



RISK MANAGEMENT IN AIR TRANSPORT AND INSURANCE

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Summary:

Air transport inherently represents one of the most important and dynamic sector of the economy. As an important economic entity it is a key factor in the development of modern society, it is a mean of economic development and it creates one of the largest sphere of the economy. With its character it is significantly involved in ensuring sustainable development of mobility, economic growth and integration of new Member States into the European structures.

Qualitative and quantitative criteria of each method of transport vary in speed, comfort, economical aspect and especially in safety. Based on selected statistical indicators, air transport is the safest method of transport and according to these criteria it maintains leading position. The occurrence of aircraft accidents is in comparison with other methods much lower, but the consequences of accidents in air transport are often, for the crew of the aircraft and passengers, fatal. Air accidents cause injuries, fatalities, property damage and damage to third parties.

The growth potential of air transport is not exhausted. Competition is increasing, there is a boom in airlines, terms of service providing are changing within every individual airline leading to an expansion of the risks and their subsequent elimination. In this paper author focuses on risk management in civil air transport and the possibility of eliminating financial impact of risks by means of insurance.

Keywords:

air transport, air transport safety, risk, risk management, insurance

1 Air transport characteristics

Despite the fact that air travel is the latest method of transport, it represents one of the most important sectors of the economy. The huge

expansion of aviation is dated from the early 20th century, and its volume is still growing.

Within aviation we distinguish civilian and military aviation. Civil aviation involves the transportation of passengers from general public, of cargo and mail for a fee both in scheduled air transport and general (non-scheduled) aviation.

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Scheduled air transport provides passenger and cargo transportation on scheduled flights according to schedule. The term „general aviation“ refers to other uncontrolled civil aviation.

According to the International Civil Aviation Organization, the airlines of ICAO's 191 Member States carried approximately 2.7 billion passengers (+5.6% over 2010) and 51.4 million tonnes of freight in 2011. (ICAO, 2012)

In Europe alone, the aviation industry provides 5.1 million job positions and contributes 365 billion EUR or 2.4% to European GDP. Global air transport, in spite of the current economic crisis, is expected to grow over the long-term by around 5% annually until 2030 (a compound increase of more than 150%). (European Commission, 2012)

The use of aviation throughout the world lags far behind the USA, where this method of transport is annually used by 60% population, while in Eastern Europe it is only 0,4% and in China 0,05% of the population. However, these figures are also highlighting the enormous potential for growth in this sector, whether in Europe or in Asia.

Growth potential of the aviation market and flexibility of conditions have resulted in increased competition that forces airlines to expand or reduce its prices. (Oros, 2010) In comparison to other methods of transport it is at a disadvantage from the financial point of view, but also in this area it leads to improvement through offering tickets at affordable prices via low-cost companies.

Major international organizations, which dominate the market for civil aviation are IATA and ICAO.

International Air Transport Association (IATA) in its nature is one of the most important organizations in civil aviation. It was established on April 19th, 1945 in Havana. Its headquarters is situated in Montreal. The organization currently has a number of regional seats worldwide. The main office is located in Geneva and regional offices are located in Amman, Johannesburg, Miami, Singapore and Beijing.

IATA for more than 60 years represents and provides the needs of the aviation industry. IATA as an international association was founded by the airlines, is composed of representatives of the

airlines and most of its activities are carried out in favor of the airlines.

Upon its establishment it had 57 members from 31 countries, mostly from Europe and North America. At the present it is a group of 240 members from more than 126 nations around the world accounting for 93% of all airlines. IATA membership is voluntary. A member of IATA can become each airline performing regular international transport of passengers, goods or mail between two or more states, while the airline that carries the traffic must be registered in a Member State of the *International Civil Aviation Organisation* (ICAO). Each member is required to participate in financing IATA with regular member contributions.

The main aim of IATA is to maintain healthy competition in the spirit of free trade and to encourage airlines in fair competition and unification of prices. Among other things, IATA sets and coordinates fares in international air transport, regulates air tickets, regulates the transport of dangerous goods, assigns codes to air carriers and to airports and grants accreditation to travel agencies, with the exception of agencies based in the USA, etc. (IATA, 2012)

ICAO is the aviation authority of the United Nations. In its character it is a specialized organization of the United Nations and the most important international governmental organization working in the field of civil aviation. It was established under the Convention on International Civil Aviation, which was on 7th December 1944 signed by 52 participating states. This document came into force in 1947, when 26 countries have ratified it.

The ICAO currently unites 191 countries of the world, it is headquartered in the *Quartier International de Montréal* and has seven regional offices: in Bangkok for the Asia Pacific region, in Cairo for the Middle East region, in Dakar for the Southern and Central Africa, in Nairobi for the area of Eastern and Southern Africa, in Lima for the area of South America, in Mexico City for the Caribbean area, North and Central America and in Paris for the area of Europe and North Atlantic.

