Skyline

n°6 Clean Sky newsletter

FEBRUARY 2012

Clean Sky

TOWARDS ALL ELECTRIC AIRCRAFT

CLEANSKY

Innovating together, flying greener

Editorial

Eric Dautriat,
Executive Director
of the Clean Sky
Joint Undertaking

Clean Sky is entering its fourth year of activity. After the design phases, the programme managers in the industry and the JU coordinators are happy to get closer to the large demonstrations and to have more and more opportunities for testing actual hardware.

In a few months, before summer, the very first Clean Sky demonstrator will be run in Derby: it concerns a large engine "advanced low pressure system", one of the SAGE Integrated Technology Demonstrators (ITD) projects. Later this year, the rotorcraft turboshaft engine demonstrator will follow. In airframe ITDs, the season of wind-tunnel testing has begun. A total number of 15 are planned in "Smart Fixed-Wing Aircraft", the highest number in a single year for this ITD. Tests are planned for aircraft configurations with Open Rotors in combination with different blade designs. Others will evaluate innovative tail designs for business jets. The helicopter rotor head and fuselage cabin drag reduction solutions will also be tested this year. As far as mechanical tests of novel hardware are concerned, large stiffened, composite panels for regional aircraft will be verified.

2012 will also be a crucial year for a flagship project of Clean Sky: the Open Rotor. Readiness reviews will address the major risks linked to this concept and the related technologies, and confirm the overall schedule. The commitment of the industry to a refined, firm roadmap, up to the flight test, has been reaffirmed.

Another major expectation for 2012 concerns the Technology Evaluator, which is just completing its first assessment. This evaluation of Clean Sky environmental impacts has definitely allowed to check and fine tune the full process; we are getting first results for a limited number of concept aircraft confirm that Clean Sky is progressing towards its objectives . We will report in more detail on these outputs in our next Skyline issue.

Three calls for proposals are scheduled for 2012 – the first one has been launched in early January – and three others in 2013. Then we should come close to the conclusion of this process. The Joint Undertaking and the Topic Managers in the ITDs have been committed to continuously improve the quality of these calls. However, misunderstandings about the topic descriptions, which address some complex technological issues, the cost ceiling, or any administrative or legal matter, may happen. To mitigate this, we have reinforced our "Questions & Answers" system on our Website. All questions are welcome on any topic and publicly answered.

This Skyline 6 issue is more about the technical scope and progress of some ITDs. Clean Sky is one programme, with significant relationships between ITDs; we are paying attention to those transverse areas where, despite different applications tailored to the type of aircraft, there is a lot of benefit from working together across ITDs. This is the case of "All Electric Aircraft" solutions, involving not less than 4 different ITDs: you will learn more about them in this newsletter. Another focus concerns a Research Organisation, CIRA, and its involvement in Green Regional Aircraft.

The Horizon 2020 approval process is on track. We have previously reported how much we believe that the JTI concept is worth being continued. The door is open to such a continuation in the H2020 proposal from the European Commission. Bringing innovation to the market thanks to the public-private partnership concept; maintaining and increasing the competitiveness of our aeronautical industry – one of the few sectors where Europe is a leading force ; reaching ambitious, long-term societal challenges, through a consistent agenda, consistently implemented; contributing to the development of the European supply chain via the participation of SMEs to a wide and targeted research programme: these features are the best remedies against the European crisis. This is the firm belief of the Chairmen of the Governing Boards of Fuel Cell & Hydrogen, Innovative Medicine Initiative and Clean Sky Joint Undertakings, in an opinion paper recently proposed to the press, which you will find here, should you have missed it at breakfast in your usual newspapers.

Eric Dautriat

Executive Director of the Clean Sky Joint Undertaking

From the desk of

Vincent Garnier, *Vice-President Research and Technology at Snecma on engine development*

What are the greatest technological challenges to more environmentally sustainable flight?

