

Aviation Insurance

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The working party would like to express its thanks to Kellie Hutchings for all her assistance and unending patience.

Introduction

The paper briefly describes the main sectors of the airline insurance market, and the factors that are determining results in this area. In particular, the after effects of September 11th are considered in some detail. The Working Party suggests changes that could be made by insurers, expected growth in the main sectors, and high profile factors that may materially impact on future experience. This paper is intended primarily as an update to the paper that was produced two years ago, and is aimed at those unfamiliar with this esoteric but high profile area of the General Insurance Industry.

Where given, premium figures have generally been taken from brokers' statistics. As such, they are before brokerage (typically 10%) and assume that the entire market gets leader's terms. This has patently not been the case; the difference in rates between lead and following slips has previously been up to 40% for Airlines. More details on this are given in the section on vertical pricing. These two factors make the actual experience considerably worse than that shown.

The paper has been split into the following sections:

The Aviation Market
Airline Insurance (Hull and Liability)
Airline Insurance (Hull War)
Product Liability
Miscellaneous Covers
Accident Statistics
Current Issues in the Aviation Market
Features of the Aviation Market
Conclusions
Appendix A – Large Losses
Appendix B – Losses on and after September 11th
Appendix C – Kuwait Airways

Disclaimer

The contents of this paper represent the personal views of the working party members and should not be considered as representing the views or policies of our employers or the Institute of Actuaries.

THE AVIATION MARKET

Summary of Industry Statistics (Ralf Olessner of Lufthansa)

- Currently employs 28m people directly or indirectly
- Contributes \$1400bn to world GDP
- Carries 30m tons cargo p/a
- Carries 1.6bn passengers p/a (+ charter passengers)

In the US 60% of the population travels annually by air, in Eastern Europe this is 0.4%, in China 0.05% so there is the potential for massive growth. In the USA 50% of revenue passenger kilometers (RPKs - the product of the number of passengers and the distance they fly) are domestic, in Europe 80%. Looking at the number of aircraft movements, it can be seen that there are as many per annum in the USA as there are in Canada, Europe, Japan, Korea, Australasia and Hong Kong added together. The growth potential is certainly there, but the high degree of competition and rapidly changing marketplace forces airlines to be either: a) big, b) cheap or c) niche operators. This is the struggle being fought in the industry at present, as large incumbent national carriers suffer at the hands of the new low cost operators.

The Airline Industry

Following September 11th, huge numbers of jobs were lost in areas associated with air travel. This was exacerbated as many operators used the opportunity to shed decades of over manning resulting from the very strong unionised workforces. Over 100,000 people employed by the five major US airlines were made redundant. Sabena and Swiss Airways went bankrupt, US Airways has recently filed for Chapter 11 and United Airlines is teetering on the brink. The indirect effects have been large, with tens of thousands of jobs being lost from the main manufacturers. Whether or not this becomes a temporary blip in the industry growth remains to be seen, but on past evidence e.g. Gulf War, the effects should quickly disappear.

There is no doubt that many of the world's airlines are experiencing financial problems after September 11th. Decreased numbers of passengers, higher charges from service providers, higher insurance and security costs have all played their part. The 5.7% decrease in traffic (IATA 2002 report) is the largest ever. The factors above combined with only small decreases in capacity have caused the largest ever loss in IATA members' history (almost as great as the previous four years profits!). Figures in USD Billion (Source IATA)

	1997	1998	1999	2000	2001
Operating Revenue	145.7	142.7	147.1	155.4	144.0
Operating Expenses	137.5	136.4	141.2	149.2	153.5
Interest	3.2	3.2	3.5	3.4	2.5
Result After Interest	5.0	3.1	2.4	2.8	(12.0)

A comparison of 2001 actual load factors (the proportion of seats that are filled) with those needed to breakeven between 1997 and 2000 is interesting. Actual load factors exceeded breakeven by about 2 percentage points, in 2001 they dropped to 62.4%

(average over last 4 years 64.2%), whilst the breakeven load factor rose to 66.6% (average 61.5%).

According to the Air Transport Association domestic airfares decreased 11.9% whilst international airfares were down 2.1% (May 2002 compared to May 2001). Passenger numbers were down 13% domestically, and 10.6% internationally, whilst load factors were 71% on domestic and 74.3% on international. Scheduled passenger numbers in 2001 fell. These statistics are given for information only, and do not entirely mirror the IATA position.

Western built airliner cycles were around 25m (passenger and freighter), with 46% being in North America, 26% in Europe, 19% Latin America, 7% Caribbean and Africa with 2%. The breakdown of passengers carried was identical (except Africa 1% of total).

Airline Growth Post September 11th

It is expected passenger and cargo growth will be as shown: -

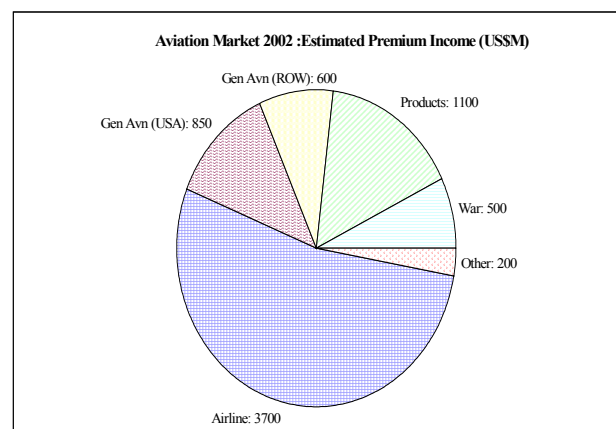
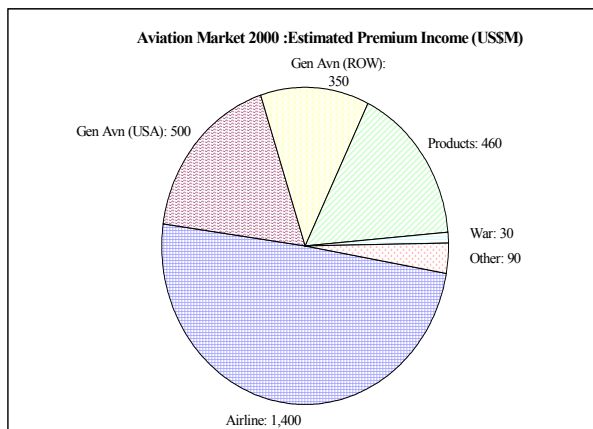
	2001	2002	2003	2004	2005
Passenger	(2.1)%	0.9%	7.9%	5.9%	5.0%
Cargo	(7.7)%	2.7%	5.3%	5.2%	5.0%

This would mean 637m international passengers being carried by 2005; the highest growth is expected in the Far Eastern routes, the lowest on Trans Pacific routes.

Monthly data from IATA suggests recovery in traffic will follow the pattern seen after the Gulf conflict, with positive long-term growth restored towards the end of 2002 Profits will take much longer. Short term the driver to increase profitability is likely to be the caution exercised in reintroducing capacity, longer term the liberalisation of air transport industry and infrastructure are likely to be the key determinants.

The Aviation Insurance Industry

The total aviation market premium, in 2000, was around US\$2,830m, this is expected to amount to US\$6,950 in 2002. The premium is before brokerage and on leaders terms. It should be noted that half of the premium comes from under 500 policyholders. This is split between the following areas:



Although overall plenty of insurance capacity is still available, this will not always be the case for individual risks. Below is the split by domicile of airline of capacity (Source Aon):

	Non US Carriers	US Carriers
Lloyd's	26%	22%
London Market	21%	21%
Europe	49%	44%
North America	1%	12%
Other	3%	1%

There are huge potential exposures arising from an individual accident. Hull values can be up to \$225m, and liability payments average \$3m per person in the US (up to \$10m in some cases). A collision between two 747's could cause a loss in excess of \$3bn (assuming they were fully laden and the flights originated in the US), historically more than the total premium for the whole market.

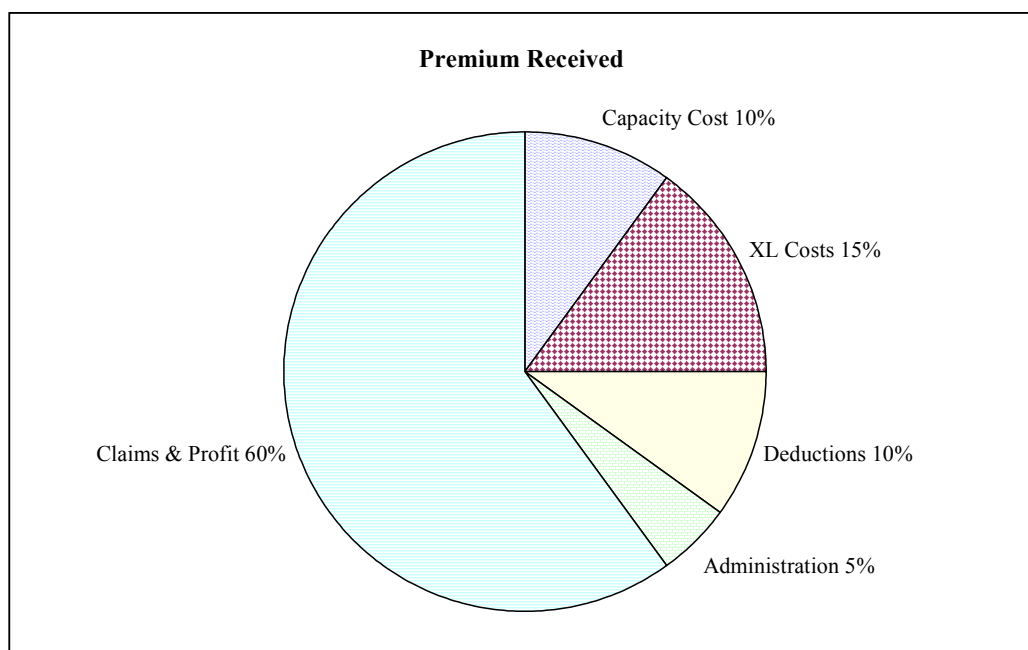
The Interaction between Insurance Costs and Airline Profitability

It cannot be argued that many airlines are suffering financially. However, this should not detract from the drive to ensure that a reasonable premium is paid by the industry for its coverage. Ralf Oelssner, of Lufthansa made a number of points in his recent speech: -

- Of the overall \$12bn loss, around \$9bn was caused by September 11th.
- Lufthansa insurance costs rose from \$28m to \$180m, with an additional \$80m of safety/security costs.
- He suggested the following figures were being charged by the insurance market: - \$4bn airline all risks premium, \$0.5m brokerage, \$0.5bn war, and at least \$1bn for airports and manufacturers. Whilst he concedes that \$1.7bn was too low historically to cover airline risks, this misses a number of points:
 - a) After years of losing money airline insurers want payback.
 - b) Aviation insurance is perceived as being more risky now, so insurers need a higher return.
 - c) Post September 11th reinsurance rates rose even more than direct rates as reinsurers attempt to rebuild their capital bases. This squeezes airline insurers who need to pass on the extra costs.

Use of Premium Received

Most of the premium goes to pay claims. Given the current amounts retained under excess of loss reinsurance programs and the high level of reinsurance rates, it is likely that reinsurance companies will make a substantial profit. When analysing profitability and usage of premium this must be allowed for as insurers could not accept the risks without their own protection. The excess cost of reinsurance (premiums received less claims paid) is included here, as is a capacity cost (opportunity cost to insurer of capital tied up in Aviation – capital taken as 40% of gross premium). This approach will be used later to develop a view of the total premium needed by the market.



Insurance as a Cost

Much is being made of the fact that airlines are losing money, and insurance costs have risen sharply, and the two things are continually being linked. Whilst both these facts are undoubtedly true, it is important to keep things in perspective. Insurance is a relatively small part of airlines' costs.

The table below gives the split of costs for IATA members (per ATK), and is taken from the IATA 2002 annual report.

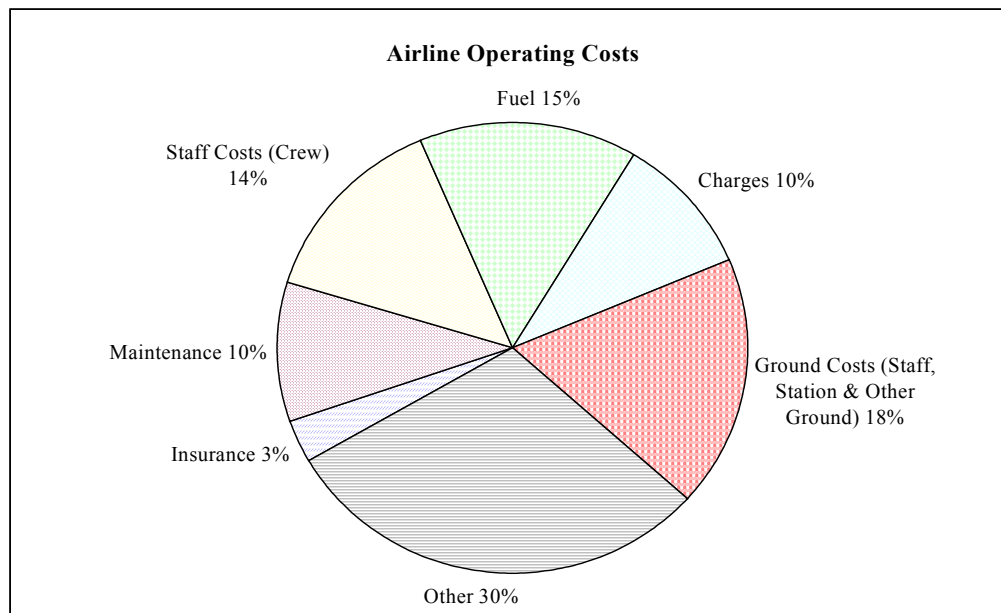
	% Total	US Cents per ATK
Cockpit Crew	7.1%	2.8
Fuel & Oil	15.4%	6.1
Equipment Insurance, Deprecation and Rentals	12.4%	4.9
Maintenance and Overhaul	10.1%	4.0
Landing Charges	5.1%	2.0
En-route Charges	4.8%	1.9
Station and Ground Costs	11.1%	4.4
Cabin Crew and Passenger Services	13.9%	5.5
Ticketing, Sales & Promotions	15.0%	5.9
General and Administrative	5.1%	2.0
TOTAL		39.5

The total represents a 3.3% rise on the previous year.

By considering the relationship between the surcharge (at \$1.25 per passenger) and the additional premium it is possible to work out an expected number of passengers for the year. If the non-surcharge premium is split over the number of passengers and the two parts added, a cost per passenger can be determined. Consider the following costs (including surcharge):

	<u>Per Passenger</u>
Typical 'A' rated operator e.g. Cathay Pacific	\$1.40
Typical 'C' rated operator e.g. Turkish	\$3.75
Typical 'D' rated operator e.g. Korean	\$4.33
World Fleet (\$3.4bn premium, 1.6bn passengers)	\$2.12

Looking at a split of airline operating costs the following can be seen:



Insurance is not a substantial part of the costs incurred by an airline (although it has risen steeply from around ½% previously). It can be calculated that a fully laden 747 would incur an approximate insurance cost of between \$700 and \$2,175 per trip (average \$1,060) for a potential exposure that could exceed \$1.7bn. For a return trip this is less than the cost of a business class ticket. Whether this is a reasonable charge is examined later.

The reason for the large rise in insurance charges are examined elsewhere (previous undercharging, manipulation of the market, availability of cheap reinsurance to insurers, and a lower risk environment).

Airlines have started imposing additional surcharges on passengers to meet these costs. The usual insurance surcharge levied by airlines is massively inflated compared to the real cost, and is usually more than sufficient to cover the cost of the insurance and all the administration. Often there will be sufficient to leave a substantial contribution towards the additional security costs. Where additional security charges are levied on top of insurance surcharges, this is in some cases blatant profiteering by the airline.

AIRLINE INSURANCE (HULL AND LIABILITY)

Introduction

This traditionally covers western built aircraft that can carry 40 or more passengers. Smaller aircraft form part of General Aviation, the definition of which will vary by insurer. The hulls of aircraft constructed in the eastern block are not generally insured. Cargo planes are often included when owned by major airline companies - although the loss or damage to cargo is usually covered separately. Ground property and liabilities arising from ground operations are covered separately. Traditionally war insurance for hulls has been covered separately, whilst the passenger and other third party liabilities have been written back into the main liability policy under the AVN52C write back with the same limits as under the main policy. This changed after September 11th.

The extreme volatility (and low rates charged by airline insurers) started in the 1980's due to the high yields available on investments, which compensated for inadequate premiums. Prior to this rate movements were relatively modest, large claims would push rates up. The increased volatility also broke the relationship between premiums and claims. This situation was further worsened by vertical placing (underwriters set their own price for their own share weakening the market and leaders position). Prior to this (and to a large extent these days) most business was placed on a subscription basis. The demise of this led to a fragmented market, operating with very imperfect information.