The ICAO's main priority is to codify the principles and techniques of international air navigation and

to ensure planning and development of international air transport with the aim to maintain the safety and systematic and sustainable development of civil aviation. It carries out surveys in the field of international transport, publishes statistical data of international air transport and promotes simplification of formalities in international traffic. Its strategic objectives include safety, environmental protection, efficiency, continuity and compliance with legal standards. It provides technical support and assistance to developing countries and cooperates with governmental and non-governmental organizations.

The ICAO acts as an unifying, standards-setting and main authority in the field of aviation. Aims of the ICAO are defined in the Article 44 of the Convention on International Civil Aviation, also better known as the Chicago Convention, whereby the ICAO ensures the development of international civil aviation. Therefore it supports

security in international air traffic, set principles, develops technical standards and regulations, supports work on the construction and operation of the transport aircraft intended for peaceful purposes, supports the development of airways, airports and aviation facilities for international civil aviation. Also it controls economy and ensures equal opportunities for the implementation of international air services to all states.

ICAO Committee approves standards and recommended procedures concerning air navigation, prevention of unlawful disruption of airspace and simplifying procedures of transitions across national boundaries for civil aviation. In addition, ICAO defines the protocols for air accident investigation for transport safety authorities in countries signed in the Convention on International Civil Aviation.

ICAO sets standards of safety, regularity and efficiency of international civil aviation. (ICAO, 2012)

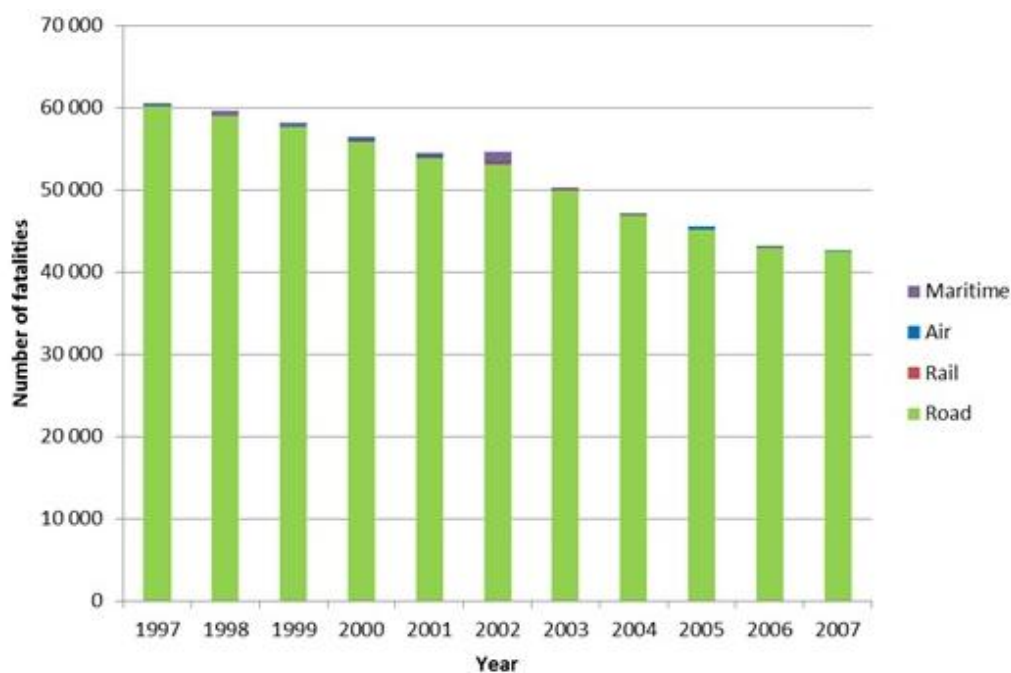


Fig. 1. Number of road, rail, air and maritime fatalities in EU27 between 1997 – 2007

Source: (European Environment Agency, 2010)

2 Air transport safety

Significant and most widely discussed issue is the question of security. Statistics point to the fact that with the increasing number of flights is increasing the number of accidents and fatalities. The occurrence of aircraft accidents when compared

to other methods of transport is much lower, but the consequences of accidents in air transport to the flight crew and passengers are often fatal. Air accidents cause injuries, fatalities, property damage and damage to third parties. Air transport along with rail transport represents unrivalled the safest method of transport. The European

Commission's report of 2010 provides an overview of the mortality for each method of transport within the Community during 1997 – 2007 (Fig. 1).

2.1 History of development in aviation safety

The Fig. 2. shows the gradual increase in aviation safety from 1942 to present. The statistics are based on data of the Flight Safety organization and shows the number of accidents and fatalities in different years aboard of aircraft in civil aviation operations.

