Air Travel

Subjects: Others

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The first aircraft at the beginning of the 20th century had too weak engines to carry passengers. Air travel that time mainly took place in large airships. The first commercial flight took place on January 1st, 1914, across Tampa Bay, Florida, with one paying passenger. The first regular passenger air transport took place in Germany, between Berlin and Weimar, from 1919. The 1920s brought fast growth of passenger aviation. In 1932, the first serial production of aircraft for passenger air travel started. However, at that time, transatlantic passenger flights were still only performed by airships. Jet aircraft replaced propeller aircraft in the 1950s. Now there are eight million commercial flights every year (status: June 2011). The crew of an airplane consists of the captain, the first, second and third officer, the flight attendants, the flight engineer, the loadmaster, the pilot and the purser. About eight million people fly every day, yielding 3.1 billion passengers in air travel in 2013. Besides people and their luggage, cargo is transported, about 140,000 tons every day, which is equivalent to 50 million tons per year. There are nearly 60 million jobs in air travel; the global turnover of the airline industry is more than 700 billion USD, with about 2.6% net profit. International aviation reached a new record in 2010 with more than 30.5 million commercial flights. 35% of the total departures in 2010 took place in North America, 25% in Asia, 24% in Europe, 10% in Latin America and the Caribbean, 3% in Oceania and 3% in Africa. Fastest growth is in Asia Pacific, Latin America, the Caribbean, Africa and the Middle East. Until 2030, an increase of the number of commercial flights to 52 million is estimated.

Keywords: air travel ; aviation ; flying disasters ; health aspects of flying ; aircraft fuel ; unruly aircraft passengers ; lost aircraft luggage

1. History of Aviation

The history of aviation starts with observation of flyers and gliders in living nature. Birds and insects are still unequaled when it comes to the way of flying and its efficiency. The first reported man-made flying devices are hang gliders in ancient China (five centuries B.C.). In the 9th century, the Spanish Muslim scientist Abbas ibn Firnas is said to have built a gliding device that enabled him to fly. In the 15th century, Leonardo da Vinci drafted various flying devices, such as parachutes, helicopters and performed flow studies on aircraft wings and streamlined bodies. None of his constructions was able to fly, but Leonardo’s drafts, which were rediscovered at the end of the 19th century, gave valuable inspiration to engineers. First air balloon experiences are reported in the 18th century, for example a 25 minutes long flight by the Montgolfier brothers in France; the first crossing of the English Channel in a balloon was in 1785 (the first crossing with a motorized airplane was years later, in 1909). Also in the 18th century, first construction drawings of aircraft heavier than air with rigid v-shaped wings are reported in Germany and the United Kingdom. Sir George Cayley (1773-1857) is known as the father of aeronautics; he was the one who disposed of the idea of flight based on moving wings, and promoted rigid wing structures and an engine instead. The first systematic flight experiments were performed at the end of the 19th century by the German Otto Lilienthal[1]. He was fascinated by birds, and saw them as basis for aviation. Lilienthal is the father of controlled flight. The development of small, mobile combustion engines by Daimler and Benz provided the basis for a breakthrough of aviation from the very early 20th century. The first passenger on a flight was Frank P. Lahm, who joined the Wright brothers on a one hour-long flight. The Wright brothers were the first to build an aircraft that allowed for a successful, lasting, controlled motorized flight. The first casualty on the passenger side in manned aviation happened in 1908. The most built airplane before WWI was the Etrich Taube, a glider inspired by the tropical Zanonia seed that can glide for 20 kilometers. William Boeing started to build airplanes in 1916; the oldest still operating aviation company, the Dutch company KLM, was founded in 1919. The first manned Atlantic crossing took place in a double decker, in 1919.

The first airport for commercial civil aviation was in Kaliningrad, the then Königsberg[2]. The first movies were shown in a commercial flight in 1925 in Germany[3]. Various airships were in use, however, the tragic Hindenburg disaster, in which 35 people lost their lives in New York in 1937, put an end to the era of airships, and paved the way for motorized airplanes. 1947 marks the beginning of ultrasound aviation, with famous proponents such as the Tupolew Tu- 144 and the

Concorde. Ultrasound aviation was not commercially pursued further, because of various reasons, including dramatically increasing fuel consumption with speed, and increased environmental consciousness. The last flight of the Concorde took place in 2003.