Because many insurers write aviation, but it is usually only a small part of their portfolio this business often attracted less interest at the corporate level. This led to the individual underwriters' views having a strong impact on this market and further fragmentation. The whole market became dependent on cheap reinsurance both to limit its risk and to achieve profitability. This reinsurance was supplied by a series of reinsurers who did not understand the market, and who provided naive capacity until forced to withdraw. In the 1980s it was the Marine XL underwriters who provided cover through whole account programs; in the late 1990s it was Australian reinsurers and specialist companies buying market share. As a result of this dependence, the price of reinsurance has a huge impact on the price charged by direct writers.

Fleets used by major carriers often number hundreds of aircraft. Many of these support regional commuter operations (even if they do not own them), which have less good experience. Whilst this may reduce the cost of insurance for the regional companies, it may increase costs for the long haul operator. In other cases, often due to regulation, the risk may initially be placed with the state insurers, in which case reinsurance costs often determine the amount charged. In the past, groups of airlines have purchased their insurance together, but following the Swiss Air loss in 1998 the largest of these, KSSAF split up.

Changes in The Airline Fleet

The world airline fleet has changed as follows over the last couple of years. It should be noted that there are around 1,600 executive size jets in addition to the figures given below:

	1999	1999	May 2002	May 2002
	In Service	Stored	In Service	Stored
Western Built Jets	13,250	554	14,067	1,399
Eastern Built Jets	2,070	545	1,794	520
Western Build Turbo-Props	4,998	365	4,570	572
Eastern Build Turbo-Props	1,965	850	1,683	713

Future projections are very general; there are around 3,100 Western built jet airliners (and 80 turbo prop aircraft) on order. These are overwhelmingly passenger aircraft (89%), of these 23% are wide bodied. 35% of the jets on order are from Boeing, 32% Airbus, 14% Embraer, 15% Bombardier and 4% Dornier.

Post September 11th

Following September 11th around 2,000 aircraft of all types (jet and turbo-prop) were stored in desert locations. Around 60% of these were ageing Boeing 727, 737-200, 747 classic, old McDonnell Douglas planes (up to DC10) and Airbus A300's. The Airbus CEO recently stated that they expect less than a fifth of these planes to be reintroduced into service. However, Boeing gave a more optimistic forecast saying it expects at least a third of the stored planes to be re-used. If the pattern of lay ups and the reintroduction of planes after the Gulf War is followed a number of these are likely to be back in service relatively quickly. The movement in the number of laid up planes and new deliveries since the end of the year tends to support this.

	End 2001	At May 2002
Inactive Western Jets	1,517	1,399
Delivered YTD (94% of 385)		360

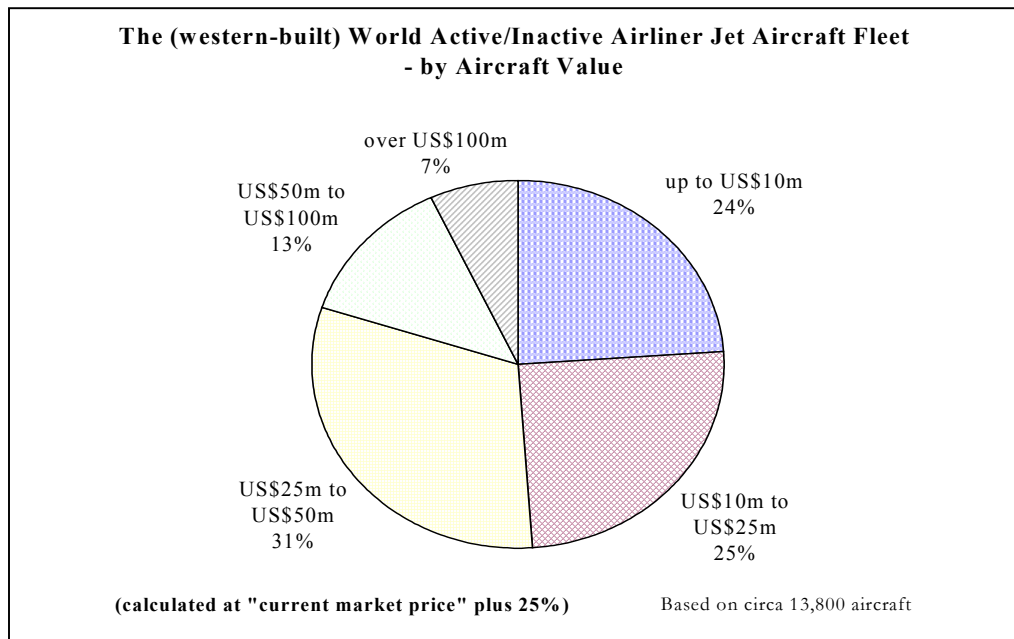
Of the active western jet fleet almost 90% are passenger aircraft, the rest being cargo planes. 25 Cargo planes were delivered in the period covered by the above table.

To put these figures in context, in January 1980 there were 7,430 operational jet airlines, by mid May 2002 there were 15,861 (14,067 Western built and 1,794 Eastern built).

Changes in Fleet Values 2002

For fleets renewing up to July 2002, fleet values had risen by over 10% from 2001. However the maximum hull values have dropped slightly. This may be as a result of the drop in second hand aircraft values. However, cumulative liability limits to this point in time had reduced slightly, probably as a result of limits imposed by underwriters.

The chart below illustrates the approximate split of the world airline fleet by insurance value. This is defined as the current market value by type and variant, grossed up by 25% (to represent the average mark up between the two values). It is surprising to note that about 50% of the total fleet is worth less than \$25m per aircraft; this is probably due to the high proportion of jet airliners that are over fifteen years old. This proportion is likely to decrease as more new, higher value planes are delivered by manufacturers over the next decade, and the new "super jumbos" come into service.



Insurance

The hull policy covers loss and accidental damage (including emergency landings) to air and ground risks: the liability policy covers the airline against legal action from third parties or customers in respect of death, injury or physical damage to property. Most airlines have 'manuscript' wordings devised by the brokers, insurers and purchasers to reflect individual needs, circumstances and preferences. Following September 11th insurers limited war third party liability coverage to \$50m forcing airlines to purchase separate cover from wherever they can.

Individual hull values can now attain \$225m, and even by then end of 1999 over 20 programs included aircraft with values of \$200m or more (source AON). Although there are few of these aircraft, numbers will rise.

Whilst hull values can easily be quantified, the same cannot be said for liability limits. In 1999 111 insurance programs had a liability limit of \$1bn or more (Aon). The amount of liability cover purchased will vary substantially by airline and area of operation. A small regional operator might buy cover for \$500m per loss; a major international airline with substantial US exposure may buy in excess of \$2bn for each and every loss. Multiple losses in one year are possible e.g. Korean Airways in 1999.

Underwriting Techniques

The small number of significant claims, the low number of deaths, and the extreme variability of liability payments make rating hard. Accidents and deaths are both miniscule in comparison to total exposure, so a significant allowance for uncertainty is needed. The various approaches employed include:

- a) Exposure based.
- b) Experience rating – burn costs adjusted for exposure changes and inflation, commission, reinsurance costs and catastrophe loads.

- c) Cash flow – used extensively when interest rates were high, runs the risk of insufficient funds to pay unexpected large claims.
- d) Comparison with similar carriers.

Rating

The rates charged will depend on:

Hull	Liability
Experience of fleet	Experience of fleet
Type & value of aircraft	Departures and number of passengers (previously RPKs flown)
Experience of pilots & crew	Passenger make up
Routes flown	Routes flown, conditions of carriage operated and underlying legal situation.
Excess used	Capacity of aircraft

Revenue Passenger Kilometres (RPKs) is defined as the number of passengers multiplied by the distance flown.

Current Approach to Rating of Hull and Liability Programs

As in the past Hull rating is based on fleet values. In the past exposure to liability claims has been based entirely on RPK's. This is now changing with rating being based on the number of passengers, and the number of take off and landings. This is a far better measure of exposure; the percentages of accidents occurring during the various phases are shown below:

On the ground	8%
Take off/climb	29%
Level flight	4%
Descent/landing	59%

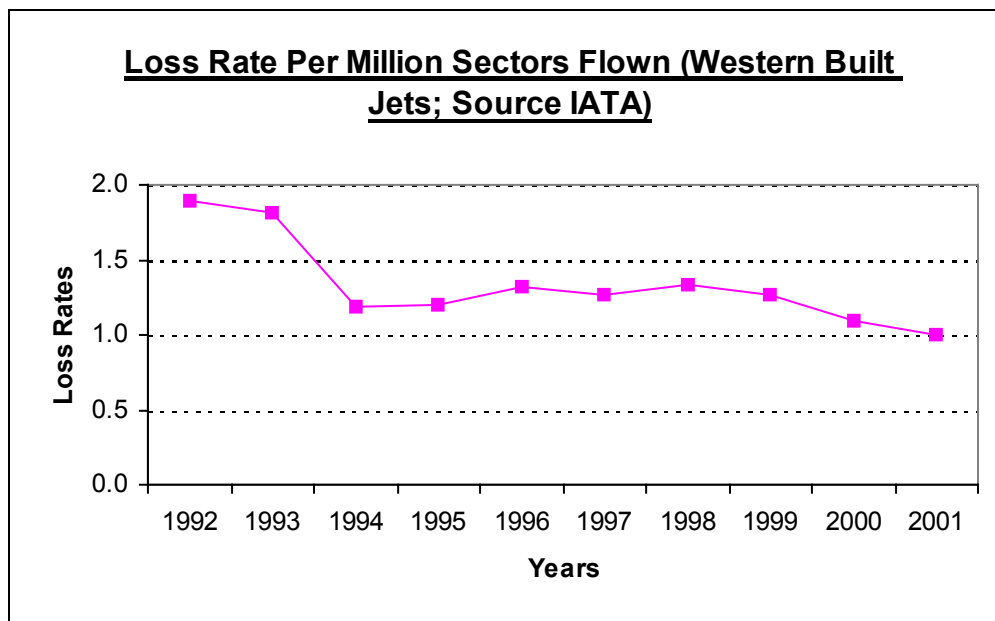
Level flight accounts for 4% of accidents, but 55% of flight time. This implies that rating on distance flown is not a good determinant of risk.

The main global factors that will also be taken in account include the worldwide level of aviation rates, changes to legal situations governing liability, the overall global claims experience the availability and cost of reinsurance, and the spare capacity from other markets. The value of the aircraft will affect the Hull rate – low valuations increase the rate as insurers will tend to pay all partial claims if a single pro-rata rate is applied to a low valuation.

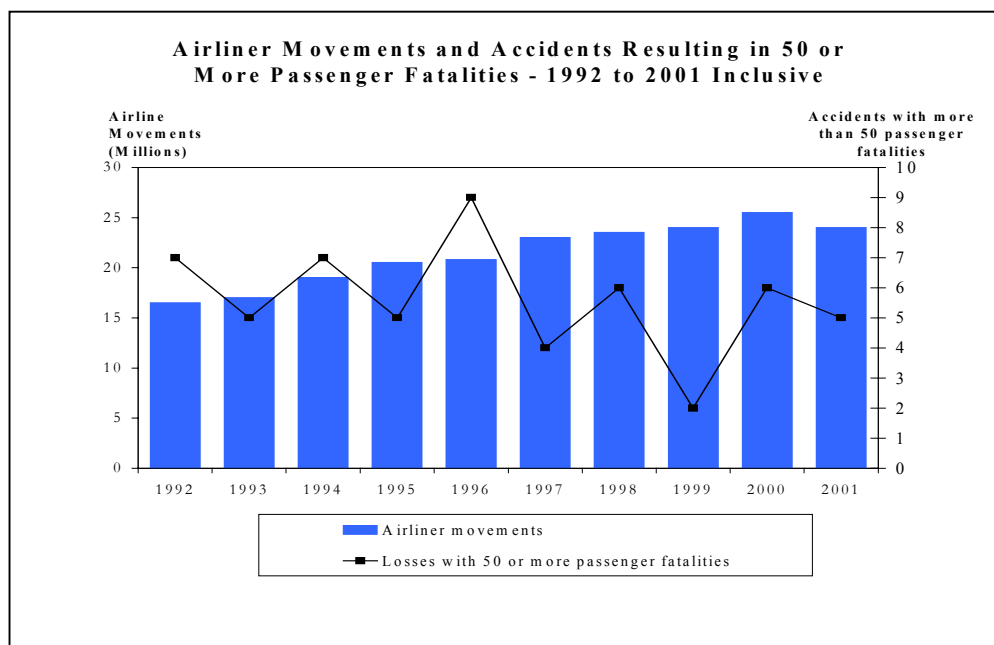
Accident Statistics

IATA Results for 2001

Amongst IATA members (basically covers most international airlines) there were 83 operational accidents to Western built jets and turboprops in 2001. There were 20 jet hull loss accidents and 36 in which the aircraft was substantially damaged. 16 turbo prop aircraft were lost and 11 were substantially damaged. Fatalities totaled 455 in these incidents compared to 897 in 2000. The biggest cause for concern was the large increase in aircraft landing short of the runway. The reason for this is unclear. The graph below shows an obvious downward trend.



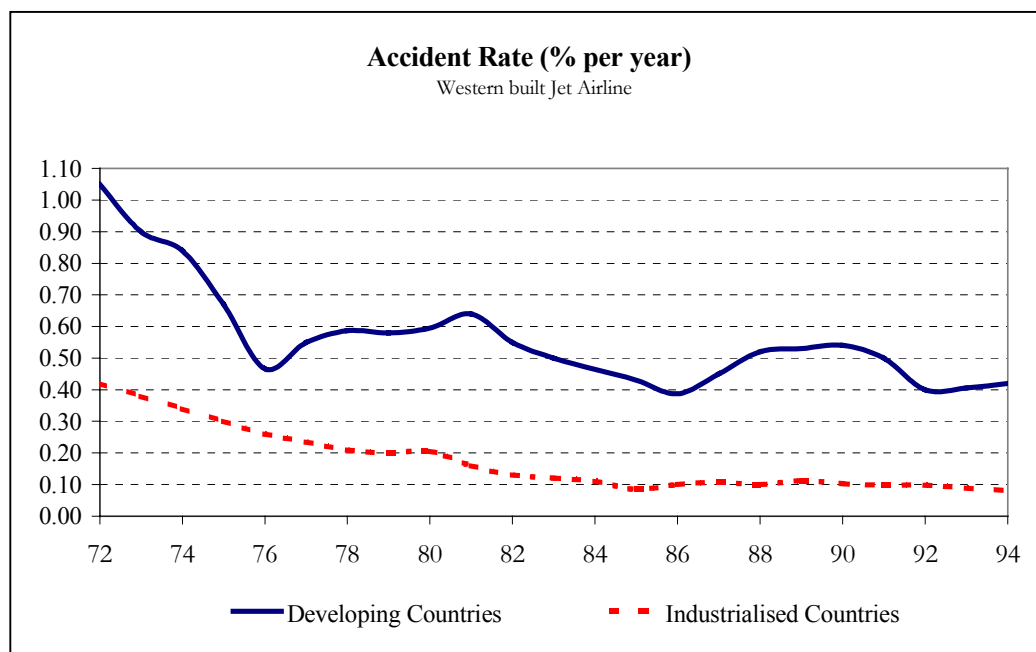
There have been 56 incidents with over 50 passenger fatalities between January 1992 and December 2001 (Source Aon), in which 6,361 people died. 2002 is not looking good, as at mid May there were 4 incidents involving over 100 deaths each, and a further 2 involving 50-100 passengers.



The average excluding 2002 is 114 per incident. Of these 56 accidents, 10 occurred in North America, 23 in Asia, 9 in Africa, 8 in Latin America but only 6 in Europe.

From looking at the above graph the number of losses appears to be reducing, despite the number of flight cycles rising. It is likely that the number of cycles in 2002 will be close to those in 2000.

From the graph below it can be seen that improvements have occurred in accident rates (number of accidents/number of planes used) for both developing and industrialised countries. Industrialised countries (US, Europe and Australasia) have an average loss rate of a quarter of that of developing countries, leading to very different premium rates. It should be noted that although the trend in both has been downwards, the fall in accident rates in industrialised countries was initially higher, and has been proportionately larger until around 1994 when the safety plateau has been approached (see later).



Investigation of an accident is the responsibility of the state in which it occurs, although other interested states (e.g. those from where the passengers originate) will also have representation. A good example of this is the recent mid air collision at Uberlingen in Southern Germany (see later). The aircraft were under Swiss ATC, and the passengers were the children of important Russians. All three countries are now investigating. Thus the jurisdiction of the claim will be complex; the liability claims will be limited by the conditions of carriage operated by the airline on international (but not domestic) flights. The situation frequently arises where one passenger is on a domestic flight but the same flight for another passenger is part of an international journey. Consequently different local laws and international agreements may be applicable at the same time for the same accident. Around 70% of all scheduled airline passengers travel on domestic flights (ICAO), of which a significant proportion are within the US.

