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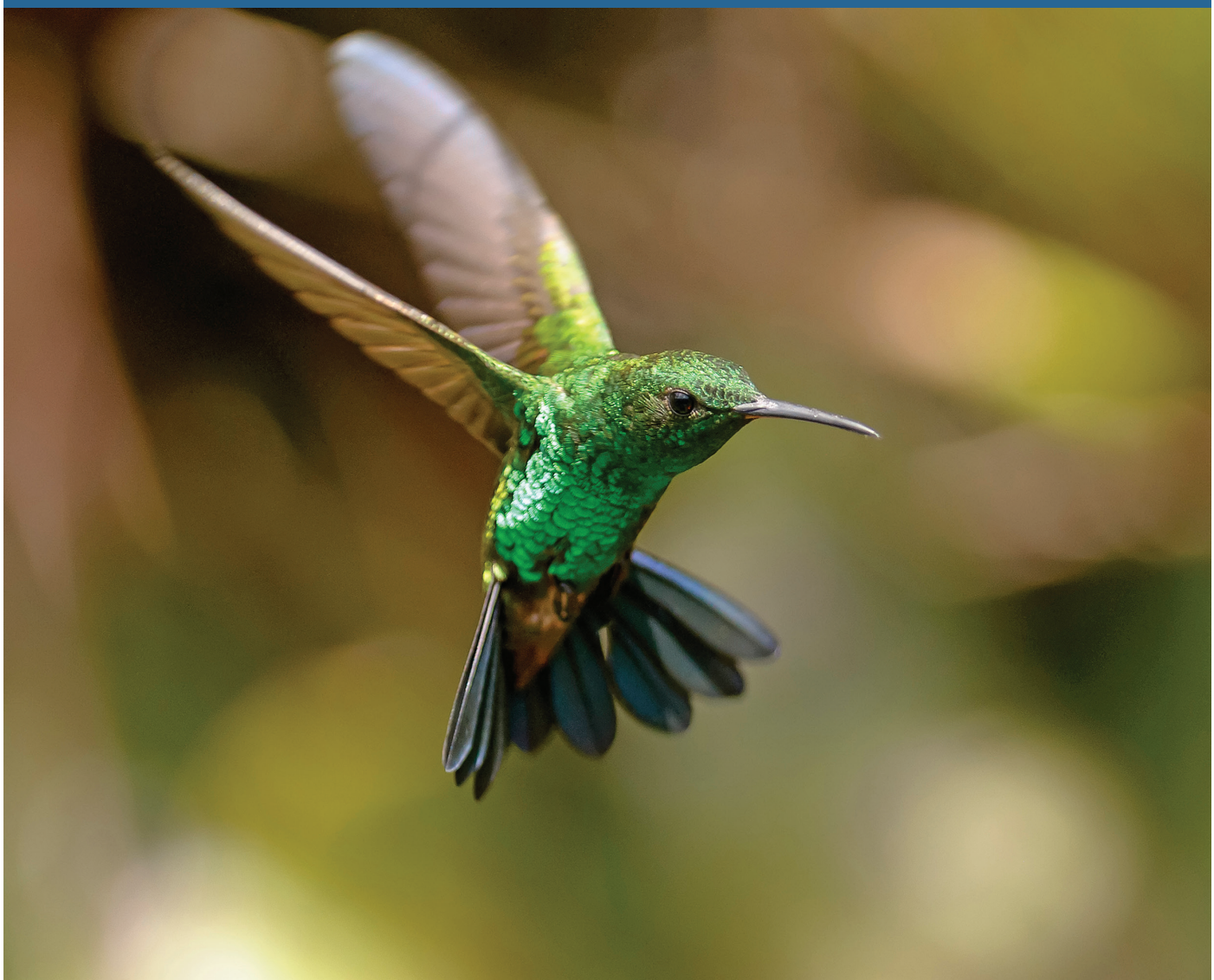
Thales: helping to reduce the environmental impact of air transport



With air traffic volumes expected to double over the next 20 years, the aerospace sector has undertaken to achieve a number of key objectives in the same timeframe:

Reduce consumption of hydrocarbons	Decrease CO_2 and NO_x emissions	Generate less waste	Cut noise pollution

A number of major international programmes are now working towards these objectives and developing concrete solutions.

