DHC-6	Puncak Jaya, Inodnesia	Enroute	12
30 December	Sky Relief	DHC-5	Nairobi, Kenya	Takeoff	0

Source: Ascend



Hull Loss Accidents

Worldwide Business Jets

1 January to 31 December 2003

Date	Operator	Aircraft	Location	Phase	Fatal
7 Jan	Coturisca SA	Premier 1	Santo Domingo, DR	Landing	0
15 Mar	Dancing Wind Aviation	Citation 501	Hailey, ID USA	Descent	3
8 Apr	Grand Aire Express	Falcon 20	St. Louis, MO USA	Approach	0
8 Apr	Grand Aire Express	Falcon 20	Swanton, OH USA	Approach	3
1 Jun	Eurojet Italia	Learjet 45	Milan, Italy	Takeoff	2
22 Jul	Tango Corporation	Citation 525	Nr. Coupeville, WA USA	Climb	0
23 Jul	Cruz de Malta Taxi Aereo	Citation II	Sorocaba, Brazil	Landing	1
4 Aug	Air East	Learjet 35	Nr. Groton, CT USA	Approach	2
19 Sep	Ameristar Jet Charter	Learjet 25B	Del Rio, TX USA	Landing	1
20 Sep	Star Flite Aviation	HS-125-700A	Nr. Beaumont, TX USA	Approach	3
27 Oct	Aerextra SA de CV	HS-125-800	Nr. Tampico, Mexico	Approach	3
12 Nov	Multi Aero, Inc.	Learjet 24	Nr. Belleville, MO USA	Climb	0
18 Nov	HAALO, Ltd.	Citation II	Mineral Wells, TX USA	Landing	0
23 Dec	Pavair Inc.	Learjet 24	Nr. Helendale, CA USA	Climb	2

Hull Loss Accidents

Worldwide Business Jets

1 January to 31 December 2004

Date	Operator	Aircraft	Location	Phase	Fatal
24 Feb 04	Cable TV Airlines	Citation 1	Cagliari, Italy	Approach	6
25 Aug 04	Grafair	Citation II	Venice, FL USA	Approach	0
24 Oct 04	Med Flight Air Ambulance	Lear 35	San Diego, CA USA	Climb	5
22 Nov 04	Business Jet Services	Gulfstream III	Houston, TX USA	Approach	3
28 Nov 04	Air Castle	CL-600	Montrose, CO USA	Takeoff	3
30 Nov 04	Grand Air Express	HFB-320	Howell Island, MO USA	Takeoff	2
01 Dec 04	GAMA Aviation	Gulfstream IV	Teterboro, NJ USA	Landing	0

Hull Loss Accidents

Worldwide Business Jets

1 January to 31 December 2005

Date	Operator	Aircraft	Location	Phase	Fatal
1 January	Jet Services	Citation II	Ainsworth, NE, USA	Approach	0
28 January	Million Air	Learjet 35	Kansas City, MO, USA	Landing	0
2 February	Platinum Jet	Challenger 600	Teteroboro, NJ, USA	Takeoff	0
21 February	Scott Aviation	HS 125	Bromont, Canada	Approach	0
16 February	Circuit City Stores	Citation V	Pueblo, CO, USA	Approach	8
24 February	Colima State Gov	Westwind	Morelia, Mexico	Enroute	7
8 March	Air Global	Citation I	Caracas, Venezeula	Approach	2
9 May	Compas Acquisitions	Sabeliner	Brownwood, TX, USA	Takeoff	0
15 May	Weibel Scientific	Citation I	Atlantic City, NJ, USA	Landing	0
20 May	Jet 2000	Falcon 20	Moscow, Russia	Descent	0
15 July	Aspen Aviation	Learjet 35	Vail, CO, USA	Landing	0
1 September	USA Jet	Falcon 20	Elyria, OH, USA	Takeoff	0
16 September	Viacao Cometa	Citation 525	Rio de Janerio, Brazil	Climb	2
5 November	Houston Cardiac Assoc	Citation I	Houston, TX, USA	Takeoff	2
28 December	Skyward Aviation	Lear 35	Truckee, CA USA	Landing	2



Major Accidents Business Jets

1 January to 31 December 2006

Date	Operator	Aircraft	Location	Phase	Fatal
2 January	Avcom	Hawker 700	Kharkov, Ukraine	Approach	3
24 January	Goship Air	Citation V	Carlsbad, CA, USA	Landing	4
15 February	Jet 2000	Falcon 20	Kiel, Germany	Landing	0
16 February	Lech Air	Citation I	Busckin, Iraq	Descent	6
2 June	International Jet Charter	Lear 35	Groton, CT, USA	Approach	2
26 June	Great Ideas Corp	Hawker F3	Barcelona, Venezuela	Landing	0
5 July	Vigojet	Saberliner	Mexico City, Mexico	Landing	0
19 July	Tomco II	Citation Encore	Cresco, IA, USA	Landing	2
28 August	Netjets	Hawker 800	Carson City, NV, USA	Descent	0
30 December	Fact Air	Saberliner	Culiacan, Mexico	Approach	2