Claims Process

After a major event the claims services will need to be carefully co-ordinated with the airline contingency plans, and will involve close co-operation between insurers, loss adjusters and lawyers. A typical disaster will involve many jurisdictions, and claims

made by passengers or next of kin may be under a number of different legal regimes, all with differing liability limits; often passengers on the plane will be both domestic and international. Claims settlement is further complicated by the involvement of other parties (e.g. manufacturers or airport operators), and there may be allegations of willful misconduct.

Often at least some money will be requested soon after an event. Where the aircraft is subject to lease or financing arrangements the money may be paid straight to the financial institutions concerned. Early financial assistance is provided to dependants (via the government) based on the airline contingency plan, claims are only settled when an undisputed amount and beneficiaries are agreed. Final settlement only occurs when all disputes are resolved.

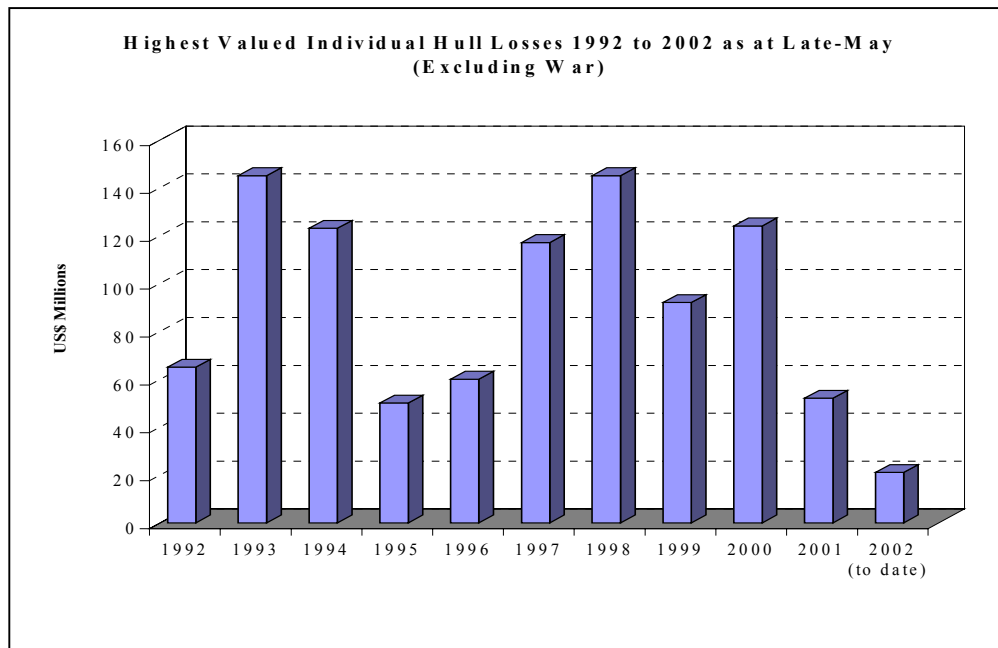
Probable Maximum Losses by Aircraft Type

A probable total loss for each aircraft type can be worked out based on the price of the aircraft plus across the board compensation levels for passengers, assuming the average load factors is 70%). These figures exclude 3rd party liabilities, unfortunately since September 11th the possibility of claims from these must be borne in mind. At \$3m per passenger, the loss of a 747 or 777 would cost \$1.35bn (there are about 800 747's in service), whilst the loss of an Airbus 340 or 440 would cause claims of around \$1,050m. If liabilities averaged \$1.5m per passenger the loss of a 747 or 777 would be \$750m whilst the Airbuses would cost around \$600m. It is likely that the A380 (not due to enter service before 2006) will carry around 650 passengers, compared to a current maximum of 600.

Hull Claims

Hull claims are quickly determined and settled. The number of total losses has been fairly steady at around 20 each year, despite the large increases in traffic. In 1985 there were 15, 1990 19, 1995 21, and 24 in 1998. Pre September 11th projections indicated that this would be around 25 by 2003, rising to around 28 by 2015 (source Airclaims). Significant partial losses are occurring, the size of which can often exceed many of the total losses. There seems to be a trend for the severity and frequency of significant partial losses to rise, for example the Qantas loss (23/09/99) exceeded \$80m. This is as a result of the rise in hull values.

There has not been a hull loss anyway near the maximum insured value (yet). The maximum hull loss for each of the last ten years is shown below (source AON). The chart below seems to imply it is a pretty much random variable. In a way this is not surprising considering how much of the world fleet is valued at under \$50m per aircraft. If hull losses exceeding \$25m are considered, 1999 and 2000 were well above the long-term average. This may represent a trend to higher valued losses, particularly as the number of wide-bodied aircraft is increasing. Losses of wide-bodied aircraft have previously been below 20% of the total; in 1999 they represented 28%.



Liability Claims

In the last decade there have been a number of moves towards unlimited airline liability. These moves began when Japanese carriers waived the convention's limits for passenger liability during 1992. This was followed by:

- IATA Inter-carrier Agreement on Passenger Liability (1995) waived the current contractual limits, reserved all convention defences and reserved all rights of recourse against third parties.
- EU Proposals (Dec 1995) suggested the abolition of all statutory and contractual limits on passenger death/injury for all flights.
- The Montreal Convention (1999) was designed to bring together the different regimes that existed into a single unified instrument. It effectively abandons limits of liability and it seems sensible to conclude that this will lead to increased claim payments in the future.

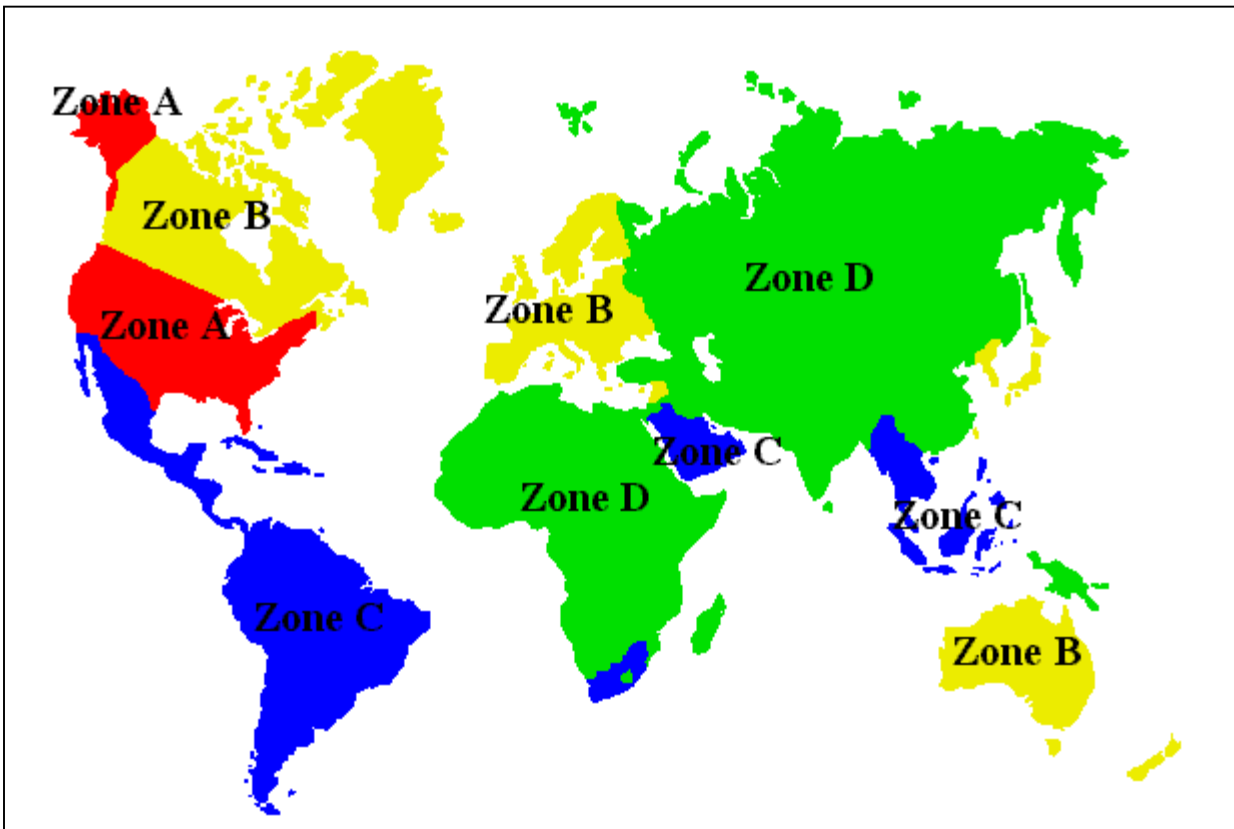
Two approaches have been used to limit liabilities: a) using the "Death on the High Seas Act" and b) attempting to assess non-US residents claims in courts in their own countries.





The law states that where the death of a person is caused by wrongful act, neglect, or default occurring on the high seas more than 1 marine league (3 miles) from U.S. shores, a personal representative of a victim can only sue for any actual pecuniary loss sustained by the victim's wife, child, husband, parent, or dependent relative. The act in this situation would not allow families of the victims to obtain any other type of damages, such as recovery for loss of society or punitive damages, no matter how great the wrongful act or neglect by an airline or aircraft manufacturer.

Whilst there is a degree of consistency in the number of accidents, the liabilities generated can vary substantially; the number of losses that are survivable by some or all of the passengers and crew seems to be increasing.

Passenger Liability profile by Domicile and Nationality

The highest compensation payments arise on incidents in Zone A, and the lowest in Zone D. It is interesting to consider the number of movements of passengers in these Zones.

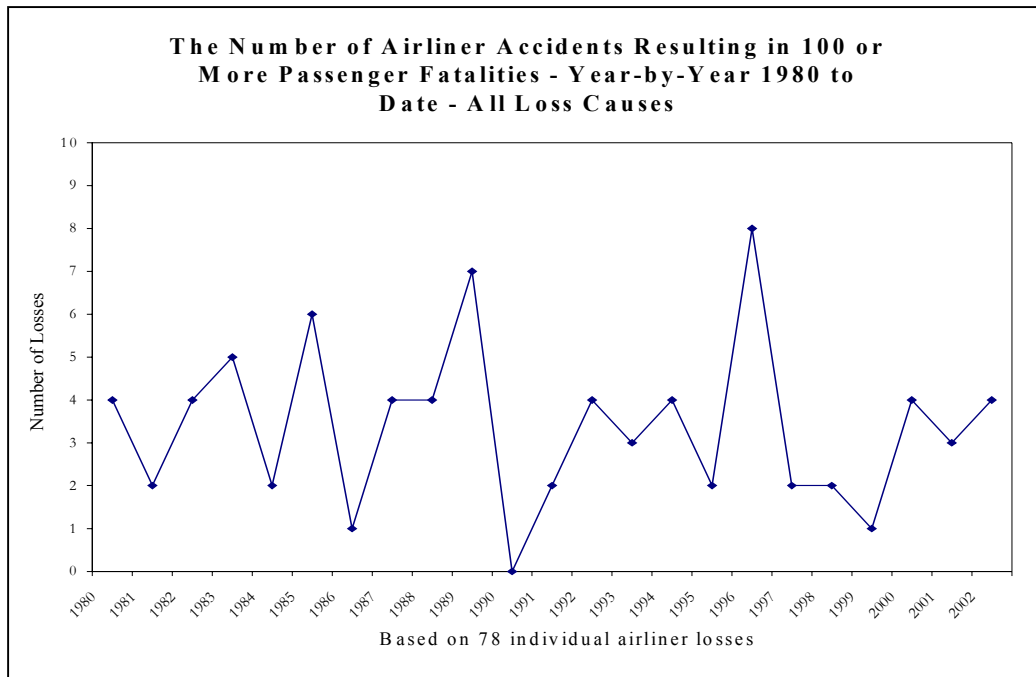


	2000 Passenger Movements	As % Split
	664,801,700	40.7%
	667,029,700	40.9%
	161,829,700	9.9%
	138,698,900	8.5%

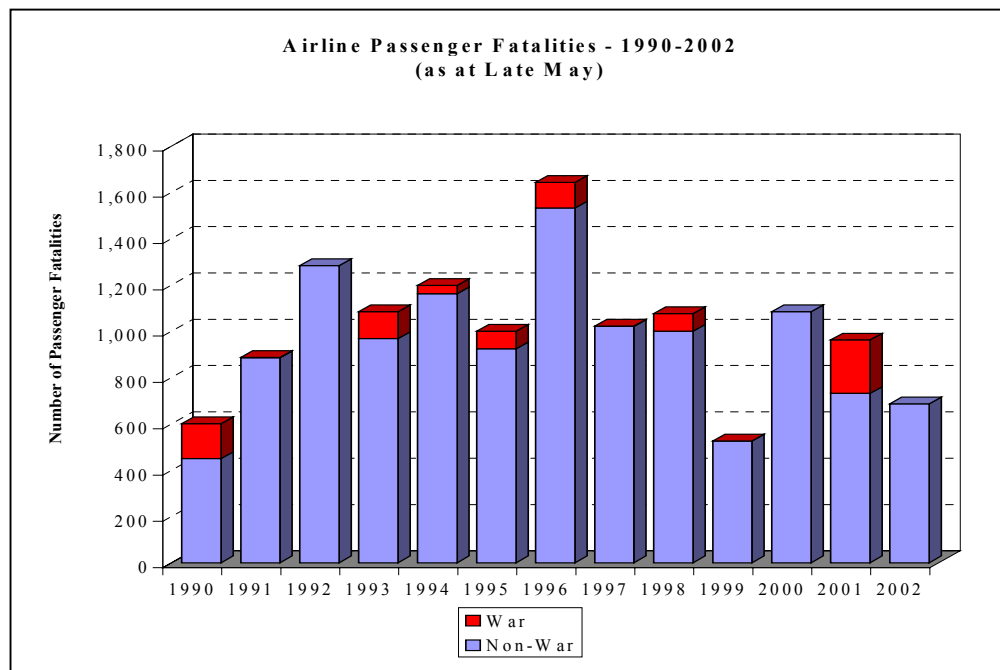
1985 produced the highest ever number of passenger fatalities at 1,489. In general, fatalities have been over 1,000 per annum. However, 1999 produced the lowest number of fatalities in the 1990's, due in part to an increasing number of accidents that are survivable by some or all of the passengers. The 1999 fatalities were 429 from jet airlines and 227 from turbo prop, although about the same number of both were total losses.

Consider the two graphs below (source Aon). These give the following:

- a) Number of incidents involving over 100 passenger deaths – (78 between 1st January 1980 and 31st May 2002) – this seems to be showing a gradual decrease as accidents seem to be becoming more survivable.



- b) The number of passenger deaths per annum, split war (mostly hijack or bombings) and other. It should be noted that although there is rarely a year without at a few war related deaths, prior to September 11th war related deaths had not exceeded 10% of the total since 1990.

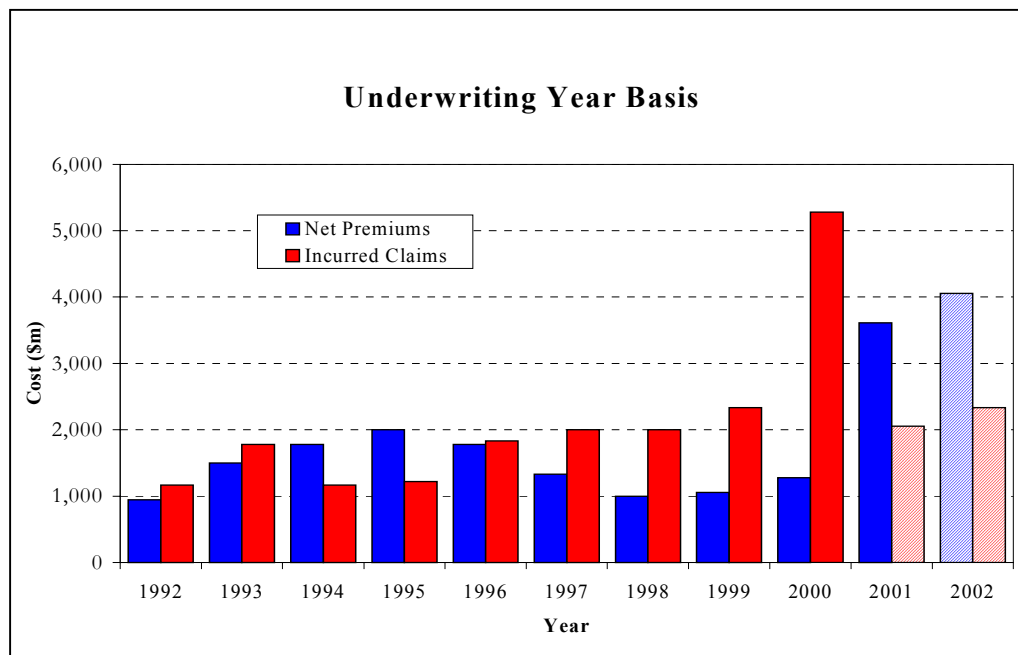


The worst single loss in terms of the number of casualties was the 1985 Japanese Airlines 747, causing 505 passenger and 15 crew fatalities; the worst incident was the Pan American/KLM collision at Tenerife (two 747s) in 1977 resulting in 560

passenger and 23 crew fatalities. The cost of either of these incidents if they occurred today could exceed \$2bn.