THALES: ORGANISING TO ACHIEVE ENVIRONMENTAL OBJECTIVES

Thales's aerospace businesses are working to achieve these goals in three main ways:

Eco-design	creating products that take the environment into account from the earliest design stage and throughout the product life cycle
Eco-products for avionics	designing flight controls and air traffic management systems that reduce pollution caused by the aviation industry
Environmental efficiency	improving day-to-day operations to use less paper, avoid unnecessary travel, recycle more and promote the use of bicycles, ride-sharing and public transport

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ECO-DESIGN

Eco-design involves incorporating environmental considerations into product design and development to decrease the overall environmental impact of a product. It is a comprehensive approach to environmental performance based on multiple criteria and affects every stage in the product life cycle.

Choosing the best raw materials

The overarching objective here is to reduce the overall weight of the equipment installed in the flight deck, cabin and cargo hold. Weight is clearly a critical factor in the aircraft industry: the heavier the aircraft, the higher the fuel consumption.

Thales experts regularly examine the potential benefits of new materials that could be used in our manufacturing processes to limit weight factors while retaining or improving performance. The importance of onboard electronics is constantly rising, but overall weight and volume are falling.

At the same time, substances that could present health risks are progressively being replaced in older equipment designs, and avoided altogether in the new products we are designing today.

Making systems simpler and easier to manufacture

Thales is successfully reducing the number of equipment items installed on board aircraft, and making them less complex. The Integrated Modular Avionics concept is an ideal illustration. First implemented on the A380 programme, this type of electronics architecture optimises the need for onboard computers, cutting the weight of hardware components by 15-20% while increasing computing power and extending equipment lifetimes.

Likewise, simpler onboard systems can bring major benefits during the service life of an aircraft. On the A320 programme, for example, Thales redesigned the onboard computers that had been used for 20 years. Without changing the form factor to minimise the impact on the aircraft's other systems, Thales developed new, more powerful computers that weigh 70 kg less — the equivalent of one additional passenger per aircraft.

Power consumption is also a critical factor on board an aircraft. Here, Thales has optimised cabin systems, reducing the number of equipment items needed while improving the passenger experience at the same time.

Lean manufacturing methods have also helped to simplify production processes, reducing inefficiencies caused by overly complex organisational models. Efforts to streamline production lines have delivered significant gains in recent years. Thales entities in France have also become more specialised to ensure that all the expertise required for a given process is available in the right place at the right time. This new organisation avoids having to transport people and equipment unnecessarily and improves the overall efficiency of the production system.

Rethinking our distribution channels

Maintenance is one of our most complex activities from a logistical point of view. The recent reorganisation of our entire global network has brought dramatic reductions in the number of movements made by customer equipment during the repair process.

Building for maintainability

Equipment maintainability starts with good equipment design. A key concern throughout the design and development cycle is to extend the product's lifetime by reducing maintenance requirements and making maintenance easier. Maintaining an electromechanical system on a Concorde, for example, used to take up to 40 hours' work; the equivalent system on board an A380 requires less than four hours of maintenance. Over the same period, there has also been a fourfold increase in the overall lifetime of an onboard electronic system.

Maximising re-use

Avionics equipment simply used to be discarded at the end of its life cycle, but many of the components can now be recycled. Thales uses specialised providers to manage the complex process of recycling circuit boards. The different materials used in manufacturing are separated out and re-used in the most appropriate ways.

ECO-PRODUCTS FOR AVIONICS

Although the aerospace sector is not a leading cause of environmental concerns — air transport accounts for 2% of global CO2 emissions but meets 12% of overall transport needs — the industry has taken a number of major steps in recent years to reduce its environmental footprint.