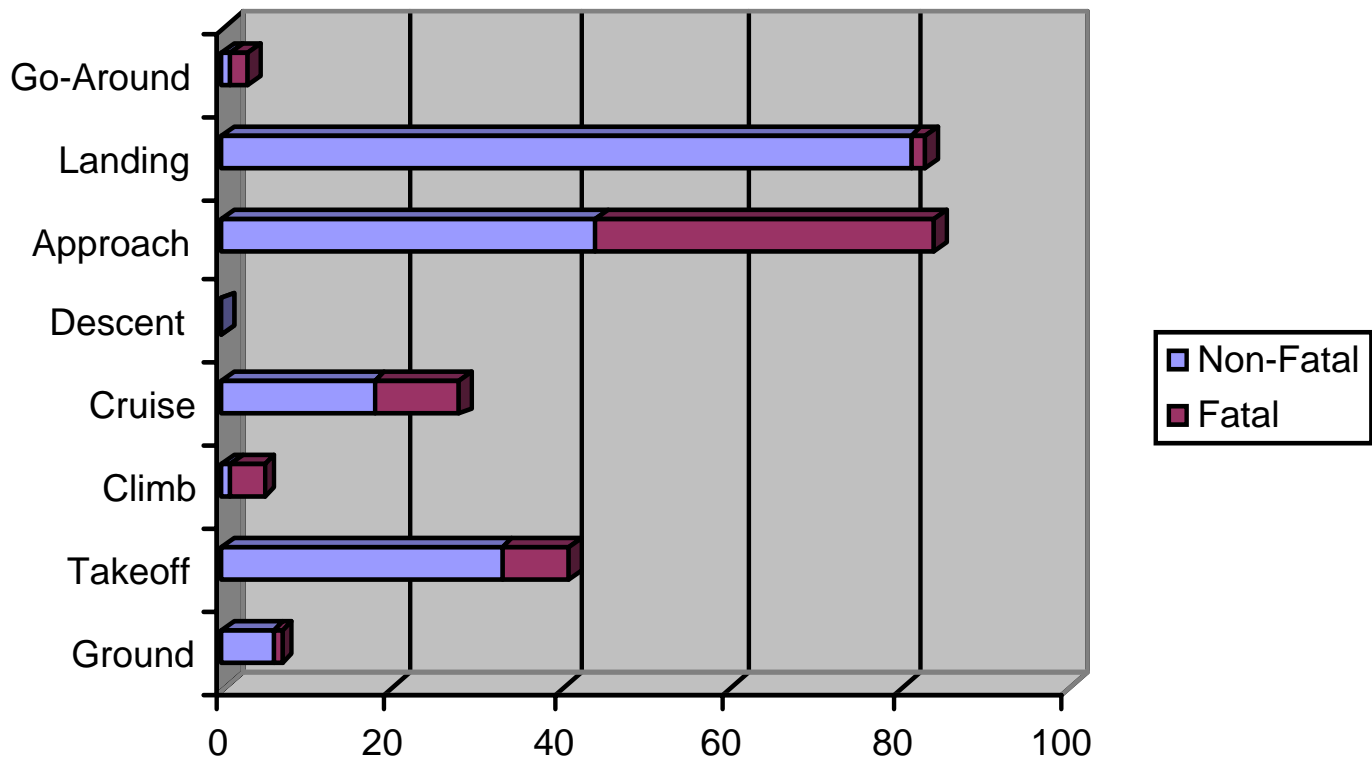
Source: Ascend

1991 - 2000 Corporate Aviation ALA Summary

	<u>Total</u>	<u>Fatal</u>
Accidents	195	54
ALA	97 (50%)	36 (66%)
CFIT	40 (21 %)	26 (48%)