"There are two areas in which we can improve the efficiency of the system: one is propulsive efficiency, the other is thermal efficiency. On the thermal efficiency side, there is a great deal to be done, such as introducing new high-temperature materials. With the support of Snecma Propulsion Solide (another Safran subsidiary), Snecma is investing heavily in a new category of materials called ceramic matrix composites and we are excited about bringing this technology to maturation. When it comes to propulsive efficiency, we are pushing hard on the LEAP engine family with the ducted architecture and there is further room for improvement. However, to really go beyond this, we may have to change the engine architecture and introduce the open rotor."

Doubts have been expressed by some people in the industry that the open rotor will ever fly. Will it?

"Those that don't want it to happen, those that are not willing to make the effort, they are saying it cannot succeed. I'm saying yes it can and it will, because we will do what it takes. It doesn't require genius, it doesn't require chance; it just needs to be worked on. I'm not saying that everything about the open rotor is risk free, but the gains to which we are committing are solid and not an exaggeration. We have a great opportunity within Clean Sky to design and build a prototype. This will happen and we'll do our part to make it fly. My vision is that we can ground-test the demo engine before the end of 2015 and deliver a flight test version before the end of 2016."

Yes the open rotor can fly and it will, because we will do what it takes. It doesn't require genius, it doesn't require chance; it just needs to be worked on."

What do you see as your main obstacles to getting the open rotor into service?

"We need to work on aero acoustics; we have additional structures and internal components in this architecture which we need to learn to optimise, along with our partners Volvo Aero and Avio; we will have to apply everything we have learned about composites from today's architecture and improve on it and we have to work with aircraft manufacturers to identify the optimal structural and performance integration of the powerplant on the new aircraft architectures they will put forward. If you stand back, you can see that, although we are mapping a new design space, this is really about applying what we already know to a new architecture and this is our trade, it's what we know how to do. There are no unknown scientific areas here. So I don't see any fundamental difficulties."

Source: Volvo AERO – Number 2/2011

ASD: Civil Aeronautics Objectives

ASD AeroSpace and Defence Industries Association of Europe

Horizon 2020

- Research and Technology and Innovation in the Aeronautics and air Transport sectors is crucial for Europe's long term competitiveness, and has a very important spill over effect over other industries which will help create high skilled jobs and boost the economic recovery. HORIZON 2020 should support the full research and innovation cycle, in order to ensure competitiveness of Europe and the appropriate skilled workforces for our sector. The budget must be targeted to be sufficient to achieve the objectives set out by the European Commission in its "Flight path 2050 Vision" document.

- The objectives are to address customer orientation and market needs as well as industrial competitiveness and the need to maintain an adequate skills and research infrastructure base in Europe. By 2050, passengers and freight should enjoy efficient and seamless travel services, based on a resilient air transport system thoroughly integrated with other transport modes. Environmental objectives such as REACH, carbon impact and noise reduction will be an overarching objective for our industries.

Developing CLEAN SKY II and how to ensure Environmental Targets

- ASD in close coordination with all relevant stakeholders (Research Centers, Clean Sky JU, Universities, Industry…) relay necessary messages to the European institutions and the Member States advocating for Horizon 2020 to include a Clean Sky II with an appropriate structure and funding to meet with Europe's expectations. SMEs represent 40% of success rate in open calls compared to 10 to 15 % in general.

- The objectives are to precisely identify the expectations, the needs and objectives of European stakeholders in the field of Environmental improvement, carbon impact reduction, and other nuisance reduction.

- Within the framework of Horizon 2020 preparation, ASD is asking the Parliament to support "the pursuit of successful FP7 instruments adapted to efficient R&T programmes" and "ring fenced funds". CLEAN SKY is part of them.

Source: Extract of ASD position paper "Civil Aeronautics Objectives", January 2012.

