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AIRCRAFT SAFETY SYSTEMS

Thematic Report by
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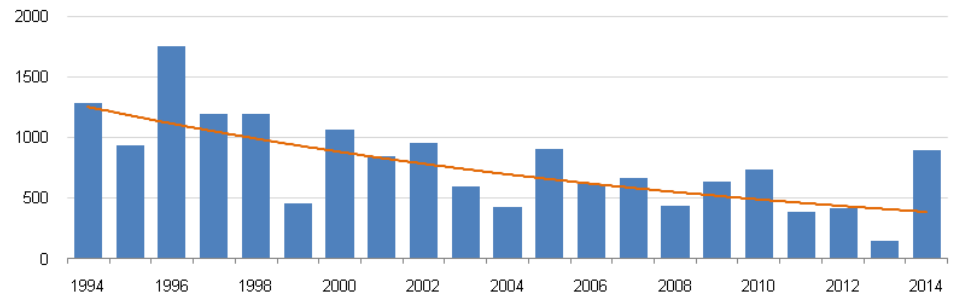
Aircraft Safety Systems
In The Spotlight

Since the introduction of the first commercial aircraft in 1914, the aviation industry has soared.

The world's fastest mode of transport served 3.1 billion passengers in 2013, and is expected to grow at a CAGR of 7% since then. Alas, a surge in air travel across the globe spiked an increase in aircraft-related fatalities.

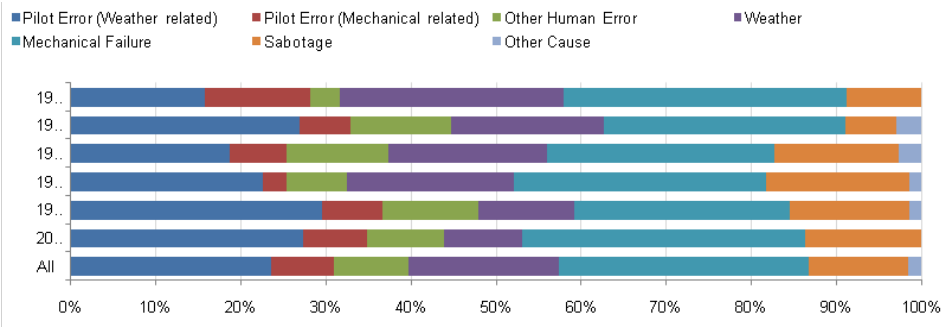
Fatal Accidents Have Reduced By Over 60% In The Past Two Decades



Number of Fatal Accidents

There are various reasons that have been identified, which include human error, weather-related problems, mechanical failures, and sabotage, among others.

Unfavorable Weather And Weather-related Pilot Errors Are The Top Factors That Pose A Major Challenge To Current Aircraft Safety Systems



Error Distribution

Over the years, pilot error has contributed to approximately 40% of aircraft fatalities. The errors committed by the pilot can be attributed to two main reasons:

- **Lack of attention**
- **Lack of information to make accurate decisions**

Thus, there is a rise in need for technologies that minimize human error. This need has led to a shift of research focus toward developing technologies that aid pilots in making informed decisions.