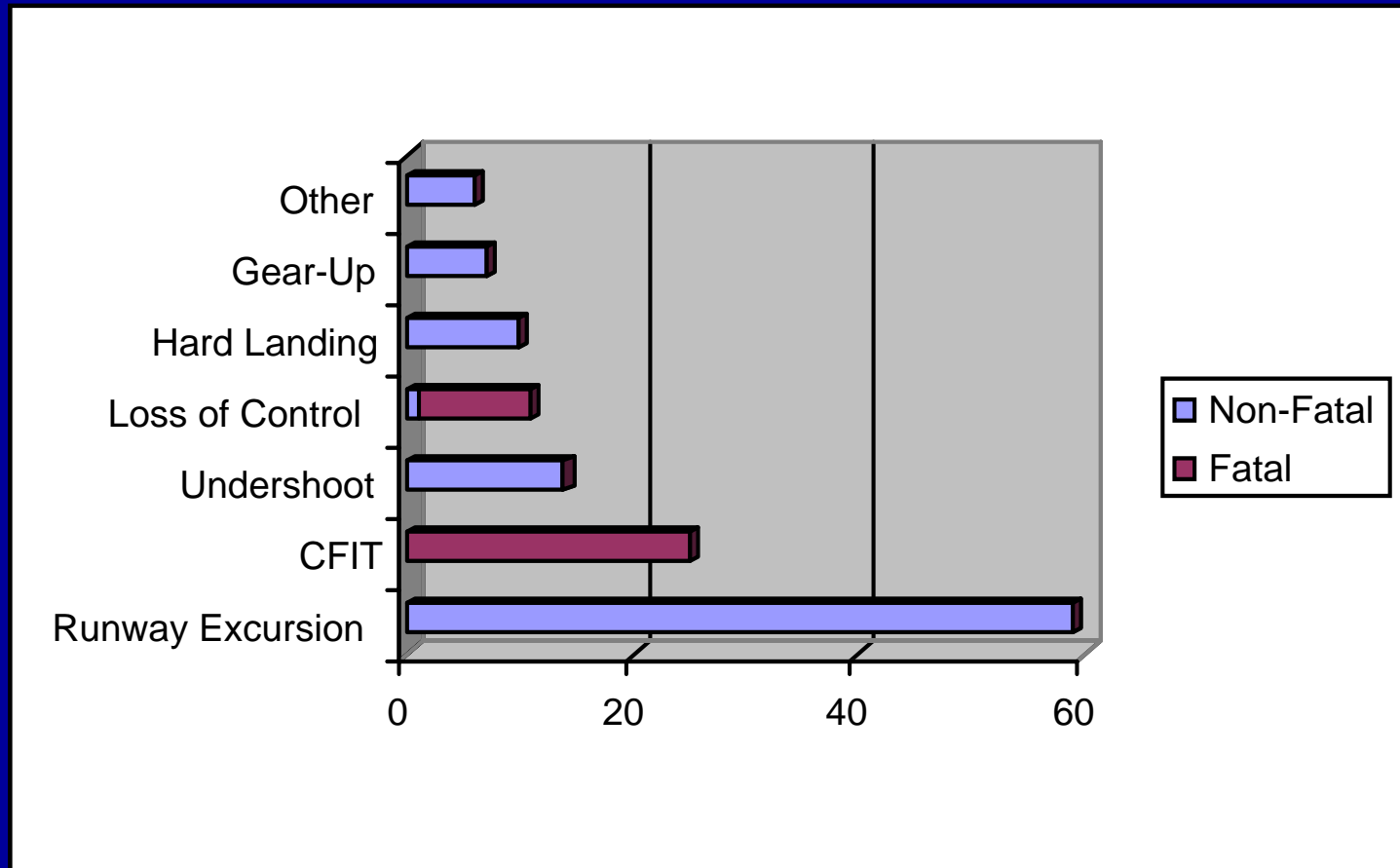
Accident Phases of Flight

1991 - 2002



Causes of Approach and Landing Accidents

1991 - 2002









Boeing B 777 Cockpit

Airbus A 330 Cockpit



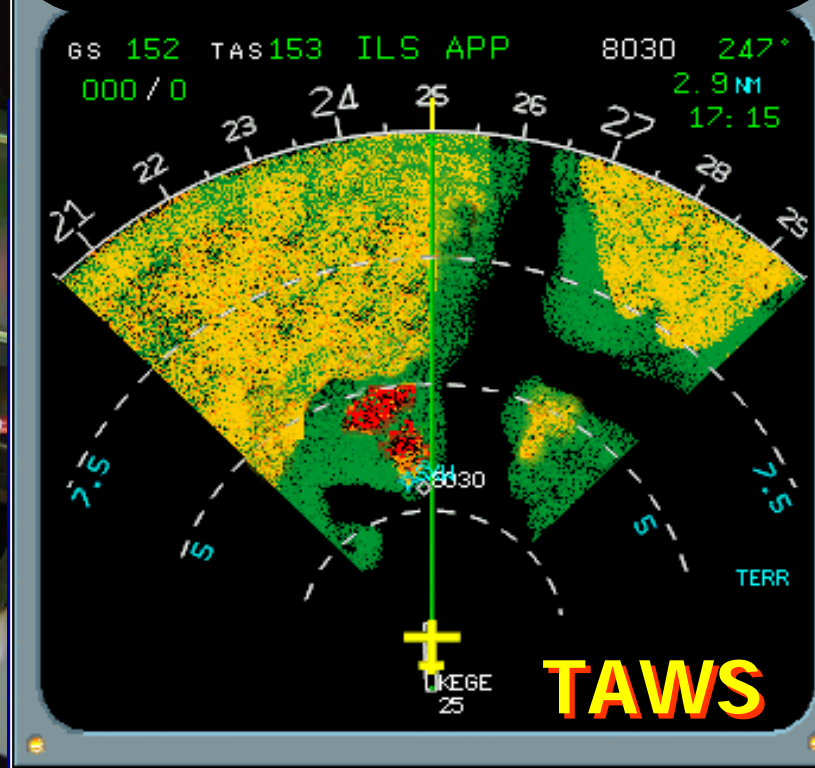
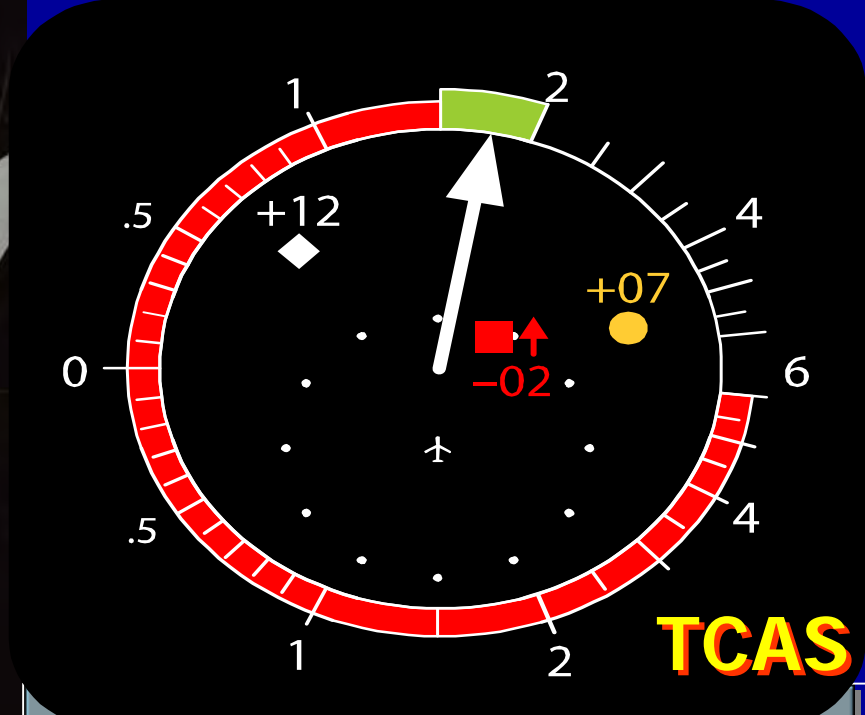