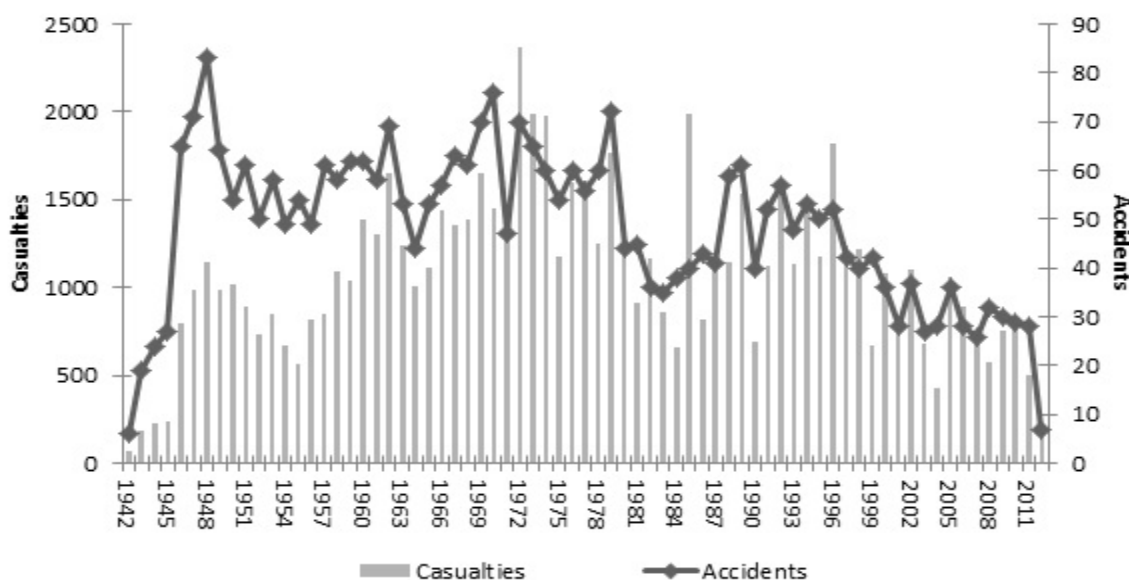


Fig. 2. The number of fatal airliner hull-loss accidents and fatalities (casualties) per year
Source: (Aviation Safety Network, 2006)

The evidence of a high level of civil air transport safety in the European Union is a graph showing the statistics of fatalities aboard the aircraft over

the territory of the Community between 1970 and 2004 (Fig. 3).

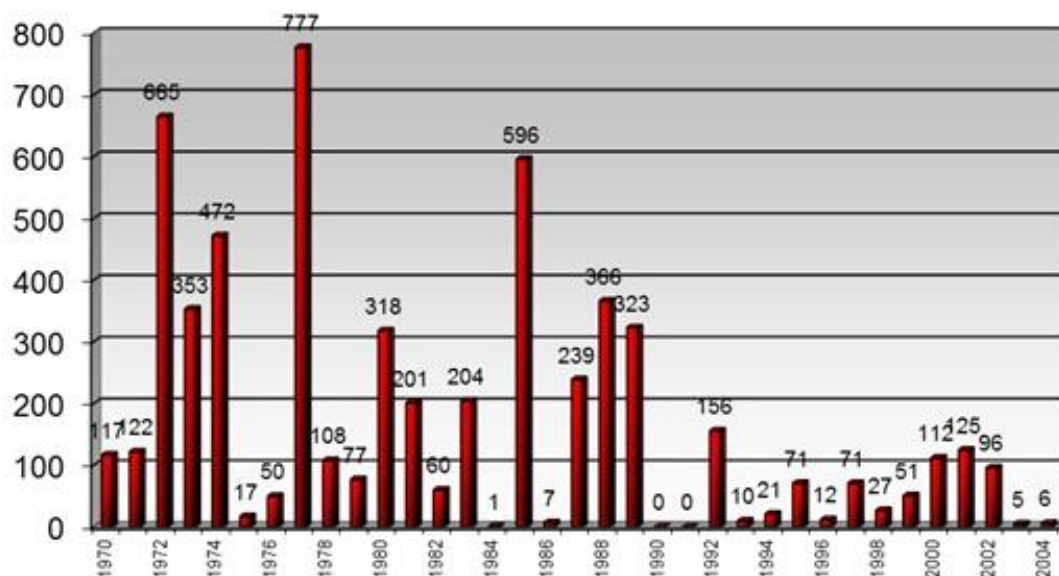


Fig. 3. Fatalities aboard aircraft over the territory of the European Union (Boeing, 2008)

Major impact on air transport safety has had the development of aviation technology, whose influence was over enormous drop in accidents. On the other hand, technical progress has increased the complexity of systems along with the requirements on the crew, leading to an increased number of accidents caused by human factor. Currently 80% of air accidents are caused by failure of the human factor.

ICAO statistics shows the following failure classification (Oros, 2010):

- procedure failures – 40,8%
- communication failures – 9,7%
- knowledge/skills – 9,2%
- staff incapability – 40,3%

Despite tremendous progress in air transport we will still find hidden risks in the design, manufacturing and maintenance of aircrafts. Many sources of accidents can be traced to disruptions in the conception and development of an aircraft. The failure usually occurs in certain stages of components` life span. Through

performing repairs or adjustment to traffic conditions, density of these failures during the main period of life decreases to a minimum. During this period there may occur random failures. In the period before the end of component's life span the number of failures increases due to their wear.