Overall Airline Results

The airline premiums and claims since 1992 are shown below. These are on an underwriting year basis; most graphs tend to be based on calendar year losses which are harder to compare directly to premiums. The premiums shown are after commission. Unless underwriting year figures are used this is misleading, as over a year 2/3 of the premium received will relate to exposure in the next calendar year (most large airlines attach in the fourth quarter of the year). These figures take no account of vertical placement (see later), which will have caused significant variations in the premium levels for different participants. The position of the late 1990's was clearly unsustainable. The graph below very clearly indicates the cyclical nature of the premium rates.



Loss Ratio: 122% 115% 65% 64% 103% 150% 202% 221% 416%

2001 net premium was around \$3.3bn including \$1.275bn of per passenger premiums. The 2002 figure is expected to be \$3.7bn including \$1.35bn of surcharge. Given the small number of airlines (under 1500), it looks unlikely that the favorable terms for group buying will continue.

Over \$600bn of hulls are insured, and with an average settlement cost per US passenger in excess of \$3m the loss of 300 lives in a US incident could easily cause a \$1bn liability claims. Although the number of deaths and hull losses are usually within certain limits, it is where these happen which causes the huge variations in claims costs. For instance, the China Airline loss currently stands at \$120m (of which around \$20m is for the Hull) despite the loss of 206 lives.

It should be noted that on top of large losses, attritional events on average add about \$300m per annum to hull claims, and these are included.

The largest 1998 loss was the MD11 Swissair claim (over \$800m, of which \$127m was for the hull), whilst the largest 1998 hull loss was the Korean Airways 747-400 at \$145m (total loss \$148m). The largest 1999 loss was Egyptair (31/10/99 at \$360m), followed by a \$250m American Airlines loss and another Korean loss at \$117m. The Federal Express MD11 (18/10/99) at \$91m was the highest hull loss, but there were two other \$80m plus hull losses. The largest losses in 2000 were Alaskan Airlines at \$429m (31/01/00), followed by Air France at \$186m and Kenya Airways at \$84m. Hull losses were small in the year, the largest being \$40m for the Kenyan Airways loss and \$37m for the Alaskan loss. Excluding WTC in 2001 the largest was the American Airlines loss (Queens 12/11/01) at \$450m, followed by the SAS and Thai Airways losses at \$49m each. Hull losses were again low, with two of \$44m each (American at Queens and United at Shanksville).

21 individual hull losses exceeded \$10m in 1999, compared to an average of 15 per annum 1989-1998. Of these, 18 were total losses with 3 partial losses.

The number of high value aircraft is rising, but there does not seem to be an obvious trend for increasing loss size over recent years.

2002 Losses

At mid May losses stood at \$157m for hull, and \$212m for liability. 6 hull losses had exceed \$10m (all except one around \$20m each), the largest being the Egyptair 737-500 (5th May) at \$22m. 700 passengers have died to date, with 4 losses claiming over 100 lives each (Iran Air Tours (107), Air China (120), China Northern (103), and China Airlines (206)). Additionally, the Executive Airline Services loss killed 66 passengers and 76 people on the ground

Analysis of Premium Required for Profitability

Between 1990 and 1999 inclusive, airline net premiums have averaged \$1.2bn with claims averaging \$1.7bn excluding any inflation allowance. Writing for gross profit has been impossible, so most insurers were depending on cash flow and reinsurance (see later sections) to achieve profitability. A certain amount of reinsurance is needed to cap exposures for most players, but usage in the downcycle was very high. With aircraft values and passenger legal liability compensation awards rising it is unlikely that losses will fall below \$1.7bn per annum. This would imply a minimum premium to allow insurers to achieve a reasonable return on capital of between \$3bn and \$3.5bn per annum. Sharply higher reinsurance costs will cost insurers on average \$500m per annum more than previously. No allowance is made for a capacity charge as this is assumed to be covered by the high level of return required.

This figure is derived as follows:

Premium	\$3.2bn
Less Add'n Reins Costs	\$0.5bn
Less Commission	\$0.4bn
Less Claims (no inflation)	\$1.7bn
Less Expenses	\$0.2bn
Gives Profit	\$0.4bn

If allowance is made for inflation (average rate of 10% per annum on aviation business), then the base claims cost would be closer to \$2.2bn, and the premium required would be between \$3.5bn and \$4.0bn.

Assuming capital required of 40% of gross premiums this gives a 30% return on capital before investment income. With catastrophe business currently requiring a minimum of 35% return on capital, this does not seem unreasonable.

Changes in Rating Levels 2001 and 2002

Rates rose far more sharply in 2001 than in 2000 for a number of reasons:

- a) Expiry of cheap reinsurance programs in 2000 led to steep rises in reinsurance costs for 2000. This was not matched by the expiry of LTAs for airline risks which held back rises in 2000, squeezing insurers.
- b) High capacity in 2000.
- c) September 11th as many airlines renewed in 4th quarter. This will be looked at in more detail later.
- d) Restructuring of liability rates to a more accurate risk based charge, and the incorporation of the surcharge levied post September 11th into these new rates.

Whilst over half the 2002 year has passed, only about 20% of the world's airlines (in premium terms) have renewed. As these avoided the large rises post September 11th, increases have been large. The real test of market conditions comes in the 4th quarter of 2002, when risks that received large rises come up for renewal.

AIRLINE INSURANCE (HULL WAR)

Introduction

These policies provide cover to airlines for loss of, or damage to, their property (aircraft and spares). The risks covered are excluded from hull all risks policies, and arise from war or war related activities including:

- War, invasion, hostilities, civil war, rebellion, attempted coups etc.
- Strikes, riots, civil commotion or labour disturbances
- Sabotage
- Hijacking (attempted or actual) or seizure of control (including pilot suicide)
- Acts for political or terrorist purposes
- Confiscation, naturalisation, detention etc for the use of any government or public authority.

Exclusions include war between any of the UK, US, CIS, France or China, loss from atomic or nuclear fusion; repossessions resulting from airline contracts or confiscation by the government of the country in which the aircraft is registered. A number of areas are subject to special rating - flights are usually permitted but may be subject to surcharge. Most are in Africa and the old CIS, excluding Russia.

Rating

The main rating factors are:

- a) Fleet size b) Country or origin c) Destinations flown d) Airline security measures
e) Claims record f) Coverage required.

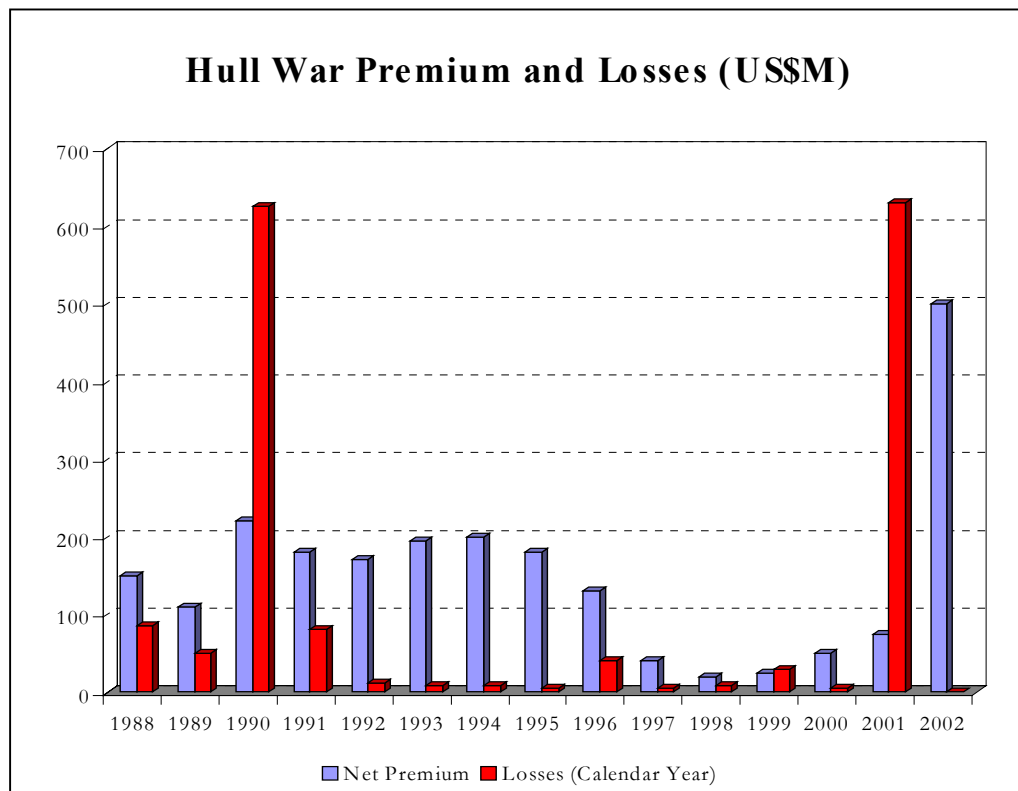
Rates are quoted as a percentage of total fleet value and are generally lowest for North America and highest for Africa (followed by the Middle East). Historically there were rarely deductibles for this type of business; but limits were imposed on both the value of spares in any one location (typically \$150m) and on the value of any individual aircraft (up to \$225m). Additionally there were annual aggregates based on a multiple of the hull maximum value covered. This has now changed, with the maximum cover being reduced and deductibles introduced, as well as massive rate rises.

The business is very short tail and responsive to claims which are extremely variable. There is potential for very large claims e.g. the Kuwait Airways (1990) claim for hulls and spares is estimated to have cost \$450m before interest. It took about five years for that loss to be recouped, after which rating levels collapsed. Typically, over the period 1990 to 1995, rates for North American risks averaged about 0.03% of the fleet value, for Europe and the Far East 0.045%, the Middle East 0.075% and Africa 0.11%. This gave an average rate of between 0.04% to 0.05%. By the end of the 1990's rating levels were somewhere below 0.015% on average.

An additional charge of 0.05% of fleet value was introduced in the immediate aftermath of September 11th to re-inflate the market. Rises in October 2001 reached a staggering 650% and on average have been running at around 200% since the start of 2002. Rises were larger where expiring programs were near historic lows, in which case rises exceeded 300%.

Traditionally liability was covered by a write back under AVN52C into the main liability policy. Following September 11th underwriters gave a week's notice and cancelled policies. Whilst hull insurance was available subsequently at higher rates, third party liability was limited to \$50m per event (previously full limit of the liability program). This left most airlines with insufficient cover to fly, as certain countries required minimum amounts of cover. Additionally most airlines were put in breach of the leasing conditions with the banks that required a minimum level of cover. Initially cover was provided by government schemes such as Troika although a number of new commercial schemes were quickly launched e.g. by AIG. These schemes gave various levels of cover with premium dependent on cover purchased.

Results



Results for 2001 are obviously bad. In addition to the Air Lanka claims (4 planes destroyed on the ground by the Tamil Tigers totalling \$500m) there was the cost of the four hulls lost in September 11th amounting to \$130m.

Pre September 11th the number of hijacking incidents seemed to be decreasing from an average of around 25 per annum in the early 1990's to between 12 and 15 per annum. The majority of these are settled without bloodshed; during 1999 hijackers killed only 2 people. There has not been a single hijacking in the twelve months post September 11th, although recently there have been a couple of attempts.

PRODUCT LIABILITY

Product liability covers an insured's legal liability to third parties for injury and loss or damage arising out of the defective design or manufacture of an aircraft product. It encompasses all types of aircraft products, for example airframes, engines, seats and minor components.

It is usual in cases where damages are being sought from third parties, for non-criminal actions, that some degree of negligence must be shown to have been present in the defendant's actions (or lack of). This however is not the case for products liability lawsuits in the US. During the 1960's and 1970's the courts developed a system known as "strict products liability", which included cases involving aviation products manufacturers. This rule means that claimants are no longer required to prove that the manufacturer acted negligently, only that a defect in the product caused the injuries. This is a lot less burdensome than normal claims for damages and made it a lot easier for claims to be made against manufacturers.

In the US there are two main tests that can be used to determine whether or not the product was "defective".

- a) A product will be defective if it is "unreasonably dangerous" for use by the "ordinary consumer". This test is not particularly applicable to aviation products as there is no consumer to speak of, as the pilots flying the planes are highly trained professionals.
- b) A manufacturer is strictly liable if the product fails to perform as safely as would be expected by a normal user using the product in the way it is intended, or in a way that was reasonably foreseeable. This test has been used by an increasing number of states, such as California, as a preferable test to the first.

In deciding whether or not the product was safe in the above test a "risk-benefit" analysis is used. This requires the courts to decide whether the risks associated with the design of the product outweigh the benefits of the design.

When using the "risk-benefit" the main defence is that at the time any hypothetically safer designs were too costly or had other adverse consequences. This is known as the "state of the art" defence and will be a matter for a jury to decide.

To establish strict products liability under the "Californian Rules" the following three points must be proven by the plaintiff:

- a) That the product was defective when it left the manufacturer's control.
- b) That the product was used in the intended manner or a reasonably foreseeable manner.
- c) That the product caused the plaintiff's injury.

The defect in the product could result from the design process, the manufacturing of the goods, or a failure to warn of the associated risks (either at the time of distribution or at a period in the future when new safety issues are discovered).

There are a number of issues that also need to be taken into account when considering aviation products liability lawsuits:

- a) In a number of cases it is not a question of deciding whether or not a manufacturer is wholly to blame for the accident but the proportion of the loss

that can be attributed to them. In this case each “party” will pay their proportion of the loss.

- b) Although the above rule states that contributory negligent parties will each pay a proportion of the loss, their liability is joint and several and so the plaintiff can pursue any party for the full amount of the claim (the defendant then seeks contribution in a separate action). In most cases the first party to the action is the manufacturer as they tend to have the “deepest pockets” and often may not be able to recover from other liable parties who do not have the same level of insurance cover.
- c) Certain states, like California have now removed the joint and several liability rules relating to liability claims and have thus limited the amount that can be recovered to the proportion of the loss for which they are to blame. Many states are copying this move and re-writing the rules as part of their “tort reform”.
- d) As stated misuse is no defence unless the use to which the product has been put was not reasonably foreseeable. This implies that if a certain misuse is foreseeable then the ensuing accident is also likely to be foreseeable. There is therefore a duty on the manufacturer to ensure that the product is designed in such a way as to protect those involved if such a crash occurs. This is termed “aviation crashworthiness” and can itself be used as a basis to bring a claim.

The legal regime for manufacturers, including those in the aviation industry, is strongly on the side of the public. Many of the normal rules of tort do not apply and the defence available to the manufacturer are limited and surely not helped by fact that a jury decides such cases. There are moves in certain states to change this.

2002 Renewals

July is the most important month for renewals with Boeing and United Technologies both renewing. Limits have been substantially reduced (see later). The majority of programs, in terms of numbers, provided coverage up to \$500m, but there are a few with higher limits. Rises have been running at between 70% and 100%, however there are wide variations. War coverage as per AV52F up to a limit of \$50m may be reinstated, and further coverage for \$100m xs primary limit and a second excess of \$850m (excess both limits) is available.

Premium and Claims

The total annual premium for this cover is expected to be around \$1100m, having been around \$450m in 1999, and nearly \$600m in 1994. Assuming a yearly cost of around \$600m and an additional reinsurance cost of \$200m per annum would imply premium levels need to be around \$1.2bn per annum.

The claims for 1994 and prior should be reasonably mature but the figures for later years can only be taken as a guide to the ultimate run-off due to the discoverability of reserves being held for particular incidents and the early stage of development. This said, a rough estimate of the average annual claims cost, in today’s terms, would be around US\$600m. It is not possible to get details of individual claims because of the sensitive nature of such information especially with regard to disclosure in the US. Many of the losses are attritional in nature, however seven claims exceeding \$100m in the 1990’s have had at least a partial contribution from product liability insurers.