Head Up Display (HUD)

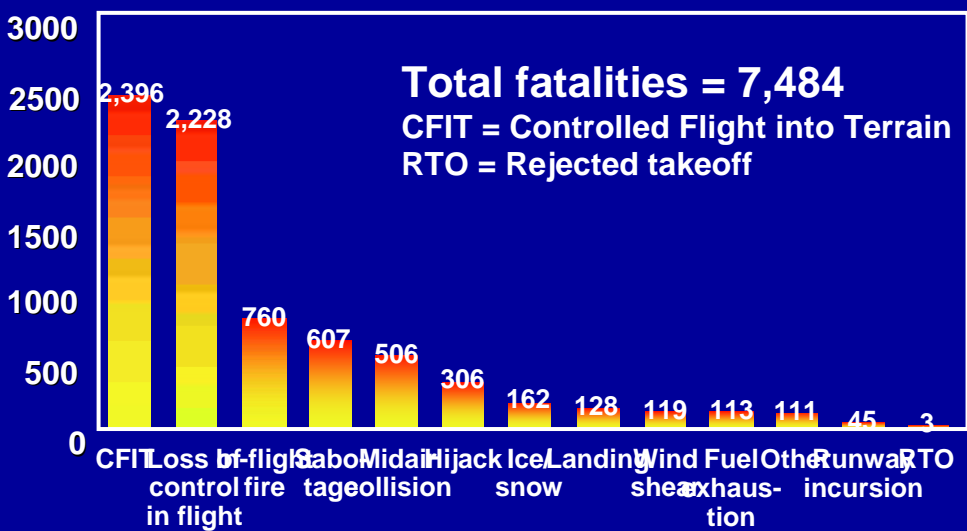
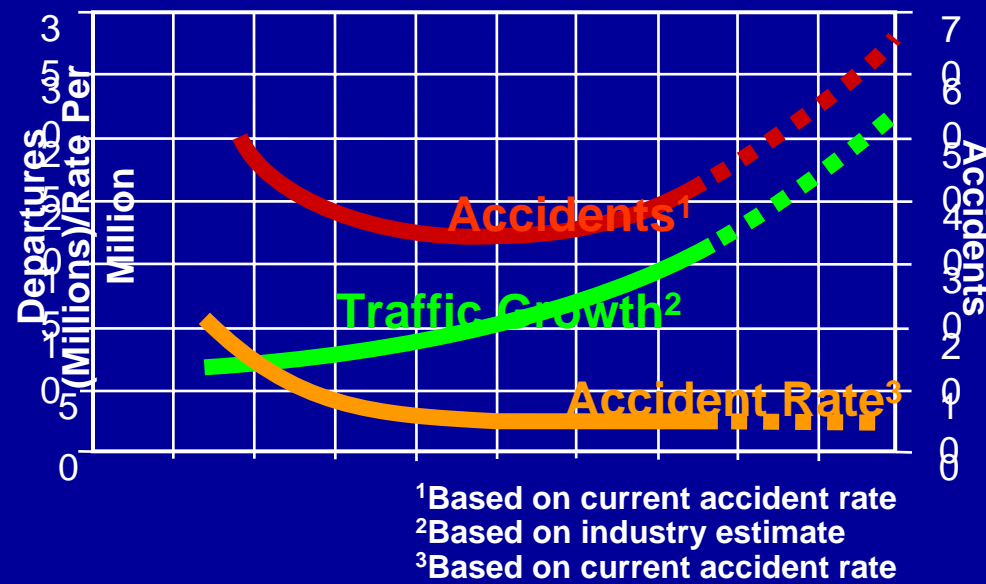