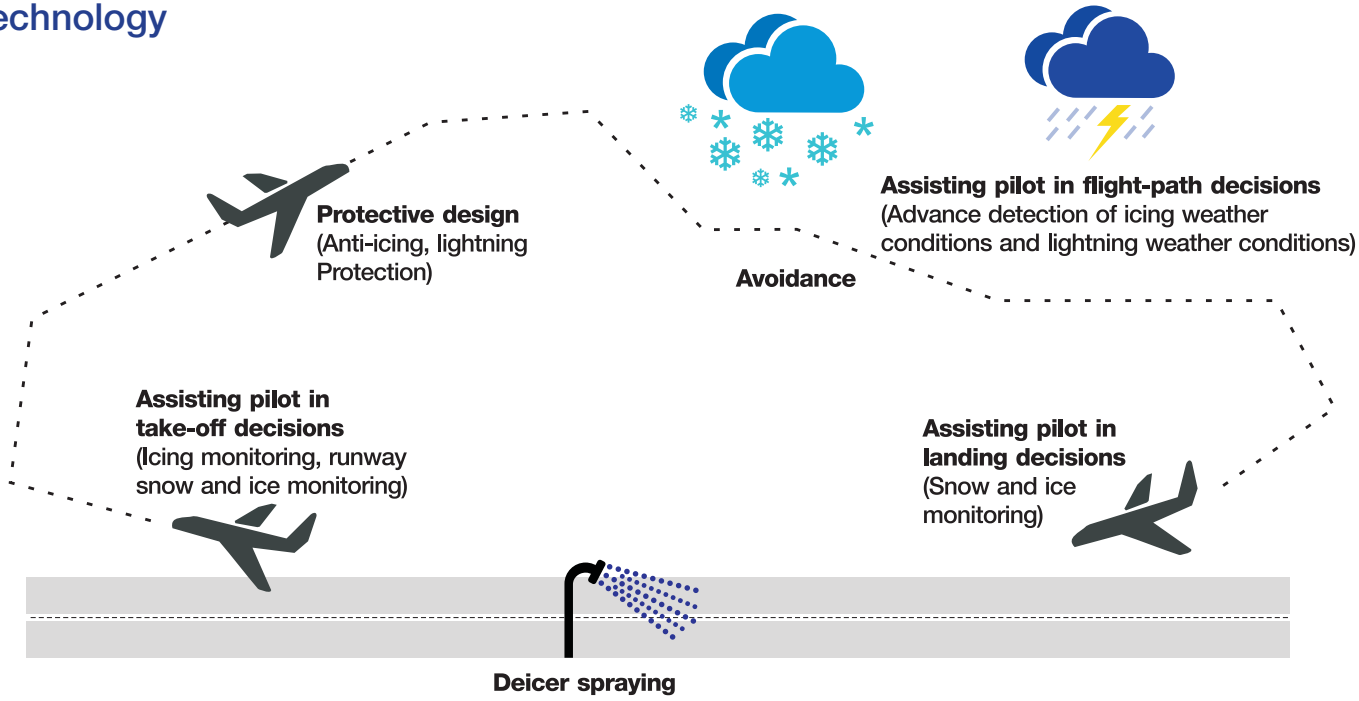
Fervent research activity in the aircraft safety system domain has led to the development of many innovative technologies, some of which will be covered in this document.

Technology Addressing Weather Related Errors

JAXA's Aircraft Safety Management Technology

Operating airplanes in winter can be very challenging. Ice disrupts aircraft aerodynamics and increases drag. As power is added to compensate for the additional drag and the nose is lifted to maintain altitude, additional area is exposed on the underside of the wings and fuselage where ice gets accumulated.Icing also causes antennas to vibrate so severely that they break. Even in moderate icing conditions, it becomes difficult to handle a light aircraft, as it may stall at higher speeds and lower angles of attack than the norm. Icing can also stop the engine by either freezing up the carburetor orblocking the engine's air source. This can prove to be fatal. There are technologies that reduce the effects of icing on the aircraft's body; however, the problem still persists. There is a need for a technology that can envisage the possibility of icing. One such technology is developed by JAXA.

JAXA plans to develop aircraft safety management technology for systems that can detect and keep track of the aircraft, runway and weather conditions, and enhancethe safety of each aircraft to be managed.



JAXA's Aircraft Safety Management Technology *Source: www.aero.jaxa.jp*

The technology includes icing and lightning monitoring systems along with passive safety systems such as anti-icing coating on the aircraft's outer body. The active system detects the weather conditions and checks for the possibility of icing, and accordingly decides the flight path that minimizes any icing incidents.

NextGen Network Enabled Weather (NNEW)

NextGen Network Enabled Weather is an attempt to standardize and simplify the access to weather data among aviation agencies. NNEW will be the FAA's portion of an interagency data cube called the 4-Dimensional Weather Data Cube. It is a collaborative effort involving the FAA, NOAA, DOD and commercial weather organizations.