It is also important to mention that within the aviation accidents there, also monitored is the phase of flight. It was found that 50% of all accidents occur within the approach and landing, which represents only 4% of total flight time, plus 27% of accidents occurred during take-off and initial climb, which represents about 2% of total flight time. Simply from the sum thus we found that more than 3/4 of all aviation accidents occurred in these relatively short segments of flight.

The Fig. 4. and Fig. 5. are illustrating frequency of accidents and casualties between years 1945 and 2012.

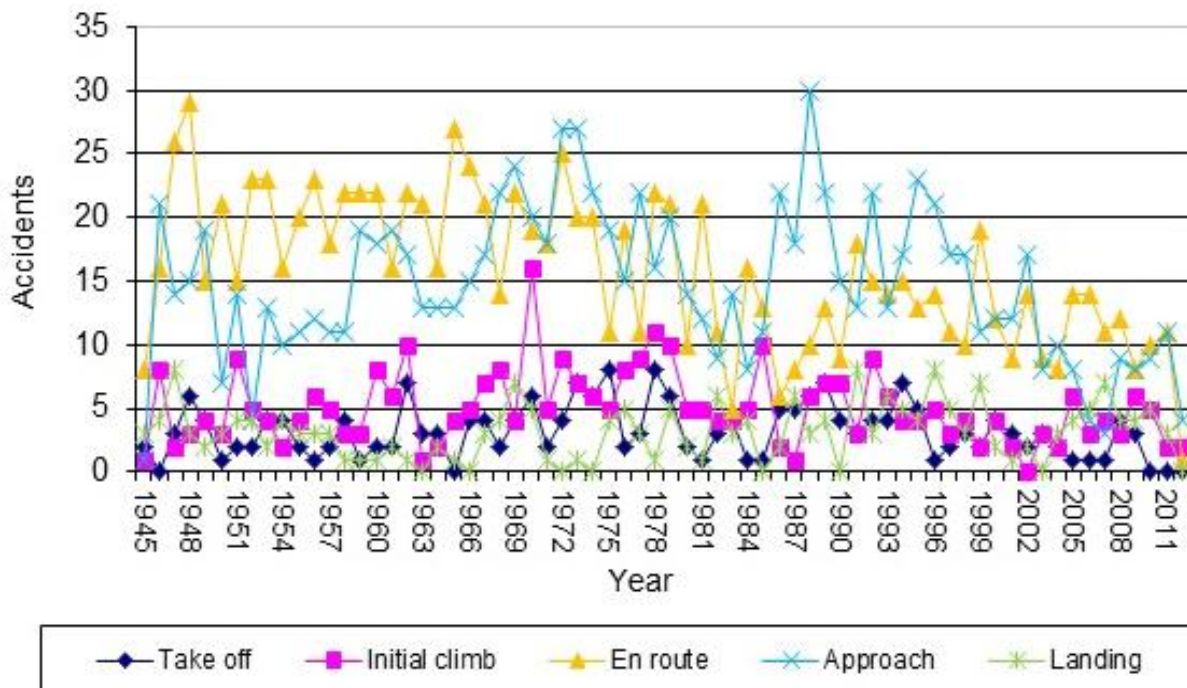


Fig. 4. Frequency of accidents by flight phase (Aviation Safety Network, 2012)