EFB



TAWS

Safety Efforts are Data Driven



Accident Class Description	Date	Location	Aircraft Type	Accident Description	Portion of Accident Eliminated	Intervention Name	
						EGPWS	CFIT TRN
						Portion of World Fl	Portion of World Fl
					.600	.900	
							Intervention Effect
CFIT	1/2/1988	IZMIR, TURKEY	737	HIT MOUNTAIN ON APPROACH	.657	.950	.226
CFIT	2/8/1988	LUANDA, ANGOLA	707	HIT ANTENNA ON APPROACH	.586	.800	.226
CFIT	2/27/1988	KYRENIA MTS, CYPR	727	HIT MOUNTAIN ON APPROACH	.657	.950	.226
CFIT	3/17/1988	CUCUTA, COLUMBIA	727	HIT MOUNTAIN DURING CLIMB	.657	.950	.226
CFIT	6/12/1988	POSADAS, ARGENTIN	MD80	CRASHED ON FINAL APPROACH	.203	.000	.226
CFIT	7/21/1988	LAGOS, NIGERIA	707	CRASHED ON APPROACH	.203	.000	.226
CFIT	10/17/1988	ROME, ITALY	707	LANDED SHORT	.203	.000	.226
CFIT	10/19/1988	AHMEDABAD, INDIA	737	LANDED SHORT	.586	.800	.226
CFIT	2/8/1989	SANTA MARIA AZORE	707	TERRAIN IMPACT/DESCENT	.657	.950	.226
CFIT	2/19/1989	KUALA LUMPUR, MAL	747	TERRAIN IMPACT/APPROACH	.657	.950	.226
CFIT	6/7/1989	PARAMARIBO, SURIN	DC8	TERRAIN IMPACT/FINAL APPRO	.203	.000	.226
CFIT	7/27/1989	TRIPOLI, LIBYA	DC10	TERRAIN IMPACT/FINAL APPRO	.203	.000	.226
CFIT	8/25/1989	ANKARA, TURKEY	727	HIT ILS ANT. ON TAKEOFF	.000	.000	.000
CFIT	10/21/1989	TEGUCIGALPA, HOND	727	TERRAIN IMPACT/APPROACH	.657	.950	.226
CFIT	10/26/1989	HUALIEN, TAIWAN	737	TERRAIN IMPACT/DEPARTURE	.657	.950	.226
CFIT	2/14/1990	BANGALORE, INDIA	A320	HIT SHORT (300 FT)	.203	.000	.226
CFIT	6/2/1990	UNALAKLEET, ALASK	737	HIT HILL 7 MILES OUT IN FO	.657	.950	.226
CFIT	11/14/1990	ZURICH, SWITZERLA	DC9	CRASHED 5 MILES SHORT	.634	.900	.226
CFIT	12/4/1990	NAIROBI, KENYA	707	HIT POWER LINE ON ILS FINA	.203	.000	.226
CFIT	3/5/1991	MT LA AGUADA, VEN	DC9	HIT MOUNTAIN/APPROACH	.657	.950	.226
CFIT	8/16/1991	IMPHAL, INDIA	737	A/C HIT HILL 20 MILES OUT	.657	.950	.226
CFIT	1/20/1992	STRASBOURG, FRAN	A320	IMPACTED GROUND/FINAL AP	.586	.800	.226
CFIT	2/15/1992	KANO, NIGERIA	DC8	CFIT OUT OF PROCEDURE TRN	.586	.800	.226
CFIT	3/24/1992	ATHENS, GREECE	707	ABANDONED APPROACH-HIT MTN	.657	.950	.226
CFIT	6/22/1992	CRUZEIRO DO SUL,	737	HIT SHORT, DRK NT, DISTRACT	.203	.000	.226
CFIT	7/31/1992	KATMANDU, NEPAL	A310	CFIT-HIT MTN-MISSED APPRO	.657	.950	.226
CFIT	9/28/1992	KATMANDU, NEPAL	A300	CRASHED SHORT DURING APPRO	.657	.950	.226
CFIT	11/25/1992	KANO, NIGERIA	707	LANDED SHORT MISLEADING LI	.538	.700	.226
CFIT	11/26/1992	MANAUS, BRAZIL	707	HIT LIGHTS ON TO/RMLG COL	.000	.000	.000
CFIT	4/26/1993	AURANGABAD, INDIA	737	HIT TRUCK AFTER TAKEOFF	.000	.000	.000





Africa 2003

Data Driven

- Accident Data
- Incident Data
- Flight Data Monitoring
- Non-Punitive Reporting
- Line Observed Safety Audit
- Cooperative Data Sharing





The Challenge of Human Error

The alleviation of human error, whether design or intrinsically human, continues to be the most important problem facing aerospace safety