Towards all Electrical Aircraft

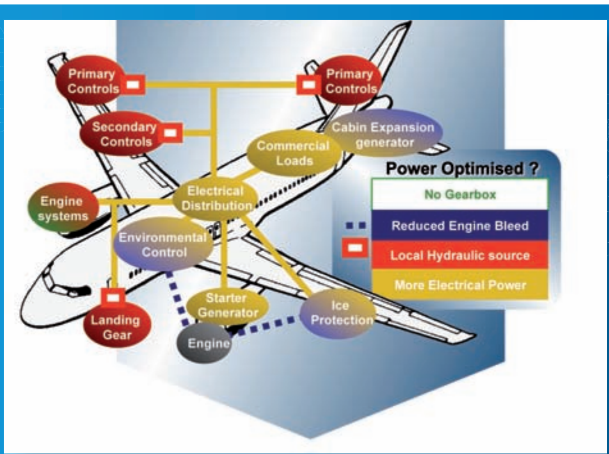
The state-of-the-art in aircraft systems architectures consists of complex technologies which make up the equipment used to power and fly a modern civil aircraft. In a conventional architecture (see figure, left), fuel is converted into power by the engines. Most of this power is expended as thrust to propel the aircraft. The remainder is transmitted via, and converted into, four main forms of non-propulsive power.

Air is bled from the engine high-pressure compressor(s). **This pneumatic power** is conventionally used to power the Environmental Control System (ECS) and supply hot air for Wing Ice Protection System (WIPS).

A mechanical accessories gearbox transfers **mechanical power** from the engines to central hydraulic pumps and other mechanically driven subsystems, and to the main electrical generator.

The hydraulic pumps transfer **hydraulic power** to the actuation systems for primary and secondary flight control, to landing gear and to numerous ancillary systems.

The main generator provides **electrical power** to the avionics, to cabin and aircraft lighting, to the galleys, and to other commercial loads (entertainment systems, for example).



Potential optimised architecture

Conventional equipment systems on civil aircraft are a product of decades of development by the systems suppliers. Each system has become more complex, and designers have striven to overcome the myriad of interactions between equipment by increasing the efficiency of each system in an evolutionary way. For further improvement, also new technologies are studied: like hybrid or bleedless air conditioning systems, the "More Electric Engine" (MEE), fuel cells, variable frequency generators and distributed system architectures are just a few of the technologies vying for space on future aircraft.

On top of these development of new technologies, further improvement is studied by looking at the a new concept:, **the integrated systems approach,** where the effects of the new systems in terms of safety, cost, reliability, maintenance, power management and fuel usage at the total aircraft level all have to be juggled against the operational benefits of implementing these systems

In European research, the Power Optimised Aircraft (POA) and More Open Electrical technologies (MOET) projects did just that. POA identified exactly which innovative aircraft equipment systems could contribute to the reduction in consumption of non-propulsive power. The role of some systems used today, including bleed air, hydraulics and emergency power systems, like ram air turbines, was challenged. In the MOET project, these technologies were further developed, and more accurate estimations of the benefits showed that some key technologies are worth maturing into flight test. And this is what will be done in Clean Sky, particularly in the Systems for Green Operations (SGO) Integrated Technology Demonstrator.

The main focus of demonstration in Clean Sky will be the validation and maturation of the technologies and sub-architectures, not just in a More Electrical Aircraft (MEA), but moving to an 'All Electric Aircraft' (AEA). This is needed to show that the technologies work in the relevant altitude, temperature, vibration and pressure environment. Thus, Clean Sky intends to demonstrate:

- Proven large-scale ground-based architectural integration of electrical generation, distribution and loads, and of thermal management
- Proven large-scale ground-based architectural integration of thermal management technologies. Where maturity is shown, these will be integrated with the electrical equipment systems
- Flight proven electrical equipment systems, including environmental conditioning and protection
- Flight proven technologies and sub-systems for thermal exchange and management, including liquid loops and heat exchangers
- Flight proven technologies, architectures and concepts for power generation and distribution.