The 4-Dimensional Weather Data Cube will comprise of:

Real-time updates on weather conditions (surface to low earth orbit, including space weather and ocean parameters)

Space and time analysis and forecast information based on conventional weather parameters from numerical models

Aviation impact parameters necessary for Initial Operational Capability (IOC) which would include:

a. Turbulence

b. Icing

c. Convection

d. Ceiling and visibility

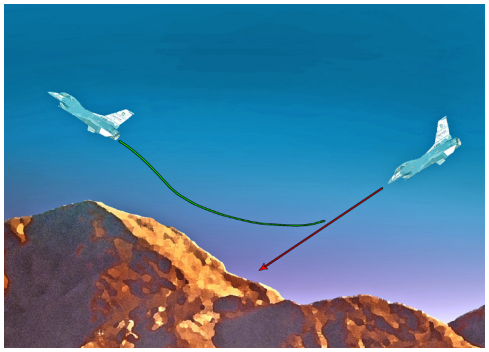
e. Winds (surface and aloft)

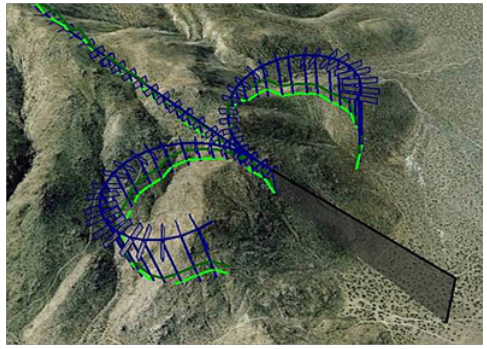
Technology Addressing Mechanical Errors

Automatic Ground-Collision Avoidance System (Auto-GCAS)

Jointly developed by NASA, the Air Force and Lockheed Martin, this technology is currently in its testing phase. The Auto-GCAS entered military service in September 2014 and has already showcased its capability by saving at least two F-16s and their crews. A similar automated GCAS system has also been developed by Saab for the JAS-39 Gripen fighter.

The GCAS is designed to warn the pilot if there is an imminent risk ofground collision. Such situations can for example arise due to g-induced loss of consciousness, target fascination, or lack of concentration. Thesystem constantly monitors the altitude, attitude, and speed. On the basis of these parameters, it determines the possibility of a crash, and if a crash is imminent, it triggers an autopilot-commanded maneuver to return to a safe flight path.





Aircraft Bird-strike Avoidance Radars

Bird strikes pose a significant safety hazard to aircraft, pilots, and passengers.It costsboth military and commercial aviation over $2 billion each year due to aircraft loss and damage, out-of-service delays,as well as lost lives.

To minimize fatalities related to bird strikes, DeTect has introduced anAircraft bird-strike avoidance radar system.

DiTect's Aircraft Bird-strike Avoidance Radars *Source: www.detect-inc.com*

The system uses solid-state S-band radar sensors with Doppler processing, providing all weather detection and tracking of birds, even in conditions like fog, rain, and snow. The solid-state radars have been engineered and manufactured specifically for bird detection.They offer greater sensitivity than traditional magnetron-based bird radar systems, which are susceptible to false positives from insect contamination, and are also "blind" in wet fog or even light rain.

Technology Addressing Human Errors

Automatic Dependent Surveillance-Broadcast (ADS-B)

Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked. The information can be received by air traffic control ground stations as a replacement for secondary radar. It can also be received by other aircraft to provide situational awareness and allow self-separation.