Four programs (Aerospatiale, Airbus Industrie, Boeing and UTC) account for roughly 50% of the annual premium income. Consequently the market suffers from concentration of risk. Further consolidation in the market is highly likely and this will make the situation worse. 65% of the total premium arises from US manufacturers, and nearly all of the rest is from Europe. At the end of 1999 of the 13,250 or so active western built jet airliners around 73% were manufactured by Boeing and 15% by Airbus Industrie. Currently around 50% of the premium arises from airframe manufacturers and 20% engine manufacturers.

Aircraft manufacturers try to limit their liability using disclaimers and warranty limitations in the purchase/sales agreements when selling the aircraft. However this does not limit their liability to third parties such as passengers.

In the event of an aircraft accident, liability may be apportioned between parties. Airlines and aircraft manufacturers often put in place a sharing agreement. This is an agreement among all defendants to voluntarily allocate percentages of the claim amongst themselves. These deals have a number of advantages:

- It prevents cross claims among defendants thereby saving legal expenses
- It means that a united effort can be made to defend the claim thereby improving the chances of success
- It will help to keep the costs of investigating, defending and settling the claim low

Claim sharing agreements mean that many aviation claims will have at least some element of a product liability claim.

The abolition of limits of liability for airlines may have a beneficial effect on manufacturers. Claimants will no longer need to seek damages from a third party (such as the manufacturer) as they will be able to seek all their damages from the airline concerned.

Events that are entirely a result of a products failure may settle at considerably higher amounts than if the cause is multiple or adjudged to be the responsibility of the airline. This is probably because of hangovers from the days of airlines liability being limited, whilst in products cases awards are subject to full judicial review. A good example of this is the September crash in Queens, New York. This is thought to have arisen as a result of the separation of the tail from the fuselage in flight. This is likely to be due to either a failure of the fibreglass tail (a replacement) or the method of joining to the fuselage. Either way it is a products claim. 260 people died on board, as well as 5 on the ground, and there was an element of third party property damage, as well as a hull claim. Although many of the passengers were not US citizens, the total cost is expected to be around \$450m.

MISCELLANEOUS COVERS

Airport legal liability

On the one hand this provides cover for minor claims such as passengers slipping or falling in the terminal but at the other extreme there is potential exposure to a catastrophic loss. For example an aircraft could crash on take off after birds are sucked into an engine. The airport could be held responsible for the crash if it did not have a comprehensive and successful wildlife control program in place. The failure of the cleaning of the runway at Charles De Gaulle Airport, which led to a strip of metal puncturing a tyre as Concorde took off, will involve a contribution from either the airport or subcontractor. Given the potential exposures it is somewhat surprising that some airport authorities have fairly low levels of cover (e.g. US\$500m). Most claims arise from passenger injuries such as slips and falls. The cover could become highly important if airport authorities were adjudged to have been negligent for failing to stop the hijackers taking weapons on board the aircraft on September 11th, e.g. by opposing increases in security.

Premium increases for airports legal liability have been running at around 85%, but once the war write back is included the overall increase rises to around 150%. Underwriters will only provide AV52 coverage in respect of security screening if it forms part of the overall risk exposure. Smaller airports are receiving the most substantial rises.

Air Traffic Control legal liability

Europe has 47 ATC organisations, using 22 different operating systems. Compare this to the USA, where there is one ATC organisation, using one system.

A number of airport legal liability programs include cover for air traffic control. Separate cover has become more common over recent years mainly as a result of privatisation of the air traffic control industry. There is the potential for large claims in this area as seen in the recent collision over Germany. This claim is likely to cost up to \$50m, including substantial environmental clean up costs.

This cover is likely to become increasingly important over the coming years as the skies become ever more crowded and the stresses on air traffic control increase.

Refueller's legal liability

There have been a number of significant claims in recent years following the supply of contaminated fuel. Most recently, at the end of 1999, thousands of light aircraft in Australia were grounded after Mobil supplied contaminated aircraft fuel. However no known accidents have resulted from the incident. This often forms part of the product liability class of business.

Security Companies Third Party Liability

It is unclear whether security screening failures allowed weapons (Stanley knives and pepper spray) on to the aircraft on September 11th, or whether these were already in secure areas awaiting collection. There was obviously some kind of security failure and security companies have been named in lawsuits issued by individuals after September 11th. It is likely that many insurers will seek to recover a portion of their September 11th costs, and security companies, airport operators and even the US government are all potential targets for a number of reasons: -

- a) Failing to tighten security despite a number of warnings.
- b) Management failure to control/limit risk.
- c) Failure to detect either weapons or terrorists (despite most of them fitting the 'standard' profile for hijackers: young males, arriving late for flights, tickets purchased one way for cash, Arabic origin).

In general, cover was purchased up to \$500m. Subsequent to September 11th the US government took responsibility for security away from individual companies, took over training and increased levels of personnel utilised.

INTERESTING STATISTICS (for Actuaries anyway)

Federal Aviation Accident Statistics

This is based on data between 1987 and 1996, for accidents involving fatalities:

	US Carriers (34 Losses)	Foreign Carriers (134 Losses)
Loss of Control	32%	28%
Controlled Flights into Terrain (CFIT)	12%	26%
Runway Incursions	12%	3%
Ice/Snow	9%	4%
In Flight Fire	6%	3%
Landing	3%	7%
Windshear	3%	2%
Sabotage	3%	4%
Hijack	3%	6%
Mid Air Collision	0%	1%
Fuel Exhaustion	0%	5%
Rejected Take Off	0%	1%
Other/Unknown	18%	10%

It can be seen that weather and factors due to higher density of traffic/usage pressure caused a much larger percentage of losses for US carriers, whilst interference with planes or flights, and CFIT caused a far higher proportion of accidents in the rest of the world. It is surprising the proportion of accidents (particularly for US carriers) where the cause is listed as other/unknown.

Fatal Accident Rates Per Million Flights (not for the nervous flyers)

This data has been taken from airsafe.com and is based on data between the start of 1970 and mid 2001.

It should be noted that accident experience generally has improved substantially over the period in question, rates over the most recent 10 years will generally be much lower than those shown.

The number of incidents is the number of flights involving fatalities; the full loss equivalent is the sum of the proportions of passengers killed per event.

Model		Fatal Event Rate	Flights (millions)	No. of Incidents	Full Loss Equivalent
Airbus	A300	0.69	8.7	9	6.0
	A310	1.36	3.4	5	4.6
	A320/21/19	0.19	13.6	5	2.6
Boeing	727	0.49	73.9	47	36.3
	737/100/200	0.49	53.2	37	26.3
	737/300/400/500	0.22	40.4	11	8.9
	747	1.02	13.4	26	13.7
	757	0.45	12.0	7	5.4
	767	0.56	9.8	6	5.5
	777	0.00	1.0	0	0
	DC9	0.56	61.6	42	34.4
	DC10	0.67	8.8	15	5.9
	MD11	0.85	1.2	3	1.0
Embraer	MD80/90	0.22	28.8	10	6.2
		1.85	14.9	33	27.3
Fokker	F28/70/100	1.11	14.7	24	16.3

The obvious conclusion is that smaller aircraft not made by the main two producers are less safe, although there are exceptions to this, particularly for the A310 and Boeing 747, which stand out as having poor records.

Comparison of the number of incidents and full loss equivalents gives an idea of survivability factors; it can be seen that survivability contributes considerably to the A310's poor loss record, whilst mitigating the high number of accidents suffered by 747s. Those planes where substantial numbers of passengers seen to survive include MD11, DC10, 747 and A320, i.e. generally the larger aircraft.

The same data can be looked at by individual airlines. Results are summarised for all major non-American and Canadian companies and compared with other areas of the world. Some well known individual airlines have been picked out purely for illustrative purposes.

It is likely that current actual rates are under 50% of those shown, as much of the data is old, and reliability has improved substantially (see section covering accident rates for industrialised and developing countries). For industrialised countries the accident rate has fallen by 75% between 1970 and 1995 (based on numbers of planes). For developing countries the rate has halved over the same period (but is still five times higher). Analysing data over shorter periods gives creditability problems.

Only airlines where the number of flights is known have been included.

North American	Fatal Event Rate	Flights (millions)	No. Incidents	Full Loss Equivalent	Last Loss
Major Carriers	0.32	117.7	61	37.86	
United	0.37	18.0	11	6.69	
Delta	0.16	20.0	6	3.24	
Southwest	0.00	9.5	0	0.00	

Ignoring airlines having completed under 1m flights, fatal event rates range from (Southwest) 0 to 0.75 (Aloha Airlines). 18 Airlines make up this group, of which 13 have completed over 1m flights. All the major carriers are around 0.2 to 0.3 fatal events per million flights.

European	Fatal Event Rate	Flights (millions)	No. Incidents	Full Loss Equivalent	Last Loss
Major Carriers (ex Russia)	0.60	50.77	42	30.56	
THY	5.92	1.10	8	6.51	
Olympic	1.52	1.80	3	2.73	
British Airways	0.22	6.35	2	1.40	
Air France	0.55	5.90	7	3.23	

Just removing Turkish Airlines from the total above changes the figures to a rate of 0.5. Results range from 0 (Aer Lingus, Finnair and Sabena) right up to 5.92. The best results of major airlines are British Airways, Lufthansa and SAS (all around 0.2) most of the major European players are in the range 0.55 (Air France) to 1.5 (Swiss Air and Olympic). Figures for former Soviet Union are not available but there were 21 accidents in the period with a full loss equivalent of 16.3 losses. 19 Airlines were analysed of which only three had completed under 1m flights.

Asia & Australasian	Fatal Event Rate	Flights (millions)	No. Incidents	Full Loss Equivalent	Last Loss
Major Carriers (exc China)	1.90	24.70	70	46.90	
Singapore/Silk Air	1.50	1.00	2	1.50	
China Airlines (Taiwan)	7.16	0.90	10	6.44	
All Nippon Airways	0.22	4.64	1	1.00	
Indian Airlines	3.53	2.00	12	8.82	

Generally, the number of flights is low by comparison with Europe and North America, with 16 airlines accumulating only 24.7m flights; but losses are high. If Air China and other PRC Airlines are included, this adds another 16 events (and 9.03 to

the full loss equivalent). It is worth noting that those airlines with a large number of incidents seen to keep having more, Japanese and Australasian Airlines have not had a loss in the last 15 years. However both of Singapore/Silk Airlines accidents are recent, as are the Thai losses. A substantial number of the losses arose in the 1970's and early 1980's, in general, excluding the three of four known poor operators, experience is improving (Korean, China Airways, Indian Airways and Chinese Operators). 7 Airlines were excluded due to lack of data (4 losses and 3 total loss equivalents).

Africa & Middle East	Fatal Event Rate	Flights (millions)	No. Incidents	Full Loss Equivalent	Last Loss
Major Carriers	2.40	9.50	31	22.84	
Air Zimbabwe	11.54	0.16	2	1.85	
El Al	0.03	0.34	1	0.01	
Air Iran	3.54	1.13	4	4.00	
Egypt Air/Air Sinai	7.60	0.75	7	5.70	

Only three of the 14 airlines have had more than a million flights, although it should be noted that Emirates and Gulf Air have been excluded as no figures are available for the number of flights (they had two almost full losses). It should be noted that a number of the airlines with poor results have not had an accident for over ten years (Air Zimbabwe and Royal Jordanian) and in general the larger African Airlines seem to be improving. Fatal event rates per million flights seem to be around 3 for African Airlines and 2 for Middle Eastern Airlines.

Latin American & Caribbean	Fatal Event Rate	Flights (millions)	No. Incidents	Full Loss Equivalent	Last Loss
Major Carriers	2.15	15.37	43	32.99	
Cubana	18.53	0.33	8	6.11	1999
Aerolineas Argentinas	0.60	1.67	2	1.01	1992

A number of the 16 airlines have had very poor results; TAME, TAM, AeroPeru all have results between 5 and 10, but many of the major long distance operators (Varig, Mexicana, Avianca and Aerolineas Argentinas) have not had a loss for over ten years, so their results are gradually improving.

Removing TAM and Cubana removes 14 losses (9.5 full losses) and 1m flights dropping the rate to around 1.6, and excluding pre 1986 losses would halve this rate.

CURRENT ISSUES IN THE AVIATION MARKET

Market Following September 11th

IATA members laid off almost 10% of their workforces, and grounded 10% of their fleets. Additionally turn around times were increased, security costs rose, routes were cut, services reduced, queuing increased at security/immigration and many airlines were almost grounded for lack of insurance cover. Insurance is identified in the IATA report as being one of the three main issues dominating the international air transport agenda (the others being security and infrastructure). They want insurance to be:

- a) Affordable
- b) Non cancelable
- c) Global

to avoid any repeat of the post global September 11th cancellation of war risk cover for airlines and other aviation interests.

Troika

Shortly after the events of 11th September, aviation insurers limited their third party war and terrorism liability cover to US\$50m per aircraft. Following this significant reduction, governments around the world stepped in to indemnify their flag carriers against larger claims otherwise airlines would have been grounded. This was due to the insistence by airplane leasing companies and regulators that airlines maintain at least US\$700m of liability cover per aircraft.

In the UK, the government set up the Troika Insurance Company, initially to provide insurance coverage in 3 layers between US\$50m and US\$2bn per aircraft for a 30 day period from 24 September 2001 for a premium of around US\$0.90 per passenger. The Treasury backed the Company.

The commercial market has been very slow to reintroduce cover at a realistic price (commercial rates are closer to US\$3 per passenger) and so Troika's existence has been extended a number of times. The latest extension was made at 30 June 2002 for another 60 days until 29 August 2002. However, the cover has been tightened. Since May 2002, Troika only provides cover in 2 layers between US\$150m and US\$2bn for a premium of around US\$0.55 per passenger.

It is not clear when Troika will be closed, but the Government has made it clear that it will be a one-off arrangement. The European Commission is currently studying two plans (see below).

The three layers of cover provided by Troika are:

- 1) US\$50m to US\$150m for a premium of around US\$0.35 per passenger (withdrawn from May 2002)
- 2) US\$150m to US\$1bn for a premium of around US\$0.3 per passenger
- 3) US\$1bn to US\$2bn for a premium of around US\$0.25 per passenger

Proposed Non Governmental New Aviation War Risk Companies

There was a proposal (from IATA/ICAO) to establish a company with start up costs being met by the aviation industry and commercial financing. Cover up to \$1.5bn would be provided in excess of \$50m, primary cover limits would be raised to \$150m

if available from the market within two years. This would avoid the need for any individual states to pay the claims. It is unclear how far this proposal has advanced at this stage.

There has also been a proposal to establish a European Scheme (called Eurotime) which would operate as a mutual to provide third party war and terrorism coverage. This would aim to establish a fund to protect against punitive surcharges and notices of cancellation. However, proposals were recently referred back to the European Commission for further study.

A special EC Committee will examine both the Eurotime and IATA/ICAO proposals. Any decision will have to be ratified by the European Transport Commission, which does not meet until the end of September. This means further extensions to government backed schemes. As a result the UK government extended Troika until the end of August, but surprisingly the Swedish Government did not extend their cover, which expired at the end of June.

It should be noted that initially nearly all world governments were in favour of an approach similar to the above, however the EC seems to have lost interest. Terrorism is an act against the state not commercial entities, without some state support can airlines be expected to respond properly?

2002 Premium Levels as at July 2002

The issue of the surcharge is currently unclear. It provided an estimated \$2.2bn of premium for the 12 months after September 11th. Up to July a number of renewals have been negotiated with a reduced surcharge incorporated in the core liability rates. There is a battle between brokers, who want to keep the surcharge separate, and insurers, who want it incorporated into the main liability rate. By offering discounts to those airlines accepting a combined basis, insurers are forcing the issue. Brokers had hoped that by keeping the surcharge separate they would more easily be able to reduce it in the future. Willis estimate at July 2002 year to date hull rate rises averaged 52%, with liability rises averaging 90%, giving a combined rise of 69% (about \$190m increase so far during 2002).

Willis estimate that the total airline premium excluding War amounted to \$4.4bn for the 12 months to 1st October 2002. Their estimate (including September 11th) of the average annual cost over the last five years is \$2.6bn. Once this is indexed (at 10% p/a) this would rise to approximately \$3.25bn. Whilst it may be arguable that September 11th was a one off and so should be excluded, some allowance needs to be made for the new more risky environment. Totally ignoring it would result in costs of around \$2.1bn per annum, or \$2.6bn after inflation. These are still higher than used when determining our estimate of the market premium needed earlier in the paper.