In the frame of the technology development and verification / validation processes, aircraft manufacturers are engaged to support the technology development and assessment with their requirements and assessment results. Therefore, the activities on electrical equipment are not limited to the Integrated Technology Demonstrator of Systems for Green Operations (SGO) only. Work in SGO is executed in close co-operation with Eco Design (ED), Green Regional Aircraft (GRA), Smart Fixed Wing Aircraft and Green Rotorcraft (GRC) Although in Clean Sky many technologies are developed, ranging from power generation-,distribution-, and-conversion systems to "electrical nacelle"-systems and (skin-) heat exchangers, in this , article **only two technologies will be explained** in some detail, the Electrical - Environmental Control System (E-ECS) and the electrical Wing Ice Protection System (WIPS).

Electrical Environmental Control System (E-ECS)

On board of an all-electric aircraft the electrical environmental control system is one of the largest consumers of electrical energy, since there is no pneumatic energy available. Therefore it is design driver for further systems, such as the electrical network architecture and its power electronic components.

In SGO, the objective will be to demonstrate the maturity of the electrical driven air conditioning system for large, business and regional aircraft applications. These activities are based on the electrically driven ECS developed within the MOET project. The studies will also focus on process air contamination and the associated impact on the ECS.

E-ECS demonstrators for large and regional aircraft applications will be developed and tested in flight campaigns. The demonstrators will enable us to validate performances issues, integration, control strategies and system reconfiguration capabilities.

Demonstration activities will also include the development and delivery of ground demonstrators to validate electrical aspects on dedicated test rigs:

- an integrated electrical systems test rig called 'PROVEN' for large aircraft applications
- an electrical test bench (ETB) for regional/business applications

A vapour cycle system complementary to the E-ECS will also be developed and tested in on a thermal test bench.

Wing Ice Protection Systems (WIPS)

Depending on the aircraft category and engine type, the reason to change existing aircraft ice protection solutions is different:

For large aircraft and business jets, the need is to replace the legacy hot air high energy ice protection solutions by solutions able to provide equivalent performance and requiring significantly less energy.

For regional aircraft using turboprops and low energy pneumatic de-icers (also called pneumatic boots), the need is to improve the ice protection performance with solutions requiring no or reasonable increase of energy.

In the frame of the SGO ITD, three ice protection technologies are developed to target the above two needs:

- Electro-thermal,
- Electromechanical,
- Hybrid solution combining electro-thermal and electromechanical technologies.

Electro-thermal and hybrid technologies are adapted for both anti-ice and de-ice operating modes. A pure electromechanical solution is only suitable for the de-icing mode.

In 2012, three technologies will be integrated in a full-scale large aircraft slat and will be tested for function in a large icing wind tunnel:

- an electro-thermal ice protection solution for large aircraft using heating elements integrated in the slat leading edge structure.
- an adapted electromechanical ice protection technology using solenoid actuators integrated in the slat leading edge.
- a hybrid ice protection system for three platforms (Large aircrafts, business jets and regional turboprop aircraft). The hybrid system comprises a combination of electro-thermal mats and electro-mechanical actuation mats integrated in the leading edge.

To conclude these developments and reach a high technology maturity, two flight test campaigns will be conducted in 2014-2015 to validate the electromechanical and electro-thermal technologies in a large aircraft, and the hybrid solution on a regional aircraft.

Ground tests and flight tests

Depending on the kind of aircraft system, the validation means to achieve Clean Sky SGO objectives, are either a ground test architecture test rig and/or a flight test aircraft.

Due to low dependence on in-flight ambient conditions, the electrical power generation and distribution systems will exclusively be tested on ground test benches and an integration test bench. For electrical environmental control, thermal and electrical wing ice protection systems, the ground test validation at partners and Airbus test rigs is planned to be followed by aircraft flight tests. For the ground system integration tests SGO will mainly rely on three test facilities:

Electrical Ground Integration Test Bench

The main purpose of the ground test campaigns on the test rig is to assess new aircraft electrical networks featuring larger electrical loads, high voltage DC bus bars and power converters. The tests performed will consist in the validation of network functions and performances with a focus on network quality and stability.