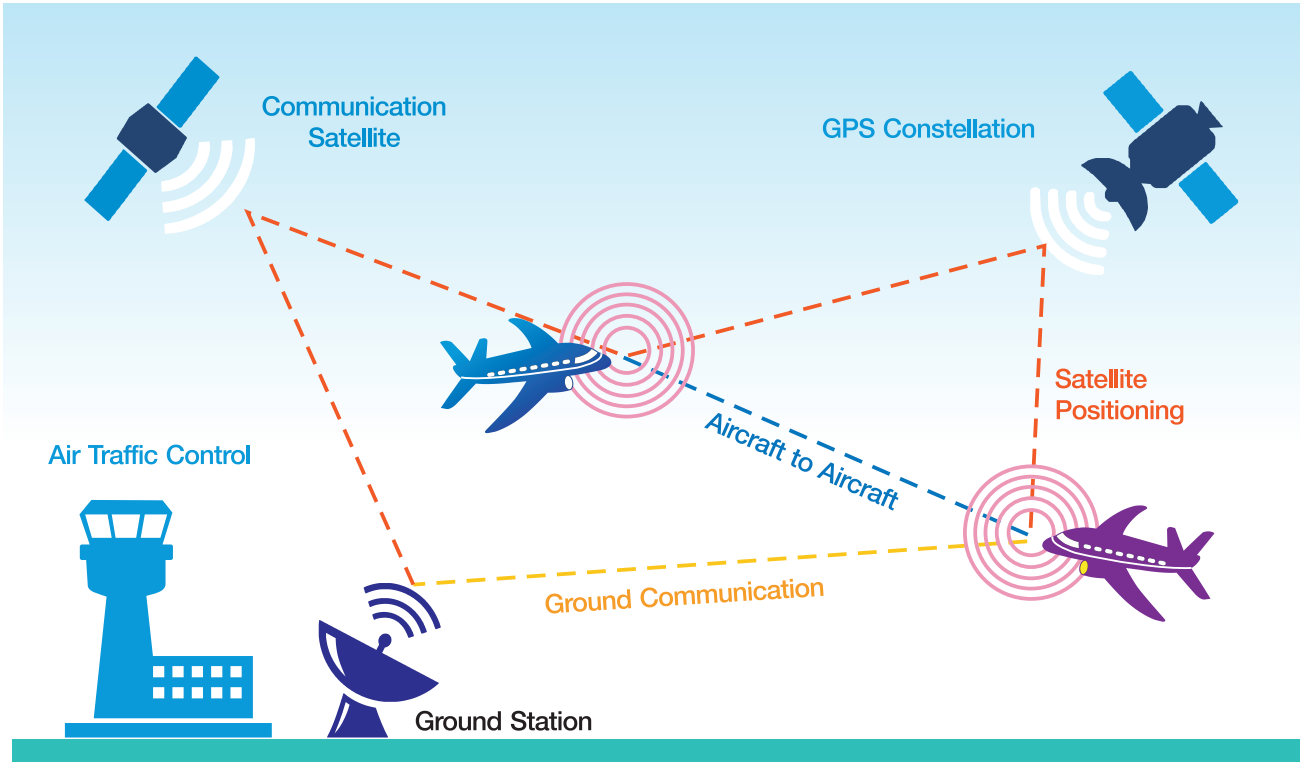
ADS-B provides many benefits to both pilots and air traffic control that improve both flight safety and efficiency.

1. Traffic: When using an ADS-B, a pilot is able to view traffic information about surrounding aircraft. This information includes altitude, heading, speed, and distance to adjacent aircraft.

2. Terrain: ADS-B technology broadcasts a terrain overlay for pilots to view in the cockpit.

3. Efficiency: ADS-B updates about once per second while radar only updates every three to 13 seconds; it's thus less likely that aircraft pilots will see a target of their own aircraft when maneuvering.

4. Expense: ADS-B ground stations are significantly cheaper to install and operate compared to primary and secondary radar systems.



Automatic Dependent Surveillance-Broadcast (ADS-B)

Source: www.propilotmag.com

The Future of Safe Flight

Even though the odds of being involved in a fatal air-crash incident are one in 4.7 million, the aviation industry is still trying to develop technologies that would make air travel foolproof. This is only possible through the collaboration of various administrations across the world.

One such collaboration is FAA's NextGen program. The program includes developing technologies that assist the pilot and ground control staff by enabling effective communication and assisting techniques between them. More specifically, we believe that the Automatic Dependent Surveillance-Broadcast (ADS-B)system could prove to be a breakthrough technology,witha system capable of providing real-time GPS tracking of aircraft along with weather conditions that aid the pilot and control room to efficientlymanage air traffic. In its current development and testing phase, ADS-B has helped reducing accidents by 40%, emissions by 34%, and noise by 30%.

Another promising technology is Automatic Ground Collision Avoidance System (Auto-GCAS). Having already proved itself in the defense industry, we believe that once implemented, this technology will play a key role in redefining aircraft safety systems in the commercial aviation industry. Who knows, auto-GCAS could have saved Germanwings flight 9525!

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