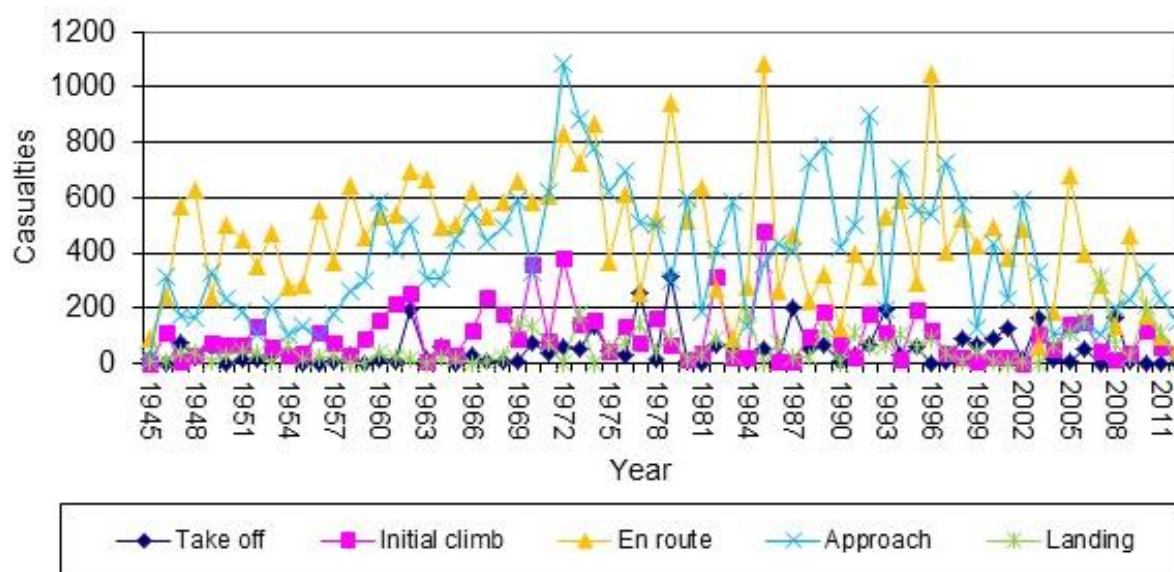


Fig. 5. Frequency of casualties by flight phase (Aviation Safety Network, 2012)

The above charts show that the majority of accidents, whether fatal or without fatalities, occurred during the flight and approach phases. Given that these figures relate to all flight operations, not just civil aviation, they can be regarded as distorted. To assess the safety of the individual phases of flight it is possible to use statistical outputs released by Boeing company, which in their research they focused on business

jet aircraft with a maximum gross weight exceeding 60 000 pounds (27 000 kg). Based on data obtained from accident reports published by governments, aircraft operators, manufacturers, from press releases and other sources for the years 2002 to 2011, Boeing conducted the following chart, which presents the percentage of accidents and casualties during the different phases of flight.

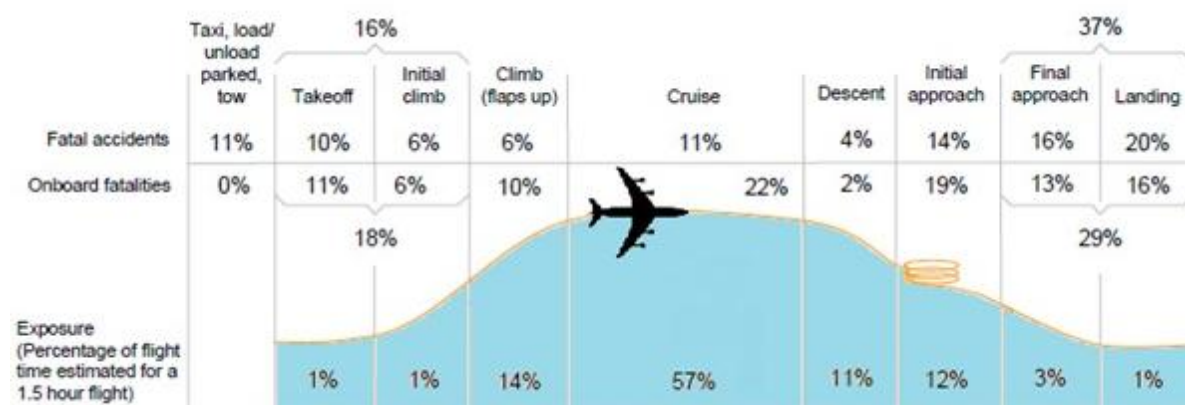


Fig. 6. Percentage of fatal accidents and onboard fatalities between years 2002 to 2011 (Boeing, 2011)

Based on Fig.6 we can conclude that the most dangerous phases of flight are take-off, initial climb, final approach and landing of the aircraft. In terms of the rate of risk, i.e. percentage of the

length of the flight phases within one flight with an average duration of 1.5 hour, these phases totals 6%. On transatlantic flights therefore the rate of risk compared to short-haul flights is negligible.

2.2 Regional statistics according to regions

Fig. 7 and Table 1. indicate the percentage of accidents and related fatalities according to the region of occurrence in 2010.

Except Oceania, accounting for 3% of all accidents, the regional distribution of accidents across five UN regions is relatively consistent, falling within range from 13% to 29%.

In the terms of fatalities, Asia is the country deserving special attention. While accounting only for 20% of all accidents, but for 47% of all fatal accidents, it accounts for 67% of all fatalities.

In 2010 North America had both the highest traffic volume and greatest number of accidents. Nevertheless of the aforementioned facts there were experienced no fatal accidents in the region.