An existing electrical systems test bench which was used in the MOET project will be improved and updated with new equipment for SGO testing.

Icing Wind Tunnel Integration Test

There are few possibilities to test large scale aircraft ice protection systems. The tested model will be a large aircraft slat with an electrically powered ice protection system. First of all the system performance shall be validated under required icing conditions.

Electrical Air and Thermal Ground Integration Test Rig

Developed out of the MOET project, an electrical driven environmental control system is the central part in the air systems architecture to be demonstrated in a test facility for ground validation.

Due to the challenging heat rejection of high electrical power electronics, special attention is paid to the thermal elements in the system. Cooling will either be provided via ambient air or by closed liquid loops.

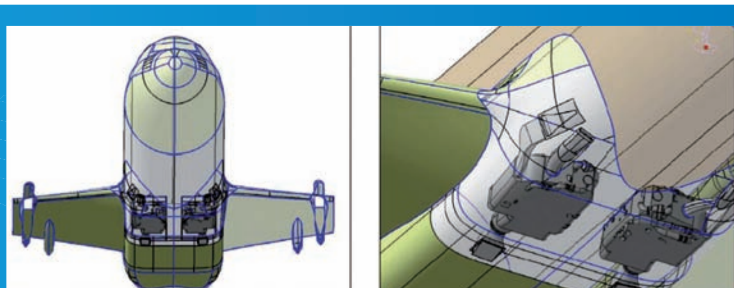
A test facility is planned for operation in 2013 from the 'Zentrum für angewandte Luftfahrtforschung (ZAL) – centre of applied aviation research', founded in 2009. SGO will carry out the air systems architecture integration tests there.

Flight Test Campaign

Wing ice protection and environmental control systems are planned to be flight tested on an Airbus A320 aircraft subsequent to ground integration tests.

For the wing ice protection test campaign, a production slat shall be replaced by the electrical operated system and tested under natural icing conditions in flight.

The electrical driven environmental control pack needs ambient air from a newly developed intake for outside fresh air. This installation shall be tested for certain operating conditions as well as under natural icing conditions.



Environmental Control intake installation on aircraft

On the role of long-tail projects in the European rebound

***This opinion paper is co-signed by** Pierre-Etienne Franc, Chairman of the Governing Board of the Fuel Cells and Hydrogen Joint Undertaking (FCH JU), Rudolf Strohmeier, Chairman of the Governing Board or the Innovative Medicine Initiative (IMI JU), Charles Champion, Chairman of the Governing Board of the Clean Sky Initiative (Clean Sky JU).*

Several paradoxes come together in the financial crisis currently weighing on European economies. The first is **optical**. Instantaneous financial movements whose fluidity is simply breathtaking jeopardize very long-tail public commitments. The second is **political.** The irascible impatience of the capital markets, an apolitical and amoral actor if ever there was one, is pushing Europe to resume the interrupted dialogue about stronger political integration.

The third is **systemic.** The implicit division among various economic cycles between the public and private spheres is called into question. Public policy used to guide the "long tail" aspect of major public works and development programs (transportation infrastructures, energy, aeronautics and space, information technologies, health care). In return, they fed industrial research and development. Now, the ability of the public sphere to project has been sharply diminished by the weight of public debt. Businesses were supposed to be in charge of creating wealth over shorter investment-profitability cycles, but things have become more complicated here as well. On the one hand, the role of the capital markets in financing businesses have resulted in higher demands being placed on performance, which in turn has had a strong impact on the framing of long-term innovation policies. Low growth is placing more pressure on businesses to be cost competitive. The issue is becoming systemic because a portion of the public debt has developed to cover the economic and social consequences of exacerbated price and cost competition in the absence of strong growth relays.