New aircraft engine designs have made a significant contribution to this effort. In addition, new navigational aids have played an active role in reducing CO_2 and NO_x emissions and curbing noise pollution:

- optimised flight paths and ground movements
- better weather data to avoid sudden changes to flight plans and longer flights
- new air traffic management solutions to improve traffic flows and reduce wait times in terminal airspace

The Flight Management System (FMS) is an intelligent onboard system that calculates optimised flight paths based on aircraft data, weather data and the scheduled arrival time, enabling pilots to choose the best combination of fuel consumption and flight duration. The system helps to cut noise pollution, emissions and fuel consumption at each phase in the flight:

Take-off and climb:
engine thrust optimisation

Cruise:
airspeed and flight level optimisation

Descent:
improved energy management
in a constrained environment

Arrival:
altitude optimisation to reduce
ground noise while ensuring safe, stable approaches

Automatic landing:
optimised braking systems to minimise
the use of thrust reversers

The FMS helps to meet the challenge of optimum airspace utilisation:

- access to all available airspace
- reduced aircraft separation minima
- more direct, optimised flight paths
- more aircraft in each flight information region
- less congestion
- shorter wait times in terminal airspace
- slot optimisation for maximum runway occupancy
- flight plan recalculations based on weather data

Thales brings to the table more than 30 years of experience and expertise in designing and developing complex, intelligent flight management systems for civil and military aircraft and helicopters. We regularly add new features and functions to further enhance usability, safety and environmental performance.

As well as investing in its people to maintain this level of expertise, Thales has a long-standing commitment to research and development. A dedicated R&D laboratory known as *The link by Thales* opened in 2013 to simulate and test new flight control and management concepts in reduced-scale airspace models. The laboratory uses the actual air traffic management systems and control tower solutions developed by Thales and in service with customers throughout the world, as well as advanced cockpit simulators, to reproduce situations in the most realistic conditions possible.

Engineers and pilots work together to develop and evaluate new flight management and control concepts on the ground before they are tested with aircraft in the air. This collaborative, user-centred approach to innovation helps Thales to meet real-life user needs and bring new solutions to market more quickly than ever before.

SUPPORTING PILOTS IN EVERY FLIGHT PHASE

From pre-flight planning to pulling up to the arrival gate, Thales proposes innovative solutions for every phase of a flight. In addition to equipment and systems, Thales solutions include new tools for flight crews and new flight procedures that help to reduce pilot workload and further improve flight safety as well as cutting fuel consumption and noise pollution.

On the ground

Pre-flight planning: from pilot cases to tablets

Many pilots still rely on paper documents for the crucial pre-flight preparation phase. But today they can access all the documents they need from an electronic flight bag. With the latest touch-screen tablets, flight manuals, maps and other documents are now just a tap away.

Thales developed the TopWings electronic flight bag solution specifically for airlines. It eliminates the need to print, store and manage reams of paper documents — then wheel them around in the pilot case and fly them around in the aircraft. TopWings stays connected to the airline's central system and updates the information right in the flight deck, so the very latest weather data is used to update the flight plan until the very moment the aircraft takes off.

Ground movements at the airport

Moving an aircraft around an airport before or after a flight can be a dangerous undertaking. Other aircraft and service vehicles are sharing the space and the flight crew needs to be fully focused on the task in hand to manage the many risks involved. When pilots frequently fly into different airports, this phase can be particularly challenging. Added to that, the only airport maps available on many planes, especially older models, are paper documents. A new digital solution from Thales helps optimise an aircraft's ground movements at any airport. Accessible on a touch-screen device or directly on the cockpit display in the most recent aircraft models, electronic maps of each airport help pilots get their bearings and check the route they need to take.

Optimised taxi-ing time saves fuel as well as making ground movements safer. A new function currently under development will make communications between the control tower and the pilot more efficient while the aircraft is on the ground. Today, controllers give pilots verbal instructions, and with dozens of aircraft on the ground these voice communications can be hard for controllers to manage and hard for pilots to follow without extreme levels of concentration. With the D-Taxi system from Thales, which is currently undergoing testing, text messages between the tower and the aircraft will appear directly on the flight display and give the pilot visual indications of the route to take. The innovative solution will include a collision warning function to avoid route conflicts between aircraft and service vehicles. It will also be used during the approach phase.