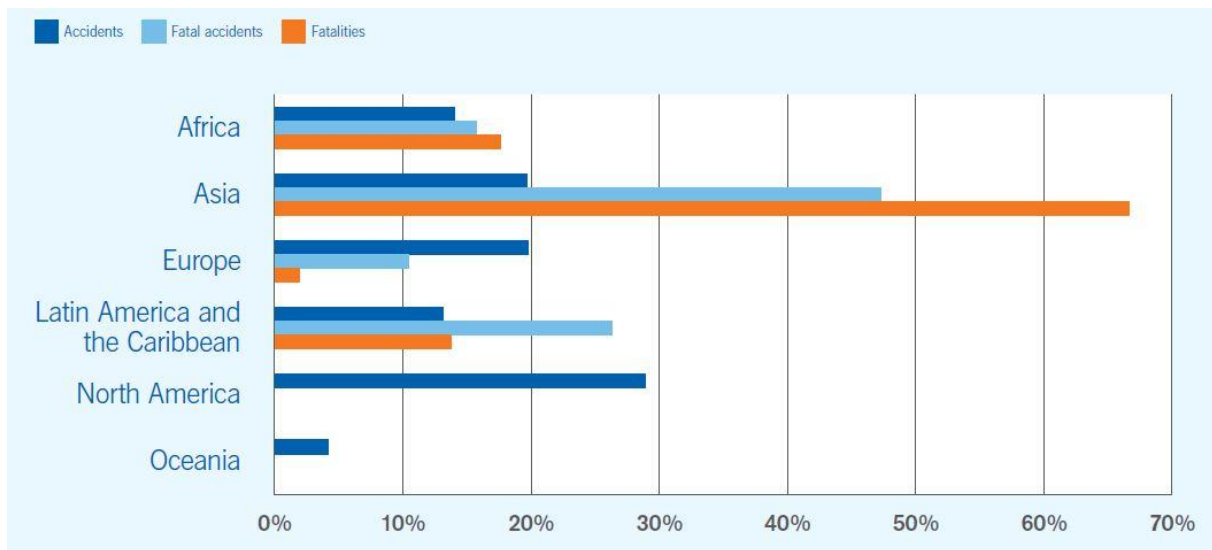


Fig. 7. Accidents by Region of Occurrence of 2010 (ICAO, 2012)

Table 1. Regional statistics according to regions of 2010 (ICAO, 2012)

Year 2010	Accidents	Fatal Accidents	Fatalities
Africa	17	3	125
Asia	24	9	471
Europe	24	2	14
Latin America and the Caribbean	16	5	97
North America	35	0	0
Oceania	5	0	0
Total	121	19	707

2.3 Causes of fatal airaccidents

The Table 2. shows the causes of aviation disasters during years 1950 to 2010. Statistics is

based on 1085 fatal air accidents. The data collected relate only to commercial aircraft. Private aircraft, military aircraft, aircraft with a seating capacity of less than 18 and helicopters were not included in the statistics.

Table 2. Causes of fatal air accidents (PlaneCrashInfo.com, 2012)

Cause	1950s	1960s	1970s	1980s	1990s	2000s	All
Pilot Error	41	34	24	26	27	30	29
Pilot Error (weather related)	10	17	14	18	19	19	16
Pilot Error (mechanical related)	6	5	5	2	5	5	5
Total Pilot Error	57	56	43	46	51	54	50
Other Human Error	2	9	9	6	9	5	7
Weather	16	9	14	14	10	8	12
Mechanical failure	21	19	20	20	18	24	22
Sabotage	5	5	13	13	11	9	9
Other cause	0	2	1	1	1	0	1

Based on this table, it is clear that the greatest number of accidents in civil aviation are connected with the human factor, namely the error caused by the pilot, who is in the history of aviation responsible for half of the accidents. In addition to human errors, the most common causes of aviation accidents are weather conditions and technical problems.

2.3.1 The human factor

The human factor includes except pilots and cabin crew all aviation personnel engaged in aircraft maintenance. Pilot error can be defined as "non-compliance with the rules to perform flights, incorrect piloting technique, incorrect handling of the aircraft and its management and incorrect navigation of the aircraft." Cause of the accident on the pilot side may be also a lack of attention or inconsistency.

Several accidents were caused by pilot error as a consequence of adverse weather conditions or technical failure of the aircraft, navigation devices, and so on. Accidents caused by human factor other than the pilot error was the result of air traffic controllers error, improper balance of

the aircraft, its maintenance or problems with the fuel. Terrorism can be considered as the human factor as well. (Viktoryová, Nesvadba, & Šteffek, 2000)

2.3.2 Technical factor

To technical factors of aviation accidents belong engines failure, equipment failure, damage to the fuel tank and a possible fire, deficiencies in aircraft construction, technical shortcomings of airports and so on.

2.3.3 Meteorological conditions

The most common causes of accidents among meteorological factors are fog, storm, strong winds, lightning, bird collisions with aircraft engines and so on. (PlaneCrashInfo.com, 2012)

3 Risk elimination in civil air transport and possibilities of their insurance

The world, in which we live, is characterized by a number of uncertainties and random events. Negative, adverse and unexpected phenomena that occur in all sectors of human activity are a part of community life. Accompanying feature of

each purposeful activity is the potential occurrence of a random event that represents the existence of risk as a negative deviation from expected result which needs to be insured.

Insurance is a specific non-manufacturing sector, or services sector of the economy, that provides the elimination of risks affecting all human activities.