- Jerry Lederer



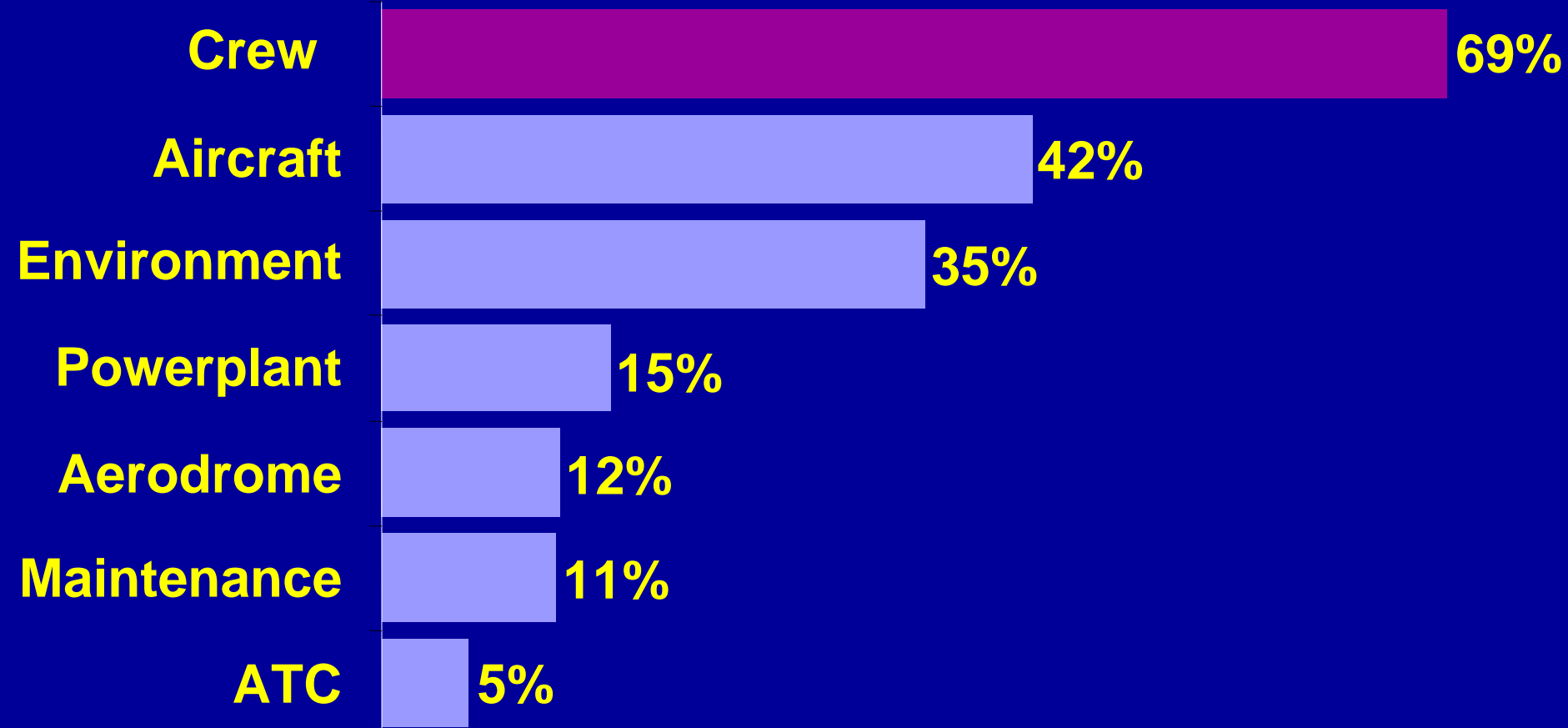
Lautman-Gallimore

1977 thru 1984

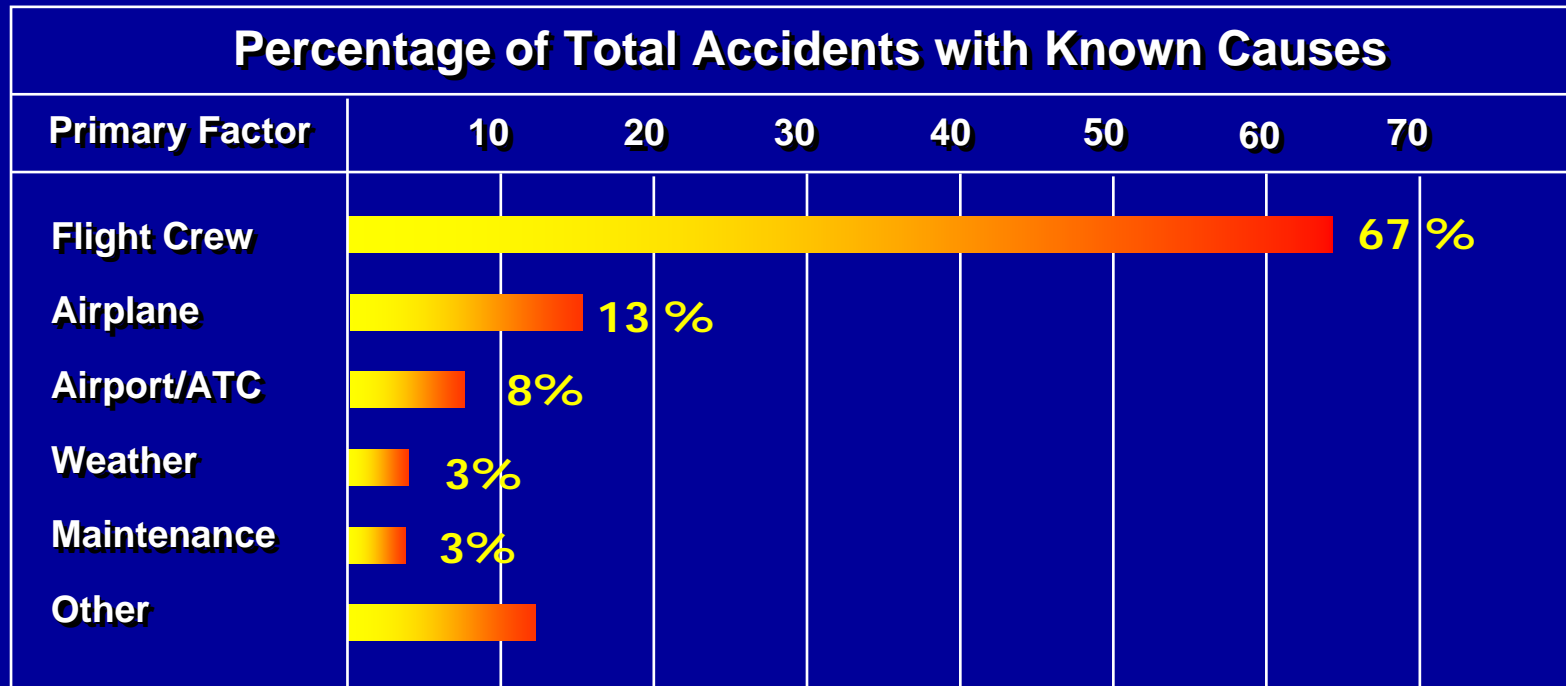
- 70% of accidents Flight Crew error was a cause factor