The fourth paradox is **societal.** The latest IEA analyses on global warming trends are very alarming. Given our rate of production, we are likely to see an average rise in temperatures far above the anticipated 2°C! Discussions at the Durban Conference concerning follow-up on the Kyoto Agreement will require further progress. The progressive exhaustion of fossil resources and the acceleration of the impacts of our productive model on our ecosystem call for action. The new economic paradigms that will allow us to accelerate the transition from the "fossil" age of the economy to its "sustainable" age— beginning with our systems of energy and transportation—require that we invest substantially in very long-tail projects. Unfortunately, we are mired in the dilemma of a debt piling up ever higher in order to cover the damage caused by an economy that lacks ambition.

Escaping from the latter two paradoxes is imperative.

We must step up the pace of the needed shift in our systems of industrial, energy and ground and air transportation production. This dynamic is of critical importance in reducing our energy dependency, strengthening local employment, improving technology and making Europe more competitive, tackling a number of urban ecology and public health challenges and, over the long term, improving the state of public finances. However, the markets don't adequately factor in the collective benefits of these developments because the players involved in making these changes do not make an immediate profit from doing so. Indeed, improving the average health of children in the big cities will not have a huge impact on the financial performances of an automaker, an airliner company, an electrician or an oil and natural gas player, even though it could be one of the results of developing renewable energy and sustainable transportation solutions. Nonetheless, coming up with and rolling out these solutions (the deployment of renewable energies, the storage of intermittent electricity productions, electric and hydrogen-powered fuel cell transportation infrastructures, and zero-emission motors or new airliners concepts) will require massive investments on the part of their inventors but will offer uncertain immediate returns.

Because these innovators will not be the direct and immediate beneficiaries of their solutions, the related investments are not granted. At the same time, if market forces are not called on to help deploy all enabling technologies at cost prices that can compete with existing solutions, this productive shift will not take place. The market needs public authorities to help it secure the implementation of new paradigms that society needs. But public authorities no longer have the financial wherewithal to fund these endeavors. Public authorities need the market to implement their societal ambitions, but businesses need tools to neutralize some of this assumption of risk, excessive or too early, in the eyes of the markets. **So we need clearly identified sanctuaries for the long-tail aspect of industrial policy currently as key levers to a European rebound.**

Here are few avenues that may be worth exploring.

First, develop public-private partnership models wherein the respective roles and responsibilities are clearly defined, by project and by sector, over multi-year periods, and with the financing commitments for each party clearly spelled out. Europe's joint technology platforms, co-piloted by industrial players and the European Commission, offer a good example. By aligning private and public players on long-term programs and projects, we can provide sanctuaries for these commitments and in return serve as a mutual reinsurance tool for the relevance of the investments. Five initiatives in the Nanotechnologies (ENIAC), embedded computing systems (ARTEMIS), Aeronautics (Clean Sky), Innovative Medicine (IMI) or Fuel Cell and Hydrogen(FCH JU) sectors are already working using those schemes.

Being both close to the markets and addressing societal challenges, those initiatives can bring significant socio-economic benefits. Their structure and operating rules show that public issues and long term competitiveness are not divergent but rather self sustaining. They must be pursued and increased in scope and reach, in line with the major challenges of productive era change are well summarized in the "Horizon 2020" paper recently released by the European Commission. In this context, aligning national and European policies more clearly with respect to these challenges would allow us to truly leverage the subsidiarity principle

Downstream, once technologies are mature, it is necessary to develop sector-driven financing logic to ensure that the support made available to European players is virtuous. Encourage financing with strings attached or insurance-type financing so that the market is left to assume its risk and only provided with the initial boost needed for development.

When the market demands the deployment of infrastructures or of substitute technologies for existing solutions, we should allow collaborative approaches so that individual interests are added together for the benefit of the collective demand. Deployed over the period of time required to become competitive in the marketplace, this approach allows players to protect themselves against the free rides and noncooperative game phenomena that are proper to the industrial economy.

The experiments currently underway within the Joint Undertakings in the here above sectors are examples among many others of the long-tail investments on the part of the economy that need to be stepped up today in order to support and enable the European rebound tomorrow.