Insurance is specific national economy sector that specializes in ensuring the functioning of the economic system through the repayable loss prevention and payment of claims, which arose from unpredictable, as well as expected events.

Insurance can be understood as a protection against risks, where the insured transfers their risks, whose potential consequences of the loss ratio from their individual point of view are unacceptable, to the insurer who with a sufficiently large set of risks of a similar nature is not only capable to cope all the taken risks by using collected premium, but they might become also the subject of a profitable commercial activity.

Insurance is a specific kind of financial service, where the insurer for reimbursement provides insurance coverage for the taken risks so that if an insured event occurs, he will provide to the insured the insurance benefit. (Majtánová A. a., 2005)

Insurance, therefore, can be defined as a financial tool to eliminate the negative consequences of random events. (Ducháčková, 2005)

These random events we identify as insurance risks. *Insurance risks* are caused by natural forces, regardless of human activity or directly through human activity. Their impact may cause *damage* to health or property. Quantified damage is called *loss*. Realization of risks leads to the insured event, in which the conditions stipulated in the *insurance contract* will lead to a financial compensation of the insured, i.e. compensation for the damage through *insurance claims*.

Insurance relationship between the insurer and the insured are characterized by:

- *solidarity* - insurance reserves are created from common paid premium,

- *conditional return* - the insurance compensation is paid only in case of insured event,
- *non-equivalence* - the amount of insurance claims is not dependent on the amount of premiums paid.

Other insurance company activities include preventive activity and reinsurance.

Preventive activity is focusing on the prevention of damage, a measure aimed at reducing risk and loss.

Reinsurance is defined by the Insurance Act as “taking insurance risks by a reinsurance company [...], risk valuation and management, management of reinsurance contracts, the creation of technical reserves [...], providing benefits from reinsurance contracts and the providing consultancy services in the insurance industry.” (Zákon č. 8/2008 Z.z. o poisťovníctve a o zmene a doplnení niektorých zákonov, 2008)

Reinsurance activity, respectively *reinsurance* can be characterized as insuring the insurance. It is a specific form of insurance, in which the insurance company “transfers to the reinsurer part of the risks that go beyond his financial capacity, and would upset the balance of its portfolio.” (Majtánová A. , 2006)

3.1 General definition of risk

Within the insurance industry, risk represents the possibility of an event that is the subject of insurance - insured event. The risk is not an insured event by itself, it indicates only a potential possibility of its occurrence.

In terms of insurance, *risk* is understood as a positive as well as an adverse event in the life of a man. (Cipra, Pojistná matematika v praxi, 1994)

In insurance, the term “risk” also refers to:

- object threatened by random danger (e.g., building, household, machinery),
- event, causing damage and thus represents a source of risk (e.g. accident, theft, natural hazards),
- likelihood of an incident, whose effects are negative for an economic entity. (Chovan, 1996)

The size of the risk is determined by two factors:

- *frequency* – frequency of risk occurrence,

- *seriousness* - quantifiable extent of the damage caused by the implementation of risk.

Event subject to insurance must meet the following criteria:

- *randomness* - it must be random in nature, it is unclear whether it will ever occur and when,
- *identifiably* – the cause of risk, should be detectable,
- *calculability* – loss itself must be quantifiable,
- *economic acceptability* - insurance must be economically feasible for the policyholder and the insurer as well.

In the case of insurable risk, it is necessary to take into account the problem of asymmetric information and systemic risk.

Asymmetric information reflects the differences in awareness of the likelihood of potential losses between insurers and clients.

Systemic risks are dependent risks, which cause at the same time loss to a large amount of economic entities. Since in such cases, the amount of insurance claims paid considerably exceeds the amount of premiums received, insurance companies against such risks provide reinsurance, or geographic distribution of insured risks.

3.2 Risks in air transport and the possibilities of insurance

According to the European Parliament and Council Regulation (EC) nr. 785/2004 and insurance requirements for air carriers and aircraft operators it is necessary under the common transport policy and consumer protection promotion to ensure the lowest possible adequate level of insurance to cover liability of air carrier in respect of passengers, luggage, cargo and third parties.

Aircraft insurance provided by insurance companies is governed by the insurance contract, general insurance conditions, contractual arrangements and generally binding regulations governing insurance. Risks insurance associated with aviation comes under non-life insurance.

3.3 Risks in air transport

In terms of insurance to the risks in aviation belong:

- the risk of damage, destruction or theft of the aircraft,
- the risk of death due to accident or permanent consequences of injury,
- the risk of damage to property caused by aircraft to third parties,
- the risk of death or injury of third parties caused by aircraft,
- the risk of damage to luggage or cargo during transportation,
- the risk of terrorism.

To the risk insurance of the aviation industry are linked the following life insurance classes:

- accident insurance,

The content of accident insurance is:

- insurance against death resulting from an accident - in case of death resulting from an accident within a certain period, the insurance company pays the entire sum specified in the contract
 - insurance in case of permanent consequences of injury, respectively insurance against disability resulting from injury,
 - insurance of the time required to treat the consequences of an accident,
 - insurance of interventions undertaken to treat accident consequences,
 - accident insurance of the seats.
- insurance of damage caused to aircraft, which is a form of transport insurance.