Dutch Aerospace Laboratory Study

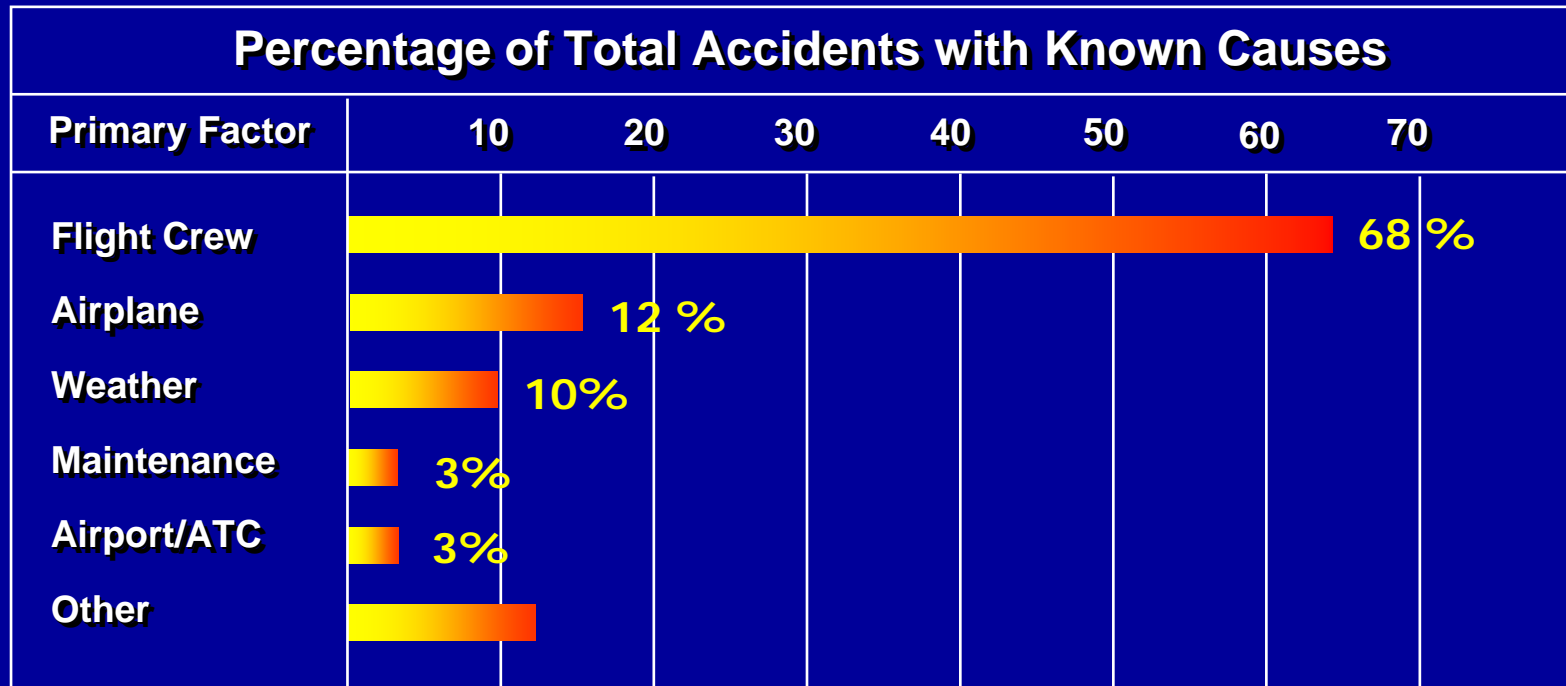
Factors in aircraft accidents 1970-1997



Primary Causes of Aircraft Accidents : 1983 - 1992

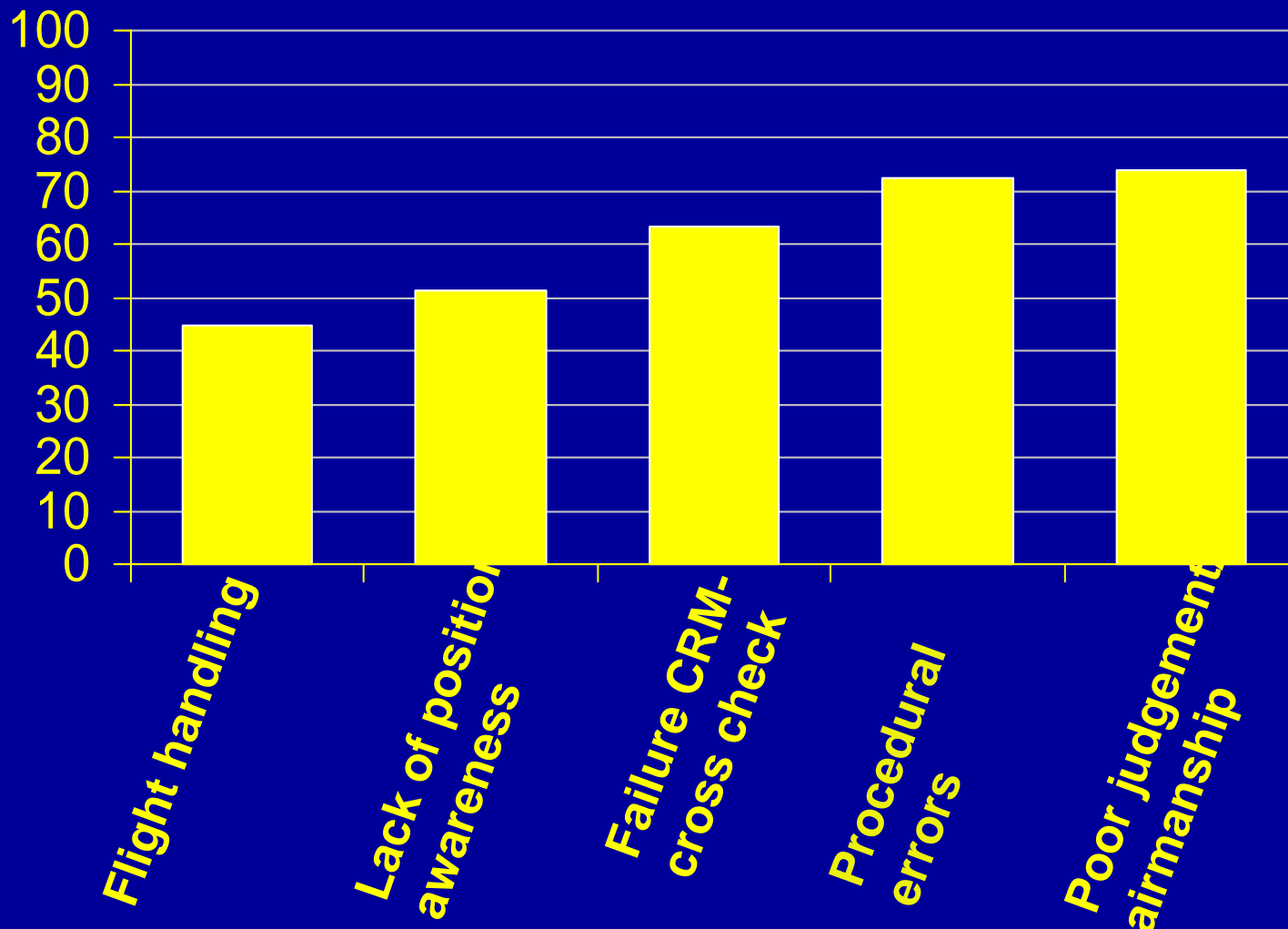


Primary Causes of Aircraft Accidents : 1993 - 2002



ALAR Causal Factors

% Occurrences





**US Airways Runway Incursion Accident –
Los Angeles: Controller cleared aircraft
to land with another aircraft on the runway.**





The Human Factor

We know the problem:
Human Error

The real challenge is
finding the solution

The Human Factor

Education/Awareness:

- CRM
- TEM
- Fatigue/Alertness Management
- Risk Management