Airline Alliances and Code Sharing Arrangements

We live in an age of globalisation where customers expect a service to be provided worldwide. Airlines are no exception to this. Consumers expect an airline to offer a truly global range of destinations from their home base. The response by airlines has been to form large strategic alliances and code sharing agreements (simple marketing and ticketing agreement between airlines enabling passengers to use more than one

carrier to reach their destination on a ticket issued by one airline). Alliances are similar, but include sharing of other parts of the operation. The main alliances are:

- One World Alliance – Aer Lingus, American Airlines, British Airways, Cathay Pacific, Finnair, Iberia, LAN Chile, QANTAS.
- Skyteam – Aeromexico, Air France, Alitalia, CSA, Delta Air Lines, Korean Air.
- Star Alliance – Air Canada, Air New Zealand, All Nippon Airways, Austrian Airlines, BMI British Midland, Lufthansa, Mexicana, SAS, Singapore Airlines, Thai Airways International, United Airlines, VARIG.

In the past alliances some bought group insurance cover. The motivation for this is the greater purchasing power the group would have, and the ability to absorb more of the insurance costs via a captive, which can profit from using cheap reinsurance. However, there are a number of potential problems: -

- The legal and regulatory requirements of the different airlines, particularly if an American airline is involved.
- Some underwriters do not write American business
- In a group of airlines some will have better loss records than others. Those with the better past performance will not want to pay the higher premiums associated with those with poorer loss records.

The latter point is illustrated by what happened to the KSSAF group after the 1998 Swissair Flight 111 disaster. The group of 40, mainly European, airlines had existed for 28 years for the purpose of buying insurance. As a result of the Swissair loss their premium at renewal attracted rate increases of 75% to 100% at a time when the rest of the market were achieving reductions in premiums. As a result of this KLM and SAS voted Swissair out of the partnership and it broke up.

Which airline is liable in the event of an accident? Passengers on a flight may have booked tickets with any of the airlines in the alliance. Therefore they might have a case for claiming compensation from either the airline they booked with or the airline they were flying with at the time of the accident.

Problems include:

- a) Claims may be pursued with more than one airline thereby increasing the cost of a claim to the airline industry as a whole.
- b) Claimants pursuing the claim in the most favourable jurisdiction or the airline with the deepest pocket (e.g. if one of the parties involved is an American airline).

A solution needs to be written into code sharing agreements. The most obvious result would be for airlines and insurers to agree that the operating carrier should be liable for, handle and pay any claims (the concept of “Your paint, your problem”). This could lead to large increases in the liability limits purchased by many airlines.

Airline Liability Costs

As mentioned earlier the Montreal Convention (1999) effectively abandons limits of liability. Another significant issue arising from the Convention comes from the fact that it is a whole new convention rather than an amendment to the old one. This

means that it will be possible to reopen discussion as to the definition of terms even where these terms were contained in the old convention. These factors will only lead to rising claims costs.

However, passengers are surviving more accidents than even a few years ago. This is in part due to luck, the type of accident, and the continual improvements in safety procedures and aircraft design.

Based on 32 survivable accidents between 1970 and 2000, the safest places to sit as a passenger are:

	Front	Center	Rear
Taxiing	1	0	0
Take Off & Climb	5	1	5
Enroute and Descent	0	0	3
Approach & Landing	5	4	13
TOTAL	11	5	21

This shows that during approach and landing it is best to be at the rear of a plane; the rest of the time it makes little difference. Perhaps in the future relatives of the deceased will sue airlines for making passengers sit in the more dangerous positions?

Safety Improvements

For industrial countries the accident rate has fallen by 80% between the early 70's and early 90's (from 0.4% to 0.08%) whilst for developing countries this has improved by 60% (from 1.05% to 0.4%). For developed countries this rate has been fairly steady since 1984 implying that given the current composition of the fleet and standards of safety and maintenance, a safety plateau is being approached (where technical advances will not lead to further reductions in the accident rate).

Planes have become more reliable as there is now considerable experience available for all the major types of planes flown by airlines, so teething problems have been ironed out. Every time a possible problem is identified, the UK, US and other Aviation Authorities issue bulletins advising of the potential problem, or requiring remedial work to be undertaken within a given timescale.

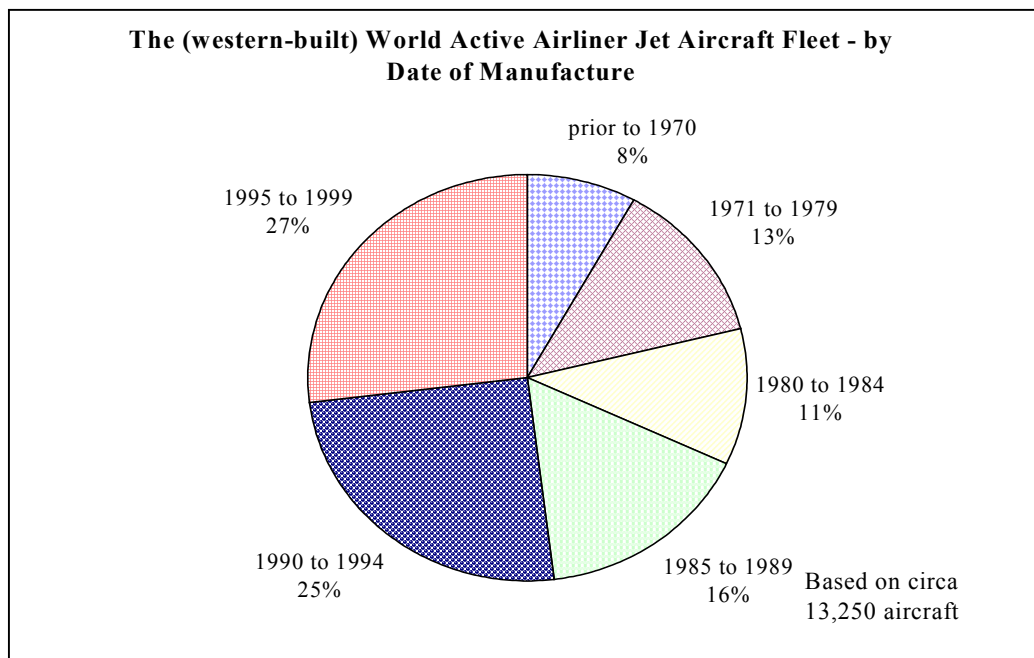
Improvements made include:

- a) Ground Proximity Warning System (GPWS) has been introduced to reduce the number of accidents where planes hit the ground.
- b) Traffic collision avoidance system (TCAS) to reduce the number of mid-air collisions. For this to work it needs to be fitted in both aircraft; currently it is only compulsory for planes operating in North American airspace. Unfortunately this only provides height-related information, the lateral positions of planes is often inaccurate. This system and its interaction with Air Traffic Control (ATC) was a factor in the recent mid air collision over Germany. See section on ATC later. ATC need a way of knowing which planes have this system, and how it will respond.

- c) The use of automatically updating route maps, which can lull pilots into a false sense of security.
- d) The introduction of cameras to cover the cockpit and parts of the exterior of the plane. Pictures would be recorded in the black box, and erased at the end of each flight.
- e) Pilot training has been improved with the use of Digital Flight Data Recorders (DFDR) which record over 100 parameters per second. These are then played back through a Special Event Search and Monitor Analysis program to identify if any flight exceeds pre-set parameters. If this happens, further investigations will be performed.
- f) Confidential incident reporting has also been introduced, where malfunctions and incorrect actions are recorded and passed around airlines and on to individual pilots.
- g) Steps are being taken to make ATC to aircraft communications more secure. It is becoming increasingly common to get interference, often this is accidental e.g. pirate radio stations or taxi radios, but there have been an increasing number of attempts to direct planes into hills or the paths of other planes.

Industry Growth and Fleet Changes

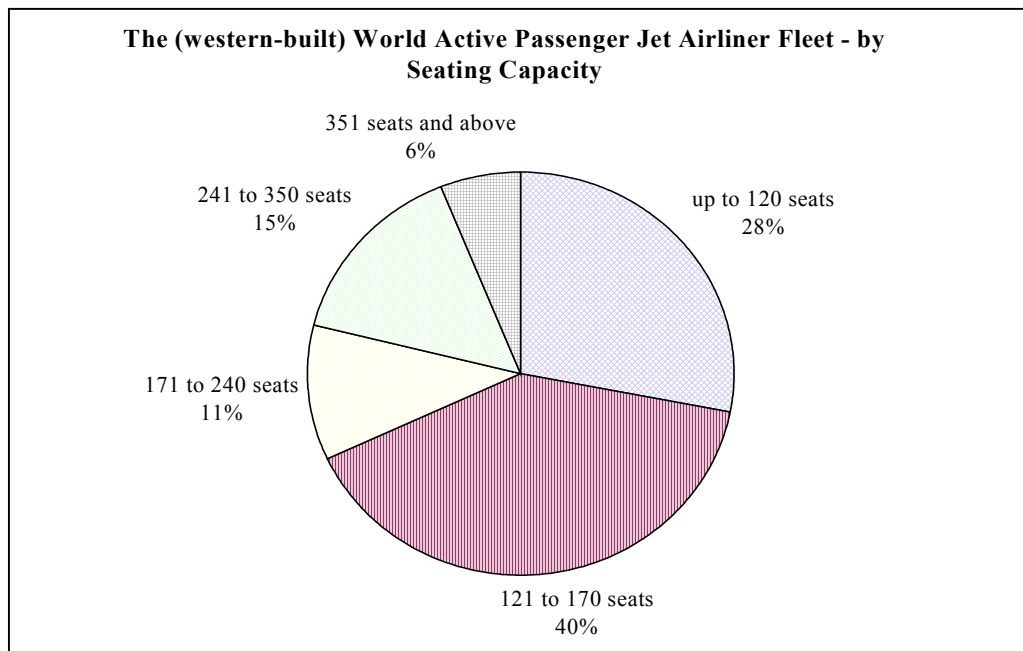
Boeing and Airbus delivered about 900 aircraft in 1999 alone, although 2000 figures were lower. Over the next ten years it was expected that 9,000 new jet airliners would be required at a cost of \$585bn (source Boeing), implying an average cost of \$65-70m per new plane. This would significantly reduce the average age of fleets. The age banding at the end of 1999 is shown below, many of the older planes are in operation in North America.



Over 20% of the jet airliner fleet is over 20 years old; the total value of all jet airliners was around \$328bn; this is expected to rise to close to \$900bn within ten

years, and \$1,380bn within the next 20 years. In general the turbo-prop fleet shows similar age banding except that the proportion of the fleet under 5 years old is about 10% lower, and the 10-15 years old proportion is about 10% higher.

The number of smaller aircraft is forecast to grow more rapidly than the overall fleet due to the demand for greater frequency on domestic and short haul international flights. At the same time, both Airbus and Boeing have been developing larger aircraft capable of carrying up to a maximum of 1,000 passengers - the Airbus A380 is expected to enter service in 2006. There are a relatively small number of new orders for this. Initially Boeing were thinking of developing a new generation of faster and more efficient planes (delta wing), but this now appears to have been shelved and in favour of modifications to the 747 to compete with the A380. The large planes were intended to be flown to hubs around the world, from where passengers were then flown on to their final destinations by smaller, frequent commuter services. However, passengers and therefore airlines seem to prefer smaller aircraft that allow them to run more routes taking passengers directly to their final destinations.



For the aviation insurance industry, these developments seem to imply a step back from very large hull values and the potential for record liability losses should one of these monster planes crash. However, it means that the skies will continue to get more crowded putting pressure on the already stretched air traffic controllers.

At the end of 1999 over the active jet airliner fleet (13,250 aircraft) about 73% were manufactured by Boeing (and McDonnell Douglas), 15% by Airbus and the rest by small manufacturers (Canadair, Embraer etc). However, when aircraft delivered in between 1995 and 1999 are considered (3,550 planes), the Boeing share was only 55% with Airbus Industries up to 2000 accounting for 26% of the total. Of the 3,070 jets on order 35% are Boeing, and 32% Airbus. The balance is definitely shifting.

It is expected the growth in RPKs will continue at around 5% per annum for the next 20 years with little long term disruption from September 11th (Boeing and Airbus market forecasts). Cargo is expected to grow slightly faster, averaging 6.5% increase per annum over the next 20 years. The number of passengers carried on scheduled

passenger flights exceeded 1.5 billion for the first time in 1999 (ICAO press release). This ignores the charter and other airline activities; the total number of passengers carried during 1999 was around 2.2 billion. Cargo traffic has shown similarly rapid growth - from 18.4 million tonnes in 1990 to 27 million tonnes in 1999.

Currently the US accounts for over 38% of the total RPKs, with Europe accounting for 27%. Larger bases of established travel in Europe and North America mean that even with lower projected growth rates, the demand for many of the new airlines will come from these regions. It is expected that Latin America and Asia will grow much faster than average, despite their economic problems.

It is worth noting that seat occupancy levels hardly changed over the last decade until September 11th, so that there is still plenty of potential for increased exposure to liability claims from unchanged levels of flight and airliners due to higher load factors. However, post September 11th these have risen as the number of flights has been dramatically reduced, and are thought to be running at up to 90% (previously in the range of 64 – 67%).

ATC deregulation

Europe has 47 ATC organisations, using 22 different operating systems. Compare this to the USA, where there is one ATC organisation, using one system. In Europe ATC causes 66% of all delays, airports an additional 9% so 75% of all delays are outside the control of airlines.

Another high-profile concern of recent months has been the UK Government's part-privatisation of the UK air traffic control services (NATS). This has caused considerable problems, with half of the delays over all of Europe being caused by the new Swanwich Centre. Systems inadequacies are being exacerbated by shortages of trained controllers and current capacity is below that provided by the old system. There are a number of points: -

- a) This is not the first such project – the Canadian government privatised its air traffic control services in 1996 without any obvious problems so far.
- b) As the part-sale has been made to a consortium of airlines, it must be far less likely safety will be sacrificed for a quick profit.
- c) Manning levels were a major factor in the Unberlingen accident.

A good example of the potentially tragic problems arising from ATC errors can be seen with the recent crash between a DHL Boeing 757 and a Bashkiri Tupolev 154M at Uberlingen.

The Bashkiri aircraft was flying between Moscow and Barcelona with 12 crew and 57 passengers on board, the 757 was enroute to Brussels from Bergamo with a crew of 2 when the collision occurred.

Communications with the Russian plane had been passed from Munich to Zurich ATC about three minutes prior to impact. Both planes were fitted with Honeywell 2000 TCAS systems. 50 seconds prior to impact the Tupelov's system warned of crossing traffic, and at the same time ATC ordered the Tupelov to descend. Ten to fifteen seconds later both TCAS system issued resolution advisory commands – descend to

the DHL plane (which complied), and climb to the Tupelov (which conflicted with ATC instructions). A few seconds later ATC repeated the instruction to descend and the Russian plane complied. About this time the TCAS on 757 instructed the pilot to increase descent (pilot contacted ATC to tell them of this). Eight to ten seconds before impact the TCAS on the Tupelov instructed the crew to increase their climb. This accident raised a number of issues:

- a) Lack of an order of precedence between ATC and TCAS (to be followed in such situations by all parties).
- b) Manning levels for ATC particularly when systems were not fully functional (controller had 2 frequencies and two scopes).
- c) Backup communications between ATC and airfields (contributory factor).
- d) How to handle periods when ATC systems are not fully operational (system in fallback mode and short-term conflict alert was not operational).

Security Issues

Plenty of new techniques are available to assist with security, but it takes time to implement new procedures.

a) Biometrics

Plenty of techniques are available to help identify passengers quickly at check in. These include fingerprints, iris, retinal, face-shape or palm scanning. However, to use these standards need to be agreed, and databases established and maintained in an ultra secure environment.

b) Restricting access to the cockpit

A number of steps are being taken to make unauthorised access more difficult. Doors and locks have been reinforced by a number of carriers, and all airlines now operate a locked door policy. Closed circuit television is actively being considered to enable pilots to view the cabin at all times.

c) Security scanning

Security needs to become more efficient and up to date. Instead of concentrating on confiscating nail clippers and scissors, improvements in screening are needed to detect weapons and other hazardous materials. Since September 11th 6 million 'potentially' offensive weapons such as tweezers have been confiscated in the UK alone, but as recently demonstrated by a reporter guns can happily be taken straight on board. Effective procedures and detection equipment exist, but these need to be bought into general use.

d) Recent security events

There is still a great deal of nervousness in the market post September 11th, as can be seen from the reaction to the light aircraft that flew into the side of the Pirelli building in Milan. In May a plot was discovered in Saudi Arabia to fire a shoulder launched air missile at an airliner. India's intelligence services uncovered a plot to crash a hijacked airliner into the India Oil Corporations largest refinery at Koyali near Baroda. Air Marshalls travelled aboard all the flights to/from Rome airports for the duration of the Nato/Russian summit.

Recent worrying events have included:

- The kidnapping of a passenger boarding a flight at Bangkok Don Muang Airport by 7 or 8 unidentified men.