Focus on an associate member: CIRA

CIRA, the Italian Aerospace Research Center is a Clean Sky Associate Member through two ITDs: GRA (as CIRA Plus Cluster Coordinator, together with INCAS, Aerosoft, DEMA and Elsis) and GRC (as CIRA Selex Cluster Coordinator together with Selex SI). Moreover CIRA is also supporting with its expertise the assessment phase granted by the Technology Evaluator.CIRA represents the national centre of excellence for the aeronautics and space activities. It was created in 1984 and consists of public and private sector shareholders. The participation of research bodies, local government, aeronautics and space industries, sharing a common goal, has led to the creation of unique test facilities and of air and space flying labs, coupled with high computational and simulation capabilities.CIRA is located in a 180-hectar area in the south of Italy, not far from Naples. It has a staff of 320 people, most of which engaged in research, technology and innovation programs, both at national and international level.

CIRA involvement in GRA ITD

CIRA is strongly supporting Alenia Aeronautica, GRA ITD leader, approach for future regional concepts. Indeed in order to be as much as possible 'green' next regional a/c generation should match stringent requirements with respect to weight reduction and energetic efficiency, granting at the same time high operative performances and drastic reduction of wasted time and related congestions. This optimization of the overall system (ATS) will deeply contribute to cut all polluting emissions, including noise too. To overcome such a challenge aircrafts shall be totally reshaped and even more 'disrupted' with respect to the current configurations, offering new structural solutions for innovative technologies and flight systems integration such as engines, avionics, landing gears, high lifting.

Reducing Weight - GRA LWC


Credit: Cira/E. Sacchetti

Through the use of advanced automatic machines and experts on materials CIRA is setting up high innovative solutions for 'ad-hoc' designed materials (nano-materials, integrated solutions with multi-layers and multi-functional approach) able to grant, beside the general objective of weight saving and required structural strength, also specific properties (e.g. electrical or sound insulation, etc.) in order to meet current stringent safety and environmental standards. A large support to mechanical and NDI tests was ensured to all GRA members, characterizing different materials and design concepts.Specific sensors embedded in the structure, in particular in the composites matrices, are considered as coupled solution, in order to monitor in real time the health status of the structure. The general aim is to reduce MRO time schedules, that's meaning to reduce related costs, both operative and wasted for ground stuck, but mainly to experience the upstream effect of proposing new advanced design criteria for weight saving, taking into account the enhanced safety prediction capabilities.

Reducing Noise - GRA LNC


Credit: Cira/E. Sacchetti

Apart of the engines, considered as a closed system, main aircraft noise sources are the high lift devices and landing gears. Indeed CIRA is developing specific integrated airframe solutions for high lift devices, coupling innovative material and concepts with optimized aerodynamic/aeroacoustic design, aimed at improving aerodynamics performances whilst reducing the generated noise. Such systems will grant both the adequate lift in the critical ground proximity phases and a general noise reduction, enabling soundless take-offs and landings nearby urban residential areas.Alenia Aeronautica and CIRA are also developing and analyzing integrated and innovative design solutions for external equipments such as landing gear systems, in order to prevent the triggered noxious turbulences and the consequent induced noise, of which actually the contribution during landing approaches is quite relevant.

New Configurations - GRA NC

As previously anticipated also the whole innovative configurations, integrating the abovementioned advanced technologies and systems (low emissions engines, electric avionics, smart and eco materials, etc.) coupled with an optimized management of flight operations will consistently contribute to the overall ATS eco-compatibility, sustainability and safety.At cruise regime in order to improve the total efficiency induced drag has to be reduced, as source of high consumptions, e.g. through dedicated flow control means. Basic idea is to get laminar fluxes all over the wing, thus reducing turbulence energy dissipation. Specific tests aimed at improving laminar wing design were performed within CIRA small transonic tunnel PT1, able to reproduce basic and preliminary effects at approximately low costs with respect to real size simulations. Indeed CIRA is closely collaborating with Alenia Aeronautica to the development of breakthrough design solutions on the future regional aircrafts, such as the Open Rotor or advanced systems efficient integration and performance.