- Decision Making
- Lessons Learned from Accidents

The Human Factor

Technology:

- FOQA
- EMAS
- TCAS
- MSAW
- TAWS

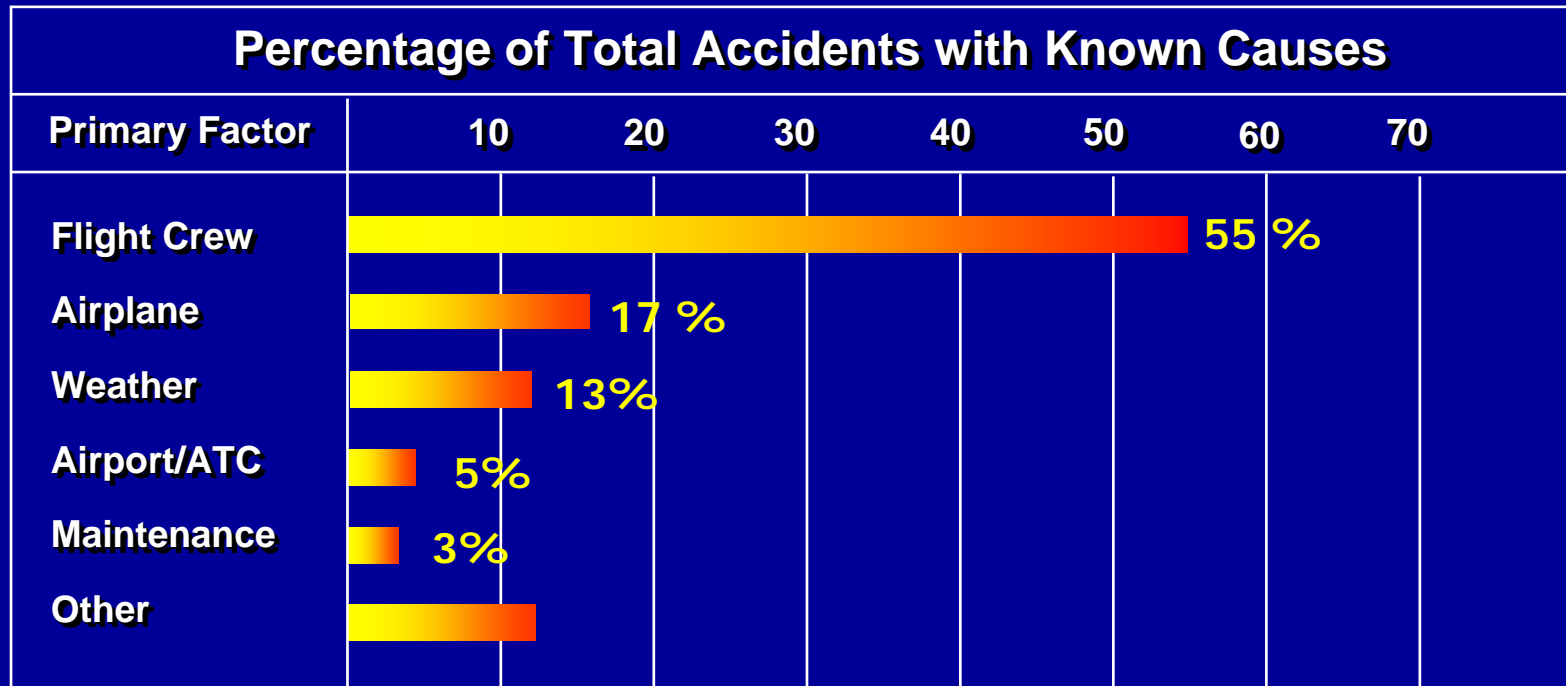
The Human Factor

Other Tools:

- SOP's
- Culture Surveys
- A "Just Culture"



Primary Causes of Aircraft Accidents : 1996 - 2005



Safety Challenges

The discovery of human error should be considered the starting point of an investigation, not the end point.....

- **Dan Maurino**

Safety Challenges

1. Who made errors ?
2. Why were the errors made ?
3. How do we prevent the errors from happening again ?



FSF Goal: **Make Aviation Safer by Reducing** **The Risk of an Accident**