From the 1970 onwards, with the development of wide body aircraft which can transport hundreds of passengers, flying became cheaper and enabled the general public to use air travel, for example for holiday flights . The increase in the possible passenger number per aircraft led to the introduction of budget airlines, in the United States from the 1980s, and in Europe from the 1990s. Thereby, air travel became a commodity for the masses. The first flight alliance, SkyTeam, was founded in the year 2000. The incident of September 11, 2001, started a major aviation crisis. In 2005, the first Airbus A380 flight took place.

2. Organizations and Conventions

Since 1944 international civil aviation of most countries worldwide has been organized in the UN specialized agency ICAO, the International Civil Aviation Organization. Under the auspices of ICAO, the related civil aviation authorities of the 191 member countries establish international standards and recommended practices (SARPs) related to civil aviation, managing the close to 100 000 daily flights in a safe, efficient and secure manner. They are active in training and the issuing of licenses to personnel and aircraft, oversee safety of commercial operators, design and construct aerodromes from where aircraft flight operations take place, and manage air traffic in the country.

The Warsaw Convention is a convention that unifies rules and regulations regarding international transport of people, luggage and freight in international commercial aviation. It originates in 1929. Meanwhile, many countries switched to the Montreal Convention from 1999.

3. Environmental Factors

Reduction of the emission of greenhouse gases (GHG) is vital in successfully addressing global warming. In the US, from 1990 to 2011, the transport sector contributed 27% of the total GHG emissions. Currently, aviation accounts for 8% of the global fossil fuel consumption; however, further increase in the number of flights might yield an increase of 60% in the worldwide fuel consumption for aviation. Alternative fuels for aviation are still an experimental stage; promising sources might be biofuels, electricity, natural gas and hydrogen. However, the corrosion resistance of engine parts to biofuels is not as good as to conventional fuels (this mainly comes from the hydrophilicity of many biofuels – they attract water, and subsequently microorganisms), and in many cases the acreage for biomass yielding biofuels competes with cultivable land for food or ancient tropical rainforests. Current batteries for energy storage are not yet powerful and light enough to provide purely electric aircraft. Further sources for the electricity in electric aircraft might be fuel cells, solar cells or ultracapacitors; however, most of these options are still at research or prototype stage. There are currently two aircraft that fly on natural gas; they are from the Russian company Tupolev. Hydrogen powered airplanes either directly burn the hydrogen, or power fuel cells with it. The Tupolev company also developed the first aircraft that uses liquid hydrogen as fuel, in 1989.

About 10% of the total emissions of an aircraft are water vapor and CO_2; the remainder is mainly heated air. From the combustion of the jet fuel, toxic substances are emitted, mainly carbon monoxide, nitrogen oxides, sulfur oxides and carbon in form of soot. These combustion products negatively influence the protective ozone layer. The sulfur oxides can cause acid rain. Because airplanes fly in such high altitudes, their emissions are not washed out by rain, and cannot be taken up by plants – on average they stay for one year in the atmosphere until they start to sink.

Often when airports are built a lowering of the groundwater level is performed. This influences local ecologies. In undeveloped areas of airports, which are sometimes vast areas, fauna and flora can develop in relatively undisturbed ways; on many airports, protected biotopes are established.

In the course of increasingly cheaper flights, the phenomenon of hypermobility can be seen. People fly thousands of miles just for a weekend getaway, or plan short trips that include various flights. This severely impacts the environment, and might have physiologically compromising effects, too. Besides the CO_2 pollution, flights add soot and combustion remains to the atmosphere, cause noise pollution and need extensive surface sealing, for airports, runways, parking areas and aviation related buildings such as hangars. In areas with many flights, the vapor trails of the aircrafts may merge, resulting in a cirrostratus that yields measurably reduced solar irradiation in the areas underneath.

4. Disasters and Health Aspects of Flying

Between 2003 and 2012, approximately 703 people died each year in aviation disasters. The years 2013 and 2014 were extremes: in 2013, 224 people died, in 2014, 862 people died in airplane accidents. Causes of the accidents were in 56% the flight crew, in 17% the airplane, in 13% the weather, in 4% maintenance issues, in 4% airport or the air traffic control and 6% were miscellaneous (2010 data).