CIRA advanced facilities at Clean Sky support

New generation of WIPS (Wing Ice Protection Systems) are under development by ITDs coordinators, based on electric supply (e.g. GRA All Electric Aircraft, SGO), ensuring reduced power systems and weights. Atmospheric factors as icing phenomena are also intrinsically relevant for the safety of the aircraft itself. Therefore the future aircrafts will be equipped with integrated advanced prevention and control systems for ice, gusts, and other general external hazardous factors.In this field CIRA is showing advanced and recognized competencies, owning the largest European facility for ice generation and accretion simulation, the IWT - Icing Wind Tunnel. Both technologies and complex systems at real scale, can be tested and validated during the certification phase reproducing real flight conditions at a -40° C with ice generation, according to the very stringent requirements demanded by the international authorities (EASA, FAA) CIRA is also developing technologies supporting advanced automatic pilot system for the aerodynamic forces control (e.g. Gusts and relevant turbulence) and optimization (e.g. energy save). A dedicated flying lab FLARE is available for specific systems tests.

More information: *www.cira.it*

Contribution of Airlines for the Reduction of Industry Nuisances and Gases

Project CARING is the only Clean Sky project that involves airlines. Its objectives are twofold :

- Understand how current and future environmental regulations affect airline's economics and how they adapt their operations

- Analyze thousands of flight trajectories to their variability, and define 'typical' trajectories

Hence, CARING provides critical inputs to Cleansky/System for Green Operation, to support the analysis of trajectories, of their environmental impact (noise and emissions) and reduce it with innovations in flight trajectories management

Figure 1: Aircraft approaches at Paris Orly. Emissions vary from blue (better) to red (worse)

CARING is analyzing thousands of real commercial flights operated by 6 partner airlines on 11 different types of aircraft.

For each of these flights, and for all phases (taxi, take-off, climb, cruise an descent), CARING processes the data extracted from the aircraft Flight Data Recorder (the black-boxes): hundreds of parameters, second by second.

Through innovative algorithms, CARING interprets these data to explain how pilots' technique, choices of trajectories and aircraft settings (engines thrust, wing configuration…) affect emissions and noise, in a real commercial environment.

By exploiting the results of CARING, specificaly best practices proven by the analysis of trajectories, partner airlines are already implementing changes in their operations that will yield a direct reduction of emissions of 2-3% with equivalent fuel savings.

In the future, leveraging CARING's research, the new Flight Management Computers that automatically pilot the aircraft will multiply these figures by automatically choosing optimal trajectories that limit the environmental impact.

Project facts :

- Leader: OpenAirlines
- Partners: Airlinair, ENAC, Envisa, FNAM, Icon, SustainAvia, Transavia, TUI (CorsairFly, Thomson Airways, TUIFly)
- Subcontractor : Swiss Intl.
- For the products: FMS for regional, single-aisle and widebody aircraft. Flight operations software for commercial airlines.
- Budget: 1 Mio EUR
- Duration: 24 months

Goals & objectives :

- Build a model of airline economics that includes the environment
- Provide operational facts to enable development of technologies and functions reducing the environmental impact (noise and emissions) of aircraft trajectories

Technology challenges :

- Model the impact of environmental constraints on airline economics in a competitive environment
- Develop statistical models that process hundreds of parameters, second by second on thousands of flights and that explain how multiple external factors influence actual aircraft consumption, emissions and noise

Milestones :

- Project kick-off: Jan 2010
- Environmental constraint analysis and airline strategies : Oct 2010
- Trajectory analysis : March 2011
- Economic model: Dec 2011

Next steps : Development of a new FMS functions that delivers green trajectories: 2014 (based on CARING's input)

More information: www.caring.aero

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