In the air

Optimal take-off and climb

Trajectory and engine thrust settings have a significant impact on fuel consumption and noise. As part of the European CleanSky programme, Thales has developed a new way for aircraft to take off. This procedure automatically adjusts speed, altitude and thrust to reduce noise levels for local residents as well as helping airlines to save on fuel costs.

I-4D: the fourth dimension

Air traffic controllers currently manage flight paths in the three dimensions of altitude, longitude and latitude. Under the European SESAR programme, Thales is helping to build the fourth dimension — time — into the equation. The I-4D concept makes it possible to manage overall traffic movements and aircraft separations more efficiently in any given sector, significantly reducing congestion and delays in terminal airspace to avoid unnecessary fuel burn and improve the passenger experience.

The latest weather reports

During pre-flight planning, the pilot studies weather maps that were printed an hour or more before take-off. And yet, even on a short route, weather conditions can change quickly. A pilot may have modified a direct flight plan to avoid a thunderstorm; but thunderstorms can move, and they can get stronger or weaker, at any time. In these cases, the pilot needs to adjust the flight plan based on the data provided by the onboard weather radar.

Currently in the testing phase under the SESAR programme, the Topmet project will bring pilots access to weather maps in near real time so that they can change their flight plan as needed. The solution provides better visibility of changing weather conditions so the new flight path can be reprogrammed quickly and accurately. A new predictive tool helps to calculate the best trajectory, saving time, avoiding unnecessary fuel consumption and making for a more comfortable flight.

Cost index optimisation

Thales is developing new solutions for regional aircraft that were formerly only available for more complex platforms. The real-time cost index function, for example, calculates the best trade-off between flight duration and fuel consumption so that pilots can optimise energy costs and still arrive on time.

In the approach phase

Precise positioning

Managing air traffic flows has a lot in common with managing vehicle traffic on the roads. Traffic can be moving smoothly on the open highway but has a tendency to bunch up in toll areas and as vehicles get closer to cities. The same is true with air traffic. Thales is developing high-precision positioning solutions to help tackle congestion issues as aircraft approach airports. With precise information about an aircraft's position and trajectory, even when turning, airspace management requirements are more predictable, and aircraft can guarantee their routes with greater accuracy. Air traffic controllers no longer need to add buffer zones around the aircraft's flight path to account for slight changes in trajectory. As a result, larger numbers of aircraft can fly in the same volume of airspace, even with dense traffic, and more direct airport approaches are possible.

Continuous descent approach

Continuous descent arrival is a flight technique designed to achieve better fuel efficiency and quieter landings compared with the normal step-down arrival procedure. Pilots can use this use this optimal descent profile technique when instrument approach procedures and appropriate airspace structures are available, or with the help of air traffic controllers.

The aircraft descends on a constant slope with the engines at idle or minimal power settings, and when possible, airframe noise is reduced by the delayed deployment of flaps and landing gear. Introduced in 2010, the new approach concept should be widely adopted when regulatory approval procedures are complete.

Continuous descent arrival can economise 100-200 kg of the 2,000 kg fuel carried by an A320 on a short 45-minute flight.

Landing at any airport

Not every aircraft can land at any airport unless the right equipment is available on board or on the ground. Thales is developing a new type of approach known as Localiser Performance with Vertical Guidance (LPV) and based on the EGNOS satellite navigation systems for Europe. Aircraft equipped with LPV can land at any airport, even when ILS systems are not available, limiting the need to install additional equipment on the ground. Another major benefit of LPV is that an aircraft can land at the nearest airport if it suddenly needs to change its flight plan instead of having to fly hundreds of miles to the nearest airport equipped with ILS.