Transport insurance is a damage insurance, which may be caused on different types of vehicles or goods, during the transport itself as well as during the preparation of goods for transport. In addition to these losses transport insurance includes salvage costs, screening costs and a contribution to a common accident. The importance of transport insurance is that the carrier is liable only for damages caused by his fault. This type of insurance with coverage of e.g. catastrophe risks or the risks caused by human factors (vandalism, theft etc.) provides wider insurance cover.

Distinctiveness of this type of insurance is the close cooperation of the insurance market participants. Especially the fact when the subject of insurance represents a relatively small number of high value aircrafts, as well as the amount of damage they can cause. The insurance claim

from occurrence of damage in the air transport is moving at high values.

As, such risk cannot be taken by any economic entity or country, there is a use of reinsurance. Nevertheless in some states the cover must be provided by domestic companies and most of the underwritten risk that is ensured is on the international reinsurance market. (Cipra, Zajištění v pojišťovnictví a jeho matematické aspekty)

4 Evaluation of the identified risks

An essential part of the risk management process is to identify all hazards, i.e. risk factors that may affect air traffic and cause higher or lower losses. Risk factors are technical and human

characteristics of objects and activities that affect risk, i.e. likelihood of a negative phenomenon and its impact.

With identifying risks we analyse them and we describe the most vulnerable parts of the system. Risk assessment is the final phase of risk analysis and it requires performing an analysis of the likelihood of a negative phenomenon - analysis of abundance, analysis of possible consequences and their mutual relationship.

Mutual combination of likelihood and consequences of identified risks to the company represents the risk matrix. It is a simple tool to assist management decision making and a mechanism to increase visibility of risks.

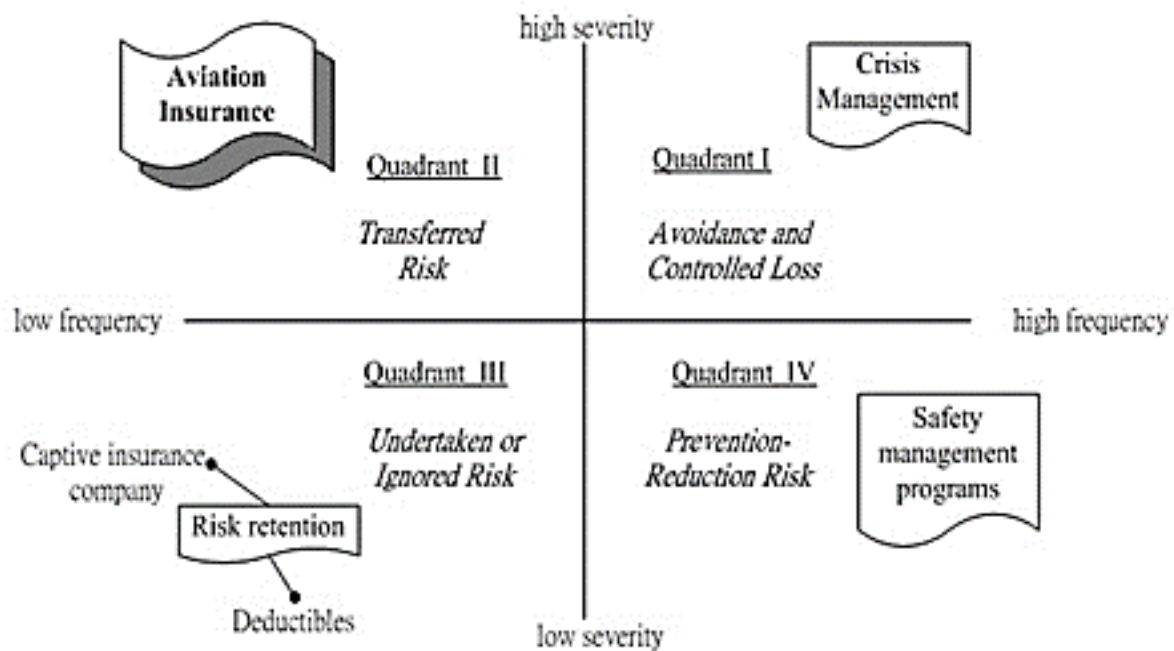


Fig. 8. Frequency-severity analysis matrix (risk matrix) (Chang & Lin, 2008)

CONCLUSIONS

Many airlines nowadays have to face various consequences after the accident in September 2001. Aftermaths of the accident include declining number of passengers, higher costs to service providers, higher insurance premiums and security costs.

With continuous improvements in aviation safety, strict supervision of compliance with safety requirements, ensuring the safety of flight operations and a number of other measures, the number of human casualties in aviation accidents year-by-year is significantly lower.

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