- The attempted storming of the flight deck on a South African Airways 747 by a passenger in July.
- The 4th of July shootings at the El Al ticket counter of Los Angeles Airport killing two people.
- The passenger who was given the wrong passport when checking out from his hotel in Spain. He then managed to return to the UK, and take another holiday abroad without being challenged. He passed through a number of major airports on a woman's passport.
- The recent attempt to board a Ryan Air aircraft from one of the small Stockholm airports by a member of an extreme Muslim sect (Sulfi) carrying a gun.
- The restrictions placed on Muslims traveling by aircraft in the US. The day before Christmas President Bush's bodyguard was removed from onboard an aircraft when travelling as a civilian.

Improvements in Airline Safety Post September 11th

Some of these changes have already been implemented whilst others hopefully will never form part of the aviation system.

Happened

- Reduce chances of planting explosives/weapons in non-sterile areas of terminals.
- Increase visible security personnel at airports (National Guard at US Airports).
- Airport security screening facilities to be under government control.
- Wider use of Air Marshalls on flights.
- Military aircraft to intercept and/or destroy hijacked or potentially hijacked aircraft – likely to be US policy – can be done without presidential approval.
- Strengthen cockpit locks and doors (done by a number of carriers).

Likely

- Train cabin and flight crew in survival tactics for violent encounters.
- Ban items that could be used defensively by hijackers, e.g. handcuffs, rope, body armour.
- Routinely check info on registered pilots, mechanics, crew etc against police information, driver's licenses and other government data.
- Allow autopilot to override flight paths through buildings.

Possible

- Record video images of cockpit and cabin and broadcast to the ground
- Pilots should be able to see cabin activity via cameras in cabin
- Redesign transponders so they cannot be turned off from cockpit.
- Ban carry on luggage being taken on board.
- Develop warning system based on current air traffic control system data to identify unusual systems events associated with hijacking.
- Transmit cockpit voice and flight data continuously to ground based data storage facility.
- Central database of passenger information to enable positive identification of passengers, e.g. photography and fingerprints.

Unlikely

- Allow remote control of planes from the ground (would require redesign of aircraft and changing existing aircraft).

- Arm flight crew and or cabin crew.
- Allow off duty police to travel armed.
- Equip cabins with knockout gas.

Reserving Issues

For aviation business the actuary should take these additional issues into account:

a) Adjustable Premiums.

An estimate is made at the outset that is used to calculate a deposit premium, which is paid at the start of the contract (or in installments). Once the actual base is known the premium will adjust and that may lead to a return or additional premium being paid.

b) Profit Commissions (PC's) and No Claim Bonuses (NCB's)

Although these are now rare PC's and NCB's were a common feature of aviation contracts during the last cycle. Adjustment of the triangles may be necessary.

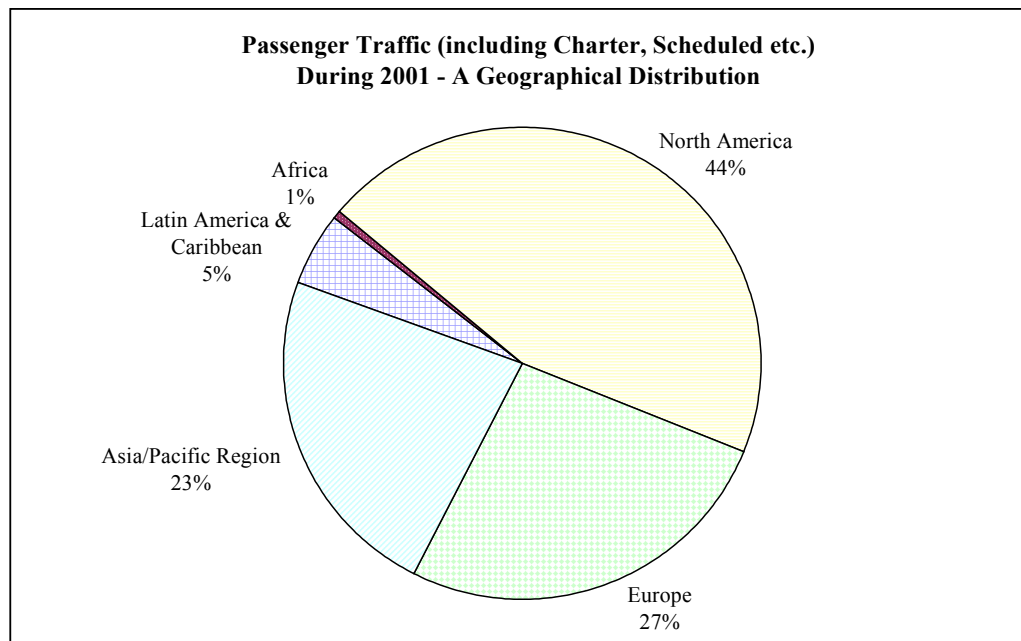
c) The War Surcharge

The war surcharge causes problems when estimating the premium and claims reserves as the losses and premiums that are associated with it are unlikely to follow the development profile of a normal airline portfolio.

FEATURES OF THE AVIATION MARKET

Distribution of Passenger Traffic

It can be seen from the pie chart below that the largest share of traffic in 2001 was North American. Whilst safety standards here are generally higher than the rest of the world, compensation payments are also considerably higher. However, it should be noted that the highest rate of growth is expected in the Asian region for passengers and in Africa for freight. Numbers of cycles are identical except 2% of cycles take place in Africa.



DVT and other New Types of Claims

Deep Vein Thrombosis (“DVT”) is a disease that can affect passengers on long haul flights. It involves the formation of a blood clot in the leg and is dangerous, requiring hospital treatment. Most of the blood clots suffered by passengers are harmless and amount to nothing. However, if the clot moves to the lung once the passenger becomes active the condition may be fatal. The contributing factors to the disease are immobility, cramped seating, compression of the thighs by seat edge, dehydration from alcohol and cabin air-con units.

At the present time, there have been no losses to the insurance industry but this may be about to change as this is attracting more press attention. In Australia, a law firm has filed over 1,000 DVT claims against 6 airlines in one year. In the UK, a travel-related medical assessment organisation believes that there are around 2,000 deaths each year from DVT. Several test cases have been filed in Australia, the UK, and the US seeking between £2,000 and £1m. The first major hearing is expected in early 2003. DVT victims have several legal hurdles to leap if they are to prove their cases against the airlines. First, they must prove that obtaining a serious blood clot during a flight is considered an ‘accident’ under the meaning of the word in Article 17 of the Warsaw Convention which governs international flights. Then, the victims must prove that DVT is caused by flying in an aircraft and could not have happened anywhere else.

A recent investigation by a College Hospital in London found that one in ten people making long haul flights develop some form of DVT, although experts have labelled this study “inconclusive”. The World Health Organisation is currently examining the factors involved.

It has been reported that the airlines have known about the problems of DVT for over 30 years but it is only now that the airlines are waking up to this disease to stop more deaths and further litigation and are starting to inform their passengers of the risks involved. Some are publishing explanatory leaflets while others are printing advice on the tickets themselves. It is the delay in informing passengers that is causing the majority of the lawsuits.

The insurance industry is starting to take note. Although DVT is a source of uncertainty for the insurance industry, it is still in its infancy and will require legal rulings before it could become a major issue. However, it is interesting to note that some travel insurers have introduced a provision for passengers to take legal action against the airlines in the event of death or injuries as a result of DVT. This will have an impact on the propensity to sue and therefore may increase the number of claims.

Other possible future claim types:

a) Pollutants in aircraft air conditioning units

The main alleged cause of this issue is the ingress of engine lubricating oils, hydraulic fluids or de-icing fluids into the cabin through the air conditioning supply system. As the contaminant enters the cabin, it is heated as it bypasses an engine becoming a vaporised mist. There is a suspected link, voiced by the Association of Flight Attendants, between health complaints (nausea, dizziness, blurred vision or disorientation) and mechanics’ records of hydraulic fluid and lubrication oil re-fittings.

In 2001, 26 current and former Alaska Airlines flight attendants alleged they had suffered severe neurological damage from being repeatedly exposed to toxic chemicals on certain aircraft during the 1980s and 1990s. They won a \$725k out-of-court settlement from Alaska Airlines.

Although this could also be an important issue for the Aviation insurance industry, its development is less mature than DVT.

b) Radiation exposure to aircrew

This is thought to be far higher for flight and cabin crew, although samples to prove any problems are limited. The most obvious manifestation would be amongst crews on Concorde, which flies at a much greater altitude than other aircraft.

Changes in Reinsurance

One of the features of the aviation market is its large reliance on reinsurance. Even in years of poor experience, some direct writers made money on the back of extremely cheap reinsurance deals. This led many players to underwrite on the strength (and hopefully security) of the reinsurance program that they managed to buy. Many were badly caught out by the collapse of Fortress Re.

In 1982 Fortress Re established a pool writing aviation reinsurance on behalf of Nissan, The Taisei Fire & Marine Insurance Co Ltd and The Aioi Insurance Co. Ltd. On 22nd November 2001 The Taisei Fire & Marine Insurance Co Ltd filed for court protection as a result of losses, believed to be around \$650m, arising from their share (26%) of the Fortress Re Pool. This in turn led to Fortress Re ceasing to trade.

Prior to that time Fortress Re had been the primary reinsurance carrier in the market writing around 80% of all low level covers. The cause of the collapse is the subject of several court actions in the US and there have been allegations of loss concealment, deceptive accounting and flawed reinsurance contracts.

Whatever the cause the collapse of Fortress Re has had immense implication for the aviation market. In particular with the shortage of reinsurance available coverage was re-examined and restricted. Risk attaching coverage is only available for select clients through Converium or Munich Re and prices have increased. Reinsurers will now only give coverage on an each loss basis going forward (rather than the option of using the limits on an each aircraft/each insured basis).

At the end of the previous down cycle, the direct market saw an increasing number of multi-year deals being offered to the major airlines. Many of the 1998 and 1999 renewals were for two or three years, as airlines tried to lock into the low rates on offer. This in itself encouraged a further deepening of the cycle, as underwriters who were unable to sign up for these large premium deals had to squabble over the business remaining in the interim years to maintain their market share.

Direct business rates started hardening in 2000, and dramatically hardened after September 11th (affecting many of the large airlines renewing in the fourth quarter of the year). The chorus of complaints from airlines is reaching a crescendo; many are in a precarious financial position, which is not being helped by rising insurance costs. The size of the rises appears unjustifiably large at first sight. As stated earlier though, the years of undercharging by insurers created unrealistic expectations. Additionally, aviation is now considered a more risky business, reinsurance costs are higher, and investment returns are low.

However, insurers are caught on a quandry. Reinsurance costs are still rising, and are likely to stay high for at least a couple of years as reinsurers seek to recover past losses and meet the payments arising from September 11th and recent European flooding. Insurers will struggle to cover further rises in reinsurance costs from writing the same levels of business. Either rates must rise further (which seems to be happening) or there may be a move to write more business, raising levels of risk and increasing competition. Including exposure increases, it looks likely that the airline premium will rise by around 10% from 2001 levels, but most of this is probably down to higher exposure.

The debate over risks attaching versus losses occurring cover continues. Many current programs have the option to cancel at the end of September, so it will be interesting to see if any programs are placed on a risk-attaching basis. To date only one major program has been done on this basis. See later for more information.

As a result of September 11th insurers have become more conscious of the fact that although their reinsurance cover is limited (usually to three losses or less at the top of

a program), in effect cover is offered for an unlimited number of incidents up to policy limits. This situation is similar to that found in most of the London Market, and in the past it was regarded as being so unlikely that a number of full program losses would occur that this possibility was ignored. However, in the new more risk adverse environment, insurers are paying more attention to this sort of factor. See later for possible solutions.

Claims Inflation

Over the last ten years this has been running at around 10% per annum for aviation claims. Much of the impact of this has been mitigated by improving safety, and is further hidden by the very variable nature of claims. As the safety plateau is approached this may become more apparent, and may need to be more explicitly priced for.

Low Cost Airlines

A few years ago the 'low cost airlines' did not exist, however since then there has been a phenomenal growth in this sector. These airlines have minimised costs by offering limited in-flight services and reducing overhead costs in areas such as ticketing and baggage handling operations.

These airlines have introduced a number of new issues for the aviation insurance industry.

- a) It has been suggested that the cost saving initiatives have been extended to more critical areas such as maintenance departments, training and optimising the amount of fuel carried. If these suggestions are true, then there is a direct influence on the risk borne by the insurers of these airlines.
- b) Although not directly related to aviation insurance, the frequent flight delays associated with low cost airlines will affect the claims frequency and claims cost of travel insurance. These delays are another consequence of cost cutting. When planes breakdown there are no spare planes to take their place, and turn around times inbetween flights are short causing knock on effects on the rest of the timetable.
- c) Low cost airlines have also opened up a number of new routes to small less established airfields that just started offering international passenger services. The emergence of these airports has introduced problems and strains on areas such as security, maintenance, airport facilities and air traffic control. All these issues have direct affects on insurers that provide cover for these services.

In general, less business customers are flying in premium seats as companies cut travel budgets. This has a negative effect on airlines revenue, and large numbers are switching to using the low cost carriers. One in five business travellers had moved from business to economy and one in six to low cost airlines. A further 1 in 4 were currently considering moving to budget airlines. Within the last year 50% of business travellers had taken 5+ flights with budget airlines. This is a drastic change in flying habits, and will probably lead to much larger liability limits being purchased by the low cost operations.

It is unclear if the success of the low cost carriers can continue. Although they do not have the massive organisational structures that hinder many of the large national carriers, other advantages will disappear.

1. Airport charges are rising, in particular at Stanstead where many of the British operations are based, as the carriers become more successful the airport authorities will increase costs.
2. Many of the carriers tend to use less convenient airports (further out of town), which is often not realised by passengers
3. To make money these operators use their aircraft more intensively. As a result even a small delay can have an impact on the rest of their schedules for that day causing a series of take off and landing slots to be missed. This is a serious problem given the current state of the UK ATC system. There have been several complaints of Ryan Air pilots ignoring ATC instructions in their efforts to meet their scheduling requirements.
4. In the UK there are strict rules on the number of hours pilot can fly. These are less onerous in some other EU states, and there are complaints that pilots working for low cost airlines operating from UK airports are not following UK guidelines.
5. The number of complaints from passengers travelling with low cost airlines is soaring.

However, it is interesting to note that there are around a total of 50 operating years worth of experience for low cost operations. To date they have had no losses.

Vertical Placing

One of the main historic problems with Aviation Insurance was the way in which risks were placed. This arises from the power of the brokers and the fact that most of the premium is generated from a small number of risks. Although a slip system is used, this is placed in a very different way from other London Market business. The system is called vertical placement, and is unique to the aviation market. It is a relatively new phenomenon, having only really emerged since 1995.

Risks are placed with the following market first, conditional on certain leader(s) taking the risk. The differential between lead and follow markets was as high as 40% for Airline insurance in the late 1990's. No member of the following market will know what price the lead is getting for the risk so each participant has to set a price for their own share. It is quite common for a different price to be offered to the leader using different slips for the various different deals on offer. This may take the form of a better rate, or a flat fee paid up front. None of the other participants on the slip would be aware of this, so often leaders will agree large reductions in the headline rate which the rest of the market will be offered, and then take an additional fee on top to compensate for some or all of this reduction. An additional fee is justified because the leader will provide capacity, claims handling and legal services, as well as the expertise when underwriting the risk, however this should be explicit and far smaller than in the past. Since September 11th the differential between lead and follow terms has substantially reduced and is now in the order of 5 – 10%. However, transparency has not really improved, so this situation may well reoccur.

Consolidation

There has been considerable consolidation within the major US airlines as code sharing arrangements lead on to alliances which evolve into full mergers. This trend is also very obvious when considering the other major group of insurance customers – the aviation manufacturers; particularly in the US.

This consolidation means that effectively, fewer risk managers will be responsible for managing enormous pools of risks. This will increase the requirements from insurers, needing stronger capital bases and more sophisticated global capabilities, particularly if an insurer wishes to remain a leader in this sector.

The smaller number of clients will further increase the power of the brokers, who have also been consolidating. The small size of the industry, large premium size, and large amounts of reinsurance premium generated (which often has to go through the placing broker as part of the original deal, generating two lots of commission) all increase the power of the broker. There are only three major brokers left.

Generally across the whole industry fewer stronger players have replaced a weaker more fragmented market. This should mean competition will be stronger and better capitalised but more professional - with fewer insurers the ability of brokers to play them off against each other should be reduced.

A more balanced approach has been achieved post September 11th, with more power in the hands of the insurer. The power of the broker needs to be reduced otherwise the same old problems will emerge as the market softens. Changes will only happen if the market works together and rebuilds long term relationships, as well as developing other sources of business. A logical extension of this will be further consolidation in the insurers across the Atlantic, to enable a more effective answer to the problems of client need and geographic diversity.