MORE ELECTRICAL AIRCRAFT: INNOVATION IN ACTION

Efforts to develop "more electric" aircraft have been underway for some time. Thales has been helping to drive this crucially important transformation, which will gradually replace traditional pneumatic and hydraulic systems with electrical equipment and improve the environmental performance of the air transport sector. The key benefits of the "more electric" aircraft are lighter aircraft and better energy efficiency for non-propulsive systems, and Thales has been innovating in a number of areas to achieve these objectives.

For example, we are working on incorporating electric motors in aircraft wheels so they can taxi without using their main engines. This could offer fuel savings of around 4% for a short or medium-haul aircraft.

For the A380 and A400M, we teamed with Safran to develop the ground-breaking variable-frequency power-generation technology. The A380 has four variable-frequency electrical generators, each delivering 150 kVA. Besides the weight gains it offers, this power-generation technology is more than twice as reliable as fixed-frequency generators.

New applications like engine starting are now going electric on modern aircraft. Thales is helping to make this a reality with the TopStart™ starter-generator for the Silvercrest® engine on Dassault Aviation's new Falcon 5X business jet. This system supplies variable-frequency AC power to the aircraft as well as starting up the latest-generation Silvercrest® engines, which offer better energy efficiency, lower emissions and significantly lower life cycle costs than older engine models. TopStart™ benefits from new technologies developed by Thales under its own R&D projects and as part of collaborative research and development programmes including the European CleanSky initiative.

Integrated modular power electronics

Thales has developed new electronics architecture to power all types of electrical load on an aircraft. The integrated modular power electronics (IMPE) architecture is built around standard, reconfigurable, redundant power electronics modules and incorporates an intelligent power management function that dynamically combines demand and pools resources as needed.

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A MAJOR PLAYER IN EUROPEAN AND GLOBAL ENVIRONMENTAL INITIATIVES

Global air traffic is expected to grow to between 415 and 500 million passengers per year by 2030 —double the figure of 228 million passengers recorded in 2005.
Largely driven by emerging countries, this growth will expand the size of the global fleet of commercial airliners, which could increase from 15,000 aircraft today to 31,500 by 2030.

Faced with these challenges, the air transport industry is working hard to raise levels of safety and efficiency, and to improve the sector's environmental performance at the same time.

Thales is a market leader in avionics and air traffic management solutions. We are also a major player in the large-scale programmes launched in the early 2000s to manage research and technological development projects with a view to enhancing aircraft operations.

Thales is a founding member of CleanSky, one of the largest European research programmes ever.
The objective of this public-private initiative is to speed adoption of new greener design practices by an industry which traditionally has very long design and life cycles.

The environmental goals for the CleanSky initiative, which need to be achieved by 2020, have been set by ACARE, the Advisory Council for Aeronautics Research in Europe:

- 50% reduction of CO_2 emissions through a drastic reduction of fuel consumption

- 80% reduction of NOx (nitrogen oxide) emissions

- 50% reduction in noise pollution, and a green product life cycle: design, manufacturing, maintenance and disposal/recycling.

Thales is coordinating one of the six main research topics, "Systems for Green Operations", which aims to reduce aircraft energy consumption through trajectory management, notably in the take-off and approach phases. We are also coordinating Clean Sky's "Technology Evaluator", a simulation tool that will be used to assess the environmental impact of the programme. Thales is also a major player on the SESAR programme, launched by the European Commission in 2004. One of SESAR's key objectives is to reduce aviation's environmental footprint. Several specific targets have been set:

- Reduce CO2 emissions by 10% per flight by 2020 (against a 2005 baseline)
- Reduce aircraft noise emissions by 20 dB during take-off and landing
- Increase the role played by local environmental regulations in air traffic management decisions

To achieve their environmental goals, manufacturers must improve the way aircraft are designed. The objective is to achieve a 10% cut in fuel consumption — and 65% of this reduction will come through better aircraft design.

Thales is also partnering a project led by the Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ), a non-profit organisation established in 2002 to increase the competitiveness of the aerospace industry. Now in its second phase, this project is currently focusing on new wing architectures in an effort to reduce drag and in turn bring down fuel consumption. Such advances will also shorten take-off and landing distances, since aircraft will be able to take off and land at slower speeds.

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