The increased cosmic radiation exposure due to flights at high altitude or across the polar caps is generally seen as low. Nevertheless, pregnant women should consider the increased radiation exposure during flights especially in the time of brain development of the child, from the 8th until the 16th week of pregnancy. The threshold of what is seen as harmless is at 0.5 millisievert. On a flight from Tokyo to New York, the radiation exposure is 0.2 millisievert.

The pressurized cabin technology of modern aircraft adjusts the environment of the passengers to dry, low-pressure conditions equivalent to the pressure in an altitude of about 2400 meters. This can yield health problems such as drying of mucous membranes yielding pain and nose bleeding. In susceptible passengers, the pressure changes can lead to acute cardiovascular failure, for example heart attacks.

The following risk groups should have their flight suitability confirmed before flying: pregnant women from the 7th month, mothers up to seven days after birth (they are generally not transported by airlines), people with high blood pressure, people at risk of thrombosis, people who recently had a heart attack or a stroke, people with acute or chronic cardio vascular or lung diseases, people with severe cases of arteriosclerosis, epileptic seizures or acute psychotic conditions, people after surgery and divers who were diving in the last 24 hours or who had a dive accident.

The increased risk of thrombosis (blood clots) on long distance flights can be lowered by wearing compression stockings, drinking non-alcoholic fluids and by exercising during the flight. Thrombosis affects about 2-5 out of 10 000 passengers in flights that are longer than six to eight hours (the longer the flight, the higher the possibility) and risk can stay increased up to eight weeks after the flight; this is a two- to fourfold increase when compared to the non flying general public. The major reasons for unplanned stopovers due to inflight medical emergencies are in 28% of the cases heart problems, in 20% neurological disorders and in 20% food poisoning.

5. Aircraft Fuel

The specific energy of jet fuel is about 46 MJ/kg. For comparison, wood has a specific energy that is only about 1/3 of this number, 16.2 MJ/kg. Due to the low specific energy of jet fuel, currently over 80% of the fully laden takeoff weight of a modern aircraft is craft and fuel. Current batteries, e.g. lithium ion batteries, lag far behind such numbers: the best lithium ion batteries on the market only have a specific energy of 0.875 MJ/kg – this is why no battery-powered airplanes are envisaged at the moment.

An airbus A380 uses 2.9 liters of fuel per passenger and 100 kilometers; a Boeing 474-400 uses 3.26 liters of fuel per passenger and 100 kilometers. This is still a lot, even when compared to a 5-seat 2014 Toyota Prius car that consumes 0.98 liters per 100 kilometers. Fuel consumption varies greatly depending on the mode of transport. Modern trains, cars and aircraft consume about 2 liters, 3-5 liters and 3-8 liters of fuel per passenger and 100 kilometers, respectively. Long distance air travel is more fuel-efficient.

In 1990 and 2010, aircraft worldwide were consuming 600 and 1000 million liters of fuel per day, respectively. Annually, 650 million tons of the greenhouse gas CO2 are emitted by aviation; this is equivalent to 2% of the global CO2 emissions. There is commitment from the side of aviation companies to increase energy efficiency by 1.5% until 2020, to reduce the net CO2 emissions from 2020 and to reduce them until 2050 by 50% compared to 2005. Currently, CO2 emissions of a modern aircraft per passenger and a certain distance are equivalent to CO2 emissions of a car traveling the same distance.

6. “Unruly Passengers”

Aircraft crew in the air have no direct access to law enforcement agents. Therefore, various “unruly aircraft passenger” policies are executed by the airlines[4]. In some countries, it is allowed to tie “unruly passengers” to the seat, in some countries, such as in Australia, it is even allowed to stun them with a stun gun. In the US, it is permitted to fix body parts to their body, but not to tie unruly passengers to their seat. Fines for “unruly passengers” can be very high, and include monetary penalty as well as prison sentences. Hundreds to thousands of “unruly passenger” incidents per year are reported on commercial airlines in the United States alone.

7. Lost Luggage

25 million people do not receive their luggage after their flights, but it is lost or delayed; about half in transport, and about 16% are forgotten at the place of departure, due to wrong handling or labeling. Most luggage reappears within two days, but about 850 000 pieces are never picked up or are reported as stolen.

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