Underwriting Cycle

As for all insurance the aviation market is cyclical. Although the market is now hard, if past history repeats itself this will not last for long.

Cash Flow

It is estimated that the average term for investment income for about 2½ years on the net premium income over the run-off of a particular year's business. With current interest rates at 4% or less, this is not a large amount.

CONCLUSIONS

Future Trends

The frequency of loss has tended to fall or at least remain relatively stable year on year. Growth in air traffic has been enormous over the past 20 years (from 7,430 active jets in 1980 to 15,861 in 2002). Travel is likely to continue to grow at around 5% per year for the next 20 years or so. On the face of it we would expect to see the number of hull losses increasing at a similar rate over this time, and hence also the insurance cost.

However, things are not so simple, and there are factors which could push this number up or down.

On the positive side, safety features in aircraft are improving all the time. These both help to keep stricken aircraft in the sky and to minimise the number of casualties in the event of a crash. As a result we would expect both the frequency of losses and the severity of a given loss to decrease as these improvements are made, all other things being equal.

It is widely believed in the market that aircraft flying in the US are close to the “safety plateau”, as efficient safety features, high quality pilot training and advanced air traffic control systems help to avoid problems. In the rest of the world western-built airlines have noticeably higher loss frequencies, and it is felt that improvements to air traffic infrastructure and emergency procedures on the ground could go a long way towards improving safety in some countries.

Equally though, the world does become more litigious every day, and liability costs will be likely to rise in line with court award inflation and personal wealth. In the case of the Air France Concorde disaster, appeals were made to hold a class action for damages in a US court on the grounds:

- one passenger was a US citizen
- those flying held one-way tickets to the US, and
- the ill-fated tyres were made by an American company.

Previously a crash involving a French carrier flying a French plane in French airspace would probably have been handled in the far less financially punitive French courts.

The other problem is that of air congestion. If passenger traffic is set to increase at around 5% per annum then we are likely to see more aircraft in the skies to meet this demand. With many major airports already operating at close to maximum capacity, and with environmental objections to new international airports being built, more pressure is likely to be put on the air traffic control system. This will be offset somewhat by the advent of larger aircraft capable of carrying more and more passengers. However, if the desire to be able to fly to more and more destinations continues then the frequency of shorter flights using smaller aircraft will increase. How airports cope with these changes will probably depend greatly on how individual governments regulate their air traffic control services, and any minimum standards developed by the international community.

Reinsurance

The debate over risks attaching versus losses occurring cover has not been resolved. Whilst the direct business attaches throughout the year, and programs are on a losses occurring basis, there will always be a fundamental mismatch between business written and the reinsurance cover. Effectively the insurer is unsure what levels of protection will be available and what they will cost for two thirds of the exposure that they underwrite in any given underwriting year.

September 11th caused three full limit losses for most insurers, an unprecedented situation. As a result insurers are more conscious of the limits on reinsurance cover (the number of reinstatement usually decreases at the top end of a program), however inwards cover is offered for an unlimited number of incidents up to policy limits. In the past it was regarded as being so unlikely that a number of full program losses would occur that this possibility was ignored. However, in the new potentially more risky environment, insurers are paying more attention to this sort of factor. Possible approaches include:

- a) restricting the cover given to airlines, but this would leave them exposed after a number of losses
- b) purchasing additional horizontal cover (but how much?)
- c) an additional charge to cover the uninsurable exposure, but it is totally unclear how this could be calculated
- d) requiring cover to be reinstated after a loss over a certain size (would also have to apply to reinsurance programs).

Costs seem to be stabilising, but are likely to stay at significantly higher levels than pre September 11th. Underwriters will have to write for gross profit, and as a result rates for direct business are likely to stay at current levels for at least a couple of years. Airlines are suffering, although the additional costs are being recouped from passengers by means of the surcharge. Competition, particularly from low cost carriers, will keep fares low so it is likely that the large international carriers will continue to suffer. The situation will only deteriorate if war with Iraq starts.

Claims Costs

This paper has identified a number of current factors, which could lead to higher future claims costs:

Moves to unlimited liability

The introduction of bigger aircraft

Moves to try more cases in the US courts

More air traffic

Smaller reductions in accident rates as the safety plateau is reached

Code sharing deals giving claimants more opportunity to pursue the deepest pocket

Increased court awards in the US

More terrorist losses.

On the other hand there are relatively few factors that will lead to lower claims costs:

Improved technology and crew training
Improved safety record due to using established designs of aircraft.

How these factors combine together is obviously not certain and there are many factors listed above the impact of which can only be guessed at this stage. However, the working party would like to hazard that over the next 15 years, airline insurance will see a gradual improvement in loss frequency offset by increases in claim severity which lead to an inflating risk premium.

Market Profitability

The aviation insurance market as a whole has without a doubt lost money over the last few years. There are a number of peculiarities of the market, which have exacerbated this situation.

Firstly broker power has grown extraordinarily since the mass merger activity of recent years, and brought with it the phenomenon of vertical placing. To some extent this feature of the market was acting to hide the true profitability of the business. This especially applied to the following market. Although at current levels of differential this is not really an issue, if given a chance this is likely to re-emerge. The following market must become better educated with respect to the huge differential in prices that they can be offered in comparison with those offered to the leader(s). Further consolidation of the aviation insurance market and/or a reduction in capacity is needed to reduce some of this imbalance.

The second peculiarity is equally difficult to get around. There seems an unhealthy fascination in Hollywood for airline disaster movies, and an equally unhealthy fascination for non-aviation specialists to throw their money at aeroplane crashes. In recent years GIO, ReAC, and Fortress Re have suffered extremely large losses from their involvement in the aviation reinsurance market, and in previous years the marine XL specialists were guilty parties. These and other players who get burnt may change, but for as long as people are wont to join the market, the reinsurance once more becomes cheap, the specialists will arbitrage at a cost to the reinsurers and the market will soften. Persuading “naive” capital that the aviation reinsurance market is not the place they want to be is not easy, even given the huge losses suffered as a result of September 11th. Companies see the huge rate rises and this acts as a red rag to a bull.

Changes to Restrict Airline Costs

In general any efforts to reduce risk will be viewed in a positive way by underwriters, by showing it uses the best safety measures and employs the latest techniques an airline can help to manage its insurance costs. By fragmenting the risk (i.e. using more insurers) it was often possible to reduce costs, but at the price of accepting insurers with a lower solvency margin.

Other approaches which would restrict the claims cost include:

- Replacement of legal liability with first party accidental injury/death cover having automatic levels of payment. This would substantially reduce costs, which often form a high proportion of liability payments.

- Risk sharing by limiting payments per accident and financing any excess above this from a levy across the market.
- A more tight definition of liability

The Conundrum

Presentations by both brokers and insurers are commonplace in the market. Recently the former claimed:

- The aviation market has done itself irreparable damage through over-reacting
- Parties lack confidence that the market will respond satisfactorily to future events
- The insurance market needs reminding of its duty to supply the environment to achieve a strong and stable market.

The latter claimed:

- Premiums are now at sustainable levels
- The world has changed for insurers
- Past market losses were unsustainable

Both are true to some extent. There is no reason why insurers should subsidise airlines profits. Based on IATA results the \$13.3bn profit made by members between 1997 and 2000 would have reduced to around \$7bn if a sustainable level of premiums had been paid.

Much of the responsibility for the breakdown in trust must rest with the brokers, who by distorted the market to keep prices artificially low. Lack of corporate control, high investment returns, and cheap reinsurance all played a part. It is not surprising following the shocks of September 11th that insurers want a more realistic price for running the huge exposures involved. Whilst it is unfortunate that the rise in costs has come at a bad time this should be no surprise; confidence, accidents and profits are obviously closely linked. It is the height of hypocrisy for airlines and brokers to complain now, and to start talking about long-term relationships once the balance has turned so markedly against them. Long-term relationships depend on fairness to all parties – perhaps the starting point going forward should be a reduction in the huge amounts of premiums swallowed by commission payments?

It has been shown earlier that even at current premium levels the average cost of insuring a fully laden 747 operated by an “average” airline, on an average length flight would be around \$1,000. For this, the insurer may be covering a hull valued at in excess of \$200m, and liabilities of \$1.5bn. Is this too high a price to ask? With average accident rates now of under one in a million flights, and a survivability factor of around a half, this is an interesting question. It serves to re-emphasise the extreme nature of this business.

APPENDIX A – LARGE LOSS DETAILS

The table below contains brief details of large losses mentioned in the paper:

Date	Airline	Plane Type	Fatalities	Estimated Total Cost	Brief Description of Circumstances
1977	KLM/PanAm	2 Boeing 747's	583	Not Known	Collision between the two planes at Tenerife Airport, Canary Islands
12/08 1985	Japan Air	Boeing 747	520	US\$213m?	Plane crashed in Japan shortly after take-off
02/08 1990	Kuwait	15 planes	0	US\$300m	15 planes of Kuwait airlines seized by Iraq
05/08 1998	Korean	Boeing 747-400	0	US\$147m	Plane ran off runway at Kimpo Airport, South Korea
02/09 1998	Swiss Air	MD-11	229	US\$800m	Plane on route from New York to Zurich crashed in the sea off Nova Scotia, Canada after smoke in cockpit
15/03 1999	Korean	MD-83	0	US\$30m	Plane overshot runway on landing at Pohang City, South Korea
15/04 1999	Korean	MD-11	9	US\$80m	Cargo plane crashed in residential suburb of Shanghai, China after take-off
24/08 1999	Uni Air	MD-90	0	US\$30m	Plane caught fire after landing at Hualien, Taiwan. 50% contribution from war underwriters
23/09 1999	QANTAS	Boeing 747-400	0	US\$80m	Plane overshot the runway at Bangkok airport, Thailand whilst landing in thunderstorm
18/10 1999	Fed-Ex	MD-11	0	US\$91m	Plane overshot the runway at Subic Bay Naval Base, Phillipines whilst landing and crashed into water

Date	Airline	Plane Type	Fatalities	Estimated Total Cost	Brief Description of Circumstances
31/10 1999	Egyptair	Boeing 767-300	217	US\$350m	Plane on route from New York crashed off Nantucket Island, US
22/12 1999	Korean	Boeing 747-2B5F	4	US\$38m	Cargo plane crashed at Stansted airport, UK during take-off in poor weather
25/07 2000	Air France	Concorde	113	US\$300m	Plane crashed into hotel on take-off from Paris on route for New York, following tyre burst leading to debris in engine and fire

Appendix B - Airline Losses on and after September 11th

China Airlines 747-200 – 25th May 2002

Occurred near Penghu Islands, Taiwan. Aircraft crashed into the sea 20 minutes after takeoff in normal weather and flight conditions. No abnormal communications were received. Flight was carrying 19 crew and 206 passengers. Subsequent reports indicated that metal fatigue (cracking) had been found towards the rear of the fuselage where additional strengthening had been added in 1980 following a tail scrape.

China Northern MD82 – 7th May 2002

Crashed near Dalian after departing Beijing. All 9 crew and 103 passengers were killed. Weather conditions were normal.

EgyptAir 737-500 – 7th May 2002

Crashed into high ground near Tunis airport on its second approach after flight from Cairo. Visibility was poor due to fog and sandstorms. 7 out of 8 crew and 11 out of 55 passengers died.

EAS Airlines BAC111 – 4th May 2002

Crashed into residential area in Lagos shortly after takeoff enroute to Kano. There were 4 survivors among 8 crew and 71 passengers, a further 70 died on the ground.

Air China 767-300 – 15th April 2002

Aircraft crashed at Pusan, South Korea just before landing after a flight from Beijing. Dense fog and low visibility were reported. 11 crew and 155 passengers died.

Iran Air Tours TU154M – 12th February 2002

Hit Sefid Kouh Mountain in Iran, conditions were poor at the time with rain, snow and fog. 15 crew and 105 passengers died.

TAME 727-100 – 28th January 2002

Flying from Quito to Cali stopping at Tulcan crashed in Columbia near Tulcan shortly before landing. No problems were reported and the weather was good. 9 crew and 83 passengers died.

CrossAir Avro RJ100 – 24th November 2001

Flying from Berlin crashed at night close to Zurich airport where it was due to land. 3 out of 5 crew and 21 out of 28 passengers died.

American Airlines A300 – 12th November 2001

Flying from New York to Santo Domingo (Dominican Republic) crashed into Queens (a residential suburb outside JFK). Plane broke up in mid air probably due to loss of vertical tail fin. All 9 crew and 251 passengers died, and 5 people on the ground.

SAS MD87 – 8th October 2001

Collision with Cessna Citation that strayed onto runway in heavy fog at Milan airport as it was taking off subsequently hit a hanger before catching fire. 6 crew, 104 passengers, 4 occupants of Cessna and 4 airport workers died.

Sibir Airlines Tupelov 154M – 4th October 2001

Exploded in mid flight near Black Sea, probably as a result of an Ukrainian accidental missile hit. All 12 crew and 64 passengers died.

WORLD TRADE CENTRE

American Airlines 767 (Flight 11)

Flying from Boston to Los Angeles. Flight was carrying 11 crew, 76 passengers and 5 hijackers.

United Airlines 767 (Flight 175)

Flying from Boston to Los Angeles. Flight was carrying 9 crew, 51 passengers and 5 hijackers.

American Airlines 757 (Flight 77)

Flying from Dallas to Los Angeles but crashed into the Pentagon. Flight was carrying 6 crew, 57 passengers and 5 hijackers.

United Airlines 757 (Flight 93)

Flying from Newark to San Francisco but crashed near Pittsburgh, Pennsylvania. Flight was carrying 7 crew, 34 passengers and 4 hijackers.

APPENDIX C - KUWAIT AIRLINES RULING

On Thursday 11 July 2002, Mr. Justice Langley ended more than eleven years of speculation in the London excess of loss (LMX) reinsurance market. In *M.A.Scott v Copenhagen Re* the Judge decided that the loss of a British Airways 747 jet in the 1991 Allied conflict with Iraq could not be aggregated into one excess of loss reinsurance claim with the plundered Kuwait Airways Corporation ("KAC") aircraft and spares.

When Saddam Hussein's forces invaded Kuwait and captured its main airport on 2 August 1990, Iraq plundered 15 aircraft and more than US\$150 million of spare parts belonging to KAC. The KAC aircraft were repainted in Iraqi Airways livery and pressed into service for Iraq. KAC itself was dissolved. In contrast, a Boeing 747 belonging to British Airways became stranded at the airport when Iraqi bombing of the runways frustrated its delayed departure to Madras. The BA aircraft remained stranded for many months. It was eventually destroyed in February 1991 during the Allied ground war.

The combined insured value of these aircraft and spares exceeded US\$450 million. The Aviation War market paid the losses in full, together with Judgment interest exceeding \$120million. Despite the lack of an overall consensus, part of the excess of loss market was initially prepared to treat the losses as arising out of one "event", and aggregated them into one excess of loss claim. The 1.1.90 Joint Excess of Loss clauses were the predominant contract terms at the time and these allowed aggregation of losses "arising from one event". However, several reinsurers believed there was more than one event. From 1996, following the *Hill-v-Mercantile* and *General* decision, most London excess of loss market participants suspended payments of the Kuwait aviation claims altogether, because of uncertainty surrounding the numbers of events, claims and deductibles. As such, LMX spiral transactions valued at many times the insured losses became paralysed despite various attempts at market resolution, and "test" litigation remained the only certain route to resolve the aggregation issue.

In *M.A.Scott-v-Copenhagen Re*, the Scott syndicates argued that all the losses arose from one event, and Copenhagen Re argued that they arose out of two or more events. Mr Justice Langley has now decided, in favour of Copenhagen Re, that whilst the losses of the fifteen KAC aircraft and spares arose out of one event, namely the invasion and capture of Kuwait airport on 2 August 1990, the loss of the BA aircraft did not.

The Judge accepted Copenhagen Re's submissions that the KAC and BA losses could be distinguished for three principal reasons. Firstly the timing and secondly the causes of the losses were different: the KAC losses were caused by the capture of the airport on August 2, but at that stage the BA aircraft was not lost: one had to "wait and see" what happened to it after a reasonable time. The BA loss was caused by the destruction of the aircraft or the outbreak of war in January 1991, or the inevitability of war (in effect in November 1990) when UN Resolution 678 was passed. Thirdly, whilst Saddam's plunder of the KAC property was economically motivated, in order to acquire assets which would relieve Iraq's dire financial condition, there were no similar designs on British Airway's property.

As such, following similar reasoning to the famous Dawson's Field arbitration award, (which concerned the Palestine Liberation Front's hijacking and destruction of several aircraft), the Judge held that three of the four "unities" of an aggregating "event" were not present and the BA loss could not be aggregated with the KAC losses.

This clear decision should bring closure on one important issue that has troubled the reinsurance market for many years.